MAY 20 1985

ALASKA POWER AUTHORITY

BOARD OF DIRECTORS MEETING

Juneau Borough Chambers

Friday, May 3, 1985

8:30 a.m.

OLD BUSINESS

I. A. Action Items

5. Licensing Review and Consideration of Proposed Staging of Construction of the Susitna Hydroelectric Project

SUPPLEMENTAL INFORMATION

Supplement 1 - ENGINEERING

Supplement 2 - PROJECT COSTS & ECONOMICS

Supplement 3 - POWER & ENERGY PRODUCTION

Supplement 4 - FINANCIAL ANALYSIS

Supplement 5 - ENVIRONMENTAL ANALYSIS

STAGED CONSTRUCTION OF THE SUSITNA HYDROELECTRIC PROJECT.

A. Action Item

Approval to incorporate staged construction of the Watana facilities into the Susitna Hydroelectric Project, and to update and/or optimize other features, as appropriate. See Figure 1, Plan and Schedule.

B. Background

The Application for License before the Federal Energy Regulatory Commission (FERC), submitted February 1983, proposes a two-stage project on the Susitna River. The first stage would be a facility at the Watana site with the dam built to an elevation of 2,205 feet, a second facility at the Devil Canyon site would have a dam built to an elevation of 1,465 feet. Several planning studies determined that this arrangement optimizes the power development of the Susitna River.

At the February 1985 Board meeting, Staff reported on a preliminary analysis of staged construction of the Watana facility which indicated that the Project, as presented in the FERC License Application, is still the optimum plan, however, the staged construction would (1) result in lesser initial cost (and thereby might facilitate financing), (2) require a smaller State contribution, and (3) provide additional decision points in the project plan and schedule that would allow project development to be more closely aligned with actual system growth. The benefits of staging would be at the expense of a somewhat higher eventual total project cost.

Staff recommended, and the Board authorized, further studies be completed to confirm the preliminary assessments of the staged project in the areas of engineering, economics, finance, and environment. This Action Item reports on those studies.

C. Issues

1. Engineering. The staged project would be constructed in three stages instead of the currently proposed two stages. The stages would be:

   Stage I - Watana Initial Dam - Dam Crest Elevation 2025
   Stage II - Devil Canyon Dam - Dam Crest Elevation 1465
   Stage III - Watana High Dam - Dam Crest Elevation 2205

   Supplement 1 describes the engineering aspects of construction staging, and contains the report of the Engineering External Review Panel on Staging.*

2. Project Cost and Economics. Staging the Watana development would reduce initial construction costs and the required state contribution for rate stabilization. However, total construction costs of

the three-stage development will be higher than those of the two-stage development, and bonding requirements will be greater. Staging the Watana Dam reduces the benefit/cost ratio of the License Application scheme by a modest degree as reported in February.

Supplement 2 provides estimated construction cost in both real and nominal dollars and provides an economic comparison between the two-stage and three-stage projects.*

3. Power and Energy. The three-stage project would provide the opportunity to align project capacity and energy more closely with actual regional demand growth as it occurs in the future. There would be increased flexibility in timing the Susitna project increments to match the utility needs.

   Supplement 3 describes energy and capacity data for the staged project, and provides a comparison between the two-stage and three-stage projects.*

4. Finance. The amount of bonds required to fund the construction of the first two stages of the three-stage project is less than that required under the FERC concept. However, due to inflation and some real cost differences, the bonds required to construct all three stages is greater than that required under the FERC concept.

   Due to the relatively greater usability and lower initial costs, the three-stage project reduces the amount required for the utilities to be fully rate stabilized.

   Supplement 4 provides an analysis of financing alternatives for the two and three stage project, the cash flow requirements, and an analysis of state contributions.*

5. Environment. The aquatic impacts of the Stage III of the project (Watana High Dam and Devil Canyon Dam) would remain essentially the same as the currently proposed project. The intermediate stages, Stage I (Watana Initial Dam) and Stage II (Watana Initial Dam and Devil Canyon Dam) would have different downstream effects because of less capability to reregulate the annual river flows, and consequently, a somewhat different thermal regime for the Watana reservoir. During the early years of the Project this cooler thermal regime results in an increased ice cover downstream from the dams as compared to the full development, with a resultant increase in overtopping flows of cooler water into aquatic habitat in the side sloughs of the middle river. This may have a negative impact on the survival of incubating salmon in these sloughs. However, it is possible to mitigate for this impact by placing berms and dikes so as to completely protect the slough from overtopping flows.

   A decision to pursue three stage development of the Susitna Hydroelectric Project would generally have no major adverse impacts on any wildlife or botanical resources within the project area. From a wildlife or botanical resource viewpoint, three stage development would in fact have several advantages over the current license application project. Under this plan approximately 15,000 acres of wildlife habitat, which would be inundated by the High Watana impoundment, would not be inundated for roughly 10 years. Construction activities would continue over a longer period of time, and thus disrupt wildlife for a longer period. However, the level of disturbance to wildlife during Stage III construction would be less due to the reduced magnitude of the construction effort, the presence of an existing infrastructure developed during Stages I and II, and the extension of the time period during which public access would be prohibited. Since Devil Canyon pool would inundate one of the principal borrow areas for fill material for the Watana Damsite, it would be necessary to open additional borrow areas when Watana Dam is raised in Stage III.

The primary effect of staged construction on cultural resources are twofold. First, it would reduce the number of archeogical sites initially impacted by reservoir flooding. Second, it would allow more time for studying those sites and for implementing the cultural resources mitigation plan. While the total construction workhours would be less and the construction period would be less, and the construction period would be reduced by one year for Stage I as compared to High Watana, the total number of workers required at peak construction would be similar. Workforce requirements for Stage II (Devil Canyon) would not change. A workforce (which would be smaller than for Stage I) would be required to construct Stage III. Therefore, the general size and timing of socioeconomic effects are not anticipated to differ substantially for Stages I and II than for the License Application. Adding Stage III would result in continued but smaller project-related employment opportunities and attendant socioeconomic effects.

Supplement 5 provides an assessment of the environmental effects of the staged project and a comparison with the currently proposed project.*

6. <u>Licensing</u>. The staged project will require additional environmental evaluation by FERC staff to permit preparation of a Final Environmental Impact Statement (FEIS). This additional period of evaluation could delay the completion of the FEIS, resulting in a corresponding delay in the current hearing schedule. FERC has asked to be promptly apprised of Board action so that appropriate resource planning can take place.

D. Costs of Revising License Application

A decision to proceed with revising the application is anticipated to increase the Power Authority project licensing costs by approximately

$972,000 not including legal fees. Table 1 shows the source of the additional costs.

Table 1. Estimated Additional Consultant Costs for Licensing to Cover Project Staging

	FY85	FY86
Engineering	$94,000	$298,000
Environment	56,000	149,000
Geotechnical	---	---
Licensing and Permitting	20,000	20,000
Logistics	---	---
Need for Power	85,000	59,000
Transmission	56,000	46,000
Hydrology	54,000	5,000
External Review Panel	30,000	---
Management and Administration	---	---
Total	395,000	577,000
Grand Total		$972,000

E. Project Schedule

Considering only the licensing delays accumulated to date, the project full power on-line date has slipped from 1993 to 1997; this latter date can be changed to 1996 with staging. Table 2 shows on-line dates for the current and staged projects.

Table 2. Online Dates for the Current and Staged Projects Assuming Final Design Authorization in December 1985

	Current Project	Staged Project
Watana Initial Dam		
First Unit Power	N/A	Oct. 1995
Full Power		Dec. 1996
Devil Canyon Dam		
First Unit Power	2002	2002
Full Power	2002	2002
Watana High Dam		
First Unit Power	Oct. 1996	2008
Full Power	Dec. 1997	2008

The shorter construction time for Watana Initial Dam results in a one year reduction for the on-line date of the first stage. In addition, there is increased opportunity to adjust on-line dates of the several stages to more closely match project energy and capacity with system demands.

The on-line dates suggested here reflect the initiation of design and geotechnical programs in December 1985. The design and geotechnical programs are critical path activities and projected on-line dates are as sensitive to delays in initiating these programs as they are to the licensing date.

F. Staff Findings.

1. Staged construction is practical from an engineering point of view.

2. Although the Project, as presently incorporated in the Licensing process, has the optimum dam height from an economic perspective, staged construction would provide several benefits:

   A) Staged construction would lower initial development costs, but would increase real project costs about 9%.

   B) Staged construction would align project energy and capacity more closely with actual system demands, and would provide greater flexibility in responding to future rates of system growth.

   C) Staged construction would lower the required state investment in the project and could facilitate financing of the project.

   D) The environmental impacts of the staged project are only modestly greater than the current project and are within acceptable bounds with mitigation.

G. Options

1. Approve:

   A) Incorporation of staged construction of the Watana facilities as part of the proposed project; and

   B) Completion by staff of required studies and preparation of materials necessary for their submission to FERC, including those revisions to the physical arrangement of the project other than staging, which are considered to be desireable means of reducing the project cost; and

   C) Staff enlisting advice from counsel for procedural actions with FERC to the extent necessary to assure orderly and expeditious pursuit of the EIS process and, ultimately, the FERC license; and

   D) Staff approaching FERC with counsel to submit necessary documentation to allay FERC's concerns with budget and schedule, and to determine FERC License schedule implications of staging. These implications will be communicated to the Board as soon as they are determined; and

E) Taking funds for the License revision from the $1.2 million Board Contingency Fund.

2.

A) Disapprove incorporation of staged construction of the Watana facilities and thereby confirm the Board's commitment to the currently proposed project, and

B) Authorize staff to prepare materials necessary for updating the Application for License to reflect realistic on-line date.

H. Recommendations

Option 1.

ALASKA POWER AUTHORITY
SUSITNA HYDROELECTRIC PROJECT
STAGED CONSTRUCTION

ENGINEERING

I. Staged Construction Concept

The Application for License before the Federal Energy Regulatory Commission (FERC), submitted February 1983, proposes a two-stage project on the Susitna River. The first stage would be a facility at the Watana Site with the dam built to an elevation of 2205 feet (see Figure 1-1), and a second facility at the Devil Canyon site, with the dam built to an elevation of 1463 feet (see Figure 1-2). Planning studies indicate that this arrangement optimizes the power development of the Susitna River.

While the proposed dam height provides the most cost effective approach to achieving the optimum power development of the river, it requires a large initial investment in the Watana stage of the project and would result in a period during which it is anticipated there would be some excess capacity.

A three-stage project could be initiated by the construction of Watana Dam to a crest elevation of 2025 feet (see Figure 1-3). With its crest at elevation 2025, the dam would require substantially less material, construction time would be reduced and only four of the planned six units would be installed. Development of the transmission system would also be staged to match transmission capacity with generating capacity (see Figure 1-4). These changes would allow Stage I of the project to be brought on line at a lower cost, although with reduced capacity and energy. After completion of Stage I, Stage II, consisting of Devil Canyon Dam, would be constructed. The Devil Canyon facility is identical with that in the FERC Application for License.

When load growth indicates the need, Stage III, Watana High Dam, would be constructed by raising the Watana Initial Dam to the full height described in the FERC Application for License (see Figure 1-5).

II. External Review Panel of Consultants

The staged construction concept was presented in detail to the External Review Panel of Consultants on 15 April 1985. Their report (copy attached) confirms the feasibility of the staging concept. The report also raises the issue of the surface powerhouse in place of the underground facility included in the FERC Application for License.

The possibility of a surface powerhouse was evaluated in the summer of 1983. It was decided at that time not to attempt this change to the FERC Applciation for License in view of the potential for delay in the licensing process.

Inasmuch as staging will involve a significant change in the FERC License process, it is believed appropriate now to study the cost effects of a surface powerhouse and, if warranted, include such a change to the FERC Application for License along with staging.

III. Description of Facilities - Staged Concept

Watana - Stage I

The Watana Initial Dam would be built to elevation 2025 with a maximum normal reservoir elevation of 2000 (see Figure 1-5). The internal zoning of the earthfill dam would incline the impervious core. The inclination of the core would reduce the amount of shell material required for stability of the Stage III dam that would be submerged by the Stage I pool, and therefore placed during Stage I construction. When the dam is being raised, all the additional fill could then be placed in the dry during the seasonal drawdown of the reservoir. The raising of Watana Dam involves no adverse effects on the safety of either the Stage I or Stage III dam, and no unusual construction operation is required during raising. An additional five feet of freeboard is added in Stage I to facilitate flood control with the smaller reservoir storage volume.

The spillway and approach channel excavations would be deepened by approximately 185 feet below that shown in the FERC license concept in order to accommodate the reservoir during Stage I (see Figure 1-6). The rock excavated from these areas would be used in the construction of the dam and would minimize or eliminate the need for opening a quarry site during Stage I. The deeper excavation would be designed with suitable rock reinforcement and berms. The spillway in either concept would pass the potential maximum flood.

For Stage I, there would be one outlet facility structure and two power intake structures (see Figure 1-3). The invert elevations would accommodate the lower reservoir elevations. The outlet facility in conjunction with the four powerhouse units in Stage I would be designed to discharge a 50-year flood before flow would be discharged over the spillway. The same applies to the current two-staged project.

The powerhouse in Stage I would have four units. With the lower head available in Stage I, each unit would generate 130 MW for a total of 520 MW.

The construction schedule for Stage I has been shortened by one year over that which was planned for in the FERC license concept. The shortening of the schedule is a result of a decrease in the quantities of the fill material necessary for the Stage I construction.

Devil Canyon - Stage II

Devil Canyon has not changed from the FERC license concept.

Watana - Stage III

The Watana Initial Dam would be raised to elevation 2205 with a maximum normal reservoir elevation of 2185 (see Figure 5). During seasonal drawdown when the Stage I reservoir elevation is below elevation 1925 (the elevation of the upstream berm) rockfill would be in the dry on the upstream side of the dam. The material for the rockfill would be excavated from quarry A and the material for the core and filters from borrow areas D, E, and F.

The concrete spillway ogee crest would be raised to El. 2135 (see Figure 7).

The outlet facility structure and the two power intakes would be raised to elevation 2201. A third power intake would be built in Stage III with an invert elevation at 2012.

Two additional units would be added to the Powerhouse bringing the total number of units to six. After completion of Stage III, the capacity of the Powerhouse would increase from 520 MW to 1020 MW because of the increase in head on the four Stage I units and the addition of two more units at 170 MW each.

LIST OF FIGURES

WATANA DAM GENERAL PLAN
FERC LICENSE CONCEPT

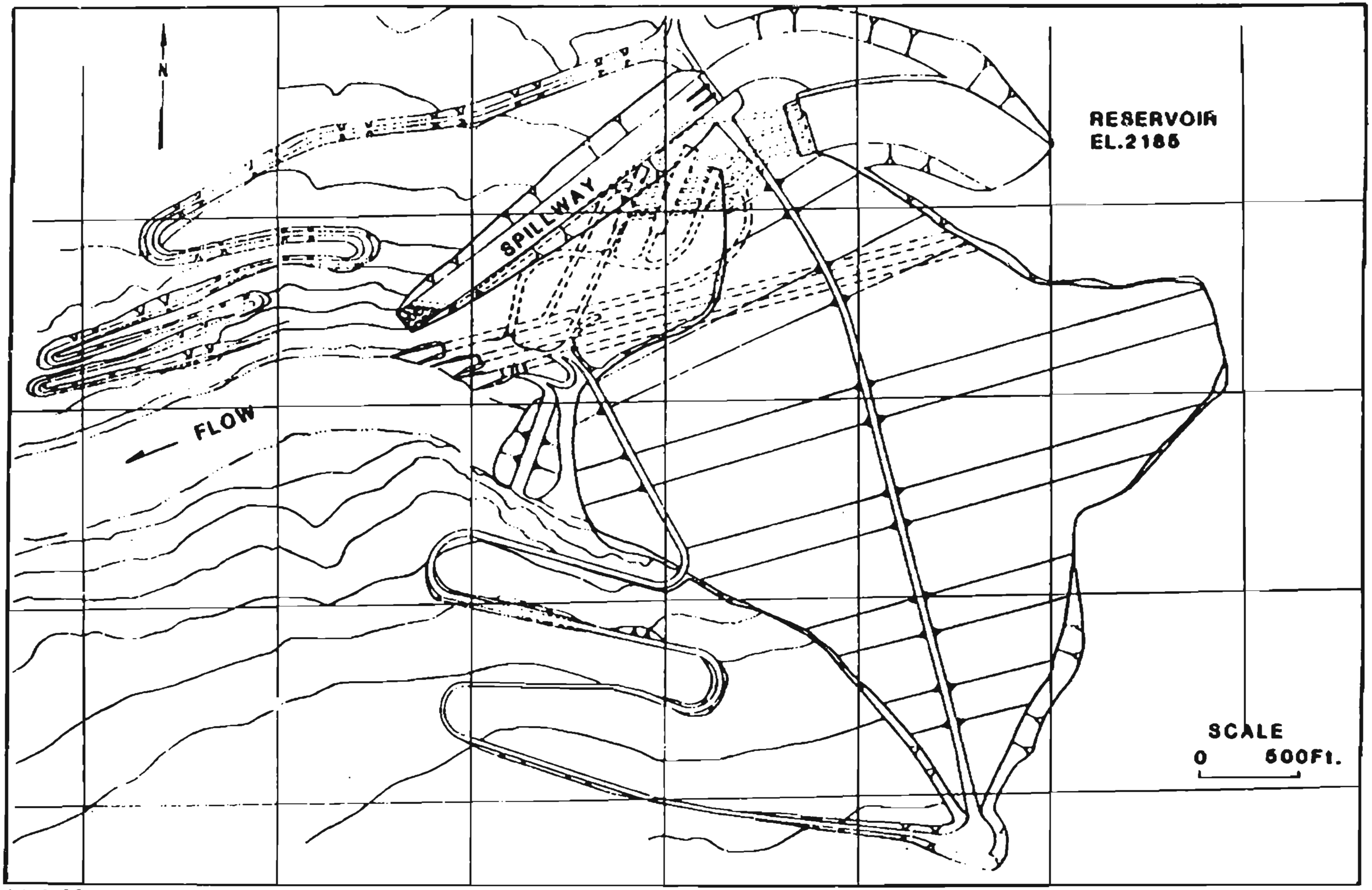

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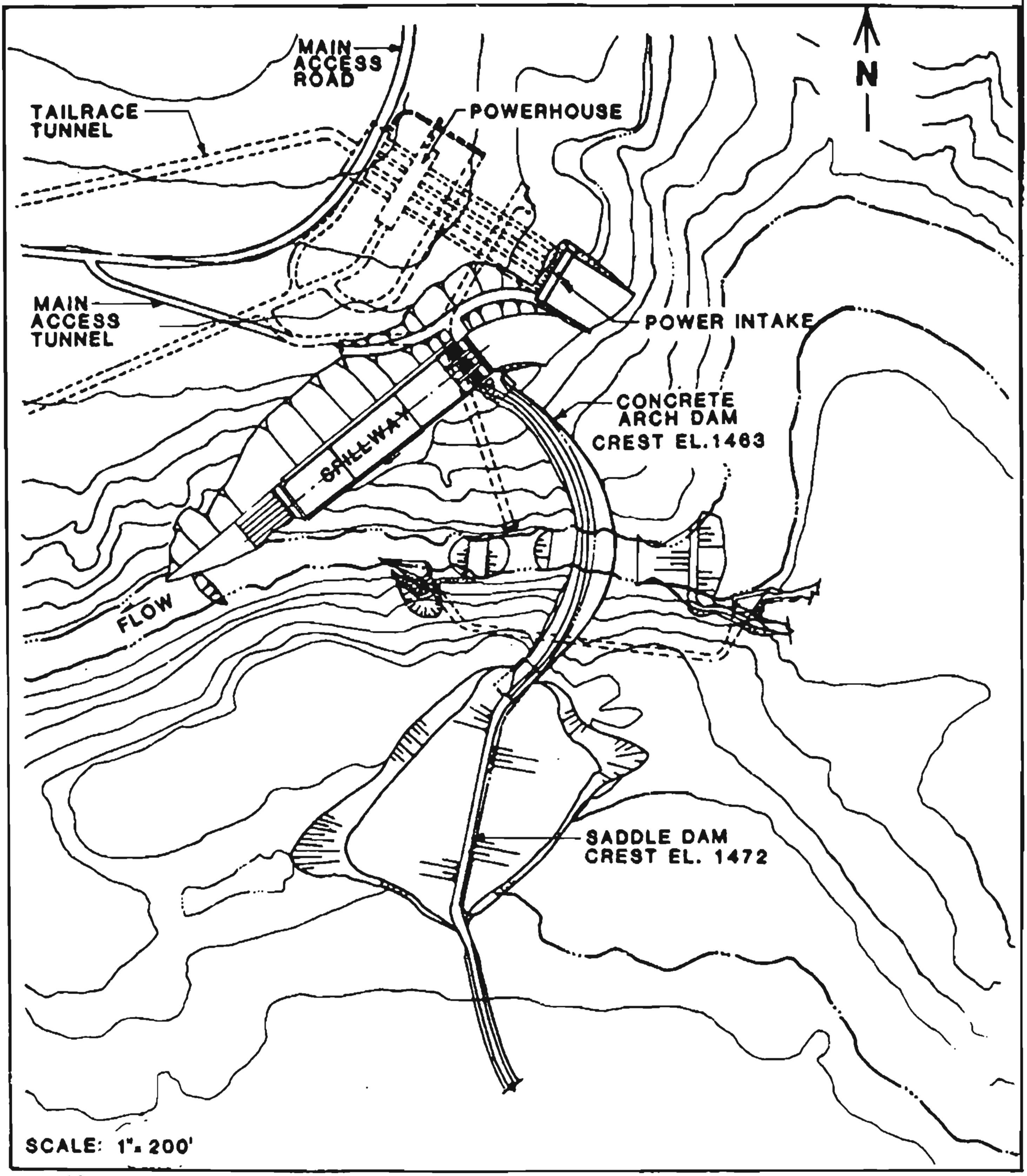
FIGURE 1-1

FIGURE 1-2

DEVIL CANYON GENERAL PLAN

FERC LICENSE OR STAGED CONSTRUCTION



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WATANA DAM GENERAL PLAN
STAGED CONSTRUCTION CONCEPT

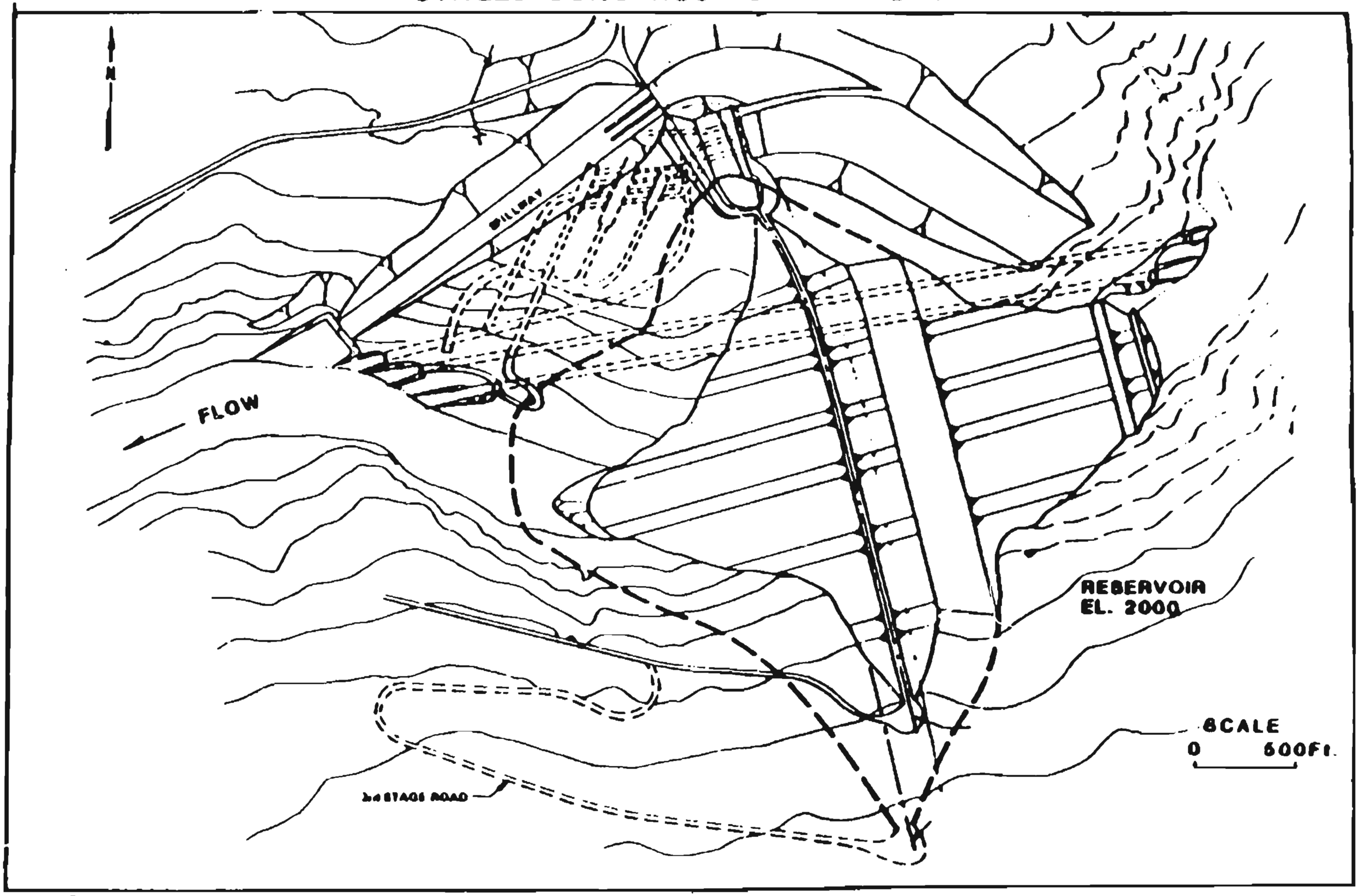


FIGURE 1-3

2/12/85

SUSITNA HYDROELECTRIC PROJECT
STAGED CONSTRUCTION PRESENTATION

STAGED CONSTRUCTION TRANSMISSION LINES
STAGE III

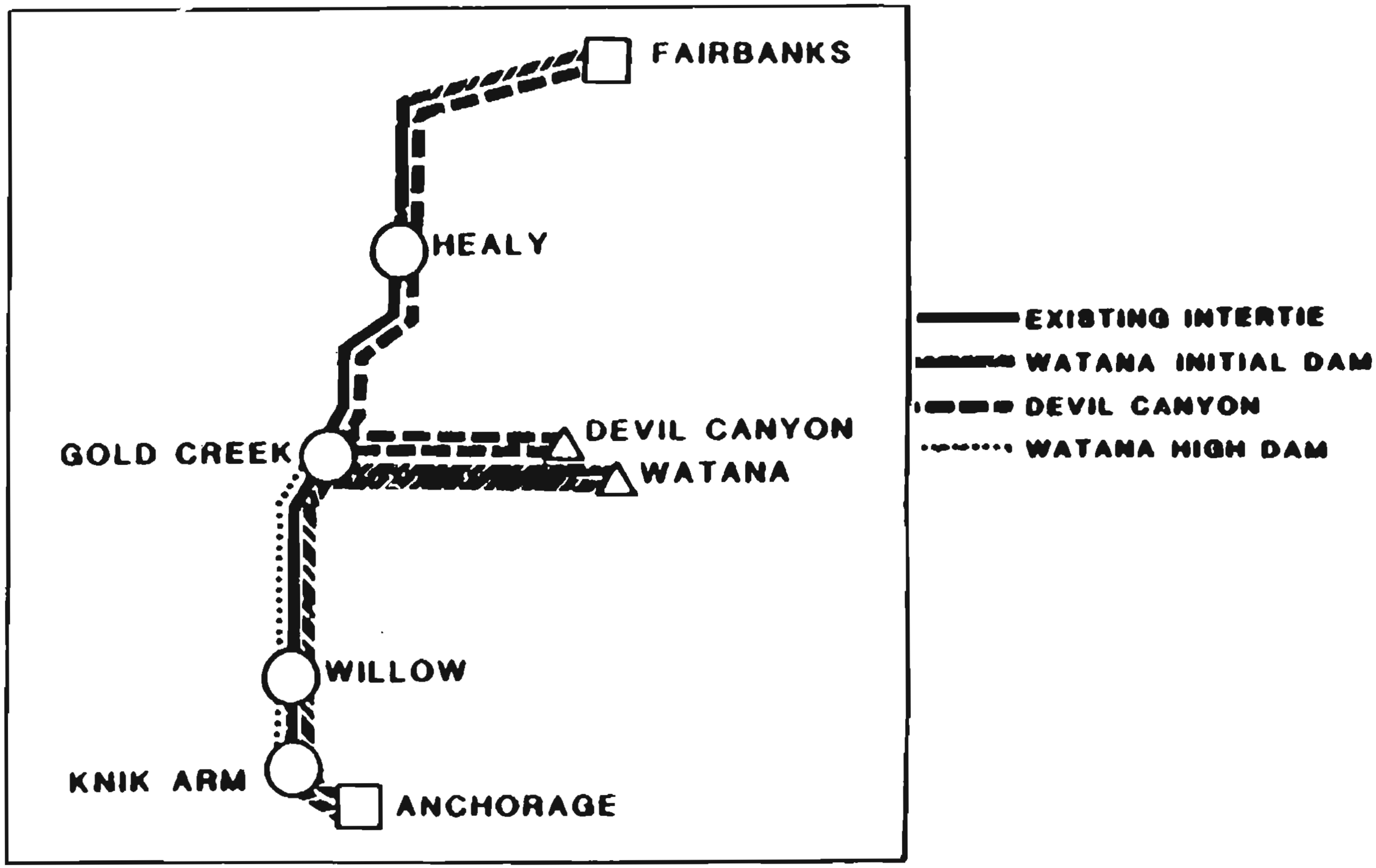
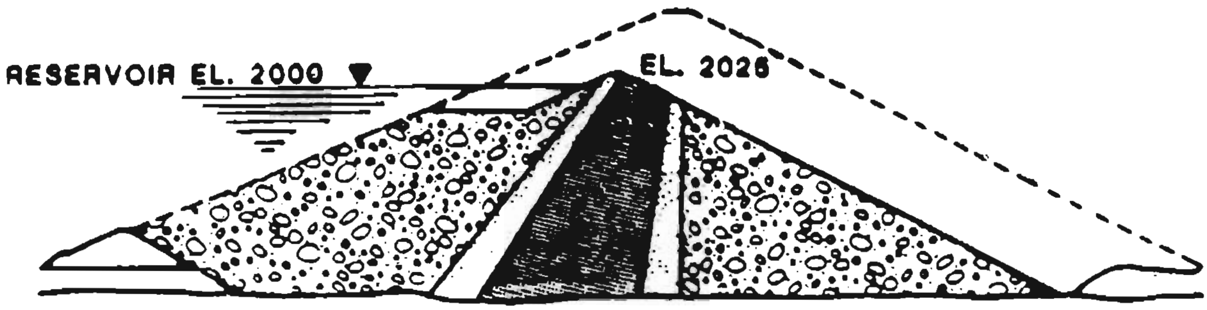


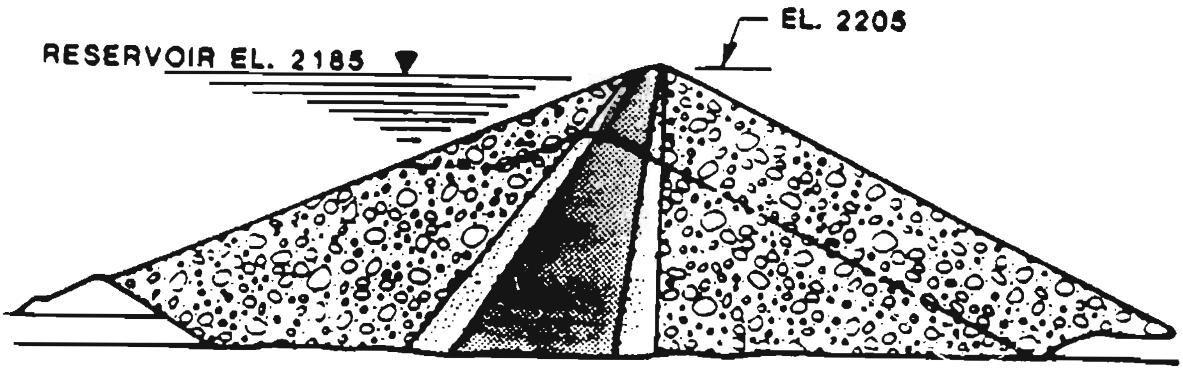
FIGURE 1-4

SUSITNA HYDROELECTRIC PROJECT
STAGED CONSTRUCTION PRESENTATION

CROSS SECTION THRU THE DAM



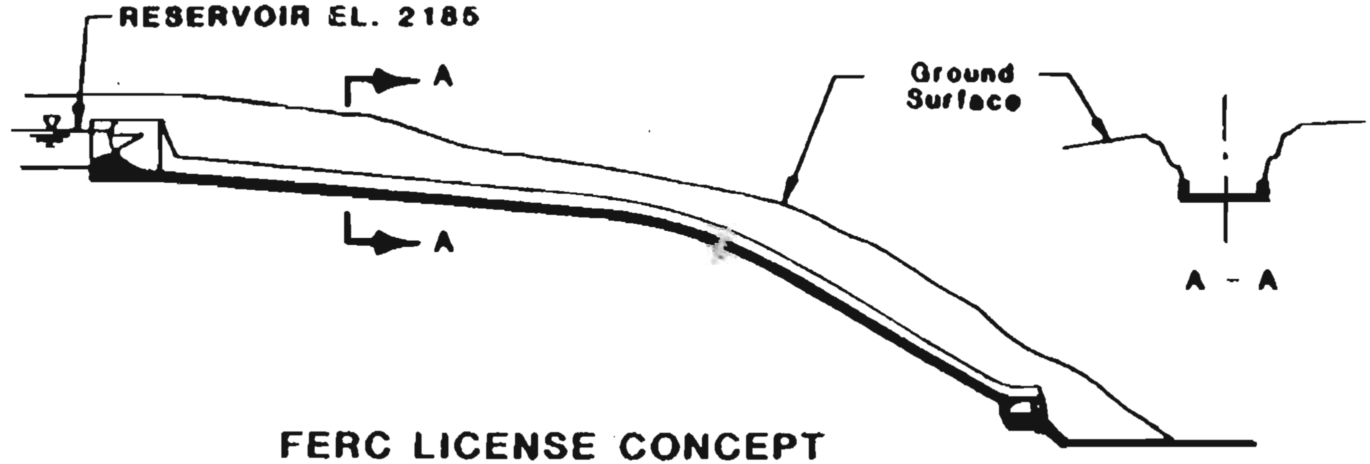
STAGE I-WATANA INITIAL DAM



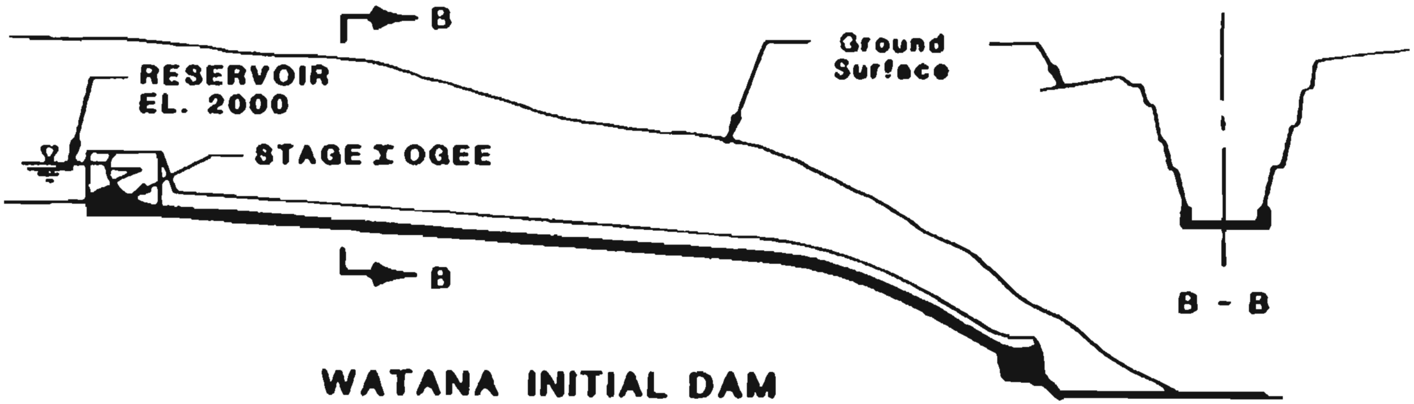
STAGE III-WATANA HIGH DAM

SUSITNA HYDROELECTRIC PROJECT
STAGED CONSTRUCTION PRESENTATION

WATANA SPILLWAY CROSS SECTION



FERC LICENSE CONCEPT



WATANA INITIAL DAM

FIGURE 1-6

SUSITNA HYDROELECTRIC PROJECT
STAGED CONSTRUCTION PRESENTATION

WATANA SPILLWAY RAISING

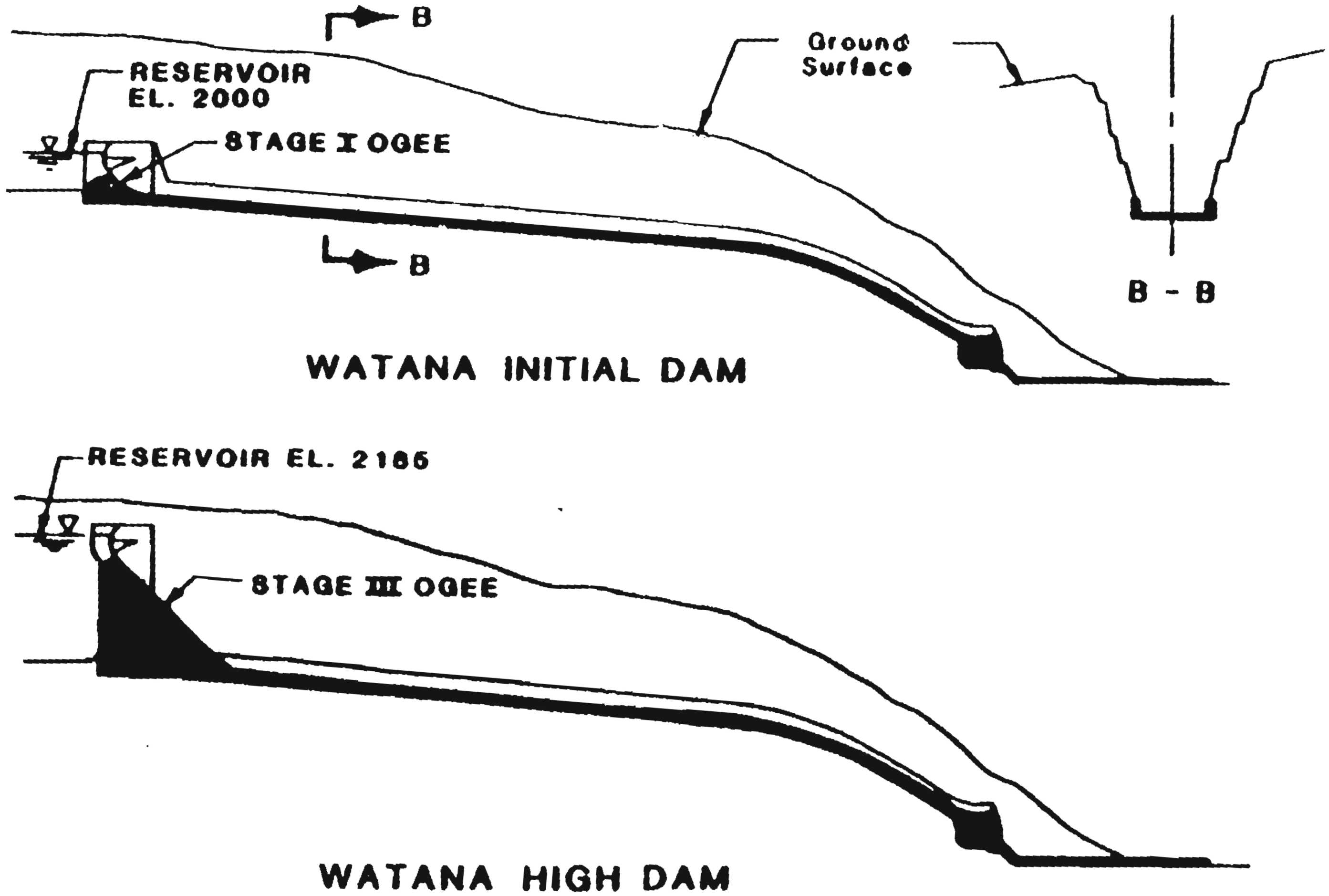


FIGURE 1-7

April 16, 1985
1.8.2/9.3.3

Mr. James B. Dischinger
Project Manager
Alaska Power Authority
334 West 5th Avenue
Anchorage, Alaska 99501

Subject: Susitna Hydroelectric Project
External Review Panel
Engineering Sub-Panel Meeting
Report No. 2

Dear Mr. Dischinger:

This letter is to transmit Report No. 2 of the External Review Panel, Engineering Sub-Panel for the Susitna Hydroelectric Project prepared by the undersigned members.

Very truly yours

James W. Libby

James W. Libby

Andrew H. Merritt

Andrew H. Merritt

Ralph B Peck

Ralph B. Peck

pd
Enclosure

SUSITNA HYDROELECTRIC PROJECT
EXTERNAL REVIEW PANEL
ENGINEERING SUB-PANEL MEETING
REPORT NO. 2

April 16, 1985

1. INTRODUCTION

The undersigned three memmbers of the External Review Panel met in Anchorage on April 15 and 16, 1985 to consider a series of design refinements to the Project license application. Primary emphasis was given to staged construction of the project. In addition, information was presented on the project schedule, some aspects of the project layout, and future exploratory work. This report presents our views on the principal matters presented.

2. STAGED CONSTRUCTION

A proposal was presented to construct Watana Dam in two stages, first (Stage I) to operate with the reservoir at El 2000, and second (Stage III) at a final elevation of 2185. Devil Canyon Dam would be constructed (Stage II) at an intermediate time. The advantages of staged construction were indicated as reducing the initial financial commitment of the State, and allowing more flexibility in meeting local growth. We agree that the proposal would accomplish these objectives. The ultimate cost, with Stage III investment, will be higher.

Technically, the proposal includes a modification of the internal zoning of Watana Dam to allow raising the dam safely and economically, and deepening the spillway and approach channel to accommodate the reservoir at the Stage I elevation.

The core of the modified cross section has been inclined upstream to reduce the amount of shell material, required for stability of the Stage II dam, that would be submerged by the Stage I pool and therefore must be placed during Stage I construction. When the dam is raised, all the additional fill can thus be placed in the dry with only a brief, modest lowering of the reservoir. We regard this modification to be appropriate. It involves no adverse effects on the safety of either the Stage I or Stage III dam, and no unusual construction operations during raising. We would anticipate that further modifications of the cross section will be found advantageous as more detailed information is developed regarding the borrow materials.

The spillway and approach channel must be deepened about 200 feet for operation during Stage I. In our judgment the quality of the rock will permit the deeper excavation with safety when designed with suitable slopes and berms, and with the anticipation that more than routine rock reinforcement will be required to meet local conditions that may be disclosed by observation and instrumentation. When the dam is raised, both the power intake and spillway structures will require extension upward. The conceptual schemes described to us appear reasonable.

3. POWERHOUSE

In the Panel's report of August 1983, we wrote that recent studies had shown significant cost advantages for a surface powerhouse as compared to the underground layout presented in the feasibility report. It was also mentioned that the surface alternate required some major open cuts, the cost of which were difficult to assess because of the lack of subsurface information in this area. It is still our view that the outdoor powerhouse design has many advantages principally because it avoids the major unknowns inherent in the excavation of three large underground chambers and numerous tunnels and intersections which is not without problems even in the best rock conditions. We recognize that considerable weight was given to the seasonal advantages of undergound excavation in the feasibility report. However, experience with similar structures in Canada has shown that outdoor construction can continue efficiently throughout the winter with proper protection of the works.

At present, there are three deep borings in the right abutment in the general area of the proposed chambers. While much of the core indicates favorable rock conditions, there is ample evidence of clay-filled joints, altered diorite, and small shear zones. Under these conditions, the rock cannot be assumed to be a relatively homogeneous mass but rather a rock possessing numerous planes of weakness, the geometry of which is unknown at this time.

Geotechnical investigations for final design would require several additional borings and an exploratory adit whose total length could be in the range of 2000 feet. This program would be expensive and require a major block of time on the overall exploration schedule. Exploration for the outdoor layout would require relatively short borings principally to determine the depth of overburden and possibly two or three short adits, whose total length would probably not exceed 150-200 feet.

In conclusion we believe that the surface powerhouse alternate has significant cost advantages and should be studied in more detail by the Engineer. An early decision on the preferred layout would result in a redirection to the proposed exploration program.

4. SCHEDULE

An overall schedule of exploration, design and construction, including detail on support facilities, was presented. This schedule shows first power on line in 1997, 12 years from now. The schedule is constrained by the decision to do only support facility (access and camp) exploration and study before power sales agreements are obtained, and to do virtually no construction of access, camp or permanent works before the FERC license has been issued. A two-year period is shown between issuance of the FERC license and commencement of first permanent work at the diversion tunnels. Total construction time of the permanent works is shown as seven and one-half years to first generation.

We agree that the imposed restraints are reasonable and appropriate. We would recommend, however, that construction of the temporary airstrip should be advanced at least a year (to mid 1987) to minimize access and support costs for exploration work, and that exploration should be accelerated with as much accomplished in 1986 and 1987 as possible in the predesign stage before FERC licensing. We feel that much of the exploration must be completed before the Harza-Ebasco general project design memorandum is final, and most completed before feature design memoranda are begun. Such exploration is also required to develop reliable cost estimates. Watana is an important major project and site data are still quite limited.

The seven and one-half year construction schedule for permanent works seems excessive. Based on our experience on other similar projects in similar environments, it is our present judgment that this schedule can be shortened by at least one year.

We also believe that the two-year interval between issuance of the FERC license and start of diversion tunnel construction can be reduced by several months.

5. EXPLORATION PROGRAM

Additional exploration was done in 1984 at the request of FERC. Eleven borings were drilled in the Fins, channel, proposed underground powerhouse, and the spillway and diversion tunnel outlets. During this meeting Harza-Ebasco presented a schedule for the overall exploration program which shows work being done for the support facilities in the summer of 1985. Beginning in early 1986 and continuing essentially through 1989, exploration is done for access roads, the airstrip, and all civil works including diversion, the dam, required open cuts, and waterways.

At this time, however, no document is available showing the required exploration for each project feature. As was explained, the production of such a plan is not part of the Engineer's current work assignment. We are concerned that, without such a detailed plan, the exploration could proceed in a manner which is not guaranteed to produce the required information at the appropriate time. We expressed similar concerns in our report of August 1983.

We recommend that APA reconsider their current position regarding the expenditure of funds for engineering efforts. In our opinion the project would benefit greatly from a carefully organized plan of exploration which incorporates all available geotechnical information and specifically mentions the additional information required for design.

NEXT MEETING

It was tentatively agreed that the next meeting of the Engineer Sub-Panel will be held October 1 - 4, 1985, with arrival in Anchorage September 30.

James W. Libby

Andrew H. Merritt

Ralph B. Peck

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SUSITNA HYDROELECTRIC PROJECT

EXTERNAL REVIEW PANEL

MEETING ON STAGED CONSTRUCTION
April 15 and 16, 1985
Sixth Floor Conference Room

AGENDA

April 15, 1985

0900-0915	Introductions - Opening Remarks	J. B. Dischinger & J. C. Stafford
0915-0930	Susitna Project Description	C. D. Craddock
0930-1000	Project Master Schedule	C. D. Craddock
	Project Status	
1000-1015	a) Licensing Effort	W. E. Larson
1015-1030	b) Engineering Effort	W. E. Larson
	Engineering Update	
1030-1100	a) Design Refinements	C. D. Craddock
1100-1130	b) 1984 Exploration Program	M. P. Bruen
1130-1200	c) Design Memorandum Concept	C. D. Craddock
1200-1300	Lunch	
1300-1415	Staged Construction Concept	C. D. Craddock
	1985 Engineering Work Effort	
1415-1430	a) Staged Construction	C. D. Craddock
1430-1500	b) Watana Support Facilities Master Plan	C. D. Craddock
1500-1530	c) Watana Camp Expansion	C. D. Craddock
1530-1600	d) Future Geotechnical Investigations	M. P. Bruen
1600-1700±	Discussion	

April 16, 1985

0900-1200	Consultants Prepare Report	Consultants
1300-1400	Outbriefing	Consultants
1400-1430	Future Involvement of Consultants	J. B. Dischinger & C. D. Craddock

SUSITNA HYDROELECTRIC PROJECT

EXTERNAL REVIEW PANEL

ENGINEERING SUB-PANEL MEETING

REPORT NO. 2

Attendees April 15, 1985

Dr. Ralph B. Peck	Consultant
Dr. Andrew H. Merritt	Consultant
Mr. James W. Libby	Consultant
James B. Dischinger	Alaska Power Authority
John C. Stafford	Alaska Power Authority
M. P. Bruen	Harza-Ebasco
C. D. Craddock	Harza-Ebasco
D. J. Duck	Harza-Ebasco
J. L. Ehasz	Harza-Ebasco
W. E. Larson	Harza-Ebasco
P. R. Samuolis	Harza-Ebasco
C. F. Whitehead	Harza-Ebasco
A. Zagars	Harza-Ebasco

ALASKA POWER AUTHORITY
SYSITNA HYDROELECTRIC PROJECT
STAGED CONSTRUCTION

PROJECT COSTS AND ECONOMICS

I Project Costs

Feasibility level costs of the Susitna Project have been estimated based on the FERC license concept and on the staged concept. A cost comparison of the two concepts shows that full development of the staged concept is more expensive than the FERC license concept as shown below. However, Stage I Watana of the staged concept is significantly less expensive than the Watana stage of the FERC license concept as indicated in Table 2-1.

TABLE 2-1
PROJECT COSTS
($ MILLION 1982)

Stage		FERC License	Staged Construction
I	Watana	$3,371	$2,528
II	Devil Canyon	1,475	1,492
	Subtotal	$4,846	$4,020
III	Raise Watana	---	1,270
	Total	$4,846	$5,290
	Cost Differential		+$444

Table 2-2 includes a more detailed summary cost comparison of the FERC license concept versus the staged concept.

II Economics

An economic analysis of the staged Susitna project has shown that it is somewhat less attractive economically than the FERC license concept, but is still significantly lower in cost than the least-cost thermal alternative. The benefit-cost ratios of the FERC license concept compared to the least-cost thermal alternative and the staged concept compared to the least-cost thermal alternative are essentially the same as those presented to the Power Authority Board in February (i.e., 1.5 and 1.4, respectively).

TABLE 2-2

PROJECT COSTS
($ MILLIONS 1982)

Item	Staged Construction Concept				FERC License
	Stage 1 Watana El. 2000	Stage 2 Devil Canyon	Stage 3 Watana El. 2185	Total - Stages 1 to 3	Watana El. 2185 & Devil Canyon
Land & Land Rights	32	22	19	73	73
Powerhouse	75	72	21	168	144
Dam, Reservoir & River Diversion	947	561	589	2,097	1,928
Power Generation Equipment	71	67	36	174	172
Roads, Rail and Air Facilities	191	119	51	361	332
Electric Transmission Facilities	294	113	118	525	487
Construction Facilities & Misc.	279	154	153	586	491
Total Direct Costs	1,889	1,108	987	3,984	3,626
Contingency Allowance	272	160	142	574	533
Subtotal	2,161	1,267	1,129	4,557	4,159
Licensing, Engineering, & Administration	367	225	141	733	687
Total Project Cost	2,528	1,492	1,270	5,290	4,846

ALASKA POWER AUTHORITY
SUSITNA HYDROELECTRIC PROJECT
STAGED CONSTRUCTION

POWER AND ENERGY PRODUCTION

Under the staged construction scheme, the initial Watana dam is about 180 feet lower than that proposed in the FERC license concept. This results in lower head and less flow regulation capability at Watana. The lower head reduces the Watana power output, while the reduced reservoir storage reduces both the Watana and Devil Canyon energy generation. After raising the Watana project (Stage III), the power and energy generation from the two concepts are identical. Table 3-1 provides a comparison of power and energy production for the two concepts.

A distinct advantage of the staged construction concept is its ability to more closely match the expected Railbelt loads without developing excess capacity. Figures 3-1 and 3-2 demonstrate this effect. Figure 3-1 shows the relation between Railbelt peak power demand and installed capacity for the least-cost thermal alternative.

Figure 3-2 shows the power demand and installed capacity relations for the Susitna case. Both the FERC license concept and the staged concept are shown. Excess reserve capacity exists with the Susitna project during its early years. The reserve capacity more closely matches system requirements under the staged concept than the FERC license concept. This is especially true for the period 2002 through 2008.

ALASKA POWER AUTHORITY
SUSITNA HYDROELECTRIC PROJECT
STAGED CONSTRUCTION

FINANCIAL ANALYSIS

The staging of the Susitna Project not only provides the means to better match the load requirements of the Railbelt utilities, but it also reduces required rate stabilization funds. With the lower Watana Dam, in the initial stages, fewer bonds are required to fund the construction of the first two stages. However when Watana is raised to its ultimate height, inflation and real cost increases act to increase the overall bonding requirements of the staged concept versus the FERC licence concept.

The bond sizing analysis is based on the construction cash flow developed by Harza-Ebasco and the assumptions listed on Table 4-1. It is important to note that the analysis is based on the bonds having tax-exempt status and therefore a lower interest rate. Because over 25 percent of the Project output will be sold to non-exempt entities, the only way for the bonds to have tax-exempt status is through specific legislation by the U.S. Congress exempting the Susitna Project (as was done for Bradley Lake), State legislation authorizing the REA cooperative utilities to reorganize into public utility districts, or State legislation authorizing the Power Authority to direct bill the consumers in the railbelt area for costs associated with the Susitna Project. Even though the Project has been found to be economically feasible, the utilities' system costs with the Project are higher than the alternative in the early years due to the high capital costs of a hydroelectric project. The staged approach reduces the capital costs during this period, and the amount required to bring the utilities' costs down to the alternative is correspondingly reduced.

After reviewing the revised construction costs, we have found the required rate stabilization to be in the same order of magnitude as presented previously to the Board. As can be seen in Tables 4-3 and 4-4, the three-stage concept reduces rate stabilization from over $1.1 billion to $500-750 million if interest earnings are retained in the fund and from $4.5 billion to $2.6 billion if they are not retained. Absent such rate stabilization, the utilities' consumers would be faced with significant rate shock.

TABLE 4-1

BOND SIZING ASSUMPTIONS

- General Inflation Rate - 6.5 percent
- Bond Interest Rate - 10.0 percent
- Reinvestment Rates:
  - short-term - 9.0 percent
  - long-term - 11.0 percent
- Amortization Period - 35 years (level debt service)
- Bond proceeds will be used to fund construction costs, licensing costs, debt service reserve, working capital, and reserve and contingency.
- First bonds issued after FERC license issued and all monies expended to date are reimbursed and deposited into the Rate Stabilization Fund.

TABLE 4-2

BOND ISSUE SUMMARY

(MILLIONS)

	FERC LICENSE CONCEPT	STAGED CONSTRUCTION
Bond Size:		
I WATANA	$12,300	$ 8,600
II DEVIL CANYON	7,000	7,000
SUBTOTAL	$19,300	$15,600
III RAISE WATANA	---	8,400
TOTAL	$19,300	$24,000
Annual Debt Service:		
I WATANA	$ 1,280	$ 890
II DEVIL CANYON	720	720
SUBTOTAL	$ 2,000	$ 1,610
III RAISE WATANA	---	870
TOTAL	$ 2,000	$ 2,480

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TABLE 4-3

RATE STABILIZATION CONTRIBUTION

(MILLIONS)

YEAR	FERC LICENSE CONCEPT	STAGED CONSTRUCTION CONCEPT
1985	$ 100	$100
1986	200	200
1987	200	200
1988	200	100
1989	200	-
1990	200	-
1991	40	-
	$1,140	$600

CONCLUSION: A TOTAL STATE CONTRIBUTION IN THE RANGE OF $500 to $750 MILLION WILL MEET RATE STABILIZATION NEEDS

TABLE 4-4

STATE CONTRIBUTION

COMPARISON OF PAY IN AND PAY OUT OF FUNDS

(MILLIONS)

	FERC LICENSE CONCEPT		STAGED CONSTRUCTION	
YEAR	CONTRIBUTION (PAY IN)	RATE STABILIZATION (PAY OUT)	CONTRIBUTION (PAY IN)	RATE STABILIZATION (PAY OUT)
1985	$ 100	---	100	---
1986	200	---	200	---
1987	200	---	200	---
1988	200	---	100	---
1989	200	---	---	---
1990	200	---	---	---
1991	40	---	---	---
1992	---	---	---	---
1993	---	---	---	---
1994	---	---	---	---
1995	---	---	---	---
1996	---	---	---	250
1997	---	540	---	270
1998	---	550	---	240
1999	---	510	---	220
2000	---	450	---	180
2001	---	410	---	150
2002	---	740	---	460
2003	---	670	---	420
2004	---	550	---	380
2005	---	80	---	---
	$1,140	$4,500	$600	$2,570

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ALASKA POWER AUTHORITY
SUSITNA HYDROELECTRIC PROJECT
STAGED CONSTRUCTION

ENVIRONMENTAL ANALYSIS

I. Introduction

Analyses have been made of the environmental implications of the staged concept for the Susitna Project. These analyses considered the potential environmental effects of the following factors identified as major differences from the FERC license concept:

1. Smaller reservoir volume and reduced storage capacity for the Stage I Watana reservoir.

2. Decreased flow stability for Stage I, and to a lesser extent for Stage II in comparison to Stage III and the FERC license concept.

3. Lower downstream river temperatures (about 1°C) and greater ice cover development with resultant water level increases.

4. Reduced area of inundated land for the Stage I Watana Reservoir which delays the loss of wildlife habitat and cultural resources due to inundation.

5. Possible need for different borrow areas and quarry sites for Stage III development with attendent increase in wildlife and cultural resource impacts.

6. Increased total time required for completion of the project would prolong construction related impacts on wildlife, as well as socioeconomic impacts.

Findings

In general, analyses of the differences between the staged and FERC license concepts reveals no significant impacts which would effect Susitna's overall environmental feasibility. As detailed below, there are both positive and negative differential impacts associated with the staged concept, most of which are judged to be insignificant. The major exception, increased overtopping flows into side slough salmon habitats in the middle river, is an impact already identified for the FERC license concept, albeit at reduced frequency. As such, it has already been accounted for in the project mitigation planning process and can be avoided by increasing the extent of slough habitat protection.

II. Reservoir Operation, Temperature and Ice Studies

Summary

Reservoir operation was simulated for Stages I, II, and III. Reservoir and river temperature analyses and river ice simulations were made for a representative climate year for Stages I and II.

These studies of reservoir operation, reservoir temperature, river temperature and river ice were made to compare the environmental effects of staged concept with the FERC license concept. As summarized in Figures 5-1 through 5-6 and Tables 5-1 and 5-2, the changes resulting from the staged concept would be:

1. Higher summer flows and lower winter flows in Stage I than with the FERC license concept.

2. Greater ice cover and higher winter water levels in the river below the Project in both Stages I and II.

3. Approximately two weeks delay in the formation of a reservoir ice cover (from mid November to late November).

Stage III of the staged concept and the final stage of the FERC license concept would be the same.

Reservoir Operation

Stage I of the staged concept has a smaller reservoir storage volume than the FERC license concept. Less water can be stored in the reservoir for winter operation and the reservoir operating plan for the staged concept attempts to take advantage of the required higher summer flows to generate energy. The result is that average summer flows are about 4000 cfs. higher and average winter flows are about 2000 cfs. lower than with the FERC license concept.

For Stage II the Watana reservoir would fill earlier in the summer than in the case for Stage I. Stage II flows would be very similar to the FERC license concept.

Simulation of Stage III reservoir operation indicates it would be the same as the final stage of the FERC license concept. Flows at all times of the year are nearly identical.

Reservoir Temperature/Ice

Stage I reservoir temperature/ice simulations show the outflow temperatures to be nearly identical to the FERC license concept in the summer. Winter temperatures, however, are reduced from the FERC license concept by about 1° to 1.5°C. Although this difference is small its significance is in the additional ice production which would occur downstream of the project. There are two apparent reasons for the reduction in winter temperatures.

1. More flow is passed through the reservoir in the summer carrying heat with it, thus leaving less heat available for the winter season.

2. The reservoir ice cover tends to form about two weeks later than with the FERC license concept. It is believed this is the result of the additional wind induced mixing in the smaller reservoir.

SUSITNA HYDROELECTRIC PROJECT

COMPARISON OF PEAK CAPACITIES AVAILABLE

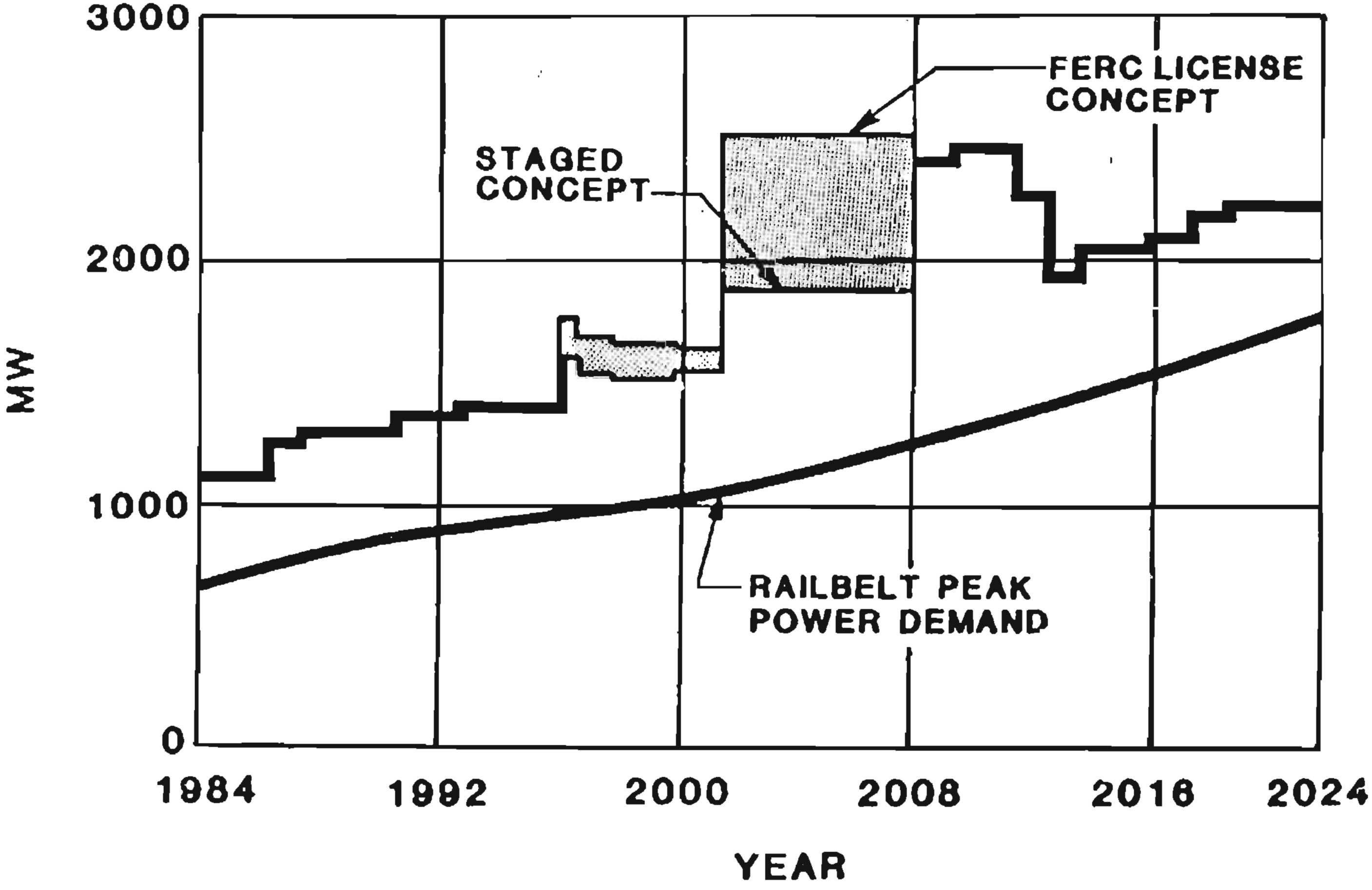

TABLE 3-1

COMPARISON OF CAPACITY AND ENERGY

	INSTALLED CAPACITY (MW)	AVG ANNUAL ENERGY (GWHR)
FERC LICENSE CONCEPT:		
WATANA HIGH DAM	1020	3500
DEVIL CANYON	600	3400
	1620	6900
STAGED CONSTRUCTION		
STAGE 1-WATANA INITIAL DAM	520	2470
STAGE 2-DEVIL CANYON	600	3120
STAGE 3-WATANA HIGH DAM	500	1310
	1620	6900

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SUSITNA HYDROELECTRIC PROJECT

NON-SUSITNA ALTERNATIVE PEAK DEMAND AND CAPACITY

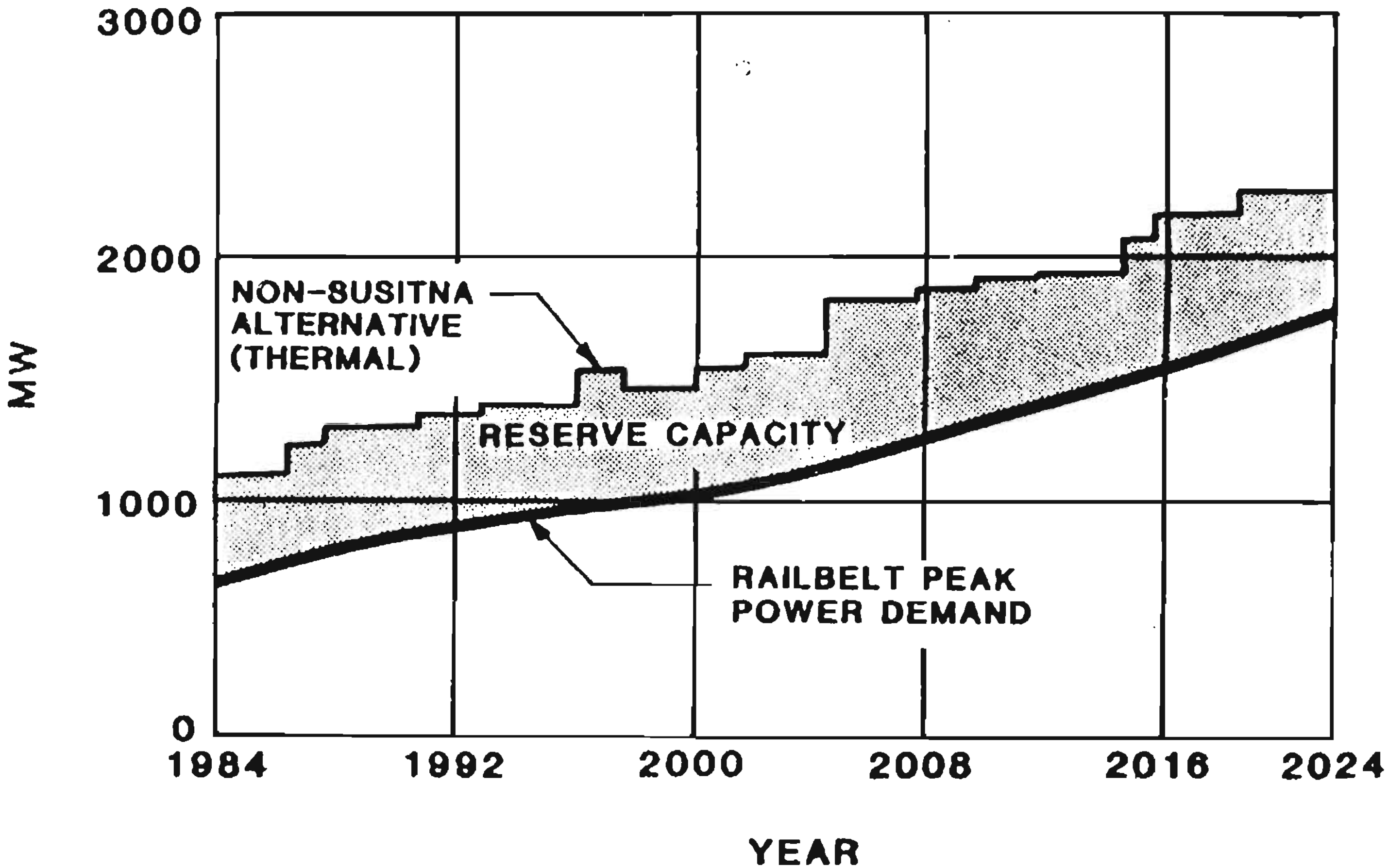

FIGURE 3.1

The ratio of surface area to volume is about 30% higher for Stage I Watana Reservoir. The delay in ice cover is important because the reservoir ice cover insulates the reservoir and reduces heat loss.

In Stage II, summer outflow temperatures are similar to the FERC license concept. Winter temperatures are about 0.5° to 1°C less than for the FERC license concept. Since flows are about the same for Stage II and the FERC license project, the main reason for the winter temperature difference is the delay in reservoir ice cover formation.

River Temperature

Simulation studies show that river temperatures would follow the same trend as reservoir temperatures. That is, they would be similar in summer to the FERC license concept and about 1°C colder in winter.

River Ice

Results of the ice modeling studies show that because of the colder winter reservoir outflow temperatures the ice cover for both Stage I and Stage II would extend further upstream and cause higher river levels than the FERC license concept.

Computer runs for Stage I suggest an ice cover about three miles further upstream than for the FERC license concept. This ice cover, in turn, results in an increase in water levels in the river. Water levels were up to four feet higher in an eight mile reach of the river between river miles 115 and 123 and about the same elsewhere. Without mitigation Slough 11 would be overtopped with Stage I but not with the FERC license concept. Melt out of the ice cover would be delayed by approximately three weeks.

Computer runs for Stage II resulted in an ice cover about seven miles further upstream at its maximum progression with water levels generally two feet higher between river miles 101 and 126. Sloughs 8A and 9 would be overtopped with Stage II where they were not overtopped in the FERC license concept. Melt out would be delayed by about 1 week.

Stage III river ice would be similar to the FERC license concept.

III. Aquatic Habitat Studies

Summary

The estimated "with project" flows, water temperatures and ice processes discussed above were compared between natural, FERC license concept and the staged concept conditions for a preliminary assessment of impacts on aquatic habitats due to project operation.

This comparison has shown only slight changes in anticipated project impacts. These changes can be ameliorated by changes in the mitigation plan. The major change necessary would be the need to increase the height and extent of artificial berms included in mitigation plans to protect side slough habitats from overtopping flows during the winter.

Flow

Smaller reservoir storage capacity during Stages I and II would result in a reduction in flow control during the summer and reduction of water available for power generation during the winter. Summer flows would be greater and less stable during Stages I and II than for the FERC license concept. This would produce a slightly greater quantity (area) of rearing habitat for fish using the mainstem and side channels, however, the loss of flow stability would reduce its quality. These factors should balance one another and result in approximately equal production from summer rearing habitats for either the staged or FERC license concepts.

Flows during August and September would be higher during Stages I and II than for the FERC license concept. These higher flows would provide improved access conditions for spawning chum and sockeye salmon to move into side slough spawning habitats. However higher, more extensive artificial berms would be required to protect these chum and sockeye salmon habitats from overtopping flows, in particular to protect the habitat modification structures which would be in place for mitigation purposes. As discussed below, these more extensive protective berms are also required to prevent overtopping flows in winter.

Winter flows would be lower during Stage I and II than for the FERC license concept. The difference between flows in August and September and flows through the winter would affect over-winter survival of salmon eggs in the side slough spawning areas. Decreasing flows during the fall would cause dewatering and freezing of some spawning locations. These flow decreases would be greater during Stage I and II than for the FERC license concept, however, both cases are an improvement over natural conditions. The improvement would simply be less with Stages I and II so there would be a loss of benefit until Stage III is operational.

Temperature

Water temperature during Stages I and II would be similar to those during the FERC license concept for the mid-summer and fall period. Temperatures through the winter and early summer would be slightly less (1-1.5°C). Such small temperature differences between the staged and unstaged projects are not expected to effect survival of the evaluation species or production from aquatic habitats.

Ice Processes

The reduced winter water temperatures during Stages I and II would result in a longer duration of ice conditions, further upstream progression of ice on the river, greater ice thickness and greater "river staging"1/ due to ice

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1/ River staging as used herein refers to increases in water level in the river. This is different from use of the term staging in relation to Project construction.

as compared to the FERC license concept. These conditions would have the greatest impact on over-wintering and incubation sites in side sloughs. Higher river staging would increase the frequency with which the natural existing upstream berms on the sloughs would be overtopped and mainstem water be passed through the slough habitats.

These winter overtopping events are considered deleterious to juvenile salmon over-wintering and salmon eggs incubating in the side slough habitats. The placement of artificial berms at the heads of important side sloughs has been included in mitigation plans to protect these habitats during operation of the unstaged project. Protection of these habitats during Stages I and II would require higher, more extensive artificial berms.

Inundated Tributary Habitat

Some minor benefits would be realized in that the Stage I Watana reservoir would not inundate as much tributary mouth and tributary stream habitat which includes some good to excellent grayling habitat in a number of the streams draining into the proposed reservoir area. The Oshetna River, one of the better grayling streams in the area would not be affected at all by the Stage I Watana reservoir. This habitat would be lost eventually, of course, when the Stage III project is constructed.

IV. Wildlife and Botanical Resources

Summary

A decision to pursue the staged concept for the project would, in general, reduce the net project impacts on wildlife and botanical resources during the initial stages. The net effect would be positive from the standpoint of wildlife and botanical resources for the time between Stages I and III. The potential impacts of the development of Borrow Area F, a high quality wildlife habitat area (which would eventually be rehabilitated), are not considered to outweigh the benefits of; 1) delayed habitat loss, 2) more time for local wildlife populations to adapt to the habitat loss and movement restrictions caused by the reservoir; and 3) more time to refine and implement required mitigation programs, and the other advantages of the staged approach.

Habitat Inundation

The major changes with the staged concept would be that approximately 17,000 acres of wildlife habitat, which would be inundated by the Watana High Dam, would be preserved for roughly 10 years. Vegetation on the 17,000 acres of preserved land consists mostly of forests. On the south side of the impoundment black spruce predominates with interspersed vertical bands of tall shrubs. South-facing slopes on the north shore of the impoundment have greater areal extent and more diverse vegetation patterns. White spruce is the most common forest type, although open mixed forests (consisting of white spruce and paper birch) and black spruce forests are also represented. Birch shrub and mixed low shrub areas are present, especially near the mouth of Watana Creek.

Much of this land area consists of the gentler sloping portions of the eventual impoundment, which represents higher quality habitat than the steeper canyon walls for most wildlife species. Extensive tracts on both sides of the Watana Creek confluence on the north side of the impoundment and bands of land on both sides of the impoundment between Watana and Deadman Creeks represent about half of the 17,000 acres. These areas provide valuable wildlife habitat, particularly for moose and black bear.

In the case of the black bear, staged develoment would delay the loss of important denning and foraging habitat. The Watana High Dam would inundate about 55% of the known den sites in the vicinity of the Watana impoundment, while the Stage I Watana Dam would inundate only 35% of these den sites.

Another advantage of the staged development approach would be that local wildlife populations would be allowed to adapt to the habitat loss and movement restrictions resulting from impoundment, in stages over a greater period of time. This could be particularly valuable to animals that are expected to suffer carrying capacity losses such as moose and black bear, since overpopulations of adjacent habitats and the accompanying overutilization of adjacent forage resources, would also occur in stages over a greater period of time and may result in less damage to these adjacent habitats.

Although significant impacts to Dall sheep use of the Jay Creek mineral lick are not expected to result from the Watana High Dam impoundment, the Stage I Watana Dam would produce even fewer problems relative to the Jay Creek lick.

Big Game Movement

The width of the Stage I Watana Reservoir would also be significantly narrower than the Watana Reservoir in the FERC license concept. The Watana initial reservoir would be less than one mile wide throughout the majority of its length, and would thus represent less of a barrier to big game movements than the reservoir in the FERC license concept.

Raptors

The delayed development of the Stage III Watana Dam would also benefit raptors. One golden eagle and one bald eagle nesting location occur near the el. 2200 contour and may be impacted by the development of Stage III. However, the Stage I development would produce a reservoir level low enough to prevent impacts to these nesting locations during the approximately 10-year period between Stage I and Stage III development. This would provide additional time for developing and implementing the artificial nest program to mitigate for lost raptor nest locations.

Impacts of Longer Project Construction Schedule

A more subtle, but real, advantage of the staged concept approach is that data collected and experience gained through the monitoring of construction and operation effects and mitigation success during Stages I and II would permit refinements to construction, operation, and mitigation plans during Stages II and III so that the ultimate impacts on wildlife and botanical resources would be lessened.

One potential disadvantage of the staged approach is that the construction period is lengthened, thereby increasing the length of the period that wildlife populations are exposed to construction-related wildlife disturbance and mortality factors. However, the level of disturbance during Stage III development would be less than during the earlier stages due to the reduced magnitude of the construction effort and the presence of an existing infrastructure and support facilities developed during Stage I. More importantly, assuming that public access is restricted during the entire construction period, the elimination of public access during Stage III and the resultant elimination of a variety of associated disturbance and mortality factors would more than compensate for the construction-related factors.

Borrow Areas

The most important disadvantage of the staged development approach is the probable requirement to obtain Stage III borrow materials from Borrow Area F.

Borrow Area E, a primary source for materials for Watana Dam in the FERC license concept and for Stage I of the staged concept, would be partially inundated by the Devil Canyon Reservoir during Stage II construction, increasing the likelihood that Borrow Area F would need to be used during Stage III (use of Area F is considered unlikely for the FERC license concept). Borrow Area F occupies about 5 miles of the middle stretch of Tsusena Creek from just above the high waterfall to Tsusena Butte. It includes areas adjacent to the stream and extending up to about 1500 ft. away. This area provides important habitat for a variety of wildlife including moose, black bear, brown bear, and other species associated with tributary stream bottoms. Because of the areal extent of this bottom area outside of the impoundment zones, extensive use of Borrow Area F could substantially increase the total amount of high quality wildlife habitat disturbed by the project. Although borrow area rehabilitation would be conducted, habitat impacts would be experienced for many years.

On the positive side, the staged concept probably would reduce the amount of material required from Quarry Site A because all quarry material for Stage I would be obtainable through excavation of the deeper spillway required for the staged concept. Although the habitat value of this area is not high, the general level of habitat disturbance and loss in the general project area would be less.

V. Effects of Staging on Cultural Resources

Summary

The primary effects of staging on cultural resource would be to reduce, at least initially, the number of archeological sites impacted through construction and reservoir flooding, and allow more time for study and implementation of mitigation plans. Both are significant positive benefits from the cultural resources standpoint. Since staging does not alter the schedule or design of the Devil Canyon Dam and Reservoir, its effect is essentially neutral.

Use of Borrow Areas

The only potential effect noted is that Borrow Area E may be partially or completely covered by the Devil Canyon impoundment prior to Stage III Watana construction. Alternative borrow sites may have to be used for this latter construction. This could have an impact on other archeological remains. In particular, the likelihood of utilizing Borrow Area F for Stage III construction would be high. As discussed below, this is an archeologically important area.

Staging of the Watana Dam construction would make a greater difference to cultural resources, though on balance the effects are positive. As the construction schedule in Stage I would be speeded up for a completion date of 1996 instead of 1997, there would be somewhat less time available in which to implement mitigation plans. However the scaled-back construction of Stage I would require less borrow, resulting in less damage due to removal of fill. This is particularly important in Borrow Area F (the Tsusena Creek area), which contain a total of nine recorded archeological sites (see Table 5-3).

Reduced Area of Inundation

The Stage I impoundment level of el. 2000 would result in inundation of 49 recorded archeological sites (see Table 5-4). This is one-third fewer than would be flooded permanently by reservoir level of el. 2185 in the FERC license concept. The 24 sites between el. 2000 and el. 2185 contours would be available for study for a much longer period under the staged concept than in the FERC license concept. Staging would allow additional time for implementation of mitigation plans for these 24 sites, as Stage III construction is not scheduled for completion until 2008.

A final consideration concerns how staging would affect sites adjacent to but outside the actual project area. Adjacent sites are defined as those lying within one-half mile of a project boundary. Though not affected directly, these sites are subject to impacts due to ancillary construction activity, improved access, greater likelihood of erosion, and increased traffic. A lower reservoir level would reduce the reservoir perimeter temporarily leaving more archeological sites outside the one-half mile zone. It should be noted, however, that the adjacency distance is arbitrarily defined, so that other factors such as topography may be more significant. Nevertheless, approximately 15 adjacent sites would fall outside the one-half mile zone for a el. 2000. reservoir level. This represents 31 percent of the sites defined as adjacent in the FERC license concept.

VI. Socioeconomic Analysis

Employment and Population

In general, the staged concept would slightly decrease peak construction employment to about 2,950 (in 1994) and extend the length of employment to the year 2008. The projected construction employment peak for the FERC license concept would be about 3,000 (in 1994) and employment would end in 2002 (see Table 5-5).

Population increases generated by the Project generally follow the same pattern as Project induced employment. The magnitude and duration of population impacts would therefore follow the trends of employment impacts. The duration of impact would be longer by five years under the staged project but the magnitude at peak would not be significantly different.

Community Facilities and Services

Impacts on demand for facilities and services are a consequence of population impacts. Since the magnitude of population impacts are similar in both the staged and FERC license concepts, impacts on community facilities and services are likely to be similar. The major difference would be that impacts would occur more gradually and last longer for the staged concept. The demand levels from 2002 until 2008 would be well below peak demand for either the FERC license or staged concepts.

Prolonging the duration of Project-induced demand would have one positive effect. That is, it delays or reduces excess capacity of facilities that would be built to meet peak demand. Since most communities in the impact area have constantly increasing baseline populations, the facilities constructed to serve peak project related demand would eventually be needed after the Project construction ends. The period of excess capacity, between the time peak project demand ends and baseline demand catches up, produces a financial burden for maintenance and operation costs for underutilized facilities. The staged concept would reduce or eliminate this financial burden.

TABLE 5-1

SUSITNA HYDROELECTRIC PROJECT
MAXIMUM SIMULATED RIVER STAGES
WINTER 1981-82
FLOW CASE E-VI, INFLOW MATCHING
2001 AND 2002 ENERGY DEMANDS

Slough or Side Channel	River Mile	Threshold Elevation	High Watana Alone	High Watana + Devil Canyon	Stage I Watana + Devil Canyon 50' Drawdown 3 Levels
Whiskers	101.5	367	$\boxed{371}$	$\boxed{369}$	$\boxed{370}$
Gash Creek	112.0	Unknown	458	456	459
6A	112.3	(Upland)	460	459	461
8	114.1	476	475	476	$\boxed{476}$
MSII	115.5	482	$\boxed{488}$	$\boxed{485}$	$\boxed{487}$
MSII	115.9	487	$\boxed{490}$	$\boxed{488}$	$\boxed{490}$
Curry	120.0	Unknown	524	520	522
Moose	123.5	Unknown	552	548	553
8A West	126.1	573	$\boxed{575}$	571	$\boxed{573}$
8A East	127.1	582	$\boxed{585}$	581	$\boxed{584}$
9	129.3	604	$\boxed{607}$	$\boxed{601}$	$\boxed{606}$
9 u/s	130.6	Unknown	621	616	619
4th July	131.8	Unknown	633	627	630
9A	133.7	651	$\boxed{654}$	649	649
10 u/s	134.3	657	$\boxed{660}$	655	655
11 d/s	135.3	Unknown	668	667	667
11	136.5	687	684	682	682
17	139.3	Unknown	715	714	714
20	140.5	730	729	728	728
21 (A6)	141.8	747	747	746	746
21	142.2	755	754	752	752
22	144.8	788	787	785	785
LRX-3 Ice Front Starting Date			12-28	12-30	12-29
Maximum Ice Front Extent (River Mile)			134	126	133
Melt-out Date			3-23	3-19	4-1

maximum up-stream extent of ice front

- $\boxed{}$ Indicates locations where maximum river stage equals or exceeds a known slough threshold elevation
- All river stages in feet

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TABLE 5-2

SUSITNA HYDROELECTRIC PROJECT
MAXIMUM SIMULATED RIVER STAGES
WATANA ONLY: 2001 ENERGY DEMAND
CASE E-VI FLOWS, INFLOW-MATCHING
WINTER 1981-82

Slough or Side Channel	River Mile	Threshold Elevation	High Watana Infl-Match	Stage I Watana Infl-Match Throughout	
Whiskers	101.5	367	$\boxed{371}$	$\boxed{371}$	
Gash Creek	112.0	Unknown	458	458	
6A	112.3	(Upland)	460	460	
8	114.1	476	475	475	
MSII	115.5	482	$\boxed{488}$	$\boxed{490}$	
MSII	115.9	487	$\boxed{490}$	$\boxed{494}$	
Curry	120.0	Unknown	524	528	
Moose	123.5	Unknown	552	555	
8A West	126.1	573	$\boxed{575}$	$\boxed{574}$	
8A East	127.1	582	$\boxed{585}$	$\boxed{584}$	
9	129.3	604	$\boxed{607}$	$\boxed{607}$	
9 u/s	130.6	Unknown	621	622	
4th July	131.8	Unknown	633	634	
9A	133.7	651	$\boxed{654}$	$\boxed{658}$	
10 u/s	134.3	657	$\boxed{660}$	$\boxed{665}$	
11 d/s	135.3	Unknown	668	675	
11	136.5	687	684	$\boxed{688}$	
17	139.3	Unknown	715	715	
20	140.5	730	729	729	maximum up-
21 (A6)	141.8	747	747	747	stream extent
21	142.2	755	754	753	of ice front
22	144.8	788	787	787	
Ice Front Starting Date			12-28	12-12	
Maximum Ice Front Extent (River Mile)			134	137	
Melt-out Date			2-23	4-12	

* $\boxed{}$ Indicates locations where maximum wiver stages equal or exceeds a known slough threshold elevation

* All river stages in feet

TABLE 5-3

SITES AFFECTED BY LICENSE APPLICATION CONSTRUCTION

BORROW AREAS:

A	None*
B	None*
C	TLM 054, 055, 078, 081, 084, 085, 086, 087, 088, 094, 095, 096, 097, 201, 211, 213
D	None*
E	TLM 022, 023, 258 Adjacent to E: 024, 035
F	TLM 176, 188, 202, 203, 209, 210, 212, 214 Adjacent to F: 164
G	None*
H	None*
I	TLM 034, 178, 259
J	TLM 080 Adjacent to J: 043, 058, 063, 177, 200, 229, 230, 233
K	TLM 030
L	None*
Devil Canyon Reservoir	TLM 023, 034, 178, 252, 253, 258, 259 Adjacent to Devil Canyon Reservoir: 022, 024, 027, 029, 030, 118

*None: No recorded archeological sites

TABLE 5-4

SITES AFFECTED BY STAGED CONSTRUCTION OF WATANA DAM/RESERVOIR

STAGE I (2000' Reservoir Level)

TLM 033, 040, 043, 050, 058, 062, 063, 065, 072, 075, 077, 079, 080, 102, 104, 115, 194, 199, 200, 216, 220, 221, 222, 224, 225, 226, 227, 228, 229, 230, 231, 232, 233, 234, 235, 236, 238, 239, 240, 241, 242, 243, 246, 247, 248, 249, 250, 256, 257 (N=49).

STAGE III (2000 - 2185' Reservoir Level)

TLM 039, 048, 059, 060, 061, 119, 126, 169, 171, 173, 174, 175, 182, 184, 196, 204, 206, 215, 217, 218, 223, 237, 244, 251 (N=24).

ADJACENT SITES (Within 1/2 Mi. of 2185 Reservoir Level)

TLM 026, 031, 032, 038, 042, 047, 049, 064, 073, 074, 076, 120, 121, 122, 123, 124, 125, 127, 128, 129, 130, 131, 132, 133, 134, 135, 136, 139, 140, 141, 142, 143, 145, 147, 148, 159, 165, 166, 167, 177, 183, 185, 189, 190, 195, 198, 207, 219 (N=48).

Sites Outside the One-Half Mile Zone, Stage I (2000' Reservoir Level)

TLM 026, 032, 038, 042, 049, 073, 074, 076, 120, 122, 159, 189, 195, 198, 207 (N=15).

Sites Adjacent to Watana Construction Area

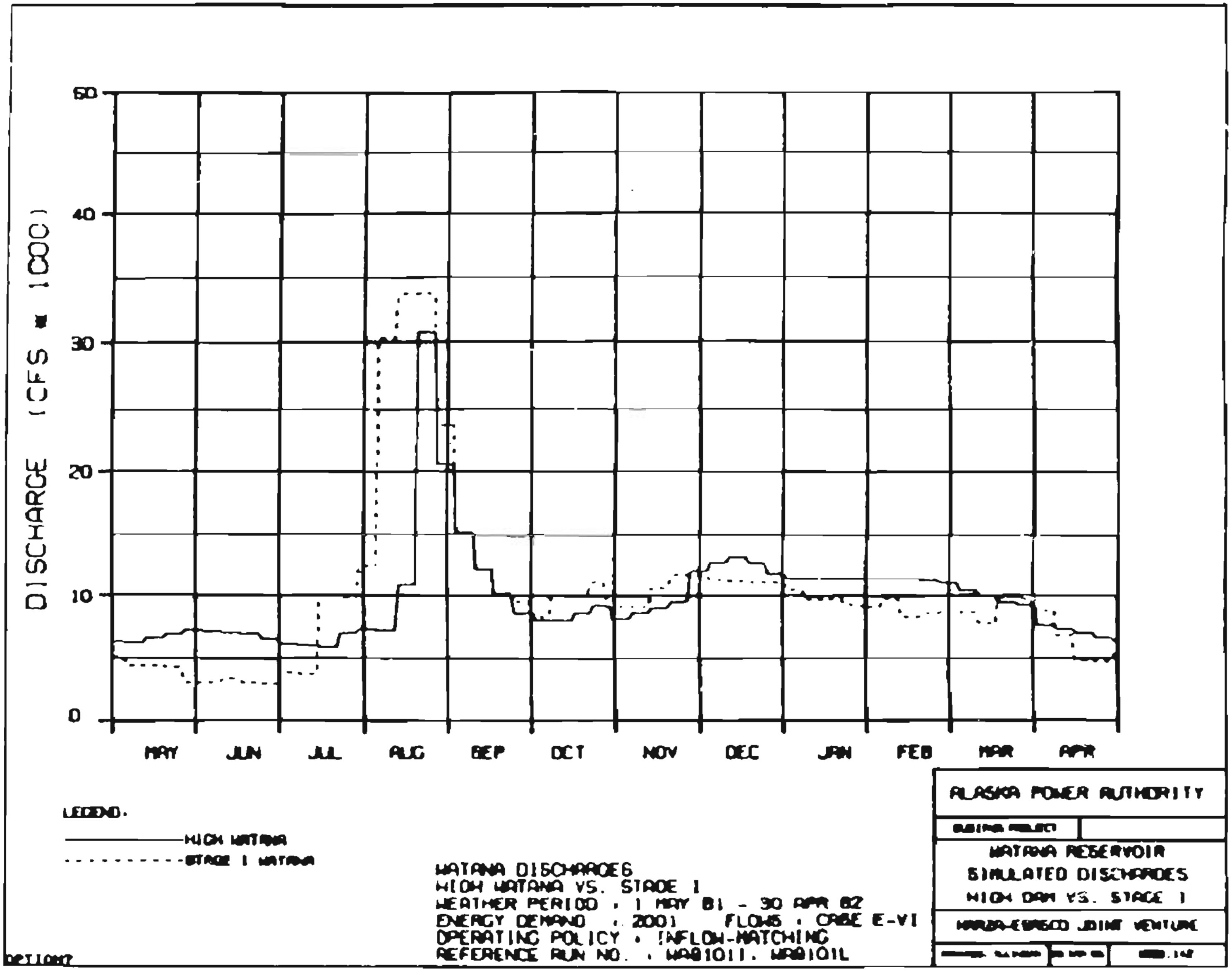
TLM 016, 018, 160, 165, 166, 167, 172, 192, 197 (N=9)

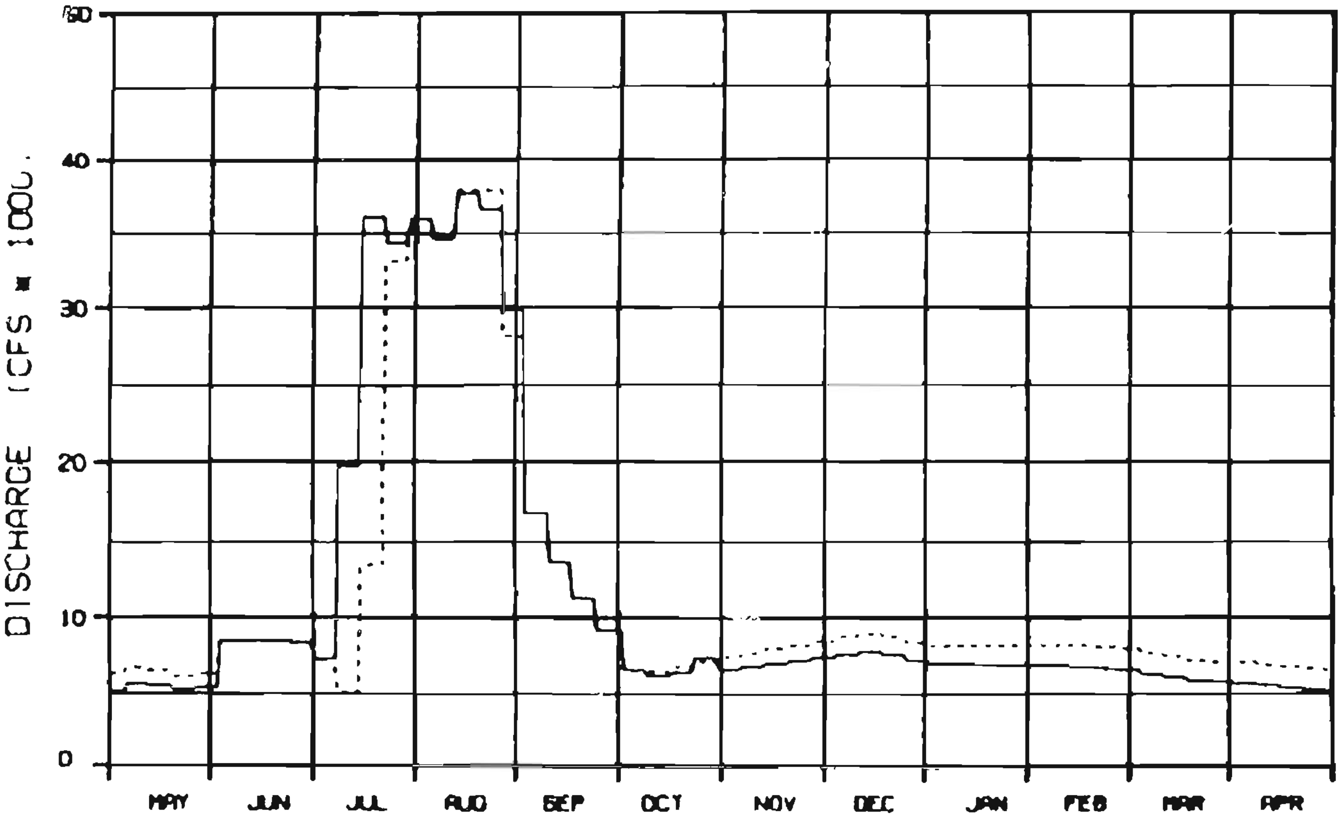
TABLE 5-5

YEARLY PEAK WORKFORCE

	Current Project			Staged			
	Watana	Devi'	Total	Stage I	Stage II	Stage III	Total
1987	-0-	-0-	-0-	-0-	-0-	-0-	-0-
1988	1,017	-0-	1,017	637	-0-	-0-	637
1989	1,512	-0-	1,512	825	-0-	-0-	825
1990	1,047	-0-	1,047	1,028	-0-	-0-	1,028
1991	1,082	-0-	1,082	1,164	-0-	-0-	1,164
1992	1,776	167	1,943	1,384	167	-0-	1,551
1993	2,142	167	2,309	1,837	167	-0-	2,004
1994	2,721	321	3,042	2,625	321	-0-	2,946
1995	2,069	501	2,570	1,831	501	-0-	2,332
1996	938	482	1,420	350	482	-0-	832
1997	259	1,182	1,441	-0-	1,182	-0-	1,182
1998	-0-	1,181	1,181	-0-	1,181	-0-	1,181
1999	-0-	1,196	1,196	-0-	1,196	-0-	1,196
2000	-0-	1,572	1,572	-0-	1,572	-0-	1,572
01	-0-	747	747	-0-	747	-0-	747
02	-0-	126	126	-0-	126	410	536
03	-0-	-0-	-0-	-0-	-0-	842	842
04	-0-	-0-	-0-	-0-	-0-	1,055	1,055
05	-0-	-0-	-0-	-0-	-0-	1,510	1,510
06	-0-	-0-	-0-	-0-	-0-	1,446	1,446
07	-0-	-0-	-0-	-0-	-0-	1,057	1,057
08	-0-	-0-	-0-	-0-	-0-	-0-	-0-

FIGURE 5-1


DISCHARGE (CFS * 1000)
0
10
20
30
40
50
MAY
JUN
JUL
AUG
SEP
OCT
NOV
DEC
JAN
FEB
MAR
APR
LEGEND.
HIGH WATANA
STAGE I WATANA
WATANA DISCHARGES
HIGH WATANA VS. STAGE I
WEATHER PERIOD : 1 MAY 81 - 30 APR 82
ENERGY DEMAND : 2001 FLOWS : CASE E-VI
OPERATING POLICY : INFLOW-MATCHING
REFERENCE RUN NO. : WA81011, WA8101L
ALASKA POWER AUTHORITY
WATANA RESERVOIR
SIMULATED DISCHARGES
HIGH DAM VS. STAGE I
HARZA-EBASCO JOINT VENTURE



LEGEND:

———— D.C. WITH HIGH WATANA

- - - - - D.C. WITH STAGE 1 WATANA

DEVIL CANYON DISCHARGES
HIGH WATANA VS. STAGE 1 WATANA
WEATHER PERIOD : 1 MAY 81 - 30 APR 82
ENERGY DEMAND : 2002 FLOW CASE : E-VI
OPERATING POLICY : INFLOW-MATCHING
3 INTAKE LEVELS. 50 FT DRAWDOWN AT D.C.
REFERENCE RUN NO. : DC8102L. DC8102Q

ALASKA POWER AUTHORITY
SUSITNA PROJECT
DEVIL CANYON RESERVOIR SIMULATED DISCHARGES HIGH WATANA VS. STAGE 1
HARZA-EBASCO JOINT VENTURE

OPTION7

FIGURE 5-2

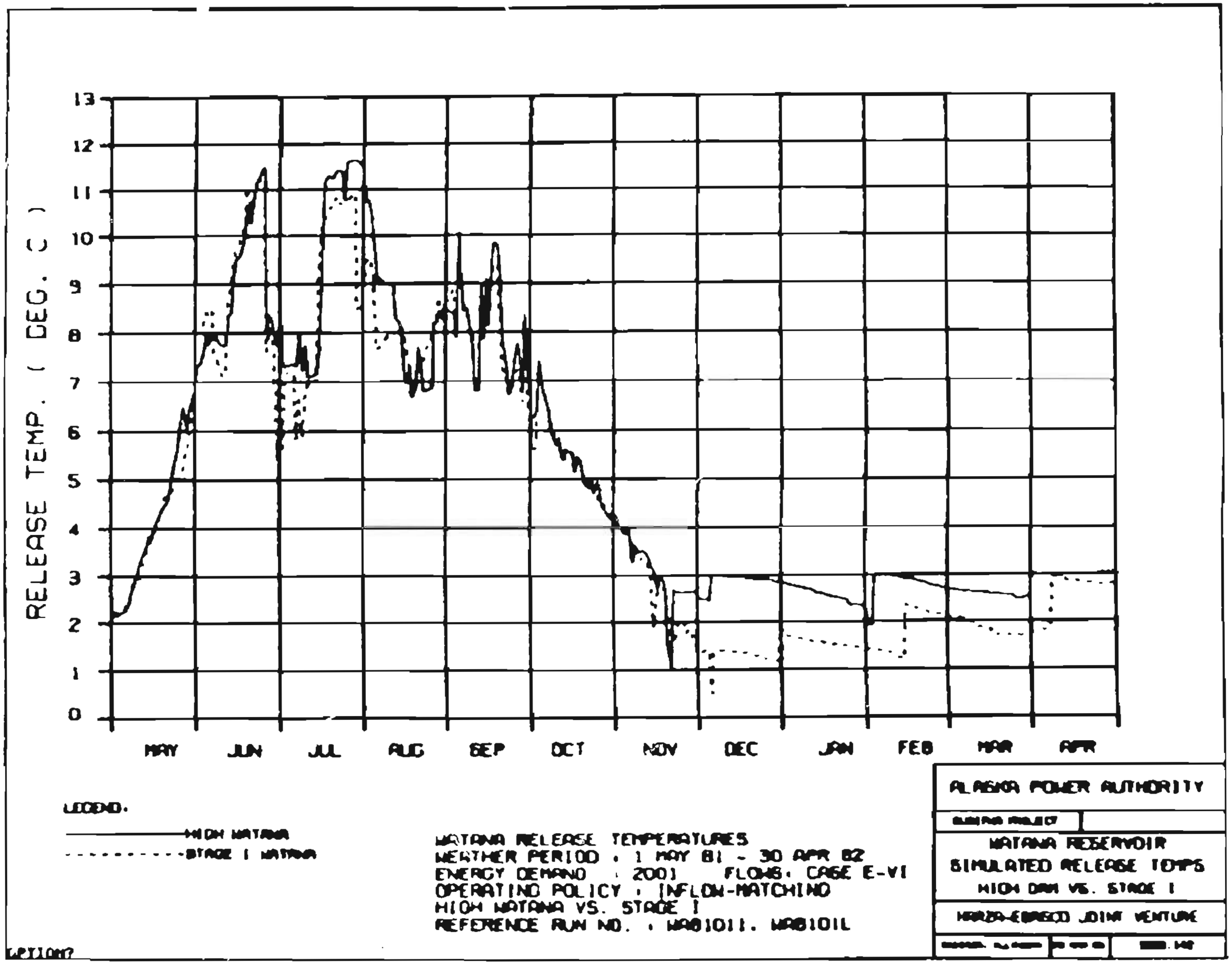
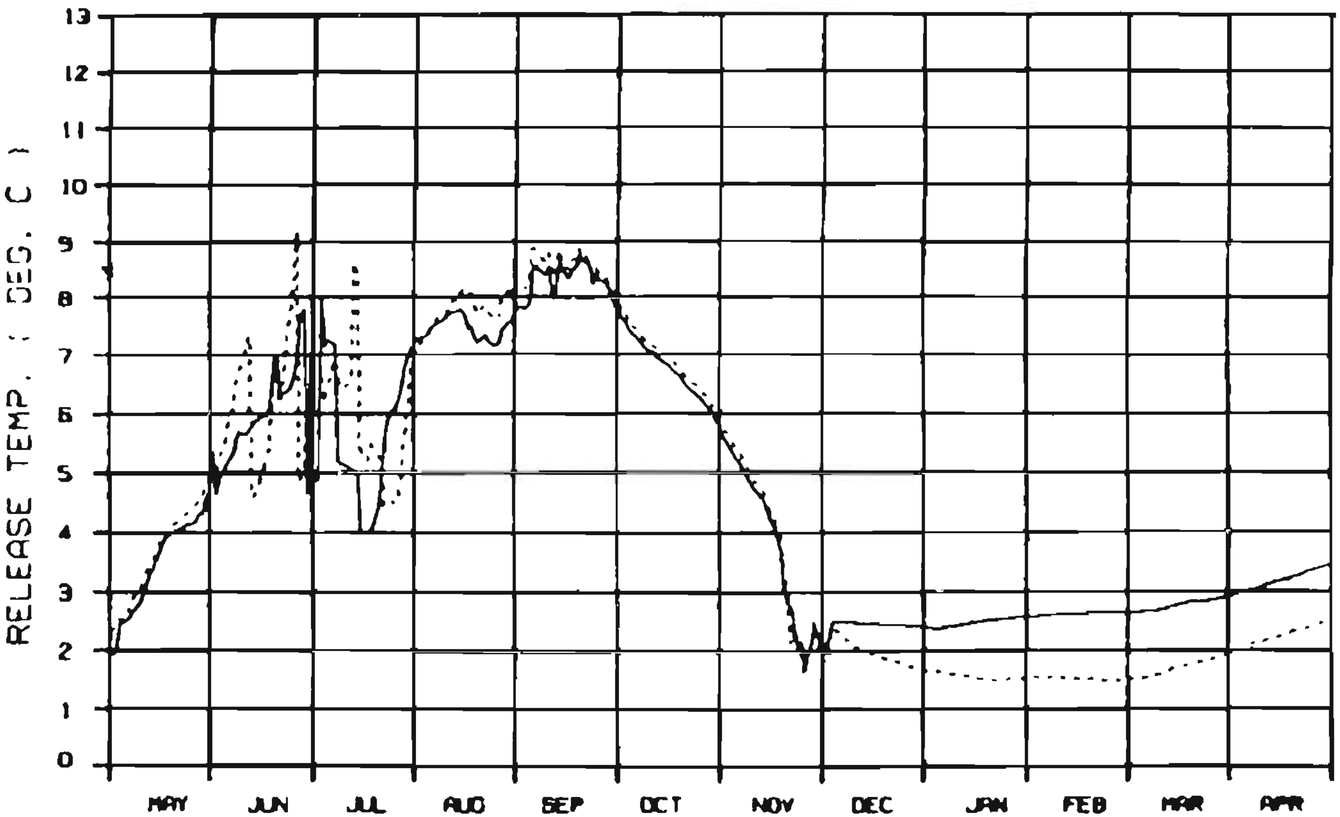

RELEASE TEMP. (DEG. C)
13
12
11
10
9
8
7
6
5
4
3
2
1
0
MAY
JUN
JUL
AUG
SEP
OCT
NOV
DEC
JAN
FEB
MAR
APR
LEGEND:
HIGH WATANA
STAGE I WATANA
WATANA RELEASE TEMPERATURES
WEATHER PERIOD : 1 MAY 81 - 30 APR 82
ENERGY DEMAND : 2001 FLOWS: CASE E-VI
OPERATING POLICY : INFLOW-MATCHING
HIGH WATANA VS. STAGE I
REFERENCE RUN NO. : WA81011, WA8101L
ALASKA POWER AUTHORITY
WATANA RESERVOIR
SIMULATED RELEASE TEMPS
HIGH DAM VS. STAGE I
HARZA-EBASCO JOINT VENTURE

FIGURE 5-3



LEGEND:

———— D.C. WITH HIGH WATANA

- - - - - D.C. WITH STAGE I WATANA

DEVIL CANYON RELEASE TEMPERATURES
HIGH WATANA VS. STAGE I WATANA
WEATHER PERIOD : 1 MAY 81 - 30 APR 82
ENERGY DEMAND : 2002 FLOWS, CASE E-VI
OPERATING POLICY : INFLOW-MATCHING
3 INTAKE LEVELS, 50 FT DRAWDOWN AT D.C.
REFERENCE RUN NO. : DC8102L, DC81020

OPTION?

ALASKA POWER AUTHORITY

SUSITNA PROJECT

DEVIL CANYON RESERVOIR
SIMULATED RELEASE TEMPS
HIGH WATANA VS. STAGE I

HARZA-EBASCO JOINT VENTURE

FIGURE 5-4

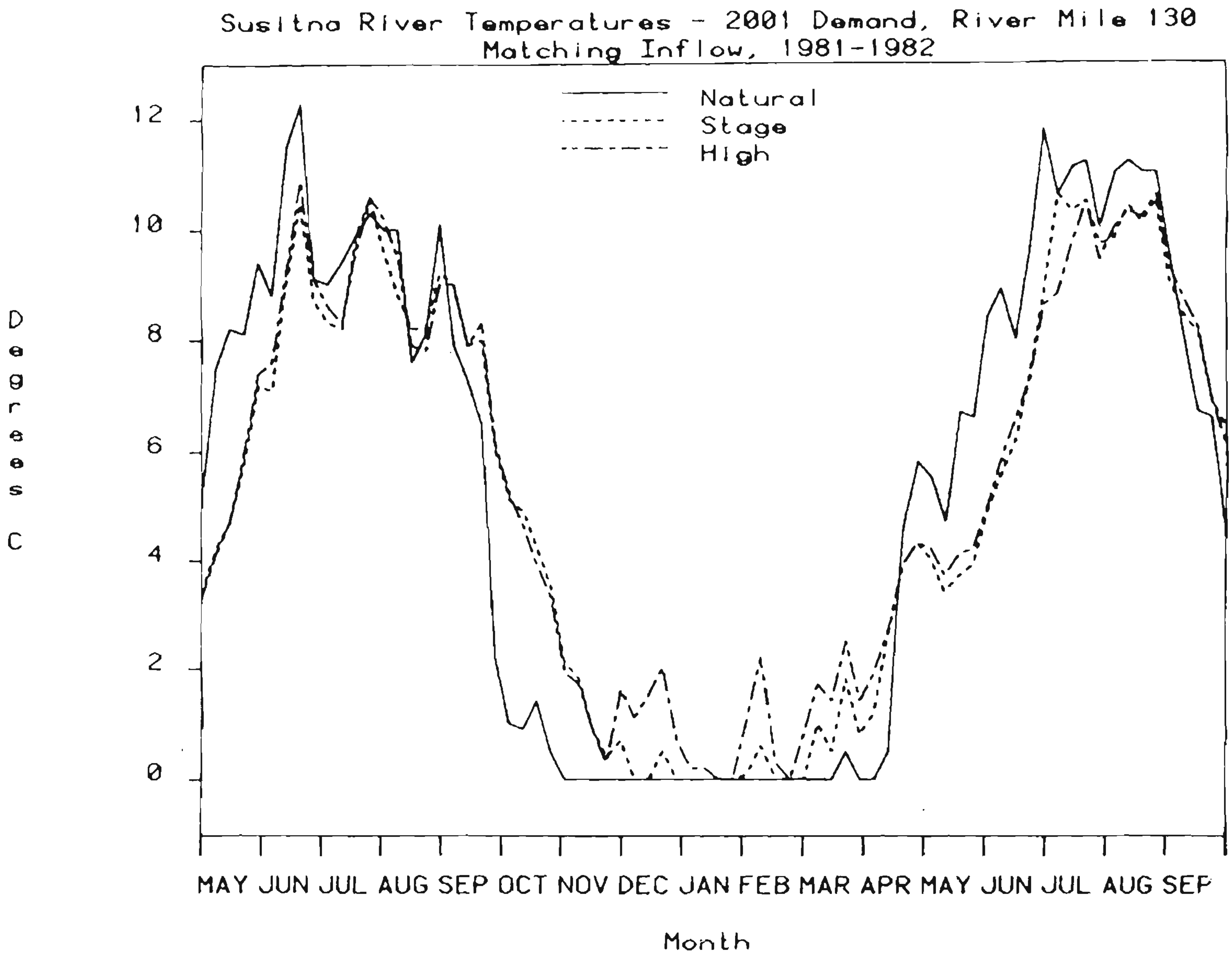

Susitna River Temperatures - 2001 Demand, River Mile 130
Matching Inflow, 1981-1982
Natural
Stage
High
Degrees C
12
10
8
6
4
2
0
MAY JUN JUL AUG SEP OCT NOV DEC JAN FEB MAR APR MAY JUN JUL AUG SEP
Month

FIGURE 5-5

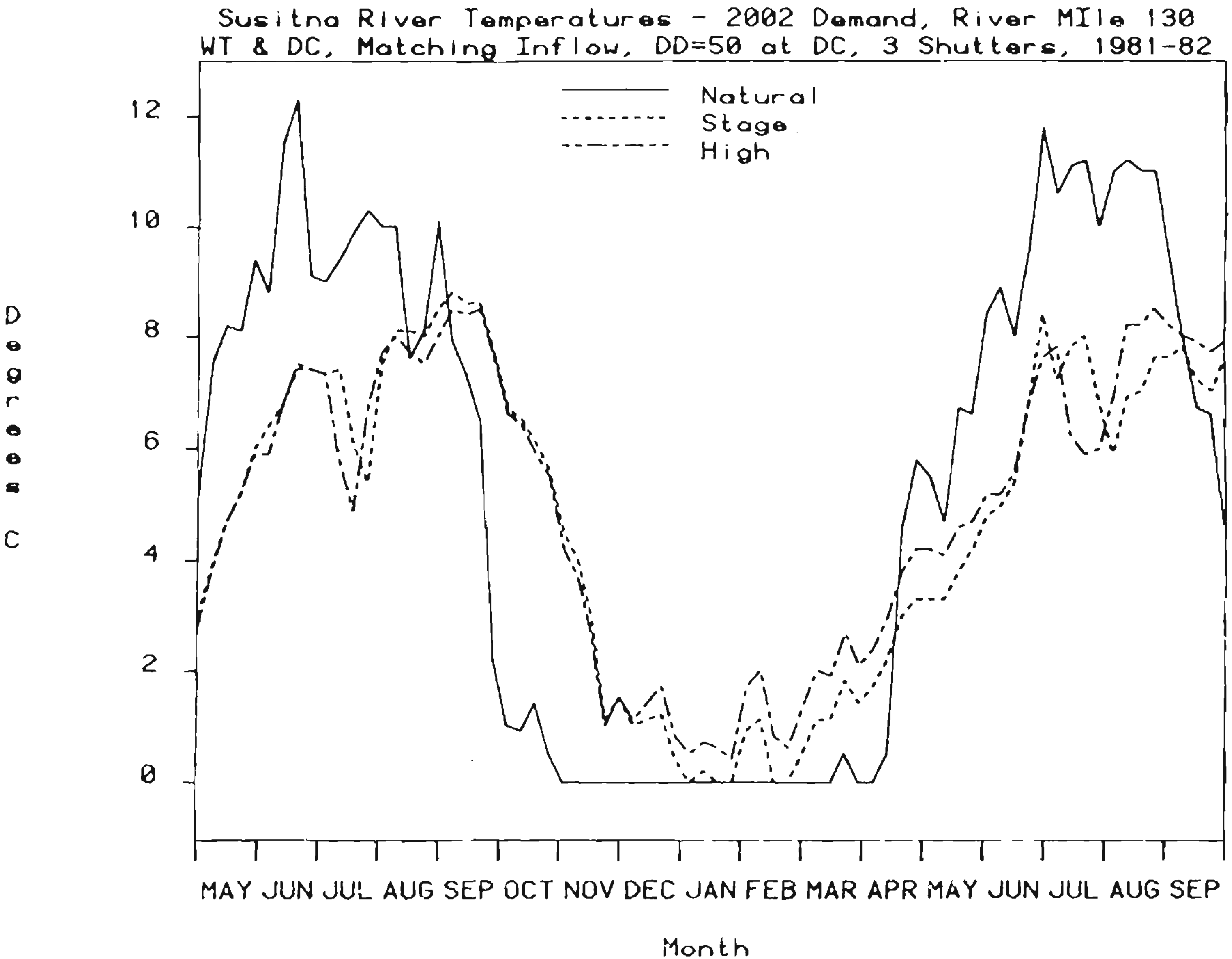

Susitna River Temperatures - 2002 Demand, River MIle 130
WT & DC, Matching Inflow, DD=50 at DC, 3 Shutters, 1981-82
Natural
Stage
High
Degrees C
0
2
4
6
8
10
12
MAY JUN JUL AUG SEP OCT NOV DEC JAN FEB MAR APR MAY JUN JUL AUG SEP
Month

FIGURE 5-8