SUSITNA HYDROELECTRIC PROJECT

MID REPORT

TO

GOVERNOR JAY S. HAMMOND

AND

THE LEGISLATURE
OF THE
STATE OF ALASKA

MARCH, 1981

ALASKA POWER AUTHORITY

ALASKA POWER AUTHORITY

March 25, 1981

The Honorable Jay S. Hammond
Governor
Pouch A
Juneau, Alaska 99811

Dear Governor Hammond:

Legislation requires that the Alaska Power Authority, by March 30, 1981 prepare and submit a preliminary report recommending whether work should continue on the Susitna Hydroelectric Project Feasibility Studies. With this letter, I am transmitting that report along with a recommendation to continue the feasibility study program.

In preparing our recommendation, the Board of Directors was guided by four primary considerations: the need for the project, seismic risk, environmental impact and economic justification. We have also been guided by the very valuable advice of the Power Authority's Susitna External Review Panel members who have also concluded that the proposed project shows sufficient promise for the future welfare of Alaska that it is clearly desirable to continue the studies. Our preliminary findings are as follows:

Based on the information available to date, it is very likely that Railbelt area power requirements over the next 30 years will necessitate new capacity approximately equal to, or greater than, the capacity of the proposed Susitna Project.

While the Upper Susitna River Basin is a seismically active area, there is ample reason to believe that structures can be built to safely withstand the worst conceivable earthquake forces that can be anticipated at the dam sites.

Based on presently available information, there is no anticipated environmental impact so adverse that the feasibility study program should be terminated prior to its scheduled completion.

Based on a very conservative Susitna Project cost estimate and reasonable assumptions relating to thermal generation costs, the Susitna Project is more cost effective over the long term than providing the same amount of power by alternative means.

It should be emphasized that these findings, in keeping with the status of the feasibility study program, are preliminary in nature. While the Board is confident in making this recommendation to continue the feasibility studies, our conclusions regarding project feasibility will not be reached until April, 1982.

Sincerely,

Charles Conway
Chairman of the Board

Thomas Kelly

Charles Webber

Robert Weeden

Arnold Espe

Enclosure: As stated

ALASKA POWER AUTHORITY

EXECUTIVE SUMMARY

Contained in this executive summary (of Susitna Hydroelectric Project, Preliminary Report on the Continuation of Feasibility Studies,) is an overview of the tentative findings by the Alaska Power Authority regarding the advisability of developing the hydropower potential of the Susitna River to meet the energy needs of Alaska's "railbelt" region. These findings are being transmitted to the Governor and Legislature of the State of Alaska as a statutory requirement under AS 44.83.320. It is not the intent of this effort to recommend for or against the construction of Susitna; rather, this is a mid-report which summarizes the findings of the first years efforts of this 2½ year feasibility study. Presented, then, are the criteria by which the Power Authority has conducted this mid-evaluation, and finally, the rational by which the Power Authority Board of Directors has concluded that the Susitna studies warrant completion.

• The Susitna studies are a 2½ year effort designed to establish whether or not the Susitna River hydropower potential should be developed to meet the electrical energy needs of Alaska's railbelt. Project funding is from the State of Alaska, and project evaluation is the responsibility of the Alaska Power Authority. Checks and balances have been built into the study process to insure an objective assessment of the project. In December 1979, the Power Authority entered into a $27.5 million contract with Acres American Incorporated to conduct the assessment of developing Susitna's hydropower potential. In the event that the 30-month study concludes that the project should be constructed and the Legislature concurs, the study would support a license application to the Federal Energy Regulatory Commission for project construction. To insure objectivity in the study, the following measures have been taken:

* A Legislative Oversight Committee was established to oversee the project and to independently analyze alternatives to Susitna.

* The University of Alaska through the Institute of Social and Economic Research (ISER) was given the independent task of developing the electrical energy projections against which Susitna would be evaluated.

* The Governors Office was appropriated $1.5 million to conduct an alternative energy assessment to Susitna. This study has been contracted to Battelle Pacific Northwest and is scheduled for completion in April 1982. In addition, a number of smaller subcontracts have been let to advise the Governor's Office on other aspects of railbelt energy development.

* The Power Authority has contracted separately with the Alaska Department of Fish and Game to collect data on fish and wildlife that might be affected by the project. Recreational and archaeological assessments have similarly been contracted to the University of Alaska.

* A public participation office has been developed within the Power Authority to keep people informed on all aspects of the study, but also to insure that the public has a voice in the direction and scope of the studies. In conducting this program, the Power Authority is striving to maintain a non-committal attitude toward the project until all data can be evaluated and disseminated for public review.

* A Susitna Steering Committee consisting of 13 federal and state governmental agencies has been established to advise the Power Authority on their concerns. While this committee acts in an advisory role, many of them will ultimately exercise jurisdictional control through the permitting process.

* A Policy Board within the Acres organization meets periodically to insure corporate attention is focussed on the project and has broad powers to act in cases where assistance to the Power Authority or the project manager is necessary. In addition, the Acres project manager is assisted by Internal Review Consultants who are not directly involved in the project, but who have achieved eminence within their respective disciplines within Acres.

* An External Review Board has been established by the Power Authority consisting of scientists, engineers, and biologists to advise Acres directly on various technical aspects of the project.

* Finally, outside of the independent review provided to the Board of Directors by the Power Authority staff, the Board has its own independent Board of Consultants to advise on all aspects of the project. Contained in this report is their recommendation on whether the Susitna studies warrant completion based on their review of the data gathered during the previous year.

• From a historical prospective, the efforts presently being undertaken by the Power Authority follow many years of interest in developing the hydropower potential of the Upper Susitna River Basin. Early assessments were conducted by both the Corps of Engineers and Bureau of Reclamation throughout the 1940's and 1950's. The most definitive recommendations were offered by the Bureau of Reclamation when in 1961 they recommended to Congress that Devil Canyon and Denali be developed as a first stage of an eventual four dam development ultimately to include dams at Watana and Vee as well. The economics of this

four dam development capable of producing twice the electricity presently consumed in the railbelt today was undercut when cheap natural gas was discovered in Cook Inlet. With the establishment of the OPEC Cartel in 1973, the economics of Susitna once again became apparent. Thus as a response to Congressional request, the Corps of Engineers reassessed the Susitna project in 1975 and recommended to Congress in 1976 that a two dam system consisting of Devil Canyon and a high Watana was economically justified and that it would develop 95% of the energy of the Bureau's four dam basin development but at the expense of only 59% of the area to be inundated by the Bureau's proposed four dams. The Alaska Congressional Delegation, however, warned Alaskans that the State should not look to the federal government to develop Susitna and advised that the State take the necessary steps to bring it forward under State sponsorship. After attempts to establish a cooperative program with the Corps of Engineers for Susitna's analysis, the State through the Power Authority ultimately chose the private sector for Susitna's feasibility assessment using Acres American Incorporated. This 2½ year study will culminate with a recommendation on construction in June 1982. It is important to note that even the federal government would have conducted the studies presently being undertaken by the Power Authority before a construction decision could have been reached.

• There are four issues that merit close review in deciding whether the Susitna feasibility studies should continue. The issues have been posed as questions, and an affirmative answer to any one would indicate that the program should be stopped or redirected. The questions are as follows:

* Are peak load requirements forecasted over the 30-year planning horizon so low that no major addition to the railbelt power generation system is required?

* Is the seismic risk associated with the project area sufficiently great so that the hydroelectric potential cannot be developed safely?

* Are the anticipated environmental losses unacceptable irrespective of other considerations?

* Is there an alternative set of projects that can be found to meet electrical energy demand forecasts through the year 2010 at a cost significantly below that of the Susitna project?

In many respects a negative finding for either of the first two questions is of little value in that economics as posed in the fourth question is the overriding factor. For instance, while it might be determined that structures can be built to withstand the seismic loading anticipated, the cost of such structures, may render the project uneconomic in comparison to other energy alternatives. Similarly, an evaluation on

the need for generation capacity does not necessarily address the economics of displacing thermal fuels such as coal, oil, and gas. A fifth criteria that the Power Authority originally considered using would have dealt with project financing. The Authority concluded, however, that economic feasibility based on a life cycle analysis did not necessarily mean that the project could be financed by the private money market. This acknowledges that over its economic life, while Susitna may be significantly less expensive than its most viable competitor, if investors are not assured that sufficient revenues can be generated in the early years to pay debt service, then financing could not be secured. The Alaska Legislature has realized this problem with smaller hydropower projects and hence has required the Power Authority to devise project by project financing schemes that would have the State providing the added degree of security needed for successful financing in the private market. During the present legislative session, however, both the Governor and the Legislature are considering establishing a blanket financing program that will provide sufficient security to insure financing of all economically feasible projects. For these reasons, the Power Authority felt that it could not make a recommendation even in the event that private financing was not assured.

• The plan of development upon which the Board of Directors recommendations are based is, in general concept, that devised by the Corps of Engineers in 1976. A number of alternative basin developments were analyzed during the previous year with the result being a reaffirmation of the Devil Canyon - High Watana plan. Project features and staging are different than that offered by the Corps, but the basic major features are unchanged. Watana would be an 800 + foot high earthfill structure with an underground powerhouse and a contiguous chute spillway. Devil Canyon would be a concrete thin arch dam roughly 650 feet high with underground powerhouse and three spillways. Double circuit, double tower 345 KV transmission lines would bring power to the Anchorage/Fairbanks load centers. Project development would take place in three stages consisting of 400 MW of capacity at Watana, initially, followed by, and as energy demand dictates, additions of another 400 MW at Watana and then the eventual construction of 400 MW at Devil Canyon for a total of 1200 MW of power capable of producing 6.2 billion kwh average annual energy. This is roughly twice the energy presently consumed in the railbelt.

• Following are summaries of the rationale by which the Power Authority has concluded that there is sufficient justification to warrant completion of the Susitna feasibility studies:

* From the standpoint of peak load requirements, it appears that even with very conservative assumptions on load growth that Susitna's capacity will be needed. If a much more moderate demand materializes, Susitna alone will not be capable of meeting demands within the planning horizon between today and the year 2010. The Institute of Social

and Economic Research (ISER) of the University of Alaska was assigned the task by the Legislature of predicting future energy demands. From an historical standpoint, between 1940 and 1978 utility electric sales in the railbelt grew at an average annual rate of 15.2 percent, with the period in the 1970's showing a growth rate of 11.7 percent, with a trend toward a decline in annual rates during the latter years of that decade. Within the railbelt today, the utilities, national defense and self-supplied industrial demand is roughly 3.1 billion kwh (rough equivalent to half the potential of the Devil Canyon and Watana plan). For the sake of projecting Susitna's market, it was assumed that Susitna would provide all utility needs, only a third of the military demands and none of the self-supplied industrial. Based on these base case assumptions, ISER ran an econometric model that attempted to project "end use" demand. Based on various combinations of foreseeable economic growth and government expenditures, the ISER model projected thirty year annual utility growth rates ranging from 2.8 percent to 6.1 percent with 4.1 percent as the most likely. This resulted in a year 2010 low forecast of 6.2 billion kwh, a mid forecast of 8.9 billion kwh, and a high forecast of 15.9 billion kwh. These forecasts are significantly lower than forecasts devised by the Corps of Engineers and by ISER in earlier studies. As mentioned earlier, the average annual energy of Susitna is estimated to be 6.2 billion kwh. Based on the above energy demands, the life expectancy of existing and projected generation to be added before a possible Susitna, and necessary reserve margins, railbelt capacity additions required under the low, mid, and high forecasts result in 1040 MW, 1550 MW, and 3025 MW respectively for the year 2010. Year 1995 capacity requirements for the same set of forecasts result in capacity additions of 0 MW, 300 MW, and 750 MW respectively. Susitna would be developed in three stages of 400 MW each for a total of 1200 MW. Based on the above forecast of demand, it was concluded that the peak load requirements within the railbelt warranted the amount of power that Susitna could provide.

* Although seismically active, it appears that safe structures can be built in the Upper Susitna. There are two primary sources from which earthquakes may eminate in the Upper Susitna region. These sources consist of surface faults which occur when two adjacent tectonic plates slide past one another horizontally, and deep seeded faults which occur when tectonic plates collide with one subsiding beneath the other. Within the project area there are three zones of interest. The first are the known boundary faults which isolate the plate upon which the Susitna River resides. These boundary faults are the Denali fault to the north (40 miles from either project) and the Castel Mountain fault

farther to the south. A second source of faulting is in the subduction zone 50 KM beneath the dams and is caused by the pacific plate diving below the plate upon which Susitna rests. A third source of potential earthquakes could come from smaller surface features in the more immediate vicinity of the projects. These latter features could be the result of stress releases caused by buildup during movement along the boundary faults or subduction zone. Although of potentially lesser magnitude of energy release, the proximity of local faults to the projects could result in their controlling project design. However, based on field investigations to date, it appears that both the subduction zone and boundary faults will provide the controlling design. Of the numerous surficial "features" (not faults) in close proximity to the damsites which have been examined, none at this point in time would appear to be "active" and thus capable of creating a more conservative design criteria than that suggested by the boundary faults or subduction zone, both of which are capable of producing 8.5 Richter magnitude earthquakes. During the ensuing field season, the major efforts within the seismic program will be oriented toward further investigation of local surface features to insure that a more stringent design criteria is not warranted. For the purposes of this study, the economic analysis has been based on a cost estimate that would reflect the added cost needed to protect against the most severe case. There is also the high possibility of "reservoir induced seismicity", which occurs primarily during the initial filling of the reservoirs. However, these events would have occurred even without the project development and would not be greater than the project design earthquake. Based on worldwide experience in dam earthquake design and the known forces at play in the Upper Susitna, it is our conclusion that both Devil Canyon and Watana can be safely constructed. The seismic risk associated with the project area, based on current knowledge is not so great that the hydroelectric potential cannot be safely developed.

* The environmental studies to date, although preliminary at this point, have revealed no impacts of such a magnitude as to warrant abandonment of the present Susitna feasibility studies. Significant efforts are underway to fully account for the present environmental setting both in the Upper Susitna and in areas which may be impacted downstream. This includes efforts not only to identify fish and wildlife resources, but also the habitat in which they exist. The dams would not cut off any traditional spawning migration, however, changes in the character of the river below the dams may alter the habitat for survival of young salmon spawned in lower tributaries. These changes may be deleterious

or beneficial to salmon fry. Whether positive or negative, the overall change in the Cook Inlet salmon fishery, absent mitigation, will probably be slight. Although it is suspected that resident fish species in the project area are limited, the annual drawdown cycle at the Watana reservoir would be sufficiently great to preclude meaningful population enhancement there. The stable water level behind Devil Canyon suggests the possibility of enhancing and introducing new resident species. While there will be an impact on wildlife species as a direct result of the project, the loss does not appear great. Of perhaps more significant concern is the impact that could be imparted as a result of human pressures in an area of presently little use. Measures can be taken, of course, to restrict access and manage the wildlife. The upcoming field season and impact assessment will allow a better understanding of project impacts in relation to power benefits.

* Based on conservative assumptions regarding costs of Susitna and other viable alternatives, there appears to be sufficient economic justification to warrant completion of the studies. The cost estimates used for Susitna are not the most likely costs, but instead are estimates of the highest possible costs, given the uncertainty that presently exists in this early stage of development. In fact, some of the additional costs included for this feasibility check would result in increased power from the project, yet no attendant benefits have been claimed. For purposes of comparison, the costs of a thermal plan and of a Susitna plan were projected for a sixty year period and then discounted to give a total present worth of plan costs. This comparison was made under five different sets of assumptions regarding the cost of thermal projects and fuels. Under each set of assumptions and using the upper limit cost estimate for Susitna, the Susitna development is estimated to be more cost effective than the most likely plan without Susitna. However, if there were no restrictions on either the availability or utilization of natural gas for power generation, and if the cost of gas rose at an annual constant dollar rate of 2 percent, and if the cost of coal rose no faster than the rate of inflation, then there would be little or no economic benefit in the Susitna plan. Given the known reserves, projected use rates, and estimated more likely fuel cost increases, there is little likelihood that this breakeven thermal scenario would occur. Based on this preliminary check of economic feasibility, the Susitna study program should continue.

* The present Internal Revenue Service codes make it very difficult to finance all of the Susitna project based on project security alone. Certain measures can be taken, however, to strengthen investor

confidence thus generating the necessary outside capital. The most obvious measures entail a State guarantee of Power Authority bonds, or converting the existing REA Cooperative utilities into municipal utilities, thus making the project eligible for long term power sales contracts and tax exempt financing. Other state measures could entail equity contributions or subordinate loans. No attempt has been made to evaluate the probability of total or partial state financing for Susitna. The State's ability to finance Susitna makes it possible to virtually dictate the cost of power to consumers. The effect of such a decision by the State could have both positive and adverse impacts. Not knowing what the State's posture will be toward providing additional security for Susitna, the Power Authority is working to pass a national hydropower program that will insure tax exempt financing regardless of the ultimate recipients of power. This effort may or may not be successful.

March 20, 1981

Mr. Charles Conway
Chairman of the Board
Alaska Power Authority
333 West 4th Avenue, Suite 31
Anchorage, Alaska 99501

Dear Mr. Conway:

The External Review Panel met with representatives of the Alaska Power Authority Board of Directors and its staff and representatives of Acres American in San Francisco on March 20, 1981 to discuss the feasibility studies for the Susitna Hydroelectric Project. Prior to the meeting, Panel members studied Acres reports on Review of Available hydrology Material, Review of Previous Design Development Studies and Reports and Project Overview. A first draft of the report from the Alaska Power Authority to the Governor and Legislature was reviewed before the meeting and a second draft was received during the meeting. APA staff members briefed the Panel on the draft report and the Acres representative presented an update of feasibility study events since the January, 1981 meeting.

This letter expresses the Panel's opinion whether, based on information available on four critical issues, the feasibility studies should continue to completion in April, 1982, or be terminated now. The Panel concurs that the four critical issues concern the power demand forecast, seismic risk, environmental impacts and economic feasibility. Our present opinions concerning these issues are summarized below.

The load forecasts have an inherent assumption of continued growth in the commercial market for electricity, and implied expansion in the service sector of the Rail Belt economy. If the economy develops in this manner, and real electric rates do not increase substantially and there is no major change in conservation, then the range of forecasts suggested by ISER seems reasonable.

The Susitna Project is probably competitive on a direct economic basis with power generated from coal. Insufficient information is available at this time to evaluate the attactiveness of the Susitna Project vis-a-vis other alternatives such as gas or tidal power.

Based on the field investigations completed to date, both the Watana and Devil Canyon sites appear to be well suited for the hydroelectric developments proposed. The initial studies have defined the general site and rock conditions at the sites and the general seismic geology of the area in which the proposed dams are to be constructed. The seismic design requirements appear to be well within the state-of-the-art for construction of facilities of this type. Important geologic features have also been recognized which merit further attention and investigation programs have been proposed which are well conceived and should provide a sound basis for feasibility design and cost estimates as well as insuring an ample level of seismic safety.

Some excellent studies are under way concerning ecologic conditions in the Susitna basin and possible environmental effects of hydro development. Above the dams there will be inundation of habitats occupied seasonally by moose, caribou, bears, and various lesser species, and there will be modification of the stream flow below the dams which could affect the habitats of salmon, moose and waterfowl. On-going studies should be continued, with amplification of hydrological studies in the Susitna River to better understand possible downstream effects on flora, fauna and the riverbed itself. Based on present knowledge however, there are no obvious environmental threats so serious as to suggest abandonment of continued planning for the hydro project.

Thus in non-economic terms, Alaska is fortunate to have the hydroelectric power potential in areas where the technical, social and environmental impacts appear to be of a manageable nature. The potential for developing renewable, non-polluting hydroelectric power has definite advantages which, though the economic implications require detailed study, are not always amenable to direct economic evaluation.

In summary, it appears that definite answers cannot yet be given to all of the issues involved in evaluating the geotechnical, environmental, economic and market aspects of developing the Susitna Project. However, we believe that the work accomplished to date shows sufficient promise for the future welfare and interests of Alaska and that it is clearly desirable to continue the present studies, supplemented by appropriate additional investigations, to their 1982 completion date.

Sincerely yours,

Merlin D. Copen

Jacob H. Douma

A. Starker Leopold

Absent but responded
Andrew H. Merritt

Dennis M. Rohan

H. Bolton Seed

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12 March, 1981

Alaska Power Authority
Attn: Mr. David Wozniak
333 West 4th Avenue
Anchorage, Alaska 99501

Susitna Hydroelectric Project:
Continuation of Feasibility Study

Dear Mr. Wozniak:

As you are aware, I will not be able to attend the meeting in California as part of the External Review Panel because of a prior commitment. The purpose of this meeting is for the Panel to present its opinion on whether the feasibility study for Susitna should be carried to its April 1982 Phase I completion or terminated on or about the end of March 1981.

The objectives of this meeting will deal with power demand forecasts, seismicity, environmental impact, and economic feasibility. I have received a substantial number of documents from Acres, the interim seismicity report from Woodward Clyde, and APA's draft report to the Governor and Legislature. Because I will not be present for any final presentation of information in California or for the Panel's internal discussions, I would like to offer some brief comments on the geotechnical aspects of the feasibility study as well as the matter of continuation of the work. It is my intention that the sense of this letter could be used where appropriate in the Panel Report of the meeting. With regard to your letter of 5 March 1981 concerning the vehicle by which to advise the Board on the continue/discontinue issue, our panel should reference the Authority's report as being an indication that we have read all pertinent documentation on the subject. Our report will almost certainly follow the same format.

TWX (OR TELEX)
(ANSWERBACK GEODUD GAIN)
810 825 2365

CABLE ADDRESS: (GEODUD) GAINESVILLE, FLORIDA

1. GEOTECHNICAL CONSIDERATIONS

Based upon the field geotechnical investigations completed to date, both the Watana and Devil Canyon sites appear to be well suited for the hydroelectric developments proposed. The initial studies have defined the general soil and rock conditions and have recognized some important geologic features that merit further attention. Acres has proposed a field program for 1981 which will provide the essential elements for feasibility design and cost estimates. Their plan is well-conceived and the results should provide a high level of confidence in the final cost estimates.

2. CONTINUATION OF FEASIBILITY STUDIES

The APA and Acres reports on continuation of the studies clearly point out the status of the work and present convincing arguments concerning the positive benefits of at least Susitna Stage I and II with regards reasonable future power demand. I also agree with their conclusion that the dams can be designed to withstand the ground accelerations caused by earthquakes generated along the Denali Fault or Benioff Zone. Such design aspects are well within the state-of-the-art.

It is also recognized that the environmental studies along the river and within the proposed reservoir are still in their infancy and definite conclusions cannot be reached at this time. It is apparent that APA is conducting an extensive environmental program and I feel confident that your efforts will provide the necessary information required for a well-informed opinion upon the environmental impact of the proposed projects. With regards the economic feasibility, further information is still required. In non-economic terms, Alaska is fortunate to have the hydroelectric power potential in areas where the social and environmental impacts appear, at present, to be of a manageable nature. Certainly in these days of concern about the pollution aspects of, for example, a coal fired thermal plant, as well as depletion of natural resources, the alternative of renewable non-polluting hydroelectric power has

definite advantages which are not always amenable to economic analysis.

In summary, it appears that definite answers cannot yet be given to most of the items mentioned above. This is not because of a lack of priority but rather than the solution requires a complex study of many factors presently being undertaken by more than one organization. I believe that the work in progress will provide the answers required in a timely manner. It is my opinion that the feasibility study should continue to its 1982 completion date to provide sufficient time to complete the assigned tasks rather than imposing a premature halt to the project because of a lack of final conclusions to complex matters.

Yours truly,

Andrew H. Merritt
AHM:e

SUSITNA HYDROELECTRIC PROJECT

Preliminary Report On the Continuation of Feasibility Studies

Submitted to the Alaska Legislature
and Governor Hammond

March 30, 1981

Alaska Power Authority

SECTION I

PURPOSE

I. PURPOSE

The purpose of this report is to recommend either for or against the continuation of the Susitna Hydroelectric Project feasibility studies and to provide certain related information. HCSSB 294 requires that the Alaska Power Authority, by March 30, 1981, prepare and submit to the governor and to the legislature "a preliminary report recommending whether work should continue" on the project. If the recommendation is for continuation of the studies, then the Power Authority is to describe:

- economic evaluations and preliminary environmental impact assessments for Susitna and all viable alternatives;
- the federal and state permits required for construction and the expected construction start date; and
- any other pertinent information.

The Susitna feasibility studies constitute an intensive 2½ year program that began in January 1980. This report, then, is an interim one, drawing upon information gained during the program's first year. It is not meant to be a final statement of the project's feasibility. That determination cannot be made until the completion of the study program, one year from now.

While HCSSB 294 requires "economic evaluations and preliminary environmental impact assessment for . . . all viable alternatives", subsequent appropriation bills have eliminated the possibility of Power Authority compliance with this directive. Specifically, the Legislature removed the responsibility for conducting alternative studies from the Susitna feasibility study contract. Simultaneously, the Legislature appropriated funds to the Governor's Office "for a Railbelt Power Market and Supply Study which will serve as the principal study on power demand and alternative supplies . . . ".

With the exception of information on alternatives, this report fully responds to the direction provided in HCSSB 294 for the preliminary report.

SECTION II

REPORT FORMAT

II. REPORT FORMAT

Following this section, general information about the history of the project, the feasibility study program and the project, itself, is presented. Part A addresses the issue of proceeding with the studies, beginning with a discussion of the criteria that the Power Authority has selected as the basis for the decision. There are four possible findings that are identified as being sufficiently important to warrant the termination or redirection of the program. These possible findings relate to load requirements, seismic risk, environmental impact, and economic feasibility.

The next four sections of Part A address each of the criteria in turn, giving factual information about what is known at this time and immediately drawing a conclusion whether or not a "stop work" finding is justified.

Part B presents other pertinent information about the project. The first section in this part is a discussion of project financing, while subsequent sections address the permit requirements and construction schedule in the event the project proceeds, the public participation program, including its nature, scope and results to date, and finally project land status and Native involvement.

SECTION III

INTRODUCTION

III. INTRODUCTION

The proposed Susitna River Hydroelectric Project is located in the Upper Susitna River Basin, approximately 125 air miles north of Anchorage, 150 air miles south of Fairbanks, and 70 miles northeast of Talkeetna.

For a year with typical precipitation and climatic conditions, the average energy potential of the basin is about 7 billion kwh. This is about twice what the railbelt generation was in 1979. There are a number of development concepts that can be designed to use all or a portion of this energy potential.

Between the Denali Highway upstream and Gold Creek downstream, twelve dam sites and two primary tunnel plans were considered as possible building blocks in the formation of a preferred development plan.

The project area is presently used by guided hunters operating principally out of the Stephan Lake area, with scattered private cabins being present on most of the larger lakes in the upper Susitna basin. In addition, mining claims have been filed on many of the tributary streams within the drainage. Access to the area is predominently by aircraft, although there is limited access by river from the east. Jeep trail access from the Alaska Railroad bridge at Gold Creek fourteen miles upriver to the Devil Canyon dam site is also possible.

The major land ownership is by Cook Inlet Region, Inc., and its Native village corporations. There are also some inholdings within the project area, such as mining claims, Native allotments open-to-entry parcels, and homesteads.

HISTORICAL CONTEXT

The Susitna feasibility studies being conducted by the Power Authority follow many years of interest in developing the hydroelectric potential of the Upper Susitna River Basin. As early as 1952, the Bureau of Reclamation published a report identifying potential hydroelectric sites in Alaska and specifically noting the strategic advantages enjoyed by the Susitna River because of its proximity to Anchorage and Fairbanks. Even earlier studies by the Corps of Engineers and the Bureau of Reclamation are on file. Report updates by the Bureau led to proposed federal authorization in 1961 of two dams - Devil Canyon and Denali as a first stage of an eventual four-dam full basin development.

Meanwhile, another project came under active consideration in the early sixties. The Rampart hydroelectric project on the Yukon River would have created a pool larger than the State of Connecticut if it had been built. Consideration of Rampart had diverted attention from Susitna long enough to allow for the discovery and development of very economical natural gas in Cook Inlet. By the time the warnings of energy shortages began to be heard in 1973, however, the Susitna project once again began to appear attractive. The Bureau of Reclamation updated its earlier

studies in 1974, reaffirming its recommendation for a four-dam system. Soon thereafter the U. S. Army Corps of Engineers launched a pre-feasibility assessment that led to a recommendation in 1976 by the Chief of Engineers that the Susitna project be authorized for detailed study. The Corps' recommended plan consisted of two high dams, the first to be built at the Watana site and the second 30 miles downstream at Devil Canyon.

By June 1978, the Corps of Engineers had prepared a plan of study outlining a program of feasibility investigations that would have required the expenditure of 24 million dollars. Subsequent refinements of the estimated study cost in late 1979 indicated that the Corps of Engineer program would cost over $28 million.[1/] Concurrently, further investigation by the Corps confirmed the adequacy of the Watana site, but revealed that some changes were required in the recommended project arrangement.

Faced with uncertain federal funding and lack of control over project development, the state, through the Alaska Power Authority, replaced the federal government in the lead development role. On November 2, 1979, the Board of Directors of the Alaska Power Authority selected the engineering firm of Acres American Incorporated to conduct the field explorations and analyses needed to determine the project's feasibility and to satisfy the licensing requirements of the Federal Energy Regulatory Commission.

PROGRAM MANAGEMENT

In December 1979, the Power Authority entered into a $27.5-million contract with Acres American, Incorporated for a thirty-month study of the Susitna Hydroelectric Project as described in the Acres proposed Plan of Study.

The contract between the Power Authority and Acres is of the "cost-plus fixed-fee" type. In this type of contract, the client pays only for work performed by the contractor plus a fixed amount which covers the contractor's profit and interest on his invested capital.

The Power Authority, as the contracting agency for the Susitna Hydroelectric Feasibility Study, is solely responsible for its execution. No other State agency has contractual control over the study. There is, however, a means by which concerned State and Federal agencies can make their questions and concerns known to the Power Authority. In mid-1980, the Power Authority invited 13 government agencies to participate in the formation of the Susitna Hydro Steering Committee. The Committee's first meeting was held in mid-June. Organizations active in the Committee include:

U. S. Fish and Wildlife Service
National Marine Fisheries Service
Bureau of Land Management
U. S. Geological Survey
U. S. Heritage Conservation and Recreation Service

Environmental Protection Agency
Alaska Department of Natural Resources
Alaska Department of Environmental Conservation
Alaska Department of Fish and Game
Arctic Environmental Information and Data Center (University of Alaska)

This Committee is an autonomous group which provides a means for the Power Authority to discuss ongoing and planned activities related to the Susitna Project. Committee members are then given the opportunity to forward their comments to the Power Authority in an advisory, rather than in a regulatory, role. If the Susitna study progresses into the FERC license application stage, all of the committee members are potential intervenors. To minimize the delays that any intervention at a later date would necessitate, this Committee gives the agencies the opportunity to express their concerns early enough so that they may be factored into the ongoing study process.

The Executive Director of the Power Authority serves as the Project Manager for Susitna. He is assisted in this capacity by members of his own staff as well as by the Project Manager for Acres American Incorporated. A full-time Native Inspector works closely with the Project Manager to assist him in proper implementation of an agreement which grants the Power Authority certain rights to conduct the Susitna study on Native lands and which requires that certain procedures be followed to ensure that opportunities for Native involvement in the project are afforded.

Directors of Engineering and Finance on the Power Authority staff serve for project purposes as Assistant Project Managers for Technical Output and Schedule and for Budget and Finance, respectively. A Project Engineer devotes his full-time attention to day-to-day monitoring and coordination of project activities. The Accountant and the Public Participation Officer provide services in their respective fields.

The Power Authority Project Manager exercises his management role in a variety of ways. He or designated senior members of his staff attend various project and Review Board meetings, review regular monthly progress reports, receive periodic formal briefings on project status, and coordinate on a day-to-day basis with the Acres Resident Manager who maintains a Project Office in Anchorage.

The conduct of the Susitna feasibility study itself is accomplished under contract to Acres whose Project Manager is responsible to the Power Authority Project Manager for all Acres' activities.

A Policy Board within the Acres organization consists of three Vice Presidents and the Project Manager and his Deputy. Meeting periodically (usually monthly), the Board ensures that corporate attention is focused on the project activities and has broad powers to act in cases where assistance to the Power Authority or to the Project Manager is necessary. From time to time, for example, the Policy Board has made available

scarce specialist manpower resources not otherwise within the power of the Project Manager to acquire and has established priorities within the corporation to support successful completion of important milestone activities.

The Acres Project Manager holds overall responsibility for the project within Acres. Principal efforts under his direction include the conduct of the study itself, maintenance of schedule and budget, coordination of Review Board activities, liaison with other state agencies and with managers of concurrent studies whose outcomes will have a bearing on the Susitna study, administration and control of major subcontracted work, and response to the requirements and requests of the Power Authority Project Manager. He is assisted in this effort by as many as 50 individuals directly involved in the day-to-day project work for Acres and is backed by major supporting staff and technical resources as necessary.

Major subcontracts, primarily with Alaskan firms, are being conducted as follows:

* R&M Consultants, Incorporated, for geotechnical and hydrological data collection, survey and mapping.

* Cook Inlet Region Incorporated in association with Holmes and Narver, for camp construction and operation.

* Terrestrial Environmental Specialists Incorporated with further subcontracts primarily with the University of Alaska, for environmental studies.

* Woodward Clyde Consultants, for seismic studies and peak load forecasting.

* Frank Moolin and Associates, for project management support activities.

* ERA Helicopters of Anchorage and Ackland Helicopters of Talkeetna, for furnishing helicopter support.

A substantial portion of the environmental data collection is being accomplished by the Alaska Department of Fish and Game (ADF&G) under a Reimbursable Services Agreement with the Alaska Power Authority. Project staff from ADF&G are located in the Acres project office in Anchorage.

The project has sufficient scope to demand that complete management information systems be established specifically for the Susitna Hydroelectric Project. Policies, procedures, and systems now in force include:

* A Policies and Procedures Manual specifying duties and responsibilities of project staff as well as regulating the manner in which all project activities are conducted.

* Cost and Schedule Control Systems providing bimonthly printouts which permit the Power Authority and the Acres Project Manager to take appropriate actions to maintain budget and meet required milestones.

* Monthly Progress Reports reflecting the status of all project activities.

* Project Documentation including design transmittals, completion reports for all subtasks, approved revisions to the Plan of Study, field notes and logs, and correspondence files.

* Subcontractor Procedure Manuals governing the conduct of subcontracted effort.

* Project Manuals issued from time to time for individual subtasks, setting forth unique work plans when necessary.

PROGRAM REVIEW

Provisions have been made for engineering and environmental reviews at various levels both within the overall project organization and separate from it. To provide the Power Authority Board of Directors an independent assessment of the program, an external review panel has been named. This impartial group of eminent engineers, environmental experts and economists provides objective professional review and advice to the Power Authority. The members of the Susitna External Review Panel and their primary areas of expertise are:

Dr. H. Bolton Seed, earth dams and seismic design
Mr. Merlin D. Copen, concrete dams design
Mr. Jacob H. Douma, hydraulics
Dr. A. Starker Leopold, ecology
Dr. Dennis M. Rohan, economics
Dr. Andrew H. Merritt, geotechnology

A second external review board also has been designated by the Power Authority; this group provides independent review and guidance to Acres. Meeting more frequently than the Power Authority External Panel, this second group convenes at the request of the Acres Project Manager when important engineering decisions influencing the course of further work are being considered. The members are:

Mr. Merlin D. Copen, concrete dams design
Dr. Ralph B. Peck, earth structures
Dr. Alfred J. Hendron, Jr., geotechnology
Dr. Lynn R. Sykes, seismology

Two additional technical advisory groups function within the Acres organization. The Manager of Operations is assisted in his work by Internal Review Consultants who are not directly involved in project activities, but who have achieved eminence in their respective disciplines within Acres, as well as international prominence. The Technical

Study Director, under whose aegis technical interpretations, analyses, and conclusions are developed, is assisted by a Working Group which provides advice and assistance to him.

PROGRAM CONTENT

The work being undertaken is divided among thirteen tasks, each one of which has been subdivided into five or more subtasks. These tasks and their associated objectives are as follows:

(a) Task 1, Power Studies

Task Objectives

To determine the need for power in the Alaska Railbelt Region, to develop forecasts for electric load growth in the area, to consider viable alternatives for meeting such load growth, to develop and rank a series of feasible, optimum expansion scenarios and finally to determine the environmental impacts of the selected optimum scenarios.

As originally contracted, Acres was required to perform an analysis of the energy alternatives available to the Railbelt area for the period 1980 to 2010. In early June, the Alaska Legislature perceived the potential for a conflict of interest in having one consultant perform an analysis of the feasibility of the Susitna Project as well as its alternatives. The Legislature then acted to remove the responsibility for conducting the alternatives studies and the associated power market studies from Acres' contract. Simultaneously, the Legislature appropriated $239,200 from the general fund to the Governor's office "for a Railbelt Power Market and Supply Study which will serve as the principal study on power demand and alternative supplies in making the decision whether to construct the Susitna Hydroelectric Project". This amount was subsequently supplemented by an additional $1,365,000.

(b) Task 2, Surveys and Site Facilities

Task Objectives

To provide for safe, cost effective, and environmentally acceptable logistical support of all project field activities; to conduct those surveys necessary to furnish data for use in other subtasks which must be performed prior to licensing; to resolve real estate issues associated with the proposed project in sufficient detail to permit preparation of appropriate documentation for the FERC license application; and to undertake initial studies of proposed reservoir areas and access roads.

(c) Task 3, Hydrology

Task Objectives

To undertake and report on all hydrologic, hydraulic, ice, and climatic studies necessary to complete the feasibility design of the Susitna project and to provide sufficient documentation for the FERC license application.

(d) Task 4, Seismic Studies

Task Objectives

To determine the earthquake ground motions which will provide the seismic design criteria for the major structures associated with the Susitna Hydroelectric Project, to provide a basis for preliminary evaluations of the seismic stability of proposed earth-rockfill and concrete dams, to assess the potential for reservoir induced seismicity and landslides, and to identify soils which are susceptible to seismically-induced failure along the proposed transmission line and access road routes.

(e) Task 5, Geotechnical Exploration

Task Objectives

To determine the surface and subsurface geology and geotechnical conditions for the feasibility studies of the proposed Susitna Hydroelectric Project, including the access roads and the transmission lines.

(f) Task 6, Design Development

Task Objectives

To undertake planning studies, to evaluate, analyze and review all previous engineering studies related to hydroelectric development of the Upper Susitna River Basin and to develop preliminary engineering design and cost information, with all associated intake, outlet works, spillways and power facilities to allow preparation of a project feasibility report.

(g) Task 7, Environmental Studies

Task Objectives

The environmental program is designed to evaluate primarily the Susitna Hydroelectric Project and associated facilities, with respect to environmental impacts. To accomplish this, a comprehensive program of studies has been developed in the following disciplines: socioeconomics, archaeological and historical resources, geology, land use and recreation, water resources, fish ecology, wildlife ecology and plant ecology. Access roads, site facilities and transmission corridors will also be studied for environmental compatibility.

The overall objective of the environmental studies is to describe the existing environmental conditions, evaluate alternatives in light of the existing conditions and, for the selected alternatives, predict future conditions with and without the proposed project so that changes (impacts) caused by the project may be assessed.

(h) Task 8, Transmission

Task Objectives

To select the transmission route and produce conceptual designs and cost estimates for the FERC license application for the following project components:

- Transmission line linking the project damsites to Fairbanks and Anchorage, with potential intermediate stations to feed local communities

- Substations, with particular reference to the two major terminals at Fairbanks and Anchorage, together with a suitable design for intermediate load points

- Dispatch center and communications system.

The Power Authority previously commissioned a separate study by International Engineering Company (IECO) and Robert W. Retherford and Associates (RWRA) to investigate transmission facilities between the Project dam site and Anchorage and Fairbanks. This study was completed in 1979. On the basis of the study, the Power Authority engaged Commonwealth Associates to design an intertie from Willow in the south to Healy in the north. Commonwealth was further directed to conduct a cost/benefit study for revenue sharing and energy transfer. Results of the Commonwealth study will be particularly pertinent to the Susitna study since commonality of transmission corridors and use of the intertie to partially accommodate Susitna power transfer is likely.

(i) Task 9, Construction Cost Estimates and Schedules

Task Objectives

To develop comprehensive, contractor-type construction cost estimates for each major element of the recommended Susitna Hydroelectric Project, detailed engineering and construction schedules and an associated analysis of the cost estimate accuracy, its impacts and the required contingencies.

(j) Task 10, Licensing

Task Objectives

To provide for timely preparation and assembly of all documentation necessary for application for license to the Federal Energy Regulatory Commission (FERC).

(k) Task 11, Marketing and Financing

Task Objectives

To establish the feasibility of financing the project and to develop an approach which provides optimum financing cost to Alaska Power Authority and the best overall benefit to the State of Alaska.

(l) Task 12, Public Participation Program

Task Objectives

To keep the public fully informed of plans, progress, and findings associated with conduct of the detailed feasibility study, and to provide a means whereby the public (including individuals, public and private organizations, and various government agencies) can influence the course of the work.

(m) Task 13, Administration

Task Objectives

To develop for the Acres team plans, policies and procedures that will set forth the basic scheme for accomplishing the POS.

The Plan of Study was conceived as a dynamic document and it has been anticipated from the start of the work that changes could and would be made in response to public input as well as to take into account new information discovered as the work progresses. A number of changes have been made since the Plan of Study was first prepared. Of particular note is the fact that the conduct of Task 1, Power Studies, has been removed from the Acres scope of work. An independent consulting firm will analyze power alternatives under contract to the Office of the Governor, ensuring thereby that no conflict of interest arises in the comparison of all viable alternatives for satisfying Railbelt energy needs. Other changes have also been made in Task 6, Design Studies, Task 7, Environmental Studies, and in Task 11, Marketing and Financing, but the stated objectives remain valid.

Heavy emphasis is placed on the opinions and concerns of the public as the study evolves. The Public Participation Office is responsible for organizing public meetings and workshops at appropriate times during the course of the study. During 1980, a series of four public meetings was held. The purpose of these meetings, held in Fairbanks, Talkeetna, Wasilla and

Anchorage, was to discuss and receive public comment upon the Acres Plan of Study, which serves as the basic guide to the conduct of the Susitna study. Two workshops, both in Anchorage, were held to discuss the findings of an electrical energy usage forecast which was produced by the University of Alaska's Institute of Social and Economic Research. The workshops have been used to focus attention on a specific topic and are of a relatively technical nature, while the public meetings cover more topics and the discussion is kept simpler. At these meetings, careful notes are taken of discussions, and those attending are invited to submit informal comments. There is also the opportunity to ask questions of the Power Authority, Acres, or Acres' subcontractors. If an immediate answer is not possible, the Public Participation Office directs a written response to the person who raised the question.

The Public Participation Office also provides the channel through which the public may access Acres and its subcontractors. Any comment or question on the Susitna Project received by the Power Authority is processed through the Public Participation Office and a record is kept on who raised the point, a summary of the question(s), the date the question was received and the action to be taken. If the question or comment cannot be adequately answered by the Power Authority personnel, it is routed to Acres. The Public Participation Office maintains its records as a means to ensure a prompt response to all questions. Responses by Acres are routed back through the Public Participation Office to the person who originally asked the question. Section XII provides a more detailed account of the Public Participation Program.

Through the end of January, 1981, $12,192,171 has been expended and the program is on schedule with one exception. Due to state personnel system constraints on hiring ADF&G staff and long lead times required to procure sonar fish counters, the fishery data collection program has been initiated in the second year instead of the first as initially planned. This element is critical to the overall program and a license application submitted in June 1982 will have the benefit of only one complete year of fishery data collection. However, this data will be augmented by albeit less comprehensive data gathered by ADF&G under previously established programs. With the exception of fisheries, the past year saw a massive field data collection effort get underway. Operating mainly out of the base camp constructed at the Watana site and supported by helicopter transportation, investigative teams were engaged in environmental data collection, survey activities, geotechnical exploration, geologic mapping, seismologic investigations and hydrologic and climatologic data collection.

Commencing in January 1980, CIRI/H&N, acting under contract to Acres American, Inc. entered into agreements with KNIK/ADC-JV, a joint venture between the KNIK village and the Ahtna Development Corporation, to undertake construction of the main base camp near the Watana site on the north side of the Susitna River. Bids were received from two camp suppliers and a purchase order was subsequently issued to Arctic Structures, an Alaskan manufacturer of modular camp components, for the supply of the camp structures.

CIRI/H&N provided camp design as well as overall management for the camp construction, which included the purchase of all camp equipment, miscellaneous structures and fuel storage facilities. The camp was designed to accommodate 40 people, with four offices and a recreation room. A warehouse is located alongside the quarters for the storage of large equipment. Transportation of the camp modules, the warehouse structure, fuel, equipment, and all building materials to the site was accomplished over snow-covered frozen ground by all-terrain vehicles called rolligons which were provided by Crowley All Terrain Company (CATCO).

KNIK/ADC-JV first established a temporary camp at the site to house the construction personnel as well as supervisory staff from CIRI/H&N and Acres American, Inc. The camp modules were then erected on wooden cribbing which minimized ground disturbance and permitted subsequent re-levelling. The warehouse structure was placed on timber footings. A prefabricated POL berm was purchased and erected at the site for containment with a total storage capacity of 160,000 gallons. Fuel was initially hauled to the site in tanks on the CATCO units. Three helicopter pads were constructed near the fuel dump and additional fuel requirements were flown in. Camp construction had been essentially completed by April 15, 1980.

A V.H.F. base station with a 100' transceiver tower and 20-watt portable radios provided base camp to air, air to ground, ground to ground, and limited ground to base camp communication. This basic system augmented by a V.H.F. air to ground capability, an F.A.A. approved aircraft operating frequency and a base camp aircraft beacon provides extensive operational communication. In addition, a commercially installed telephone line enables reliable communication to take place anywhere in North America.

The bulk of the aircraft support came from two local Alaskan helicopter firms; ERA stationed in Anchorage and Akland Helicopters stationed in Talkeetna. Aircraft service for the 1980 year logged more than 4000 hours employing primarily 206 Bell helicopters for light air transportation needs and a Bell 205 (Huey) supporting the heavier requirements primarily involving transportation of the drilling rigs to the various sites and the vital resupply needs of the camp.

Day-to-day operation of the camp is handled by a full-time Cook-Bull Cook, Maintenance Mechanic, and a janitorial helper. In addition to the normally anticipated maintenance and operation functions it became evident early in the operation that poor area drainage and reduced well water capacity necessitated additional site drainage work and running an overland pipe to a nearby lake to augment the failing water well.

Field activities and camp loading during our 1980 operation involved numerous engineers, scientists, technicians and others, the bulk of whom are based in Alaska. Cook Inlet Region Incorporated (Anchorage), R&M Consultants Incorporated (Anchorage), Frank Moolin Associates (Anchorage), Robert W. Retherford Associates (Anchorage), University of Alaska and Alaska Department of Fish and Game along with the Acres American Anchorage staff are among those Alaskans working on the project. A total of 6,270 man-days of field work was undertaken from the Watana and associated base

camps. Camp density reached a peak of 394 man-days effort, an average of over 56 daily occupants, during the week of July 20-26, 1980. A total of 440 man-days were also spent in satellite tent camps for various environmental field programs. Tent camps peaked at 15 people in August.

Surveyors from R&M, Inc. spent much of the year surveying in the horizontal and vertical control network from Gold Creek through the Susitna Valley to the Denali Highway. They also put in the ground control for the air photography and mapping work and surveyed cross sections on the Susitna River between Talkeetna and Portage Creek. Hydrologists, also from R&M, undertook periodic field excursions to collect data, to install water level recorders, automatic climatic stations and snow depth markers, and to undertake streamflow and sediment gaging. The U. S. Geological Survey (USGS) and the Soil Conservation Service (SCS), under contractual agreements with the Power Authority, are also actively involved in stream gaging and snow depth measurement. Seismologists from Woodward Clyde Consultants (WCC) installed and operated a microseismic network involving ten seismographs located near the dam sites. All earthquakes recorded by this equipment were transmitted by radio to the base camp where the tremors were recorded on strip charts. Teams of geologists from Acres, WCC and R&M undertook extensive geologic reconnaissance mapping in the basin, evaluated several hundred surface lineaments to determine whether they had any potential for generating earthquakes, conducted geologic mapping of the dam sites, supervised exploratory diamond and auger drilling at the dam sites and potential borrow areas and supervised seismic refraction surveys.

A major group of people in the field consisted of the scientists and sociologists who, managed by Terrestial Environmental Specialists (TES), were engaged in base line data collection. TES assigned a full-time field coordinator to assist with the groups from ADF&G engaged in the study of furbearers, non-game mammals and birds and large game. Groups from the University of Alaska were engaged in archaeological and land use and recreational planning studies. Members from the University and TES were engaged in vegetation mapping and habitat description studies.

Should the State decide to proceed with the project, the 1981 field activities will involve an even larger data collection effort. Most of the programs started during 1980 will be continued and some will be expanded. All this information will be required to refine the details of the Susitna Project during the latter part of 1981 and early 1982 and to produce the FERC license application documents by June 1982.

PLAN OF DEVELOPMENT

The development selection activities are not yet complete, but the extensive study of the alternative dam and tunnel schemes for developing the power potential of the Susitna Basin indicate that High Devil Canyon and Watana are the two largest and most economic energy producers in the basin.[2/] Other sites such as Devil Canyon, Olson and Gold Creek are competitive provided they have additional upstream streamflow regulation. Sites such as Vee and Susitna III are medium energy producers although somewhat more costly than the larger dam sites. Sites such as Denali, Maclaren and Tyone

are expensive compared to other sites. A comparison of the Devil Canyon site to the best tunnel alternative shows that the tunnel scheme is more expensive.

The environmental impacts of the various sites are a function of their location along the river.

Under existing conditions, salmon migrate as far as Devil Canyon, utilizing Portage Creek and Indian River for spawning. The development of any dam downstream of Portage Creek would result in a loss of salmon habitat. The necessary FERC license and permits for such development would probably be difficult to acquire. Between Devil Canyon and Watana, the concerns associated with development relate mainly to the inundation of Devil Canyon, which is considered a unique scenic and white water reach of the river, and has dam safety aspects associated with the occurrence of major geological faults. In addition, the Nelchina caribou herd has a general migration crossing in the area of Fog Creek. In the next upstream reach, between Watana and Vee, there are concerns which relate to the loss of some moose habitat in the Watana Creek area and the inundation of sections of Deadman and Kosina Creeks. Other aspects include the effect on caribou crossing in the Jay Creek area, and the potential for extensive reservoir shoreline erosion and dam safety because of the possibility of geological faults. Between Vee and Maclaren, inundation of moose winter range, waterfowl breeding areas, the scenic Vee Canyon and the downstream portions of the Oshetna and Tyone Rivers are all potential environmental impacts. In addition, caribou crossing occurs in the area of the Oshetna River. The area surrounding this section of the river is relatively inaccessible and development would open large areas to hunters. The segment between Maclaren and Denali, appears to be more sensitive than the area downstream of Vee. Inundation could affect grizzly bear denning areas, moose habitat, waterfowl breeding areas and moist alpine tundra vegetation. Improved access would open wilderness areas to hunters. The area upstream of Denali is similar to the reach immediately downstream with the exception of grizzly bear denning areas. Human access to this area would not impact to the same extent that it would downstream. However, due to the proximity to the Denali highway, the inflow of people could be greater.

Detailed generation planning analysis of the most promising development plans indicates that the Watana-Devil Canyon development plan is the preferred option. The studies to date clearly show that the tunnel option is higher in cost and provides less energy, but it may offer certain environmental advantages, in that approximately 15 miles of the Susitna River, including a part of Devil Canyon itself, would not be inundated. However, the environmental benefit would not at this time appear to be justified by the substantial additional cost and energy loss of this alternative.

It is considered essential that the continuation of studies in the Susitna Basin and, if appropriate, submission of a license application should be based on a preferred total Basin development concept. Thus, for the purposes of this report, it will be assumed that the Watana-Devil Canyon plan is the selected development.

The most appropriate plan of Watana-Devil Canyon development involves constructing the full height dam at Watana with a minimum installed capacity of 400 MW initially. The second stage involves adding an additional 400 MW capacity at the Watana site. The third major stage involves constructing the Devil Canyon dam and installing a minimum of 400 MW at that site. It should be stressed that these installed capacities are still approximate and subject to refinement during the 1981 studies.

Conceptual Design[3/]

The engineering layouts described are also preliminary and a considerable amount of additional study is currently underway to complete many of the details associated with these developments. In particular, further studies are being undertaken to firm up the general arrangement of the two dam projects; i.e., to determine the exact location of the dams, the dam types, the number and location of spillways, diversion and power tunnels and powerhouses. Also, the exact dam heights will be determined from more detailed economic studies and additional studies of reservoir operation will be undertaken to determine optimum operating policies. Throughout 1981 the environmental studies will be continued and the required reservoir operational constraints and necessary mitigation measures will be determined in more detail and incorporated in the design of the project. The river and ice field surveys and computer model studies also will continue with the results incorporated into the engineering studies.

Watana - The conceptual design involves a fill type dam incorporating a central core of impervious material. Properly graded filters are located both upstream and downstream of the core, supported by shells comprised of compacted, quarried rockfill and/or gravels and cobbles.

At this stage it is assumed that foundations will be excavated to bedrock beneath the entire dam. The bulk of the rockfill material will be taken from quarry areas located on the left abutment although some will be recovered from excavations for the various structures.

Gravels and cobbles and filter materials will be recovered from the excavated riverbed borrow areas and processed as necessary. Core material will be taken from borrow. The extent to which river gravels and cobbles can be utilized in the dam shells will be investigated from both technical and economic considerations in 1981.

The overall maximum height of the dam is approximately 840 feet above existing rock level. Allowance has been made for static and dynamic settlement, wave runup and freeboard, and potential deformation under seismic shaking. Upstream and downstream slopes average 1:2.75 and 1:2, respectively, and crest width is 80 feet. Shafts and galleries will be provided within the rock foundations and abutments for grouting and pressure relief drains.

Construction of an alternative concrete arch dam at Watana appears to be technically feasible but greater in cost. This option will be investigated further in 1981, but at this time, a fill dam appears to be the most suitable at this site.

Devil Canyon - A thin concrete arch dam, similar to that proposed by the U. S. Bureau of Reclamation (USBR), with a central integral spillway, is currently being analyzed for gravity, hydrostatic, temperature and seismic loadings.

The preliminary geometry for a two-center arch dam designed around the asymetric shape of the valley has been laid out, and stress analysis under gravity, hydrostatic and temperature loadings is proceeding. Vertical sections through the center of the dam take the form of a cupola with upstream and downstream faces formed by simple vertical curves. The foundation at the center is somewhat thicker than proposed by the USBR with a general increase in area occuring at the more highly stressed sections.

The overall maximum height of the dam is approximately 625 feet above existing rock level, with a crest width of 20 feet. As currently conceived, the power facilities including the power intake structure, will be kept separate from the dam. Shafts and galleries will be provided outside the dam to facilitate grouting and drainage.

Studies are currently underway to confirm the technical feasibility of constructing the thin arch dam and to evaluate in more detail the costs associated with this type of concrete dam. Evaluation of alternative rockfill and concrete dams at this site is also being undertaken.

Spillways

The reservoirs at Devil Canyon and Watana will be operated in accordance with "rule curves" defining normal operating water surface levels over a given period. These levels are contained by an envelope of extreme upper and lower surface elevations for normal operating conditions. If the reservoir level rises above the maximum normal operating level and the excess reservoir inflows cannot be absorbed by the power facilities, this excess flow must be released from the reservoir and discharged downstream. Spillways are provided at both sites to accommodate these releases.

The spillways may consist of one or more facilities each combining a gated control or a simple overflow structure, a discharge chute and some means of dissipating the energy of the released water downstream of the dam. The combined facilities at each site are designed to contain reservoir levels below an allowable surcharge level for floods corresponding to a frequency of occurrence of 1 in 10,000 years. These flows will be discharged with no significant damage at the site. The discharge capacity of the structures also will be checked to ensure their ability to pass flows corresponding to the probable maximum flood (the maximum flood that may occur from a coincidence of extremes of all influencing factors such as precipitation, temperature and snowpack) without overtopping the dam crest.

At present, spillways have been examined as part of the concept of comparing various sites from an economic and energy standpoint and selecting certain sites for further study. To simplify this comparison, a common form of spillway has been utilized which will be viable at all sites, but may not represent the most economic arrangement at any one particular site. During 1981, comparisons of various types of spillways at the selected sites will be made before a particular type is decided upon. Consideration is also being given to separate emergency spillways to handle extreme floods in excess of the 1 in 10,000 year or other selected design floods.

Watana - At its upstream end, the spillway consists of a concrete gravity control structure with five water passages, incorporating ogee-crested weirs and vertical lift gates. Downstream of the control structure is an inclined open chute excavated in rock. The chute is lined with concrete and runs to an intermediate stilling basin where the energy at that point is dissipated in the form of a hydraulic jump. An additional lined chute continues to a downstream stilling basin situated close to river level.

Possibly more economical spillway systems such as one or more single-chute flip-bucket and plunge-pool arrangements, or a combination of single-chute flip-bucket and stilling basins are currently being studied together with a separate emergency spillway with a breachable fuse plug.

Devil Canyon - At Devil Canyon a similar system to Watana has been located on the right abutment. It is envisaged that future studies will consider a spillway of restricted capacity discharging through openings below the dam crest with near vertical discharge into a plunge pool, in combination with one or more chutes and flip-buckets discharging into a separate downstream plunge pool. Alternatively, concrete lined tunnels and flips also discharging into a plunge pool, will be evaluated as well as a separate emergency spillway with a breachable fuse plug. Spillways may be situated on either or both of the abutments.

An alternative dam design in which it will be possible to discharge over the dam crest via a chute located on the downstream face into a lined stilling basin, is also being evaluated.

Power Generating Facilities and Equipment

For the preliminary planning purposes, a similar arrangement of the power facilities has been utilized at all sites, including Watana and Devil Canyon. The system consists of an upstream approach channel and intake structure discharging into concrete-lined penstocks dropping to an underground powerhouse complex. Concrete-lined tailrace tunnels lead from the powerhouse to the river located downstream of the toe of the dam.

The intake is a concrete structure founded in a rock cut and situated at the end of the approach channel. Provision is made for drawing off water at different levels within the reservoir in order to control the quality of water released downstream. The present scheme allows for separate water intakes at three levels. Separate penstocks are provided for each turbine/generator unit. These are inclined at 55 degrees with steel-lined sections

immediately upstream of individual turbines which are located in an underground powerhouse. The turbine/generator units, service bay, workshop, switchgear room and some offices are located within the main powerhouse cavern. The turbines and generators are serviced by overhead cranes running the length of the powerhouse cavern including the service bay area.

A separate transformer gallery is located upstream of the powerhouse cavern and a draft tube gate gallery just downstream of the powerhouse cavern with gates operating in vertical shafts descending to the four draft-tube tunnels. Isolated phase bus ducts located in separate inclined galleries connect each generator to a separate transformer. Power cables exit via vertical shafts to the switchyard at the surface. Vehicle access to the caverns is via unlined tunnels with additional personnel access provided by an elevator shaft to the surface.

The control room and administration offices are housed in a separate building at the surface adjacent to the switchyard.

The draft tube tunnels terminate in a common manifold. Two tailrace tunnels exit from the manifold and terminate in outlet structures located at the river downstream of the dam. These downstream tunnels are concrete-lined, and provision is made to seal off the tunnels for maintenance by inserting stop logs at their outlets.

Watana - The power facilities described are presently assumed to be within the left abutment and are based upon 4 - 200 MW turbine/generator units. However, it is possible that the rock quality and orientation of the jointing in this abutment will prevent the economical excavation of the long power caverns. Alternatively, relocation to the right abutment or a surface powerhouse on either abutment could be utilized. These alternatives will be examined and the most suitable system selected.

Devil Canyon - A similar layout to that at Watana is presently assumed at Devil Canyon based upon 2 X 200 MW turbine/generator units and located within the right abutment, with the intake located upstream of the dam.

Access Roads

A study is currently underway to determine the most desirable location for an access route and the most economical transportation modes. R&M Consultants are conducting this work as a subcontractor to Acres.

Three general corridors have been selected to provide access to potential dam sites. These include a corridor located to the North and another to the south of the Susitna River linking each site either to Highway 3 near Hurricane, or the railroad near Gold Creek (alternatives 1 and 2) or road access from the Denali Highway to the east of the project sites (alternative 3).

Using design criteria generally conforming to primary highway design several feasible alignments within the selected corridors were sketched on contour maps. From these the route within each corridor showing the most advantageous grade, alignment and length characteristics were selected.

These routes allow consideration of a number of transportation alternative plans including allowance for staged upgrading of the road and utilizing rail transporation segments.

The environmental considerations of each route as well as land ownership constraints are currently being addressed, in addition to transportation economics. During the week of March 16, 1981, a series of public workshops were held to gain public input to the route selection process. It is anticipated that a final decision on the selected route will take place during 1981, following which further engineering and field studies will be undertaken for the selected route.

Mitigating Measures

In developing the detailed project designs a range of mitigating measures required to minimize the impact on the environment will be incorporated. This is achieved by involving the environmental studies coordinator as a member of the engineering design team. This procedure ensures constant interaction between the engineers and environmentalists and facilitates the identification and design of all necessary mitigation measures.

There are two basic types of mitigation measures that are being developed: Those which are incorporated in the project design and those which are included in the reservoir operating rules. These are briefly discussed below.

Design Features - The two major design features currently incorporated include multi-level power intake structures to allow some quality control of released water and provision of a downstream re-regulation dam to assist in damping the downstream discharge and water level fluctuations induced by power peaking operations at the dam. During the 1981 studies these two features will be designed in more detail and other features incorporated as necessary. Of particular importance will be the design of the spillways to eliminate or minimize the impact of increased nitrogen in the downstream river reaches.

Consideration will also be given to developing mitigation meaures to limit the impact on the environment during the project construction period. The access roads, transmission lines and construction and permanent camp facilities will also be designed to incorporate mitigation measures as required.

Operating Rules - Limitations on seasonal and daily reservoir level drawdown, as well as on downstream minimum flow conditions have been imposed in plan formulation studies. During 1981, more detailed studies will be undertaken to refine these current constraints and to look at detailed operational requirements to adequately control downstream water level fluctuations, water temperature and sediment concentration.

SECTION III. ENDNOTES

1/ Letter from Colonel Lee Nunn, Alaska District Engineer, to Eric P. Yould dated November 12, 1979.

2/ Subtask 11.01 - Project Overview (second draft), Acres American, February 11, 1981, Section 7.

3/ The preliminary project description is based on information provided by telecopy from Acres American on March 13, 1981.

Part A -

DECISION ON PROCEEDING

SECTION IV

DECISION CRITERIA

IV. DECISION CRITERIA

In the opinion of the Power Authority, there are four issues that merit close review in deciding whether the Susitna feasibility studies should continue on their present course. The issues have been posed as questions, and an affirmative answer to any one would indicate that the program should be stopped or redirected.

> QUESTION #1. ARE THE PEAK LOAD REQUIREMENTS FORECASTED OVER THE 30-YEAR PLANNING HORIZON SO LOW THAT NO MAJOR ADDITION TO THE RAILBELT POWER GENERATION SYSTEM IS REQUIRED?

Existing facilities are adequate to meet today's peak load requirements in both Anchorage and Fairbanks. Many of these existing facilities will reach the end of their useful lives over the next 2 or 3 decades. At issue is whether the difference between forecasted loads and available facilities over the next 30 years is of sufficient magnitude that projects the size of Susitna hydroelectric development make sense. As noted earlier, the proposed Watana - Devil Canyon plan is presently envisioned as having an installed capacity of 1,200 megawatts that would be brought on line in three equal stages as demand dictates.

> QUESTION #2. IS THE SEISMIC RISK ASSOCIATED WITH THE PROJECT AREA SUFFICIENTLY GREAT THAT THE HYDROELECTRIC POTENTIAL CANNOT BE DEVELOPED SAFELY?

The Upper Susitna River Basin is a seismically active area, and the safety of any structures is of paramount importance. This question is related to question #4 below, which addresses project costs. While structures may be designed to withstand anticipated earthquake effects, the cost of building the earthquake resistant structure may be extreme. Question #2 does not relate to project cost; instead, it asks whether safe structures can be built regardless of cost.

> QUESTION #3. ARE THE ANTICIPATED ENVIRONMENTAL LOSSES UNACCEPTABLE IRRESPECTIVE OF OTHER CONSIDERATIONS?

Evidence that the construction of the Susitna Hydroelectric Project will cause a truly major and irretrievable environmental loss would be reason to consider study termination or redirection. Environmental values, of course, are very subjective, and the Power Authority must bring its own collective value judgement to the evaluation of this issue.

> QUESTION #4. IS THERE AN ALTERNATIVE SET OF PROJECTS THAT CAN BE FOUND TO MEET THE ELECTRICAL ENERGY DEMAND FORECASTS THROUGH THE YEAR 2010 AT A COST SIGNIFICANTLY BELOW THAT OF THE SUSITNA PROJECT?

The reason for the Power Authority's existence is to insure the lowest reasonable cost of power. If the studies show a non-Susitna alternative to be significantly cheaper than Susitna, then the studies should be terminated. If the evaluation shows a non-Susitna alternative to be approximately the

SECTION V

LOAD REQUIREMENTS

V. LOAD REQUIREMENTS

HISTORICAL TRENDS

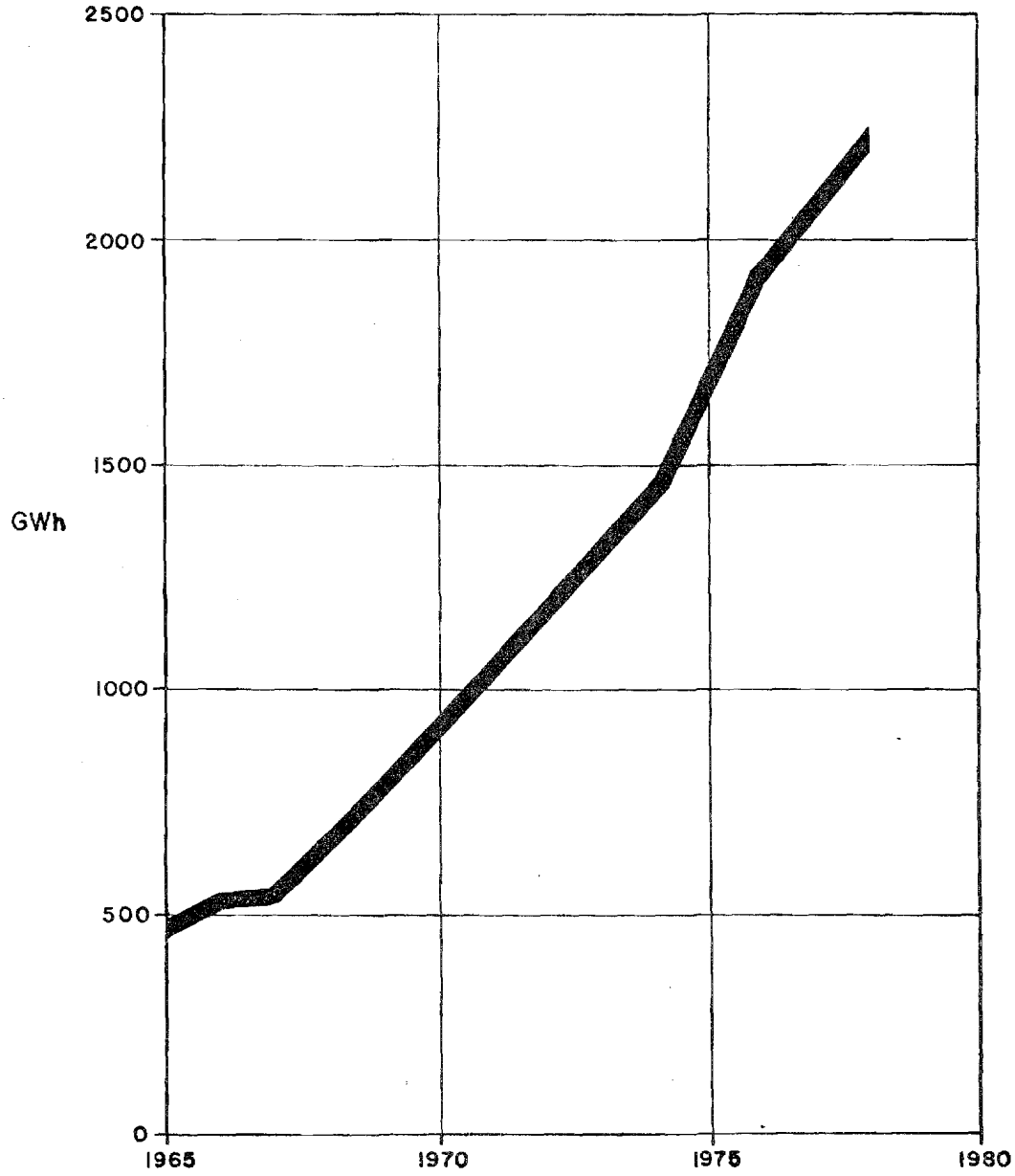
Between 1940 and 1978, utility electricity sales in the Railbelt grew at an average annual rate of 15.2 percent. [1/] During this period, the 1940's had the highest growth rate at 20.5 percent. This was followed by a gradual decline over the years and by the 1960's, the growth rate was below the long-run trend. In the 1970's, the growth rate had declined to 11.7 percent.

At the national level, electricity sales grew at an average annual rate of 7.3 percent during the same period. By the 1970's, the growth rate was below the long-run trend. Between 1970 and 1978 the growth rate was 4.5 percent, with growth in the years prior to the Arab oil embargo of 1973 double that of later years.

A comparison of the national and Railbelt growth rates indicates that utility electricity sales in the Railbelt have been more rapid than the national average since 1940. Although the Railbelt growth rates are higher, there is a discernible downward trend due to the gradual maturing of the Alaskan economy. The relatively high rate of growth is the result of both more rapid increases in the number of customers and in consumption per customer. Growth in the Railbelt has exceeded the national average for two reasons. First, population growth in the Railbelt has been higher than the national rate. Second, the proportion of Alaskan households served by electric utilities was lower than the U. S. average so that some growth in the number of customers occurred independent of population growth. The historical utility sales growth in the Railbelt in recent years is illustrated graphically in Figure V-1. These figures do not include military or self-supplied industrial consumption.

During the period 1965 to 1978, the residential and commercial-industrial-government sectors of total utility sales grew at annual growth rates of 12.8 percent and 12.6 percent, respectively, while the miscellaneous sector grew less rapidly at 8.8 percent. In the residential sector, electricity consumption is largely attributed to space heating, while refrigerators, water heaters, lights and cooking ranges are next in order of usage. In the commercial-industrial-government section, end-use consumption is less clear because of lack of data; however, it is expected that end-use consumption is attributed mainly to lighting, space heating, cooling and water heating. End-use consumption in the miscellaneous sector is attributed mainly to street lighting and electricity usage in second homes.

During this period, the distribution of electricity consumption in these end-use sectors has been fairly stable. In 1965, the commercial-industrial-government and residential sectors accounted for 53 percent and 45 percent of Railbelt utility sales while the miscellaneous sector accounted for only 2 percent. By 1978, the situation had only changed marginally with commercial-industrial-government and residential sectors accounting for 52 percent and 47 percent respectively, while the miscellaneous sector dropped to 1 percent.



TOTAL RAILBELT UTILITY SALES TO FINAL CUSTOMERS

FIGURE V-1

ELECTRICAL ENERGY FORECAST

As originally conceived, the Susitna Feasibility Study program included the forecasting of Railbelt energy needs. Before work on this activity had begun, the House Power Alternatives Study Committee (Representatives Malone and Rogers) commissioned the production of an identical forecast to be conducted by the University of Alaska's Institute for Social and Economic Research (ISER). Believing ISER to be well qualified to undertake this work and desiring an arm's length relationship to the forecast of electrical energy needs, the Power Authority deleted the energy forecasting work package from the Susitna Plan of Study (POS). It was decided, instead, to utilize the forecast produced by ISER. The Power Authority agreed to share the cost of the forecast equally with the House Power Alternatives Study Committee, while the responsibility for contract administration resided with the Committee. In this way, the electrical energy needs forecast has been produced independently from the Power Authority and its Susitna planning activities.

Methodology

The ISER electrical demand forecasting model has a logical structure and flow of information between components. 2/ The output of the model is in the form of projected values of electricity consumption for each of the three geographical areas of the Railbelt (Greater Anchorage, Greater Fairbanks and Glennallen-Valdez) classified by final use (i.e., heating, washing, cooling, etc.) and consuming sector (commercial, residential, etc.). The model produces values for the years 1985, 1990, 1995, 2000, 2005 and 2010.

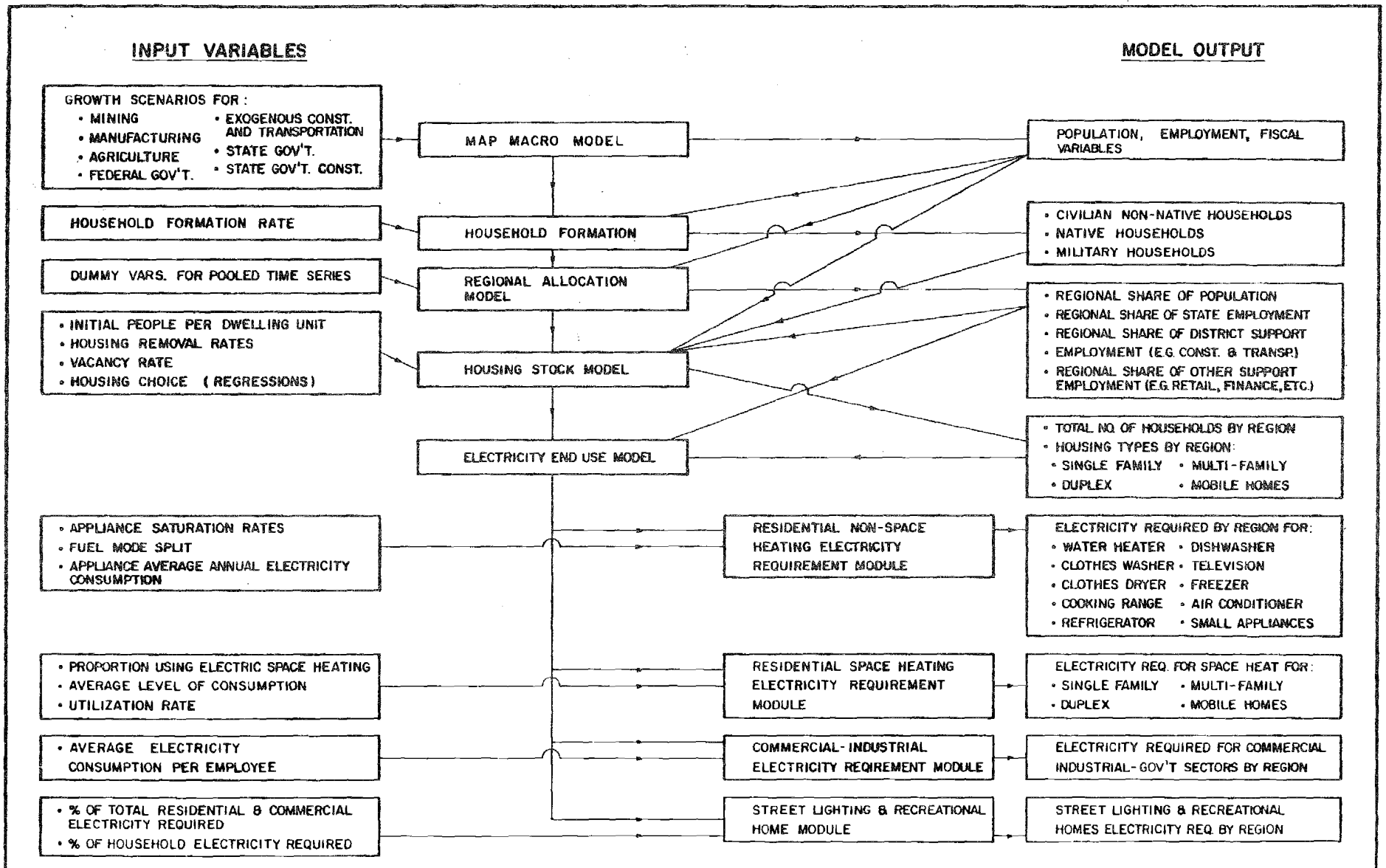
The ISER model consists of several submodels linked by key variables and driven by policy and technical assumptions and state and national trends. These submodels are grouped into economic models which forecast future levels of economic activities and electricity consumption models which forecast electricity requirements by consuming sectors.

Economic Submodels

* Man in the Arctic Model (MAP)
* Household Formation Model
* Regional Allocation Model
* Housing Stock Model

Electricity Consumption Submodels

* Residential Non-space Heating Electricity Requirement
* Residential Space Heating Electricity Requirement
* Commercial-Industrial-Government Electricity Requirement
* Miscellaneous Electricity Requirement
* Military Net Generation
* Self-supplied Industrial Requirement



ISER ECONOMETRIC END-USE FORECASTING MODELS

FIGURE V-2.

A brief description of these submodels and their interaction with one another follows. The model is depicted graphically in Figure V-2. 3/

MAP Econometric Model - MAP is an econometric model which translates forecasted or assumed levels of national economic trends, state government activity, and developments in the Alaska resource sector into forecasted levels of statewide population by age and sex, employment by industrial sector and income. MAP is internally complex, but its basic logic is that the State of Alaska will tend to follow national trends, resource activity and state government policies assumed as inputs.

The output produced by MAP is not appropriate for direct input into the electricity model for two reasons. The first is that MAP produces forecasts for the entire State of which the Railbelt and its component areas are only a part. Secondly, MAP produces population forecasts, but electricity consumption is more closely related to households and the number of housing units than to the number of individuals in the market area. Therefore, the downstream submodels of household formation, housing stock, and regional allocation are required to translate MAP output into its required form for input into electricity demand models.

Household Formation Model - The household formation model groups individuals into household units on the basis of national and state demographic trends. The model estimates the probability if an individual's being a household head as a function of age and sex. Input is required from the MAP model in the form of projected level and age-sex distribution of the population. The output of the model is future number of household heads by age and sex, which is used as input to the housing stock and electricity consumption models.

Regional Allocation Model - This model regionalizes MAP's projections of population to regions of the Railbelt. The model uses a regional shares technique under the assumption that population location is sensitive to regional employment opportunities. Regional shares are estimated as a function of basic sector activity and dummy variables representing comparative advantage and scale of regional variation, the estimation is based on pooled-time-series cross-section technique. The results serve as input into both the housing stock models and the electricity consumption model.

Housing Stock Model - The housing stock model combines the household headship information from the household formation model, the regional population information from the regional allocation model, and the results of an independent survey on housing choice, to produce the number of housing units by type (e.g., single family, duplex, multifamily, etc.) and region for each of the forecast years. Two basic steps are involved. Initially the number of households per region is calculated for the forecast period by combining household and regional population information. This is followed by estimating the probability that a household head of a specific age and sex will choose to live in a particular housing type. In this way, the model produces future housing stock by type and region for input into electricity consumption models.

Residential Non-space Heating Electricity Requirements - This model estimates electricity requirements for ten categories of household appliances. Electricity requirements for each appliance type is the product of five factors: number of households, appliance saturation rate, fuel mode split, average annual consumption, and average household size. Residential non-space heating electricity requirements are obtained by summing the electricity requirements of all appliances.

This model is linked to the economic submodels through the household variable. The remaining variables such as appliance saturation rates, fuel mode split and average annual consumption are determined within the submodel. For example, saturation rates are based on 1978 estimates and extrapolated to future years by past Alaskan and national trends. Fuel mode split is calculated as the proportion of appliances using electricity by taking into account the vintage of consuming devices. Average annual electricity consumption is calculated as a function of the age distribution of the appliance stock and the electricity requirement for each vintage.

Residential Space Heating Electricity Requirements - This model estimates space heating electricity requirements for four types of dwelling units: single family, duplex, multifamily, and mobile home. The space heating electricity requirement for each type of dwelling unit is calculated as the product of the number of dwelling units, fuel mode split and average level of consumption. The number of dwelling units is obtained from the housing stock model. The fuel mode split is calculated as the proportion of houses for each vintage using electricity space heating. The average level of consumption for each vintage is computed as the product of base level consumption, a size factor and conservation factor. In arriving at these parameter values, explicit assumptions are introduced where appropriate.

Commercial-Industrial-Government Electricity Requirement - Total electricity requirements for the commercial-industrial-government sector is defined as the product of non-agricultural wage and salary employment and average electricity consumption per employee. Electricity consumption per employee is a function of time and application of conservation standards. This implies that new electricity users in this sector will have different electricity requirements from previous customers.

Miscellaneous Electricity Utility Sales - This model estimates two remaining sectors of electricity consumption: street lighting and recreational homes. Street lighting requirement is calculated as a fixed percentage of the total of residential (space heating and non-space heating) and commercial-industrial-government electricity requirement. Recreational home consumption is calculated as the product of a fixed level of electricity consumption and a fixed proportion of households.

Military Electricity Requirements - For many reasons, including a lack of historical data series, no model was constructed to correlate military electricity consumption with causal factors. Hence, future electricity requirements for the military are assumed to be the same as the current level. It should be noted that, while the military requirements are included in the ISER forecast, only one-third of the military demand is assumed as a market for Susitna power.

Self-Supplied Industrial Electrical Requirements - No model was constructed to project future self-generated electricity for industry. Existing users were identified and current electricity consumption was determined. New users and future consumption levels were identified from economic scenarios. While this sector was included by ISER in the Railbelt forecast, it has not been assumed as a market for Susitna power.

Model Assumptions

To make these models operational, a number of assumptions enter the model through a series of calculations. The following is a summary of the assumptions utilized in the model.

- Economic growth in the state will be driven by different assumptions concerning development of special projects and industry, and state government fiscal policy. The development of special projects and industry is assumed to grow at a high, moderate or low rate. State government fiscal policy is assumed to follow three directions representing high, moderate and low government expenditures. This results in nine possible economic growth scenarios for the state.

- The electricity market is presently in relative equilibrium except for space heating in Fairbanks, where a shift away from electric space heating is underway.

- This equilibrium is expected to remain in effect throughout the forecast period because of relatively constant fuel price ratios.

- The price of energy relative to other goods and services will continue to rise.

- Rising real incomes will act to increase the demand for electricity.

- Federal policies will be effective in the area of appliance energy conservation, but will have a much smaller impact on building stock thermal efficiencies.

- No State conservation policies directed exclusively toward electricity will be implemented.

- No significant State policies designed to alter the price or availability of alternative fuels are implemented.

- No new electricity technologies will be introduced.

- In terms of residential appliances

  * saturation rates will track national trends;
  * for some appliances, reduced household size will act to reduce average electricity requirements;
  * consumption is sensitive to the appliance scrapping rate;

* unspecified appliance consumption grows in order to accommodate the possibility of new domestic electricity applications.

- In terms of residential space heating

  * a slight trend toward single family homes is projected;
  * average housing unit size continues to grow;
  * natural gas availability will not significantly increase;
  * space heating alternatives such as oil, wood or coal will not greatly affect aggregate space heating demand;
  * no significant increase in heat pumps occurs.

- In terms of commercial-industrial-government use

  * employment will grow more rapidly than the population;
  * no major conservation measures are anticipated;
  * the distribution of electricity end-uses will not shift significantly.

- Miscellaneous utility sales (street lighting and second home use) will grow at rates consistent with overall utility sales.

Forecast Results

Many assumptions enter the model through a series of calculations. Of the nine economic scenarios formulated by ISER, only three have been run by the model. The three scenarios are those representing high, moderate and low economic growth combined with moderate government expenditure. At the same time, ISER has held constant its electricity end-use assumptions with the exception of the moderate economic growth shift to electricity case. Of all of the runs made by the model, ISER considers the moderate economic growth-moderate government expenditure case (no shift to electricity) to be the "most probable." Therefore, this is used as the base case in the study.

According to the base case, utility sales for the Railbelt will grow from the 1980 level of 2390 Gwh to 7,952 Gwh in 2010, representing an average annual growth rate of 4.1 percent. Over the period, the highest growth rate will occur during 1990 to 2000 at 4.8 percent, followed by a decline at 3.3 percent during 2000 to 2010.

ISER's other forecasts represent a higher and lower rate of economic growth and also the case where a shift to electricity takes place, all in combination with the moderate government expenditure case. To provide a complete envelope of the forecast range, Acres estimated the high industrial growth/high government expenditure case and the low industrial growth/low

government expenditure case, using the ISER data. [4/] A summary of aggregate Railbelt electricity growth for the range of scenarios is presented in Table V-1. Between 1980 and 2010, the following annual growth rates in utility sales are associated with each scenario:

	Annual Growth in Total Railbelt Utility Sales (Percent)
1. Low Economic Growth, Low Government Expenditure (LES-GL)	2.8
2. Low Economic Growth, Medium Government Expenditure (LES-GM)	3.2
3. Medium Economic Growth, Medium Government Expenditure (MES-GM)	4.1
4. High Economic Growth, Medium Government Expenditure (HES-GM)	5.5
5. High Economic Growth, High Government Expenditure (HES-GH)	6.1

The medium growth rate of 4.1 percent is shown to be bounded by lower and upper limits of 2.8 percent and 6.1 percent. In comparison, historical utility electricity demand increased at an annual rate of 12 percent in the Railbelt during the 1970's. The forecasts are shown graphically on Figure V-3.

Previous Projections

A number of electricity projections have been developed in the past. This discussion is confined to work conducted since 1975. The purpose is to compare ISER's forecasts with previous work and to understand the basic differences between them. Forecasts of electric power requirements developed since 1975 (excluding ISER's latest forecast) are summarized in Table V-2. A cursory examination indicates that there is a dispersion of forecasts in initial years and progressively widening within the forecast period.

These forecasts are also significantly different from those developed recently by ISER. The differences are mainly attributed to assumptions concerning economic growth and electricity consumption rates. Economic growth assumptions among the various studies have been inconsistent on the type, size and timing of projects and other economic events which result in higher projections of economic activities compared to the recent ISER study. Electricity consumption rates in these studies are also high because the recent ISER study has explicit estimates of appliance saturation rates, end-use patterns and conservation measures. For these reasons, the recent ISER forecasts are lower than those in previous studies.

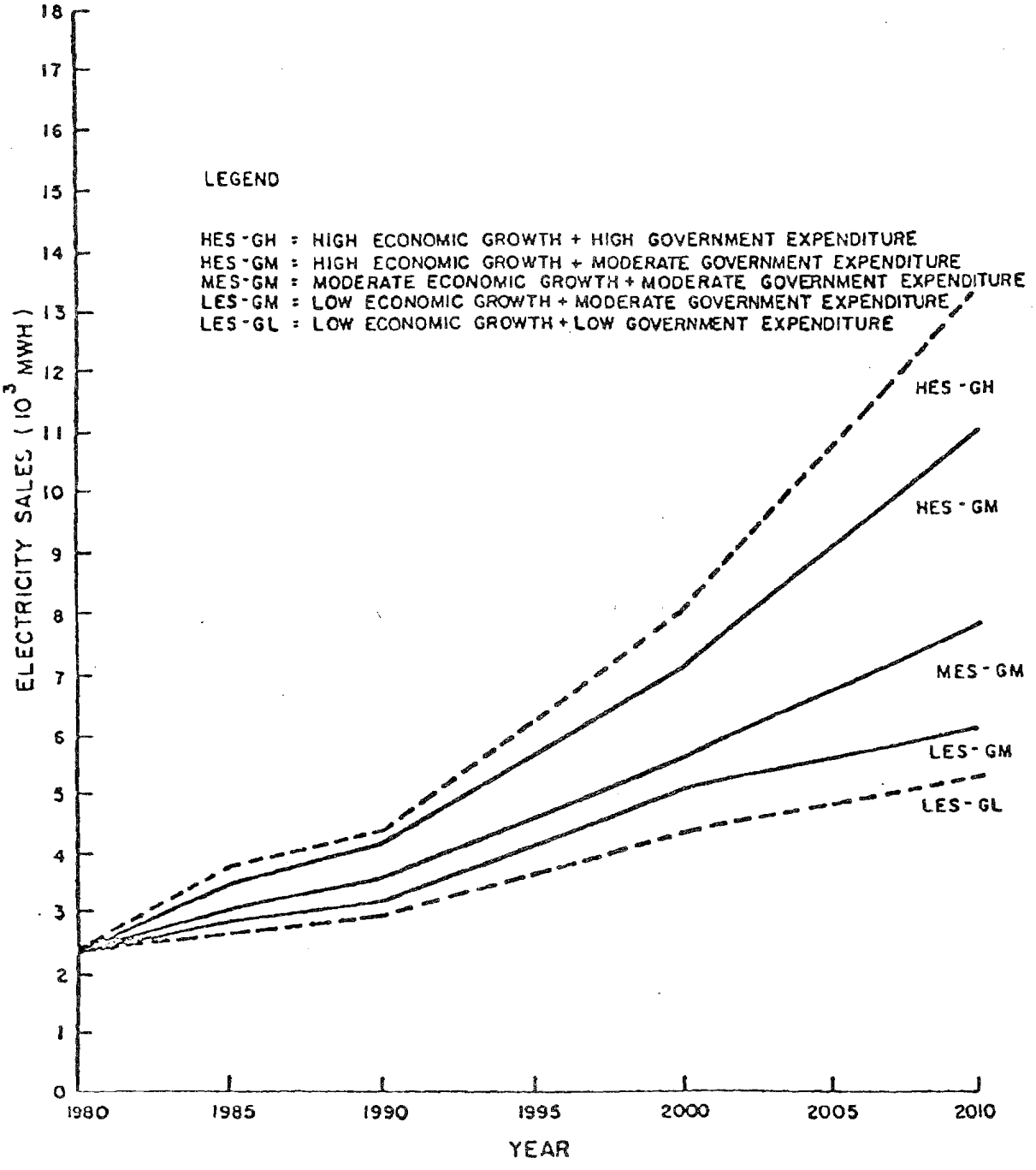
TABLE V-1. SUMMARY OF RAILBELT ELECTRICITY PROJECTIONS (GWh)

Year	Utility Sales to All Consuming Sectors						Military Net Generation	Self-Supplied Industry Net Generation		
	LES-GL	LES-GM	MES-GM (Base Case)	MES-GM with Price Induced Shift	HES-GM	HES-GH	MES-GM (Base Case)	LES-GM	MES-GM Net (Base Case)	HES-GM
1980	2390	2390	2390	2390	2390	2390	334	414	414	414
1985	2798	2921	3171	3171	3561	3707	334	414	571	847
1990	3041	3236	3599	3599	4282	4443	334	414	571	981
1995	3640	3976	4601	4617	5789	6317	334	414	571	981
2000	4468	5101	5730	6525	7192	8010	334	414	571	981
2005	4912	5617	6742	8219	9177	10596	334	414	571	981
2010	5442	6179	7952	10142	11736	14009	334	414	571	981
Average Annual Growth Rate (%)										
1980-1990	2.44	3.08	4.18	4.18	6.00	6.40	0.0	0.0	3.27	9.0
1990-2000	3.92	4.66	4.76	6.13	5.32	6.07	0.0	0.0	0.0	0.0
2000-2010	1.99	1.94	3.33	4.51	5.02	5.75	0.0	0.0	0.0	0.0
1980-2010	2.78	3.22	4.09	4.94	5.45	6.07	0.0	0.0	1.08	2.92

LES = Low Economic Growth
MES = Moderate Economic Growth
HES = High Economic Growth
GL = Low Government Expenditure
GM = Moderate Government Expenditure
GH = High Government Expenditure

TABLE V-2 SUMMARY OF RECENT PROJECTIONS OF RAILBELT ELECTRIC POWER REQUIREMENTS (GWh)

Source	1980			1990			1995			2000			2025		
	Low	Med	High	Low	Med	High	Low	Med	High	Low	Med	High	Low	Med	High
1. South Central Railbelt Area, Alaska Interim Feasibility Report: Hydroelectric Power and Related Purposes for the Upper Susitna River Basin, Alaska District Corps of Engineers, Department of the Army, 1975.	3020	3240	3550	5470	6480	8540	6656	8688	12576	8100	11650	18520			
2. Electric Power in Alaska 1976-1995 Institute of Social and Economic Research, University of Alaska, 1976.	2478	-	3877	5415	-	12706	8092	-	20984						
3. Alaskal Electric Power: An Analysis of Future Requirements and Supply Alternatives for the Railbelt Region, Battelle Pacific Northwest Laboratories, 1978.	2600	-	3400	8500	-	10800	10341	-	17552	16000	-	22500			
4. Upper Susitna River Project Power Market Analyses, U.S. Department of Energy, Alaska Power Administration, 1979; South Central Railbelt Area, Alaska, Upper Susitna River Basin, Supplemental Feasibility Report, Corps of Engineers, 1979 and Phase I Technical Memorandum: Electric Power Needs Assessment, South Central Alaska Water Resources Committee, 1979.	2920	3155	3410	4550	6110	8200	5672	8175	11778	7070	10940	16920	8110	17770	38020



ALTERNATIVE UTILITY SALES FORECASTS

FIGURE V-3

PEAK DEMAND FORECASTS

The peak demand forecasts for the Railbelt Region were prepared by Woodward-Clyde Consultants (WCC) of San Francisco. [5/] The overall approach was to examine the available historical data with regard to the generation of electrical energy and to apply the observed generation patterns to existing sales forecasts. The main sources of data are two: the information supplied by the Railbelt utilities to the Federal Energy Regulatory Commission (used to determine standard load patterns) and the sales forecasts produced by the University of Alaska's Institute of Social and Economic Research.

Load Patterns

The first component of the forecast methodology is an analysis of the load patterns in the Railbelt. The analysis emphasizes the identification of average patterns over the 10-year period from 1970 to 1979 and not trends or changes in the patterns. Regardless, such trends are not evident in the available data. In addition, the use of average values reduces the impact of yearly variations in such parameters as weather and outages.

Four standard load patterns are developed to represent electrical use in the Railbelt based on data covering over 98 percent of the sales in the area. Each load pattern consists of five items:

(1) average hourly distribution of generation for the first weeks of April, August and December. These figures are the average of the normalized use patterns for each month.

(2) average monthly distribution of generation for all months.

(3) average distribution of annual generation by consumer category.

(4) average percentage of energy generation unaccounted for or lost.

(5) average annual load factor.

Sales Allocation

The sales forecasts provided by ISER are based on service area rather than generating utility, whereas the above load data is available by utility and not service area. To resolve this, WCC allocated the sales data to the individual utilities in accordance with the predicted mix of consumer categories in the area and the current mix of sales by consumer category for the utilities serving the area. This procedure will determine a reasonable allocation provided that the expansion plans captured in the sales forecasts does not markedly change the residential percentage at each utility.

Peak Loads

The two data sets discussed above are combined to determine peak loads for the Railbelt area.

The first step is an adjustment to the allocated sales to reflect losses. The adjustment was made by increasing the energy allocated to each utility by a factor computed from historical sales and generation levels. The result is gross energy generation for each utility.

The factors determined for the monthly distribution of total annual generation were used to allocate the gross generation for each year by month. The monthly generation figures for April, August and December were further allocated based on the average of the first week's hourly distribution pattern.

The largest load is the peak load for the month in the interconnected Railbelt region. This and the total gross generation in the month determines the monthly load factor. The load factors for the other months are calculated as a linear interpolation from the three available months. The monthly peak loads for all months are then computed based on gross monthly generation and the monthly load factors. The largest monthly peak is the annual peak load and allows the calculation of the annual load factor.

The energy and load forecasts developed by ISER and Woodward Clyde Consultants include energy projections from self-supplied industrial and military generation sectors. A conservative review of the industrial self-suppliers and the military indicates that effectively none of the industrial and only about one-third of the military should be considered as a future load on the system. Table V-3 summarizes the total energy generation and the peak loads for the mid and two extreme forecasts. It should be noted that these peak loads do not include any reserves.

TARGET GENERATION PLANT RELIABILITY

In order to perform a system study, criteria for generating plant system reliability are necessary. These criteria are important to determine the adequacy of the available generating capacity as well as the sizing and timing of additional units.

There appear to be no specific criteria currently applied to generation planning in the Railbelt area. The primary reason for this is that utilities have developed individually without the benefits of reliable interconnections. Since Susitna planning is to meet region needs some 15 to 20 years hence, it is assumed that within this time frame an interconnected system will exist or be in the process of implementation. There are two alternative methods to account for reliability which are currently in wide use in electric generation system planning; the use of a reserve margin or a loss of load probability (LOLP).

A reserve margin refers to the excess capacity available to a system during the peak power demand of the year. Reserve margins are typically set to permit the outage of the two largest units in the system without interrupting service. For large or interconnected utilities, typical reserve margins vary from 15 to 25 percent. In recent years, reserve margins have been greater than planned in some regions due to the depressed load growth trends. These margins have in some cases approached 45 percent.

TABLE V-3

LOAD AND ENERGY FORECASTS ALASKA RAILBELT AREA *

	Low Forecast (LES-GL)		Mid Forecast (MES-GM)		High Forecast (HES-GH)	
Year	MW	Gwh	MW	Gwh	MW	Gwh
1980 base	514	2,789	514	2,789	514	2,789
1985	578	3,158	650	3,565	695	3,859
1990	641	3,503	735	4,032	920	5,085
1995	797	4,351	944	5,171	1,294	7,119
2000	952	5,198	1,173	6,413	1,669	9,153
2005	1,047	5,707	1,379	7,526	2,287	12,543
2010	1,141	6,215	1,635	8,938	2,901	15,933
Percent Growth/Year 1980-2010		2.7		4.0		6.0

* Adjusted to eliminate industrial self-supplied and two-thirds of the military sector, and to account for losses.

A LOLP for a system is a calculated probability based on the characteristics of capacity, forced and scheduled outage and cycling ability of individual units in the generating system. The probability defines the likelihood of not meeting the full demand within a one year period. For example, a LOLP of 1 relates to the probability of not meeting demand one day in one year; a LOLP of 0.1 is one day in ten years. For this study, a LOLP of 0.1 will be adopted. This value is widely used by utility planners in the country as a target for independent systems. [6/]

POTENTIAL FOR LOAD MANAGEMENT AND ENERGY CONSERVATION

The utilities are currently paying increasing attention to the implementation of load management and conservation measures in an attempt to reduce or shift peak load and reduce energy demand in the future, and, consequently, to increase average load factors. In this study, load management is defined as the "shifting" and corresponding reduction of peak demands and the alteration of daily load shapes by means of appropriate measures, with no significant difference in total energy demand. Load management may generally be achieved by one of two methods: direct control, in which the utility controls the end-use devices; indirect control, in which price incentives are used to motivate load shifting by consumer. Conservation is defined as a net reduction in energy demand by means of appropriate measures, with a corresponding reduction in peak demand.

The potential benefits of power demand control and reduction measures require careful evaluation before implementation on a major scale. A considerable amount of research and development work has been undertaken in the Lower 48 states on methods, cost strategies, as well as the potential impact of such strategies on demand. One Anchorage utility, Municipal Light and Power, has instituted an experimental time-of-day rate for electricity.

Load management measures were not incorporated in the ISER's energy forecasting model. With respect to energy conservation, however, provisions were made in different components of the model to account for such measures as improvement of appliance efficiencies, retrofitting of existing housing stocks and insulation in new construction.

In the residential sector the federally-mandated efficiency standards for electrical home applicances were assumed by ISER to be enforced during the period 1981 to 1985 but the target efficiencies were reduced by 10 percent. The energy saving improvements resulting from retrofitting were assumed to be confined to single family residences and to occur on the existing housing stock during the period 1980 to 1985. The improvements would be 4 percent saving for Fairbanks, 2 percent for Anchorage and between 4 and 2 percent for Glennallen-Valdez. Mandatory construction or performance standards for new housing was assumed to be enforced in 1981. The effect would be to reduce the heat load in new construction by 5 percent except for mobile homes.

In the commercial-industrial-government sector, the assumed reduction in electricity requirements for new construction would be 5 percent during the period 1985 to 1990 and 10 percent during the period 1990 to 2000. Retrofitting measures in the commercial sector were assumed by ISER to have no impact on electricity consumption.

A survey of potential measures under experimentation or in application in other parts of the country indicated there are opportunities for further reductions in electric energy and peak demand forecasts for the Railbelt by implementation of additional programs of intensified conservation and load management measures. 7/

In addition to the applicance efficiency standards, there are other provisions in the National Energy Conservation Policy Act. It includes a variety of incentives and mandates for energy conservation and alternative energy use by individuals, state government and business. The new programs consist of energy audits of residential customers and public buildings, insulation and retrofitting of homes through loan and grant programs, improvement of energy efficiency of schools and hospitals, and use of solar energy.

The Public Utilities Regulatory Policies Act (PURPA) of November 9, 1978 requires state public utility commissions to consider certain rate-making standards for utilities if they have sales in excess of 500 million kilowatt hours. The established standards to be considered are:

- Rates to reflect cost of service
- Abolition of declining block rates
- Time-of-day rates
- Seasonal rates.

Both Chugach Electric (CEA) and Municipal Light and Power (ML&P) are affected by the provisions of PURPA regarding rate and service standards for electric utilities.

Working under contract to the House Power Alternatives Study Committee, the consulting firm Energy Probe explored two levels of conservation more stringent than the conservation measures assumed by ISER. 8/ Energy Probe's conservation Case A represents anticipated results from recent Alaskan conservation legislation, combined with national trends in conservation policies and technologies. Case A includes changes in the residential space heating sector and in the commercial-industrial-government sector.

The Case B conservation scenario represents a program more stringent than Case A and affects the residential space heating, the major residential appliance, the unspecified residential appliance, and the commercial-industrial-government sectors.

Acres superimposed the Energy Probe conservation scenarios on the ISER low forecast (LES-GL) to explore a lowest reasonable bound of future energy demand. An annual growth rate of 2.1 percent resulted from this exercise and represents a reasonable lowest limit for electrical energy demand growth. 9/

TABLE V-4. SUMMARY OF LOW RANGE PROJECTIONS

Year	LES-GL			LES-GL With Stringent Conservation And Load Management		
	Electric Energy GWH	Peak Load MW	Load Factor Percent	Electric Energy GWh	Peak Load MW	Load Factor Percent
1980	2789	514	62.5	2789	514	62.5
1985	3158	578	62.4	3092	562	62.8
1990	3504	641	62.4	3433	620	63.2
1995	4351	797	62.3	3810	685	63.5
2000	5198	952	62.3	4237	756	63.8
2005	5707	1047	62.2	4689	835	64.1
2010	6215	1141	62.2	5201	922	64.4
Average Annual Growth, Percent						
1980-2010	2.7	2.7	---	2.1	2.0	---

In addition to conservation measures, the implementation of load management measures would also result in reduction of peak load [10] demand. The residential sector was found to be the most affected by the shift of load from peak period to off-peak period. With load management measures such as rate reform and load controls the resultant annual growth rate in peak load would be reduced to 2.0 percent. The annual load factor for year 2010 would be increased from 62.2 percent in the low forecast to 64.4 percent in the lowest case.

Table V-4 gives a comparison of different projections of annual electrical energy, peak load and load factor showing the impact of superimposing stringent conservation and load management measures on the low economic growth-low government expenditure case (LES-GL) and comparing that to the LES-GL case.

EXISTING AND CURRENTLY PLANNED GENERATION

The system used as existing capacity in the Railbelt for the generation planning studies includes the capacity of all utilities in the region, including the Alaska Power Administration. Table V-5 summarizes the information developed from the data research effort. [11]

TABLE V-5. 1980 RAILBELT EXISTING-CAPACITY

Railbelt Utility	Installed Capacity (MW)
Anchorage Municipal Light & Power Department	215.4
Chugach Electric Association	411.0
Golden Valley Electric Association	211.0
Fairbanks Municipal Utility System	67.2
Copper Valley Electric Association	----
Homer Electric Association	0.9
Matanuska Electric Association	2.6
Seward Electric System	5.5
Alaska Power Administration	30.0
TOTAL	943.6

The total Railbelt installed capacity of 943.6 MW as of 1980 consists of 53 units with the following types of capacity:

No. Units	Type	Capacity (MW)
1	Combined cycle	140.9
2	Hydro	45.0
18	NG gas turbines (Anchorage)	470.5
6	Oil gas turbines (Fairbanks)	168.3
5	Coal-fired steam	54.0
21	Small diesels	64.9
53	TOTAL	943.6

Only two additional projects are considered to be committed future projects for the Railbelt system. Those will be developed by Chugach Electric Association (CEA) and the U. S. Army Corps of Engineers (COE).

CEA is in the process of adding 60 MW of gas-fired combined cycle capacity in Anchorage. The plant will be called Beluga No. 8, and for study purposes, is assumed to be operating on line in January 1982.

The COE is currently in the post-authorization planning phase for the Bradley Lake project, located on the Kenai Peninsula. Project formulation is not completed. The project, as input to the planning model, includes 95 MW of installed capacity and 420,000 HWh of annual energy, on the average. For study purposes, the project is scheduled to be on line in 1988.

In order to establish a retirement policy for Railbelt utilities, a number of references were consulted including the Power Authority report guidelines, FERC guidelines, historical records and consultation with utilities, particularly in the Fairbanks area. From consideration of all of these sources, the following retirement policy is used: 12/

* Large Steam Turbines (>100 MW) = 30 years
* Small Steam Turbines (<100 MW) = 35 years
* Oil-Fired Gas Turbines = 20 years
* Natural Gas-Fired Gas Turbines = 30 years
* Diesels = 30 years
* Combined Cycle Units = 30 years
* Conventional Hydro = 50 years

CAPACITY REQUIREMENTS

The generation capacity additions required over the next 30 years can be found by deducting the existing generation at any point in time from the forecasted requirements at that time. This total includes the reserve margins necessary to maintain the target reliability and replacement of retired equipment. General Electric Company's Optimized Generation Planning Model (OGP-5) has been used to perform these calculations. The results are presented in Table V-6 for the low (LES-GL), mid (MES-GM), and high (HES-GH) forecasts as well as for the lowest case with stringent conservation and load management applied to the low forecast.

TABLE V-6. RAILBELT CAPACITY ADDITIONS REQUIRED (MW)

Year	Low Forecast	Mid Forecast	High Forecast	Lowest Forecast
1995	0	300	750	0
2000	475	650	1225	300
2005	860	1110	2100	550
2010	1040	1550	3025	815

The capacity of the Susitna Hydroelectric Project can be compared against these figures to determine if the forecasted requirements are sufficient to warrant study of a project the size of Susitna. As currently proposed, the Susitna project would have three stages with 400 MW each, giving a combined total of 1200 MW. As can be seen from Table V-6, according to the mid-range forecast, about 400 MW of additional capacity is required every five years from 1995 to the end of the planning period. In the case of the high forecast, the entire Susitna capacity could be fully absorbed by the year 2000; meeting this demand with Susitna would require an extremely accelerated construction schedule. For the low forecast, new capacity approximately equal to the first two Susitna stages would be needed by 2005, while the third stage would not be fully absorbed over the planning period. If the Susitna project were developed and demand growth occurred in keeping with this low scenario, the Devil Canyon stage could be deferred several years unless, of course, estimated power production costs indicated that the third stage was more cost effective than alternative fossil-fuel-fired energy generation. Under the lowest case forecast, in which stringent conservation and load management measures are superimposed on the low economic growth-low government spending scenario, only 815 additional megawatts would be needed over the planning period.

CONCLUSIONS

The energy demand forecasts were conducted at arms length from the Susitna studies by the Institute of Social and Economic Research. Given the availability of data, the researchers employed the most reasonably sophisticated forecasting tools available. There are deficiencies in the forecast data base and methodology which have been identified and will be at least partially corrected by Battelle as part of the Railbelt Power Alternatives Study. The updated results will be available for use in the feasibility analysis of the Susitna project scheduled for completion in March 1982.

The energy and peak load forecast results presently available cover a wide range of possible economic growth and energy use scenarios. Actual demand will very likely fall within the forecast range. Except at the very lowest extreme of the range, the forecasts indicate that additional capacity comparable to the Susitna project's total installed capacity will be required over the next 30 years. Even at the lowest extreme, capacity equivalent to the first two stages of Susitna development is needed.

Therefore, it is concluded that anticipated capacity addition requirements are such that continued study of the Susitna Hydroelectric Project is warranted.

SECTION V. ENDNOTES

1/ Summarized from Subtask 11.01 - Project Overview (second draft), Acres American, February 11, 1981, pp. 6-1 thru 6-4.

2/ For a detailed presentation of the ISER forecast, see Electric Power Consumption for the Railbelt: A Projection of Requirement, Scott Goldsmith and Lee Huskey, May 16, 1980.

3/ Figure is taken from Subtask 1.01 - Closeout Report, Review of ISER Work, Acres American, December 1980, p. A-53.

4/ Subtask 11.01 - Project Overview (second draft), p. 6-13.

5/ For a detailed discussion of the Woodward Clyde peak load forecast, see Forecasting Peak Electrical Demand for Alaska's Railbelt, Gary Smith and Craig Kirkwood, December 1980.

6/ Subtask 6.36 - Generation Planning Parameters, Acres American, January 1981, p. 11.

7/ Subtask 11.0 - Project Overview (second draft), p. 8-12.

8/ An Evaluation of the ISER Electricity Demand Forecast, Energy Probe, July 30, 1980, pp. 31-43.

9/ Subtask 11.01 - Project Overview (second draft), pp. 8-13 and 8-14.

10/ It is important to distinguish between peak load and energy demand. In a single day, for example, if twenty-four people turned on a 1000 Watt appliance simultaneously and used it for one hour, the "load" would be 24,000 Watts (24 kW). Energy consumed would be 24 kilowatt hours (24 KWh). On the other hand, if each turned on his appliance one hour after the other, the load would only be 1000 Watts (1 KW). Energy used would be the same.

11/ Subtask 6.36 - Generation Planning Parameters, pp. 11, 12.

12/ Subtask 6.36 - Generation Planning Parameters, p. 13.

SECTION VI

SEISMIC RISKS

VI. SEISMIC RISKS

Risk assessment of a large hydraulic structure requires an interdisciplinary approach. This is particularly true for seismic risk assessment. Here, the interrelationships between geology, seismology, and geotechnical engineering are many and complex, as well as very highly specialized. This complexity and high degree of specialization has led to its own technical language and methodology. The following discussions attempt to review the seismic aspects of the Susitna Hydroelectric Project in laymen's terms, a task which implicitly demands substantial simplification and recasting of concepts and terminology. While this approach has the benefit of permitting the lay observer an opportunity to gain an appreciation of the general forces at play, it also carries the danger of over simplification and misinterpretation. Accordingly, while we believe the following discussions to be conceptually correct, their use should be restricted to an appreciation of the general seismic question. Beyond that, recourse to the technical source documents is essential.

DESIGN PHILOSPHY[1]

The first consideration of the design team is that the dam structure safely withstand the most severe seismic event conceivable without releasing the impounded waters. This consideration controls the basic shape and composition of the dam structure, and tolerates no compromise of materials, cost, or siting. The controlling seismic event for this worst conceivable case is called the "maximum credible earthquake" (MCE).

The next design objective is for the hydroelectric project to be able to continue operating after being subjected to a more probable level of seismic shaking. This seismic event, called here the "operating basis earthquake" (OBE) is defined as the earthquake that could reasonably be expected to occur within the lifetime of the facility, and is usually less than the MCE.[2]

There is general agreement that the largest earthquake that is mechanically possible under present geological conditions (an MCE without regard to location or time) would have a magnitude less than about 9.0 on the Richter scale. The largest earthquakes recorded since the Richter scale was devised (two events) were about magnitude 8.9. Based on very close analysis of these massive seismic events, there is broad agreement within the technical community that an earth structure can be designed to withstand the ground shaking caused by the maximum theoretical MCE.[3] More directly to the Susitna proposal, it can be stated that a structure at Watana can be designed and built that will retain its impoundment; a safe structure can be built. For a concrete dam, only one failure mode cannot be consistently overcome; a crack caused by a fault directly underneath the dam. However, at Devil Canyon, no such fault exists. Therefore, the same conclusion can be drawn there -- a safe structure can be built. However, if the seismic event is very severe, construction of that safe structure for either type of dam can be very expensive. In practical terms, then, the impact of a seismically active area is directly felt in the economic feasibility of the proposal through the mechanism of increased construction costs.

In summary, the dam structures must be able to survive the most severe earthquake conceivable and retain the impoundment, should be able to survive relatively unscathed the more probable earthquake to be expected during its life, and must be economically viable.

THE SEISMIC STUDIES[4/]

Just as seismic concerns interrelate with the economics of the project, they also interrelate with the geology of the site, the geotechnical properties of the construction materials and foundations, the hydraulic characteristics of the river, weather conditions, and many other factors. The multidisciplinary approach of the feasibility study now in progress is designed to address these interactive relationships. Therefore, although the following discussions are confined to the "seismic" aspects, the broader perspective of the total feasibility study objectives and findings is appropriate to a better understanding of the problem.

The approach used in the feasibility study to assess the seismic risks associated with development of the Susitna basin follow this pattern:

* The physical setting is identified.

* A tectonic model of the physical setting is hypothesized -- that is, the physical setting is described from a seismic geology viewpoint.

* Key features within that model are identified and then assessed for their potential of generating a seismic event.

* The interaction of the resulting key features is evaluated and an estimate of the magnitude of a seismic event is postulated.

* The probable affects of the postulated seismic event on the dam is then estimated and through an iterative process the dam design is modified until the seismic event is adequately resisted.

The following paragraphs address each of these steps in detail.

A widely accepted premise of earthquake theory is that earthquakes are generated when two adjacent plates on the outer skin of the earth move relative to each other. These plates are very large, sometimes encompassing entire continents. The movement of these plates sets up internal stresses within the plates. An earthquake is a sudden release of the accumulated strain energy. The energy release is centered on a feature called a fault, and is accompanied by relative displacement (vertically, horizontally, or both) of the land on opposite sides of the fault.

Earthquakes are often classified as shallow, intermediate or deep. If two adjacent plates slide past one another horizontally, as do the Pacific plate and the adjacent North American plate along the San Andreas fault system in California, shallow earthquakes will be generated. However, when two adjacent plates collide with one another, one plate slides beneath the

other. Given the appropriate composition of materials, the lower plate may pass downward into the mantle of the earth. This process is called subduction, and as the plate subducts, it generates earthquakes that are progressively deeper in the direction of movement, leading to intermediate and deep events.

From the viewpoint of earthquake risk, the shallow earthquakes in landward areas associated with two colliding plates, two plates sliding past one another, or two plates pulling apart from one another present the greatest hazards to engineering works. Further refining that assessment, the most destructive of the shallow earthquakes are usually associated with the sudden rupturing of the earth's crust.

Examination of the earth's surface can disclose the relative association of the plates and their degree of motion (which through various empirical and statistical methods of analysis can result in a prediction of earthquake intensity and recurrence). The main clues are called features or lineaments; distinct geologic features that appear to go in a relatively straight, continuous line, show shear, or otherwise reflect signs of movement. In essence, these lineaments are rupture scars.

A very key point must be made at this time. Not all lineaments are the result of past, present or potential seismic activity. For example, a moving glacier may gouge a feature that goes in a straight line, exposes a bluff so as to give the appearance of shear, etc. However, such a lineament has absolutely no seismic significance as it was formed by a purely surficial mechanical action and not as the result of movement within the earth's crust. Hence, one of the major objectives of the initial tectonic model structuring and mapping effort is to identify those features that are truly associated with seismic activity and to eliminate those that are not pertinent.

The project site is part of the North American plate. Within the northern area of the plate, there is a tectonic unit defined as the Talkeetna Terrain, a relatively integral and stable mass. The terrain boundaries are the Denali-Totschunda fault to the north and east, the Castle Mountain fault to the south, a broad zone of deformation with volcanoes to the west and underneath, an area called the Benioff Zone which is the zone of subduction of the Pacific plate under the North American plate.

The Talkeetna Terrain appears to be a relatively stable and quiescent unit. However, there is substantial evidence of frequent strain accumulation and resultant release along the terrain margins. In other words, the Talkeetna Terrain, while stable itself, is in a seismically active area. The specific dam locations are roughly centered on the Talkeetna Terrain. Thus, a potential hazard to the dam sites is known to exist from the seismic activity along the borders of the terrain (which are shallow events) and from the Benioff Zone (which range from moderate to deep).

This description of the tectonic model is very roughly established in the existing literature. The 1980 feasibility study investigations concentrated upon more precise definition of the model and identification and

categorization of the active features. In addition, a micro earthquake sensing network was set up to assess the risk potential of the Benioff Zone.

The Benioff Zone, the subducting of the Pacific plate under the North American plate, generates strains which are periodically released by fracturing or disintegration of the leading edge of the Pacific plate. The depth and frequency of these strain releases is important to the magnitude of the seismic event that might be reflected at the dam sites on the earth's surface. If the Benioff Zone is very deep, the seismic risk is probably low; if shallow, probably high. This feature was assessed by establishing a network of sensors to monitor strain releases within the zone; the micro earthquake sensing network. During a three month period of monitoring, a ten station micro earthquake array monitored more than 260 earthquakes within 30 miles of the project ranging from Richter magnitudes of 0 to 3.7. As a indicator of the severity of these seismic events, the passing of a truck in front of a single story house causes shaking equivalent to a seismic event of about Richter magnitude 3.0. This extensive data return permitted good definition of the location and depth of the Benioff Zone, allowing prediction of the ground shaking that could be expected.

The strain released from a seismic event, or earthquake, is reflected as a series of shock waves or vibratory motions of differing frequencies and intensities, and continuing for a period of time (duration of shaking) varying from about one second for small magnitude events to several minutes for the largest magnitude events. The force components are frequently related to the force of gravity and can be expressed as a percent of the gravitational force, e.g., 40 percent of 1 g or .4 g. All three factors (force, frequency and duration) influence the dam design, and they are interactive. The stronger the shaking, the larger the force. The longer the duration, the greater the possibility of displacements. Materials might fail when shaken at one frequency but be totally unaffected by another frequency; very generally speaking, the lower the frequency the higher the damage potential to a dam structure.

Precise predictions of all three parameters will be necessary for detailed design of the dam structures. However, for feasibility considerations, a Richter magnitude and its maximum associated force as a percent of "g" are of primary importance.

FIRST YEAR RESULTS

As a result of the first year study effort, the tectonic model structure as postulated by the existing literature was confirmed. From a very large number of features (some seismically related, some not) 216 candidate features were selected for additional study. These features were screened by field examination and that number reduced to 48 candidate significant features. These 48 features were then subjected to additional intense evaluation and in turn were reduced to 13. Final assessment and risk categorization of these remaining 13 features will be accomplished during the 1981 field season.

The remaining 13 candidate significant features were broadly assessed for their magnitude and acceleration that could be anticipated if they were determined to be controlling features. As the features are of varying distances from the dam sites, the magnitude and acceleration at the feature had to be modified (or attenuated) to a probable magnitude and acceleration at the dam site. When this is done, it can be seen that a large event some distance from the dam site might pose less hazard than a smaller event much closer to the dam site. Ranking all of the probable effects from the various features at the damsite results in a "controlling event". This controlling event is then used as the basis for conceptual design at the feasibility level of analysis.

It is to be emphasized that these controlling event assessments represent worst case scenarios, and are based on data in hand to date. It is anticipated that the 1981 field investigations will elminate nearly all of the remaining 13 candidate significant features by virture of their posing no risk, low risk, or not being a controlling feature.

The controlling event parameters for both the Watana and Devil Canyon dam sites at this point in time reflect seismic activity in the Benioff Zone. The MCE is Richter magnitude 8.5 and when attenuated to the dam sites results in an estimated mean peak acceleration of 0.41 g at the Watana dam site and 0.37 g at the Devil Canyon dam site. A Richter magnitude 8.5 MCE is estimated for the Denali fault, the next potential controlling feature, with a resulting peak acceleration at both dam sites of 0.21 g. The OBE has not yet been established.

RESERVOIR INDUCED SEISMICITY[5/]

Another potential source for an earthquake at the dam site is the filling of the impoundment. The water facilitates slippage along the various rock planes under the reservoir. Also, the weight of the water tends to induce movement. This action is termed "Reservoir Induced Seismicity" (R.I.S.).

Again, an important distinction must be made. A reservoir cannot induce more seismic activity than an area could have produced if the reservoir had not been there. Instead, R.I.S. means the event that would have occurred sooner or later is induced to occur sooner. If, at the time of filling of the impoundment, the accumulated strain energy is small, the corresponding seismic event could be small. Conversely, if the accumulated strain energy is high, the resulting event could be large, but not larger than what would naturally occur "sooner or later".

The potential for R.I.S. appears to be a function of the size and depth of the reservoir. Since the Watana reservoir is both very large and very deep, it is important to estimate both the probability of R.I.S. occurrence and the potential magnitude of the resulting event.

The probability of occurrence was estimated by comparing the Watana reservoir with other large and deep reservoirs that had experienced R.I.S. This comparison showed that the likelihood of a reservoir induced event of any size (including micro earthquakes) at the Watana reservoir was very high; in fact, almost a certainty.

Assessment of the tectonic model from an R.I.S. perspective suggests that natural earthquakes in the Talkeetna Terrain are not likely to have magnitudes larger than 5, unless major active faults are shown to exist in the region. However, no faults with recent displacement are known to be present within the vicinity of the proposed reservoirs. Accordingly, while additional study of the R.I.S. risk will be done over the next year, there is considerable confidence in the present assessment that R.I.S. is not a controlling event.

CONCLUSIONS

Seismic forces can cause damage to a dam through several mechanisms. In earth dams, these include settlement, scope failures (sliding), overtopping, etc. In concrete structures, the damage could be overstressing and rupture. The engineering design must address all of these potential failure mechanisms. Feasibility testing must allow for earthquake resistant measures and their cost. Many such techniques are included in the Watana dam presently being studied. (They were selected on the basis of previous dam design for seismic areas. A prime model was the Oroville, California Dam which is of similar materials and height and has been shown analytically to be capable of withstanding an event of Richter magnitude 8.5.) These measures include additional freeboard to compensate for possible settling and to prevent overtopping; flattened side slopes to increase dam stability under shaking conditions; selection of materials and methods of placement ensuring that they are stable under the maximum anticipated forces; a wider crest; and removal of all materials under the dam down to bedrock to eliminate the possiblity of foundation problems. For the Devil Canyon dam the structure is being designed to insure that rupture will not occur. Finally, there are increased cost contingencies to permit incorporation of additional but as of yet unidentified earthquake resistant features for either or both locations.

Given continuation of the feasibility study, the 1981 field investigations are expected to eliminate as controlling events most or all of the remaining 13 candidate features, confirm the MCE and define the OBE, and increase the confidence level of the findings and recommendations.

It is our conclusion that both the Watana and Devil Canyon Dams are subject to substantial seismic events. However, empirical evidence makes it clear that the magnitude of the events at play can be successfully resisted through prudent design. The seismic risk associated with the project area, based on current knowledge, is not so great that the hydroelectric potential cannot be developed safely.

SECTION VI. ENDNOTES

1/ A general reference to material throughout the paper, Geologic Considerations for Seismic Micro Zonation by Lloyd S. Cluff, proceedings of the Second International Conference on Micro Zonation, 1978, San Francisco, California, Volume I, pages 135-152.

2/ Summarized from lecture notes of Dr. Lloyd S. Cluff for the Seminar and Workshop on "New Prespectives on the Safety of Dams", cosponsored by Stanford University and Massachusetts Institute of Technology, August 28 - September 1, 1978.

3/ Summarized from General Discussion of Earthquakes and Faulting, Woodward-Clyde Consultants, undated. (Supplement to seismic assessments produced by this firm.)

4/ Unless otherwise noted, the remainder of this section is summarized from Subtasks 4.01 through 4.08, Interim Report on Seismic Studies for Susitna Hydroelectric Project, December 1980, except as below.

5/ This discussion on R.I.S. is a synthesis of the Subtask 4.01 through 4.08, etc. Report (endnote 4 above) and a transcript of an interview of Dr. H. Bolton Seed conducted by the Power Authority Public Participation Office on February 10, 1981.

SECTION VII

ENVIRONMENTAL IMPLICATIONS

VII. ENVIRONMENTAL IMPLICATIONS

A substantial portion of the feasibility study is being directed to environmental considerations. Objectives are (1) to assess the probable environmental effects that would be caused by development of the Susitna Basin for hydroelectric purposes, and (2) to insure that any schemes devised for the hydroelectric development of the basin fully consider and integrate environmental considerations.

During the first year of the study, a comprehensive review of existing literature was made, and field studies were initiated. Existing data were used in the preliminary planning of the basin development. Findings derived from the continuing field investigations will be used to modify those initial development plans, leading by the end of the study to a sound project configuration and to identification of mitigative actions as needed.

The 30 month feasibility study currently underway (identified as Phase I) will provide sufficient data for a license application to the Federal Energy Regulatory Commission (FERC). However, it will not provide all the data ultimately needed, because the study period is too short to observe a substantially complete life cycle of certain species. Also, Phase I develops only preliminary mitigation measures. Accordingly, Phase II is planned to run concurrent with the FERC license application processing. Phase II studies will continue field investigations initiated during Phase I and will fully develop mitigation plans. During the FERC license processing, results of these Phase II studies will be integrated into the original license application. The amplified application will then form the basis for license approval or disapproval by FERC. The investigations comprising the Phase I program include fisheries, wildlife, plant ecology, land use analysis, cultural resources, recreation planning and socio-economic analysis.

The literature search provided a base line for predicting some probable effects of developing the Susitna Basin. That literature survey suggested that while there might be both gains and losses from the environmental viewpoint, none were of sufficiently major or irretrievable effect as to unequivocally rule out the project concept. New field data being collected are tending to reinforce the initial literature suggestions. Conclusions evolving from the first year of field investigations will not be available until April/May 1981. However, indications and tentative expectations are emerging. They are discussed below, together with expanded details of the various areas of investigation.1/

FISHERIES

Although it is generally known that the Susitna River has heavy anadromous runs, relatively little is known about the contribution of the Susitna Basin to the total Cook Inlet fisheries, the capacity of the basin to rear fish, or the distribution of fish by species and season. The initial objective of the fisheries studies is, via field surveys, to answer these points. The principal field investigator (the Alaska Department of Fish and Game) is conducting an extensive program of sampling, mapping and

assessment to determine the relative abundance and distribution of adult anadromous fish populations within the Susitna drainage, determine the distribution and abundance of selected juvenile anadromous fish populations, and delineate the seasonal habitat requirements of the anadromous and the resident fish species during each stage of their life histories. A related outcome of the field investigations will be an assessment of the economic, recreational, social and aesthetic values of the existing resident and anadromous fish stocks and habitat. These investigations are directed at the entire basin, from the Tyone River confluence down into the Cook Inlet. Hydroelectric development of the Susitna River will change the nature of the river below the dam sites. The normal flow regime will change from the present flow pattern of high flows in the summer and very low flows in the winter to a more or less uniform discharge below Devil Canyon dam. Also, the sedimentation characteristics, temperature and chemical balance of the river might be affected. Extensive hydrologic investigations are presently underway to assess present river conditions and to predict conditions after development. These predictions will then be integrated with data from the fish studies to provide an impact assessment on fisheries.

Because of a late start of the ADF&G field investigations, few field data have been gathered to date. However, information from the literature search together with first year hydrologic data suggests several possible effects after development.

The upper Susitna River, whose flow would be regulated by the proposed dams, contributes about 40 percent of the total annual Susitna River flow passing the Parks Highway Bridge and approximately 17 percent of the total Susitna River flow entering Cook Inlet. Seasonal flow changes will be greatest immediately below the dam with increasing attenuation downstream towards Cook Inlet as tributaries augment the volume of the river. According to preliminary indications there are no anadromous fish above Devil Canyon because fast-moving rough water at that location poses a natural barrier to their migration. If true, the dams will not cut off any traditional spawning migration. However, changes in the character of the river below the dams may alter the habitat for survival of young salmon spawned in lower tributaries. These changes may be deleterious (or perhaps beneficial) to salmon fry. Additional hydrologic data are needed to better judge the changes in flow that may be anticipated.

It is suspected that resident fish species in the upper reaches of the Susitna are very limited. The creation of an extensive reservoir behind Devil Canyon dam suggests that resident fish populations might be developed through increasing existing species or introduction of new species. However, the annual draw down cycle of the Watana reservoir will be sufficiently great to preclude any meaningful resident population there. Much more work needs to be done before these points can be answered.

WILDLIFE

The wildlife studies are subdivided into a number of components and are discussed below. Extensive interrelation exists between the various wildlife studies and complimentary studies of plant ecology, recreation planning,

land use analysis, socio-economic analysis, access road location, and design development.

Wildlife investigations are being pursued by the Alaska Department of Fish and Game and the University of Alaska, Fairbanks. The primary objective is to define the types and extent of wildlife habitats in the study area, and the utilization of those habitats by wildlife. These data will serve to predict the probable effects on wildlife of river impoundments. They likewise will be a basis for planning mitigation measures.

Wildlife Studies: Caribou

First year investigations concentrated on estimation of numbers, composition of sub-herds, delineation of calving areas, determination of migratory routes, and timing of movements. Particular emphasis was placed on evaluating potential impacts of the proposed impoundments on movements and sub-herd isolation of the caribou. Study techniques used included radio collaring, aerial tracking, and photography.

The Nelchina caribou population is estimated to number about 17,000 animals, divided into several sub-heards. The bulk of the animals summer in the Talkeetna Mountains and foothills, with others occupying several localities on the north side of the Susitna River. During the rut in autumn most of the caribou congregate on the Lake Louise Flat. Winter concentrations in 1980 occurred from the Maclaren River east to the Chistochina River, and in the Slide-Mountain-Little Nelchina River area. These seasonal movements involve crossings of the Susitna River in the sector to be inundated by the Watana dam. The impoundments will be something of an impediment to migration, but because it is relatively narrow caribou can swim across it readily provided that the shorelines are not blocked by ice shelves, frozen mud banks, or floating timber. Crossings undertaken during spring break-up would appear to be the most troublesome. At that time the animals are in weakened condition and ice flows are treacherous.

Development of access roads, air fields, and transmission lines may prove disruptive to caribou movements and general welfare. Particular concern should be directed to minimizing disturbance of the animals on their traditional calving grounds in the Talkeetna Hills and Oshetna/ Kosina hills, which lie just south and north of the Watana impoundment. Improved access by hunters would permit increased hunting of the caribou.

Distribution and movement studies and habitat selection studies will continue through Phase I with routine monitoring of radio-collared caribou.

Wildlife Studies: Moose

Major points of investigation concern numbers of moose, seasonal habitat uses, movement patterns, and supplies of forage on winter ranges. Approximately 2,000 moose were estimated to exist on the

upper Susitna basin. Forty of these were captured and fitted with radio collars and their movements monitored. Of 563 observations of marked animals, 6 to 9 percent occurred in areas scheduled to be inundated, largely by the Watana dam. More data are needed, especially in winter, to interpret adverse effects of inundation on riparian moose range. Calf production in this population is high, signifying adequate nutrition at present. Many calves are lost to predators, particularly brown bears.

In the lower Susitna valley 10 moose were collared and their movements traced. Some lived all year close to the river, while others migrated seasonally to adjoining uplands. Willow, cottonwood, rose, and highbrush cranberry were preferred browse foods. An important issue to be further studied is the possible effect on these forage species of changes in river discharge and channel meandering.

Wildlife Studies: Dall Sheep

An aerial survey of sheep ranges was conducted in July, 1980. Three discrete areas of occupied range were identified, namely, Watana Creek hills, Portage-Tsusena, and Mount Watana. All are close to the areas to be impounded, and disturbance may become a factor in sheep welfare. The current population is estimated to be near 300 animals. Aerial surveys will be repeated in 1981.

Wildlife Studies: Black and Brown Bears

Studies are being conducted to determine the distribution and abundance of black and brown bears in the vicinity of the proposed impoundment areas, seasonal ranges, including denning areas, and movement patterns of bears. In 1980, 27 black bears and 27 brown bears were captured and marked using helicopter darting techniques. Adults were radio-collared and their movements traced. Brown bears utilize the proposed impoundment areas in spring but spend summer and autumn at higher elevations; they also den at these upper sites. Black bears drop down in late autumn to select dens near the river at elevations that will be inundated. All summer they frequent the timbered slopes which will be close to the level of flooding. This species probably will be more severely affected by the hydro-development than the brown bear. However, both species are abundant at present and probably will still be present in goodly numbers after development.

Wildlife Studies: Wolf, Wolverine

Five wolf packs were identified in the study area and 23 wolves were captured and fitted with radio collars to trace movements. The average size of a pack's territory was 450 sq. mi. (212 to 821). The five packs constituted at least 40 animals in spring 1980. By fall, the packs had increased to 77 wolves. Moose were the principal prey (52%), with caribou second (38%). Each pack made a kill about every fourth day. The most important potential impact of the Susitna hydro-electric project on wolves would relate to reductions in numbers of prey.

Four wolverines were radio-collared and 86 radio locations were obtained in 1980. Home ranges were large, as would be suspected (100 to 150 sq. mi. for males, 33 sq. mi. for a female). Wolverines prey largely on rodents, hares, and an occasional caribou calf. They seem to be somewhat intolerant of human disturbance but probably would be little affected by hydrodevelopment.

LAND USE ANALYSIS

Land use analysis studies are being conducted by the University of Alaska, Fairbanks. Primary objectives are to evaluate past, present, and future land use trends, describe present and future resource management programs and identify the major changes in land use that could result from the hydroelectric development of the Susitna Basin. Investigative tools have included inventories, review of resource management planning done to date, and assessment of present land use legal constraints such as the recently passed D-2 bill.

Data to date indicates little resource management planning done or proposed for the Susitna area. A complicating factor is the heterogeneous mosaic of land management activities and objectives as a result of the fragmentation brought about through the ANCSA and state land selection events. One of the major concerns relates to access to the area that will result from a basin development. Increased access would bring more opportunity to use the land, leading to more pressure on existing resources. This could force a change in land use, the lifestyle of those who have used and are still using the area, and could alter the ecological system. No assessments are available yet as to the degree of severity of these changes.

CULTURAL RESOURCES

The objectives of this investigation are to identify archaelogical, historical, and paleontological resources in the project area, to test and evaluate these resources, and to propose mitigation measures and lessen the impact of ground disturbing activities. The principal investigator is the University of Alaska Museum. Activities to date have included a literature search, substantial aerial photography, evaluation, and some archealogical excavation.

A number of sites have been identified that contain finds from both historic and prehistoric times. While only limited assessment of the finds has been made, no unexpected data has emerged. If this trend continues, post-basin development impacts will not be extreme. However, this assessment could be substantially qualified by next year's investigations.

RECREATION PLANNING

In addition to assessing the recreational aspects as part of the wildlife, land use and socioeconomic feasibility study subtasks, the principal investigator (University of Alaska, Fairbanks) is coordinating

the preparation of a recreation plan for development of the total project lands and waters associated with the basin development. The objectives of this plan are to provide the most socially acceptable and desirable mix of public recreation opportunities in concert with conservation and preservation objectives.

Considerations include the degree of access generally desired, extrapolating therefrom the amount of utilization of project lands that would result, balancing that degree of utilization against the capability of the project lands to support it and to identify and incorporate unique natural features, recreational opportunities or other unusual characteristics. Techniques used include inventorying, crossfeeding from other feasibility study subtasks, consultation with management agencies at all governmental levels, and seeking public input on the various alternative recreation concepts.

To date, only broad concepts have been developed. Response to these broad scenarios suggest moderate to high development is desired. Substantial further input and refinement to the proposals is necessary before an optimized configuration can result.

PLANT ECOLOGY

The plant ecology studies, being principally investigated by the University of Alaska, Fairbanks, have as their objective the mapping and characterization of the vegetation/habitat types ocurring in the project area. Desired results include identification of rare or endangered types, concentrations or conditions, and support to other investigations such as food source assessment for fauna. Principle investigative tools have been high altitude infra-red photography and landsat imagery.

To date, vegetation types and dispersal have been roughly categorized. Principle vegetation types in the area of inundation are closed mixed conifer and deciduous forest, closed and open conifer forest, tall shrubland and open and closed shrubland. Losses of vegetation/habitat in the area of proposed haul roads and borrow areas will probably consist largely of low shrubland and mat and cushion tundra. It appears that no biologically important types will be lost. Assessment of the impact of loss of habitat remains to be made.

CONCLUSIONS

It must be firmly stated that insufficient data exists as of the date of this report to definitively predict the overall impact of the Susitna Basin development. From that inability follows a corresponding inability to judge the acceptability or lack thereof of the probable impact.[27] The Susitna project will result in a change in stream flow, but there is as much evidence to indicate that these alterations would create a positive overall fisheries impact as there is to suggest the opposite. Whether positive or negative the overall change in the Cook Inlet salmon fishery will probably be slight. Although the Susitna

may be a major salmon producer for the Cook Inlet the major Susitna contributions are expected to come from tributaries such as the Yentna, Kashwitna, Willow, Deshka, etc. - none of which are affected directly by Susitna development. Some questions for which there is totally inadequate data to even speculate on impacts are - what is the importance of the mainstem Susitna for winter rearing and how important for spawning and rearing are the sloughs and side channels? These questions are being addressed in the Phase I studies. It may be worth noting that some of the aspects of other hydro projects which have created significant impacts on fisheries are not inherent to Susitna. For instance:

1. There is no direct blockage of fish migration or escapement resulting from the dam itself.

2. There are no significant river diversions resulting in subsequent low flows in the diverted river.

3. Regulation is being factored into design to eliminate significant daily fluctuations in flow.

4. Nitrogen entrainment will not be significantly increased because there are not numerous reservoirs in series.

The possibility may exist for enhancing the Susitna River salmon fishery by taking steps to remove the velocity barrier at Devil Canyon and thereby open the upper Susitna River to salmon access. It is not known at this time whether the existence of the Susitna Hydroelectric Project would be an assistance or an impediment to the realization of this concept.

There will, of course, be a reduction in wildlife habitat resulting from inundation. The magnitude of this reduction is a key question which cannot be quantified until more data is available. However, the basin's most sensitive moose, caribou and furbearer areas are upstream of the Watana reservoir area.

Numerous concerns have been raised regarding the potential social impacts of the project. Continual reference is made to the pipeline project. As with any large construction project, there will be unavoidable socioeconomic effects in the local, regional and state areas. However, the pipeline had a large, transient, short-term construction force, much less controllable than a large, central, long-term (10 - 15 years) workforce as would be associated with Susitna. The degree to which this workforce is selfcontained can be controlled.

The influence of people in the area is likely to have a greater impact on the local area than the project itself. If the wildlife and land use disbenefits associated with increased access outweigh the social benefits of increased access, measures can be taken to restrict access. Since total restriction is not realistic, impacts will result from human intrusion into this relatively pristine area.

The absence to date of findings of serious negative impacts suggests studies should continue. Study continuation has the supplemental benefit of substantially increasing the data base of the southcentral Alaska ecological systems, a worthwhile benefit whether the Susitna Basin is developed for its hydroelectric potential or not.

No attempt is made in this report to assess the environmental implications of alternatives to hydroelectric development of the Susitna Basin. When the requirement for this report was established, the Power Authority was responsible for assessing alternatives to Susitna hydroelectric development. However, subsequent legislation removed the study of alternatives from the Power Authority and transferred it to the Governor's office. The Governor's staff, in turn, contracted assessment of alternatives to Battelle Northwest Laboratories. In the absence of alternatives assessment, the Power Authority is unable to effectively evaluate environmental impacts stemming from those alternatives. However, the Battelle Northwest Laboratories contract includes such environmental assessments. Battelle will also independently investigate the projected need for power (which will largely influence the question of timing and degree of future power development) and they will assess the full range of alternatives to meet that projected power need. As noted previously, their assessment of alternatives will include such factors as environmental impact and their social and economic costs. Battelle's efforts are scheduled to be completed by April 1982 so that the decision-making process will have the benefit of both the Battelle findings and the recommendations of the Power Authority.

SECTION VII. ENDNOTES

1/ The discussions of fisheries and wildlife were provided by Dr. Starker Leopold, member of the Susitna External Review Panel. Dr. Leopold based his presentation on his previous knowledge of the project area on interviews with study team members and on the first set of annual reports from the environmental study team. The sections on Land Use, Cultural Resources, Recreation Planning and Plant Ecology were summarized from Subtask 11.01 - Project Overview, Second draft, Acres American Incorporated, February 11, 1981, pages 10-4 through 1-25.

2/ These conclusions are based on discussions with members of the Acres study team.

SECTION VIII

ECONOMIC FEASIBILITY

VIII. ECONOMIC FEASIBILITY

The question of economic feasibility can be simply stated as follows: does Susitna hydroelectric development provide lower cost power than any other viable alternative? The answer to this question requires a great deal of field investigation and engineering analysis to provide reliable cost estimates. This work is scheduled for completion at the end of the program's second year, so it is premature to assert at this time that the Susitna Project either is or is not economically feasible. Previous studies have indicated that the project does provide lower cost power over the long term, and nothing to date suggests otherwise. Nonetheless, a definitive statement of economic feasibility must await March 1982.

In the meantime, to guide the decision on whether the study program should proceed, it is appropriate to check the economic feasibility with the best information presently available. In assessing feasibility, a project cannot be viewed in isolation, but instead must be considered as part of a generation system. The check of feasibility then entails comparing the costs of the entire system first without the Susitna Project and then incorporating the Susitna Project as a system component.

GENERATION PLANNING

Any projection calling for growth in demand necessarily implies a requirement for sufficient generating capability to meet that demand, as well as a prudent reserve to deal with emergency requirements and normal scheduled maintenance on primary generating facilities. Development of the Susitna Basin offers one means for expansion of Railbelt generating capability. Adding thermal units to the current predominantly thermal power system offers another. A detailed independent study of alternatives to meet future Railbelt needs is being conducted concurrently with the Susitna Hydroelectric Project Feasibility Study. It is unlikely, however, that any single type of development will be selected as the exclusive solution for the future. Rather, some mix of generation approaches will be necessary to meet the many constraints which must be considered. If, for example, the earliest possible date for putting power on line for any favored generation means is later than the point at which reserve margins become dangerously low, it may be necessary to develop other facilities in the interim--in spite of possibly higher costs or less desirable impacts.

To determine which of the possible Susitna developments represents an apparent optimum to deal with the range of forecasts and their associated uncertainties, it has been necessary to synthesize the Railbelt Electric System as it might exist in the 1990's and beyond. This synthesis provides the basis for a dynamic evaluation of the benefits for a Susitna project and other generating resources under varying power needs and levels of economic activity.

The generation planning process recognizes that the system which will exist in 1990 is largely predetermined. Existing facilities and certain improvements now in process will constitute the bulk of the 1990 system and any

currently unscheduled additions necessary to meet 1990 requirements must necessarily be limited to those which can be installed in the near term without violating regulatory constraints. Since it is not possible to bring a Susitna project on line before the 1990's, a base 1990 system was developed as a starting point for consideration of alternative future system expansions. The economic viability of various thermal and hydroelectric developments in the post 1990 period was then tested against most likely future needs with and without inclusion of a Susitna Project. The various expansion plans will later be evaluated to determine their environmental impacts as well as overall sensitivity to the relatively broad range of potential growth patterns and possible variations in financial and economic assumptions. This supplemental information will not be incorporated in this report. Instead the check of economic feasibility will be based on a "base case" set of assumptions and a limited number of alternative assumption sets. Full sensitivity testing will be presented in future reports.

The primary tool used for the generation planning studies was the mathematical model developed by the General Electric Company Utility Systems Engineering Department, called Optimized Generation Planning (OGP). 1/

The OGP program was developed over ten years ago to combine the three main elements of generation expansion planning (system reliability, operating and investment costs) and automate generation addition decision analysis. OGP will automatically develop optimum generation expansion patterns in terms of economics, reliability and operation. Many utilities use OGP to study load management, unit size, capital and fuel costs, energy storage, forced outage rates and demand forecast uncertainty.

The OGP program requires an extensive system of specific and generalized data to perform its planning function. In developing an optimal plan, the program considers the existing and committed (planned and under construction) units available to the system and the characteristics of these units including age, heat rate, size, and outage rates as the base generation plan. The program then considers the given load forecast and system design and operation criteria to determine the need for additional system capacity based on given reliability criteria. The program iterates month by month through time. If a need exists during any monthly iteration, the program will consider additions from a list of alternatives and select the available unit fitting the system needs in the optimal fashion. Unit selection is made by computing production costs for the system with each alternative included and comparing the results.

The first calculation in selecting the generation capacity to install in a future year is the reliability evaluation, using input corresponding to the desired system characteristics. This will answer the questions of "how much" capacity to add and "when" it should be installed. A production costing simulation is also done to determine the operating costs for the generation system with given unit additions. Finally, an investment cost analysis of the capital costs help to answer the question of "what kind" of generation to add to the system.

The model then is further used to compare alternative plans for meeting variable electrical demands, based on system reliability and production costs for the study period.

The following paragraphs discuss the base case set of assumptions that underlie the check of economic feasibility for the determination of whether the Susitna studies should proceed.

OPTIONS AVAILABLE TO MEET CAPACITY REQUIREMENTS [2]

Coal-Fired Steam Power Generation

Aside from the military power plant at Ft. Wainwright and the self-supplied generation at the University of Alaska, there are currently two coal-fired steam plants in operation in the Railbelt. Fairbanks Municipal Utilities System (FMUS) operates the Chena unit with 29 MW capacity. The other is operated by Golden Valley Electric Association (GVEA) in Healy with a 25 MW capacity. These plants are small in comparison to new units under consideration in the lower 48 and in Alaska.

Based on the general magnitude of the Railbelt load requirements, three coal-fired unit sizes were chosen for potential capacity additions: 100, 250 and 500 MW. However, it is unlikely that a 500 MW plant will be proposed in the Fairbanks region because forecasted demand there is insufficient to justify placing this much capacity on line at one time. All new units would have an average heat rate of 10,500 Btu/kWh [3], maximum flue gas desulphurization equipment and an average construction period of five to six years. Capital costs and operating parameters are defined for coal and other thermal generating plants on Table VIII-1.

Fuel not used for power production can, of course, be used for other purposes. The value of alternative usage is said to represent an "opportunity cost" since other opportunities are foregone when the fuel is consumed. Projected January 1980 opportunity fuel costs for Alaskan Coal range from $1.00 to $1.33 per million Btu [4] (MMBtu). A January 1980 cost of $1.15 was selected as the base coal cost for generation planning. This amount is equivalent to $1.32 in 1981 dollars. The market price for coal is currently within the same general cost range as the indicated opportunity cost.

Combined Cycle Generation

A combined cycle plant is one in which electricity is generated partly in a gas turbine and partly in a steam turbine cycle. Combined cycle plants achieve higher efficiencies than conventional gas turbines. There are two combined cycle plants in Alaska at present. One is operational and the other is under construction. The operational unit is owned and operated by the Anchorage Municipal Light and Power Department (AMLPD). This facility, the George M. Sullivan plant, consists of three units which, when operating in tandem produce a net capacity of 140.9 MW, 33 MW being associated with the combined cycle addition. The plant under construction is the Beluga #9 unit owned by Chugach Electric Association (CEA). It will add a 60 MW steam turbine to the system sometime in 1982.

TABLE VIII-1

SUMMARY OF THERMAL GENERATING RESOURCE PLANT PARAMETERS

PARAMETER	PLANT TYPE					
	COAL-FIRED STEAM			COMBINED-CYCLE	GAS-TURBINE	DIESEL
Plant Size Considered:	500 MW	250 MW	100 MW	250 MW	75 MW	10 MW
Heat Rate (Btu/kwh)	10,500	10,500	10,500	8,500	12,000	11,500
O&M Costs						
Fixed O&M ($/yr/kw)	0.55	1.17	1.45	3.07	3.07	0.55
Variable O&M ($/MWH)	1.56	2.00	2.45	0.33	0.33	5.58
Outages						
Planned Outages (%)	11	11	11	14	11	1
Forced Outages (%)	5	5	5	6	3.8	5
Construction Period (yrs)	6	6	5	3	2	1
Start-up Time (years)	6	6	6	4	4	1
Economic Life (years)	30	30	30	30	gas-fired 30 oil-fired 20	30
Capital Cost ($/kw)	--	3,064	3,460	813	390	869

NOTE: These costs are in 1981 dollars and include Interest During Construction. They are appropriate for comparison purposes only in generation studies.

A new combined cycle plant of 250 MW capacity was considered to be representative of appropriate future additions in the Anchorage area based on economic sizing for plants in the lower 48 and projected load increases in the Railbelt. A heat rate of 8500 Btu/kWh was adopted based on technical publications issued by the Electric Power Research Institute (EPRI).

The combined cycle facilities would only burn gas, with the opportunity value in January 1980, ranging from $1.08 to $2.92 per million Btu. A January 1980 gas cost of $2.00 was chosen to reflect the economic value of gas in Anchorage, assuming development of the export market. Updating to 1981 gives a cost of $2.32. Currently, the local incremental gas market price is about half of this amount due to the relatively light local demands and limited facilities for export. The most recent forecast of actual natural gas prices is from Battelle; a 1986 price (in 1981 dollars) of $2.86 is projected. 5/

Gas-Turbine Power Generation

Gas turbines are by far the main source of thermal power generating resources in the Railbelt area at present. There are 470 MW of installed gas turbines operating on natural gas in the Anchorage area and approximately 168 MW of oil-fired gas turbines supplying the Fairbanks area. Their low initial cost, simplicity of construction and operation, and relatively short implementation leadtime have made them attractive as a Railbelt generating alternative. The extremely low cost contract gas in the Anchorage area also has made this type of generating facility cost effective for the Anchorage load center.

A unit size of 75 MW was considered to be representative of a modern gas turbine plant addition in the Railbelt region. The gas turbine plants can be built over a two-year construction period and have an average heat rate of approximately 12,000 Btu/KWh.

Gas Turbine units can be operated on oil as well as natural gas. The potential for coal conversion to methanol for use as synfuel in a gas turbine is also a possibility, but no cost advantage is likely to occur. The oil opportunity value and market cost are considered to be equal in this evaluation at $4.00 per million Btu in January 1980. The 1981 equivalent is $4.62.

Impact of the Fuel Use Act

The "Power Plant and Industrial Fuel Use Act of 1978" (FUA), Public Law 95-620, regulates the use of natural gas and petroleum to reduce imports and conserve scarce non-renewable resources.

Section 201 of the FUA prohibits the use of petroleum or natural gas as a primary energy source in any new electric power plant and precludes the construction of any new power plant without the capability to use an alternate fuel as a primary energy source. Exemptions may be granted under certain conditions.

There are twelve different exemption categories of standards and criteria, any of which may qualify a new power plant for a permanent exemption. These are:

(1) Cogeneration
(2) Fuel mixture
(3) Emergency purposes
(4) Maintenance for reliability of service (short development lead time)
(5) Inability to obtain adequate capital
(6) State or local requirements
(7) Inability to comply with applicable environmental requirements
(8) Site limitations
(9) Peak load power plants
(10) Intermediate load power plants
(11) Lack of alternative fuel supply for the first ten years of useful life
(12) Lack of alternative fuel supply at a cost which does not exceed the cost of using imported petroleum.

The two Anchorage utilities, Chugach Electric Association (CEA) and Anchorage Municipal Light and Power Department (AML&P) have been able to maintain relatively low electric rates to their customers by the use of natural gas from the Cook Inlet region. As reported to the DOE in June of 1980, CEA paid an average of $0.32/MMBtu for gas, with its cheapest contract supplying its largest plant with gas at $0.24/MMBtu. Compared to the U.S. average price of over $2.00/MMBtu, this situation represents an obvious incentive for the continued use of natural gas for electric generation by CEA. Anchorage Municipal reports that its cost for gas is approximately $1.00/MMBtu, which is still significantly lower than the national average utility price. The price differences exist because CEA holds certain long term contracts at favorable rates.

Recent and planned capacity expansions by these two utilities have been directed toward increasing natural gas utilization. AML&P has recently (1979) installed a 33 MW combined-cycle addition to its George M. Sullivan plant. CEA currently plans to include a 60 MW addition to its Beluga plant for operation as a combined cycle unit. This type of expansion could be considered typical in the near term for Anchorage utilities.

The source and nature of the gas used to fuel future plants could be a critical issue. Several arguments could be raised to keep Cook Inlet gas from being considered. The gas could be proven to be of unmarketable quality or quantity, due to the location of the gas in a remote area, relative to the large gas markets of the lower 48. However, this argument is not valid considering the size of Cook Inlet reserves and the relative cost of gas delivery to the available markets in the lower 48 and overseas.

Assuming that new gas-fired generation would be either a gas turbine or gas-fired boiler located in the Anchrage area, there would be no particular capital or time planning constraints and the unit would be actively used to meet the load. Under these assumptions, the exemption categories (1) through (5) would not apply.

Categories (6) and (7) require the existence of some state, local or environmental requirement which would preclude the development of the plant using an alternative fuel. At this level of review, no such constraint is foreseen.

Site limitations (8) could be the basis for an exemption particularly relative to the coal alternative. To obtain this exemption, it must be shown that alternative fuels are inaccessible due to physical limitations, transportation facilities are unavailable, handling and storage facilities are unavailable, waste disposal is unavailable or other physical limitations exist. Evidence of the investigation of alternatives and methods to overcome the site limitations must be provided to the Economic Regulatory Administration (ERA).

To qualify for the exemption for peak load power plants using natural gas (9), a petitioner must certify that the plant will be operated solely as a peak load plant. In addition, the ERA or appropriate state administrator must certify that alternative fuel use will contribute to concentration of a pollutant which would exceed a national air quality standard. This second certification may be difficult since there are few competing uses in the service area which have pushed base line air quality parameters up to a high level. Even if this criterion could be met, any plant operating under this exemption would be limited in output to only 1500 hours of generation per year at design capacity. An exemption for intermediate load power plants is available (10), but only when petroleum is used as the primary energy source.

To obtain a "lack of alternate fuel supply" (11) exemption, the petitioner must demonstrate a good faith effort to obtain an adequate and reliable supply of an alternate fuel and show that such a supply will be available within 10 years of the useful plant life. The petition must show a description of alternatives studied, specific fuel characteristics considered and a list of detailed criteria regarding alternative fuels, sites and generation methods. The earliest possible on-line date for any favored generation means must be proven to be later than the point at which reserve margins become dangerously low.

The final available exemption would be a lack of alternate fuel supply at a cost which does not substantially exceed the cost of using imported petroleum (12). Thus, the actual cost of the natural gas used would not enter into the decision. Alternative coal, hydro or other developments will be compared to a similar plant using imported oil as a cost basis. Under the interim rules, the alternative must be at least 30 percent more expensive if an exemption is to be granted.

In short, the Anchorage utilities are subject to the prohibitions of the FUA for development of new sources of power generation. Existing facilities may continue to use gas, but the use of gas in new facilities under FUA regulations will apparently be restricted to peak load applications. In the event that coal and hydropower resources are undevelopable environmentally or would prove to be much more expensive by comparison than the use of imported petroleum, an exemption might also be possible. For the base

case economic analysis, it is assumed that new gas-consuming units must be in compliance with the Fuel Use Act and are therefore restricted to operation in a peaking mode. Two alternative cases examined relax this constraint.

Diesel Power Generation

Most diesel plants in the Railbelt today are on standby status or are operated only for peak load service. Nearly all the continuous duty units were retired in the past several years due to high fuel prices. About 65 MW of diesel plant capacity is currently available.

The high cost of diesel fuel and low capital cost makes new diesel plants most effective for emergency use. A unit size of 10 MW was selected as appropriate for this type of facility. Diesel fuel costs are the same as oil costs for gas turbines.

Non-Susitna Hydroelectric Alternatives

Conceptual plans and cost estimates were prepared for ten hydropower sites, selected as most suitable for development following a two-phase screening process. Screening of potential sites was based on both total comparative production costs and environmental considerations. Data provided by the U.S. Army Corps of Engineers and the Alaska Power Administration were particularly useful in this analysis.

Sites with production costs less than 120 mills per kilowatt-hour based on an annual carrying charge of 10.62 percent on capital plus operation and maintenance were first selected from the Corps of Engineers or Alaska Power Administration inventory. 6/ A preliminary regional environmental evaluation was then undertaken based on critical environmental restrictions (endangered species habitat, wild and scenic rivers, Federal parks, wildlife refuges and major anadromous commercial fishing) as an input to the secondary screening. A total of 49 sites passed the primary screening: 12 sites in the 0 - 25 MW range, 26 sites in the 25 - 100 MW range, and 11 sites greater than 100 MW. An additional preliminary analysis was performed in order to determine transmission cost impacts on feasibility of these 49 sites.

The second phase included a more comprehensive environmental review of the economically attractive sites within the three capacity categories which had passed the first screening. Considerations related to location, river system development, and proximity to the load centers or to the proposed Anchorage-Fairbanks Intertie were also part of the rationale.

Twenty-seven sites having low costs were ranked for degree of adverse environmental impacts. Of these, fifteen with superior environmental ranking were submitted for review to the Susitna Hydro Steering Committee. 7/ The technical and economic selection factors in this screening involved qualitative selection of sites which were cost competitive and located in reach of a load center or transmission line where the capacity could be marketed. Two possible projects with clear economic advantages and relatively significant capacity were retained on the selected list in spite of their low environmental ratings. Chulitna and Talkeetna 2 fall in this latter category. Ten selected sites were analyzed through detailed engineering, energy and cost studies. The results of these analyses are presented in Table VIII-2.

TABLE VIII-2. OPERATING AND ECONOMIC PARAMETERS

(Ten Selected Hydroelectric Plants, Railbelt, Alaska)

No.	Site	River	Rated Head Ft.	Installed Capacity MW	Annual Energy GWH	Capital Costs[8/] $/kw
1	Snow	Snow	640	120	300	2475
2	Bruskasna	Nenana	210	70	114	4460
3	Keetna	Talkeetna	295	110	463	4760
4	Cache	Talkeetna	266	75	180	6750
5	Browne	Nenana	162	210	360	4990
6	Talkeetna 2	Talkeetna	304	83	245	5080
7	Hicks	Matanuska	262	265	246	2700
8	Chakachamna	Chakachamna	793	485	1938	2870
9	Allison	Allison Creek	1170	7	35	8050
10	Strandline Lake	Beluga	710	28	85	4980

These sites were made available for the generation planning effort as the better non-Susitna hydro resources which could be implemented within the study period. Note that Bradley Lake is assumed to be in operation by 1990.

Load Management and Energy Conservation

Load management and energy conservation measures were discussed as factors affecting the load forecasts in Section V. The applicability and potential for these approaches will also be examined by Battelle in the Railbelt power alternatives study.

Other Potential System Components

Other options for power generation exist. Examples include:

- Cogeneration options
- Fuel cells
- Geothermal
  - -- Hot Dry Rock
  - -- Hydrothermal
- Steam Electric
  - -- Peat-fired
  - -- Biomass-fired
  - -- Synfuel-fired
  - -- Distillate-fired
- Tidal Power
- Solar photovoltaic
- Solar thermal
  - -- Distributed system
  - -- Central receivers
- Wind turbines
- Small hydroelectric power facilities.

Each of these options will be considered in the "Railbelt Electric Power Alternatives Study" to be done by Battelle Memorial Institute, Pacific Northwest Laboratories. Although they have been excluded from the set of major generation facilities used in preliminary generation planning, it is anticipated that these options may provide some energy in future Railbelt energy systems.

Tidal power in the Cook Inlet is currently under separate study by Acres for the Office of the Govenor. Few places in the world lay claim to tidal ranges as high as those in Cook Inlet. Therefore, the tidal power potential in Cook Inlet is of considerable interest for long term planning possibilities for the Railbelt Region. The tidal power study will determine the most favorable courses of development available, potential contribution to Alaska's energy needs, the costs of such an undertaking and the consequences of proceeding. Results of the tidal power study will become inputs to the Railbelt alternatives study. However, preliminary indications are that tidal power will not prove to be competitive with more conventional sources within the time frame being considered for Susitna.

DISCOUNT RATES

Discount rates are required to compare and aggregate cash flows occurring in different time periods of the planning horizon. In essence, the discount rate is a weighting factor reflecting that a dollar received tomorrow is worth less than a dollar received today. This holds even in an inflation-free economy as long as the productivity of capital is positive. In other

words, the value of a dollar received one year from today must be deflated to reflect its earning power foregone by not receiving it today. The use of discount rates extends to both real dollar (economic) and escalated dollar (financial) evaluations, with corresponding inflation-adjusted (real) and inflation-inclusive (nominal) values.

Several approaches have been suggested for estimating the discount rate applicable to public projects (or to private projects from the public perspective). Three common alternatives include:

(i) the social opportunity cost (SOC) rate,
(ii) the social time preference (STP) rate, and
(iii) the government's real borrowing rate or the real cost of debt capital.

The SOC rate measures the real social return (before taxes and subsidies) that capital funds could earn in alternative investments. If, for example, the marginal capital investment in Alaska has an estimated social yield of X percent, the Susitna hydroelectric project should be appraised using the X percent measure of "foregone returns" or opportunity costs. A shortcoming of this concept is the difficulty inherent in determining the nature and yields of the foregone investments.

The STP rate measures society's preferences for allocating resources between investment and consumption. This approach is also fraught with practical measurement difficulties since a wide range of STP rates may be inferred from market interest rates and socially desirable rates of investment.

A sub-set of STP rates used in project evaluations is the owner's real cost of borrowing, that is, the real cost of debt capital. This industrial or government borrowing rate may be readily measured and provides a starting-point for determining project-specific discount rates. For example, long-term industrial bond rates have averaged about 2.0 percent in the U.S. in real (inflation-adjusted) terms. [10] In comparison, the Alaska Power Authority guidelines recommend a value of 3.0 percent for economic appraisals conducted in real terms. [11] In the current hydroelectric project evaluation, a real rate of 3.0 percent has been adopted as the base case discount and interest rate for the period 1980 to 2040, which is the period of economic analysis. While this sixty year period of analysis is shorter than the estimated economic life of the Susitna Project, it is long enough for a valid economic comparison of benefits and costs.

COST ESCALATION RATES

In the base case set of generation planning parameters, it is assumed that all cost items, except energy, escalate at the rate of general inflation. This results in real growth rates of zero percent for non-energy costs.

Energy prices were estimated based on both market and shadow (opportunity) values. The base case set of generation planning parameters uses 1981 costs (market and shadow prices) of $\$1.32/10^6$ Btu and $\$4.62/10^6$ Btu for coal and distillate respectively. For natural gas, the current actual market price

TABLE VIII-3

FUEL COSTS AND ESCALATION RATES

	Natural Gas	Coal	Distillate
1981 Costs ($/million Btu)			
Market Prices	$1.05	$1.15	$4.62
Shadow (Opportunity) Values	2.32	1.32	4.62
Real Escalation Rates (Percentage Change Compounded Annually)			
Composite (average) 1980-1995	3.98	2.93	3.58
1996 - 2005	3.98	2.93	3.58
2006 - 2040	0	0	0

is about $1.05/10^6$ Btu and the shadow price is estimated to be $2.32/10^6$ Btu. The shadow price for gas represents the expected market value assuming an export market were developed. This assumption and value is used for the base case analysis.

Real growth rates in energy costs (excluding general price inflation) are shown in Table VIII-3. These are based on fuel escalation rates from the Department of Energy (DOE) mid-term Energy Forecasting System for DOE Region 10 (including the States of Alaska, Washington, Oregon and Idaho). [12] Price escalators pertaining to the industrial sector were selected over those available for the commercial and residential sectors to reflect utilities' bulk purchasing advantage. A composite escalation rate has been computed for the period 1980 to 1995 reflecting average compound growth rate per year. As DOE has suggested that the forecasts to 1995 may be extended to 2005, the composite escalation rates are assumed to prevail in the period 1996 to 2005. Beyond 2005, zero real growth in energy prices is assumed. The Power Authority has some concern that the assumed escalation rate for Alaskan coal is too high. [13] Economic feasibility will, therefore, also be checked with the lower escalation rate of zero percent.

MARCH 1981 CHECK OF PROJECT FEASIBILITY

While the feasibility analysis is not scheduled for completion until the project configuration is better defined and construction - type cost estimates are prepared, a preliminary check of feasibility was performed to help determine if the study program should continue. The base year for all cost estimates is 1981. The estimates for Susitna include a 20 percent allowance for contingency and 12.5 percent for engineering, construction supervision and owner's costs.

The cost estimates for the Susitna Project used for this feasibility check represent an upper limit which has a low probability of being reached or exceeded. The approach was to be consistently conservative with the anticipation that more detailed analysis will result in lower estimated costs as the feasibility studies proceed.

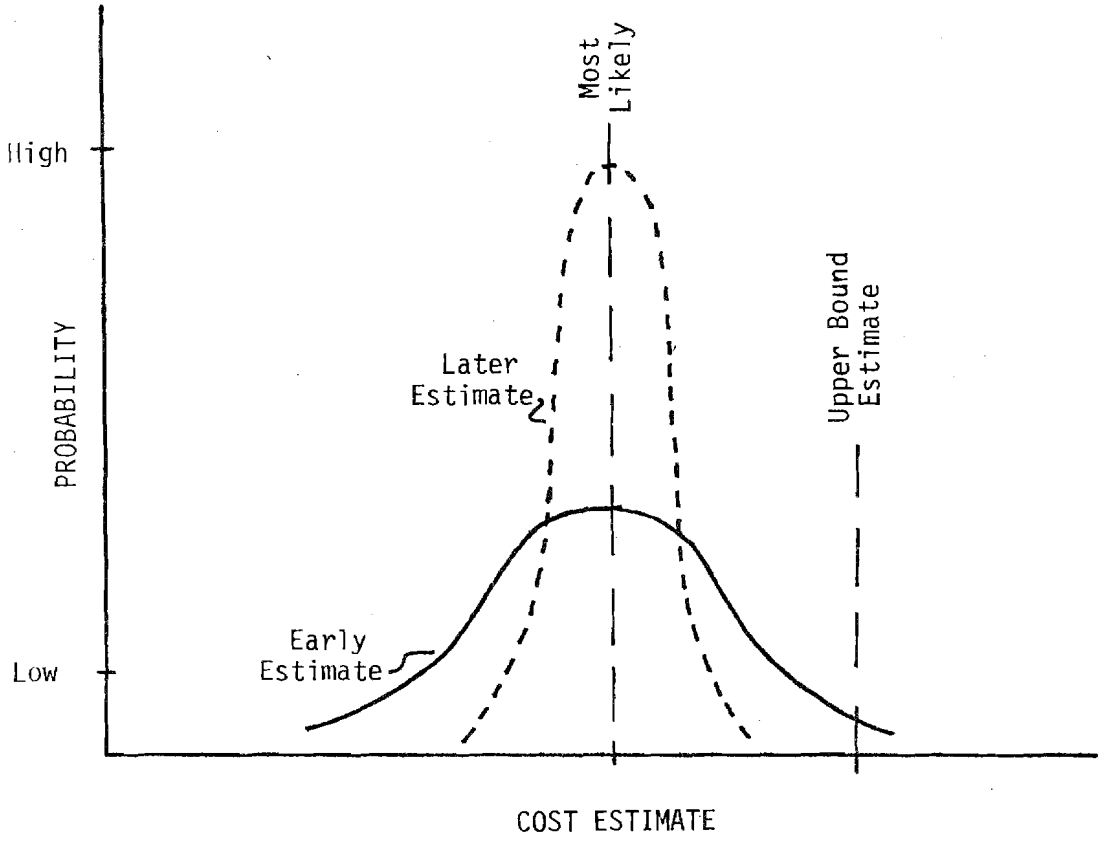
The cost estimates for any large project that are made at an early stage of feasibility investigations are characterized by significant uncertainty. In fact, rather than a single figure, preliminary cost estimates are more appropriately presented as a range of possible costs. The approach is depicted in Figure VIII-1.

As studies proceed and more becomes known about the project design and the site characteristics, the degree of uncertainty decreases. However, right up until the time construction is complete, there is some probability that the actual construction cost will be somewhat higher or somewhat lower than the estimate.

In as much as the purpose of this report is to assess the advisability of continuing the feasibility program, a worse case cost estimate assumption has been used for the Susitna Project. It is not the most likely estimate;

FIGURE VIII-1.

GRAPHICAL DEPICTION OF COST ESTIMATE UNCERTAINTY



in fact, it is an estimate that has an extremely low probability of being equalled or exceeded if the project were actually to be constructed. Also, it is today's estimate of the upper limit cost; future more refined estimates will have a decreased band of uncertainty and therefore a lower upper limit cost estimate.

A most likely cost estimate for the Susitna Project has not been prepared. In lieu of that, the October 1978 Corps of Engineer estimate can serve as a reasonable approximation in as much as the Corps plan of development is very similar to the present conceptual design proposed by Acres American. The Corps of Engineer's estimated cost for the Susitna Project, updated at 12 percent per year from October 1978, is $3.44 billion.

The check of feasibility was made for a base case set of assumptions and several alternative cases. [14/] No attempt was made to fully test the sensitivity of economic feasibility for this report. Consequently, no attempt was made to test project feasibility against the more likely lower cost estimate. In the event this were performed, net benefits would be higher than reported below. The objective here, in keeping with the intent of this report to the legislature, is to test the project under the most adverse circumstances. The full feasibility analysis is scheduled for completion in early 1982. All cases tested for the purposes of this report use an upper limit Susitna Project cost estimate of $2.83 billion for Watana (400 MW), $160 million for the additional 400 MW at Watana, $1.42 billion for Devil Canyon, and $525 million for Susitna transmission. To reemphasize, these figures are not the most likely costs for these projects.

With the base case set of assumptions described earlier in this section, the thermal plan over the period 1981-2040 has a discounted present worth cost of $9.67 billion. The "with Susitna" plan over the same period has a present worth cost of $7.94 billion. The net benefits of the Susitna plan are therefore $1.73 billion.

The first alternative case explored project feasibility in the event coal-fired steam plant costs were lower than estimated in the base case. Specifically, plant costs were reduced 22 percent for this test, representing lower Alaskan cost adjustment factors. With this alteration of the base case set of assumptions, the thermal plan's present worth cost over 60 years is $9.04 billion, while that of the Susitna plan is $7.77 billion. The difference of $1.16 billion are the net benefits with Susitna.

The second sensitivity test involved an adjustment of the fuel escalation rate assumptions. Specifically, the cost escalation rate for coal was assumed to be zero instead of the base case's 2.93 percent. The effect on economic feasibility is to reduce net benefits with Susitna to $540 million. The present worth costs of the thermal plan are $8.31 billion and those for the Susitna plan are $7.73 billion.

The third sensitivity test released the Fuel Use Act constraints on natural gas use. If natural gas use was unconstrained and if there were no limitations on the quantities of gas available, an additional 250 MW of combined

cycle generation would be added to both plans. The present worth cost of the thermal plan would be $9.39 billion, and that for the Susitna plan $7.89 billion. The net benefits of the Susitna plan are $1.50 billion. This result, in comparison to the base case, indicates that the Fuel Use Act constraint assumed in the base case is not a controlling assumption. In other words, the feasibility check is insensitive to the Fuel Use Act constraint assumption.

The fourth and final sensitivity test also released the Fuel Use Act constraint on natural gas, but also decreased the base case fuel escalation rates for gas and coal. An escalation rate of 2 percent is assumed for gas and zero percent for coal. With this set of assumptions the present worth cost of the two plans are virtually equal, with Susitna plan net benefits of only $60 million. Thus, if there were no restriction on either the availability or utilization of natural gas, and if the cost of gas rose at an annual constant dollar rate of 2 percent, and if the cost of coal rose no faster than the rate of inflation, then there would be little or no economic benefit in the Susitna plan. In contrast to this set of assumptions are the recent Battelle findings that Cook Inlet natural gas reserves potentially available for in-state use will be exhausted by the year 2005 (and ten years earlier if the Pacific Alaska LNG Project proceeds). 15/

CONCLUSION

While it is premature to make any definitive statement regarding project economic feasibility, a check of feasibility was made for use in this report, using presently available data. The cost estimates used for the Susitna Project are not the most likely costs, but instead are an estimate of the highest possible costs, given the uncertainty that presently exists in this early stage of study. The costs of a thermal plan and of a Susitna plan were projected for a sixty year period. These costs were discounted to give a total present worth of plan costs. The costs of the two plans were then compared to determine which was the lowest cost plan.

This comparison was made under five different sets of assumptions regarding the cost of thermal projects and fuels. While this in no way qualifies as a thorough test of sensitivity, the results do provide adequate information on which to judge the advisability of continuing the feasibility study program.

Under each set of assumptions, and using an upper limit cost estimate for the Susitna Project, Susitna hydroelectric development is estimated to be more cost effective than the most likely plan without Susitna. Based on this preliminary check of economic feasibility, the Susitna study program should continue.

SECTION VIII. ENDNOTES

1/ The discussion of the OGP model comes from Development Selection Report (first draft), Acres American Incorporated, January 8, 1981, pages 89-95.

2/ Subtask 11.01 - Project Overview (second draft), pages 8-2 thru 8-11.

3/ Heat rate is a measure of the efficiency of conversion of heat energy to electrical energy. In general terms, low heat rates suggest high efficiency. The selected value of 10,500 Btu/kwh is consistent with rates currently being achieved in modern coal-fired steam plants in the selected capacity range.

4/ A Btu (British thermal unit) is a measure of heat energy. By expressing costs for coal and other fuels in terms of price per million Btu rather than per ton or gallon, it is possible to make economic comparisons readily.

5/ Cook Inlet Natural Gas: Future Availability and Price Forecasts (draft), Battelle, February 1981, augmented by personal communication with Ward Swift on March 18, 1981.

6/ Using economic parameters, the ceiling mill rate for screening would be approximately 50 mills per kilowatt hour.

7/ This committee is made up of individuals from various State and Federal agencies concerned with resource management. It provides advice and assistance to the Susitna study team.

8/ Annual operation and maintenance costs are applied at $22/KW/yr for all hydroelectric facilities listed as well as for existing plants. These costs are in 1980 dollars and are appropriate for comparison purposes only in generation studies.

9/ Personal communication with Mr. John Lawrence, Acres American Incorporated, March 13, 1981.

10/ Based on data from the U. S. Department of Commerce, Survey of Current Business.

11/ These guidelines are based on recommendations from a number of sources including: personal communication with Mr. David Reume, Chief of Research for the Division of Economic Enterprise of the Department of Commerce and Economic Development; the Electric Power Research Institute's Technical Assessment Guide, 1977; and a report entitled Treatment of Inflation in the Development of Discount Rates and Levelized Costs in NEPA Analyses for the Electric Utility Industry, by the Nuclear Regulatory Commission, 1979.

12/ Department of Energy, Office of Conservation and Solar Energy, Methodology and Procedures for Life Cycle Cost Analysis, Federal Register, October 7, 1980.

13/ Based on personal communications with Mr. Ward Swift of Battelle Pacific Northwest Laboratories and Dr. Dennis Rohan, member of the Susitna External Review Panel.

14/ Calculations provided by telecopy from Mr. John Lawrence, Acres American Incorporated, March 17, 1981 and by phone from Mr. Phil Hoover, Acres, March 23, 1981.

15/ Cook Inlet Natural Gas: Future Availability and Price Forecasts (draft), pp. 3.8, 3.15.

Part B -

OTHER PERTINENT INFORMATION

SECTION IX

PROJECT FINANCING

IX. PROJECT FINANCING

Financial planning and risk analysis have not been a major task to date in the overall study. Most activity in this task will be performed after the basin development plan is completed and a more refined cost estimate is available. Work to date has involved development of financial models to assess preliminary financing concepts for a hypothetical Susitna development plan and cost, and investigation of alternatives to permit tax exempt revenue bond financing of the project. Future activities will include more detailed investigations and expansion of the work accomplished to date with more specific analysis of the selected Susitna Plan, the financing options, risk analysis, and revenue assurance.

PROBLEMS AND ISSUES

Two major financing problems exist for the Susitna project. The first involves the exemption from federal income tax of interest on obligations issued by the Authority to finance the project. Tax exemption does not apply to interest on "industrial development bonds" for public power projects with a broad service area, unless certain tests are satisfactorily met. To accomplish a project financing, retail utilities must contract to purchase power from the project, and current IRS regulations preclude tax exempt financing if over 25% of the output of the plant during the life of the bonds is contracted for sale to non-exempt persons, or in this case, the REA cooperative utilities. Currently, the REA utilities generate and sell approximately 65% of the power in the Railbelt or market area for Susitna. Thus, power sales contracts with the REA cooperatives would only be allowed for a period of 15 to 20 years after which the utilities would be relieved of their obligations to continue receiving Susitna power. From a practical standpoint, when this point is reached, the cost of Susitna in comparison to other thermal alternatives would be so low, that there would be little fear of loosing the Susitna market even if the contracts expired. Regardless of this, efforts to insure tax exempt financing under all circumstances are being made in Congress. The Windfall Profits Tax Bill of 1980 provided tax exemption for small hydroelectric projects, however, it did not resolve the problem for Susitna. An effort is currently underway to establish nationwide support for an exemption for all renewable energy resource power projects that are owned and operated by political subdivisions of a state, no matter what type of person or entity is contracting to purchase the output of the project. The ability to achieve this legislation in the present Congress is uncertain.

If tax exempt financing through other or Congressional action is not available for the full costs of the project, there may be other solutions. These may involve tax exempt financing of a staged development of Susitna, with municipal utilities contracting to purchase at least 75% of the capacity of the first stage, and REA utilities contracting to purchase only 25%. Another alternative may be to establish Public Utility Districts coincident with the boundaries of existing REA utility service areas. Yet another option is State of Alaska equity investment in the portion of project costs which would not be eligible for tax exempt financing.

The second major financing issue is the magnitude of the capital costs of construction and the long duration of the construction schedule. Both factors combine to produce significant exposure to inflation and high interest during construction costs. The impact of inflation and interest during construction combined could increase the capital requirements for the project in nominal terms by 300 to 400%. This impact will also be felt in consumer prices for power until all debt service is paid.

Another factor which has a negative influence on project financing of Susitna is the uncertainty of market conditions. To initiate the financing of a major project over a 12 to 15 year period during a time of unstable markets and historically high interest rates is a serious undertaking. Long term maturities are disappearing for capital intensive financing of projects in today's market. Forty-year term bonds are being replaced by 30-year term bonds, and what may occur to structure offerings in future markets in unknown. This recent development is a response to current economic conditions and uncertainty about the future. It will make the financing of all projects, including Susitna, more difficult and only result in higher consumer costs of power.

Resolving uncertainty is not always possible, but uncertainty can be understood through formalized risk analysis. Understanding the element of risk will be a major consideration in any future decision to proceed with construction of the project, and in any decision that may involve State of Alaska participation in the financing of Susitna.

FINANCING ALTERNATIVES

The following is a partial list of financing alternatives which may be considered for Susitna.

1. Tax Exempt Revenue Bonds

   Merits: No State funds required and no impact on State credit.

   Problems: Methods must be developed to make this alternative possible under current IRS Regulations. Uncertain market conditions, inflation, and interest during construction will make this alternative difficult to accomplish.

2. Taxable Revenue Bonds

   Merits: No State funds required and no impact on State credit.

   Problems: Uncertain market conditions, high interest rates, inflation, and interest during construction will make this alternative difficult to accomplish and more expensive.

3. Taxable and Tax Exempt Revenue Bonds

   Merits: No State funds required and no impact on State credit.

Problems: The portion of tax exempt financing under current IRS Regulations may be limited to approximately 60%. Uncertain market conditions, high interest rates, inflation, and interest during construction will make this alternative difficult to accomplish and more expensive than would be the case with complete tax exempt financing.

4. State General Obligation Bonds

Merits: The entire capital cost of construction could be tax exempt financed.

Problems: This option seriously impacts State credit since almost all debt service would be payable during a period of decreasing revenues from non-renewable resources. The impacts of uncertain market conditions, high interest rates, inflation, and interest during construction would not be diminished with this option.

5. Tax Exempt Revenue Bonds and State Equity Investment

Merits: Tax exempt financing could be utilized to the maximum extent permitted under IRS regulations. Impacts of uncertain market conditions, high interest rates, inflation, and interest during construction could be diminished. Debt repayment could be more flexibly structured to produce lower consumer rates during early years of project operation. The State could realize a return on its investment for the entire useful life of the project, which should far exceed the retirement of debt service associated with the revenue bond financed portion of the projects.

Problems: A significant amount of State funding would be required which will impact the State Treasury and preclude competing uses for the funds.

6. Utility Participation in Funding and Ownership with both Equity and Debt Interest in the Project

Merits: The State is not involved, nor is it a participant in the development of the project. All costs of financing and risks are assumed by the utilities and their customers to the extent of participation.

Problems: The project may never by developed, even if it is proven to be feasible, due to the inability of utilities and/or local governments to finance the capital costs of construction.

These and other alternatives will be explored and analyzed in more detail as the development plan and cost estimates are refined. The principal methods presented above can be combined in various scenarios and structured to optimize the project financing to achieve lowest costs of power from the project and minimize state participation and assumption of risk in the project financing.

SECTION X

PERMIT REQUIREMENTS AND CONSTRUCTION SCHEDULE

X. PERMIT REQUIREMENTS AND CONSTRUCTION SCHEDULE

PERMITS

Permits (the term used herein to represent all governmental approving actions) necessary for the authorization, construction and operation of the Susitna Hydroelectric Project are required from federal, state and local government entities. [1/] There is some overlapping of the regulatory requirements, which introduces a degree of complexity in the overall permitting process. The most critical authorization is the Federal Energy Regulatory Commission (FERC) license. The supporting data needs are voluminous and the processing time lengthy. However, the data needed for the FERC application generally meets all other permitting action needs. Overall, the feasibility study currently in progress meets those data needs, and the present schedule incorporates the anticipated regulatory lead times.

The first and most critical round of permitting will occur upon completion of the feasibility study and a decision to proceed with the project. Under the current schedule, this action will occur by July 1, 1982. Submitted would be the FERC license application, the U. S. Army Corps of Engineers permit application, a master permit application to the State of Alaska, and an application to the Matanuska-Susitna Borough. The FERC license is the most significant regulatory requirement for the development of the Susitna Hydroelectric Project, and also incurs the most processing time -- approximately 3 years. The Corps of Engineers permit is almost equally as significant but requires only about 2 years of processing time. Approval of these two applications (which are somewhat interactive) represent federal authorization for the project. Simultaneously with the FERC application, a set of applications necessary for initial project implementation will be filed with the State of Alaska and with the Matanuska-Susitna Borough. These applications interact with the FERC application to the degree that they must be approved by the appropriate local government before FERC will issue a license. These state and local applications take nine months to one year for processing.

Near the end of the FERC processing, a second group of state and local applications will be submitted. In the aggregate, these permits relate to actual construction activities such as requirements for dust control, restrictions on stream crossings, etc. Permits of this type will continue to be required during the construction period. No problems are anticipated with these applications as they apply to restricted areas and are relatively simple to process and approve.

As the project nears completion, a third set of applications will be necessary. This group deals with regulation of the operation of the completed project.

As mentioned previously, the controlling regulatory requirement is for the FERC license. One of the major objectives of the feasibility study is to meet the data needs for this application. Virtually no additional investigation or data gathering is necessary for any other applications.

The FERC is an independent federal commission which is administratively part of the United States Department of Energy. It is established by the Federal Power Act and is authorized to regulate hydroelectric power development within the United States. The Commission's review objectives include assurance that the project development is justified, the structures are technically sound and economically acceptable, and that there has been adequate consultation and coordination with other concerned regulatory or governmental bodies. To quote from the Commission's own statements:

"The Federal Energy Regulatory Commission, pursuant to the Federal Power Act (FP Act) and the Department of Energy (DOE) Organization Act, is authorized to issue licenses for terms up to 50 years for the construction and operation of non-federal hydroelectric developments subject to its jurisdiction, on the necessary condition:

> (T)hat the project adopted...shall be such as in the judgment of the Commission will be best adapted to a comprehensive plan for improving or developing a waterway or waterways for the use or benefit of interstate or foreign commence, for the improvement and utilization of waterpower development, and for other beneficial public uses, including recreational purposes...

The Commission may require such other conditions not inconsistent with the provisions of the FP Act as may be found necessary to provide for the various public interests to be served by the Project. Compliance with such conditions during the license period is required."

Three categories of problems can cause delay in the FERC licensing process; those which relate to noncompliance with regulations, those which relate to deficiencies in the feasibility study, and those involving issues not detected before application submittal. To date, no evidence has emerged to suggest that there will be problems concerning noncompliance with regulations. The feasibility study currently underway will meet the submission requirements for the FERC license. However, subsequent to application submission, additional data will be provided, especially in areas that relate to the impact of project development upon fish and wildlife. To meet that data need, certain fish and wildlife studies will be continued beyond the April 1982 completion date of the present feasibility study, and those results will be integrated into the application at some point prior to final FERC approval. By its very nature, assessment of the third type of problem, discovery of issues during the licensing process, is extremely difficult. Clearly, certainty on this point cannot be obtained. However, review of the plan of study by the various federal and state regulatory agencies, including FERC, suggests that the risk of an undetected issue surviving the feasibility study investigations is very low.

Next to FERC, the U. S. Army Corps of Engineers (CoE) performs the most comprehensive review of the project on the federal level. Their responsibilities stem from the Rivers and Harbors Acts of 1899 and Section 404 of the Federal Water Pollution Control Act Amendments of 1972. In brief, a project that could affect navigable waters or wetlands must receive CoE

approval. Their areas of emphasis overlap somewhat the FERC jurisdiction, and include detection of adverse impacts, consistency of the proposal with other plans and interests, effects on navigation, fish and wildlife, water quality and related issues, and economics. Due in large part to the overlap between CoE data needs and the depth of investigations being performed to meet the FERC needs, expectations are that satisfaction of the FERC requirements will also meet Corps of Engineers requirements. The CoE data requirements formats are broadly stated to the point that only minor reformatting of the FERC application will be necessary for CoE use.

In all likelihood, certain federal land use permits (primarily from the BLM) will be necessary for the transmission corridors. That need awaits explicit definition. However, no serious problems are anticipated in obtaining these land use rights.

As many as 30 permits may be required by the State prior to commencement of construction. To simplify the process of obtaining these permits, a consolidated master application process is in existence. Under the master application process, the Alaska Department of Environmental Conservation coordinates the action between the applicant and all state agencies. The Matanuska-Susitna Borough is included in this process.

The required state permits will be acquired in two separate steps separated by approximately 18 months. The first block will pertain to project approval and the second block to practices and compliance requirements incidental to the construction process. Again, the data acquired for the FERC application will meet the state and local permitting needs. A listing of these permit requirements (as well as other miscellaneous permit needs) is shown in Table X-1.

In summary, it is concluded that activities underway plus those planned for the post FERC application period will meet both the substantive and time needs of the permitting processes.

CONSTRUCTION SCHEDULE

For a very large scale project, a multiplicity of concerns going well beyond those of trade coordination, weather, materials delivery, etc., must be considered. For the Susitna Hydroelectric Project, these broader concerns primarily are:

-- Timing project attainment to match the load growth. As is more fully discussed in the financial section to this report, the initial commissioning of a hydroelectric project is very capital intensive. If the debt service on this capital investment is to be borne by the electrical consumers, as is usually the case, overcapacity of the project (or put another way, insufficient sales of output) would represent an extraordinary burden upon the initial consumers. It is therefore desirable that the capacity of the facility when it is commissioned be roughly equivalent to the potential market, and that additions to the facility be timed with corresponding growth of the market. Because the Susitna development will bring into service large increments of power availability, coordination with the market is necessity.

TABLE X-1

LIST OF PROJECT LICENSES, PERMITS AND CERTIFICATES

Federal

Federal Energy Regulatory Commission License - Major Hydroelectric Project

Corps of Engineers Permits

Bureau of Land Management - Land Use Permit

Notice of Airspace Obstruction

State

Coastal Management Certificate of Consistency

Water Rights Permit

Water Quality Certificate

Right-of-Way Easements (and other Land Use permits as identified)

Highway Encroachments Permit

Anadromous Fish Protection Permit

Dam Safety Permit

Fire and Safety Plans Check

Burning Permits

Water and Sewer Plan Review

Local

Talkeetna Mountain Special Use District Permit

-- The capital investment cash flows must be managed in a prudent manner. A long construction schedule can mean a lessened cash flow requirement but incurs the penalty of an increased inflationary growth impact and higher interest during construction. Conversely, rapid construction intensifies capital requirements, has potential economies stemming from decreased inflationary impact and economics of scale of application of resources.

-- Coordinating design effort with construction. A completed design prior to construction commencement is expensive in time but often results in a decreased total construction cost. Potential hazards to this approach include inflexibility of schedule and high penalty costs in the event design changes are necessary to meet unforeseen site conditions, and constrains somewhat the acceleration or deacceleration of the construction schedule. The alternative is to design and construct the project in increments or as a continuing process. This method has the advantages of decreased design cost cash flows and increased responsiveness, but incurs the penalities of greater uncertainty in the total project cost and completion.

-- The appropriate permits must be executed prior to the affected stages of construction.

Feasibility studies to date suggest the Watana Dam should be built first. Still unresolved are the questions of building it initially to its full capacity or to bring the capacity on line in increments; cash flow management; and design method.

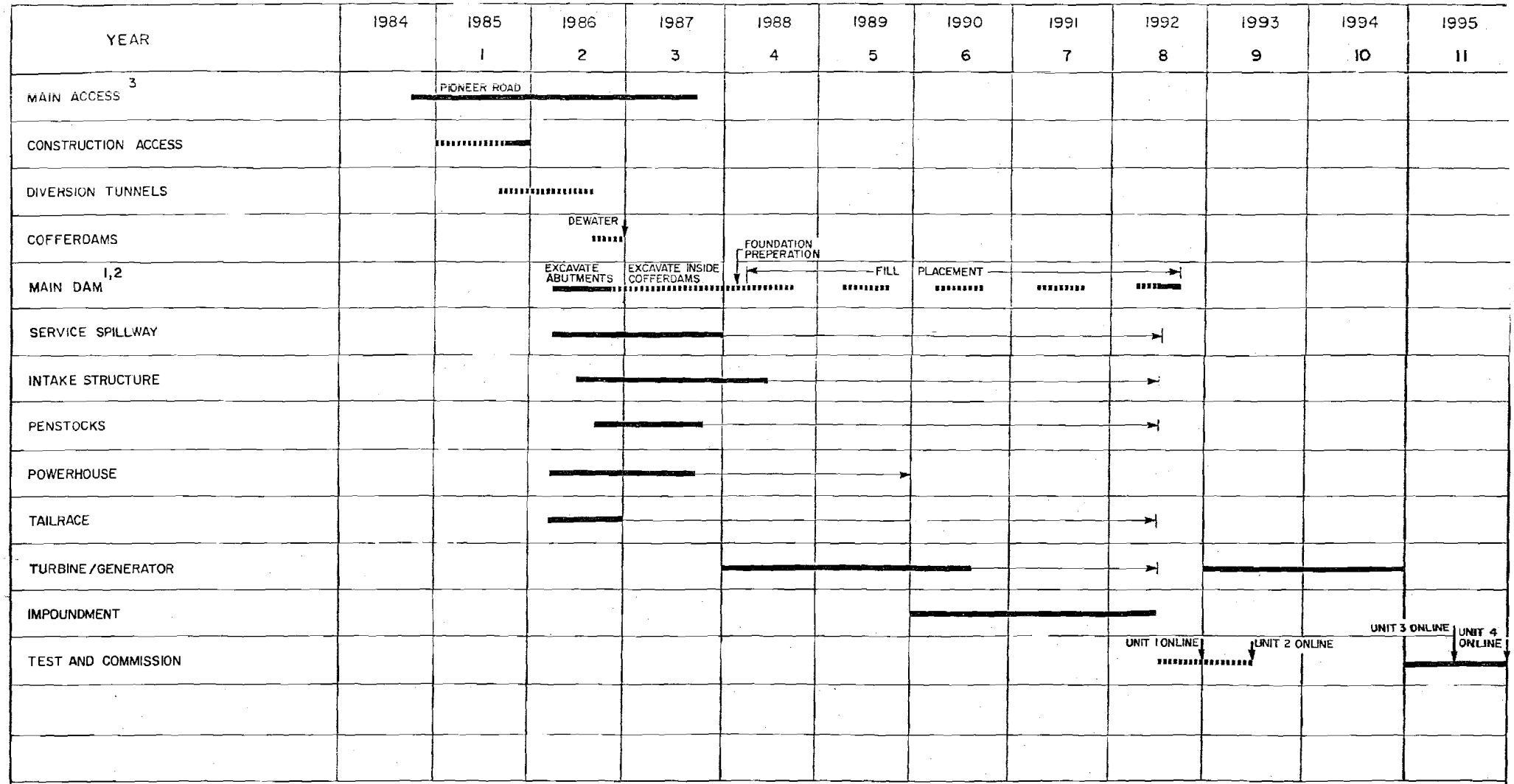
It will take 8½ years for complete construction of the Watana dam from the start of an access road to the testing and commissioning of all the generating units. 2/ Principal components of the schedule include approximately 3 years for site and local access, 1 to ½ years for river diversion and most of the remaining time for foundation preparation and embankment placement. The schedule presently being evaluated reflects an early date of power production from the Watana dam of 1993. This is based on availability of the Denali Trail access route to the Watana dam site at the time of FERC license approval assumed for early 1985.

Should an access route other than the Denali Trail be selected (and several are under consideration) a schedule delay of 1 to 2½ years would result while that access route was constructed to a level suitable for the transport of heavy equipment. The duration of the delay is contingent on the precise access alternative selected and the degree to which compensating methods and procedures could be developed. One such technique would involve constructing an airstrip and flying the necessary equipment and camp facilities in. This would allow paralleling the permanent access road construction period with the initial on-site construction.

The optimum time to start construction of the Devil Canyon Dam awaits resolution. This decision will be driven by the need to match capacity additions to the actual market requirements.

It will take approximately 6-1/2 years to complete the Devil Canyon Project from the time of access to the site to the testing and commissioning of the power units. The key elements in determining the entire project duration are the construction of diversion tunnels, cofferdams, the excavation and preparation of the foundation and the placement of the concrete dam. This construction time assumes that access to the Devil Canyon site can easily be made available over existing access developed for the Watana project. If this is not the case, one to three years would have to be added to the front end of the Devil Canyon schedule in order to construct access.

Figures X-1 and X-2 depict the construction schedule presently being used as the base case. It will be refined as the system development plans are advanced.



NOTES:

1. MAIN DAM SCHEDULE BASED ON FILL PLACEMENT RATES OF 2.5 TO 3.0 MILLION CUBIC YARDS PER MONTH
2. FIVE TO SIX MONTH FILL PLACEMENT SEASON ASSUMED
3. BASED ON ACCESS FROM DENALI HIGHWAY AND ASSUMES OVERLAND WINTER ACCESS AND AIRCRAFT SUPPORT DURING 1985

LEGEND

CRITICAL ACTIVITIES

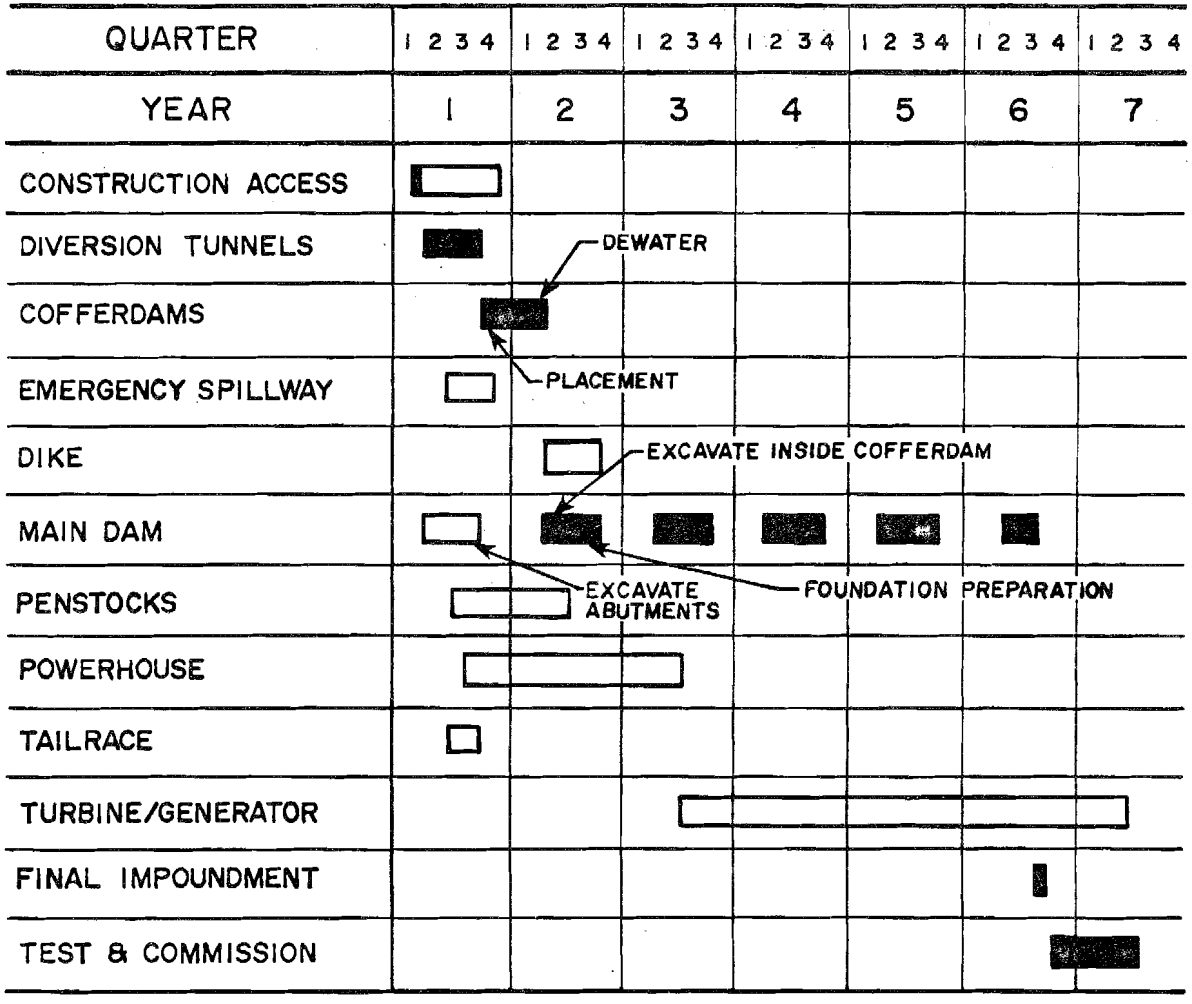
EARLIEST START OF ACTIVITY

EARLIEST FINISH OF ACTIVITY

LATEST FINISH OF ACTIVITY

WATANA FILL DAM PRELIMINARY CONSTRUCTION SCHEDULE

FIGURE X-1.



CRITICAL ACTIVITIES

1. ASSUMES ACCESS TO SITE FROM MAIN HIGHWAY ALREADY AVAILABLE.
2. ASSUMES SIX MONTH CONCRETE SEASON.
3. ALL ACTIVITIES SHOWN AS "EARLY START."
4. SCHEDULING OF NON CRITICAL ACTIVITIES IS DEPENDENT UPON RESOURCE, SEASONAL, AND FINANCIAL CONSTRAINTS.
5. MINOR NON CRITICAL ITEMS NOT SHOWN.

PRELIMINARY CONSTRUCTION SCHEDULE FOR THE DEVIL CANYON DAM

FIGURE X-2

SECTION X. ENDNOTES

1/ Summarized from Subtask 10.2 Design Transmitting, Initial Version, Preliminary Licensing Documentation, Acres American, April 1980 and Subtask 11.01, Project Overview, Second Draft, Acres American, February 11, 1981, pages 15-1 through 15-14.

2/ Based on Figure X-1 provided by Acres American on March 20, 1981.

SECTION XI

PUBLIC PARTICIPATION

XI. PUBLIC PARTICIPATION

No development of the Susitna River Basin can be accomplished without producing important changes within the State of Alaska.

The prospects of long term economic benefits and of reducing national dependence upon non-renewable energy sources must necessarily be weighed against the implications of permanently altering an important ecosystem and of introducing social change in certain Railbelt communities. From the start of the Susitna Study the interests, concerns, and opinions of the public have been important factors in the decision making process. Thus, a major effort is being made to encourage public involvement and to see to it that such involvement does in fact influence the course of the work.

The Public Participation Program is conducted by the Power Authority. The Director of Public Participation (DPP) is a key member of the Power Authority staff. The DPP is responsible to the Executive Director for designing and implementing all aspects of the Public Participation Program. From time to time, the Acres Project Team is called upon to make presentations and to assist in responding to questions and concerns, but responsibility for the program rests with the Power Authority.

The first part of this section summarizes the major changes that have been influenced by public concerns expressed during 1980 (expanding the alternatives study, addition of a sociocultural study, and additional study of alternative Susitna developments).

The last part describes the nature and objectives of the Public Participation Program, discusses future planned activities, discusses public concerns in 1980, and summarizes the activities and concerns of those special interest groups that were particularly active during 1980.

MAJOR CHANGES THAT HAVE OCCURRED FROM PUBLIC CONCERNS

A concern for what the public had to say in regard to energy development in the Railbelt area of Alaska prompted the Power Authority to make changes in the Susitna Plan of Study in 1980. The first edition of the Plan of Study was published in February 1980. It was distributed to over 250 persons, including libraries, State and Federal agencies, groups and organizations, and individuals. In September, 1980, a revised Plan of Study was published and again widely distributed. This revised version contains a complete description of the changes and is available through public libraries.

This section summarizes the major changes and discusses the events that precipitated them.

Expanding the Alternatives Study

The main conclusion from the April 1980 community meetings was that there was a need for greater emphasis on a study devoted to alternative energy sources.

Many people were concerned that the scope of work as outlined in the February 1980 Plan of Study unduly favored the Susitna project, and that more time and more money was needed to look at alternatives. A moderate amount of concern was also expressed about the ability of Acres to conduct an objective assessment of alternatives to Susitna.

In May a report to the legislature by Arlon R. Tussing and Associates, Inc., reemphasized the need for a expanded work in this area, and the Power Authority subsequently requested funds for this purpose. In June, in addition to funding the expanded scope, the legislature also decided that an independent consulting firm should conduct the alternatives study, and Battelle Northwest Laboratories was subsequently chosen to do this.

Addition of a Sociocultural Study

A sociocultural study was added to the revised Plan of Study as a result of concerns expressed at the Power Authority's community meeting in Talkeetna last spring. The concern was articulated by one speaker this way:

"When the Plan of Study speaks of social or human impacts, it consistently labels this "socioeconomic". When it speaks of cultural impact, it does so in terms of archaeology and historical investigation."

"I feel that it is desirable and timely that the plan recognize the existence of that concept which is sociocultural, in a contemporary sense."

As a result of this comment and similar comments expressed by others from the area, the Power Authority concluded that a study should be made of the effect that construction of Susitna might have on the life style of the people who live in the immediate project vicinity.

The study will begin in 1981 and will be coordinated with Frank Orth & Associates' work on the identification and analysis of socioeconomic conditions.

Additional Studies of Alternative Susitna Developments

There were two events that precipitated an increased level of study on alternative Susitna developments. One was a concern expressed by the public at community meetings for "excess power" from Susitna. The Fairbanks Environmental Center referred to it as "cheap blocks of power" or "gluts of power" in their written materials. There is a perception that excessive power would be produced from Susitna and that it would encourage industrialization, particularly heavy industry such as aluminum smelting.

In June, 1980, ISER's report was published entitled "Electric Power Consumption for the Railbelt: A Projection of Requirements." These projections indicate that future lower load growth would be lower than what was previously indicated by the Corps of Engineer's studies. This meant that the Corps scheme (dams at both Devil Canyon and Watana) needed to be reassessed and a more detailed study of alternative levels of development needed to be considered.

Specifically, the additional studies added were:

- additional work on investigating the tunnel alternative to Devil Canyon dam;
- additional work exploring the possibility of smaller hydro facilities at the Watana and Devil Canyon sites than what the Corps recommended;
- additional work to broaden the scope of work previously identified to consider staged development within the Susitna basin;
- work to provide cost information and characteristics of the most likely fossil-fueled generating resources in the Railbelt and cost and characteristics of other hydro projects competitive with Susitna (of the same size) and other hydro projects non-competitive with Susitna (of a smaller size);
- environmental screening of proposed thermal, hydro and tidal generating facilities; and
- work to determine the effects of load management and conservation on power needs.

THE PUBLIC PARTICIPATION PROGRAM

In the traditional sense, typical public information programs focus upon the public's right to know what is happening when an important action may affect the future. The Power Authority program ventures beyond this traditional approach and seeks to establish interaction with the public, providing a two-way communication process. Thus, emphasis is placed on "participation" rather than simply "information." Major objectives include:

- To distribute information to the public concerning the issues, problems, alternative choices, opportunities and impacts regarding the plans and decisions to be made on the Susitna Hydroelectric Project.
- To solicit information from the public about values, attitudes and opinions bearing upon the plans and decisions to be made.
- To ensure that information provided by the public is fully and carefully considered along with technical, economic and environmental data otherwise collected and analyzed in the planning and decision-making process.

To achieve these objectives, the program provides for a regular series of publicized information "events" as well as a continuing aggressive effort to encourage interest in the Susitna Project.

Community Meetings

Four community meetings were held in April, 1980, to provide the public an opportunity to comment on the adequacy of the Plan of Study and to contribute opinions and concerns for consideration by the Alaska Power Authority (See Figure XI-1). All comments and questions were recorded and organized in a manner which facilitates recovery. At least one more set of community meetings is planned and will be conducted in three or four Railbelt locations before a determination is made on project feasibility and before a license application is filed with the Federal Energy Regulatory Commission (FERC).

Attendance at the first meetings, by community, was as follows:

- Fairbanks - 70
- Talkeetna - 31
- Wasilla - 42
- Anchorage - 109

In total, there were 182 comments received on the adequacy of the Plan of Study. These are recorded in a summary report entitled "A Report on the first series of community meetings on the feasibility studies for the Susitna Hydroelectric Project and other power alternatives." This same report also lists (by task) the 165 questions asked at all four meetings.

The report was distributed to the 252 people who attended meetings, public libraries within the Railbelt area, commercial fishing groups, public-interest groups, recreation groups, business groups, media, sportsmen's groups, environmental groups, energy groups, mining groups, State and Federal agencies, Acres and all Acres subcontractors, the Office of the Governor, Battelle (who was later selected to conduct the energy alternatives study) and individuals upon request. In addition to the report, a permanent record of all proceedings is available through verbatim transcripts.

Workshops

From time to time during the course of the study, workshops are conducted to permit members of the Acres study team and the Power Authority staff to discuss and coordinate important issues with State and Federal agencies and special interest groups. These sessions are open to the public and announcements are made in advance to encourage attendance by interested parties.

Two workshops were held in Anchorage. The first, concerning load forecasting, electrical energy forecasting and conservation, was attended by 25 people. The second, concerning an overview of the FERC licensing process and specific license requirements for Susitna, was attended by two people.

At the first meeting more information was desired on conservation, load forecasting and end-use data, but the workshop was reported to meet most people's needs and the language was clear and understandable.

The second meeting was considered not to have furnished the two attendees with clear information on the FERC licensing process.

Audio tapes permanently stored in the Public Participation Office provide a record of each workshop.

Action System

A unique aspect of the program involves a specially designed "action system." Recognizing the importance of feedback in encouraging public interest, the action system provides a vehicle whereby every comment or question is given careful consideration and a personal response is provided. To minimize the burden of letter writing, forms are widely distributed for use by the public, although the forms are not a prerequisite for processing written comments.

Forty-six letters were received through the Action system in 1980. Each letter averaged three issues, so that 156 questions and comments received responses.

Of the 46 letters, 19 contained questions or comments about the alternatives study, and copies were forwarded directly to Fran Ulmer in the Office of the Governor for a response. This rendered the alternatives study the top-priority item in 1980.

The second priority included questions and comments on the environmental studies (including life style, industrialization and local hire issues), and the third priority included questions and comments on the public participation program. Talkeetna by far sent the most questions and comments (about half of the total 156).

Newsletter

One eight-page newsletter entitled "The Susitna Hydro Studies" was produced in November 1980.

Contents included articles on the following subjects:

- Energy decision facing Railbelt
- Social and economic impacts
- Susitna vicinity map and background information
- Energy needs expected to double
- Tunnel option
- Earthquake studies
- Wildlife and small mammal studies
- Hydrology studies
- Susitna fish studies
- Potential recreation sites
- Bird studies
- How to be involved
- Public comment changes study plan

Of 30,000 printed copies of the newsletter, 27,000 copies were distributed by direct mail.

The newsletter presents objective information on the progress of the Susitna hydroelectric studies so that readers may draw their own conclusions based on accurate information.

MAILING LISTS

The Public Participation Office has compiled and currently uses three mailing lists. The first is a list of special-interest organizations, including members the organizations identified as needing information. The list was originally obtained by telephoning known special-interest organizations. Each organization contacted was asked to identify other special-interest groups. Finally, a list of 46 organizations including about 225 individuals was developed in February and March. This list is continually being expanded as new groups are identified.

The list of organizations is generally considered to be representative of the pro, con, and neutral special-interst groups. It is divided into categories: commercial fishing groups, sportsmen's groups (mostly fishing, some game), general public interest groups, environmental groups, recreation groups, energy groups, business groups, and mining groups.

The following information was recorded for each organization after interviewing as many as five people within the organization:

- anticipated level of interest in studies
- names, addresses, and phone numbers of contact people (staff, key officers, newsletter editor and others identified as particularly interested in the studies)
- type of membership, number and distribution (community, state-wide, national)
- information about organization's newsletter, including circulation, when published and deadlines for submitting articles
- any other information that would be helpful to the Public Participation Office in working with the organization.

Contact with these groups has been person-to-person, by telephone and by mail. Mailings are generally notices of meetings or information about the study. Information is sent when it become available or when growing concern or considerable interest develops in a particular aspect of the study.

The following list of special-interest groups was developed by the Public Participation Office in February and March, 1980. Beside each group is shown the level of interest that each group expressed in following the progress of the Susitna studies. The DPP uses this to determine the content and frequency of communications with the groups.

Sportsmen's Groups (Mostly fishing interests, some game)

1.	Alaska Sports Fishing Association	- High
2.	Eagle River Sportsmen's Game Preservation Society	- Moderately High
3.	Izaac Walton League of America	- High
4.	Tanana Valley Sportsmen Association	- Uncertain
5.	Real Alaska Coalition	- Moderate
6.	Alaska Sportsmen's Council	- High

Commercial Fishing Groups

1.	Cook Inlet Aquacultural Association	- High
2.	Commercial Fisherman of Cook's Inlet	- High
3.	Cook Inlet Fisherman's Fund	- High
4.	North Pacific Fisherman's Association	- High
5.	Kenai Peninsula Fishermen's Cooperative	- No response yet
6.	Cook Inlet Fishermen's Association	- High
7.	West Side Set Netters	- No response yet

General Public Interest Groups

1.	State League of Women Voters	- Moderate
2.	League of Women Voters - Anchorage	- Moderate
3.	League of Women Voters - Fairbanks	- Low
4.	Federation of Community Councils - Anchorage	- Low
5.	AkPIRG	- Moderately high
6.	Talkeetna Community Education Program	
7.	Wasilla Community Education Program	

Environmental Groups

1.	Alaska Chapter - Sierra Club	- High
2.	Sierra Club - Anchorage/Alaska Office	- Moderate
3.	Sierra Club - Knik Chapter (Anchorage)	- High
4.	Sierra Club - Denali Chapter (Fairbanks)	- High
5.	Alaska Conservation Society - Statewide/ Fairbanks	- High
6.	Alaska Conservation Society - Anchorage Group	- Moderate
7.	Kenai Peninsula Conservation Society	- Low
8.	Alaska Center for the Environment	- High
9.	Fairbanks Environmental Center	- High
10.	National Audubon Society - Alaska Regional Office	- Low
11.	Arctic Audubon Society - Fairbanks	- None
12.	Anchorage Audubon Society	- Low
13.	Friends of the Earth	- Moderate
14.	Greenpeace	- Low
15.	Denali Citizen's Council	- High
16.	Trustees for Alaska	- Moderate to high
17.	National Wildlife Federation	- Low

Recreation Groups

1.	Mountaineering Club of Alaska	- Moderate
2.	Knik Kanoers and Kayakers	- High

Energy Groups

1.	Alaskans for Alternative Energy	- High
2.	Alaska Rural Electric Coop Association	- High

Business Groups

1.	Susitna Power Now	- High
2.	Resource Development Council/Pacific Legal Foundation	- Moderately High
3.	Commonwealth North	- Moderate
4.	Devil Canyon Corporation	- High

Mining Groups

1.	Alaska Miners Association	- Moderate

The second mailing list compiled and used by the Public Participation Program is computerized. About 7000 names are on this list, which is continually being expanded.

This list will be used primarily to mail newsletters giving project updates. It could be used for other purposes as well.

The method of compiling the mailing was is as follows:

1. 70,000 inserts were placed with the Anchorage Municipality's utility bill in February, 1980. About ten percent were returned, with 6500 individuals asking to be placed on the mailing list in Anchorage.

2. Coupons were available in the Matanuska Electric Association's publication Ruralite in July, 1980 to solicit responses from the MEA area. Coupons were also available in Golden Valley Electric Association's issue of Ruralite for the Fairbanks area.

3. Coupons for interested persons to send to the Public Participation Office were included in the November, 1980 newsletter which had a distribution of 27,000 households in the Fairbanks, Anchorage, Valdez, Glenallen, Kenai Peninsula Railbelt locations.

4. Names are continually added to the list in the following ways:

   - All persons submitting items to the Action System are added to the mailing list.

   - Organizations and individuals identified as needing information are added to the mailing list.

- Persons who attend workshops and community meetings are automatically added to the mailing list.

The third type of mailing list does not include the names of individuals. It is rather a listing of 6000 boxholders and star route boxholders in the communities listed below.

Talkeetna	Cantwell	Trapper Creek
Willow	McKinley Park	Healy
Usibelli	Copper Center	Glennallen
Gakona	Sutton	Valdez
Delta Junction	Tonsina	Chickaloon
Big Delta	Sourdough	Rapids
Richardson		

PLANNED ACTIVITIES

A second newsletter is anticipated in June 1981. This will highlight both the project overview report and the design development report received from Acres in March. The environmental and seismic information known to date will be included.

A third workshop is scheduled for the week of March 16-19 in Fairbanks, Talkeetna and Anchorage. These will be the first workshops held outside Anchorage. Recreation and access to the dam sites will be discussed.

Some kind of activity (e.g. workshop, television show or newsletter) is anticipated to discuss the seismic studies to date. This is anticipated in May 1981.

A second and final set of community meetings is anticipated for spring, 1982 prior to a State decision on proceeding with a license application to FERC. The timing will be coordinated with a set of meetings conducted by Battelle on the results of their alternatives study.

Other workshops and newsletters will be scheduled as needed and appropriate. An environmental workshop is one of the more important to be held when enough information is known to report on.

PUBLIC CONCERNS

Community meetings, workshops, information exchange and the action system have produced a comprehensive profile of frequently mentioned concerns and comments. In accordance with the objectives outlined earlier, specific and important changes have occurred as a result of public participation. Succeeding sections in this paragraph summarize comments made. Actual changes to the planning process were addressed previously.

Interests Expressed at the April Community Meetings

Figure XI-1, reproduced from the report of the April meetings, notes concerns, questions, and discussion areas. Of particular note is the heavy

emphasis on the determination of future energy needs (forecasts) and of how such needs might be satisfied in the future (alternatives).

Public Concerns as Expressed Through the Action System

Summary of Letters Received Through the Action System in 1980. - The Action System was introduced to the public during the week of meetings in April, 1980. Initially the system was designed to accommodate suggestions by the public for changes and additions to the Plan of Study. All items submitted to the System are reviewed by the Alaska Power Authority and Acres American, Inc., and receive a written response.

Most of the items submitted, however, have been questions or expressions of opinions. Therefore, in addition to its original purpose to accommodate suggestions for changes and additions to the Plan of Study, the Action system has also become a method for monitoring, recording, and responding to questions and concerns raised by the public outside the format of the workshops and community meetings.

The three primary areas of concern expressed through letters received in 1980 were, in order:

1. the alternatives study
2. environmental studies
3. public participation

The primary concerns in Talkeetna were environmental (including lifestyle questions and local hire and concern for industrialization).

Almost all concerns expressed from the Kenai Peninsula in 1980 were about the potential impacts of Susitna development on the commercial fishing industry.

In all other communities (Anchorage, Fairbanks, and the Matanuska Valley), the top concern expressed in 1980 was for the alternatives study.

Fairbanks also had a high number of questions and comments on environmental issues and public participation.

Responses to Letters - Letters received through the action system averaged three questions and/or comments. More than one resource person was usually required for an adequate answer. Three staff members from Acres American, Inc. were involved in writing responses and seven members of the Power Authority. An attempt was made to make the letters friendly and not bureaucratic.

An attempt was also made to educate the public. For instance, in the response to the 19 letters on the alternatives studies, enough information was included so that the person knew what changes had been made, why, how the two separate studies would relate, and where to go for follow-up.

8 MAJOR CONCERNS

The following areas received the most comments during the table top discussions:

15 comments saying Plan of Study adequate.

29 comments saying alternatives study not adequate and why.

25 suggestions for energy sources that should be considered in alternatives study.

17 suggestions for serious consideration of decentralized alternatives.

17 comments describing what the socioeconomic studies should address.

11 comments suggesting a level of effort on studies on fish, wildlife and plants.

8 comments describing concerns about transmission studies.

8 suggestions for getting information *to* the public.

THE 8 MOST ASKED QUESTIONS

Written questions were asked most often in the following areas (listed in rank order):

27 questions expressing concern for completeness of alternatives study

13 questions on adequacy of energy forecasts

11 questions on objectivity of those conducting the alternatives study

10 questions on the decision making process and the timing of decisions

10 questions on construction costs and schedules

8 questions on marketing and financing of Susitna

7 questions on access roads to damsites

7 questions on local hire in feasibility studies

TABLE TOP DISCUSSION SUMMARY

This chart summarizes the total number of table top comments received on the adequacy of the Plan of Study.

	# of comments	% of total
Plan of Study	29	16%
Task 1: Power Studies	84	46%
Task 2: Surveys and Site Facilities	none	-0-
Task 3: Hydrology	7	4%
Task 4: Seismic	4	2%
Task 5: Geotechnical	none	-0-
Task 6: Design Development	2	½%
Task 7: Environmental	30	17%
Task 8: Transmission	8	4%
Task 9: Construction Costs and Schedules	none	-0-
Task 10: Licensing	none	-0-
Task 11: Marketing and Financing	4	2%
Task 12: Public Participation	14	8%
TOTALS	182	100%

QUESTION AND ANSWER SUMMARY

This chart shows how many questions were asked about each TASK in the Plan of Study.

	# of questions asked	% of total questions
Plan of Study	5	3%
Task 1: Power Studies	79	48%
Task 2: Surveys and Site Facilities	9	6%
Task 3: Hydrology	2	1%
Task 4: Seismic	7	4%
Task 5: Geotechnical	2	1%
Task 6: Design Development	7	4%
Task 7: Environmental	9	6%
Task 8: Transmission	5	3%
Task 9: Construction Costs and Schedules	13	8%
Task 10: Licensing	1	less than 1%
Task 11: Marketing and Financing	8	5%
Task 12: Public Participation	6	4%
Miscellaneous	12	7%
TOTALS	165	100%

SUMMARY RESULTS OF APRIL COMMUNITY MEETINGS

FIGURE XI-1

Questions on Alternatives Study - When the Alternatives study was turned over to the Office of the Governor in July, 1980, that made it necessary for questions about the alternatives study to be turned over to that office also. Unfortunately, some people using the Action system for the first time, may have felt that the buck was being passed from the Public Participation Office, referring them to another state office. That possibility, however, was handled by giving specific names in the response letter to which people could refer. This was done in almost all cases. In total, 19 letters were sent to Fran Ulmer in the Office of the Governor.

Response Time - The average response time for letters received through the Action system was five months due to some initial problems in setting up the system. By the end of 1980, however, the system was intact, and many letters that were received in December, 1980, were also answered in December, 1980. Of the 46 letters received, only four remain unanswered. Now that the system is in place, it is expected that most files will be closed in a matter of six weeks.

SPECIAL INTEREST GROUPS

Certain special interest groups holding widely divergent views on the Susitna Project were particularly active during 1980. Table XI-2 summarizes this activity.

TABLE XI.-2 SPECIAL INTEREST GROUP SUMMARY

ORGANIZATION	SUSITNA POWER NOW	FAIRBANKS ENVIRONMENTAL CENTER	ALASKA CENTER FOR THE ENVIRONMENT	RAILBELT UTILITIES
OBJECTIVE	Assure that Susitna becomes a reality.	Preservation of Arctic and Interior Alaska environment. Wise resource management.	Educate Alaskans on environmental issues. Encourage public to participate in decision making.	Generation and distribution of electric power and energy.
MEMBERSHIP	1000	400	500	Eight utility systems
ACTIVITIES	Newsletter, brochure, articles, displays, meetings, public appearances	Comments on POS, bulletins, letters, articles, displays, brochures, public appearances	Comments on POS, monthly publication, articles, discussion sessions, letters, public appearances, study groups	Review POS, letters, articles, public appearances
REACTION TO PUBLIC PARTICIPATION PROGRAM	Generally favorable. Suggest more time for questions at public meetings	Generally favorable. Advance workshops prior to public meetings and more time for answers sought. Desire more information on activity and progress.	Generally favorable. ACE encourages citizens to participate. PPO should become citizen advocate.	Golden Valley, Anchorage ML&P and Matanuska Electric Association were generally complimentary about the program. Chugach Electric Association - minimum participation but no criticism of program.
COMMENTS ON STUDY PROCESS	- How can land be acquired? - How should project be funded? - What permits are needed? - What obstacles are there?	- Supports conducting detailed Susitna study and proper independent alternatives study. - Concerned that proponents may short-circuit detailed studies.	- Supports high funding level for alternatives study. - Studies are progressing professionally.	- Chugach Electric Association (largest utility) did not comment on the study. - Anchorage ML&P will increase study activity. - Many concerns were expressed about forecasting methodology.

TABLE XI-2 SPECIAL INTEREST GROUP SUMMARY (Contd.)

ORGANIZATION	SUSITNA POWER NOW	FAIRBANKS ENVIRONMENTAL CENTER	ALASKA CENTER FOR THE ENVIRONMENT	RAILBELT UTILITIES

COMMENTS ON SUSITNA PROJECT	- Would provide low-cost energy.
	- Would reduce winter ice fog in Fairbanks.
	- Would provide renewable energy.
	- Would offer employment opportunities.
	- Major recreation facility is possible.
	- Opportunity exists for major fish hatchery.
	- Stabilized flow could improve opportunity for agriculture downstream.
	- Large project is less costly than many small ones.
	- Second dam can be staged to meet demand, so project will not produce more energy than needed.
		- Regional hydro projects could cost less
		- Inexpensive energy could lead to waste or inefficient use.
		- Needs should be met by choosing sources that minimize social and environmental effects.
		- Susitna Basin is a prolific & accessible hunting area. A project there could disturb this situation.
		- Cook Inlet fisheries should not be hurt.
		- Concern about earthquake potential.
		- Forecasts may be wrong. Notes that consumption has decreased in Fairbanks area.
		- Major project could set the stage for centralized facilities.
			- Issue is long-term and complex. ACE will sustain a long-term participation in the study process.
			- There is a lack of knowledge about implications of the project. Public should be educated.
			- Alternative energy futures should be promoted.
			- Concerned that excess electric energy may lead to forced usage for space heating or promote growth of heavy industry.
			- Impact on Cook Inlet fisheries is important.
			- Centralized vs. decentralized power systems are a concern. Energy future should reflect unique Alaska lifestyle.
				- Chugach Electric Association has not offered support of a Susitna Project.
				- Those utilities which have commented contend Susitna is needed as an economic & relatively benign alternative to petroleum dependence.
				- Tom Stahr, Anchorage Municipal Light and Power Department, noted:
				  - Hydroelectric energy is clean.
				  - Less environmental harm than coal.
				  - Susitna would be efficient electrical energy source.
				  - Project could eliminate dependence on petroleum for generation & space heat.

SECTION XII

LAND STATUS AND NATIVE INVOLVEMENT

XII. LAND STATUS AND NATIVE INVOLVEMENT

The purpose of this section is to provide an overview of the results obtained from through the identification of the general land ownership status within the Upper Susitna River Basin and along the Anchorage-Fairbanks Transmission Corridor.

SIGNIFICANT LAND POLICIES AFFECTING THE STUDY AREA

The Federal government remains the largest land owner in Alaska. However, this domination of ownership has been eroded with the passage of the Alaska Statehood Act in 1959 and the Alaska Native Claims Settlement Act in 1971. These Acts have placed in question the ultimate land ownership patterns of the State with competition for the land divided among the Federal government, the State of Alaska, and private Native regional and village corporations.

With the enactment of the Statehood Act, the State of Alaska became entitled to a total of 104.5 million acres. Section 6(b) of the Act included 102.5 million acres of general grant lands to be used at the discretion of the State. In addition, certain federal lands were to be held in trust for both public schools and for the University of Alaska. Public Law 84-830, passed in 1956, provided for one million acres of mental health grant lands.

In 1978, the State legislature passed a law designed to convert the 1.2 million acres of land held as special trusts for funding public schools, mental health programs, and the University of Alaska into general grant lands to be treated in the same manner as other state-held land. The plan was to replace the land with an annual income, a percentage of the total receipts from the management of State land, including oil royalties. However, the University of Alaska exercised its option and turned down this trust fund and retains management over the lands it holds title to.

The State of Alaska has granted land entitlements to the organized Boroughs and Municipalities. As a result of this entitlement, both the Matanuska-Susitna and North Star Boroughs have extensive land holdings. The Municipality of Anchorage has received its entitlement, which is considerably less than that received by the boroughs.

In response to increasing public pressure and changing laws, the State legislature passed HB66 in 1979, charging the Department of Natural Resources with the responsibility of disposing 100,000 acres of land annually to private ownership.

This land is disposed through four methods: direct sale, homesites, remote parcels, and agricultural rights. It is apparent from recent discussions between the Alaska Power Authority and the State Division of Lands that the State Division of Lands is severely encumbered by its

requirement to annually dispose of 100,000 acres of land to the public. Consequently, necessary regional and site considerations, e.g. proposed Transmission Corridor, relating to the disposal of these lands are frequently omitted from the State's land disposal selection process.

With the passage of the Alaska Native Claims Settlement Act (ANCSA) in 1971, the State of Alaska was no longer the sole entity selecting federal lands. Under the Act, private Native regional and village corporations were entitled to select lands from the Federal government holdings and from those lands previously selected, but not patented to the State of Alaska. To date, neither the State nor the Native Corporations has received its full entitlement under the Statehood Act and the Alaska Native Claims Settlement Act.

PRESENT LAND OWNERSHIP TRENDS 1/

Anchorage-Willow Transmission Corridor

This portion of the project area contains a complex mixture of land ownership with extensive private ownership interspersed with large blocks of State and Borough lands. The State has reserved several areas for public recreational use (Nancy Lake State Recreation area, Goose Bay and Susitna Flats Game Refuge, and Chugach State Park). The only large State land disposal within this area is the Pt. MacKenzie Agricultural Project scheduled for disposal in spring 1981. The holdings by the Federal government are dominated by military reserves in the Anchorage area.

Willow-Talkeetna Transmission Corridor

This area is characterized by numerous private holdings along the Parks Highway. Large blocks of State, Native, and Borough lands dominate the remainder of the land in this area. Numerous State land disposals have taken place and more are projected for this area.

Talkeetna-Fairbanks Transmission Corridor

This section represents an area of large blocks of State owned land. Numerous private holdings are concentrated in scattered communities located along the Parks Highway. The most notable of these are Cantwell, Healy, Clear and Nenana. Cantwell and Nenana are both surrounded by large blocks of Native lands. The Denali State Park and the Mt. McKinley National Park are located in this section.

Upper Susitna River Basin

The land status in this area is relatively simple, due to the large amount of public land managed by the Bureau of Land Management. There are large blocks of private Native Village corporation lands along the Susitna River. Other private holdings consist of widely scattered remote parcels. The State has selected much of the Federal land in this area and is expected to receive patent. Refer to Figure XII-1.

ACQUISITION OF LANDS

Native lands conveyed to CIRI and its villages in the Susitna Hydroelectric Project study area that will be needed by the Alaska Power Authority may be acquired by the following:

A. Land Exchanges (with options)
B. Land Leases (with options)
C. Land Purchases (with options)
D. Easements (with options)
E. Condemnation

Land Exchanges

It is the unofficial position of CIRI and its villages to prefer Land Exchanges, which will require an extensive land identification for each village concerned. 2/ It will require a professional land appraisal by an impartial appraiser to determine the fair market value of the land to be exchanged.

Mineral values, subsistance values, timber resources and other opportunity values will have to be considered for purpose of the exchange.

The village of Chickaloon is not a party to this unofficial position nor are Native allotments, homesites, fishing sites, mining claims and other land inholders; they will have to be identified and treated on a case by case basis. This procedure limits out-of-pocket costs to land identification, surveying and appraisal. The land to be exchanged by the State (DNR) will have to be of a like nature with similar values and would have to be surveyed and appraised by the state, and have the full approval of the villages involved, including CIRI. A reasonable time frame will have to be established for the Natives to select the land that the State (DNR) is willing to exchange.

The state would have to make available a bank of land for the Natives to select from. The Natives under ANCSA are entitled to the subsurface estate and the state must transfer this estate with the exchange whatever it may be (oil, gas coal, gravel etc.).

The firm selected for the survey and appraisal should be qualified to appraise the land for timber, geology, and subsistance values. The value must be placed at the current market value of land, minerals and timber at the time of taking.

Land Purchases

This requires the same procedures as land exchanges but entails the additional up front cost of the land purchased, thereby adding to the initial cost of the project. The Native Villages (excluding Chickaloon) do not seem to favor this scenario.

The advantage to the state is that the state could do what it wants on purchased land barring any environmental restrictions by federal and state regulations and citizen concerns.

Condemnations

This requires the same procedure as land exchanges and purchases but will require extensive litigation costs that could impact negatively on project timing and cost. CIRI and the five villages involved in the present lease agreement do not seem to favor this approach. The preferences of the village of Chickaloon, again, are not known.

Land Leases and Easements

This approach should only require a survey, and this is the only recognizable up-front cost. The balance of the cost would be incurred over the project life and would have to be negotiated.

Other Inholders

These individuals will have to be treated on a case by case basis. These acquisition costs could be quite considerable if it is found that a large number of inholders do in fact exist. Based on past experience no case will be the same. The options available to acquire these lands are the same as those available for Native lands: land purchases, leases, condemnations, easements, and exchanges.

CULTURAL RESOURCES LANDS

Studies are underway to locate and assess cultrual resources in the study area. These lands should be preserved in their original state if there is a significant find of artifacts or a proven archeological site. If the site is essential to the project, important cultural resources would be excavated and preserved.

The Native village or corporation would retain ownership of archeological sites on Native lands; all other sites would be controlled by the State.

D-2 LANDS

There are no recognizable D-2 lands in the Susitna Hydroelectric Project study area, with the exception of a scenic highway study to be conducted over the next three years along the Parks Highway between Cantwell and a point 136 miles south of Cantwell and along the full length of the Denali Highway. The scenic highway study is not expected to pose any threat or restriction to the project. 3/ The Power Authority will provide the federal BLM and the DOT with any data it has on access roads for the scenic highway study.

NO ACTION SCENARIO

Regardless of the status of the project it is the intention of the Native land owners to develop their lands in the Upper Susitna Basin for mining, recreation, subsistance, and small timber operations. 4/ This would require a road, clearing of land, and settlement for recreation development. This development may close the area to hunting, ATV's and rock hounding, as the bulk of this land has been acquired by CIRI and its villages.

Another aspect of development on state land in the area has been the recent land disposals to individuals, and large tracts for agricultural development, which requires the clearing of the land for grazing, growing crops, making roads, subdivisions, etc. There are numerous existing mining claims in the area with valid existing rights; these miners disturb the land considerably in placer mining operations, and have an impact on water use for sluicing operations.

It is apparent that, with or without the Susitna Hydroelectric Project, major land use changes and land disturbances will take place.

SECTION XII. ENDNOTES

1/ This information is a compilation and synthesis of the following data:

a. R & M Consultants, Access Corridor Maps, 1980.

b. Commonwealth Associates, List of Mining Claims, November 13, 1980.

c. Meetings with CIRI Homes & Narver and CIRI Land Dept., January-March, 1981. CIRI H & N provided land status maps.

d. Resource Library Alaska Native Foundation, January-March 1981. Title 43 Book Public Easements under ANCSA June 1979.

e. Public Law 96-487 D-2 Bill Alaska Lands Act dated December 2, 1980 D-2 Land Status Map titled Alaska National Interest Lands 1980. Provided by the State D-2 Office.

f. Meetings with Robert Arnold, Director of ANCSA and his CIRI staff of ANCSA, U.S. Department of the Interior, Bureau of Land Management - Public Law 92-203 dated December 18, 1971, Public Law 94-204 dated January 2, 1976, Public Law 96-487 dated December 2, 1980.

g. Research at the Bureau of Land Management Federal Library and Records information office - Federal Power Act Sec. 24 June 5, 1920, Power Site Classification 443, Public Law 96-487 dated December 2, 1980. Chapter 28 Wild and Scenic Rivers October 2, 1968.

h. Archaeological data researched by Dr. James E. Dixon, PHD Principal Investigator Susitna Cultural Resource Study of the University of Alaska Museum, Fairbanks for terrestrial Environmental Specialists, Inc.

i. Native ownership of archeological sites data provided thru ANCSA Projects Office, Bureau of Indian Affairs 1981.

j. State Land Policy acquired thru research in Chapter 181, SLA 1978 and Article VIII, Section 1 of the State Constitution dated July 18, 1978. Alaska Statehood Act Public Law 85-508 dated July 7, 1958.

k. Mining Laws CFR-43 June 1979 Letter of Confirmation from Fred Wolf Acting State Director, Bureau of Land Management dated December 31, 1980.

l. Map existing recreational use titled Susitna Basin Land Use/ Recreation Atlas State Land and Resource Planning Section Division of R & D Alaska Department of Natural Resources in cooperation with Soil Conservation Service U.S. Department of Agriculture 1980.

m. Summary of Recreational Development and Cabins and Lodges identified for other inholders researched by Dr. Alan Jubenville PHD, University of Alaska, Fairbanks, Principal Investigator-Susitna Project Land Use and Recreation Studies, January - March 1981.

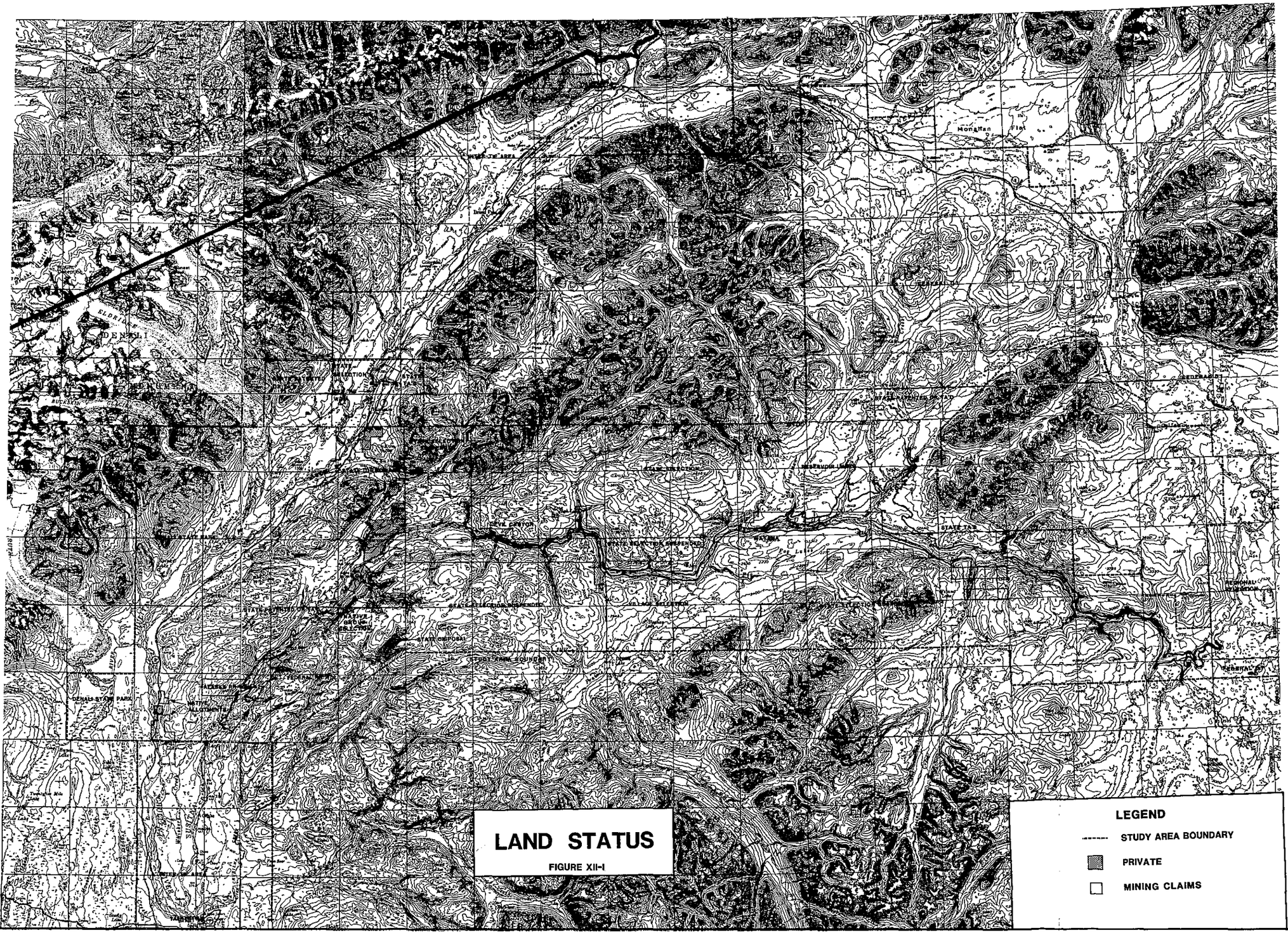
n. Land disposals researched thru the State Department of Natural Resources and meetings with various staff personnel at DNR. Legal descriptions and maps provided by DNR, January 1981.

o. Scenic Highway Study - Public Law 96-487 Sec. 1311, 94 Statute 2481-2482 dated December 2, 1980 provided by the State D-2 Office, February 1981.

2/ The preliminary preferences of Native landholders were provided during a series of meetings with representatives of CIRI and its villages held during January - March, 1981.

3/ Letter from Birch, Horton, Bittner and Monroe to Eric P. Yould dated February 3, 1981.

4/ Meetings with CIRI and village representatives, January - March, 1981.



LAND STATUS

FIGURE XII-1