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GENERAL

INVESTIGATION MEMORANDUM

Susitna Hydroelectric Project

Aquatic Program

Fiscal Year 1984

--- FINAL DRAFT ---

Harza-Ebasco Susitna Joint Venture

November 1983

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1.0 INTRODUCTION

1.1 BACKGROUND

This General Investigation Memorandum sets forth the objectives, methodology, organization and personnel, schedule, deliverables and budget for accomplishing the fisheries and aquatic habitat studies needed to support the Federal Energy Regulatory Commission (FERC) licensing of the Susitna Hydroelectric Project. The activities and budget described in this memorandum are for Fiscal Year (FY) 1984 (July 1983 through June 1984).

The understanding for developing the activities described in this memorandum for the Aquatic Program was gained through: review of previous study reports on the Susitna Project; review of the FERC License Application, particularly Exhibit E; and meetings with the Power Authority, Resource Agencies, and aquatic studies subcontractors.

1.2 GENERAL OBJECTIVES

Task 4 of the H·E contract for the Susitna Project contains the Environmental Program for the Licensing and Design of the Project. The program is designed to meet the following general objectives:

1. To evaluate the environmental effects of the proposed Project in order to recommend modifications and other measures necessary to assure compatability of the Project with the environment;

2. To ensure that the technical aspects of the environmental study program enable compliance with statutory and regulatory requirements governing project development;

3. To develop coordinated, effective data collection and analysis programs which facilitates evaluation of project effects and mitigation of adverse effects of the proposed Project; and

4. To assist and support engineering activities to ensure proper and efficient implementation of design features to comply with environmental constraints and objectives.

The specific study objectives for the Aquatic Program are presented in Section 2.0 of this memorandum.

2.0 STUDY OBJECTIVES

Several specific study objectives have been defined for the Aquatic Study Team. These study objectives are based primarily on the Task 4 scope of work presented in the Susitna Project Contract. A list of aquatic study activities for FY 1984 are presented on Table 2-1.

The specific objectives for the Aquatic Program are as follows:

1. Review, refine, and continue on-going aquatic programs that quantify Susitna resources potentially affected by the Project in order to establish existing conditions;

2. Identify issues and concerns expressed by the FERC, resource agencies, and the public about fisheries/aquatic habitat impacts associated with the Susitna Project in need of resolution for successful licensing of the Project. Coupled with this objective will be the development of appropriate data collection and analysis programs to resolve these issues and concerns;

3. Develop and refine, as necessary, appropriate mitigation plans for the impacts identified;

4. Interact with other Tasks and Project participants to assure common goals and a coordinated effort; and

5. Coordinate with Power Authority personnel to plan and manage the Aquatic Program as necessary to complete licensing and permitting activities.

TABLE 2-1

AQUATIC ECOSYSTEMS STUDY ACTIVITIES

1. Prepare general investigation memorandum
2. Prepare detailed plan of study
3. Review and evaluate previous fish and aquatic habitat studies
4. Review project plans and proposed operation
5. Review and evaluate impacts of design modifications
6. Prepare sections for revisions to the FERC License Application
7. Design, implement, and monitor field data collection programs:
   - o Slough fish habitat studies
   - o sidechannel fish and habitat studies
   - o tributary mouth fish habitat studies
8. Provide liaison among Aquatic Program participants to assure communication of data and results to appropriate parties
9. Provide liaison between Aquatic Program and the Hydrology Task efforts
10. Provide liaison between Aquatic Program and regulatory agencies through FERC Licensing and Permitting Coordinator
11. Prepare responses to FERC requests for information and agency comments on License Application
12. Review and prepare comments on the Draft Environmental Impact Statement
13. Review and prepare responses to agency comments on he DEIS
14. Evaluate significance of quantified effects of altered flow and temperature on aquatic habitats
15. Participate in negotiation of project flow and temperature criteria with agencies
16. Participate in Settlement Process

3.0 IDENTIFICATION OF ISSUES

The first step in preparing the Investigation Memorandum and the Detailed Plan of Study for the Aquatic Program is the identification of specific issues which must be addressed during the licensing process. A preliminary list of issues has been developed from the following sources:

1. The FERC and State and Federal Resource Agency comments on the draft Exhibit E of the Susitna License Application which was circulated in November 1982;

2. Review of the impact issues presented in the Exhibit E as filed with the FERC in February 1983 and comparison with the issues identified from comments on the Draft Exhibit E;

3. Discussions with the Susitna Project aquatic studies subcontractors. These discussions are held to develop an approach to the continuing data collection program to fill data gaps and complete data sets perceived as necessary by the study participants.

Based on these sources, the following list of licensing issues was developed as a core program for the Aquatic Study Team. The issues are presented in order of priority to satisfy immediate and future needs in the FERC licensing process. The list is as comprehensive as possible at this time and encompasses studies that may continue after FY84. However, modifications to this list and changes in priorities may be indicated during the licensing process. A detailed summary of this listing is included in Section 10.0 as Appendix A.

3.1 IMMEDIATE PRIORITY ISSUES

Issues and concerns identified by the FERC and the resource agencies which require immediate attention center on the proposed flow regimes and potential temperature changes resulting from regualtion of the Susitna River by the proposed Project. The principal concern is that the magnitude and timing of the proposed changes in flow regime and the potential alteration of temperatures, particularly in the Devil Canyon to Talkeetna reach, will affect anadromous and resident fish populations and their habitats. Specific potential impacts and are attributable to regulation of flow and alteration of temperature include:

1. Inhibition of access to slough spawning and rearing habitats for resident and anadromous fish;

2. Changes in access to tributary rearing and spawning areas by resident and anadromous fish populations;

3. Alteration of juvenile rearing habitats in the main channel and side channels;

4. Alteration of winter habitats for resident and rearing anadromous fish populations; and

5. Effects on outmigration of anadromous fish;

Quantification of aquatic habitats for resident and anadromous fish between Devil Canyon and Talkeetna over a range of flow conditions in the river during appropriate portions of the year will enable resolution of these specific issues. To provide this quantification, data describing the habitat requirements of the fish species and their habitat relationships coupled with a detailed quantification of the physical habitat will be provided.

Also, fish habitat data availability under various flow regimes is necessary. Much of this information is available, either as raw data or in preliminary analysis. Completion of the collection of required data and analysis of the data to quantify fish habitats in the Devil Canyon to Talkeetna reach of the Susitna River constitutes the highest priority for the Aquatic Program.

Another study that will be given high priority is an examination of the physical changes in aquatic habitat between Talkeetna and Cook Inlet. Information concerning this reach is not currently sufficient to make adequate impact predictions. Therefore, a stepwise approach to studying this reach will be undertaken. During FY84, studies will be primarily focused on a physical description of potential changes attributable to the Project. Some biological studies will be included (see Appendix B) that will describe habitat utilization by fish. In addition, a summary of information pertaining to fish and their habitats in the Lower River will be prepared. By the end of FY84, an analysis will be complete on the signficance of potential impacts to the lower river, and recommendations will be made on whether additional studies are needed and the extent of such study, if necessary.

3.2 HIGH PRIORITY ISSUES

In addition to the quantification of impacts to the fisheries/ aquatic habitats between Devils Canyon and Talkeetna, several issues have been identified which are of a less urgent nature yet require attention in the near future. These issues include:

1. The potential success of plans for mitigating effects of flow regulation on the fisheries and aquatic habitat between Devils Canyon and Talkeetna. This issue raised questions regarding the effects of modifying the flow

regimes to accommodate resident and anadromous fish populations, particularly during critical seasons of the year. Based on the results of this analysis, potential mitigation measures include modification of spawning and rearing areas in the Susitna River, which must be demonstrated to be effective;

2. The potential loss of fish populations, particularly resident arctic grayling, in the impoundments of the Watana and Devils Canyon dams;

3. Potential impacts to resident and anadromous fish populations and aquatic habitats in the Cook Inlet to Talkeetna reach of the Susitna River;

4. Development of a longterm construction and operation period monitoring program to document Project effects on resident and anadromous fish populations and habitat;

5. Potential effects of the construction camp and ancillary faciities on fisheries and aquatic habitats in the immediate area of the camp. This issue includes potential effects to the lakes to be inundated by the proposed reservoir and affected by the permanent village and to the nearby stream; and

6. The potential increases and subsequent loss of salmon spawning habitat in the area of the Devils Canyon impoundment.

3.3 LOW PRIORITY ISSUES

Issues that will require attention in the future but are not of immediate concern will focus on the final resolutions to existing issues. Studies to resolve these lower priority issues will be conducted, but not necessarily in the immediate future. These issues include:

1. Determination of specific plans for mitigating effects of flow regulation and alteration of temperature on fisheries and aquatic habitats. This will include determination of which sloughs will be modified and to what extent and specification. Design of the modification of a particular slough will require relatively intense evaluation of the hydrologic processes and characteristics of the slough and specification of the desired characteristics to be achieved;

2. Specification of the methods for enhancing resident fish populations in the impoundment zones and determination of the level of effort necessary to replace lost fisheries resources in areas outside the impoundment zone.

4.0 PREVIOUS STUDIES AND DATA AVAILABILITY

The Susitna Environmental Program is an ongoing process which relies and builds on the data, results, and conclusions of previously conducted studies. A list of representative studies conducted or initiated prior to the Licensing Period which help to provide baseline data for the Aquatic Studies Program is presented in Section 10.0. Appendix B. Additional reports, studies and relevant data will be reviewed and utilized in our assessment of the aquatic impacts of the Susitna Hydroelectric Project.

5.0 DELINEATION OF STUDY AREA

The primary focus of the current Aquatic Studies Program will be the fisheries and aquatic habitats that occur along the Susitna River and floodplain between Devils Canyon and Talkeetna. Within this reach of the river, six habitat types (mainstem, side sloughs, side channels, upland sloughs, tributary mouths and tributaries) have been identified.

The study area also encompasses the reach of the Susitna River between Talkeetna and Cook Inlet. Detailed delineations of specific study sites are presented in the Detailed Plan of Study for the Aquatic Program.

6.0 GENERAL METHODOLOGY

The basic methodology for completion of activities for the Aquatic Program will involve, as a first step, identification of the licensing issue or concern to be addressed. This will also include a reexamination of issues raised that prompted the development of on-going programs (e.g., those designed to establish existing conditions). Once issues are identified, a detailed Plan of Study will be developed for each activity. The Plan of Study will present a statement of the issue and its justification, the hypothesis to be tested, methodology for data collection and analysis necessary, a description of the proposed output, and a schedule for deliverables.

For the FY84 program and thereafter, all subcontractors will be required to provide the above information for their continuing work tasks as a part of their scopes of work in their contracts.

The following activities will be used to identify and utilize existing data bases for addressing licensing issues.

	Item	Responsibility
1.	Identification of the License Issue	Harza-Ebasco, APA
2.	Evaluate Existing Data Bases, Proposed Impact Assessment and Mitigation Plans as Appropriate to Address Issue	Harza-Ebasco, Appropriate Subcontractor
3.	Decision on Use of Existing Data Base	Harza-Ebasco
4.	Retrieval of Applicable Data Base	Appropriate Subcontractor

	Item	Responsibility
5.	Selection of Analytical Procedure for Data Reduction and Evaluation.	Harza-Ebasco, Appropriate Subcontractor
6.	Data Analysis	Harza-Ebasco, Appropriate Subcontractor
7.	Review and Evaluate Impacts on Design Criteria	Harza-Ebasco
8.	Data Interpretation Report Preparation	Harza-Ebasco
9.	Review and Comment on Draft Report	Power Authority and Subcontractors as Appropriate
10.	Finalization and Submittal of Report	Harza-Ebasco
11.	Submittal of Report	Power Authority

In addition to Harza Ebasco's need for access to and support in analysis of the existing data base for the Susitna Project, the Arctic Environmental Information and Data Center habitat modeling studies will have a similar need for access to all baseline data. The timely transfer of data among study participants will be facilitated through biweekly coordination meetings of the Aquatic Study Team which includes all aquatic subcontractors. The Aquatic Study Team will have the responsibility for assuring identification of, access to and transfer of data with in the program.

The specific environmental program activities to be accomplished by the Aquatic Study Team are given in the Table 2-1. The work tasks proposed to accomplish these activities are presented below.

6.1 REVIEW AND ANALYSIS OF ENGINEERING DESIGN CHANGES

As a part of the work scope for the Susitna Project, a review of the project engineering and operations will be performed to optimize the overall project concept. A major aspect of this process is to consider the environmental implications of proposed engineering design modifications. Ultimately this will lead to the preparation of environmental reports on project design modifications which may be incorporated into an interim report or the FERC License Application.

The following process has been identified for the development of the required Environmental Reports.

After initial discussions concerning the nature of a potential design modification between engineering and environmental personnel, a "Discussion Memorandum" will be prepared by the appropriate environmental scientist. The objectives of this memorandum will be to promote communication between engineering and environmental personnel. Specifically, the memorandum will:

1. Verify understanding of proposed design modifications;

2. Alert environmental task leaders to the potential design modification and associated environmental implications;

3. Provide initial environmental inputs to the engineering planning process regarding potential environmental consequences of the proposed modification; and

4. Serve as a mechanism to identify additional environmental consequences or data requirements regarding the modification and its impacts.

When the engineering evaluation process is complete, a draft report will be prepared to accompany the engineering study report. The depth and detail of the environmental review and the expertise required will depend on the nature of the design modification and the anticipated Project impacts.

The Environmental Evaluation Memorandum will be specific in its discussion of potential impacts of the recommended engineering approach. It will include, whenever feasible, quantification of impacts, recommended mitigation options, engineering alternatives, and costs of implementation. Differences in the nature and magnitude of impacts of alternative engineering plans will be pointed out. If quantification of impacts cannot be provided on the basis of available information, methods to obtain the information will be recommended including field studies, if necessary. Finally, and most importantly, the nature and extent of changes to the rest of the Exhibit E will be identified and transmitted to the Power Authority for transmittal to the FERC, if appropriate.

The environmental report on design changes will essentially be a compilation of the individual evaluation memoranda supplemented by any additional detail that can be developed regarding the design modifications contained in the engineering report.

In order to assure needed inputs to this evaluation process, copies of the Discussion Memoranda and Environmental Evaluation Memoranda will be circulated to appropriate individuals for their information. Specific requests for information or assistance will be made

on a direct basis. Comments or questions on the memoranda will be discussed with its author as soon as possible to assure adequate flow of up-to-date information.

6.2 DATA ANALYSIS AND INTEGRATION

Reviews performed on field data from past studies conducted for the Susitna Project feasibility study and license preparation phase of the Project have shown that there is an extremely large data base available. Much of these data concerning Project impact issue has been only partly analyzed. Efficient utilization of this data base to answer existing or new Project licensing issues as they develop over the coming months will be of critical importance. Since the majority of these data were collected and maintained by the ADF&G Su Hydro Studies Team, it is necessary that the appropriate members of this team be made available to work in close coordination with the Harza-Ebasco Aquatic Study Team. Consequently, the Aquatic Program has requested that three task leaders of the ADF&G Su Hydro Study Team be made available to work directly with Harza-Ebasco for about 20% of their time over the first six month of FY84. Likewise, appropriate personnel from R&M Consultants, Inc. will be asked for approximately 10% of their time over the same period.

6.3 IMPACT ASSESSMENT AND QUANTIFICATION

6.3.1 Introduction

The Impact Assessment and Quantification Program is designed to predict the potential physical and biological changes in aquatic habitat that could result from Project construction, filling and operation. The studies are generally divided into 1) hydrology and hydraulic modeling and, 2) aquatic habitat and fisheries investigations. The modeling efforts are primarily being performed under Task 42 Hydrology whereas the aquatic habitat and fisheries studies are under Task 4 Environmental. As such, intensive coordination of

the two Tasks will occur to assure that the goals of each are compatible and interactive. Figure 6-1 presents a general diagram of how information and models from both tasks will be used to evaluate impacts. It also shows the input from Harza-Ebasco and the various subconsultants.

The following list provides the key elements of the Hydrology studies as they relate to Environmental objectives:

1. Review existing data and studies - existing data and studies will be reviewed to evalute their adequacy for describing baseline conditions and for input to mathematical models;

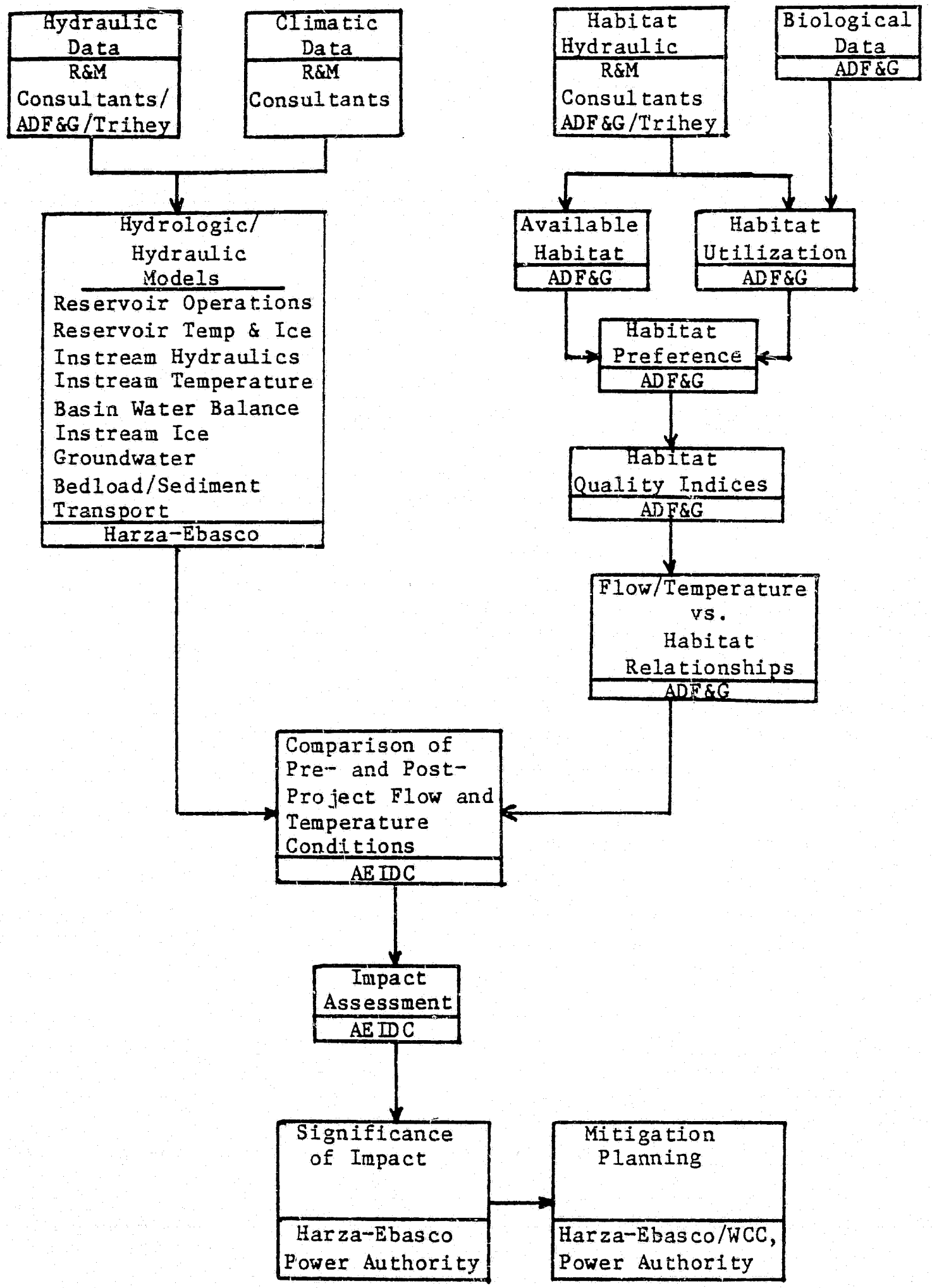
2. Reservoir operations model - the reservoir operations model is key to both the power generation studies and the environmental studies as it simulates timing and quantity of power generated and water released from the reservior. The model will be developed and used to simulate operation for four to eight electric load demand conditions;

3. Reservoir temperature/ice studies - the Dynamic Reservior Simulation Model (DYRESM) will be calibrated to simulate vertical temperature profiles and reservoir ice thickens under unsteady flow conditions;

4. Instream hydraulic model - the HEC-2 backwater program calibrated and operated by R&M Consultants will be used to determine instream hydraulic conditions during ice free periods required by the habitat model;

5. Instream temperature model - the AEIDC is calibrating a dynamic temperature - steady flow heat transport model called SNTEMP which locates tributary and groundwater inflows by reach between points of measured stream flow;

FIGURE 6-1 - OVERVIEW OF AQUATIC PROGRAM EFFORT



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6. Instream ice model - the instream ice model will be coupled with the instream temperature model to study the influence of ice on water surface profiles and on heat transfer and the formation and progression of ice cover;

7. River-reservoir sediment studies - the principal concerns of this analysis will be to determine effects of Project generation on fish access to tributaries and sloughs and the need for the design of mitigation measures; and

8. Slough groundwater and temperature studies - certain sloughs between Talkeetna and Devil Canyon have been identified as salmon spawning habitat. A major feature of these sloughs is that they are fed by groundwater which is much lower in turbidity than river water. In winter, the inflowing groundwater is above freezing and open water is maintained in the sloughs. Higher post-project winter flows could adversely affect slough water temperaturs and hence, fish habitat by increasing the proportion of cold groundwater inflow from the river. The studies proposed at this time are based on existing field data and evaluation of modeling studies performed by Acres.

6.3.2 Task 4: Aquatic Habitat and Fisheries

The Aquatic Program is prepared to: 1) address the specific impact issues and goals summarized in Appendix A and, 2) improve input to the AEIDC modeling efforts (see Figure 6-1). The primary study areas in FY84 will be Talkeetna to Devil Canyon and Talkeetna to Cook Inlet, respectively. The baseline data collection and impact evaluations designed for these study areas are presented in Tables 6-1 and 6-2. Harza-Ebasco will coordinate this program with specific tasks assigned to the following Harza-Ebasco or Power Authority subcontractors.

TABLE 6-1

TALKEETNA TO DEVIL CANYON -

BASELINE DATA COLLECTION AND IMPACT EVALUATIONS

DATA COLLECTION	DATA ANALYSIS	IMPACT EVALUATION	END RESULTS
Fish: Abundance, Distribution, Migration Rates	Fish Abundance Estimates	Simulation Modeling Reservoir Operation	Incremental Analysis Reports:
	Fish Distribution	Reservoir Temp.	Open Water Season
Fish Numbers			Ice covered Season
	Juvenile Salmonid Survival Summary	Instream Hydraulics Temp. and Ice	Verfication of Model Elements
Habitat Available: Preferred, Utilized	Juvenile Salmonid Outmigration Timing	Groundwater	Habitat Map
Hydraulic Data: Velocity, Depth, Substrate, Dishcharge, Thalweg and WSEL, Temperature	IFG Type Incremental Analysis	Bedload/Suspended Sediment Transport	Ice Observations Report
	Correlation of Habitat and Distribution of Fish	Fish Habitat Model	
	Distributions of Habitat Types	Quantitative Impact Assessment - Fish & Aquatic Habitat	Position Paper on Water Quality
Relationships to Mainstem Discharge	Ice Processes Analyses		Position Paper on Gas Supersaturation
Groundwater			
Ice Processes: Front Locations, Thickness, Break-up, Jams			

TABLE 6-2

LOWER RIVER STUDIES (COOK INLET TO TALKEETNA) -
BASELINE DATA COLLECTION AND IMPACT EVALUATIONS

DATA COLLECTION	DATA ANALYSIS	IMPACT EVALUATION	END RESULTS
Aerial Photography	Preliminary Flow Evaluations	Magnitude of Change for Each Aspect	Position Paper on Hydrologic Relationships
Groundtruthing (cross sections)	Temperature Modeling		Position Paper on Ice Processess
Fish Habitat Description	Water Balance Modeling		Position Paper on Bedload Sediment Transport
Fish Distribution	Ice Processes Synthesis		Evaluation of Effects on Fish Habitat
Bedload/ Suspended Sediments	Review Available Data		Assess Effects to Navigation
Ice Observations	Fish Populations		Determine Need for Future Studies
	Fish Habitats		
	Fish Habitat Ground Truthing		

1. Alaska Department of Fish and Game - the ADF&G will be primarily responsible for developing and conducting field studies that provide information and data on existing resources and information geared to the identification or updating of the impact assessment. Also, the information developed will be used during construction and operation as a basis for monitoring impacts. The ADF&G has a team of biologists led by Mr. Tom Trent assigned to study the aquatic fisheries resources of the Susitna Basin. The team has been organized into distinct units to address various aspects of the fisheries resource questions. These units and their assignments are:

   - o Resident and juvenile anadromous fisheries - this unit will examine the seasonal distribution, relative abundance, and habitat requirements of resident and juvenile fish on the Susitna River between Cook Inlet and Devil Canyon;

   - o Anadromous adult fisheries - this unit will determine timing, distribution and relative abundance of adult anadromous fish within the Susitna Basin that could be affected by the Susitna Project;

   - o Aquatic habitat and instream flow studies - this unit is primarily responsible for characterizing the seasonal habitat requirements of selected anadromous and resident fish within the Susitna Basin. Although other subcontractors may also collect information on habitat requirements, it is the main purpose of this group to use that data and the data collected under studies by this unit, to synthesize the relationships among physical parameters such as discharge, velocity, depth, temperature and water quality to fish habitat;

- o Data processing - this unit supports the efforts of the other units by providing data analyses, compilation and sampling design; and

- o Administration and support - this unit provides for the overall administration and operation of the Su Hydro Aquatic Studies Team.

2. Arctic Environmental Information and Data Center - the primary task of the AEIDC is to take information from other study groups (primarily the ADF&G, Harza-Ebasco, and E. Woody Trihey and Associates) and develop a model of the relationships among discharge, temperature, and fish habitat as related to Project construction and operation. From this model, various flow regimes will be assessed as to their impact on fisheries resources. To achieve this goal, AEIDC will link various models (reservoir operations, temperature, etc.) to provide discharge versus habitat relationships. The principal investigator for AEIDC is Mr. William Wilson.

3. E. Woody Trihey and Associates - Mr. Trihey of this organization is a hydraulic engineer who has worked on the Susitna system for several years. Mr. Trihey will be directly responsible for providing technical advice and expertise to the ADF&G for their field studies and analyses. Mr. Trihey will also help coordinate exchange of information from the ADF&G to the AEIDC as input for their modeling efforts.

4. R&M Consultants - this firm will provide information on the physical aspects of the Susitna Basin which can help determine physical impacts due to the Project and be used by other subcontractors to support impact assessment efforts.

Examples of efforts to be conducted are: development of instream cross-sectional data, observing and recording information concerning ice break-up, and performing water quality measurements. The R&M studies will be directed by Mr. Steve Bredthauer.

5. Woodward Clyde Consultants - this firm will primarily be responsible for developing a detailed mitigation plan that will be submitted to the FERC as a supplemental information report. Woodward Clyde will also assist in the overall planning of the aquatic program and in the instream flow negotiation process. This work will be directed by Dr. Larry Moulton of Woodward Clyde.

Considerable amounts of data have been collected and/or analyzed by the above groups during the 1981 and 1982 field seasons. Additional studies will be performed during the 1983 field season. This information will be used to support licensing activities, mitigation planning and development of long-term monitoring plans.

The Harza-Ebasco Aquatic Study Team will also perform the following tasks:

1. Provide input to FERC licensing efforts - this will include the development of responses to the FERC comments and requests for information, responses to agency comments, and interaction with other groups that require aquatic information (e.g., information on the effects of Project impacts on subsistence fishing are required as part of socio-economic studies). Input from other groups will be provided as needed. A major effort will be answering the FERC supplemental questions and development of any licensing amendments, if required;

2. Provide input to other tasks - includes transmission line routing and access corridor selection;

3. Work interactively with the Project engineers - assist on design questions (e.g., how to minimize gas supersaturation) and operation questions (e.g., flows needed to maintain aquatic habitat);

4. Interface with the Public Participation and Need for Power Alternatives Study Groups; and

5. Work with the Power Authority to develop information for negotiation of instream flow requirements.

The major emphasis of FY84 studies will be on the river reaches between Talkeetna and Devil Canyon and between Talkeetna and Cook Inlet. The studies will be concentrated on the following:

1. Sloughs - including studies on access, incubation, emergence, habitat availability and utilization for rearing and spawning, groundwater (upwelling, temperature and water surface elevation), physical habitat (e.g., velocity, depth, and substrate), outmigrant timing and abundance;

2. Side channels - including studies on habitat availability and utilization for rearing and spawning physical habitat, fish abundance and distribution;

3. Mainstem - physical habitat studies primarily aimed at assessing incremental flow versus habitat relationships studies on outmigrant timing and abundance;

4. Tributary mouth - fish abundance and distribution and physical habitat studies aimed at assessing available habitat for spawning; and

5. Tributaries - studies will concentrate on developing species preference curves for spawning and rearing.

In all of these habitats except the mainstem, spawning ground surveys of adult anadromous salmonids will be made to assess escapement. These surveys will be performed in conjunction with counts made at fish wheels located at Yentna, Talkeetna, Sunshine, and Curry stations.

In the river below the confluence of the Chulitna and Talkeetna rivers (lower river), physical impacts of the Project should be somewhat reduced because the flow from the Susitna River upstream of Talkeetna contributes less than half of the total mean annual flow. Therefore, only reconnaissance level studies were planned in 1983 to gather data on wetted surface areas of the lower river and specific habitat types such as sloughs and tributary mouths over a range of river flows. This will be accomplished by means of aerial photography. A range of 12,000 to 60,000 cfs mainstem flows at Sunshine Station were targeted.

Groundtruthing to support th` 'photography will be conducted at selected sites. Ground data will include cross sections, water surface profiles and discharge measurements. No attempt to tie slough elevations into a regional datum will be made at this time. Slough flow conditions on the observation dates will be related to a temporary bench mark set at each slough and staff gage readings on the main river. In addition, bedload and suspended sediment studies and ice observations will be made. Integrated with these physical studies will be studies on fish distribution and habitat.

The details for accomplishing this major work task will be provided in a detailed Plan of Study.

6.4 MITIGATION DEVELOPMENT

An initial mitigation plan was described in the FERC License Application submitted February 28, 1983. Through discussions with the Power Authority, Woodward Clyde and Harza-Ebasco, a more detailed plan will be developed and refined. Following this, a draft plan

will be presented to key state and federal resource agencies for review and comment. Official written comments will be solicited on the plan with a follow-up meeting to resolve areas of disagreement. The goal of this process will be to achieve a final mitigation plan that can be submitted to the FERC. This planning process will be on-going and the plan will be modified through time in response to design changes and results of on-going and future studies such as the slough modification and grayling enhancement studies. The general approach to these latter studies is presented in Tables 6-3 and 6-4. As part of the mitigation planning efforts, there will also be the development of a monitoring program (Table 6-5) to evaluate the mitigation planning effort.

6.5 REPORT PREPARATION

The reports to be produced by the Aquatic Study Team are described in this section and are listed in Table 8-I (Section 8.0).

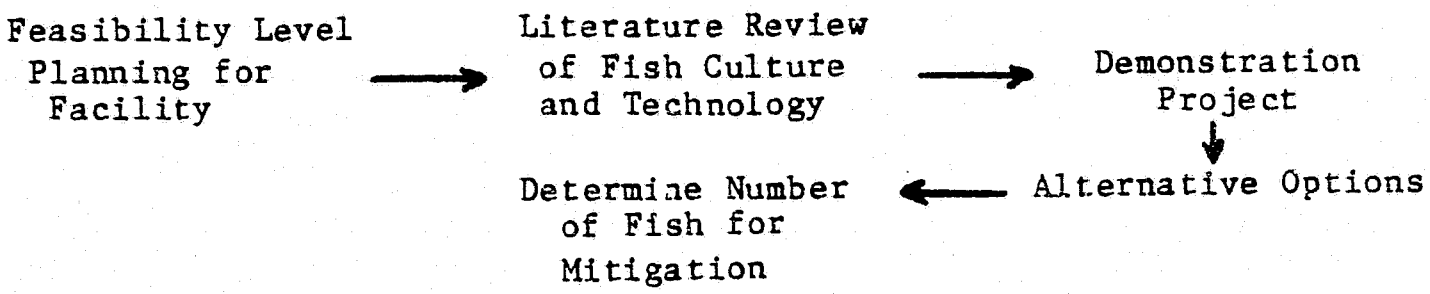
6.5.1 Review Reports

Harza-Ebasco will review subcontractors' reports for technical content, completeness, responsiveness to the agreed scope, and analysis of subcontractors' conclusions and recommendations as to their appropriateness for use in licensing activities. Based on this review, Harza-Ebasco will judge the acceptability of subcontractor reports as to the completeness of the subcontractor's technical scope. Reviews will be presented to the subcontractor and the Power Authority in letter format with attached memorandum detailing the technical review.

TABLE 6-3

MITIGATION PLANNING
GRAYLING HATCHERY

APPROACH[1/]



INFORMATION REQUIREMENTS	RESULTS OF ASSESSMENT
Analysis of Magnitude of Lost Populations	Feasibility Level Determination of Hatchery
Document Experience in Arctic Grayling Culture	Implementation Plan
Facility Siting Study	
Arctic Grayling Culture Information	
Baseline Data on Grayling Population	

1/Principal subcontractors will be Woodward Clyde Consultants.

TABLE 6-4

MITIGATION PLANNING:
STRUCTURAL HABITAT MODIFICATION

APPROACH1/

Feasibility Level Study → Slough Modification and Biologic Data → Modification
- °Modification Plan
- °Monitoring

INFORMATION REQUIREMENTS	RESULTS OF ASSESSMENT
Slough Hydrologic and Biologic Data: °Productive Slough °Unproductive Slough	Recommended Mitigation Plan Negotiated Mitigation Plan
Results of Incremental Flow Analysis: °IFG Studies °Susitna Simulation (SUSIM) Modeling	

1/ Principal subcontractors will be Woodward Clyde Consultants with assistance from AEIDC, ADF&G, R&M AND EWT&A.

TABLE 6-5

MITIGATION PLANNING:
MONITORING PROGRAMS

APPROACH[1/]

Baseline Conditions → Time-Series Summarization → Statistical Evaluation

INFORMATION REQUIREMENTS

Data Collection:

- °Fish Distribution and Abundance
- °Habitat Data
- °Migration and Movements
- °Representative Species

RESULTS OF ASSESSMENT

Evaluation of Impact Assessment and Mitigation Plan

6.5.2 Discussion Memoranda and Environmental Evaluation Memoranda

These two documents are intended to be Harza-Ebasco internal working documents to promote internal communications among the engineering design team, the Aquatic Study Team, members of other environmental programs and the Task 6 permitting group. These are general memoranda that identify specific issues or items that have been identified for potential analysis or additional work, They are generally less than two pages, present the issue (e.g., a design change) and identify potential means to examine the issue and resolve it.

6.5.3 General Investigation Memoranda

A General Investigation Memorandum will be prepared for all major technical work task undertakings (i.e., modeling studies, impact assessment studies, data analysis) planned by the Harza-Ebasco Aquatic Study Team. These Investigation Memoranda will generally address the following topics: background, need for the study, objectives, methodology, description of outputs and/or deliverables, schedule, personnel and costs.

6.5.4. Planning Memoranda

Planning Memoranda are detailed documents to provide all required information to the engineering design teams to allow them to incorporate required environmental protection features into the Project design and/or to provide the basis for design of mitigation and enhancement features of the Project. Environmental Planning Memoranda typically provide the physical criteria such as permissible ranges, maximum and/or minimum standards which must be met by the engineering design group (i.e., velocity, rate of change in flow, etc.) and may include preliminary layouts of the feature under design.

6.5.5 Project Reports

Project reports are "stand alone" documents of a wide variety of types which cover a major topic. A Fisheries Mitigation Report is an example of a stand alone document and would contain introductory and background material taken from the literature, results of various project field and office investigation, input from reviewing agencies, and planning memoranda prepared for specific features of the Mitigation Plan.

6.6 QUALITY ASSURANCE

All subcontractors will be required to apply a Quality Assurance Program to their studies. This will include quality assurance procedures for data collection, checking, and storage, analytical procedures, analyses performed on data, and processes for incorporating data into final reports. Harza-Ebasco will develop a QA Manual to encompass any studies in which it directly participates and to include an overview of QA procedures by all Task 4 subconsultants.

Other items included in the QA Program will be organization charts, lines of authority and identification of the person(s) responsible for QA, methods for assuring competency and safety of files, audit programs and the identification of persons responsible for technical quality of the reports.

7.0 STUDY COORDINATION AND MANAGEMENT

As a result of the large area potentially affected upstream and downstream of the Project, the amount of information available concerning the Susitna River prior to Project licensing, and the complexity of the aquatic ecosystem, an extensive effort has been made to study this system and the potential impacts of the proposed Project on it. The organizational structure developed to assure that the objectives of the Task 4 efforts are accomplished involves overall management and coordination of the efforts by Harza-Ebasco with support from subcontractors and other Tasks. This section provides a general description of the organizational structure.

7.1 HARZA-EBASCO

The Aquatic Program will be performed by a Study Team under the overall guidance of Dr. Gary Lawley, the Harza-Ebasco Environmental and Regulatory Operations Manager. The personnel participating in the Aquatic Study Team, under the direct supervision of Dr. G. Lawley include:

Group Leader	Dr. J. Bizer
Fisheries Biology	Dr. D. Beyer
	Mr. K. Fresh
Aquatic Ecology	Dr. T. Stuart
Hydrologist	Mr. W. Dyok
Biologist	Ms. A. Rivkin

7.2 INTERACTION WITH OTHER STUDY TEAMS

The Aquatic Study Team will work closely with members of the FERC Licensing and Permitting Group (Task 6) to provide necessary support for compliance with the FERC, agency and public requests.

The evaluation and assessment of potential impacts on the ecological interface between the aquatic and terrestrial habitats will be coordinated with the Harza-Ebasco (Task 4) Terrestrial Study Team. This team is supervised by Mr. R. Fairbanks.

The Aquatic Study Study Team will also work with Dr. E. F. Dudley, who is presently charged with coordination of environmental evaluation and review of engineering operation and design modifications studies being undertaken by members of the Engineering Design (Task 3) and Need for Power Study (Task 40) Teams.

7.3 SUBCONTRACTORS

For FY84 the Aquatic Study Team will be supported by four subcontractors. These subcontractors and their areas of responsibility for the Susitna Project include:

1.	Arctic Environmental Information and Data Center (AEIDC)	Impact Assessment through Fisheries Habitat Modeling Study
2.	R&M Consultants	Hydrological, Climatological and Water Quality Data Collection and Monitoring

3.	E. Woody Trihey and Associates	Hydrology, Aquatic Habitat Studies
4.	Woodward Clyde Consultants	Assistance in the Aquatic Mitigation Program and General Licensing Support Activities

Continued fisheries and aquatic habitat baseline studies will be conducted by the Alaska Department of Fish and Game's (ADF&G) Susitna Hydroelectric ("Su Hydro") Aquatic Studies Team under a Reimbursable Services Agreement (RSA) with the Power Authority.

7.3.1 Arctic Environmental Information and Data Center (AEIDC)

The AEIDC's 1984 scope of work will be directed to completion of modeling efforts previously initiated. The Harza-Ebasco Aquatic Study Team will provide significant support in the physical modeling effort required (operation model, hydraulic model, ice model, sediment model). For this effort the AEIDC will concentrate on the habitat modeling designed to quantify fisheries impacts that will result from alternative flow regimes. The results of the AEIDC modeling studies will be used for negotiations with the resource agencies.

7.3.2 R&M Consultants Incorporated

The R&M Scope of work provides for collection and preliminary reduction of hydrologic, hydraulic, temperature and climate data necessary for calibration of the mathematical models that are being developed. In addition, R&M is responsible for the preliminary hydrologic and hydraulic evaluation of the Talkeetna to Cook Inlet

Reach of the Susitna River. This later information will be used to determine what detailed studies will be required to fully evaluate the effects of the Susitna Project on the Lower River and will provide the basis for selecting appropriate study sites.

7.3.3 E. Woody Trihey and Associates

The efforts of Mr. Woody Trihey will be directed to supporting the ADF&G Su Hydro field data collection program. In addition, he will assist in coordinating data and information transfer from the ADF&G to the AEIDC to meet the AEIDC data needs and will assist Harza-Ebasco aquatic program staff on an as-needed basis.

7.3.4 Woodward-Clyde Consultants, Inc.

Woodward Clyde Consultants will provide assistance in the development of a detailed fisheries mitigation report based on existing information. Harza-Ebasco will take the lead role in the mitigation planning aspects of the Aquatic Program and will rely on Woodward Clyde Consultants on an as-needed basis.

7.4 COORDINATION AND MANAGEMENT OF SUBCONTRACTORS

One of the major roles of the Harza-Ebasco Aquatic Study Team is to coordinate and manage the overall activities of the subcontractors. This will be accomplished through review of: proposed scope of work; program schedules and deadlines; deliverables; progress reports; and budget expenditures by the subcontractor.

In addition to review, Harza-Ebasco will conduct coordination meetings with the subcontractors to determine progress, details of information transfer, project planning, and data gaps. Important issues or concerns that arise during these meetings will be directly relayed to the Power Authority.

8.0 SCHEDULE AND DELIVERABLES

The overall schedule will conform to the major milestones identified for the FERC licensing process. The major deliverables and the target dates for completion are presented in Table 8-1.

All reports will be reviewed by the Aquatic Study Team as appropriate, before submittal to the Power Authority for their final review and acceptance. As a minimum, the review will include group leaders, the Environmental Program Manager and the Project Manager.

TABLE 8-1

AQUATIC STUDIES MAJOR DELIVERABLES
AND DUE DATES

Deliverable	Due Date
HARZA-EBASCO ONLY	
1. Review Memoranda of Technical Reports	As necessary
2. FERC License Revision	2/15/84
3. Response to FERC non-Conforming Items	7/11/83
4. Responses to FERC Supplemental and Other Requests	7/11/83 2/9/83
5. Responses to Agency Comments on License Application	1/15/84
6. Review Draft Environmental Impact Statement (DEIS)	5/30/84
7. Responses to Agency Comments on DEIS	9/7/84
8. Progress Reports	Monthly
9. Agency Workshops	As necessary
10. Finalize FY'85 Work Scopes	3/31/84

TABLE 8-1 (Cont)

11. Position Paper on Turbidity	12/1/83
12. Position Paper on Gas Saturation	4/31/84
13. General Investigation Memorandum	11/18/83
14. Plan of Study (FY'84)	12/15/83
15. Settlement Process	11/4/84
16. Transmission Line Report	11/15/83
E. WOODY TRIHEY & ASSOC	
1. Habitat Maps, Draft	8/30/83
2. Devil Canyon to Talkeetna Habitat Map Report	12/1/83
3. Technical Documentation of 1FG-4 Methodology	10/30/83
4. IFG-4 Calibration of Sloughs	11/1/83
5. IFG-4 Calibration of Side Channels	12/1/83
R & M	
1. Lower Susitna River Morphological Assessment	12/1/83

TABLE 8-1 (Cont)

2. Develop Lower River Plan of Study	3/31/83
3. 1983-84 Ice Observations Report:	
Freeze-up	1/31/84
Breakup	7/1/84
4. Slough Hydraulic Process Report	1/31/84
5. Stream Gaging Report	12/31/84
6. Climate Station Data Report	12/31/84
7. Field Data Index	1/31/84
8. Glacier Lake Data Report	1/31/84
9. Glacier Studies (Tall Portion) Report	1/31/84

AEIDC

1. Document Stream Temperature and Water Balance Models	8/30/83
2. Preliminary Analysis of Stream Temperature and Water Balance Conditions	9/30/83
3. Preliminary Assessment of Effects of Susitna Project on Aquatic Habitats	10/30/83
4. Stratification of Lower River Habitat Types for Further Studies	3/1/84
5. Updated Aquatic Impact Assessment	11/2/84

TABLE 8-1 (Cont)

WOODARD CLYDE CONSULTANTS

1. Draft Detailed Plan of Study	11/30/83
2. Responses to Agency Comments on License Application	1/19/83
3. Impoundment Mitigation Plan	6/30/84
4. Habitat Modification Mitigation Plan	6/30/84

ADF&G

1. FY'84 Procedures Manual	6/30/83
2. Winter Data Report (1982-83)	8/30/83
3. 1983 Anadromous Adult Report:	
Draft	12/15/83
Final	2/1/84
4. 1983 Resident and Juvenile Anadromous Reports:	
Draft	1/15/83
Final	3/1/84
5. 1983 Aquatic Habitat Report:	
Draft	3/1/84
Final	4/15/84

9.0 BUDGET

Table 9-1 below presents the FY'84 budget for the Aquatic Program.

TABLE 9-1

FY'84 AQUATIC PROGRAM BUDGET

Position	Workhours
Group Leader	2,160
Sr. Fisheries Biologist	2,160
Fisheries Biologist	1,100
Hydrologist	1,040
Aquatic Ecologist	2,160
Staff Biologist	1,100
TOTAL	9,720

10.0 ATTACHMENTS

APPENDIX A - AGENCY RAISED ISSUES

APPENDIX B - LIST OF REPORTS OF PREVIOUS STUDIES

PRELIMINARY APPENDIX A

4 October 1983

SUSITNA HYDROELECTRIC PROJECT: AGENCY-RAISED ISSUES

Subtask: Aquatic Resources

ISSUE		AGENCY	SOURCE	STATUS	COMPLETION DATE
A-1.	Effects of construction wastes on turbidity.	ADEC	1. Dwight & Trihey 81 Survey	1. Addressed in Exhibit E.	
A-2.	Effects of construction wastes on suspended solids.	ADEC	2. Dwight & Trihey 81 Survey	2.	
A-3.	Capability of the Susitna to assimilate treated discharges from increased population growth in the area during operation.	ADEC	3. Dwight & Trihey 81 Survey	3.	
A-4.	Water quality changes associated with different operational flow regimes.	ADEC	4. Letter to APA June 6, 1983	4. Addressed in Exhibit E; will continue to be studied.	June 1984

PRELIMINARY

4 ber 1983

SUSITNA HYDROELECTRIC PROJECT: AGENCY-RAISED ISSUES

Subtask: Aquatic Resources

ISSUE		AGENCY	SOURCE	STATUS	COMPLETION DATE
A-5.	Water quality effects of waste materials discharged into the river by communities and industrial operations downstream of the dam during construction and operation.	ADFG	5. Dwight & Trihey 81 Survey	5. Addressed in Exhibit E. Quantification and refinement are continuing on some.	
A-6.	Temperature conditions in all reaches of the river affected by construction and operation.	ADFG	6. Dwight & Trihey 81 Survey	6. Addressed in Exhibit E.	
A-7.	Sediment levels and turbidity affected by construction and operation.	ADFG	7. Dwight & Trihey 81 Survey	7. Addressed in Exhibit E. Quantification and refinement are continuing.	June 1984
A-8.	Effects of construction and operation of project on aquatic animal organisms.	ADFG	8. Dwight & Trihey 81 Survey	8. Addressed in Exhibit E. Additional studies continuing.	June 1984
A-9.	Effects of construction activities on fishery resources in the access road corridor.	ADFG	9. Dwight & Trihey 81 Survey	9. Addressed in Exhibit E. Additional studies continuing.	June 1984
A-10.	Effects of construction activities on fishery resources in transmission line corridors.	ADFG	10. Dwight & Trihey 81 Survey	10.	
A-11.	Effects of construction and operation on ice conditions upstream of the dams.	ADFG	11. Dwight & Trihey 81 Survey	11. Addressed in Exhibit E. Additional studies continuing.	June 1984
A-12.	Effects of construction and operation on ice conditions downstream of the dams.	ADFG	12. Dwight & Trihey 81 Survey	12.	
A-13.	What is the life of the reservoir?	ADFG	13. Dwight & Trihey 81 Survey	13. Addressed in Exhibit E.	June 1984
A-14.	What effect will release of sediment and glacial flour to prolong the life of the reservoir (if this is done) have downstream?	ADFG	14. Dwight & Trihey 81 Survey	14. No release of sediments anticipated.	
A-15.	Effects of operation of reservoir(s) on dissolved nitrogen concentrations downstream of dam(s).	ADFG	15. Dwight & Trihey 81 Survey	15. Addressed in Exhibit E.	
A-16.	Effect of altered flows on winter icing in Cook Inlet.	ADFG	16. Dwight & Trihey 81 Survey	16. Addressed in Exhibit E.	

PRELIMINARY

4 ober 1983

SUSITNA HYDROELECTRIC PROJECT: AGENCY-RAISED ISSUES

Subtask: Aquatic Resources

ISSUE		AGENCY	SOURCE	STATUS	COMPLETION DATE
A-17.	Estuary impacts need evaluation.	ADFG	17. Dwight & Trihey 81 Survey	17. Addressed in Exhibit E.	————
A-18.	Overwintering of resident and juvenile anadromous fish in the mainstem needs to be evaluated.	ADFG	18. Dwight & Trihey 81 Survey	18. Addressed in Exhibit E; additional winter studies by ADFG are continuing.	Oct. 1983
A-19.	Impacts on access of juvenile salmon to east side tributaries below Talkeetna for rearing.	ADFG	19. Dwight & Trihey 81 Survey	19. Rearing access is being studied.	April 1984
A-20.	Water quality impacts downstream from Talkeetna.	ADFG	20. Dwight & Trihey 81 Survey	20. This is currently part of an ongoing study that will quantitatively assess impacts to aquatic habitat downstream from the project.	June 1984
A-21.	Water quantity impacts downstream from Talkeetna.	ADFG	21. Dwight & Trihey 81 Survey	21.	————
A-22.	Sediment transport conditions at the confluence of the Susitna, Chulitna and Talkeetna Rivers.	ADFG	22. Dwight & Trihey 81 Survey	22. Aggradation/degradation questions are being addressed in ongoing studies.	June 1984
A-23.	Adequate mitigation studies.	ADFG	23. Dwight & Trihey 81 Survey	23. Mitigation plans are a continuing process and will be modified based on additional information.	————
A-24.	Impacts on rearing, fish passage, and egg incubation in the mainstem river from its mouth upstream.	ADFG	24. Letter Trent to Carson Oct 13, 1980	24. Most effort to date in Devil Canyon to Talkeetna Reach; more effort being directed to Cook Inlet Reach.	June 1984
A-25.	A cost/benefit analysis of potential mitigation alternatives must be made.	ADFG	25. Letter Trent to Carson Oct 13, 1980	25. Part of Phase II effort. Cost/benefit analyses will be refined and modified as additional studies are completed.	————
A-26.	Access of the public and commercial interests to fisheries provided by mitigation program.	ADFG	26. Letter Trent to Carson Oct 13, 1980	26. Addressed in Exhibit E.	————

ISSUE		AGENCY	SOURCE	STATUS	COMPLETION DATE
A-27.	Access road impacts on fisheries including access for fishing.	ADFG	27. Letter Trent to Carson Oct. 13, 1980	27. Addressed in Exhibit E.	_____
A-28.	The entire length of the river should be evaluated for project impacts.	ADFG	28. Letter Trent to Carson Oct. 13, 1980	28. Most effort to date in Devil Canyon to Talkeetna Reach; more effort being directed at Talkeetna to Cook Inlet reach.	June 1984
A-29.	Effects of T-Line corridor to maintain watershed integrity.	ADFG	29. Memo from Yanagawa to Trent August 6, 1981	29. Addressed in Exhibit E.	_____
A-30.	Effects of the alignment of T-Line corridors on aquatic resources.	ADFG	30. Memo from Yanagawa to Trent August 6, 1981	30. Addressed in Exhibit E.	_____
A-31.	Change in the bed characteristics of areas utilized by chum salmon for mainstem spawning.	ADFG	31. Letter Trent to Weltzin Jan. 19, 1982 and April 16, 1982 Board testimony	31. Part of continuing study.	June 1984 and annual ADFG reports
A-32.	Influence of changes to sediment transport patterns on productivity of the aquatic community.	ADFG	32. Letter Trent to Weltzin Jan. 19, 1982 and April 16, 1982 Board testimony	32. Part of continuing study.	April 1984
A-33.	Post-project effects on downstream turbidity.	ADFG	33. Letter Trent to Weltzin Jan. 19, 1982 and April 16, 1982 Board testimony	33. Preliminary studies on turbidity have been performed; additional studies are planned.	April 1984
A-34.	The costs of aquatic mitigation specified.	ADFG	34. Testimony before APA Board April 16, 1982	34. First estimates were included in Exhibit E. Additional cost estimates will be made as the mitigation planning process continues.	_____

ISSUE		AGENCY	SOURCE	STATUS	COMPLETION DATE
A-35.	Instream flows required to maintain present populations of fish below the two dams. The areas immediately below the dam sites as well as areas further downstream should be included.	ADFG	35. Letter to APA Board July 27, 1982	35. These evaluations are in progress.	June 1984
A-36.	Temperature regimes should be evaluated concurrently with stream flows.	ADFG	36. Letter to APA Board July 27, 1982	36. These evaluations are in progress.	June 1984
A-37.	Compare options for onsite mitigation of fisheries impacts with possibilities for hatcheries.	ADFG	37. Letter to APA Board July 27, 1982	37. KCM report available on possible hatchery sites. Mitigation planning is a continuing process that will be refined as additional information becomes available.	_____
A-38.	Impacts from construction and maintenance of the transmission corridor should be evaluated.	ADFG	38. Letter to APA Board July 27, 1982	38. Addressed in Exhibit E.	_____
A-39.	Impacts from construction and maintenance of access road corridor should be evaluated.	ADFG	39. Letter to APA Board July 27, 1982	39.	_____
A-40.	Grayling hatchery for impoundment losses.	ADFG	40. Comments at December 2, 1982 Workshop	40. Evaluation of this alternative is continuing.	Sept. 1984
A-41.	Slough modification plans.	ADFG	41. Comments at December 2, 1982 Workshop	41. Mitigation plans for sloughs continue to be evaluated.	Sept. 1984
A-42.	Instream flow analysis on sloughs to look at the mitigation options.	ADFG	42. Letter to APA June 3, 1983	42. Studies on instream flow analysis are on-going and will address many of these issues.	June 1984
A-43.	Instream analysis on side channels to look at the mitigation options.	ADFG	43. Letter to APA June 3, 1983	43.	_____
A-44.	Instream analysis on mouths of tributaries to look at the mitigation options.	ADFG	44. Letter to APA June 3, 1983	44.	_____

SUSITNA HYDROELECTRIC PROJECT: AGENCY-RAISED ISSUES

Subtask: Aquatic Resources

ISSUE	AGENCY	SOURCE	STATUS	COMPLETION DATE
A-45. Existing water rights affected by the proposed project.	ADNR	45. Dwight & Trihey 81 Survey	45. Addressed in Exhibit E. Additional instream flow studies are currently directed at fish habitat analysis. However, many of the studies may be useful in assessing potential impacts on water rights.	June 1984
A-46. All aspects of water use.	ADNR	46. Dwight & Trihey 81 Survey	46. This is part of a continuing study.	June 1984
A-47. Talkeetna to Cook Inlet not being studied in adequate detail.	ADNR	47. Dwight & Trihey 81 Survey	47. Lower river is receiving increased study effort.	June 1984
A-48. The instream flows studies should define the impacts of various flow releases and related reservoir water surface elevations.	ADNR	48. Letter to APA May 13, 1982 and Testimony on April 16, 1982	48. Instream flow studies are continuing. Much of this was addressed in Exhibit E.	June 1984
A-49. Flow rates studied should include an evaluation of pre-project flows in comparison to one resulting in no impacts, one resulting in significant impacts and flow rates between the two.	ADNR	49. Letter to APA May 13, 1982 and Testimony on April 16, 1982	49. This is part of continuing studies.	June 1984
A-50. Morphological changes to the aquatic system resulting from (1) decrease in spring flood frequencies, and (2) alterations of sediment transport.	ADNR	50. Letter to APA May 13, 1982 and Testimony on April 16, 1982	50. Studies on morphological changes and habitat transformation are presently being conducted. Aggradation/degradation questions are being analyzed to the extent possible.	June 1984
A-51. Will there be enough water to support present species of fish?	BLM	51. Dwight & Trihey 81 Survey	51. Continuing instream flow studies will address this question.	June 1984
A-52. Effect of winter flow on fry that migrate into the Susitna from tributaries.	BLM	52. Dwight & Trihey 81 Survey	52. Addressed in Exhibit E; continuing impact assessment.	June 1984

ISSUE		AGENCY	SOURCE	STATUS	COMPLETION DATE
A-53.	What will the river stage be at different times of the year?	BLM	53. Dwight & Trihey 81 Survey	53. Addressed in Exhibit E; will be refined.	June 1984
A-54.	What is the effect of temperature change on spawning, movement, outmigration, and egg development?	BLM	54. Dwight & Trihey 81 Survey	54. Addressed in Exhibit E; additional studies will further refine the impact assessment of temperature change.	June 1984
A-55.	The importance of side channels and sloughs between Talkeetna and Devil Canyon for spawning and rearing salmon.	NMFS	55. APA Board Testimony April 16, 1982	55. Sloughs have received substantial study effort; 1983 field studies have investigated side channels.	June 1984
A-56.	The impacts of various flow regimes on the habitat, balancing of fish habitat losses against power generation, and other mitigation possibilities that could be evaluated.	NMFS	56. APA Board Testimony April 16, 1982	56. Instream flow and flow selection studies are continuing.	June 1984
A-57.	Temperature changes within the Susitna River resulting from construction and operation of the dams.	NMFS	57. APA Board Testimony April 16, 1982	57. Addressed in Exhibit E; temperature modeling is on-going so as to refine existing information.	June 1984
A-58.	As some salmon within the Susitna River have life cycles of five or more years, it would seem reasonable to allow at least this long for fishery studies.	NMFS	58. APA Board Testimony April 16, 1982	58. Three field seasons have been completed.	June 1986
A-59.	Adequate instream flow regimes for spawning, rearing and migration of indigenous fish species.	NMFS	59. Letter to APA Oct. 15, 1982	59. Flow selection studies are continuing.	June 1984
A-60.	Maintenance of water quality for fish.	NMFS	60. Letter to APA Oct. 15, 1982	60. Addressed in Exhibit E. Additional studies are continuing.	June 1984
A-61.	Construction should proceed at times of least biological activity and should employ best management practices to further reduce these impacts.	NMFS	61. Letter to APA Oct. 15, 1982	61. Addressed in Exhibit E.	_____

ISSUE		AGENCY	SOURCE	STATUS	COMPLETION DATE
A-62.	Discuss temperature changes related to project operation, the impact such changes would present to fish, and proposed mitigation measures which will avoid or lessen such impacts.	NMFS	62. Letter to APA Oct. 15, 1982	62. Addressed in Exhibit E, being refined w/modeling effort.	_____
A-63.	Potential for gas supersaturation during project operation.	NMFS	63. Letter to APA Oct. 15, 1982	63. Addressed in Exhibit E.	_____
A-64.	Turbidity changes due to reservoir construction and operation.	NMFS	64. Letter to APA Oct. 15, 1982	64. Addressed in Exhibit E.	_____
A-65.	River morphology changes due to project operation.	NMFS	65. Letter to APA Oct. 15, 1982	65. Addressed in Exhibit E.	_____
A-66.	Effective flow releases and water quality conditions to avoid losses to existing and potential anadromous fish resources.	NMFS	66. Letter to APA Oct. 15, 1982	66. This is recognized, and is part of APA mitigation policy.	_____
A-67.	Compensation in the form of fish habitat improvements, artificial production or similar methods is required to fully replace unavoidable losses.	NMFS	67. Letter to APA Oct. 15, 1982	67. Mitigation planning is a continuing process that will be refined based on additional information.	_____
A-68.	Development of a release schedule which would mitigate impacts to fisheries.	NMFS	68. Letter to APA Review of Draft Ex. E	68. Flow selection studies are continuing.	June 1984
A-69.	Maximum winter flow limits in light of potential staging should ice cover develop below Devil Canyon.	NMFS	69. Letter to APA Review of Draft Ex. E	69. Instream flow studies to consider winter flow limits are on-going.	June 1984
A-70.	Minimize impacts and/or enhance conditions for salmon spawning in the Susitna River.	NMFS	70. Letter to APA Review of Draft Ex. E	70. Instream flow studies are on-going.	June 1984
A-71.	Minimize impacts and/or enhance conditions for juvenile salmon feeding.	NMFS	71. Letter to APA Review of Draft Ex. E	71.	_____
A-72.	Minimize impacts and/or enhance conditions for salmon passage in the Susitna River.	NMFS	72. Letter to APA Review of Draft Ex. E	72.	_____

ISSUE		AGENCY	SOURCE	STATUS	COMPLETION DATE
A-73.	Minimize impacts and/or enhance conditions for out-migration of juvenile salmon.	NMFS	73. Letter to APA Review of Draft Ex. E	73.	_____
A-74.	Minimize impacts and/or enhance conditions for overwintering of juvenile salmon in Susitna River.	NMFS	74. Letter to APA Review of Draft Ex. E	74.	_____
A-75.	Retaining the habitat value of side sloughs through physical alteration: a slough mitigation plan which identifies the sloughs to be modified, the design criteria, and the operation plan and target fish species specific to each slough.	NMFS	75. Letter to APA Review of Draft Ex. E	75. This is being done as the mitigation plan is further developed.	June 1984
A-76.	To what extent will other tributaries be available for power development?	FWS	76. Dwight & Trihey 81 Survey	76. Other tributaries are not being actively considered for power production at this time.	_____
A-77.	Commercial use of the river by interests.	FWS	77. Dwight & Trihey 81 Survey	77. Additional studies on flow below Talkeetna are being conducted.	June 1984
A-78.	Effect on icing at mouth of Chulitna because of increased flows in winter.	FWS	78. Dwight & Trihey 81 Survey	78. Ice processes were addressed in the Exhibit E; additional analyses are on-going to refine previous analyses.	June 1984
A-79.	More aquatic habitat will be lost below Talkeetna than above.	FWS	79. Dwight & Trihey 81 Survey	79. Analyses on impacts to habitat below Talkeetna are on-going; corollary studies on recreation can use information from the habitat studies for analysis.	June 1984
A-80.	Effects of altered flow regimes on side channels that are used for spawning and rearing by salmon.	FWS	80. Dwight & Trihey 81 Survey	80. Addressed in Exhibit E; continues to receive study.	June 1984
A-81.	Effects of changes in water temperatures on seasonal use of mainstem and side channel habitats by resident and anadromous fish.	FWS	81. Dwight & Trihey 81 Survey	81. Addressed in Exhibit E; continues to receive study.	June 1984

SUSITNA HYDROELECTRIC PROJECT: AGENCY-RAISED ISSUES

Subtask: Aquatic Resources

ISSUE		AGENCY	SOURCE	STATUS	COMPLETION DATE
A-82.	Small boat access into and out of clearwater tributaries, i.e., Willow, Little Willow, Deshka, etc.	FWS	82. Dwight & Trihey 81 Survey	82. Access for navigation was discussed in the Exhibit E; additional lower river studies will potentially help to answer additional questions.	June 1984
A-83.	Effects of the project on waste load assimilation capacity of the Susitna River.	FWS	83. Dwight & Trihey 81 Survey	83. Described in Exhibit E.	_____
A-84.	Requirements for all major species of fish, including salmon (5 species), rainbow trout, grayling. All stages - spawning, migration, overwintering, rearing, feeding.	FWS	84. Dwight & Trihey 81 Survey	84. Addressed in Exhibit E; also part of continuing ADFG and AEIDC study.	June 1984
A-85.	Mitigation for transmission line construction and maintenance impacts.	FWS	85. Letter to APA Jan. 5, 1982	85. Mitigation through avoidance of impact has been incorporated into the design where possible. Impacts are minimized where avoidance was not possible (addressed in Exhibit E).	_____
A-86.	Effects of construction of the transmission line on wetlands during winter months.	FWS	86. Letter to APA Jan. 5, 1982	86. To the extent possible, construction will be such that impacts will be minimized. The comment is noted for future reference for planning of construction.	_____

SUSITNA HYDROELECTRIC PROJECT: AGENCY-RAISED ISSUES

Subtask: Aquatic Resources

ISSUE		AGENCY	SOURCE	STATUS	COMPLETION DATE
A-87.	No more than one route between major stream crossings or other geographic barriers of the transmission line.	FWS	87. Letter to APA Jan. 5, 1982	87. This will generally be the case, to the extent possible.	_____
A-88.	100-foot-wide vegetation buffers remain along all streams and rivers crossed by the transmission lines.	FWS	88. Letter to APA Jan. 5, 1982	88. This will be done where possible.	_____
A-89.	Enhancement opportunities as well as potential negative impacts to fish of the transmission line.	FWS	89. Letter to APA Jan. 5, 1982	89. Enhancement opportunities are not overlooked and are considered where appropriate.	_____
A-90.	Timing of project construction to minimize impacts.	FWS	90. Letter to APA Jan. 5, 1982	90. Construction timing was considered in Exhibit E.	_____
A-91.	The assessment of fishery resources must be extended to downstream areas, transmission and access corridors, and areas of secondary or indirect impacts.	FWS	91. Testimony at APA Board Meeting April 16, 1982	91. These were addressed in Exhibit E.	_____
A-92.	There are inadequate data to describe the relationship between various stream flows and the productivity of fisheries and aquatic habitat downstream from the proposed Devil Canyon Dam.	FWS	92. Testimony at APA Board Meeting April 16, 1982	92. Instream flow studies by ADFG and AEIDC are continuing.	June 1984
A-93.	Anticipated water temperatures in the reservoirs.	FWS	93. Testimony at APA Board Meeting April 16, 1982	93. Temperature models are being refined. Studies on turbidity are continuing as part of the impact assessment evaluation.	June 1984
A-94.	Anticipated turbidity levels in the reservoirs.	FWS	94. Testimony at APA Board Meeting April 16, 1982	94.	_____
A-95.	Anticipated temperatures downstream from Devil Canyon.	FWS	95. Testimony at APA Board Meeting April 16, 1982	95.	_____
A-96.	Anticipated turbidity levels downstream from Devil Canyon.	FWS	96. Testimony at APA Board Meeting April 16, 1982	96.	_____
A-97.	We believe that alternatives to Susitna must also continue to be studied.	FWS	97. Testimony at APA Board Meeting April 16, 1982	97. Alternatives to the Susitna Project are re-examined on a continuing basis.	_____

ISSUE		AGENCY	SOURCE	STATUS	COMPLETION DATE
A-98.	The effects of the project on benthic productivity.	FWS	98. Letter to APA Oct. 5, 1982	98. Many of these concerns are addressed in Exhibit E. Inst.eam flow and temperature studies are continuing.	June 1984
A-99.	Effects of the project on chemical composition of the River to maintain existing fishery.	FWS	99. Letter to APA Oct. 5, 1982	99.	———
A-100.	Mitigation options must be examined on the basis of a defensible, quantified impact analysis.	FWS	100. Letter to APA Oct. 5, 1982	100. Mitigation planning is a continuing process that will be refined as additional information becomes available. Quantification of impacts is currently being analyzed by AEIDC.	June 1984
A-101.	Quantify the relationship between mainstream discharge and the availability of fish habitat by life stage.	FWS	101. Letter to APA Oct. 5, 1982	101. AEIDC and Harza-Ebasco are currently analyzing these relationships.	June 1984
A-102.	Assess the interrelationship of the Susitna River to its tributaries in regard to fishery habitat requirements vs. life stage.	FWS	102. Letter to APA Oct. 5, 1982	102. This information was provided in the Exhibit E.	———
A-103.	Flow regimes versus fish habitat downstream of Talkeetna throughout the year.	FWS	103. Letter to APA Oct. 5, 1982	103. Studies are in progress.	June 1984
A-104.	Identify the source, flow, chemical and temperature characteristics of upwelling water in the sloughs and their relationship to mainstream conditions throughout the year.	FWS	104. Letter to APA Oct. 5, 1982	104. Initial studies have been completed, but additional studies are continuing.	June 1984
A-105.	Influence of ice cover on the relationship between the mainstream and the sloughs.	FWS	105. Letter to APA Oct. 5, 1982	105. Studies are in progress.	June 1984
A-106.	Baseline surface and intergravel temperature data sufficient to describe the annual thermal regimes of the mainstream river, side channels, and sloughs above Talkeetna.	FWS	106. Letter to APA Oct. 5, 1982	106. Initial studies have been completed with on-going studies continuing to add refinement to the existing knowledge.	Sept. 1984

ISSUE	AGENCY	SOURCE	STATUS	COMPLETION DATE
A-107. The relationship between ambient and potential project-caused temperature conditions and salmon embryo survival and rate of development.	FWS	107. Letter to APA Oct. 5, 1982	107. USFWS egg incubation study and baseline field studies will resolve this question.	June 1984
A-108. The viability of slough modifications to increase fishery habitat needs to be demonstrated.	FWS	108. Letter to APA Oct. 5, 1982	108. APA will be trying to maintain habitat, not increase it. The feasibility of these modifications is being examined. Mitigation planning is an on-going process.	June 1984
A-109. The long range implications of proposed project flows vs. natural flows and potential habitat maintenance flows in terms of possible slow loss of sloughs, and loss of flushing flows.	FWS	109. Letter to APA Oct. 5, 1982	109. Discussed in Exhibit E. Additional studies are on-going to refine this information.	June 1984
A-110. Salmon enhancement potential above Devil Canyon without the Susitna project, with the Susitna project and the impacts of any program to establish salmon in the upper river on existing fisheries, particularly grayling.	FWS	110. Letter to APA Oct. 5, 1982	110. This was part of an ADFG study funded by the Alaska legislature.	Draft completed June 1983
A-111. The potential to establish/expand the salmon fishery between the Devil Canyon and Watana dam sites in the absence of a Devil Canyon development.	FWS	111. Letter to APA Oct. 5, 1982	111. Addressed in Exhibit E.	_____
A-112. Within and out-of-basin opportunities to offset losses to fisheries such as stream stocking, lake fertilization, extension of existing fisheries, and increasing public fishing access and opportunities.	FWS	112. Letter to APA Oct. 5, 1982	112. Discussed in Exhibit E.	_____
A-113. Extent of dewatering between the Devil Canyon and its powerhouse and associated fishery impacts, and mitigation options.	FWS	113. Letter to APA Oct. 5, 1982	113. Discussed in Exhibit E.	_____
A-114. Pre- and post-project nitrogen levels in Devil Canyon and impacts.	FWS	114. Letter to APA Oct. 5, 1982	114. Discussed in Exhibit E.	_____

ISSUE		AGENCY	SOURCE	STATUS	COMPLETION DATE
A-115.	Changes in flows, temperature, and chemical composition of the Susitna River due to the proposed project for dry, average and wet years.	FWS	115. Letter to APA Oct. 5, 1982	115. Will be considered by continuing studies.	June 1984
A-116.	The impact of changes in winter flows, turbidity, chemical composition, salinity levels, and timing and extent of ice formation and break-up on the estuary.	FWS	116. Letter to APA Oct. 5, 1982	116. Will continue to receive study.	June 1984
A-117.	The viability of a reservoir fishery needs to be evaluated through an assessment of: predicated reservoir temperatures, turbidity, chemical composition and anticipated primary productivity, available spawning habitat, potential for establishing spawning habitat, and the relationship of a reservoir fishery to establish tributary fisheries.	FWS	117. Letter to APA Oct. 5, 1982	117. Addressed in Exhibit E. Additional studies are on-going.	June 1984
A-118.	Hydraulic turbine configurations with both a one and two dam configuration related to maximizing flow release options vs. more flexible turbine system alternatives.	FWS	118. Letter to APA Oct. 5, 1982	118. Addressed in Exhibit E.	_____
A-119.	Changes in the existing ice patterns and reliable predictions of what these patterns would be with the project.	FWS	119. Letter to APA Oct. 5, 1982	119. Part of continuing studies.	ne 1984
A-120.	The timing of formation, extent, thickness, and time of breakup of ice vs. a range of water releases and winter conditions.	FWS	120. Letter to APA Oct. 5, 1982	120. This is discussed in Exhibit E. However, additional studies and analyses are continuing so as to refine the existing knowledge on ice-processes.	June 1984
A-121.	What would be the impact on beaver, moose, salmon utilization of the mainstream, grayling and other resident fishery use of the mainstream.	FWS	121. Letter to APA Oct. 5, 1982	121. Addressed in Exhibit E. This is the subject of on-going studies.	June 1984

ISSUE		AGENCY	SOURCE	STATUS	COMPLETION DATE
A-122.	The extent to which ice functions in channel formation and modification and predicted changes in this role.	FWS	122. Letter to APA Oct. 5, 1982	122. Discussed in Exhibit E; subject of on-going studies.	June 1984
A-123.	Adjustments to the Watana reservoir filling schedule to minimize impacts to fish.	FWS	123. Letter to APA Oct. 5, 1982	123. Adjustments to the schedule create beneficial and adverse impacts. Flow schedules are discussed in the Exhibit E. However, additional instream flow studies are on-going.	June 1984
A-124.	Quantification of aquatic habitat to be inundated.	FWS	124. Letter to APA Oct. 5, 1982	124. Discussed in Exhibit E.	_____
A-125.	Magnitude, duration, and frequency of occurrence of daily fluctuations and their impacts on fish resources with both a one and two dam system.	FWS	125. Letter to APA Oct. 5, 1982	125. Discussed in Exhibit E.	_____
A-126.	Disposal of material excavated from tailrace and power tunnels, saddledam and general dam construction and potential uses.	FWS	126. Letter to APA Oct. 5, 1982	126. Discussed in Exhibit E.	_____
A-127.	Impacts of the construction village, permanent village, and alternatives to the proposed system to minimize adverse effects on fish resources.	FWS	127. Letter to APA Oct. 5, 1982	127. Discussed in Exhibit E.	_____
A-128.	Timing restrictions to minimize adverse impacts due to access road, transmission lines, and dam construction.	FWS	128. Letter to APA Oct. 5, 1982	128. Discussed in Exhibit E.	_____
A-129.	The impacts due to construction and maintenance of the transmission lines need to be fully evaluated.	FWS	129. Letter to APA Oct. 5, 1982	129. Discussed in Exhibit E.	_____
A-130.	Impacts of construction and maintenance of access road need to be fully evaluated.	FWS	130. Letter to APA Oct. 5, 1982	130.	_____

PRELIMINARY

4 ber 1983

SUSITNA HYDROELECTRIC PROJECT: AGENCY-RAISED ISSUES

Subtask: Aquatic Resources

ISSUE	AGENCY	SOURCE	STATUS	COMPLETION DATE
A-131. Fishery impact assessment of borrow areas and access to these sites.	FWS	131. Letter to APA Oct. 5, 1982	131.	_____
A-132. Minimizing fish and wildlife impacts through proper timing of woody material removal in the impoundment areas.	FWS	132. Letter to APA Oct. 5, 1982	132. Discussed in Exhibit E.	_____
A-133. Handling of hazardous materials to and at the construction sites and safety precautions.	FWS	133. Letter to APA Oct. 5, 1982	133. Discussed in Exhibit E.	_____
A-134. Public access to the upper Susitna basin should be evaluated within the context of the project's need to minimize, to the extent possible, adverse impacts to fish and their habitats.	FWS	134. Letter to APA Aug. 17, 1982	134. Access associated impacts were addressed in the Exhibit E; studies are continuing on potential access-related impacts.	June 1984
A-135. Mitigation measures which are proposed should have proven success in Alaska, or in a similar environment.	FWS	135. Jan. 14, 1983 Comments on Draft Ex. E to APA (letter)	135. Mitigation planning is on-going.	_____
A-136. Should fully consider impact of lower oil prices and revised electrical demand forecast on overall project feasibility.	NMFS	136. Letter to APA Review of Draft Ex. E	136.	_____
A-137. Should fully consider impact of lower oil prices and revised electrical demand forecast on the need for Watana to be operational by 1993.	NMFS	137. Letter to APA Review of Draft Ex. E	137.	_____
A-138. Should fully consider impact of lower oil prices and revised electrical demand forecast on the economics associated with providing sufficient downstream fisheries flows.	NMFS	138. Letter to APA Review of Draft Ex. E	138.	_____

APPENDIX B

LIST OF PREVIOUS STUDIES

1. Alaska Department of Fish and Game. 1974. An assessment of the anadromous fish populations in the Upper Susitna River Watershed between Devils Canyon and the Chulitna River. Anchorage, Alaska.

2. _____. 1976. Fish and Wildlife studies related to the Corps of Engineers Devils Canyon, Watana Reservoir Hydroelectric Project. ADF&G. Anchorage, Alaska.

3. _____. 1977. Preauthorization assessment of the proposed Susitna Hydroelectric Projects: preliminary investigations of water quality and aquatic species composition. ADF&G. Anchorage, Alaska.

4. _____. 1978. Preliminary environmental assessment of hydroelectric development on the Susitna River. Anchorage, Alaska.

5. _____. 1979. Preliminary final plan of study. Fish and wildlife studies proposed by the ADF&G. ADF&G. Anchorage, Alaska.

6. _____. 1981. Susitna Hydro Aquatic Studies. Phase I. Prepared for Acres American, Inc. by the ADF&G/Su Hydro. Anchorage, Alaska.

7. Alaska Dept. of Fish & Game. 1982. Susitna Hydro Aquatic Studies. Phase II. Prepared for Acres American, Inc. by the ADF&G/Su Hydro. Anchorage, Alaska.

8. Acres American, Inc. (Acres). 1983. Susitna Hydroelectric Project FERC License Application, Exhibit E. Anchorage, Alaska.

9. R & M Consultants, Inc. 1980, 1981 and 1982. Water Quality Annual Report. Prepared for Acres American, Inc. by R & M Consultants, Anchorage, Alaska.

10. _____. 1982. Hydraulic & Ice Studies. Prepared with Acres American, Inc. by R & M Consultants, Inc. Anchorage, Alaska.

11. _____. 1982. Reservoir Sedimentation. Prepared for Acres American, Inc. by R & M Consultants, Anchorage, Alaska.

12. _____. 1982. Glacial Lake Studies. Prepared for Acres American, Inc. by R & M Consultants, Anchorage, Alaska.

13. _____. 1982. Water Quality Effects Resulting from Impoundment of the Susitna River. Prepared for Acres American, Inc. by R & M Consultants, Anchorage, Alaska.

14. Peratrovich, Nottingham & Drage, Inc. 1982. Susitna Reservoir Sedimentation and Water Clarity Study. Prepared for Acres American, Inc. by Peratrovich, Nottingham & Drage, Inc. and Ian P. Hutchinson, Anchorage, Alaska.

15. E. Woody Trihey, P.E. 1982. Winter Temperature Study. Prepared for Acres American, Inc. by E. Woody Trihey with contributions from the ADF&G and AEIDC, Anchorage, Alaska.