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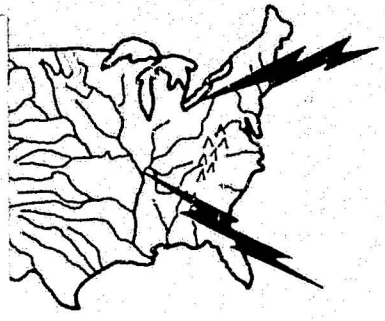

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E.P. Yould, Executive Director; R.A. Mohn, Director of Engineering, Alaska Power Authority; J.D. Lawrence, Project Manager; Dr. J.W. Hayden, Study Director, Acres American Incorporated, "Susitna Hydroelectric Project: Selection of Basin Development Plan."

N. Blunck, Director of Public Participation, Alaska Power Authority; K.R. Young, Environmental Coordinator, Acres American Incorporated, "Susitna Hydroelectric Project: Public Participation Program."

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WATER AND ENERGY:

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Susitna Hydroelectric Project: Selection of
Basin Development Plan

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WATANA

Introduction

The Alaska Power Authority issued on March 15, 1982 a final draft of the Feasibility Report for the Susitna Hydroelectric Project. This comprehensive report is the product of 27 months of intensive study undertaken on behalf of the Power Authority by a group of companies led by Acres American Incorporated. The report presents a detailed evaluation of the technical and economic feasibility of hydroelectric development of the Susitna River in the South Central Railbelt Region of Alaska (Figure 1). It also addresses the environmental consequences of construction and operation of the proposed project and its financial and marketing implications.

A number of alternatives are available for development of this important resource. Selection of optimum locations, types and sizes of the elements of the proposed project involved a wide range of considerations. Apart from the obvious concerns of technical design, safety, economics and environmental impacts of the available options, much attention was also paid to other key issues such as public preferences, socioeconomics and sociocultural aspects and the long term implications of financing the project.

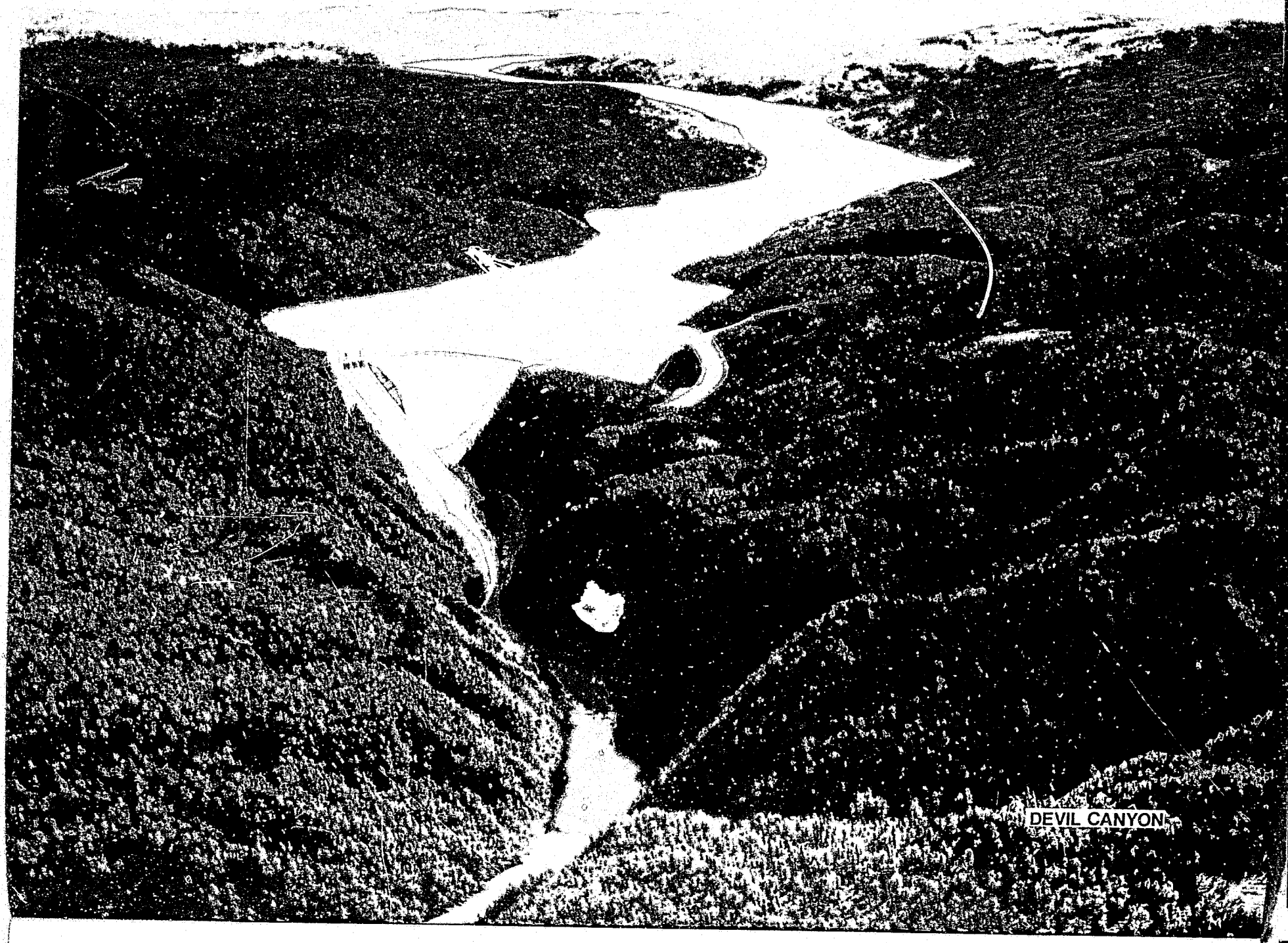
The purpose of this paper is to describe the process used in selection of the proposed development.

Historical Background

The hydroelectric potential of the Susitna River has long been recognized. With an estimated generation of almost 6,800 GWH of energy per year, the project would meet more than twice the current demand in the Railbelt Region. Lying between the Principal Railbelt load centers of Anchorage and Fairbanks, the Susitna Project would meet projected demands over the 1993-2010 time frame by largely displacing thermal generation capability (Figure 2). These plants rely predominantly on the use of coal, oil, and natural gas fuels which are available from within the state.

Initial investigations of hydroelectric potential in Alaska were conducted by the U.S. Bureau of Reclamation shortly after the end of World War II. Responding to a recommendation in 1949 by the nineteenth Alaska territorial legislature that Alaska be included in the Bureau of Reclamation program, the Secretary of Interior provided funds to update the initial studies. The resulting report, issued in 1952, placed particular emphasis on the advantages enjoyed by the Susitna River because of its proximity to Anchorage and Fairbanks as well as to the connecting Railbelt.

A series of studies followed over the years. A number of dam sites were identified and geotechnical investigations were undertaken at some (Figure 3). By 1961, the Department of Interior proposed authorization of a two dam system. The definitive 1961 report was subsequently updated by the Alaska Power Administration (at that time an agency of the Bureau of Reclamation) in 1974, at which time the desirability of proceeding with hydroelectric development was reaffirmed.


DEVIL CANYON

Hydropower investigations were also undertaken in Alaska by the U.S. Army Corps of Engineers during the 1950's and 1960's. As a result of these studies, further consideration of the Susitna Project was deferred in favor of a more ambitious development at Rampart on the Yukon River. This project was capable of generating five times as much electric energy as Susitna annually. The Rampart proposal was finally shelved in the early 1970's largely because of strong environmental concerns. The uncertainty of marketing prospects for so much energy and the discovery and exploitation of abundant natural gas resources also led to a general reduction of interest in major hydroelectric developments at that time.

The energy crisis occasioned by the Arab oil boycott in 1973 revived the general interest in seeking development of renewable resources. Federal funding was made available both to complete the Alaska Power Administration's update report on Susitna in 1974 and to launch a pre-feasibility investigation by the Corps of Engineers. The State of Alaska itself commissioned a reassessment of the Susitna Project by the Henry J. Kaiser Company in 1974.

The Corps of Engineers' studies of the Susitna Project were the most comprehensive undertaken prior to the Acres feasibility assessment. A detailed report was issued in 1975 and subsequently updated by a supplementary report in 1979. The Corps evaluations were based on Alaska Power Administration forecasts for Railbelt electricity demand. A total of 23 alternative developments elsewhere in the Railbelt were considered in the analysis including those proposed by the Bureau of Reclamation. The use of coal was also considered as a primary energy source in formulation of system generation plans. The Corps reports recommended construction of major dams and hydroelectric generating facilities at two Susitna Basin sites, Watana and Devil Canyon.

The Alaska Power Authority, which had been formed in 1976, appointed Acres to undertake a detailed feasibility assessment of the Susitna Project commencing in 1980.

The Alaska Power Authority

The Power Authority was created by action of the Alaska Legislature in 1976, as an autonomous branch of the Alaska Department of Commerce and Economic Development. The Power Authority's mandate is to develop the State's hydroelectric and fossil-fuel energy-generation projects in an economical manner.

Within this constraint, the Authority was given certain powers to carry out its task of developing power projects, including the purchase or leasing of property; and the obtaining of project financing when appropriate. The Authority may enter into contracts to achieve its project goals or exercise the right of eminent domain as needed for construction of a power project. It may also enter into contracts to sell any power generated by its projects.

The basic mission of The Power Authority is the production of economical energy. Although the primary energy sources available in the state are hydroelectric, coal, gas and oil, the Authority is also empowered to investigate and develop, if appropriate "wind power, tidal, geothermal...or solar energy production and waste energy conversion facilities." Nuclear energy is, however, specifically omitted from the list of energy resources which may be considered.

A Board of Directors oversees the general activities and policies of the Authority. The Board originally had five members: The Commissioner of Commerce and economic development and four members-at-large appointed by the Governor. Recent legislation has also made the Commissioners of the Alaska Department of Community and Regional Affairs, the Alaska Department of Natural Resources, the Alaska Department of Transportation and Public Facilities, and the Alaska Department of Revenue ex-officio members of the board. The Board's chairman is elected from among the four members-at-large. These at-large members serve four-year terms and are not paid for their work as board members.

The Board of Directors approves the Authority's involvement in its projects, and presents its budgetary requirements to the State legislature. A staff, currently numbering 35 and headed by the Executive Director, is employed by the Board of Directors for the day-to-day operation of the Authority. The Power Authority regularly engages the assistance of consulting engineers, financial advisors, and legal counsel. The Executive Director and his staff oversee the work done by these outside contractors.

In addition to technical, economic, financial, and administrative functions, the Power Authority staff includes a Director of Public Participation and a Native Inspector. These important positions contribute a great deal to the formulation of energy development plans. The Director of Public Participation is also responsible for collecting public opinion concerning the Authority's activities, for disseminating such information to the public and for planning and organizing whatever public informational meetings are to be held. The Native Inspector oversees Power Authority activities to ensure compliance with agreements entered into with Alaska Native organizations regarding access to lands held by such organizations, and advises the Executive Director on general Native concerns.

The Susitna River Basin

The main stream of the Susitna River originates about 90 miles south of Fairbanks where melting glaciers contribute much of its summer flow. The river flows south for the first 50 miles across a broad alluvial fan and plateau, and then it turns westward. For the next 75 miles the river flows in a well defined valley between essentially continuous canyon walls. Near the Alaska Railroad, the river changes course once again and flows to the southwest for another 125 miles before entering Cook Inlet, west of Anchorage. This stretch is characterized by broad lowlands and braided channels. The Susitna River system, with a drainage area of more than 19,000 square miles is the sixth largest in Alaska. Major tributaries include the Yentna, Chulitna, Talkeetna, and Tyone Rivers. Because a substantial portion of the total stream flow is provided by summer glacial melt and heavy runoff from large saturated muskeg areas, the sediment laden waters are turbid in summer. Winter flows consist almost entirely of

ground water supply and are generally free of sediment. Freezeup starts in October in the upper reaches of the basin and, by late November, ice covers have formed on all but the most rapidly flowing stretches of the River.

The Susitna River and its tributaries are important components of Alaska's highly prolific fishery resource. Salmon, Dolly Varden, trout, grayling, and whitefish are found within the Basin. Waterfowl habitat in the glacial outwash plain supports trumpeter swan and migratory fowl. Wildlife resources are plentiful, particularly bear, moose, and caribou. Extensive studies are still in progress both to determine the impacts which any development may have upon these resources and the nature of mitigative measures which might be taken to eliminate or offset negative environmental consequences of hydroelectric development.

Hydrology and Geology

The climate of the Susitna Basin is generally characterized by cold, dry winters and warm, moderately moist summers. The upper basin above Talkeetna is dominated by continental climatic conditions, the lower basin falling within a zone of transition between maritime and continental climatic influences. Precipitation in the basin varies from low to moderate amounts at lower elevations to heavy in the mountains. At Talkeetna Station, at EL 345, the average annual precipitation is about 28 inches and average snowfall is about 106 inches. At elevations of about 3,000 feet in the Talkeetna mountains, over 80 inches of precipitation are estimated. About 68 percent of Talkeetna precipitation occurs during May through October. Mean daily temperatures at the Watana site during the study period varied from -36.7°C in December to 23.9°C in July.

The longest period of available Susitna River stream flow data is for the station at Gold Creek (32 years from 1949 to 1981). At other stations, record length varies from 6 to 23 years. Gaging was continued at all these stations as part of the current program. A gaging station was established at the Watana damsite in 1980, and stream flow records are available for the study period. Using the available records, average annual flows at the Watana and Devil Canyon damsites are computed as 7,943 cfs and 9,042 cfs, respectively.

Above its confluence with the Chulitna River, the Susitna contributes approximately 20 percent of the mean annual flow measured at Susitna Station near Cook Inlet. At Gold Creek, the average winter and summer flows are 2,100 and 20,250 cfs, respectively, i.e., a 1 to 10 ratio. Approximately 88 percent of the stream flow recorded at Gold Creek station occurs during the summer months. The lowest annual flow at Gold Creek was observed in the Water Year 1969 with an average flow of 5,560 cfs. The return period of such an event is estimated at about 1 in 10,000 years.

The most common causes of floods in the Susitna River Basin are snowmelt and/or rainfall over a large area. Annual maximum peak discharges generally occur between May and October, usually in June. Some flood peaks have also occurred in August or later and are the result of heavy rains over large areas augmented by significant snowmelt from higher elevations and glacial runoff.

The geologically complex Talkeetna Mountain area has a history of at least three periods of major tectonic deformation. The oldest rocks exposed in the region are volcanic flows and limestones which are estimated to be 250 to 300 million years old. These are overlain by younger sandstone and shale deposits. Subsequent tectonic action resulted in the intrusion of large diorite and granite plutons, which caused intense thermal metamorphism. This was followed by marine deposition of silts and clays. The argillites and phyllites which predominate at Devil Canyon were formed from the silts and clays during faulting and folding of the Talkeetna Mountains area in the Late Cretaceous period. As a result of this faulting and uplift, the eastern portion of the area was elevated, and the oldest volcanics and sediments were thrust over the younger metamorphics and sediments.

The diorite pluton that forms the bedrock of the Watana site was also intruded into sediments and volcanics at about the same time. The andesite and basalt flows near the site may have been formed immediately after this plutonic intrusion, or after a period of erosion and minor deposition. The area surrounding the sites was again uplifted by as much as 3,000 feet during the subsequent Tertiary period. Since then, widespread erosion has removed much of the older sedimentary and volcanic rocks. During the last several million years, at least two alpine glaciations have carved the Talkeetna Mountains into the ridges, peaks, and broad glacial plateaus seen today. Postglacial uplift has induced and is still causing downcutting of streams and rivers, resulting in the 500-to-700 foot deep V-shaped canyons that predominate, particularly at the Vee and Devil Canyon damsites. This continuing erosion has removed much of the glacial debris at higher elevations but very little alluvial deposition has occurred. The resulting landscape consists of barren bedrock mountains, glacial till-covered plains, and exposed bedrock cliffs in canyons and along streams. The arctic climate has retarded development of topsoil.

The Susitna Basin lies within the Talkeetna Terrain, a part of the north American Plate. The Terrain boundaries are denoted by 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 the Benioff Zone at depth. The Talkeetna Terrain is a relatively stable tectonic unit with major strain release occurring along its boundaries, but no evidence of faults with recent displacement within those boundaries.

Feasibility Assessment

The feasibility study was undertaken in accordance with a Plan of Study (POS) for the Susitna Hydroelectric Project, which was first issued by the Power Authority for public review and comment in February 1980. The POS describes in detail the many and complex studies undertaken from January 1980 through June 1982 to assess the feasibility and the environmental impact of the proposed Susitna Project. The POS also addresses the requirements for filing a FERC license application, which is currently tentatively scheduled for early 1983. The filing of the FERC license application is contingent upon a decision by the State to proceed with development of the project.

Studies by Acres through March 1981 were mainly concerned with evaluation of the need for electric power in the Alaska Railbelt Region and preliminary consideration of the alternatives for meeting these power needs both with and without a Susitna Basin hydroelectric development. This work was undertaken in parallel with Railbelt power demand forecasting studies initially undertaken by the Institute for Social and Economic Research (ISER) for the State of Alaska. A Development Selection Report was issued in June 1981 to provide recommendations and justification for continuation of study of basin development at the Watana and Devil Canyon sites.

Subsequent to selection of this basin development plan, engineering studies have continued to develop preliminary design and cost information for the Watana and Devil Canyon sites. An independent study of alternatives for meeting projected Railbelt electrical power requirements has also been undertaken for the State of Alaska by Battelle Pacific Northwest Laboratories. All of this information has been used to establish definitive project arrangements for Watana and Devil Canyon as well as for the associated transmission facilities. Estimates of construction and operating costs, and economic and financial evaluations have also been undertaken together with assessments of the environmental impact of the project and appropriate mitigation measures.

The development selection studies completed by Acres in 1981 confirmed that the preferred Susitna development plan should consist of two large hydroelectric dams at Watana and Devil Canyon. The Development Selection Report recommended further study of hydroelectric installations at these two sites. The preliminary studies indicated that an earthfill dam, roughly 880 feet maximum height, should be constructed at Watana first. The large reservoir volume created would provide adequate storage for seasonal regulation of the flow. Initially approximately 400 MW of generating capacity would be installed at this site. This would later be expanded to around 800 MW to allow for additional peaking capacity. The Devil Canyon Dam would be the next stage of the development. It would involve a 675-ft maximum height double curvature concrete arch dam and incorporate a 400 MW powerhouse. The total average annual energy yield from this development was estimated as 6,200 GWh. The Watana and Devil Canyon developments together comprise the Susitna Hydroelectric Project.

Design studies undertaken subsequent to the selection of the Susitna development plan confirmed that the optimum installed generating capacity for Watana should ultimately be 1,020 MW, and that first power should be available in 1993. Devil Canyon would add 600 MW to the system by 2002. The assessment of feasibility of an undertaking as significant as the proposed Susitna Hydroelectric Project required an appropriately high level of effort in terms of field and office activities.

The scope of work was consequently carefully structured to meet these requirements in the available time frame in a manner appropriate to the scale, variety, and complexity of the problems involved.

Activities have ranged from engineering and scientific data acquisition, literature review, research, dam studies, design computations and analysis, to field surveys, hydraulic measurements, seismologic observations, geologic mapping, geotechnical exploration, environmental data gathering, and the

necessary logistical support services. The study directly involved up to as many as 300 participants at one time and drew upon a broad cross-section of contributions from expert specialists to concerned citizens.

Alternatives to Susitna Development

Between 1940 and 1978, electricity sales in the Railbelt area grew at an average annual rate of 15.2 percent, about twice the national average. Between 1973 and 1978 the rate of growth fell to 10.9 percent. The two main reasons for these differences are the relatively higher growth rates in Alaska for both population and the proportion of households served by electric utilities.

Total utility sales in the Railbelt in 1980 reached 2,390 GWh, requiring 510 MW of generating capacity, at a load factor of 62.5 percent. Approximately 80 percent of these sales were consumed in the Anchorage area, about 19 percent in the Fairbanks area and the remainder in the Glenallen-Valdez area. In recent years approximately 47 percent of sales has been consumed by the residential sector, attributable mostly to space heating with smaller uses for lighting and domestic appliances such as refrigerators, water heaters and ranges. The remaining 53 percent has been accounted for by the commercial-industrial-government sectors. These proportions compare with national averages of 34 percent and 65 percent, respectively.

Study forecasts of Railbelt energy range from 6,303 GWh to 11,435 GWh in the year 2010 for projected low and high growth scenarios. Railbelt generation planning studies undertaken for Susitna feasibility assessment are based on a medium load growth scenario. In this case an energy demand of 7,791 GWh is forecast for 2010, requiring 1,537 MW of generating capacity at a projected load factor of 57.9 percent. This forecast is based on average annual growth rates from 1981 varying from 4.9 percent through 1990 to 3.5 percent overall.

Planning of future electric power generation for the Railbelt Region has given careful consideration to economic necessity, acceptable environmental impacts, and social preferences. Development of the Susitna Basin could provide a major portion of the Railbelt Region energy needs well beyond the year 2000. However, this is but one of the available options for meeting Susitna Railbelt demand.

The two major load centers of the Railbelt Region are the Anchorage/Cook Inlet area and the Fairbanks/Tanana Valley area. At present, these two areas operate independently. There are currently nine electric utilities, including the Alaska Power Administration, providing power and energy to the Railbelt system. In 1980 total Railbelt installed capacity of 984 MW consisted of two hydroelectric plants totaling 46 MW plus 938 MW of thermal generation units fired by oil, gas, or coal. An additional 12 MW of hydro has recently been commissioned by Copper Valley Electric Association at Solomon Gulch. Five more projects are currently expected to be added to the Railbelt system prior to 1990; 116 MW of gas-turbines and 97 MW of hydro.

Engineering studies are currently in progress for construction of an intertie between the Anchorage and Fairbanks systems. These studies indicate that there is an economic benefit in having this intertie capability. As presently

envisaged, the connection will involve a 345 kV transmission line between Willow and Healy scheduled for completion in 1984. The line will initially be operated at 138 kV with the capability for expansion as the loads grow in the load centers.

Current forecasts of Railbelt demand indicate that a significant amount of new generating capacity will be needed by 1993 in addition to that already planned. A number of alternatives exist for meeting these needs. A significant amount of non-Susitna hydroelectric potential identified in the Railbelt Region includes the following more attractive developments:

- Chakachamna (330 ' ;
- Keetna (100 MW); id
- Snow (50 MW).

Although these ources would have generally stable energy costs once constructed, they would not alone be sufficient to meet projected demand, and they are relatively more costly than Susitna.

The major portion of generating capability in the Railbelt is currently thermal, principally natural gas with some coal and oil-fired installations. There is no doubt that the future electric energy demand in the Railbelt could be satisfied by an all-thermal generation mix, but the continued rise in cost of fuels would lead to significant increases in long-term energy costs using these alternatives. The broader perspectives of other alternative resources and the relevant environmental, social, and other issues involved have been addressed in the Battelle Alternatives Study. Emphasis in the Acres study was placed in the following more likely alternative forms of thermal power generation:

- Coal-fired steam;
- Gas-fired combined-cycle;
- Gas-fired gas turbine; and
- Diesel.

To assess the economics of developing the Susitna project, the costs of meeting the Alaska Railbelt load forecast with and without the project have been compared. Thus, plans were developed using appropriate combinations of the alternative hydroelectric and thermal generating sources identified above. The resulting all-thermal and mixed hydro-thermal generating scenarios were used as a basis for comparison with appropriate Susitna-thermal generating scenarios developed to meet the projected Railbelt demand. Comparisons of a much broader range of possible types of generation were also made by Battelle in its alternatives study. These studies were made using economic parameters over a wide range of load forecasts, capital costs, interest (discount) rates, fuel cost and fuel escalation rates.

The initial Acres planning studies through early 1981 concluded that Susitna showed promise of economic feasibility and was worthy of further study. Of the available non-Susitna alternatives the study showed that the all-thermal generation scenario was the most likely competitor. This alternative is based on addition of substantial coal-fired developments at Beluga and Healey and natural gas-fired turbines.

Further sensitivity studies have confirmed that scenarios involving the Chakachamna hydroelectric development may also result in some reduction in cost. However, this alternative was not included in the non-Susitna plan due to environmental impact and cost uncertainties.

Plan Selection Process

A key element in the studies undertaken was the process applied for formulation and comparison of development plans. Emphasis was placed on consideration of every important perspective which could influence the selection of a particular course of action from a number of possible alternatives. An essential component of this planning process involved a generalized multi-objective development selection methodology for guiding the planning decisions. A second important factor was the formulation of a consistent and rational approach to the economic analyses undertaken by the studies.

A generalized plan formulation and selection process was developed to guide the various planning studies being conducted. Of the numerous planning decisions made in these studies, perhaps the most important were the selection of the preferred Susitna Basin development plan and appropriate access and transmission line routes.

The basic approach involved the identification of feasible candidate courses of action, followed by the development and application of an appropriate screening process. In the screening process, less favorable candidates were eliminated on the basis of economic, environmental, social, and other prescribed criteria. Plans were then formulated which incorporated the shortlisted candidates individually or in appropriate combinations. Finally, a more detailed evaluation of the plans was carried out, again using prescribed criteria and aimed at selecting the best development plan. Figures 4, 5, and 6 illustrate this general process.

In the final evaluation, no attempt was made to quantify all the attributes used and to combine these into an overall numerical evaluation. Instead, the plans were compared utilizing both quantitative and qualitive attributes; where necessary, judgmental tradeoffs between the two types of attributes were made and highlighted. This allowed reviewers of the planning process to quickly focus on the key tradeoffs that affected the decisions. To facilitate this procedure, a paired comparison technique was used so that at any one step in the planning process, only two plans were being evaluated.

In conformance with usual state practice, all planning studies were carried out using economic parameters as a basis of evaluation. This ensured that the resulting investment decisions maximized benefits to the state as a whole rather than any individual group or groups of residents. The economic analyses incorporated the following principles:

- Intra-state transfer payments such as taxes and subsidies were excluded.

- Opportunity values were used to establish the costs for coal, oil, and natural gas resources used for power generation in the alternatives considered. These opportunity costs were based on what the open market is prepared to pay for

these resources. They therefore reflect the true value of these resources to the state. These analyses ignored the existence of current term-contractual commitments which may exist, and which fix resource costs at values different from the opportunity costs.

- The analyses were conducted using "real" or inflation-adjusted parameters. This means that the interest or discount rate used equaled the assessed market rate minus the general rate of inflation. Similarly, the fuel and construction cost escalation rates were adjusted to reflect the rate over or under the general inflation rate.

- A 3 percent discount rate was used as the basis of the economic analysis. A lower value would tend to improve the relative economic position of capital intensive projects (such as hydro generation) versus high level consumptive projects (such as thermal generation). A higher value would have the opposite effect.

- To illustrate for the purpose of this paper the application of the plan selection process, the selection of the Susitna Basin development is described.

Susitna Basin Development Selection

A number of engineering and planning studies were carried out during the early phases of the project feasibility assessment as a basis for formulation of Susitna Basin development plans and selection of the preferred plan. The recommended Watana/Devil Canyon dam project was compared to alternative methods of providing the Railbelt energy needs including thermal and other potential hydroelectric developments outside the Susitna Basin on the basis of technical, economic, environmental, and social aspects.

In previous Susitna Basin studies, twelve damsites were identified in the upper portion of the basin, i.e., upstream from Gold Creek. Preliminary assessments of these sites, on the basis of published data, showed that three sites, Devil Canyon, High Devil Canyon, and Watana are potentially the most economic large energy producers in the basin. Sites such as Vee and Susitna III have only medium energy production and are slightly more costly. Other sites such as Olson and Gold Creek are competitive provided they have additional upstream regulation. Sites such as Denali and Maclaren produce substantially higher cost energy than the other sites but can also be used to increase regulation of flow for downstream use.

An initial screening process was used to eliminate sites which would obviously not feature in the initial stages of a Susitna Basin development plan. This screening was based on consideration of environmental factors and the relative merits of each site in terms of economic energy contribution. The seven sites remaining after this screening were:

- Devil Canyon;
- High Devil Canyon (Susitna I);
- Watana;

- Susitna III;
- Vee;
- Maclaren; and
- Denali.

Preliminary construction cost estimates were developed for developments at each site. The relative cost differences between rockfill and concrete dams at the sites are generally marginal or greatly in favor of the rockfill. Rockfill dams were therefore assumed at all developments for general consistency. These estimates, together with energy production estimates, provided a basis for conceptualization of basin development plans.

Basic development plans involving appropriate combinations of the seven sites were formulated. A computer assisted screening process identified the plans that are most economic as those of Devil Canyon/Watana or High Devil Canyon/ Vee. In addition to these two basic development plans, a tunnel/Watana dam scheme was introduced. This provided potential environmental advantages to the Devil Canyon/Watana scheme by replacing the Devil Canyon dam with a long power tunnel.

Evaluation Process

Other important conclusions drawn from the initial screening were as follows:

- For energy requirements of up to 1,750 GWh, the High Devil Canyon, Devil Canyon, or the Watana sites individually provided the most economic energy.

- For energy requirements of between 1,750 and 3,500 GWh, the High Devil Canyon site is the most economic.

- For energy requirements of between 3,500 and 5,250 GWh, the combinations of either Watana and Devil Canyon/ or High Devil Canyon and Vee are the most economic.

- The total energy production capability of the Watana/Devil Canyon developments is considerably larger than that of the High Devil Canyon/Vee alternative and is the only plan capable of meeting energy demands in the 6,000 GWh range.

A scheme involving a long power tunnel could conceivably be used to replace the Devil Canyon dam as a second stage of the Watana/Devil Canyon development plan. It could develop comparable head for power generation and may provide some environmental advantages by avoiding inundation of Devil Canyon. Conceptually, the tunnel alternatives would comprise the following major components in some combination, in addition to the Watana dam reservoir and associated powerhouse:

- Power tunnel intake works;

- One or two power tunnels of up to forty feet in diameter and up to thirty miles in length;

- A surface or underground powerhouse with a capacity of up to 1,200 MW;

- A reregulation dam if the intake works are located downstream from Watana; and

- Arrangements for compensation flow in the bypassed river reach.

Of the tunnel schemes considered, an alternative was selected involving two 30-foot-diameter tunnels 13.5 miles long. This scheme, which includes a 245-foot high reregulating dam downstream from Watana, and a total installed capacity of 1,180 MW, was judged to be the environmentally and economically superior alternative.

The final plan screening process indicated that the Watana/Devil Canyon and the High Devil Canyon/Vee plans were clearly superior to all other dam combinations. In addition, plans involving the tunnel scheme as an alternative to the Devil

Canyon dam and a plan combining a Watana/High Devil Canyon/Portage Creek combination were also formulated for more detailed evaluation. Four basic plans were established as a result of this process. Plan 1 involved the Watana-Devil Canyon sites, Plan 2 the High Devil Canyon-Vee sites, Plan 3 the Watana-tunnel concept, and Plan 4 the Watana-High Devil Canyon sites. Some additional economic benefits are also gained if the Chakachamna hydroelectric project is constructed instead of the Vee dam.

Selection of a development plan for further, more detailed study was based on a final consideration of the economic, environmental, social and energy contribution attributes of each alternative. A preliminary evaluation of plans was initially undertaken to determine broad comparisons of the available alternatives. This was followed by appropriate adjustments to the plans and a more detailed evaluation and comparison.

The results of the Watana tunnel comparison indicated that the tunnel scheme versus the Devil Canyon dam scheme would add approximately $680 million to the total system present worth cost. A sensitivity analysis made to determine the effect of halving the tunnel costs indicated that the tunnel scheme was still more costly than constructing the Devil Canyon dam.

The plans with the lowest present worth cost were also subjected to further sensitivity analyses to assess the economic impacts of various load growths. The results for low load forecasts illustrated that the most viable Susitna Basin development plan is the Watana-Devil Canyon plan with a capacity of 800 MW which has a present worth cost of $210 million less than its closest competitor, the High Devil Canyon-Vee plan. For the high load forecasts, the results indicated that the economic advantage of the Watana/Devil Canyon plan improves significantly.

For the remaining three Plans 1, 2, and 3 a final evaluation process was conducted in a series of steps. At each step, two plans are compared. The superior plan is then passed on to the next step for evaluation against a third plan, and so on.

Devil Canyon Dam Versus Tunnel

The first step in the process involved the comparison of the Watana-Devil Canyon dam plan and the Watana-Tunnel plan. Since Watana is common to both plans, the evaluation was based on a comparison of the Devil Canyon dam and the preferred tunnel alternative. From an economic point of view, the Watana-Devil Canyon dam scheme is superior. Consideration of the sensitivity of the basic economic evaluation to potential changes in capital cost estimate and other economic parameters did not change the basic economic superiority of the dam scheme over the tunnel scheme.

In the environmental comparison of the two schemes, the tunnel scheme was judged to be superior. In terms of impact on state and local economics and risks because of seismic exposure, the two schemes are rated equal. However, the dam scheme has a greater potential for energy production, develops a larger portion of the basin's potential, and displaces a larger amount of non-renewable energy resources.

Overall, the estimated cost saving of $680 million in favor of the dam scheme plus the additional energy produced are considered to outweigh the reduction in the overall environmental impact of the tunnel scheme. The dam scheme is therefore judged to be superior.

Watana-Devil Canyon Versus High Devil Canyon-Vee

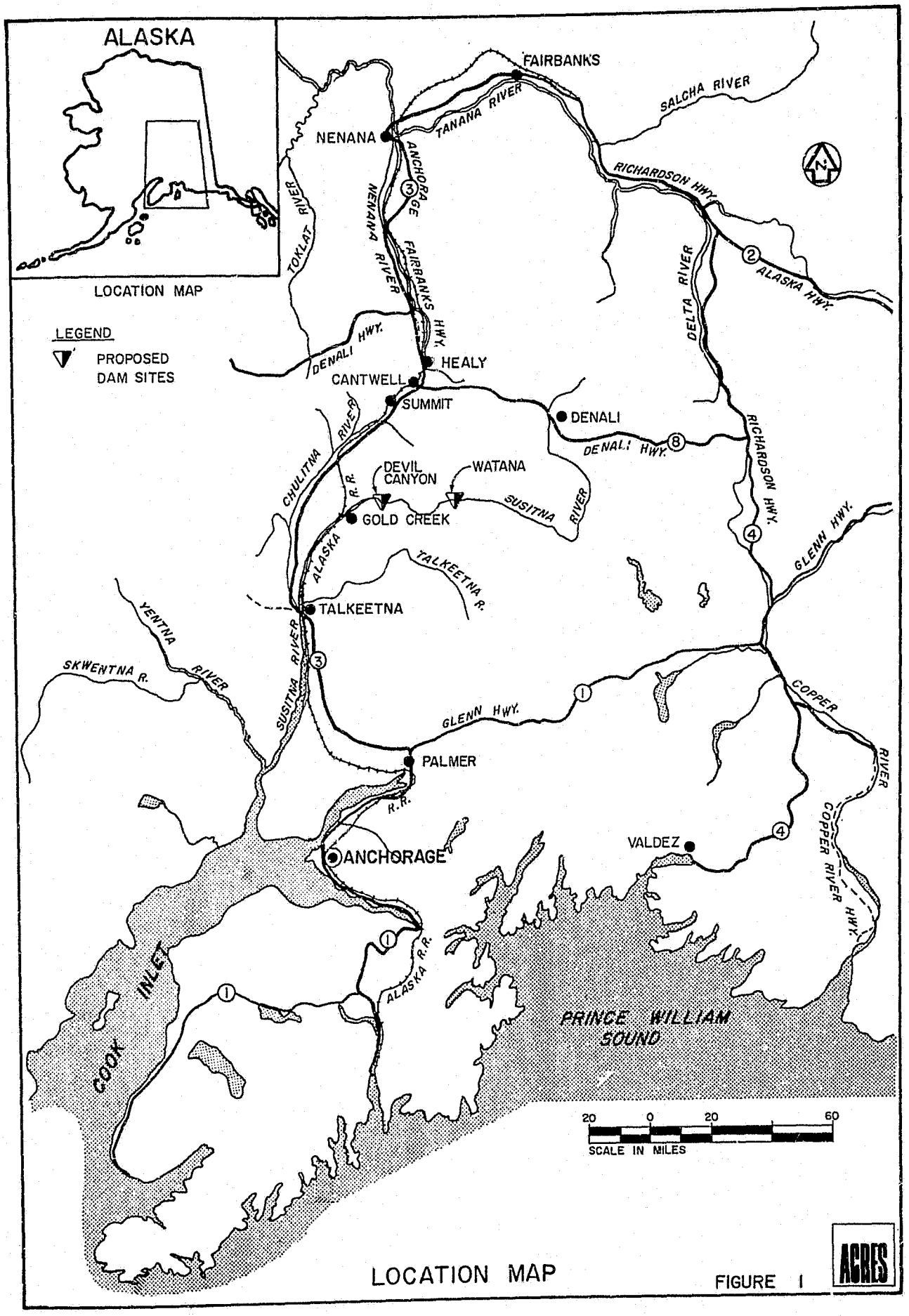
The second step in the development selection process involved an evaluation of the Watana-Devil Canyon and the High Devil Canyon-Vee develop ment plans. In terms of the economic criteria the Watana-Devil Canyon plan is less costly by $520 million. Consideration of the sensitivity of this decision to potential changes in the various parameters consid- ered did not change the basic superiority of the Watana-Devil Canyon Plan.

In assessing these plans environmentally, a reach-by-reach comparison was made for the section of the Susitna River between Portage Creek and the Tyone River. The Watana-Devil Canyon scheme would create more potential environmental impacts in the Watana Creek area. However, the potential environmental impacts above the Vee Canyon dam with a High Devil Canyon-Vee development were judged to be more severe.

In terms of energy contribution criteria, the Watana-Devil Canyon scheme was assessed to be superior because of its higher energy potential and the fact that it develops a higher proportion of the basin's potential. In terms of the social criteria, the Watana-Devil Canyon plan was judged to have a slight advantage over the High Devil Canyon-Vee plan. This is because of its greater potential for displacing nonrenewable resources.

Overall, the Watana-Devil Canyon plan is thus considered to be generally superior for all the evaluation criteria. This plan was therefore selected as the preferred Susitna Basin development plan, as a basis for continuation of more detailed design optimization and environmental studies.

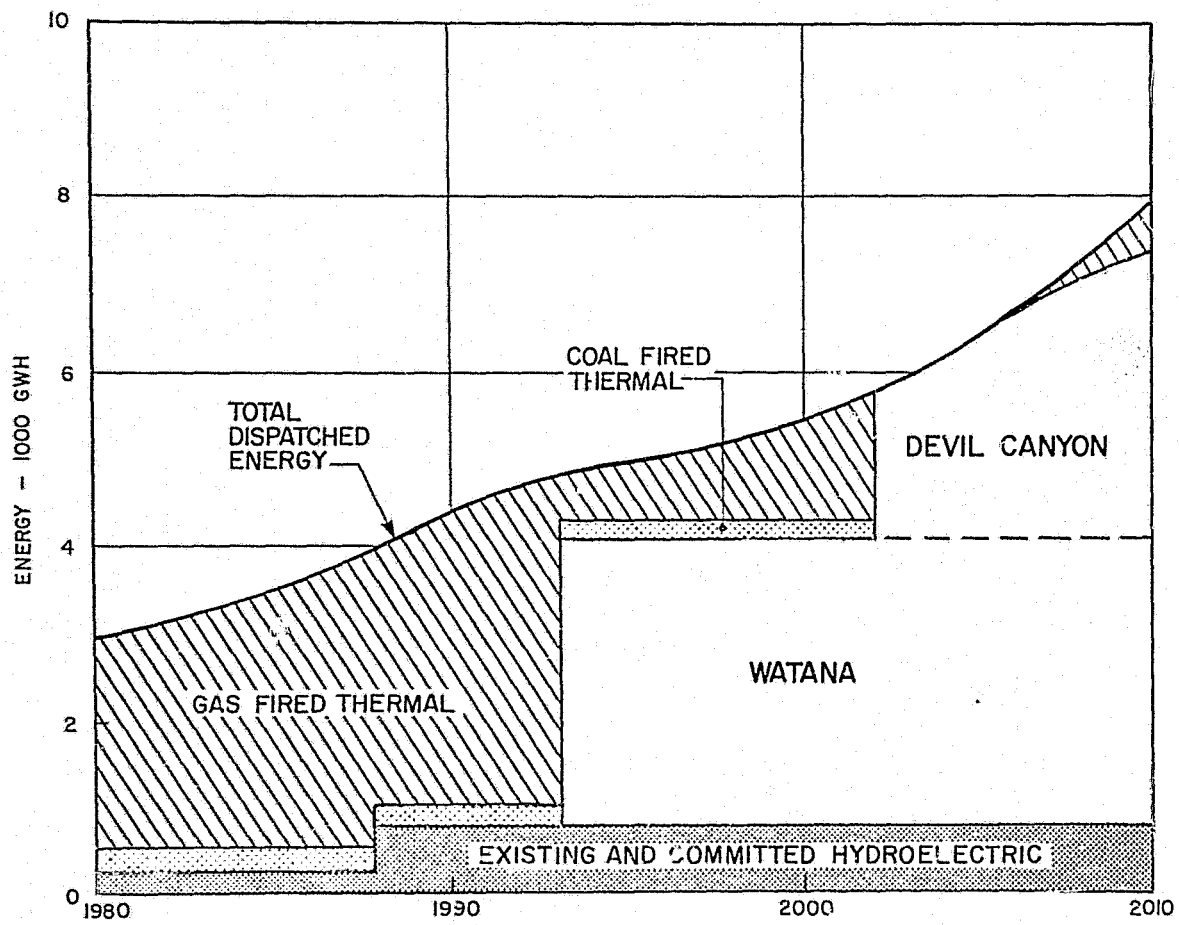
The conclusion of the initial development selection studies was thus that the hydroelectric potential of the Susitna Basin should be tapped by installation of power plants and related facilities at the Watana and Devil Canyon sites. The Power Authority recommended to the governor in March 1981 that further study of these sites be undertaken. These studies culminated in the issue of the Feasibility Report in March 1982.



LOCATION MAP

FIGURE 1

ACRES



SUSITNA INSTALLATION SEQUENCE

FIGURE 2

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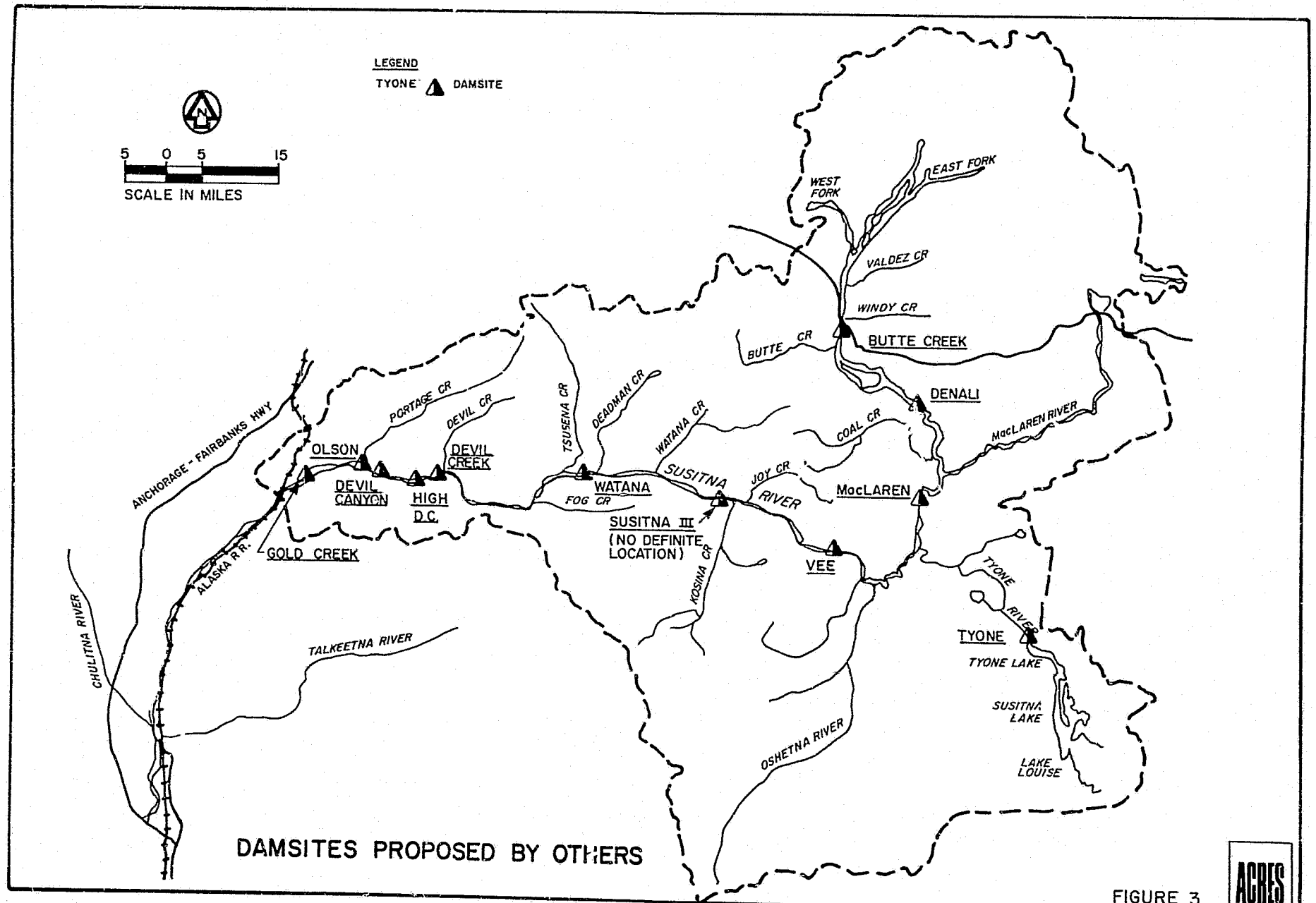

FIGURE 3

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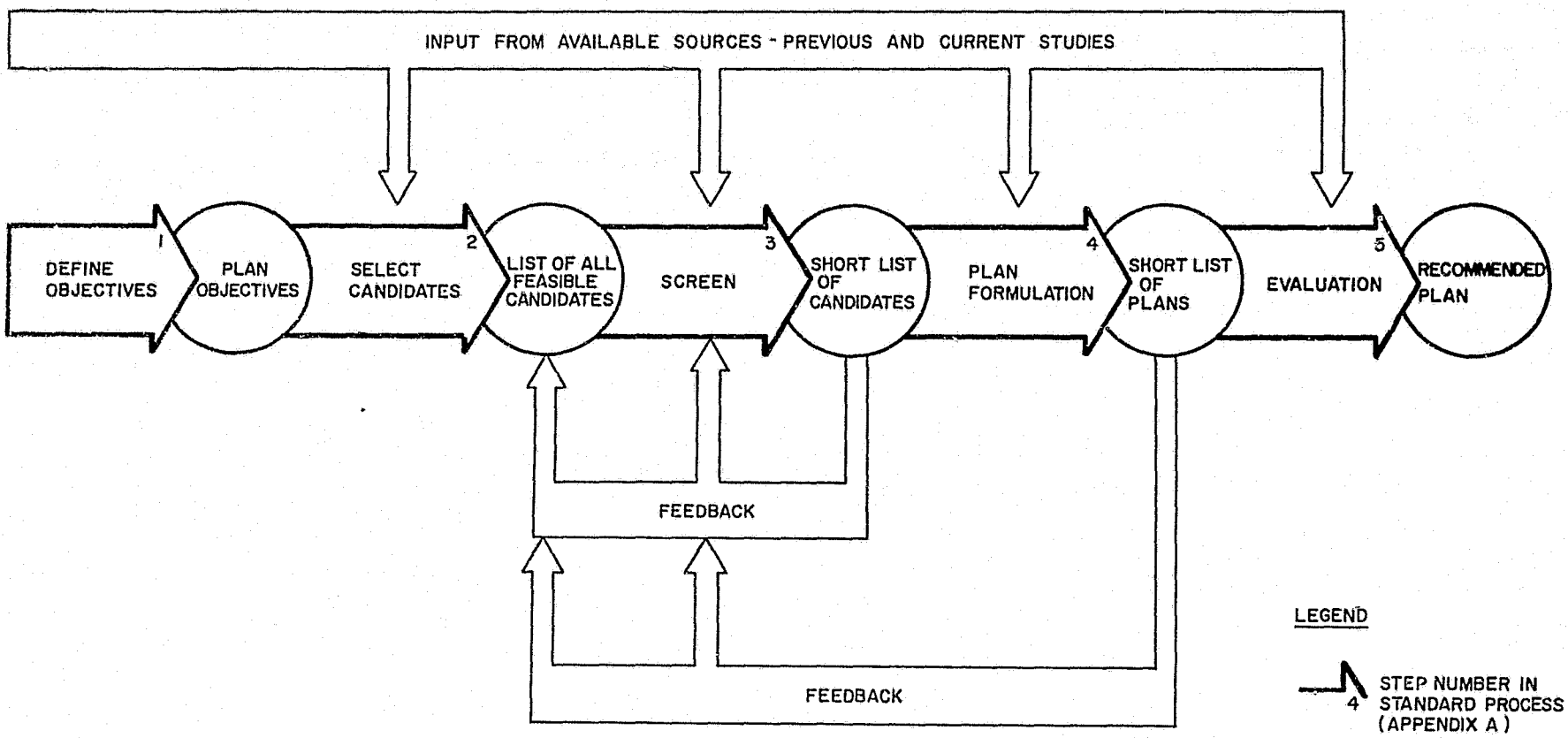
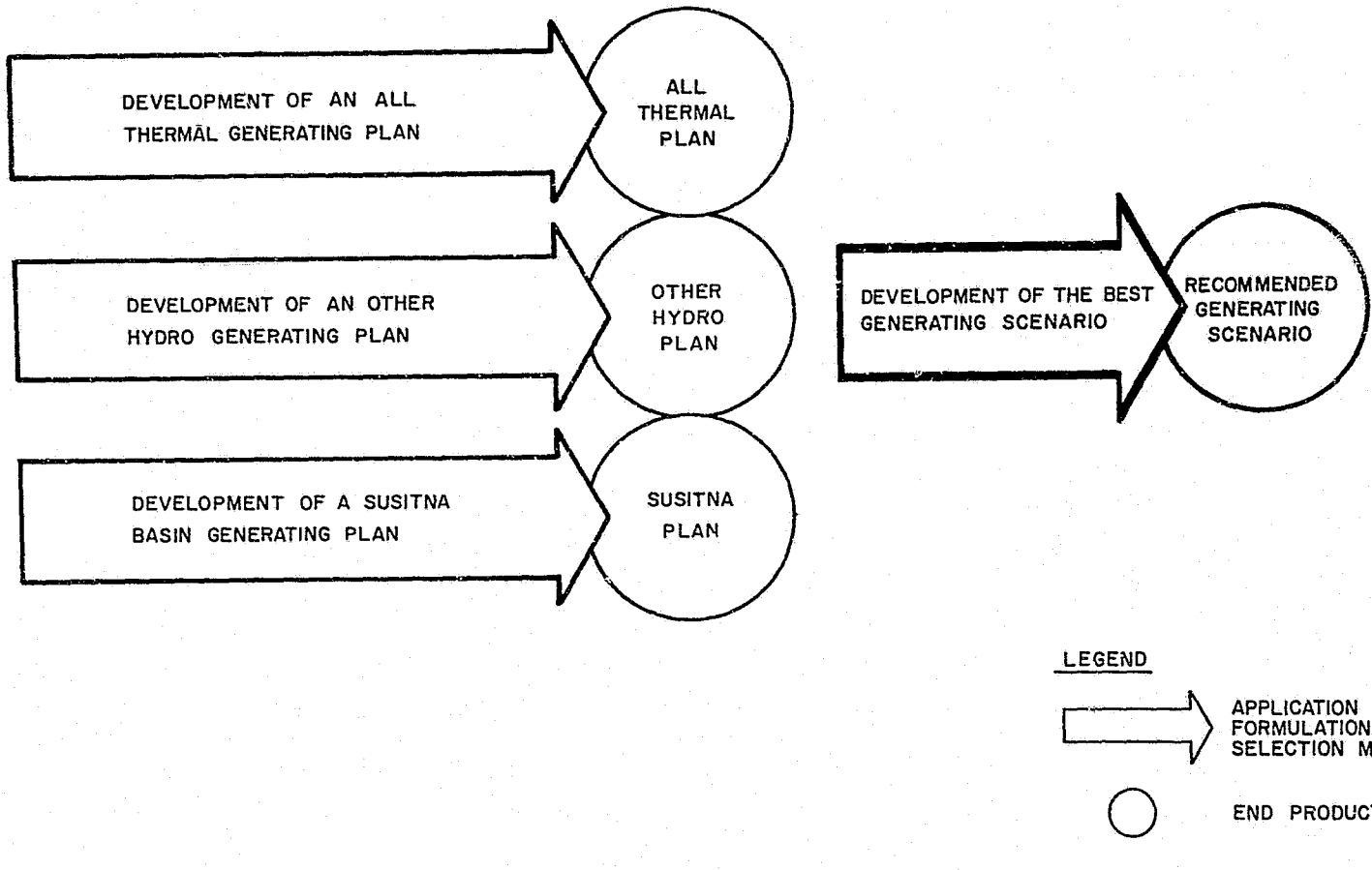


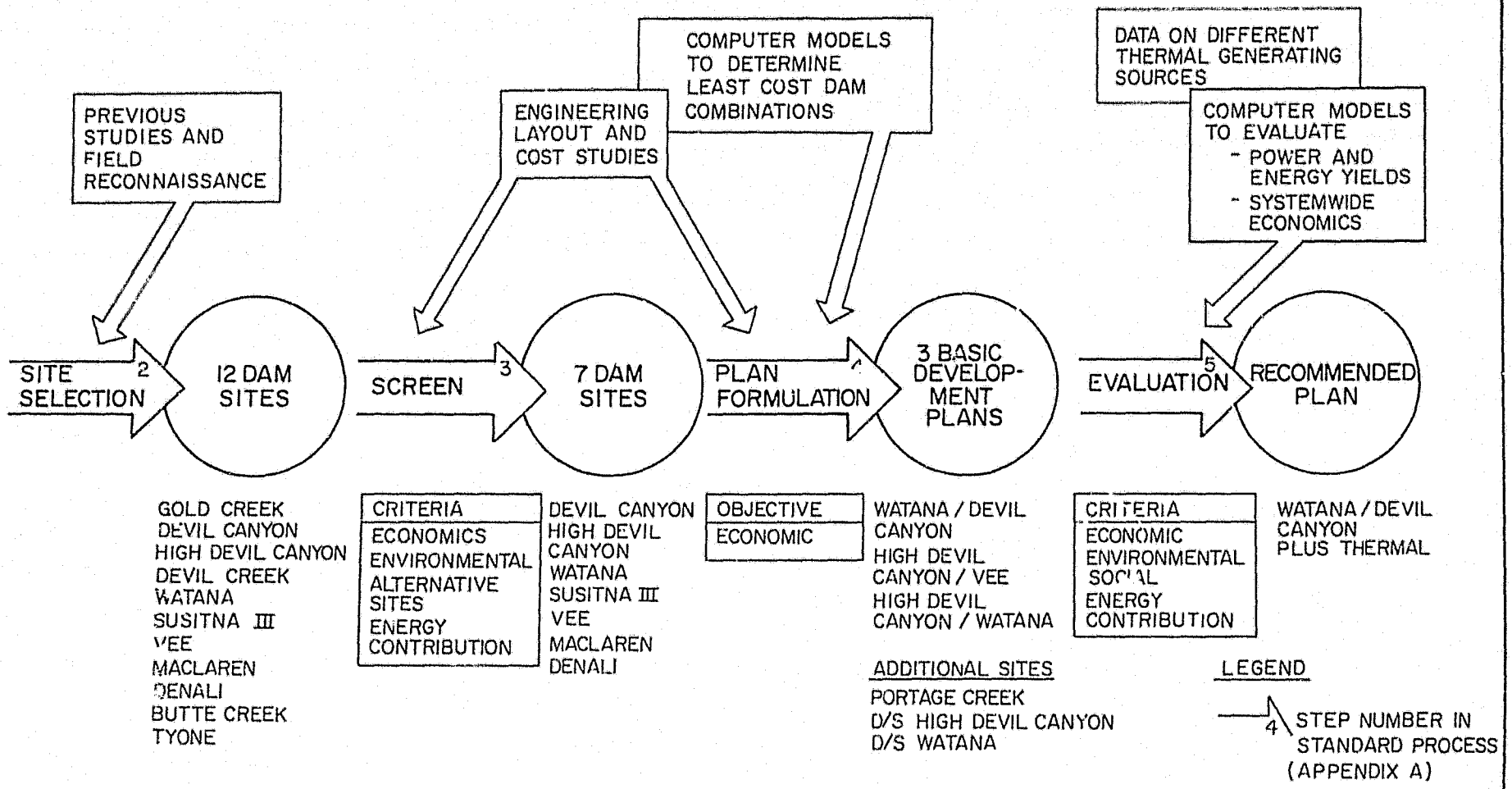
PLAN FORMULATION AND SELECTION METHODOLOGY

FIGURE 4



PLANNING APPROACH

FIGURE 5



SUSITNA BASIN PLAN FORMULATION AND SELECTION PROCESS

FIGURE 6

ACRES

WATER AND ENERGY:

Technical and Policy Issues

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Susitna Hydroelectric Project:
Public Participation Program

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Proposed Abstract
Susitna Public Participation Program

An integral part of a feasibility study presently being conducted by the Alaska Power Authority for a large (1,200-1,400 MW) hydroelectric project on the Susitna River is an extensive Public Participation Program. The program is considered a two-way communication process designed to strengthen the planning and decision-making, it is not a public relations program. As such it has three main objectives: (1) to distribute information to the public regarding decisions to be made; (2) to gather information from the public; and (3) to ensure that the information from the public is fully considered along with technical information in the planning process. The various approaches used in trying to meet these objectives and the adequacy with which the objectives were met is discussed.

The Alaskan setting presents a wide range of publics including special interest groups, potential users, local communities, taxpayers in general, political officials, and various political jurisdictions including native corporations unique to Alaska. Due to the attitude and geographical diversities within Alaska a variety of communication methods were used including public meetings/ workshops, personal interviews, mass media, and direct mail. The effectiveness of these methods as relates to the various publics is discussed. New techniques presently being considered are also presented.

Susitna Hydroelectric Project: Public Participation Program

The proposed Susitna hydroelectric project would be located in a remote, Alaskan wilderness area on the upper Susitna River between Anchorage and Fairbanks. The project calls for two large dams, 885-foot earth rockfill dam at Watana and a 645-foot concrete arch dam at Devil Canyon. It could provide for the electrical energy needs of the Anchorage to Fairbanks "railbelt" region through the year 2010.

Placing a hydroelectric power project on the pristine upper Susitna River could not be accomplished without producing changes. Whether these changes are perceived as positive economic growth, or feared as a threat to this wilderness area and to an "Alaskan lifestyle" will largely depend on the level of involvement the public sector has had in the feasibility study process, the openess and objectivity of information regarding the progress of the studies, and the degree to which the public was able to influence the outcome.

Too often the ability to imagine the perceptions of the people of the project area is a neglected aspect of planning. Very few of the people most often affected by a major project seem to know exactly what the project entails--generally because the engineers are dealing with a few "higher ups."

To bridge such a gap between the people and the planners, the Susitna hydroelectric project has made a point of including the human element at the grass roots level since the inception of the study. The concerns and the opinions of the public have been important factors in some of the decision-making process.

Goals of the Public Participation Program

The Public Participation Office of the Alaska Power Authority was set up as a major effort to encourage public participation during the feasibility study. Early on, a high level of conflict was expected. A general rule of thumb in the public participation business is: the higher level of conflict anticipated, the more time, energy and money needed to help resolve it. A sizeable budget ($408,000 over 2-1/2 years) reflected the Power Authority's desire for an aggressive program.

The program was unique in that it was a two-way communication process, not just an information distribution center, nor is it a public relations program to "sell" the project. Rather, it had three main goals: (1) to distribute accurate and objective information to the public regarding all aspects of the project--its problems, its opportunities, alternate choices, decisions to be made, etc., (2) to gather feedback from the public in reaction to the information they were given; and (3) to ensure that the opinions, values, and concerns of the public were fully considered along with technical information in the decision-making process.

To achieve these objectives, various approaches were used. The emphasis was on venturing beyond the traditional "public's right to know" to that of "participation." Before we discuss the methods of the program, it is perhaps necessary to state why so much care was taken on this aspect of the project.

One must understand that the prospects of long-term economic benefits and of reducing national dependence on non-renewable energy sources must be weighed against the implications of permanently altering an important ecosystem and of introducing social change in certain rural Alaskan communities, communities that value both the natural environment and a wilderness lifestyle. To a certain extent, these values are found throughout Alaska, including the more urban areas of Anchorage and Fairbanks. In conducting the Susitna hydroelectric studies, however, the Power Authority made extra efforts to identify the attitudes and preferences of the rural communities nearest the proposed project. This was because the Power Authority recognized the possibility that small communities close to the project could incur more of the costs (and fewer of the benefits) than the larger, more distant urban areas.

As to how the Public Participation Office (PPO) went about achieving these goals: they provided community meetings and workshops as well as continuing efforts to inform the public about the progress of the Susitna studies through a series of very readable, graphic, to-the-point newsletters. An "action system" was also established to give a timely response to comments and questions received through the mail.

COMMUNITY MEETINGS

The earliest series of COMMUNITY MEETINGS were held within four months of the start of the 30 month feasibility study. The purpose was to solicit comments on the adequacy of the Plan of Study and to suggest additional areas of concern that the Power Authority should examine.

In order to ensure public participation, the meetings were heavily advertised. Personal letters were sent to groups and organizations in various communities, including commercial fishing groups, sportsmens groups, conservation groups, general public interest groups, energy-related groups, business groups and mining groups.

Display ads were placed in community newspapers, paid radio ads and public service announcements were made, press releases announced that Plans of Study were available for review in local libraries; several newspapers wrote up stories on the project. Then at the meetings, cards were provided for people to write down questions they wished answered and comments on the adequacy of the Plan of Study.

In order for these meetings to fulfill the goal of considering public opinion in the decision-making process, all questions and comments were recorded. These were included in a readable summary report, "A Report on the First Series of Community Meetings on the Feasibility Studies for the Susitna Hydroelectric Project and Other Power Alternatives". This report was widely distributed to libraries, special interest groups, state and federal agencies, Acres American and its subcontractors. Public opinion and concerns played a role in several important changes that were made to the original Plan of Study (these are discussed later).

WORKSHOPS

Another technique used in this on-going public participation program was the WORKSHOP. In these smaller, informal groups, frequently composed of state and federal agencies and of special interest groups, particular aspects of the project were discussed in greater detail than what the general public was interested in. The Alaska Power Authority, Acres or other study investigators met with these concerned parties and covered such topics as: FERC licensing, proposed access routes and modes to the dam sites, proposed levels of recreation, potential impacts on the Cook Inlet commercial salmon industry, potential environmental, and social impacts associated with the project as a whole or various components of it.

A total of eight workshops were held during the first two years of the study. They were all advertised through very graphic display ads purchased in newspapers as well as through personal letters to groups and organizations. As of the writing of this paper, an additional two workshops are planned.

A rather unique aspect of the PPO is the ACTION SYSTEM. This is a system by which every question, concern or comment written is given careful consideration by the Power Authority and its study teams, and a personal written response sent to the author. It is designed to maximize public interest, incorporate suggested changes into the study process when appropriate, and monitor concerns raised by the public outside the format of the workshops and community meetings.

Over 225 individual questions and concerns have been expressed so far through the ACTION SYSTEM. For the most part, seven members of the Alaska Power Authority staff and three Acres coordinators have been involved and responsible for writing responses. An attempt is made to keep the replies freindly and non-bureaucratic. The most common questions and comments have concerned the study of alternatives to Susitna, environmental issues, the proposed access routes to the dam sites, and the desired level of recreation development.

NEWSLETTERS

One of the best information tools has been the NEWSLETTERS. Their purpose is to present objective information on the progress of the Susitna feasibility study so that the public could draw its own conclusions based on accurate information. They have covered a wide range of topics related to the Susitna development including building dams in seismic areas, economic concerns, concerns related to the potential for industrialization within the railbelt if Susitna were built and there were excess power, socio-economic and socio-cultural impacts, fish and wildlife impacts, basic project information, information related to the projected need for power and other alternatives being looked at in addition to Susitna.

A total of five newsletters has been produced. Each newsletter had a distribution to 30,000 citizens through direct mail (this is 3/4 the circulation of Alaska's largest newspaper).

MAILING LISTS

The development of extensive MAILING LISTS for newsletters, other announcements, and public information packets were an important part of the Public Participation Office's ability to reach people through direct mail. A special list of 46 groups and organizations (with over 225 individuals) was developed to reach a broad spectrum of special interest sectors. Included were: sportsmen, fishing, public interest, conservation, recreation, energy, business and mining. These groups were sent more detailed levels of information than what was generally available to the general public because they had a higher "need to know".

Another mailing list was computerized and had over 7,000 names. Methods used to compile this extensive mailing list included: inserts in 70,000 utility bills asking interested parties to place their name on the mailing list; coupons in local papers, the Action System; and names of persons attending workshops and community meetings. In addition, voter registration lists were used to distribute newsletters, as well as inserting the newsletters directly into some of the local community newspapers.

The effort to compile a thorough mailing list was critical to involving those who were most interested in following the progress of studies as well as to inform the general public.

MAJOR CHANGES THAT RESULTED FROM PUBLIC CONCERN

All of the above approaches by the PPO helped bring the pieces of public opinion together. The existence of the Public Participation program has at times made the difference between communities and special interest groups working with the Alaska Power Authority to control changes, or working against it in resisting changes.

The Public Participation program is designed to provide a means for the general public and special interest groups to express concerns and ask questions about the feasibility studies. Several components of the overall studies were changed due in part to input from the public. The major influence the public has had on changes in the studies resulted from the April 1980 meetings that were held to receive comments on the adequacy of the original Plan of Study. The Plan of Study was conceived as a dynamic document and it was anticipated from the beginning that changes could and would be made in response to public input.

The following summarizes these changes: the study of alternatives to Susitna was expanded (more money and more time) and an independent consultant was selected to concuct the study and assure objectivity; a socio-cultural study of people living in the immediate vicinity of the project was added to better understand and incorporate local community preferences regarding the future of their communities; additional studies were conducted to respond to a public perception that excessive power could be produced by Susitna that would encourage heavy industry (such as aluminum smelting) to locate in the railbelt region; more time and more data were collected prior to making a recommendation on access to the proposed dam sites; additional study was done to identify what level of construction facilities would best discourage large numbers of families

from moving to the small local communities and creating a boom bust situation for the small communities; and the level of recreation development recommended was moderated to a fairly low level of development.

EVALUATION OF THE PROGRAM

As of the writing of this paper, the 2-1/2 year study is culminating and the time for a decision on whether to proceed with a FERC license application will be made within three months. A final evaluation of the program will be made after the feasibility process ends but an interim evaluation made halfway through the study serves as an indication of the success of the program. All major special interest groups that were actively following the progress of the Susitna studies were called by phone and asked to evaluate the effectiveness of the Public Participation program. One pro-Susitna group (1,000 members), two conservation groups who have been aggressive in their tracking of the Susitna studies (combined memberships of about 1,000), and the eight railbelt utilities were all generally favorable and supportive to the public participation program.

SUMMARY

The Alaska Power Authority, by including the public in the total planning process, is an example of the public included in the decision making. Too often big projects become exclusively developed from above. The PPO was one way this project strived to keep the human element on par with the technical input--both necessary components of a true "impact" study.