A

STATE OF ALASKA

JAY S. HAMMOND, GOVERNOR

DEPARTMENT OF FISH AND GAME

OFFICE OF THE COMMISSIONER
SUBPORT BUILDING
JUNEAU 99801

December 21, 1977

Robert W. Ward
Chairman
Alaska Power Authority
6711 Foothill Drive
Anchorage, Alaska 99501

Dear Mr. Ward:

Re: Susitna River Hydropower Plan of Study

The Alaska Department of Fish and Game has reviewed the Corps of Engineers' Plan of Study (POS) for Phase I of the proposed Susitna Hydropower development. We appreciated the time extension granted our Department on these comments since the POS represents a focal point where our concerns for the proper environmental studies can be expressed.

Although the Corps' POS generally addresses broad concerns we feel it is not specific enough to arrive at answers that we believe are necessary to properly evaluate the project. Consequently it was decided that the Department would outline a complete Biological Study Plan for the Susitna Project (see attached) rather than comment point by point. Our rationale for this approach is based on the interpretation of updated information from Departmental baseline information developed on the Susitna Basin since 1974. The POS did not consider this new information and is therefore incomplete.

We have outlined tasks which in total will provide not only necessary biological baseline information, but will establish a base from which to develop a rational mitigation plan. Based on this approach, we are providing a description of the tasks, objectives, and scheduling information necessary for the timely completion of the evaluation. My staff believes quite strongly that a 5-year period is needed for an adequate biological study of the Susitna River Basin. The area encompassed is quite large and rather complex in its composition. The anadromous fish runs themselves pose special problems because different salmon stocks are spread over a 5-year cycle.

It was discovered early that the costs projected by the Corps were totally inadequate to evaluate properly what was outlined even in the POS itself. We believe from our extensive experience that we have excellent insight into what it actually costs to do business in the State. We have developed detailed cost estimates for each task described and these total $10.5 million for the 5-year period. At your convenience in the near future I would like to meet with you, discuss our approach, and justify the costs we foresee as necessary to carry out this project. If for some reason the time allotted must be less than 5 years, to some extent the estimated work could be accomplished perhaps in 3 years but only with much increased annual effort and costs.

I appreciate the opportunity afforded this Department by the Alaska Power Authority to review the Corps' POS. I hope further that a comparison of it with the ADF&G Study Plan will provide a constructive view of the fish and wildlife assessment needs for the Susitna Hydropower Project.

Sincerely,

Ronald O. Skoog
Commissioner

cc: Phil Hubbard, Commissioner - DCED, Juneau
Directors - ADF&G, Juneau
Richard Logan - Habitat Protection, ADF&G
Regional Supervisors - ADF&G, Anchorage

Attachment

BIOLOGICAL PLAN OF STUDY

FOR THE

SUSITNA HYDROPOWER FEASIBILITY ANALYSIS

Prepared By

ALASKA DEPARTMENT OF FISH AND GAME

December 15, 1977

BIOLOGICAL PLAN OF STUDY
FOR THE
SUSITNA HYDROPOWER FEASIBILITY ANALYSIS

Prepared by

Alaska Department of Fish and Game

1977

Introduction

The Susitna River drainage is located north of Cook Inlet and encompasses a total of 19,400 square miles. The free-flowing Susitna River is approximately 275 miles long from its source in the Alaska Mountain Range to its point of discharge into Cook Inlet. The mainstem Susitna River and its major tributaries originate in glaciers and carry a heavy silt load during the ice-free months. There are also many smaller tributaries which are perennially silt-free.

The U.S. Army Corps of Engineers is currently evaluating the Susitna River for hydroelectric power development. A two dam system (Watana and Devils Canyon dams) with transmission facilities to Anchorage and Fairbanks has been proposed. If the project is deemed feasible, the Watana dam will be the first project built. It will consist of an 810-foot high earth-fill structure located at river mile 165. The reservoir will extend 54 miles upstream and have a surface area of 43,000 acres. The Devils Canyon Dam will follow completion of Watana and will be a concrete thin-arch dam 635 feet high. This reservoir will inundate 7,550 acres and 28 miles of natural river. The transmission line will be approximately 400 miles in length and includes double towers and substations. Four corridor routes are under consideration. The access road to the proposed dam sites will be approximately 60 miles long. Construction pad sites will be located throughout the project area.

The two dams will inundate an estimated 50,550 acres of the Susitna River basin aquatic and terrestrial habitat upstream of Devils Canyon. Regulation of the mainstem river will substantially alter the natural flow regime downstream. The transmission line corridor, substations, road corridor, and construction pad sites may also impact aquatic and terrestrial communities and their habitat. Historically, the long and short-term environmental impacts of hydroelectric dams have adversely altered the extremely delicate balance of ecosystems.

Background knowledge of the Susitna River basin is limited. The proposed hydroelectric development necessitates gaining a thorough knowledge of its natural characteristics and populations prior to final dam design approval and construction authorization in order to protect the aquatic and terrestrial populations from unnecessary losses. All engineering, hydrological, biological, and other Project Feasibility Study activities conducted by the various governmental and private agencies will also have to be monitored and regulated to prevent ecological disturbances.

The complex relationships within the aquatic and terrestrial communities and between their habitat must be defined. Adverse impacts to populations will most likely result from loss or alteration of habitat. Where habitat will be totally lost to a population through destruction, inundation, or blocking of migrations, it is necessary to know the importance of that particular habitat to the population and the availability of alternative habitats. Where habitat will be merely altered, it is necessary to know what elements within that habitat are important to the population and what changes will occur in those elements.

The effects of impoundments and construction activities which alter natural flow regimes, water chemistry, mass transport of materials, and quantity of wetted habitat areas are of primary concern. These changes may disrupt the trophic structure and habitat composition and reduce or eliminate terrestrial and aquatic populations. These populations and vegetation in and around the free-flowing rivers have evolved to their current levels due to flow variations. Some species may be present only because this particular hydrologic regime exists. Direct studies of aquatic and terrestrial species can delineate a population and indicate their distribution throughout the year and to a certain extent define why species are there. Seasonal life history studies must be accompanied by habitat studies if we are to determine the full significance of habitat alteration to the population.

Five species of Pacific salmon (chinook, coho, chum, pink, and sockeye) inhabit the Susitna River drainage during their freshwater life history stages. The majority of chinook, coho, chum, and pink salmon production in Cook Inlet occurs within this drainage. Grayling, rainbow trout, Dolly Varden, burbot, lake trout, and whitefish are some of the more common and important resident fish species.

The studies identified for the pre-authorization environmental assessment are necessary to predict the impacts of hydroelectric development on the ecosystem. The proposal is designed to assess the major components of the ecosystem in determining the effects of major dam construction. The objectives of the biological investigations are based upon the assumption that the Devils Canyon and Watana two dam plan will be selected. It must be realized that as the plan evolves and new information becomes available, the program must be flexible enough to permit adjustment in study direction. If other basin development schemes are proposed, study time and costs will have to be re-evaluated. Capital requirements for each year were based upon FY-78 dollars. Therefore, inflation will necessitate annual supplemental allocations which represent revised cost estimates. The proposals are closely integrated and demonstrate the need for continuity. The design, timing, manpower requirements, and funding levels of the individual projects have been coordinated.

A team of resource specialists representing various scientific disciplines will be required to carry out field investigations in habitat assessment. Adequate time will be required to organize study personnel and procure equipment prior to the first field season. An untimely delay could prevent the initiation of the field studies one year.

Introduction

The proposed Susitna River hydroelectric project will have various impacts on both the indigenous organisms and the natural conditions within the aquatic environment. The fish populations are the most obvious aspects of the aquatic community where impacts will be evident due to their economic and recreational importance to the people of Alaska and the nation. However, studies cannot be limited to the fishery resource alone due to the complex interrelationships between all biological components of, and within, the aquatic community and the associated habitat. The majority of the impacts on fish species will likely result from changes in the natural regimes of the river rather than direct impacts on the fish in the vicinity. Primary areas of concern are reduction of stream flow, increased turbidity levels during winter months, and thermal and chemical pollution. Alterations of the habitat may adversely affect the existing fish populations and render portions of the drainage either nonproductive or unavailable in future years.

Baseline fisheries inventories were conducted by the Alaska Department of Fish and Game in the upper Susitna River during the 1974-1977 field seasons. The Susitna Basin is the major coho, pink, chum, and chinook salmon production area within the Cook Inlet area. Although total escapement estimates have not been derived for this system, it is probably the second or third largest sockeye salmon production area within Cook Inlet. Grayling, rainbow trout, Dolly Varden, lake trout, whitefish, and burbot are among the important resident fish species present.

The interrelationships within the biological communities and between their habitats must be clearly defined to protect the aquatic ecosystem from losses incurred by hydroelectric development. The effects on the anadromous and resident fish populations are of primary concern to the Alaska Department of Fish and Game fisheries divisions. Aquatic studies will, therefore, concentrate on the seasonal life histories and critical habitat requirements of fish species present.

Seasonal fluctuations in the physiochemical composition of the aquatic habitat are apparently the major factors influencing distribution of fish within the upper drainage. Any alterations resulting from hydroelectric project activities which restrict or reduce quality or quantity of required habitat will also reduce fish populations and associated members of the aquatic community.

Each aquatic community is dependent upon various river mechanics to provide the necessary habitat for its existence. Depth, width, and velocity of the stream flow determine the quality and quantity of habitat available to aquatic organisms. High water discharge associated with spring and summer run-off results in important physical habitat alterations. Unregulated flowing waters dilute and transport natural and man-generated pollutants. A flushing or scouring action occurs during periods of high flows and removes deposited sediments and fines, resulting in an annual cleansing of the river bottom. This is an important factor in rivers like the Susitna which transport large amounts of glacial silt. Deposition of sediment without the annual scouring could change the overall productivity of the river, eventually suffocating some of the aquatic organisms.

Individual study proposals are designed to provide the necessary background information to enable proper evaluation of impacts. Six general objectives have been outlined:

1) Determine the relative abundance and distribution of anadromous fish populations within the drainage.

2) Determine the distribution and abundance of selected resident fish populations.

3) Determine the seasonal habitat requirements of anadromous and resident fish species during each stage of their life histories.

4) Determine the economic, recreational, social, and aesthetic values of the existing resident and anadromous fish stocks and habitat.

5) Determine the impact the Devils Canyon project will have on the aquatic ecosystems and any required mitigation prior to construction approval.

6) Determine a long term plan of study, if the project is authorized, to monitor the impacts during and after project completion.

Fisheries and physiochemical sampling techniques and equipment for large rivers similar to the Susitna are in the early stages of development. Research and development must accompany the study to modify equipment and techniques to the habitat conditions of the specific environment to be evaluated.

The large drainage areas encompassed by the project are divided and categorized by location and activity. The three major study areas are:

1) The Susitna River basin between Denali Highway and Cook Inlet.

2) The proposed transmission line corridor and construction road drainage areas.

3) The Cook Inlet estuarine area.

All proposed studies are interrelated and have been coordinated to produce specific results. The elimination of any segment of a project will require revision of study plans. Investigations have been arbitrarily divided into anadromous and resident species studies. To insure precise and adequate aquatic data are collected each study is limited to a specific geographic area. A sufficient number of personnel must therefore be distributed throughout the study areas to insure a cross-section of habitat conditions is examined and movements of fish populations are monitored.

Title: Impact of the Proposed Devils Canyon-Watana Hydropower Projects On Anadromous Fish Populations Within the Susitna River Drainage.

Objectives: Determine the abundance and distribution of anadromous fish populations.

Determine the seasonal freshwater habitat requirements of adult and juvenile salmon, including spawning, incubation, rearing, and migration.

Background: The salmon stocks of the Susitna River drainage are major contributors to the Cook Inlet area fishery. Determining total escapement into this system is greatly complicated by the glacial conditions of the major streams and the enormity of the area. Management of the northern Cook Inlet salmon stocks has been difficult due to the mixed stock commercial fishery in Cook Inlet and the lack of adequate tools to provide accurate in-season escapement estimates for the drainage.

The major hydroelectric project impacts on the anadromous fish species are expected to be due to changes in habitat. Alteration of the normal flow regimes and the physical and chemical water characteristics will probably be the most critical impacts. It is difficult at this time to determine the distance downstream from the proposed dams that changes will occur. Studies conducted by Townsend (1975) in the Peace River demonstrate that effects were observed 730 miles downstream from the Bennett Dam.

The Alaska Department of Fish and Game has conducted fisheries investigations in the area of proposed dam construction downstream since 1974. Emphasis has been on the inventory of adult and juvenile salmon stocks and habitat assessment. Current research investigations have concentrated on determining total escapement of salmon species into the Susitna drainage and intrasystem migrations of fry. Successful tag and recovery projects were operated in the lower river during 1975 and 1977 and the feasibility of sonar operation was tested in the mainstem Susitna River approximately 25 miles upstream from Cook Inlet during 1976.

Only through complete stock assessment will it be possible to determine what portion of the Susitna River anadromous fish runs will be affected by the project and determine the level of mitigative measures which will ultimately be required. It is essential to know what portion the affected stocks contribute to the total Susitna River salmon escapement in order to determine potential losses of fish populations and numbers. Economic values and relative importance can be determined after establishing this. Pink, chum, and chinook salmon are the dominant species utilizing the upper reaches of the drainage although sockeye and coho salmon are also observed.

Adults

Population estimates of salmon species utilizing the Susitna River above the Chulitna River confluence were estimated during the 1974, 1975, and 1977 field seasons based on tagging and subsequent recovery of fish. These studies indicate a portion of the salmon tagged are not destined to spawn above the tagging site, but rather below it. The importance and extent of this milling behavior in the upper river areas requires

definition. The alterations in flow and water quality in the mainstem river after project completion could significantly affect this behavior and consequently spawning success. Behavior modifications and disorientation of fish due to tagging and handling may have been a contributing factor.

Observations of spawning areas between the Chulitna and Susitna river confluence upstream to Portage Creek during fall surveys indicate that a reduction in flow to proposed post-construction levels would prevent access to many important spawning areas.

The degree of impact of reduced flows will be dependent on the total area affected. The distance affected downstream would depend partially on the contribution of the natural Susitna River flow regimes to that of each major tributary and the drainage as a whole.

Studies conducted during the late 1950's indicate that Cook Inlet salmon stocks are unable to ascend the Susitna River beyond Devils Canyon, the latter being a natural water velocity barrier to migration (U.S. Department of the Interior, 1957). Reports from local residents of salmon observations above Devils Canyon indicate that this should be investigated further.

Juveniles

Previous studies have defined important clearwater streams and spring fed sloughs within the Susitna River drainage which support juvenile anadromous fish species. Investigations have, however, concentrated primarily on summer rearing areas. Surveys indicate these populations are not static, but vary in abundance and distribution. Studies conducted during the winter of 1974-1975 revealed that juvenile anadromous species also utilize the mainstem Susitna River.

Data collected since 1974 provide only baseline information. Generalizations may be made, but sufficient information is not available to determine specific impacts of dam construction and operation on incubating and rearing anadromous species.

Adults

Procedures: Emphasis should be on determining total salmon escapement into the drainage, stock separation, and habitat evaluation. Types of sampling gear which can be utilized in the upper area of the river and catchability of adult salmon migrating upstream greatly affect the success of a tag and recovery program. Recent developments and improvements in sonar salmon counters are a viable option. A sonar counting system suitable for operation in the upper Susitna River would have to be designed and tested. Installation of weirs or counting towers to determine escapements would be feasible on most clearwater tributaries.

Commercial Fisheries Division will operate side-scanning sonar salmon counters in the lower Susitna River during 1978 as part of their ongoing studies. A salmon tag and recovery program to provide an alternate escapement estimate could be funded through Devils Canyon studies to provide additional data and supplement sonar escapement information. The duration of this project is dependent on correlation of population estimates and sonar counts. Data obtained from these studies would be correlated with population estimates in the upper Susitna River. Through these studies the importance of the Susitna River salmon stocks to the Cook Inlet area as a whole could be determined.

Evaluation of milling behavior of adult salmon in the upper Susitna River will require new sampling techniques. Obtaining escapement samples and marking them to determine migrational characteristics without causing some modification of normal behavior is difficult. Internal sonic transmitters may be utilized to evaluate this. The effectiveness of this type of tag in heavily silt laden waters would have to be tested. Recently developed stock separation techniques based on salmon scale characteristics may eventually enable researchers to assign unknown stocks to specific areas. This technique is still in the developmental research stage, but preliminary data indicate that samples obtained from Cook Inlet can be assigned to one of the three major salmon producing systems with $\pm$ 14 percent confidence. A large data base of scale characteristics from tributary systems would have to be established before analysis could be made.

Surveys and escapement sampling should be conducted in the proposed impoundment areas between the Denali Highway and Devils Canyon during periods of peak adult salmon abundance. Initial observations would be conducted by aerial surveys to document the presence or absence of adult salmon. Surveys would be done in conjunction with resident fish investigations. Data obtained would be utilized to determine necessary mitigation measures.

Water quality, quantity, and biological studies to predict the effects on spawning and migration habitat are described in the habitat study section.

Juveniles

Year-round studies are required to determine complete juvenile salmon distribution and habitat utilization data.

Surveys of all rearing areas defined in previous studies should be continued. The distribution, species composition, and growth characteristics of juvenile salmonids should be monitored. Additional sampling equipment should be employed to assure representative samples are being collected. These include seines, minnow traps, small fyke traps, and dip nets. Foregut sample analysis should be continued and related to invertebrate studies. Winter sampling should be initiated on selected sloughs and clearwater tributaries that support significant populations of rearing fish during the summer and are also accessible during the winter months. Physiochemical parameters of the aquatic habitat will be monitored during each survey.

The timing of migration of juvenile fish from sloughs and tributaries to the mainstem river and extent of mainstem utilization should be documented. Factors which trigger the outmigration will be determined through habitat monitoring. These will include water temperature, ice cover, relative water levels, dissolved oxygen, pH, and conductivity. Fish samples will be collected primarily by traps. Coded wire tags and/or pigment dye marking may be effective methods of determining intrasystem migrations after initial documentation of this phenomenon.

The quantity and quality of water within the mainstem Susitna River will be monitored year round. Data will be obtained from U.S.G.S. gauging stations and at additional sites by field crews monitoring fry distribution. (See Habitat Section).

Schedule: Following is a preliminary schedule of anadromous fish project activities. The initiation of some segments of the studies will be dependent on testing of sampling equipment and delivery time required for more complex equipment, i.e., sonar counters.

The fiscal years (FY) outlined encompass the period of July 1 through June 30.

FY-79

Determine total salmon escapement estimate for the Susitna River drainage.

Determine total escapement in selected streams in the upper drainage.

Monitor abundance, distribution, characteristics, and habitat requirements of adult and juvenile salmonids.

Monitor physical, chemical and hydrological parameters of the mainstem Susitna River, sloughs, and clearwater tributaries.

Evaluate the feasibility of operation of various types of sampling gear for use in the upper river areas.

Begin building data base for stock separation studies.

FY-80

Continue salmon escapement estimates.

Continue fry and habitat studies.

Evaluate milling behavior of adult salmon.

Continue water quantity and quality monitoring.

Continue impoundment surveys, if salmon are observed during FY-79.

Continue stock separation studies and begin detailed analysis.

FY 81 Continue all FY 80 studies and revise programs as necessary.

FY 82 Continue ongoing field projects (FY 81) and begin final analysis of projects.

FY 83 Continue field monitoring and prepare final report.

Cost:

FY 79	$909,800
FY 80	$592,700
FY 81	$592,700
FY 82	$592,700
FY 83	$592,700

Literature Cited:

Townsend, G.H. 1975. Impact of the Bennett Dam on the Peace-Athabasca Delta. J. Fish. Res. Board Can. Vol. 32 (1). pp. 171-176.

U. S. Dept. of the Interior. 1957. (Unpublished). Progress Report 1956 field investigation Devils Canyon Dam Site, Susitna River Basin. 15pp.

Title: Impact of the Susitna Hydroelectric Project on Resident Fish Species

Objectives: Determine species present and distribution.

Determine seasonal abundance of selected populations.

Determine seasonal habitat requirements necessary to sustain the species present.

Background: The Alaska Department of Fish and Game has conducted limited fisheries investigations in the Susitna River and its tributaries, both upstream and downstream of the proposed dam sites and in lakes near the impoundment area. The general distribution of resident species was monitored and basic seasonal life history and habitat observations were conducted during portions of the spring, summer, fall, and winter seasons. Some resident species make major migrations from lake and tributary systems into the mainstem Susitna for purposes of overwintering. The importance of this intrasystem migration and the role of the mainstem Susitna River is not understood at this time. Surveys conducted between 1974 and 1977 document that a high quality sport fishery is provided by the Susitna River, its tributaries, and nearby lakes.

Procedure: Seasonal life history, distribution, population abundance, and habitat requirement investigations of selected resident fish species will be continued and expanded. These studies will be closely coordinated with the anadromous fish studies. Special attention will be given to those areas important to resident fish which may not coincide with anadromous fish habitat. The study area for resident fish investigations may be considerably greater, extending along the Susitna River from the mouth of the Tyone River to Cook Inlet, including tributaries bisected by transmission and road corridors.

Of particular importance in this study will be the determination of winter distribution, migrational and habitat requirements within areas subject to project impact. Studies will be made of the tributaries where resident fish predominately spawn and reside during the summer months, and the mainstem Susitna River where many of these same fish may winter. Emphasis will also be given to streams impacted by inundation. Human utilization of resident species will also be determined.

This study will be conducted in two parts, with results of the first two years of effort being compiled and analyzed for use in related studies and as a basis for determining areas where efforts should be concentrated during the remaining years of the study.

Due to difficulty in capturing fish from the Susitna River through the winter ice cover, high velocities and turbid water conditions in the summer, considerable equipment and sampling technique adaptations will be necessary. Boom and backpack electrofishing, side scanning sonar, sonar, angling, radio tags, anchor tags, coded wire tags, fyke nets, seines, gill nets, fixed traps, fish wheels, weirs, and ground surveys will be among the techniques to be employed.

Those elements of the physiochemical and trophic makeup of the existing natural habitat which will be analyzed are discussed under the Habitat Studies Section.

Schedule:

FY 79 Organize Susitna River Basin study team and coordinate work schedule with other study teams where necessary.

Establish base camps and begin fisheries inventory, seasonal life history, and associated habitat investigations.

FY 80 Continue field activities and relocate various personnel dictated by data which are generated. Areas of investigation include impoundment, transmission and road corridors, and downstream of Devils Canyon to Cook Inlet.

FY 81 Continue field activities and relocate various personnel as dictated by data which are generated.

FY 82 Continue field activities and relocate various personnel as dictated by data which are generated.

Initiate report writing process.

FY 83 Continue field activities and relocate various personnel as dictated by data which are generated, and integrate and summarize all data collected into final report.

Cost:

FY 79	$462,900
FY 80	$416,600
FY 81	$416,600
FY 82	$416,600
FY 83	$416,600

Title: Investigations of the Cook Inlet Estuarine Area and Potential Effects of Hydroelectric Development.

Objectives: Identify the fisheries resources of the lower Susitna River and the Cook Inlet estuary.

Determine the existing water quality and biological productivity of the lower Susitna River and the Cook Inlet estuary.

Determine the contribution and importance of the Susitna River to the Cook Inlet estuary.

Background: Cook Inlet is approximately 170 miles long and 60 miles wide at its mouth, with a total volume of 1.7×10^{13} feet^3. It can be divided into two natural regions, a northern and southern portion, by a natural topographic feature, the East and West Forelands. The Susitna River and the major streams and rivers entering Knik Arm represent about 70-80 percent of the total freshwater entering the Inlet (Rosenberg, 1967).

Estuaries generally have exceptional usefulness in support of fisheries as rearing areas. It is generally a high food production area for primary consumers such as clams and other filter feeding organisms and the secondary and tertiary level consumers, including finfish and shellfish species. Migratory fishes such as salmon must pass through the estuarine area to reach their spawning grounds.

The estuary is, in many ways, the most complicated and variable of the aquatic ecosystems. Current and salinity shape the life of the estuary where the environment is neither fresh nor salt water. Estuarine currents result from the interaction of one-direction flow which varies with seasonal run-off, oscillating tides and the winds. The unique assemblages of organisms utilizing the estuarine habitat have evolved to survive these rigorous conditions.

Oceanographic data from the Cook Inlet estuarine area is limited. The extent to which juvenile and adult salmon species utilize this estuarine area is unknown. If natural flow regimes and water quality are altered by the hydroelectric project, adverse effects would possibly be observed within the Inlet. Baseline studies to determine existing physiochemical habitat conditions and biological productivity should be conducted. Parameters which need to be evaluated include: temperature, salinity, pH, nutrients, sedimentation processes, water stage and velocity, and biological activities.

Investigations of estuarine areas are more difficult than for river systems and will require elaborate equipment and use of large vessels.

Procedures: Baseline aquatic biology, and habitat studies and a thorough investigation of existing data available on the Cook Inlet area will be conducted prior to initiation of any comprehensive field investigations. This environmental data will provide an adequate data base for determining the direction and level of future field studies necessary to project the effects of the hydroelectric project on the estuarine ecosystem.

Schedule:

FY 79 Conduct field research and analyze the data collected.

Review and evaluate existing environmental data of the Cook Inlet area.

Develop comprehensive study plan.

FY 80 Activities will depend on FY 79 findings. Ongoing monitoring and previous studies may provide sufficient data. If not, additional field investigations will have to be initiated.

Cost:

FY 79 $75,000

FY 80-83 Open. Will depend on FY 79 results. Overall allocation may have to be amended.

Literature Cited:

Rosenberg, D.H., S.C. Burrell, K.V. Matarajan, and D.W. Hook, 1967. Oceanography of Cook Inlet with special reference to the effluent from the Collier Carbon and Chemical Plant. Institute of Marine Science, University of Alaska. Report No. R67-5. 80 pp.

Title: Susitna River Basin Habitat Investigations

Objectives: Identify seasonal habitat characteristics associated with the Susitna River Basin anadromous and resident fisheries.

Define the complex interrelationships between the various components of the habitat.

Determine which habitat components are critical to the sustenance of the existing fisheries, and why.

Background: Maintenance of anadromous and resident fish populations within the Susitna River Basin will require a thorough understanding of their life sustaining habitat. Impacts by the hydroelectric project which alter or reduce the quantity or quality of the critical spawning, incubation, rearing, and migration habitat of these species will reduce or eliminate their populations. Major changes may take place in the biotic community with only a subtle change in the habitat.

Baseline physiochemical and biological aquatic habitat data were collected between 1974 and 1977 by the Alaska Department of Fish and Game at selected sites within the Susitna River drainage. The United States Geological Survey and other agencies have also monitored physiochemical parameters of the drainage.

Literature on the physiochemical and biological composition of aquatic habitat in lotic and lentic environments and its relationships to aquatic communities is also available.

Procedure: Personnel conducting seasonal fisheries life history investigations within the Susitna River Basin will concurrently collect the majority of the associated physiochemical field habitat data. In situ water velocity, width, depth, gradient, temperature, conductivity, pH and dissolved oxygen measurements will be collected with sophisticated electronic and mechanical instrumentation. Water samples will also be collected for laboratory analyses of basic metals, dissolved solids, total suspended solids, alkalinity, hardness, pH, conductivity, and total recoverable solids. Additional investigations by fisheries personnel will include water surface and sedimentation profiles. The U.S.G.S. will be contracted to install stream gauging stations at selected sites.

Biological habitat investigations will include primary productivity, benthos species composition and diversity, forage fish, pathological, and bioassay studies. Benthos, forage fish and fish pathology investigations will be integrated with fisheries life history studies. The remaining three will be conducted as individual studies.

To define the complex interrelationships of the dynamic habitat conditions of the Susitna River Basin it will be necessary to collect data over an extended period of time. Because of the precise measurements required, equipment for this investigation will be costly.

Schedule:

FY 79	Organize field staff and procure equipment. Establish field camps, install equipment, and initiate field and office research.
FY 80	Continue field and office research.
FY 81	Continue field and office research.
FY 82	Continue field and office research.
FY 83	Continue field and office studies, analyze data, and write report.

Cost: Personnel and their associated expenses are included in the fisheries investigations.

FY 79	$191,000
FY 80	$149,000
FY 81	$149,000
FY 82	$149,000
FY 83	$149,000

Title: Transmission Corridors, Access Road Corridor, and Construction Pad Sites Fisheries Investigations

Objectives: Identify all fishery resources within the four proposed transmission corridors, the access road corridor, and the construction pad sites.

Identify species present in these waters and determine seasonal presence.

Identify the habitat associated with these species.

Background: Four transmission corridor routes, one access road corridor, gravel and fill sites, and numerous building site pads are under consideration. The corridors will provide human access to previously inaccessible areas. This access will concentrate sportsman efforts in certain areas which may result in adverse impacts to aquatic life. Uncontrolled removal of gravel and fill for construction activities will also adversely affect the aquatic habitat. No hydroelectric related fishery investigations of these areas have been conducted. Other sources of fisheries data in these drainages are insufficient.

Procedures: Fishery resources, their seasonal presence and associated habitat will be identified within these areas. Ground surveys, fish trapping, fish marking, benthic species collection and physiochemical water quality measurement techniques will be conducted. Backpack electrofishing, nets, traps, anchor and radio tags, electrophoresis instrumentation, weirs, benthic samplers, sophisticated water quality measurement devices, water quantity measurement equipment, and survey equipment are among the equipment which will be utilized.

Schedule:

FY 79 Organize corridor and building site study teams, procure equipment, and coordinate schedules with other study teams where necessary.

Establish base camps and initiate fisheries resource identification, species identification, and seasonal presence and habitat investigations.

FY 80 Continue field activities.

FY 81 Continue field activities and relocate various personnel as dictated by data and overall study findings.

FY 82 Continue field activities and relocate various personnel as dictated by data and overall study findings.

FY 83 Conduct concentrated studies if necessary and integrate and summarize all data collected.

Cost:

FY 79	$130,500
FY 80	$125,500
FY 81	$125,500
FY 82	$125,500
FY 83	$125,500

Title: Existing Economic, Recreational, Social and Aesthetic Evaluations of the Susitna River.

Objectives: Determine the economic values of the aquatic and terrestrial ecosystems.

Determine the recreational values of the aquatic and terrestrial ecosystems.

Determine the social values of the aquatic and terrestrial ecosystems.

Determine the aesthetic values of the aquatic and terrestrial ecosystems.

Background: Economic, recreational, social, and aesthetic values of the project drainages must be determined in order to project whether the project will enhance or diminish these values. The close proximity of municipalities containing half the human population of Alaska emphasizes the need to assess these values. The Susitna drainage is highly used and important to the sport and commercial fisherman, the recreational enthusiast, industry, and municipalities. The popularity of Denali State Park and nearby Mt. McKinley National Park further attests to the high social, recreational, and aesthetic qualities of the area. Specific data on these subjects in the hydroelectric project area watersheds are incomplete or lacking.

Procedure: The four objectives will be accomplished through statistical surveys and analyses. Some of the methods employed will be literature searches, mail surveys, creel surveys, personal interviews, and fish tag return data.

Schedule:

FY 79	Organize personnel, procure equipment, and begin literature searches, and develop survey approaches.
FY 80	Continue literature searches, analyze data, and begin surveys.
FY 81	Continue literature searches, analyze data, and continue surveys.
FY 82	Continue literature searches, analyze data, and continue surveys.
FY 83	Continue data collection and analyses and write report.

Cost:

FY 79	$200,000
FY 80	$200,000
FY 81	$100,000
FY 82	$100,000
FY 83	$100,000

Title: Predict Project Impacts

Objectives: Determine the direct, indirect, and magnitude of effects the Devils Canyon/Watana project will have on the Susitna River Basin fisheries and other drainages prior to construction approval.

Background: Susitna River Basin investigations to date have not generated sufficient data to predict the impacts of this project on the aquatic ecosystem. Scientific literature is available on the ecological effects of hydroelectric dams which have been constructed in other areas.

Procedure: This study culminates all previously outlined studies. An evaluation of data obtained from the proposed fisheries related biological, habitat, socio-economic, and recreational studies will be combined with other engineering and design studies. A predictive model of the aquatic ecosystem with and without the hydroelectric project will be constructed. Concerns will not be limited to fisheries; secondary effects and how humans will be affected will also be addressed. Information required in this analysis includes seasonal life history habitat requirements of the existing aquatic community, a thorough understanding of the interrelationships between physical, chemical, and biological components of the habitat, and recreational and socio-economic values. Project engineering and design models will also be required, especially those concerned with sedimentation, temperature, dissolved gasses, discharge, and other related physiochemical characteristics.

Literature searches and various project data will be continually analyzed to insure all sources of pertinent data are included.

Schedule:

FY 79	Literature research
FY 80	Literature research, analyze data
FY 81	Literature research, analyze data
FY 82	Literature research, analyze data
FY 83	Literature research, analyze data, predict impacts

Cost:

FY 79	$ 5,000
FY 80	$ 5,000
FY 81	$20,000
FY 82	$60,000
FY 83	$60,000

Title: Mitigative Measures for Lost Aquatic Habitat

Objective: To identify and evaluate the Devils Canyon/Watana Dam project fisheries mitigation requirements and implementation costs prior to construction approval.

Background: Critical habitat for various life history stages of aquatic species could be eliminated or reduced in quality and quantity by the Susitna hydropower project. For example, regulation will result in decreased flows downstream of the dams during the summer months which could eliminate critical rearing areas for salmonid fry. The proposed aquatic and related habitat studies should quantify the losses and resulting impact on the fisheries. This activity is designed to provide information to assess the feasibility of mitigation and to indicate long term studies which would direct actual mitigation efforts. Evaluation of these studies will go beyond phase I if the project is deemed feasible.

Procedure: Analyze all project data collected which relate to the fisheries and aquatic habitat of the Susitna River Basin and other impacted drainages. Conduct special studies where necessary and analyze. Conduct literature research to obtain aquatic impact data relating to existing and proposed hydroelectric projects.

Conduct preliminary site surveys which include reconnaissance and topographic analysis. Detailed site surveys and analysis will begin in the last two years of this study.

Schedule:

FY 79	Preliminary site surveys. Reconnaissance and topographic analysis Conduct literature research and review.
FY 80	Continue preliminary site surveys. Analyze data and identify potential areas for mitigation. Continue literature search and review. Report on findings.
FY 81	Detailed site surveys. Analyze surveys. Continue literature search and review.
FY 82	Continue literature search and review.
FY 83	Continue detailed site surveys and literature search and review. Report on findings.

Cost:

FY 79	$26,000
FY 80	$10,000
FY 81*	$60,000
FY 82	$50,000
FY 83	$60,000

*Assumes $10,000 per site survey.

Title: Plan of Study During and After Completion

Objective: Develop a plan of study to monitor the effects of the project to the aquatic ecosystems during and after completion.

Procedure: This ongoing activity will be dependent on the feasibility results. The data generated from all of the pre-authorization studies will provide the ground work for this plan. Flexibility must be built into this plan until the results of the biological and detailed feasibility studies are available.

Schedule: Complete plan within an additional 14 months after completion of the detailed feasibility studies.

Cost: $50,000

Introduction

The proposed Susitna Hydropower Project will have impacts on several wildlife species which either reside in the project area, use the area for migration or other seasonal purposes or use habitat downstream which will be altered by the stabilization of water flow. The following individual proposals comprise an integrated program to provide information needed to predict the impacts of the Project on wildlife and to provide a basis for making decisions which might minimize those impacts.

This program will not answer all questions. It is designed to provide an acceptable basis of knowledge in a limited time period using presently available techniques. Emphasis has been placed on species which are likely to be most adversely affected by the project and are of greatest interest to man.

The design, timing, manpower requirements and funding levels of the individual projects have been coordinated for efficiency. No single project can be conducted by itself without considerable change in design and increase in cost. For example the moose study is the core of the entire package. The wolf, wolverine, bear and caribou studies are dependent on the moose study for manpower equipment and logistic support. The moose, habitat mapping and vegetation studies are also dependent on each other as each will influence the design of the others and their results must be compatible for final data analysis. If one project does not produce results at the proper time other projects will be delayed, reducing the quality of information and increasing the overall cost of the program.

Title: Habitat Mapping and Vegetation Studies Required for Analysis of the Effects of the Susitna Hydropower Project on Wildlife.

Objectives: To prepare a vegetative type map of areas within and adjacent to proposed impoundments, along transmission corridors and along the downstream floodplain.

To identify key moose browse species and determine the condition and trends of selected moose habitats.

To determine the effects of altered water flow on key plant species and map areas where substantial vegetation changes will occur.

Background: Most impacts of the Susitna Hydropower Project on wildlife will occur through loss or alteration of habitat. Where habitat is totally lost to a population through inundation or blocking of migrations it is necessary to know the importance of that particular habitat to the population and the availability of alternative habitats. Where habitat will be merely altered, it is also necessary to know what elements within that habitat are important to the population and what changes will occur in those elements. Direct studies of wildlife species can

delineate a population and tell us where various components of the population are at different times and to a certain extent why they are there. However, wildlife studies must be accompanied by habitat studies if we are to determine the full significance of habitat alteration to the population.

This project is not an actual proposal. Several of the studies outlined here could be expanded to meet the needs of other disciplines. Therefore, this is a statement of information needed to evaluate the effects of the Susitna Project on wildlife. Actual study proposals should be developed to provide this information on the schedule outlined.

Procedures: A habitat type map of the proposed impoundment areas, all drainages flowing into the impoundments, access and transmission corridors and the downstream floodplain should be prepared during the first two years of the study. This map should be of sufficient detail to permit delineation of specific habitats favored by moose and must be accompanied by sufficient ground truth data to identify the distribution and abundance of moose browse species. In order to accomplish this it is essenital that the principal investigators of moose studies work directly with the habitat mappers.

Studies of the effects of water table and influence of water level fluctuations on vegetation, particularly moose browse species, along the floodplain of the Susitna River should be initiated immediately. A map of areas where changes in flow caused by the dams will alter the vegetation, either through changes in soil moisture or by allowing plant succession to occur, should be prepared. Emphasis should be placed on areas of high moose use such as the lower Susitna River.

Detailed studies of vegetation in important moose wintering areas should be conducted to identify plant species used by moose and quantify their presence, use and trends. Study areas would be identified from data collected under the moose studies.

Schedule:

FY 78	Habitat mapping, effects of water level studies
FY 79	Habitat mapping, effects of water level studies
FY 80	Map areas of expected plant composition changes. Detailed vegetation studies on moose winter range
FY 81	Moose winter range studies
FY 82	Moose winter range studies

Title: Impact of the Susitna Hydropower Project on Moose Populations

Objectives: To identify moose subpopulations using habitat subject to direct and indirect impact of the Susitna Hydropower Project.

To determine the seasonal distribution, movement patterns, size and trends of those subpopulations.

To determine the timing and degree of dependency of those subpopulations on habitat to be impacted by the Susitna Hydropower Project.

Background: Several subpopulations of moose occupy habitats that may be inundated or substantially altered by the proposed Susitna Hydropower Project. Limited studies conducted in 1977 identified one subpopulation which occupied the upper ends of tributaries north of the proposed impoundment areas during spring, summer and fall, then migrated to the Susitna River bottomlands during winter. Similar populations almost certainly occupy drainages to the south of the impoundments. There is also strong evidence that riparian habitat along the mainstem, which may be significantly altered by the stabilization of water flow, also serves as winter range for several subpopulations of moose. These habitats may be critical to these populations in severe winters. Other subpopulations may be nonmigratory and use areas to be affected all year. Some migratory populations may not rely on the river bottoms for seasonal range but may migrate through them on their way between seasonal ranges.

The degree of impact will vary depending on the subpopulations size, status and degree of dependence on altered habitat and the nature of the habitat alteration. Many factors must be considered including: the sex and age composition of members of the subpopulation using the habitat (often pregnant cows or cows with calves are more dependent on lowland areas than bulls), the overall range of the subpopulation (some members of a nearby subpopulation migrate up to 60 miles indicating that reductions in moose densities could occur over a vast area), the availability of alternative ranges particularly during severe winters (habitat alterations which may be relatively insignificant in normal or mild winters may be devastating when heavy snowfall makes alternative ranges unavailable), etc.

An adequate assessment of the potential impacts of the Susitna Project on moose requires a thorough understanding of moose populations using the area. This information must then be related to a knowledge of the habitat and the elements within that habitat that are necessary for moose. This study is designed to provide the necessary information on moose. It is essential that certain habitat studies be conducted concurrently. A habitat map of sufficient detail to delineate types selected by moose, covering the impoundment area, surrounding drainages, transmission corridors and the floodplain of the Susitna River to its mouth, should be prepared at an early stage of the studies. Detailed browse studies should be conducted at sites selected on the basis of use by moose to identify important browse species, measure the degree of use and identify other elements of the habitats that are important to moose. The role of

the water table and spring flooding in maintaining moose habitat below Devils Canyon should be determined and maps delineating areas where the alteration of the flow will result in vegetation changes should be prepared.

This moose study and the habitat studies outlined above should be closely coordinated as each will influence the final design of the other and all are necessary to relate habitat changes to moose.

Procedures: During 1977, 12 moose were radio collared and 14 others were collared with visually identifiable collars. These moose were tracked from March to December 1977. Under this study, tracking of those moose will be continued, to further delineate the ranges of that subpopulation.

Additional moose will be radio collared in drainages along the south side of the proposed impoundment area and in riparian habitats along the mainstem below Devils Canyon.

Each radio collared moose will be relocated regularly. For each relocation the exact location, habitat type, activity of the moose and association with other animals will be recorded.

A random stratified census and seasonal sex and age composition counts will be conducted on subpopulations most likely to be affected by the Susitna Hydropower Project. Concentrations of moose will be mapped throughout the area whenever the opportunity arises.

These data will be used to identify subpopulations using areas to be impacted, to determine the seasonal ranges and migration routes of each subpopulation and to estimate the size and composition of those subpopulations most likely to be impacted. Locations of moose will be overlayed on habitat maps to determine the degree of use of certain habitat types as well as specific habitats. This information will be analyzed by subpopulation, season, sex and age class and reproductive status. Areas likely to be altered by the project that are critical to a subpopulation will be identified and recommended for more detailed vegetation studies.

Schedule:

FY 78	Radio collar moose, tracking flights, composition counts
FY 79	Tracking flights, composition counts, random stratified count. Review habitat map and map of downstream areas to be impacted and identify data gaps. Identify areas for detailed vegetation studies.
FY 80	Replace radios and radio collar new moose to fill identified data gaps, tracking flights, composition counts.
FY 81	Tracking flights, composition counts, random stratified counts.
FY 82	Tracking flights, composition count, start final analysis of data.

FY 83 Tracking flights, complete analysis of impact of Susitna Hydropower Project on moose, write final report.

Cost:

FY 78	$220,000
FY 79	$210,000
FY 80	$180,000
FY 81	$210,000
FY 82	$175,000
FY 83	$ 85,000

Title: Mitigation Measures for Lost Moose Habitat.

Objectives: To identify and evaluate measures for enhancing moose habitat.

To locate areas where moose habitat enhancement would effectively mitigate loss or deterioration of moose habitat resulting from the Susitna Hydropower Project.

Background: Important and perhaps critical moose habitat will be totally lost or reduced in quality by the Susitna Hydropower Project. The proposed moose and habitat studies should quantify this loss and its resulting impact on moose populations.

Moose tend to favor subclimax ranges. In recent years several agencies have recognized a potential for enhancing habitat for moose by setting back plant succession through artificial means. The Alaska Department of Fish and Game, U.S. Fish and Wildlife Service and U.S. Forest Service have all experimented with such techniques as mechanical crushing, prescribed burning and fertilizing. At present these techniques have not been fully evaluated.

Such techniques are probably effective only in certain types of habitats. In some cases it might be possible to fully mitigate the impact on a particular subpopulation of moose. For example, if an effective technique can be found to maintain willow habitats on river bars without periodic flooding, impacts on subpopulations dependent on downstream habitat might be kept to a minimum.

In other cases where critical habitat will be completely destroyed it might be possible to make alternative habitat available to the affected subpopulation of moose. However, there will likely be some subpopulations for which mitigation measures will not be possible. In these cases the loss to human users could be offset by enhancing the range of populations of moose away from the Project area.

In order to assess these possibilities it is necessary to evaluate the various techniques and to delineate habitat where these techniques would have a positive effect on moose.

This project is designed to provide information to assess the feasibility of mitigation and to initiate long term studies which would direct actual mitigation efforts. Evaluation of these long term studies will take many years. The need to complete the long term studies will depend on the results of the feasibility study.

Procedures: A complete review of potential moose habitat manipulation techniques will be made. Areas which have been experimentally manipulated in the past will be visited and the quantity and quality of potential moose browse produced will be assessed. Information gaps will be identified and if necessary further experimental manipulation will be recommended.

Data from the habitat mapping, vegetation and moose studies will be used to identify areas where habitat manipulation might offset adverse impacts on each of the subpopulations of moose that are identified.

Schedule:

FY 79	Preliminary review of techniques and identification of areas of past experimentation.
FY 80	Evaluation of success of previous manipulation efforts. Identification of data gaps. Recommendations on future experimentation.
FY 81	Continue evaluation of manipulated areas. Initiate manipulation experiments to fill data gaps.
FY 82	Evaluate techniques. Identify potential areas for mitigation.
FY 83	Evaluate techniques. Identify potential areas for mitigation.

Cost:

FY 79	$ 5,000	
FY 80	$ 20,000	
FY 81	$275,000	(actual cost will depend on results of FY 79 and 80 studies)
FY 82	$ 20,000	
FY 83	$ 20,000	

Title: Impact of the Susitna Hydropower Project on Caribou Populations.

Objectives: To identify subpopulations of caribou in the Nelchina Basin.

To determine the seasonal ranges and migration routes of these subpopulations with emphasis on traditional migration routes across proposed impoundment areas and potential alternative routes.

To determine the availability of suitable alternative seasonal ranges to caribou subpopulations that might be isolated from traditional ranges by the proposed impoundments.

Background: The Nelchina basin has been the most important sport hunting area for caribou in Alaska. Although caribou numbers were reduced from a recorded high of 72,000 to a low of 10,000 the population is presently increasing and is now estimated to exceed 14,000 cariobu. Proposed management plans state that the population will be allowed to increase until it numbers 20,000 caribou.

Caribou traditionally have used a variety of ranges on both sides of the Susitna River and varying numbers have crossed the Susitna at least twice a year. Major crossing locations have been recorded in areas which would be affected by the proposed hydropower project. Because caribou frequently migrate long distances and may periodically overgraze one range and shift to another, it is necessary to examine the status of caribou and identify alternative ranges over a large area.

Range studies conducted by the Alaska Department of Fish and Game have shown that the most desirable winter ranges remaining in the Nelchina basin are located in the Clearwater Mountains, Chunilna Hills, Susitna Uplands and Monahan Flats. Most of these ranges are north of the Susitna River while historical and recent calving and summer ranges exist south of the river. The preferred lichens south of the river have generally declined and have not shown substantial recovery even with lowered caribou populations. Meanwhile, the Nelchina population has used this area to a greater extent than the other portions of its range. A portion of the winter range exists east of the Richardson Highway in the Wrangell Mountains but movement into this range may be affected by the recent construction of the oil pipeline from Prudhoe Bay to Valdez. All of these factors make it likely that the ability to cross the Susitna will remain critical to the well being of the Nelchina caribou herd.

To determine the extent that the impoundments will affect this movement is difficult. Other migration routes may be used in addition to those already shown in the literature or sufficient range may be available to the east to support the proposed population level. It is also possible that a separate but smaller population exists north of the Susitna which may increase to fill the available range in that area even if the existing Nelchina population were confined to the area south of the proposed impoundments.

Procedures: Caribou on both sides of the Susitna River will be radiocollared during the breeding season. Monitoring flights will be made at a relatively low intensity (approximately monthly) throughout most of the year to determine if more than one population exists in the area and to determine seasonal ranges of each population identified. More intensive monitoring flights will be made during the periods of precalving and postcalving movements and winter shift to determine present migration routes and the timing of migration. It will be necessary to repeat this procedure for several years to determine variation among years.

Traditional migration routes will be determined by mapping trails and will be compared with present routes.

Potential alternative ranges will be identified and evaluated using the modified Hult Surlander method of range analysis. These ranges will be compared with Nelchina ranges that have been studied for a number of years.

Schedule:

FY 79	Radio collar caribou, monitor movements. Conduct range analysis.
FY 80	Replace inoperative radios, monitor movements.
FY 81	Replace inoperative radios, monitor movements.
FY 82	Replace inoperative radios, monitor movements.
FY 83	Monitor movements. Repeat range analysis to determine trends.

Cost:

FY 79	$120,000
FY 80	$ 95,000
FY 81	$ 95,000
FY 82	$ 95,000
FY 83	$102,000

Title: Effects of the Susitna Hydropower Project on Wolves.

Objectives: To determine the number of wolf packs and the number of wolves in each pack that inhabit areas to be directly affected by the Susitna Hydropower Project.

To determine the proportions of each pack's territory that lies within areas of impact.

To determine the location of dens, rendezvous sites, hunting areas and the other essential activity areas of each pack in relation to proposed impoundments and construction activities.

To determine the dependence of each pack on prey populations that may be adversely affected by the Project.

Background: Wolves are of considerable national concern as evidenced by recent newspaper and magazine articles. They are known to inhabit the entire project area and information on population size and movements is needed to determine project impacts.

Studies in other areas of southcentral Alaska have demonstrated that some wolves have home ranges as large as 2,000 square miles while many packs have territories ranging from 200 to 600 square miles. It is known that the immediate project area may contain five or more wolf packs. It appears that some of these packs use the Susitna River as a territory boundary, and inundation and associated development could have a dramatic influence on them. These packs depend heavily on moose populations that use the impoundment areas. In addition other studies have shown that any human disturbance relatively close to a wolf den may cause abandonment of the traditional site and perhaps reproductive failure.

Procedures: Two to four wolves will be radio collared in each pack whose territory is believed to include potential impoundment areas and construction sites. The numbers of wolves in each pack will be determined, each pack's territory will be delineated and the degree and nature of use of potential impact areas will be determined through repeated relocations and observation of activities. Specifically, all den sites, rendezvous sites and favored hunting areas will be mapped. These data will be used to determine the degree of dependence of wolves on various areas that will be impacted by the Project.

Dependency on various prey species will be determined by scat analysis and observation of hunting behavior and kills. This information will be used in conjunction with data from the accompanying studies of prey species, particularly the moose study, to estimate indirect impacts on wolves caused by a reduction in prey availability.

Field activities and manpower for this study will be integrated with the moose study. Wolves frequently will be tagged and relocated at the same time as moose. Full funding of the moose study is required for the successful implementation of this study.

Schedule:

FY 78	Radiocollar wolves, monitoring flights.
FY 79	Replace lost radios, monitoring flights.
FY 80	Replace lost radios, monitoring flights.
FY 81	Radiocollar new wolves to fill data gaps. Monitoring flights.
FY 82	Monitoring flights.
FY 83	Monitoring flights.

Cost:

FY 78	$55,000
FY 79	$36,000
FY 80	$29,000
FY 81	$40,000
FY 82	$25,000
FY 83	$13,000

Title: Effects of the Susitna Hydropower Project on Black and Brown/Grizzly Bears.

Objectives: To estimate the numbers of black and brown/grizzly bears using the area to be impacted by the Susitna Hydropower Project.

To determine the dependency of these bears on areas to be impacted, with emphasis on identification of denning areas and seasonal feeding areas.

Background: Very little is known of either brown or black bear populations in the Susitna Basin except that brown bear densities appear to have been very high for several years. We do not know how many bears inhabit the area or how dependent they are on the impoundment areas. Studies should be conducted to estimate bear numbers in and surrounding project area, determine whether the same bears are resident or whether a larger number have a seasonal dependency on the area, and determine the location and extent of denning activities.

A major problem with any large construction project is the attraction of bears to camps and construction sites. This usually results in threats to human safety, delays in construction and destruction of bears. If areas of bear concentration can be identified and avoided during construction, these problems can be substantially reduced.

Procedures: Bears will be radiocollared in the project area. Movements in and around the area will be monitored. Den sites and concentration areas will be mapped.

Bear numbers will be estimated through marked/unmarked ratios observed during spring and fall composition counts and by recording all bears seen during tracking flights.

Field activities for this study will be closely integrated with those for the moose and wolf studies. Full funding of the moose study is required for the successful implementation of this study.

Schedule:

FY 79	Radiocollar bears, monitoring flights composition counts.
FY 80	Monitoring flights, composition counts.
FY 81	Monitoring flights, composition counts.
FY 82	Monitoring flights.

Cost:

FY 79	$95,000
FY 80	$57,000
FY 81	$50,000
FY 82	$35,000

Title: Effects of the Susitna Hydropower Project on Wolverine.

Objectives: To determine the population status of wolverines using areas to be impacted by the Susitna Hydropower Project.

To determine movement patterns and identify habitats of seasonal importance to wolverines.

Background: Less is known about the wolverine than any other big game species in Alaska. Threatened with extinction throughout most of its range in the Scandinavian countries, parts of Russia, the continental United States and Eastern Canada, it is still considered relatively abundant in Alaska. Studies in Idaho and Sweden indicate that wolverines have exceptionally large home ranges. Records of males moving 15 miles in a 24 hour period are not uncommon.

The Talkeetna mountains on either side of the Susitna River between Gold Creek and the MacLaren River presently support a healthy population of wolverines. Although their density is not known at this time, it is probably as high or higher there than in any other portion of their range in Southcentral Alaska. Because the welfare of this species in Alaska is of both national and international concern, some intensive efforts to determine the status, distribution, and movement patterns of wolverine in the project area are warranted.

Procedures: A limited number of wolverines will be radiocollared and tracked in conjunction with other telemetry studies in the area. Home ranges, movement patterns, and seasonal habitat use will be determined by systematic relocation of radiocollared animals.

A systematic aerial survey of wolverines and their tracks will be made in conjunction with wolf studies to determine the distribution and numbers of wolverines using the area.

These data will be used to estimate the number of wolverines using the impoundment areas, determine the degree of dependency of certain wolverines on those areas and identify specific areas of importance to wolverines.

Schedule:

FY 79	Radiocollar, monitoring flights, census.
FY 80	Radiocollar, monitoring flights, census.
FY 81	Monitoring flights.

Cost:

FY 79	$30,000
FY 80	$25,000
FY 81	$10,000

Title: Distribution and status of Dall Sheep Adjacent to the Susitna Hydropower Project Area.

Objectives: To determine the numbers of Dall sheep inhabiting mountains adjacent to proposed dam sites.

To delineate the seasonal ranges of the sheep population.

Background: A relatively isolated sheep population inhabits mountains adjacent to the proposed dam sites. While there will probably be little direct impact on this population by the proposed project, there is a possibility of adverse impacts from human disturbance as a result of dam construction activities and increased access.

Procedures: Aerial surveys will be conducted to determine the size of the sheep population and to delineate seasonal ranges.

Schedule:

FY 79	Aerial surveys.
FY 80	Aerial surveys.
FY 81	Aerial surveys.

Cost:

FY 79	$3,000
FY 80	$3,000
FY 81	$1,000

Title: Distribution and Abundance of Furbearers and Small Game in the Proposed Susitna Hydropower Project Impoundment Areas.

Objectives: To determine the distribution and relative abundance of furbearers and small game in the proposed impoundment areas and determine the degree of use of those species by humans.

To determine the dependence of furbearers and waterfowl on downstream habitats which will be altered by changes in water flow.

Background: Little is known about the distribution and abundance of either furbearers or small game. In order to assess the potential impact of the project on small game it will be necessary to conduct a basic biological reconnaissance. It is known from data collected incidentally to other projects that the Susitna River Basin provides habitat for large numbers of fox, wolverine, and river otter. All three of these species are highly sought by trappers.

Stabilization of water flow could substantially alter aquatic furbearers and waterfowl habitat downstream.

Procedures: Limited aerial surveys will be conducted to determine the presence, distribution and relative abundance of fox, otters, beavers, ptarmigan, waterfowl and raptors. On the ground observations will be made in conjunction with the nongame project.

Trappers and residents of the area will be interviewed.

Surveys of aquatic furbearers and waterfowl will be conducted in downstream areas of probable habitat alteration that will be identified by studies on the effects of water flow on habitat.

Schedule:

FY 79	Surveys in impoundment areas, interviews.
FY 80	Surveys in impoundment areas, interviews.
FY 82	Surveys downstream.
FY 83	Surveys downstream.

Cost:

FY 79	$35,000
FY 80	$35,000
FY 82	$25,000
FY 83	$25,000

Title: Distribution and Abundance of Nongame Species of Wildlife in the Area to be Impacted by the Susitna Hydropower Project.

Objectives: To determine the occurrence, distribution and relative abundance of small mammals and passerine birds in the proposed impoundment areas.

Background: Little is known about the occurrence, distribution or abundance of small mammals and both resident and migratory passerine birds in the Project impact area. A limited reconnaisance should be conducted.

Procedures: A literature search will be conducted. Surveys from the ground will be made and limited trapping will be done. Portions of this study will be coordinated with small game and furbearer studies.

Schedule:

FY 79	Literature search, initiate surveys.
FY 80	Complete surveys.

Cost:

FY 79	$7,000
FY 80	$8,000

FISCAL SUMMARY

Biological Plan of Study

For the Susitna Hydropower Feasibility Analysis

Project	Cost
1. Impact of the Proposed Devils Canyon Watana Hydropower Projects on Anadramous Fish Populations Within The Susitna River Drainage	$ 3,280,600
2. Impact of The Susitna Hydroelectric Project on Resident Fish Species	$ 2,129,300
3. Investigations of The Cook Inlet Estuarine Area and Potential Effects of Hydroelectric Development	$ 75,000+
4. Susitna River Basin Habitat Investigations	$ 787,000
5. Transmission Corridors, Access Road Corridor, and Construction Pad Sites Fisheries Investigations	$ 632,500
6. Existing Economic Recreational, Social and Aesthetic Evaluations of the Susitna River	$ 700,000
7. Predict Project Impacts	$ 150,000
8. Mitigative Measures for Lost Aquatic Habitat	$ 206,000
9. Plan of Study During and After Completion	$ 50,000
10. Impact of the Susitna Hydropower Project on Moose Populations	$ 1,080,000
11. Mitigation Measures For Lost Moose Habitat	$ 340,000
12. Impact of The Susitna Hydropower Project On Caribou Populations	$ 507,000
13. Effects of The Susitna Hydropower Project On Wolves	$ 198,000

14. Effects of The Susitna Hydropower Project on Black and Brown/Grizzly Bears	$ 237,000
15. Effects of The Susitna Hydropower Project On Wolverine	$ 65,000
16. Distribution and Status of Dall Sheep Adjacent To The Susitna Hydropower Project Area	$ 7,000
17. Distribution and Abundance of Furbearers and Small Game in The Proposed Susitna Hydropower Project Impoundment Areas	$ 120,000
18. Distribution and Abundance of Nongame Species of Wildlife in the Area to be Impacted by the Susitna Hydropower Project	$ 15,000
Total	$10,579,400+