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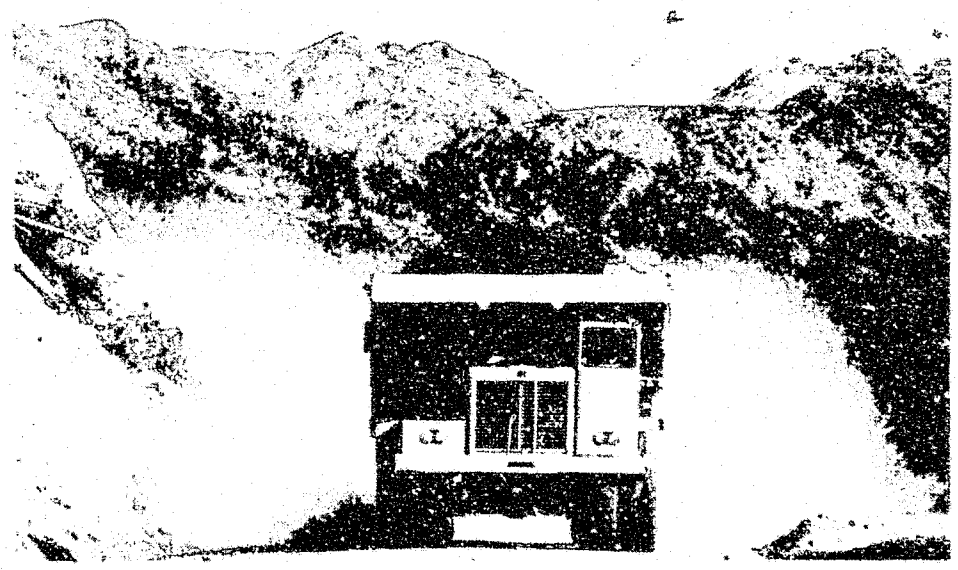
SUSITNA HYDROELECTRIC PROJECT

ACCESS PLAN REPORT
1983

PRELIMINARY

ALASKA POWER AUTHORITY

SUSITNA HYDROELECTRIC PROJECT



ACCESS PLAN REPORT

HARZA-EBASCO A Joint Venture

1983

PRELIMINARY WORKING DRAFT

ACCESS PLAN REPORT

SUSITNA HYDROELECTRIC PROJECT

for

ALASKA POWER AUTHORITY

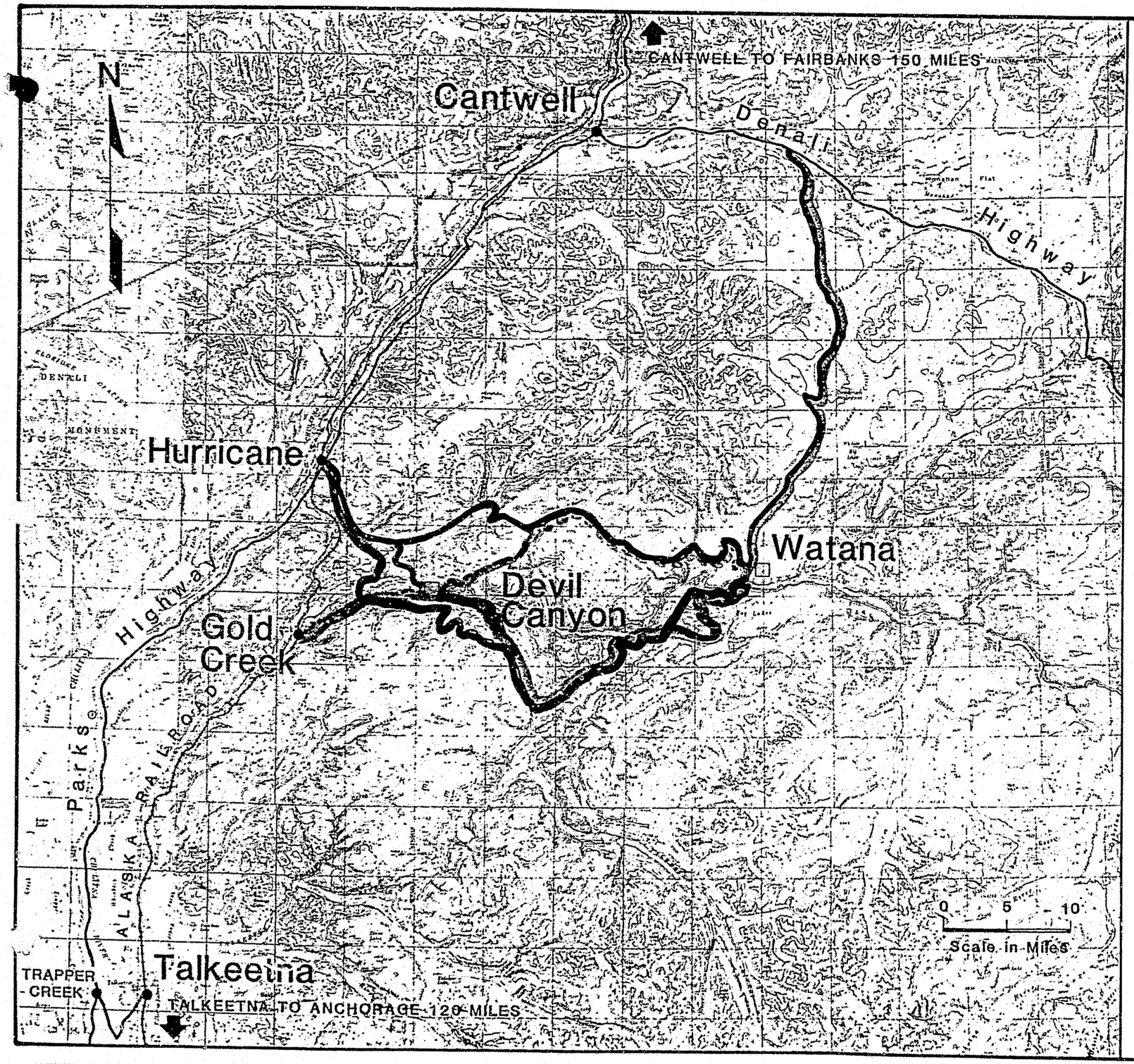
by

HARZA-EBASCO

1983

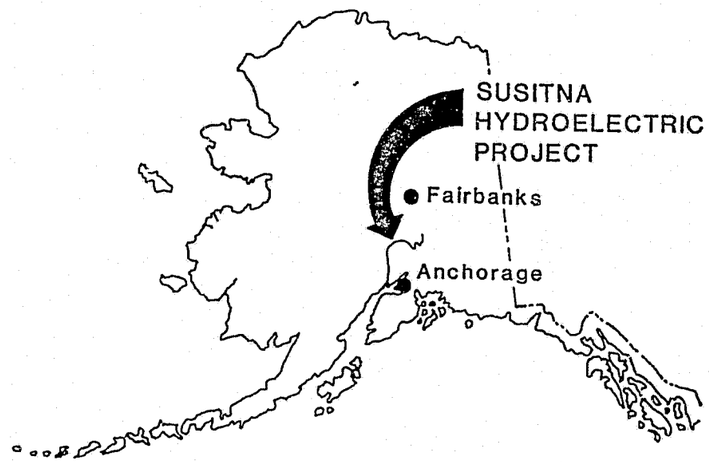
NOTE TO REVIEWERS

This preliminary working draft is not complete and will be updated to incorporate new or revised information from other studies being conducted by the Harza-Ebasco team. Other studies which would effect findings of this report include those related to the need for power, transportation plan, construction camp, permanent town and socioeconomics. Comments on the approach, methodology, and general findings are most appropriate, while reviewers should recognize that final conclusions or recommendations will not be available until other studies are complete.



LEGEND

- EXISTING ROADS
- EXISTING RAILROAD
- WATANA ACCESS ROAD
- DEVIL CANYON ACCESS ROAD



- DENALI PLAN (18)
- NORTH PLAN (13)
- SOUTH PLAN (16)
- RAIL PLAN (2)

ALASKA POWER AUTHORITY

SUSITNA HYDROELECTRIC PROJECT

STUDY AREA MAP

ACCESS PLAN

HARZA-EBASCO
SUSITNA JOINT VENTURE

FIGURE S-1

FOLD LENGTH
12 IN
11 IN
8.5 IN
8 IN
AUTO
MANUAL
FEED

SUMMARY

Major Finding

Studies conducted by Harza-Ebasco conclude that either the North or Denali access plans is acceptable and that the Denali plan is preferred.

Background and Purpose

A variety of access alternatives for the Susitna Hydroelectric Project have been studied since 1980. Over 18 plans have previously been identified and formally evaluated. Denali plan (Plan 18) is the access plan recommended in previous reports and shown in the February 1983 FERC Susitna Hydroelectric Project License Application as the project access plan. The purpose and objective of this report is to review available data and studies to provide the Power Authority with an independent appraisal of the access issue and, if necessary, make recommendations for changes in design, mode of transportation or route from those shown or described in the February 1983 FERC License Application.

Report

This report contains an evaluation of the Denali plan and three of the most promising other candidate access plans studied by previous investigators. These other plans include all-rail (Plan 2), North plan (Plan 13) and South plan (Plan 16), and are shown in Figure S-1. Studies were based primarily on review of prior reports, discussions with Power Authority staff, and limited field reconnaissance. The approach employed included a preliminary screening to eliminate obviously less desirable alternatives and a detailed comparison of the two better routes. The all-rail and South plan were eliminated from detailed consideration during the preliminary screening process after considering the effect of their adoption on project schedule, cost, and environmental impact. The Denali and North plans are the subject of detailed engineering and environmental analysis presented in this report.

The report is organized into five sections as follows.

- Section 1 - Introduction, contains background data and references along with a description of the four access plans analyzed in this report. It also describes the relationship of this work effort to other Harza-Ebasco Susitna Project tasks.

- Section 2 - Engineering Studies - Methodology and General Findings, contains a general review of roadway design and descriptions of the cost study methodology used for route evaluation.

- Section 3 - Environmental Studies - Methodology and General Issues contains a ranking of environmental issues affecting access route selection and presents access evaluation criteria for resource categories which affect the decision process.

- Section 4 - Detailed Route Comparisons, contains a description of the preliminary route screening process where 2 of the 4 routes were eliminated from consideration and presents the detailed evaluation of Denali plan and North plans with respect to 11 resource and engineering categories.

- Section 5 - Conclusions and Recommendations, contains Harza-Ebasco recommendations and a description of the multi-objective decision analysis process employed in developing these recommendations from the results of detailed comparisons in Section 4.

Principal findings as a result of engineering and environmental studies are described below.

Engineering

The access road design parameters included in the FERC license

application are appropriate for the access needs of the Susitna hydroelectric project. The geometric and unit section designs of the proposed roads and railroads are generally appropriate for the intended service. The selection of a gravel, as opposed to an asphalt, surface for the access roads was a logical choice. With one exception, the 34-foot wide road included in the present design is appropriate for the access requirements of the Susitna project. The road segment from Watana to Devil Canyon under Denali plan seems too wide for its probable future use. This road segment will only be used as an access back-up during Devil Canyon construction and as a commuting road for operators between Watana and Devil Canyon after construction. Width for this road segment could be reduced to 18 feet. A savings of approximately $10,000,000 in road construction cost would occur.

Evaluation of the relationship of access road construction to the overall project schedule revealed that either route could be constructed without serious effect on the overall Watana construction schedule. There is little chance that either route would result in a year's delay in overall project construction as a result of unanticipated construction difficulty. There is less risk for such a delay, however, for the Denali plan because it is shorter, and easier to construct than the North plan. The comparatively flat terrain and fewer major stream crossings along the Denali route result in generally easier construction than for the North route where the ground is more rugged and 4 major stream crossings would be required. Construction time for the North plan could be reduced if pre-license work on pile foundations for bridges could be permitted.

The construction schedule for the overall Watana Project requires quick mobilization of diversion tunnel, airfield, construction camp and access road contractors. Use of snow roads for contractor mobilization and supply during the first two years of construction could be very important. The Denali plan corridor is slightly higher in elevation than the North plan and the terrain is flatter. A snow road along the Denali route would be easier to build and last somewhat longer in the spring than a North plan snow road. Regardless of which access plan is

ultimately selected for the permanent access road, the Denali corridor should be strongly considered as the route for snow road hauling and contractor mobilization.

Present worth life cycle cost studies were performed for the North and Denali plans using standard Power Authority procedures. Costs included capital construction cost, cost for accelerated construction as defined in previous studies, maintenance, personnel transportation, and logistics costs from the closest point to the site common to all plans. Results, using a 3.5% discount rate and assuming that construction of Devil Canyon begins in 1993 as scheduled are as follows.

COMPARATIVE ACCESS COSTS

	WATANA PROJECT		WATANA AND DEVIL CANYON PROJECTS	
	Capital Cost	Present Value of Total Cost Stream	Capital Cost	Present Value of Total Cost Stream
Denali Plan	$54,597,000	$111,157,000	$98,811,000	$150,751,000
North Plan	$79,896,000	$126,600,000	$88,861,000	$150,500,000

As shown above, adoption of the Denali plan would result in a savings of about $15,000,000 if only Watana is built. The North plan is slightly less expensive than the Denali plan if Devil Canyon is constructed as scheduled. Studies show, however, that the small differences in costs in favor of the North plan is reversed if start-up of Devil Canyon construction is delayed 10 years. Logistics costs are a significant portion of the total costs, but differences between total logistics costs for the North plan and Denali plan are small compared to the differences in capital costs for the two plans. Conclusions based on economic modeling are not sensitive to reasonable changes in logistics volumes or unit costs.

Environmental

The initial activity in analyzing environmental impacts was to review previous studies so that potential impacts of access road development could be identified and prioritized. The relative importance of impacts on various resource categories was developed by project team members after identifying potential access related impacts. Emphasis was placed on those factors which were most important in differentiating between the routes. For example, historic/archaeologic resources were not considered to be important in evaluating the merits of the various access alternatives. Potential impacts to such resources do not affect the decision because impacts to these resources would be avoided or mitigated as a result of laws and regulations. Such laws require that cultural sites be avoided or appropriately recovered and preserved, regardless of the route adopted. Recognizing both the significance of impacts and the relative importance of the impacts for differentiating between the alternative access plans, the following list of prioritized impacts (in decreasing order of importance) was developed.

- Wildlife;
- Socioeconomic;
- Fisheries;
- Land use;
- Recreation; and
- Aesthetics.

Of the resource categories listed above, wildlife, socioeconomics, and fisheries stood out as ones most important in the decision-making process.

Wildlife considerations were important because development of access roads would increase accessibility to previously inaccessible areas. Accessibility indices based on slope adjacent to proposed roads were developed for the North and Denali plans to form a quantitative basis for evaluating changes in land accessibility attributable to road

construction. In general, the Denali route greatly increases accessibility because it is largely within an unroaded area while the North plan traverses an area which is presetnly more easily reached by humans.

Quantitative estimates of habitat loss were also developed for comparative purposes. Results show that the Denali plan will result in increased accessibility for a significantly larger area than for the North plan. Impacts to wildlife in general are comparable for the two plans or slightly greater for the Denali plan. The major difference between the two plans is the potential impact to the Nelchina Caribou herd whose range is crossed by the Denali Highway-Watana segment of the Denali plan. Potential impacts include reduction in numbers due to incresed hunting pressure, vehicle collisions, and loss of habitat due to road construction. Traffic on this road segment may reduce the extent of caribou use of the area west of the road.

Socioeconomic effects can be placed into two categories. First, the economic benefits that would be created by the project can be considered a benefit. Second, the social impacts which would result from unwanted changes in lifestyles can be considered a negative impact.

(INSERT SOCIOECONOMICS DISCUSSION HERE)

Fisheries impacts relate primarily to the increased erosion potential, particularly for the North plan near the vicinity of Portage Creek, and to the potential for increased public access and likely associated increased fishing pressure. The latter potential is more of a concern on the Denali plan where human access is very limited at present.

Decision Analysis and Recommendation

Based on the analysis approach used by the project team, the North and Denali plan were determined to be nearly comparable. Engineering factors tended to favor the Denali plan, while the most important environmental considerations (wildlife, socioeconomics, and fisheries)

were mixed. Wildlife considerations because of the potential impact on the Nelchina Caribou herd favored the North plan, while the other environmental categories suggested that impacts were comparable or that the Denali plan was preferred. Environmental investigations also revealed that limiting access and controlling hunting and fishing through regulation or enforcement along either corridor would reduce impacts overall with greater reductions expected for the Denali plan than for the North plan. This fact highlights the importance of developing an effective access control policy in the access plan selection and implementation process.

Recommendation:

Based on the above considerations, the Denali plan is recommended as the preferred access plan. While either access alternative is acceptable and could, with some cost and environmental tradeoffs, be adopted as the preferred access plan, there is no compelling reason to change plans at this time.

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FOREWARD

This report is comprised of five sections and a summary. A brief description of the issues covered in each section is presented below. This description is included to enable readers to identify those sections of most interest to them.

Summary - Contains the major finds of the report and summarizes important issues affecting the access plan selection process.

- o Section 1 - Introduction, contains background data and references along with a description of the four access plans analyzed in this report. It also describes the relationship of this work effort to other Harza-Ebasco Susitna Project tasks.

- o Section 2 - Engineering Studies - Methodology and General findings, contains a general review of roadway design and descriptions of the cost study methodology used for route evaluation.

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- o Section 5 - Conclusions and Recommendations, contains Harza-Ebasco recommendations and a description of the multi-objective decision analysis process employed in developing the recommendations from the results of detailed comparisons in Section 4.

CHAPTER 1

INTRODUCTION

1.0 INTRODUCTION

1.1 BACKGROUND

Access alternatives for the Susitna Hydroelectric Project have been studied extensively by Acres American, Inc. (Acres)(1981, 1982a, 1982b, 1982c, and 1983a), R&M Consultants (1982a and 1982b), and others since 1980. A plan was recommended by Acres in August 1982 in their "Access Plan Recommendation Report" (1982b) after a study of 18 candidate routes in 3 major route corridors in the project area. The Acres recommendation was adopted by the Alaska Power Authority Board of Directors by resolution in September, 1982.

The Denali plan, also known as Plan 18, was selected after a detailed engineering and environmental/socioeconomic study of the three best routes of the original 18 candidates. Each of the three general routes studied in the 1982 "Access Plan Recommendation Report," which provide access to both Watana and Devil Canyon Projects, are shown on Figure 1-1. In addition, raily only access (Plan 2) is evaluated in this report because it is the acccess plan favored by many agencies. All four plans studied are described below:

South (Plan 16): this plan consists of a gravel access road from Gold Creek on the Alaska Railroad to the area of the Devil Canyon Dam then continuing along the south bank of the Susitna River to the Watana Dam site area.

North (Plan 16): this plan consists of a gravel road from the George Parks Highway at a railhead to be constructed at Hurricane along the north bank of the Susitna River to Watana with provisions for a future branch road to the Devil Canyon area.

Denali (Plan 18): this plan consists of a railhead at Cantwell near the intersection of the Parks and Denali Highways with a new project access road leading south towards Watana from a point on the Denali Highway 21 miles east of Cantwell. Under this plan, construction of Devil Canyon Dam would be supported by a rail spur

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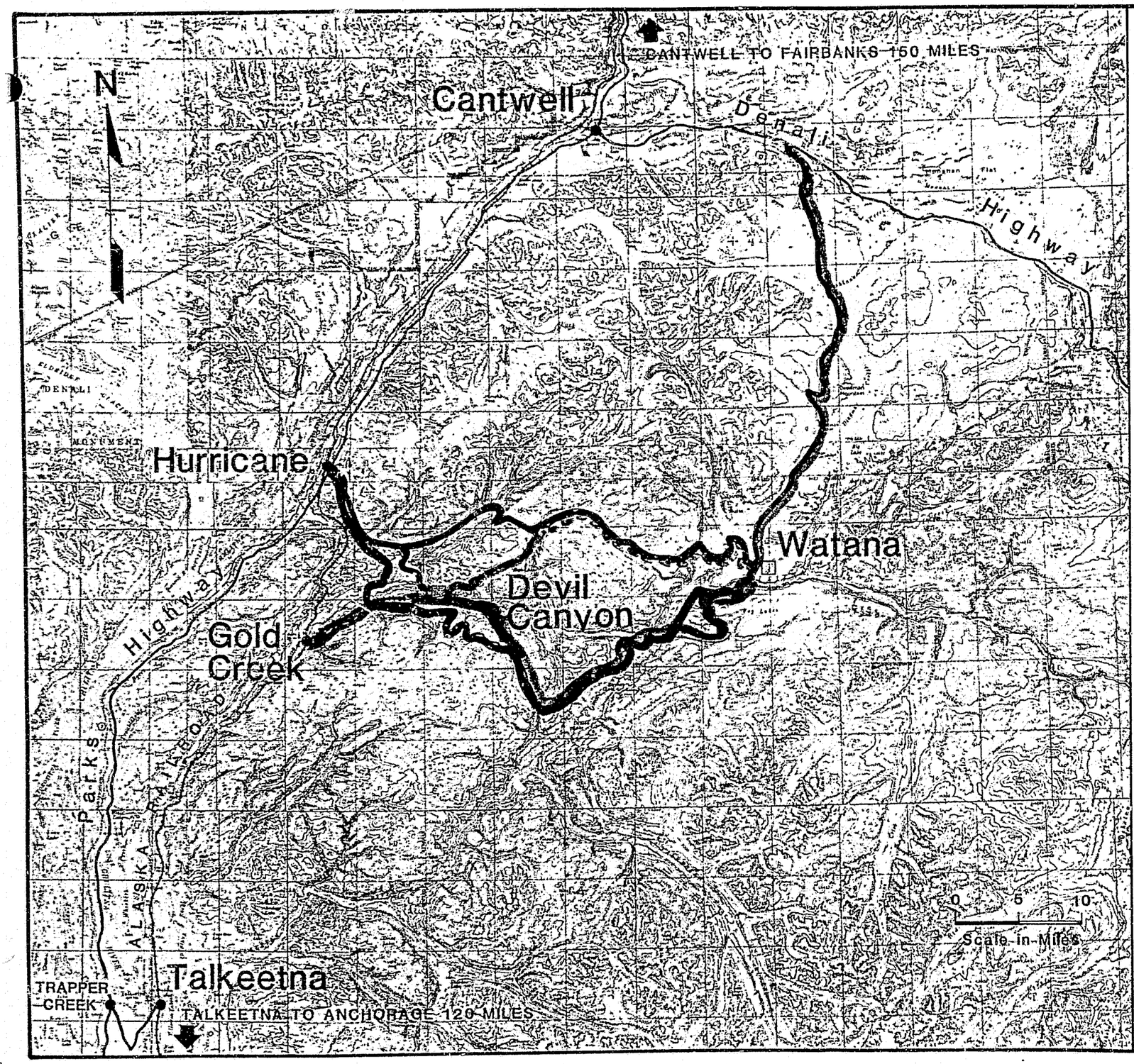

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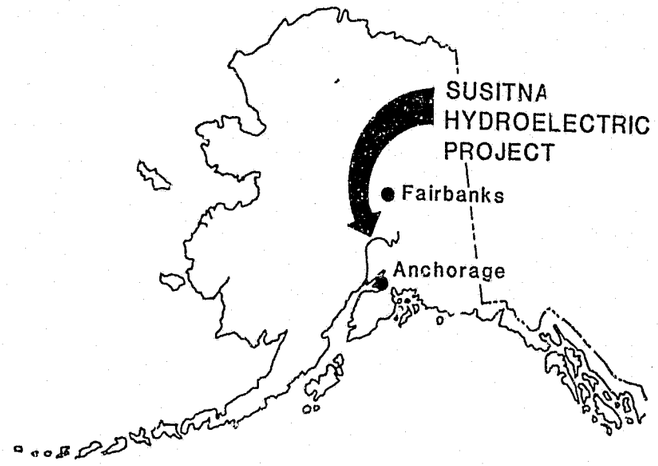
- DEVIL CANYON ACCESS ROAD



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ALASKA POWER AUTHORITY

SUSITNA HYDROELECTRIC PROJECT

STUDY AREA MAP

ACCESS PLAN

HARZA-EBASCO
SUSITNA JOINT VENTURE

FIGURE 1-1

from Gold Creek. A road from the permanent operator's town at Watana to Devil Canyon Dam would eventually be constructed to permit operation of both Watana and Devil Canyon with single staff housed in one new townsite at Watana.

Rail Only (Plan 2): this plan consists of constructing a rail line from Gold Creek to the Devil Canyon project and then on to the Watana Project on the south side of the Susitna River.

Of the four plans considered by Acres (1982b) and shown in Figure 1-1, the North (Plan 13) and South (Plan 16) plans were eliminated on the basis of higher cost and longer duration of construction compared to the other alternative. The rail only alternative (Plan 2) was eliminated because of its costs effect on schedule and its lack of flexibility in undertaking construction activities. The Denali plan was recommended by Acres as the preferred plan and is the proposed route in the Project FERC License Application, submitted in February, 1983 (Alaska Power Authority).

1.2 OBJECTIVES

The purpose and objective of this report is to review available data and studies to provide the Power Authority with an independent appraisal of the access issue and, if necessary, make recommendations for changes in design, mode of transportation or route from those shown or described in the February, 1983 FERC License Application.

Five of the more important factors studied as a part of the route selection review are:

- Construction Costs
- Equipment and Material Transportation Costs
- Effect on Overall Construction Schedule for the Susitna Project
- Environmental Impact
- Socioeconomic Impact

These five major factors were combined with investigations of other issues to develop specific recommendations using concepts of multiobjective decision analysis.

1.3 ROUTES STUDIED

The three best plans studied by Acres in the "Access Plan Recommendation Report" are re-evaluated along with an all-rail access alternative from Gold Creek to Watana along the south bank of the Susitna River. Rail access to both Devil Canyon and Watana was analyzed because resource agency comments were, in some instances, strongly in support of a rail only access plan.

All four routes were studied equally until some compelling reason for elimination of a particular route was identified. Once this occurred, that alternative was not studied on an equal basis with the remaining viable alternatives.

The two best plans were compared in detail prior to developing recommendations. Comparison included a detailed life cycle economic cost analysis, environmental analysis, and an engineering study complete with sensitivity analyses in some areas to obtain a qualitative sense of the strength of the final recommendation as a function of variation in certain parameters, including overall project scheduling, phasing of the Watana and Devil Canyon Dams, transportation costs, and mitigation measures involving controlled access.

1.4 TASK ORGANIZATION

A special Harza-Ebasco task force was established to investigate the access issue as well as other related issues concerning construction camp policies, transportation planning, and employment training. Work of the task force as a whole is described in detail in the Access, Transportation, Construction Facilities, and Employment Training Task

Force Investigation Memorandum transmitted to the Power Authority by letter dated February 16, 1983 from Dr. Ramon S. LaRusso, Harza-Ebasco Susitna Project Manager (Harza-Ebasco 1983a). The task force consists of project management personnel and technical specialists from both the engineering and environmental disciplines, due to the technical complexity of the access issue.

This is the first of five task force reports which will ultimately include the following:

- Access Plan Report
- Transportation Plan Report
- Construction Camp Report
- Employment Training Report
- Access, Transportation, Construction Facilities and Employment Training Task Force Summary Memorandum

Work on all reports began simultaneously in February 1983 with this report, the first in the series, submitted to the Power Authority in April, 1983.

As described in the Task Force Investigation Memorandum, the Task Force was to have originally included Harza-Ebasco personnel plus a representative of the Project Construction Management Firm. The plan was for a close Harza-Ebasco - Construction Manager - Power Authority task force working relationship. Power Authority input was an important component of the overall access road evaluation process. Power Authority staff with responsibilities for overall management, engineering, environmental studies, construction, public participation, licensing, and intergovernmental relations all provided guidance and views on the access question. Selection of a Construction Manager, however, has been deferred by the Power Authority so his input is not included in this report.

1.5 DATA SOURCES

1.5.1 General Review

Task force activities included a thorough review of both the geometric and unit section designs of the proposed access road and railroad; and a study of the process of selecting the best plan as described in the August, 1982 "Access Recommendation Report." This work was limited to review of existing reports; public, resource agency, and native organization correspondence; and limited field reconnaissance. Resource agencies, native organizations, and the public were not contacted as their views on the access question have been presented in numerous forums earlier in project planning activities (see Sections 3.4 and 4.3.7).

1.5.2 Available Data

Primary data sources reviewed for this study (as referenced in the text) included:

- "Access Roads Closeout Reports, Access Route Selection Report," March 1982, by Acres American.
- "Access Recommendation Report," August 1982, by Acres American.
- "Access Planning Study," January, 1982, by R&M Consultants.
- "Access Planning Study Supplement," September, 1982 by R&M Consultants.
- "Susitna Hydroelectric Project FERC License Application," Feburary, 1983 by Acres American.
- "Susitna Hydroelectric Project Feasibility Report - Final Draft," 1982 by Acres American.

While other standard references, government reports, professional papers, and project documents were consulted, the documents listed above formed the primary reference base for task force work. A complete listing of documents consulted is presented in the list of references.

CHAPTER 2

ENGINEERING STUDIES METHODOLOGY AND GENERAL FINDINGS

2.0 ENGINEERING STUDIES - METHODOLOGY AND GENERAL FINDINGS

2.1 SCOPE

This section contains a discussion of the methods used to develop costs for access route economic comparisons, the method of economic analysis, and the need for access in the context of the overall Susitna Project construction schedule. Review of prior engineering, scheduling, and cost estimating studies as they apply to the access issue is also included. Detailed comparison of access alternatives is presented in Sections 4 and 5.

2.2 ACCESS REQUIREMENTS

2.2.1 General

Access is required for personnel transportation and delivery of construction equipment, construction materials, supplies, and major project mechanical and electrical equipment. This section contains a discussion of overall Susitna Project construction schedule and logistics requirements.

2.2.2 Logistics Requirements

Logistics requirements for both the Watana and Devil Canyon developments are presented in R&M Consultants' January, 1982 "Access Planning Studies." R&M developed estimates for total project logistics requirements for 13 major material and commodity types. No estimate of annual requirements during project construction was developed or presented by R&M. The R&M logistics figures seem reasonable based on experience with similar sized projects and a study of the Feasibility Report cost estimates and schedules.

The R&M total project logistics requirements for Watana and Devil Canyon have been broken out by project year by Harza-Ebasco personnel for use in more sophisticated economic construction and logisitics costs modeling than was done for the prior studies. Annual logistics breakdowns for both the Watana and Devil Canyon Projects are given in Tables 2-1 and 2-2, respectively. While calendar year dates are given on the Tables for each construction year, it should be noted this was done only for convenience so that the logistics spreads would conform to the schedule chronology given in the Feasibility Report. The annual requirements for each project were developed using R&M total project logisitics data for each dam and Harza-Ebasco experience with similar projects. The annual distribution of logistics requirements is not based on a rigorous examination of the construction schedule or estimate.

2.2.3 Personnel Transportation

Access is required for both construction materials and personnel. Worker transportation policy for the Susitna Project has yet to be developed. The mode of worker transportation to and from the jobsite has both economic and environmental implications and is an important factor in access route selection. The transportation options include driving to the site by personal vehicle, or busing workers either from the head of the access road or from major population centers. The sensitivity of route selection to transportation policy from an environmental and socioeconomic point-of-view is discussed in Sections 3, 4, and 5. For purposes of life cycle cost studies of candidate access routes, it was assumed that round-trip bus service from Anchorage and Fairbanks would be provided for each worker 26 times each year. This corresponds to a 10 day work, 4 day off schedule at the camp. Based on data in Exhibit E of the 1983 FERC License Application, it was assumed that about 70% of the workers would travel from the direction of Anchorage and 30% would come from the direction of Fairbanks.

TABLE 2-1

ANNUAL CONSTRUCTION LOGISTICS REQUIREMENTS
SUSITNA PROJECT - WATANA PROJECT
(1000's TONS)

Scheduled Year	1985	1986	1987	1988	1989	1990	1991	1992	1993	Total
Const. Equip.	1	2	5	8						16
Explosives	0.5	0.5	2	2	3	4	4	3	1	20
Cement	5	52	50	64	67	76	26	7	3	350
Reinf. Steel	0.5	5	5	6	7	7	2.5			33
Rock Bolts	2	1.5	4	4	1					12.5
Steel Support	1	1.5	1.1							3.6
Mech., Elec., and Street Equip.					4	5	4	2		15
Constr. Fuel	4	45	43	55	57	65	22	6	3	300
Camp Fuel	1	7	7	8	10	11	5	1	1	51
Tires, Parts, Camp Supplies, Village, & Misc.	4	45	45	55	55	60	25	4	1.4	294.4
Total	19	159.5	162.1	202	204	228	88.5	23	9.4	1095.5

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TABLE 2-2

ANNUAL CONSTRUCTION LOGISTICS REQUIREMENTS
SUSITNA PROJECT - DEVIL CANYON PROJECT
(1000's TONS)

Scheduled Year	1993	1994	1995	1996	1997	1998	1999	2000	Total
Const. Equip.	5								5
Explosive	1	2							3
Cement		100	120	130	130	100	70		650
Reinf. Steel		5	5	5	5	2			22
Rock Bolts and Steel Support	3	2.2							5.2
Mech., Elec., and Street Equip.				4	4	4	1.5		13.5
Constr. Fuel	2	10	12	13	13	10	7	1	68
Camp Fuel	1	4	5	5	5	5	4	1	30
Tires, Parts, Camp Supplies, Village, Misc.	10	39	45	50	50	45	27	3.9	269.9
Total	22	162.2	187	207	207	166	109.5	5.9	1066.6

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By including transportation costs for all project personnel in the cost data base for subsequent economic modeling, a conservative input was made. The differences in logistics costs between various routes would tend to be accentuated by this appoach. Other scenarios were studied by sensitivity analyses of the life cycle cost model. Average annual worker loadings for use in the busing cost development were computed from data in Exhibit E of the February, 1983 FERC License Application (see Table 2-3).

2.2.4 Watana Construction Schedule

Access is critical for airfield, construction camp and diversion tunnel contractors. The diversion plan for Watana calls for upper and lower concrete-lined tunnels. The lower tunnel has an inlet invert at El. 1420; the upper tunnel's is at El. 1490. The plan is to construct the lower tunnel and a first-stage low cofferdam across the river so that initial river diversion can be accomplished through the lower tunnel at the start of the low flow season on about October 1st of any given year. After initial diversion, the cofferdams are raised and the upper diversion tunnel is completed. This work must be completed before the onset of the next high flow season on about April 1st.

A general construction schedule for diversion tunnel construction and contractor mobilization is given on Figure 2-1. Two schedules are given: Schedule "A" which assumes that the tunnels are excavated sequentially, and Schedule "B" which assumes simultaneous work in both tunnels to accelerate, or compress, the schedule. This would add an estimated $7,000,000 to $10,000,000 to the cost of the overall project.

The October 1st date is a fixed date. Assuming an October 1, 1986 initial diversion date, it can be determined when construction must start to meet that date for either schedule. For Schedule "A", tunnel excavation on the lower tunnel must begin on about June 1, 1985. For Schedule "B" it would be November 15, 1985.

TABLE 2-3

ONSITE CONSTRUCTION AND OPERATIONS MANPOWER REQUIREMENTS BY MONTH - 1985 TO 2002

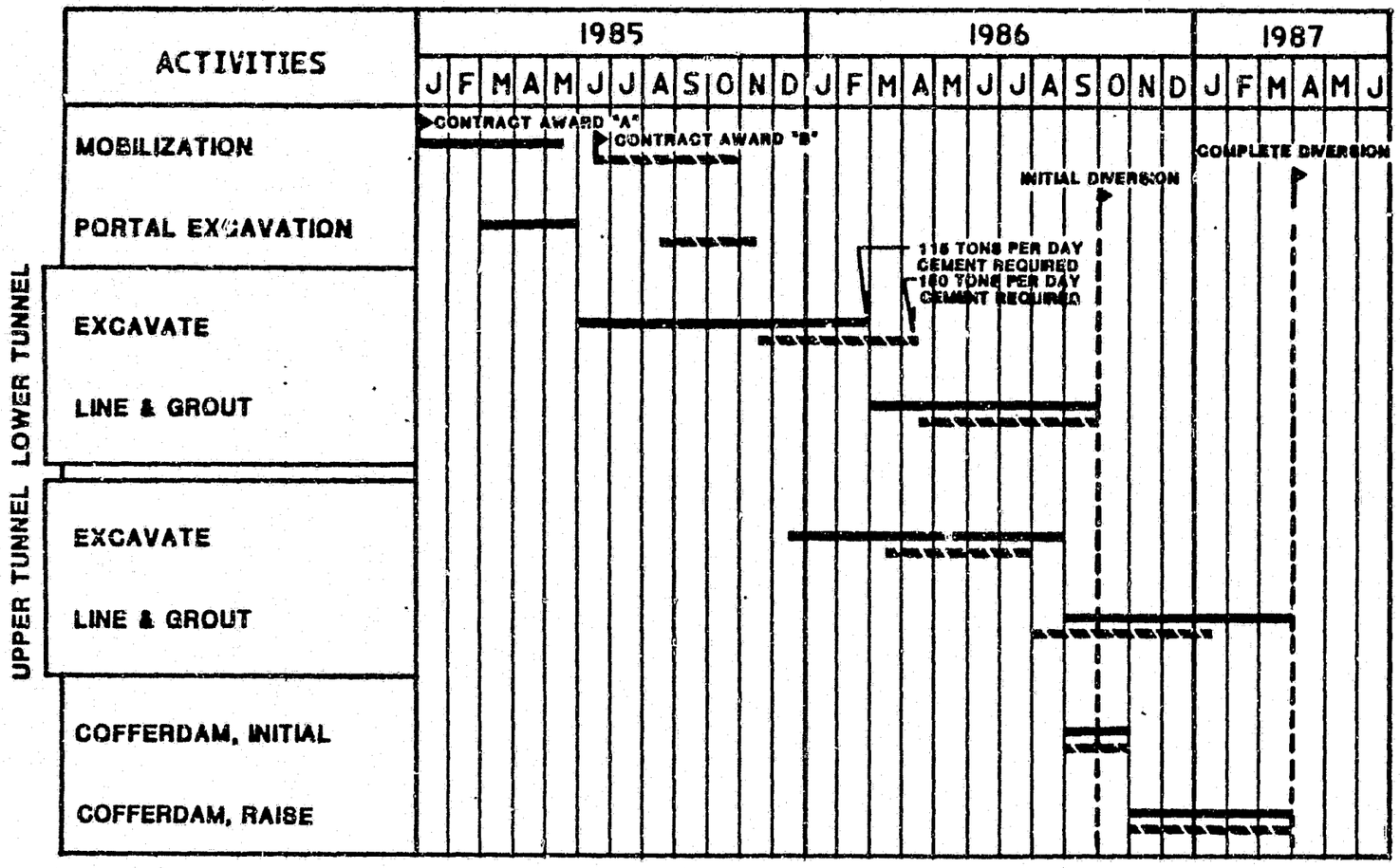
	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
CONSTRUCTION																		
January	330	405	571	750	840	1,050	976	750	390	240	151	239	376	479	510	449	270	45
February	341	419	590	775	868	1,085	1,008	775	402	248	156	247	388	495	527	464	279	47
March	473	581	818	1,075	1,205	1,504	1,398	1,075	558	344	217	343	539	686	730	643	387	65
April	726	891	1,255	1,650	1,849	2,309	2,146	1,650	857	528	333	527	827	1,054	1,121	988	594	100
May	792	972	1,370	1,800	2,107	2,519	2,341	1,800	935	576	363	575	902	1,149	1,223	1,077	648	109
June	957	1,175	1,655	2,175	2,437	3,044	2,829	2,175	1,130	696	439	694	1,090	1,389	1,478	1,302	783	131
July	1,089	1,337	1,883	2,475	2,773	3,463	3,219	2,475	1,285	792	499	790	1,241	1,581	1,681	1,481	891	149
August	1,100	1,350	1,902	2,500	2,801	3,498	3,252	2,500	1,298	800	504	798	1,253	1,596	1,698	1,496	900	151
September	990	1,215	1,712	2,250	2,521	3,149	2,927	2,250	1,169	720	454	718	1,128	1,437	1,529	1,347	810	136
October	759	932	1,312	1,725	1,933	2,414	2,244	1,725	896	552	348	551	865	1,102	1,172	1,033	621	104
November	561	689	970	1,275	1,429	1,784	1,658	1,275	662	408	257	407	639	814	866	763	459	77
December	385	473	666	875	980	1,224	1,138	875	454	280	177	279	439	559	594	524	315	53
PEAK CONST./YR	1,100	1,350	1,902	2,500	2,801	3,498	3,252	2,500	1,298	800	504	798	1,253	1,596	1,698	1,496	900	151
OPERATIONS/MAINT.																		
SUBTOTAL - YEAR									70	145	145	145	145	145	145	145	145	170
TOTAL	1,100	1,350	1,902	2,500	2,801	3,498	3,252	2,500	1,368	945	649	943	1,398	1,741	1,843	1,641	1,045	321

Note: Annual manpower requirements and trade mixes for peak years by Acres American, Inc.

Source: Frank Orth & Associates, Inc. and FERC License Application.

WATANA PROJECT

DIVERSION TUNNEL CONSTRUCTION SCHEDULE



NOTE

SCHEDULE "A" ASSUMES ONE TUNNEL SPREAD. SCHEDULE "B" ASSUMES TWO SIMULTANEOUS HEADINGS AT AN ESTIMATED EXTRA CONSTRUCTION COST OF $7 TO $10 MILLION.

LEGEND

SCHEDULE "A"

SCHEDULE "B" (COMPRESSED)

ALASKA POWER AUTHORITY		
SUSITNA HYDROELECTRIC PROJECT		
GENERAL CONSTRUCTION SCHEDULE FOR DIVERSION TUNNEL CONSTRUCTION AND CONTRACTOR MOBILIZATION		
HARZA-EBASCO SUSITNA JOINT VENTURE		FIGURE 2-1

Prior access studies and public agency contacts have resulted in abandoning any plans for pre-FERC license construction of access roads or any project features. The construction scenario, then, is to begin mobilization of the diversion tunnel, airfield, camp, and access road contractors on the day that the license is issued. Assuming unlimited access, about 2 months would probably be required to mobilize to the extent that preliminary tunnel portal work could begin, with an elapsed period of up to 4-1/2 months from contract award to the beginning of tunnel excavation. For Schedule "A" this would put the latest award date at January 1, 1985 and at June 15, 1985 for Schedule "B".

The initial mobilization logistical requirements are significant, but manageable. Equipment for tunnel, airfield, and road construction would be required, along with camp facilities for 150 to 200 people. Table 2-4 is a listing of the probable equipment required along with monthly supply needs for the first three months of work. Logistical requirements increase as construction progresses, but remain manageable until concrete is required for diverson tunnel lining. Assuming a diversion date of October 1, 1986, cement at the rate of about 115 tons per day would be required beginning on or about March 1, 1986 for Schedule "A" and at a rate of about 150 tons per day on about April 15, 1986 for Schedule "B". When analyzing any access alternative in the context of these scenarios, the key issue is whether or not uninterrupted ground access can be achieved in time to support concreting operations in the diversion tunnels or if the construction would have to be supported by air. To some extent massive airlift operations could be avoided by good planning and utilization of winter snow roads for stockpiling materials.

2.3 ACCESS CONSTRUCTION COST ESTIMATE AND SCHEDULE REVIEW

2.3.1 Basic Construction Cost Estimates

Construction cost estimates for the four principal routes were reviewed by Harza-Ebasco estimators. Engineers originally responsible for preparing the estimate at Acres American and R&M Consultants were interviewed and back-up data were obtained.

TABLE 2-4

WATANA MOBILIZATION AND INITIAL
LOGISTICAL REQUIREMENTS

EQUIPMENT

ITEM	QUANTITY
Office Trailers	4-6
Shop Trailers	4-6
1200 cfm Compressor	2
1000 kW Generator	2
4 Boom Hydraulic Jumbo's	2
966 FEL's	2
24 T Rear Dump	4
Flat Bed Trucks	6
Pickups	12
Airtrac Drills	2
D-8	1
D-7	2
480 FEL/Backhoe	2
12-15,000 Gal. Fuel Tanks	4

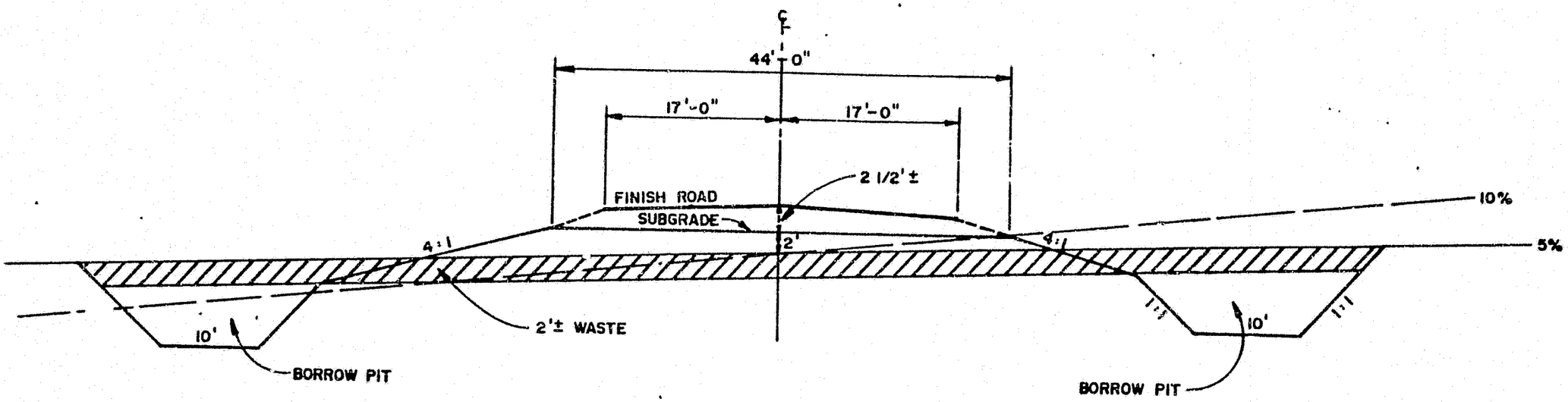
LOGISTICAL REQUIREMENTS
(Monthly for 3 Months)

Diesel Fuel	300 T
Camp and Miscellaneous Supplies	50 T
Explosives	60 T
Repair Parts, Drill Steel, etc.	17 T

Unit prices for all the access estimates in the Acres 1982 "Access Recommendation Report" and the R&M 1982 "Access Plan Study" (both volumes) are based on Alaska Department of Transportation bid history for similar types of work; specifically from the recent Nome to Council and Taylor Highway projects. No site specific unit prices were developed.

The routes were laid-out and the material quantities were computed using topographic maps with a contour interval of 100 feet. At this scale of mapping, only the largest cut and fill sections would be identifiable from the route grade studies. Variations in quantities among the various routes are based on the obvious cut and fill sections identifiable on the maps, plus changes in quantities required by the side slopes across the route alignment. Figures 2-2 and 2-3 are typical side hill cross sections used by R&M for their estimating work. Quantities for a given range of side hill construction conditions were developed and multiplied by the route length with the appropriate side hill cross slope and summed with other similar data to develop total quantity estimates. No attempt to adjust the unit prices for differing soil conditions along the routes was made.

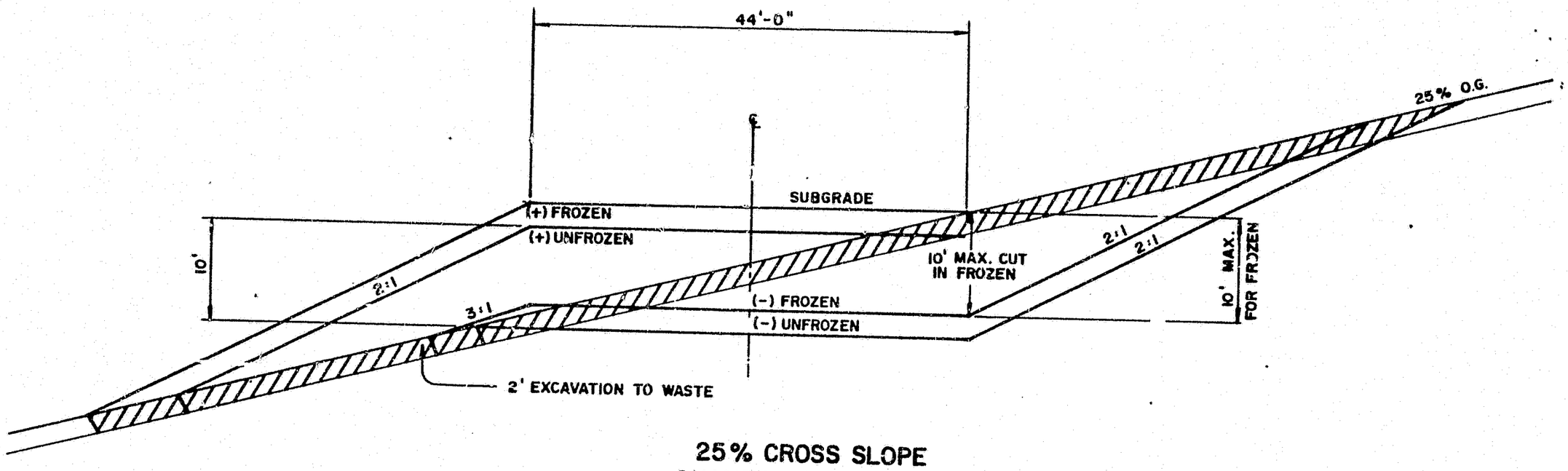
The estimating approach used in earlier studies (Acres 1982b and R&M 1981 and 1982b) is acceptable for purposes of comparison plan. Given the scale of available maps (which are the only ones available), making new, revised quantity and cost estimates does not seem justifiable. There is not enough data available to significantly increase the level of estimating accuracy at this time. The only change that might be worthwhile would be to vary the quantities of borrow required on various routes as a function of soil conditions determined from an examination of the Terrain Unit Maps in the R&M reports (see Figure 2-4). The variations in total cost that could be reasonably achieved by making adjustments in borrow quantities is small, however, and can be ignored at this level of study.



BORROW PIT SECTION
0-10% CROSS SLOPE
QUANTITY ESTIMATING
CROSS SECTION

0 5 10 20
SCALE IN FEET

ALASKA POWER AUTHORITY		
SUSITNA HYDROELECTRIC PROJECT		
TYPICAL SIDE HILL CROSS SECTION 10% CROSS SLOPE		
HARZA-EBASCO SUSITNA JOINT VENTURE		FIGURE 2-2



25% CROSS SLOPE
QUANTITY ESTIMATING
CROSS SECTION

0 5 10 20
SCALE IN FEET

ALASKA POWER AUTHORITY	
SUSITNA HYDROELECTRIC PROJECT	
TYPICAL SIDE HILL CROSS SECTION 25% CROSS SLOPE	
HARZA-EBASCO SUSITNA JOINT VENTURE	FIGURE 2-3

00050

FOR CONTINUATION, SEE SHEET 2

FOR CONTINUATION, SEE SHEET 6

FOR CONTINUATION, SEE SHEET 8

FOR CONTINUATION, SEE SHEET 14

Terrain Unit Symbol	Terrain Unit Name
Bxu	Unweathered, consolidated bedrock
C	Colluvial deposits
Cl	Landslides
Cs-f	Solifluction deposits (frozen)
Ffg	Granular alluvial fan
Fp	Floodplain deposits
Fpt	Terrace
GFo	Outwash deposits
GFe	Esker deposits
GFk	Kame deposits
Gta	Ablation till
Gtb-f	Basal till (frozen)
O	Organic deposits
L-f	Lacustrine (frozen)
L / Gta	Lacustrine sediments over ablation till
L / Gtb-f	Lacustrine deposits over basal till (frozen)
Cs-f / Gtb-f	Solifluction deposits (frozen) over basal till (frozen)
Cs-f / Gta	Solifluction deposits (frozen) over ablation till
Cs-f / Fpt	Solifluction deposits (frozen) over terrace sediments
Cs-f / Bxu	Solifluction deposits (frozen) over bedrock
Gtb-f / Bxu	Frozen basal till over bedrock
Gta / Bxu	Ablation till over unweathered bedrock
C / Bxu + Bxu	Colluvium over bedrock and bedrock exposures
C / Bxw + Bxw	Colluvium over weathered or poorly consolidated bedrock

Bedrock Mapping Units	Tv	Tsu	Tbgd	Tsmg	TKgr	Jam (Jtr)(Jgd)	Trv	Pzv (Pls)	Kag	Trvs
Abbreviated Descriptions	Tertiary volcanic rocks, shallow intrusives, flows and pyroclastics, rhyolitic to basaltic	Tertiary non-marine sedimentary rocks, conglomerate, sandstone and claystone	Tertiary biotite granodiorite, local hornblende granodiorite (Thgd)	Tertiary schist, migmatite and granite, representing the roof of a large stock	Tertiary and/or Cretaceous granitics forming small plutons	Jurassic amphibolite, inclusions of greenschist & marble, local trondhjemite (Jtr) and granodiorite (Jgd)	Triassic basaltic metavolcanic rocks formed in shallow marine environment	Late Paleozoic basic and andesitic metavolcanogenic rocks, local metalimestone (Pls)	Cretaceous argillite and graywacke of a thick deformed turbidite sequence, low grade metamorphism	Triassic metabasalt and slate, an interbedded shallow marine sequence.

Miscellaneous Map Symbols

Scarp — Slide Scar — Buried Channel — Trail — Rock Contact

SCALE 0 2000 4000 FEET

DATE | NO. | REVISIONS | CH. | APP. | APP.

ACRES

ALASKA POWER AUTHORITY

SUSITNA HYDROELECTRIC PROJECT

SUBTASK 5.05

PHOTO INTERPRETATION

TERRAIN UNIT MAPS

R&M CONSULTANTS INC.

DATE APRIL 1981

PROJECT 052504

SHEET 7 OF 81

The detailed cost estimates presented in the 1982 R&M "Access Planning Study" reports were used as a basis for comparison of the four plans discussed in this report. An adjustment was made to all road estimates to eliminate the asphalt road surfacing costs in the R&M estimates to match the unpaved gravel design shown in the FERC License Application. The R&M estimate for the recommended Denali plan is somewhat different from the estimate by Acres in the Feasibility Report and FERC License Application. Regardless, however, the R&M estimates were used for this study since they are the only convenient source of cost estimating data for all four plans at acceptable and comparable levels of accuracy and detail.

2.3.2 Route Construction Scheduling

Construction schedule durations for the four plans studied are given in the 1982 "Access Recommendation Report" and "Access Route Selection Report." Estimated duration for complete construction of all permanent road features associated with access for the four alternatives are summarized below:

Denali plan	2-3 years
North plan	2-3 years
South plan	2-3 years
Rail Access	3-4 years

Acres construction scheduling backup data for the South plan was reviewed by Harza-Ebasco and seems reasonable. While detailed backup was not reviewed for the other routes, it seems likely that the construction schedule durations given in previous reports for the other plans are also reasonable.

Note that the above construction period durations are for completion of all route construction activities, including the connection to the Devil Canyon site. Access can be achieved earlier, on a hasty basis, by temporary bridging (particularly on the North Route), use of redundant fill, or extra crews. On this basis, initial access to the Watana Site could be achieved in one year or less for all four alternatives except all-rail.

A number of techniques have been identified by Acres (1982b) that could be employed to accelerate road construction:

- Construct minimum width and fill depth consistent with available materials and foundation conditions.

- Place gravel fill in winter on frozen ground.

- Develop borrow areas ahead of road construction. If work is to be done in freezing weather, open a limited face and keep work going 24 hours per day.

- Install culverts by excavating through fill, or use partially prefabricated Super Arch and panel box culverts which can be rapidly placed and covered.

- Use short construction time single span military "Bailey" or panel type bridges over narrow stream channels.

- Place fill over filter or geotextile fabric to minimize excavation and stripping.

- Avoid cut and fill operations. Initial road should be constructed with gravel fill.

- Provide adequate right-of-way width to give flexibility in alignment in areas of poor foundation conditions (bogs, permafrost, sidehill spring areas, slope stability problem areas).

- Minimize stripping, both to save time and to avoid many permafrost problems - clear and fill directly.

The above techniques have application mainly to roads, not railroads. The critical element in the rail only plan is a high level bridge across Chechako Creek. It is difficult due to grade and weight restrictions to use temporary bridging in rail construction. Estimated construction schedule durations for initial access for the three remaining plans have been estimated as follows:

Plan	Miles of New Road Required (Watana Phase)	Initial Access Period
Denali	40	6 months
North	69	9 months
South	52	12 months

These are the durations used by Harza-Ebasco in access scenario evaluations for this report given access road construction histories compiled by Acres for several other recent hydro projects in subarctic areas (see below). "Initial Access" as defined by Acres means a road capable of supporting all-weather 30 mph truck traffic.

Project Location	Length of New Road Built	Duration of Construction
Lower Churchill	57 miles	3 months
Ling Spruce, Manitoba	14 miles	6 months
Limestone, Manitoba	20 miles	5 months
Cat Arm, Newfoundland[1/]	15 miles	12 months
Upper Salmon, Newfoundland[2/]	42 miles	19 months
Trans Alaska Pipeline	360 miles	One summer season

1/ Extensive rock excavation required.
2/ Contractor defaulted and work had to be relet.

In addition to roads, time to build an airstrip for construction logistical support is an important part of the overall access plan. An airstrip capable of handling Hercules aircraft should be able to be constructed in about 6 weeks by enlarging the strip planned for the Design Phase, as described in an R&M Report dated October, 1980.

2.3.3 Accelerated Schedule Costs

Acres and R&M developed costs for the extra temporary work and crews necessary to provide initial access as quickly as possible. These costs seem reasonable and were included in the cost base for this study.

2.4 ROUTE DESIGN

2.4.1 Geometrical Road Design

The design data for the recommended access road as described in the February 1983 FERC License Application is as follows:

Surfacing:	Unpaved Gravel Treated
Width of Running Surface:	24 feet
Shoulder width:	5 feet
Design Speed:	55 mph
Maximum Grade:	6%
Maximum Curvature:	5^{o}

Design Loading

- During Construction - 80k/axle, 200k total
- After Construction - HS-20

These criteria are proposed for as much of the route lengths as is reasonably practical. According to the License Application (p. A-1-24), more severe grades and curvatures will be permitted in some areas to avoid excessive cost or environmental impact. Minimum design speed will reportly never be less than 40 mph. While the stated geometric design criteria are, in our opinion, stringent for a project access road, an examination of the route terrain does not reveal any areas for significant cost savings by relaxing design criteria.

2.4.2 Unit Section Road Design

The unit section designs shown in the FERC License Application are conventional designs based on Alaska Highway Department Standards and common subarctic practice. A diagram of the typical unit section design is shown in Figure 2-5.

Although the proposed unit section is well designed it may be possible to save a significant amount of both time and money by building the road directly on the unprepared subgrade, where possible, using non-woven filter cloth as a stabilizing base. This would be most applicable on flat terrain. The present scheme calls for 2 feet of waste excavation in all areas, with filter cloth beneath the base course in areas where it is uneconomical to remove all the unsuitable foundation material. This technique may have wider application than just in these areas.

Use of filter cloth on unprepared subgrade may permit up to a 75% reduction in waste and common excavation. Including provisions for the filter cloth, with the same amount of base and finish aggregates as originally assumed, savings could be about 20% of construction cost for most routes for total savings on the order of $10,000,000 or more. Further investigation of this method of construction should be undertaken during future Task 38 studies. A test strip might be worthwhile.

2.4.3 Railroad Design Parameters

Rail design parameters used for estimating and layout purposes in previous studies conform to accepte practice and were not altered for purposes of re-layout or estimating for this report.

2.5.2 Trucking Rates

Rates for trucking on access roads from Cantwell, Hurricane and Gold Creek were developed using estimating file data with verification from quotes by local haulers. Rates independently developed were based on Harza-Ebasco estimating files for prior Alaska projects and assumptions regarding speed, load and unload time, and payload. For example, the cost of operating a bulk cement truck with a 65,000 lb. payload would be about:

Driver	$ 38/hr
Equipment	$ 65.80/hr
Fuel	$ 19.69/hr
Parts & Tires	$ 13.13/hr
	$136.62/hr

Add 4% for O.T. = $142/hr excluding overhead and profit
Add 65% for O.H.&P = $235/hr total including camp expense

The total cost per 8-hour shift would be $1880 including camp expense for the driver. Assuming a 35 mph average speed over the Plan 13 - North road from Hurricane to Watana and a 1 hour load and unload time at each end, the total cycle time per load would be about 3.5 hours, or roughly 2 trips per day per vehicle, at an average cost of about $1.44 per hundredweight. Quotes were obtained for this haul from Big State Motor Freight, Inc. of Anchorage, who also estimated 2 trips per day at a cost of $1.30/cwt. excluding driver accommodation. Based on Terror Lake project projections, the cost of 1 man-day in the camp should be about $100, which would increase the Big State quote to about $1.38 per hundredweight, which compares well with the Harza-Ebasco developed rate.

A flat rate per ton-mile for all commodities of $0.2069 per ton-mile was used in previous studies. The average equivalent rate per ton-mile used in this study was about $0.50 per ton-mile; over twice as high as the previous rate. The lower rate, however, is applicable only to over-the-road trucking, where the load and unload time is a smaller proportion of the total running time, more ton-miles are produced per unit hour, and the empty return ratio is low. For comparison, Big State quoted an over-the-road rate for cement hauling from Anchorage to Hurricane of $1.50 per hundredweight, or about $0.2308 per ton-mile, which compares well with the previously used rates for access road logistics costing.

2.5.3 Airfreight

Airfreight rates for a fully loaded Hercules aircraft with a payload of 44,000 pounds from Anchorage to Watana is about $6800 per trip, based on quotes from Alaska International Air.

2.5.4 Personnel Transportation

Busing costs per passenger year were computed assuming that the buses would stop at communities enroute from Anchorage or Fairbanks to Watana. Since exact statistics concerning the numbers of workers likely to live in various communities are not available, it was assumed that 100 percent of the passengers from Fairbanks would have been picked-up by the Cantwell stop, and 100 percent of the Anchorage passengers would have been picked-up by the time the bus reached Hurricane for any of the access routes. By estimating costs of transporting all workers 26 times per year from these close-to-the-site communities, we have essentially adopted a policy of studying only differential costs attributable to various access routes; not total costs of transportation.

In the case of busing, this approach does not permit inclusion of differential labor costs paid to passengers while en route. This could be a significant figure over the life of the project if it can be assumed that a worker will actually work 3 hours productively after a 5-hour bus ride or 2 hours after a 6-hour bus ride. Experience from the Trans Alaska Pipeline worker busing and air transportation programs (Frank Moolin and Assoc. 1983) from Anchorage to Valdez shows that this was not the case. It was found that workers flown or bused to Valdez were not very productive the day of their arrival in camp. This potential cost for lost productivity has, therefore, not been included in the present model.

The cost of operating buses on an hourly basis with a union driver was developed based on Harza-Ebasco file estimating data and input from Transportaion Services, Inc. of Anchorage. Total hourly cost of operation of a 44 passenger motor coach was estimated at $109/hr, with a union driver. Speed on access roads was assumed to be 35 mph, with a 50 mph speed on the Parks Highway.

2.6 MAINTENANCE COSTS

Maintenance costs for the gravel surfaced access roads were developed using Harza-Ebasco file estimating data and experience on prior projects. R&M rail maintenance data was used for the rail-only alternative.

It is very difficult to differentiate between the three road routes from a maintenance viewpoint for purposes of estimating. It was assumed that the equivalent of two motorgrader/water wagon crews would operate about 2300 hours annually on any of the roads and that about 50% of the gravel surface course on the road would be lost each year over the entire surface of the road. This gravel was assumed to be spread by the graders from gravel previously stockpiled at a cost of about $20 per ton. Unit maintenance costs developed on this basis are about $48,000 per mile per year, or about 2% of total construction costs, which is a reasonable percentage.

2.7 LIFE CYCLE COST ANALYSIS METHODOLOGY

The cost and logistical data described above were used for life cycle cost modeling of the two best plants (see Section 4). The approach used in the modeling was consistent with the approach used on other Power Authority planning studies as required by state law and regulations. Simple present worth computations were prepared using construction, maintenance, and transportation costs as identified above. The material transportation costs included costs from the closest point to the site common to all routes; in this case Gold Creek, assuming all materials and equipment arrive via the Alaska Railroad from Anchorage. This is a different approach than was adopted for the previous studies, which included transportation costs all the way from Seattle in the access road cost base. The effect of the earlier assumption is to make differences between transportation cost differentials appear insignificant. The approach adopted for the present work includes only those costs attributable to construction and use of a particular access route with the equalizing effect of total transportation costs removed from the data base.

For present worth studies, the discount rate was assumed to be 3.5% in a non-inflationary environment with a 2.5% real escalation of the fuel consumed in transportation and maintenance operations. A second case assuming no fuel escalation was also developed. For purposes of analysis, construction of the Watana Project was assumed to begin in 1985 as described in the FERC License Application. The duration of Devil Canyon construction was assumed to be as described in the license application, but the starting date was shifted to determine if the route selection conclusions were sensitive to timing of Devil Canyon with respect to Watana. For the base case, it was assumed that Devil Canyon would be constructed beginning in 1993 as described in the Feasibility Report and License Application. Sensitivity analyses were conducted for the base case transportation costs.

CHAPTER 3

ENVIRONMENTAL STUDIES METHODOLOGY AND GENERAL RESULTS

3.0 ENVIRONMENTAL STUDIES METHODOLOGY AND GENERAL ISSUES

3.1 SCOPE AND GENERAL METHODOLOGY

This section contains a general discussion of the methods used to evaluate the various access plans from an environmental perspective. Environmental considerations are defined broadly and include physical, biological, and social science considerations. General data and route evaluation criteria are presented in this section, along with an examination of agency, native organization and public comments on the access question. A more detailed impact analysis and route comparisons follow in Section 4 and recommendations in Section 5.

The basic steps used in environmental analysis of the access issue included:

- o Identification and prioritization of affected resources
- o Definition of evaluation criteria for affected resources
- o Analysis agency, native organization and public comments
- o Impact analysis and comparison of alternative access routes
- o Development of recommendations including mitigation measures

The objective was to identify potential impacts and rate the various access route alternatives in a systematic manner with respect to environmental effects of each alternative under consideration.

3.2 IDENTIFICATION AND PRIORITIZATION OF ENVIRONMENTAL ISSUES

3.2.1 General Methodology

Environmental specialists in the physical, biological, and social sciences began study by reviewing potential generic impacts of access road development. Based on this review, an evaluation procedure was

established whereby potential impacts which had the greatest effect on selection of an access plan were identified and singled-out for detailed analysis in subsequent investigations.

The initial activity in the identification of important environmental impact areas was to establish a systematic approach to analyze effects on all potentially affected resource categories. To achieve this end potential impacts were considered by reviewing generic impacts according to the categories defined by the Federal Energy Regulatory Commission (FERC) in the requirements set forth for license applications for major hydroelectric projects (46FR55926). These categories include:

- Water Use and Quality
- Fish, Wildlife, and Botanical Resources
- Historic and Archaeologic Resources
- Socioeconomics
- Geology and Soils
- Recreation
- Aesthetics
- Land Use

Impacts in these categories have been extensively studied by others and are discussed in the Susitna Hydroelectric Project FERC License Application (Alaska Power Authority 1983b), Access Plan Recommendation Report (Acres 1982C), and numerous other project and resource agency documents, including those described in Section 1.5.1.

The technique used to rank the importance of impacts in these resource categories draws on the principles advanced by Linstone and Turoff (1975), although the process employed by the team of engineers and scientists evaluating impacts on this project was less structured and more informal than is typically undertaken in structured group sessions. Several meetings were held, during which project scientists

and engineers discussed impacts of the access plans and established criteria for distinguishing which resource categories influenced the access decision. During these meetings, the relative influence of each of these impacts in determining the overall environmental impacts was discussed.

3.2.2 Resource Category Ranking

Group discussions of environmental impacts surfaced the need to consider the potential impact of access development as well as the likelihood that such impacts would occur. For example, it is known that large quantities of gravel will be needed for road construction, but it is not known how much gravel would be obtained from specific locations along the route. This can make a sizable difference in impacts, depending on the quantity and location of borrow sites. In the case of the North Plan, the development of a borrow area in the Portage Creek drainage could have a significant fisheries impact, depending on the location and amount of borrow obtained. Consequently, judgements were required in categorizing potential impacts, considering the potential impacts, and the likelihood they would occur.

During initial impact review, it was also determined that it was appropriate to divide the Fish, Wildlife and Botanical Resources category into two sections. The first category includes fisheries resources while the second includes wildlife and botanical resources. Wildlife and botanical resources have been grouped together because of the interrelationship of habitat types and wildlife impacts and because of the importance of wetlands to wildlife as a botanical resource. Further, it was recognized that socioeconomic impacts should be divided into two categories. The first category includes impacts regarded as positive by local communities, including economic benefits resulting from increased levels of economic activity in local communities. The second effect is the undesirable change in lifestyle which could result from increased settlement near or within affected communities. Such undesirable changes are a reflection of community attitudes and perceptions. Because of the distinct nature of these types of socioeconomic considerations, they are analyzed separately in the following analysis.

Group discussions of the important environmental impacts, in light of the considerations reviewed above, led to a ranking of the relative importance of potential impacts in each of the resource categories. This ranking was established so that alternative access plans could be compared. It is based on the potential impact, the likelihood that such impacts would occur, and the importance of the potential impacts in selecting one route as compared to another. Based on these considerations, the environmental resource categories that are most important as they affect route selection are listed in Table 3-1. The categories of Water Use and Water Quality, Historic and Archaeologic Resources, and Geology and Soils were evaluated and recognized as having a limited role in the selection of a preferred access plan. A discussion of the factors leading to the ranking described above, by resource category, follows.

Water Use Quality: Although access road development and use could lead to increased erosion, chemical spills, and the degradation in water quality, it was determined by project team members that water use and water quality was not an issue which directly influenced access route selection. This finding was based on the recognition that a potential degradation of water quality would occur locally and would be a concern as it affected fishery resources (see below). Therefore, it was concluded that although water use and quality is an area of potential impact, it need not be considered as a separate issue in this report; rather it was subsumed in the analysis of fisheries related impacts.

Wildlife and Botanical Resources: Impacts to these resource categories were determined to be the most important environmental issue associated with the selection of any of the access plans. Removal of important wildlife habitat and opening of previously inaccessible areas to human activities would significantly affect existing botanical and wildlife resources. Alteration and removal of wetland areas was also identified as important on botanical and wildlife impact.

TABLE 3-1

RANKING OF IMPORTANT RESOURCE CATEGORIES
IN THE SELECTION OF AN ACCESS PLAN

Factors Influencing Plan Selection

Wildlife and Botanical Resources
Socioeconomics
Fisheries
Land Use
Aesthetics
Recreation

Factors Not Influencing Plan Selection

Water Use and Quality
Historic and Archaeologic Resources
Geology and Soils

Fisheries Resources Fisheries impacts were determined to be important as several streams with important anadromous fish populations and streams with substantial populations of graylings could be affected by access road construction. Fisheries impacts were identified as being the third most important impact area.

Historic and Archaeological Resources: Although there are historic and archaeologic resources along certain portions of the access routes under consideration, detailed studies of all routes have not been conducted. Further, potential impacts to cultural resources are site-specific and should not influence which access plan should be selected. Potential impacts stemming from disturbance to historic and archaeologic resources can be largely controlled or avoided through careful design and construction practices during the detailed design phase. Therefore, potential impacts to these resources are not considered in this report.

Socioeconomics: The extent and variety of public comments on the various access alternatives illustrate the public concern and potential socioeconomic impact of access route development. Strong feelings, both for and against various access alternatives, have been expressed and there is well-founded concern regarding the level of induced changes the project would have on communities surrounding the project area. A variety of significant socioeconomic indicators could change for several communities (depending on the access plan ultimately developed). Socioeconomics are an important issue in access route selection, second only to wildlife and botanical resources in the overall comparison of environmental impacts.

(THIS DISCUSSION OF POSITIVE AND NEGATIVE SOCIOECONOMIC ISSUES IS TO BE REVISED AND UPDATED AS NECESSARY)

Geology and Soils: The development of access roads could potentially increase soil erosion. Construction activity across slopes could result in slope instability, which could compound soil erosion concerns and increase the general level of disturbance caused by road or railroad construction. However, project scientists and engineers determined that the geology and soils impacts were important only as

they affected the engineering design and costs of various route alternatives and potential impacts on fisheries. For example, the categorization of the access routes according to the slope of the area traversed is obviously related to geologic and soils considerations, but the effects of the geologic and soils conditions are important to other resource categories; not to geology and soils in themselves as an identifiable resource. Geology and soils were therefore treated in the context of evaluation of other categories and were not treated separately.

Recreation: Impacts to existing and future recreation opportunities are affected by the selection of either access plan. The importance of recreation in the overall decision making process, however, is less significant than other resources because there will be an abundance of new recreational opportunities in the project area, regardless of which access plan is selected. Therefore, even though the current recreation plan is based largely on opportunities for the Denali route, comparable, but different, recreational experiences can be found along other candidate plans. While the selection of either one of the two access routes would create recreation opportunities and, therefore, produce positive impacts, adverse impacts to fish and wildlife resources could occur with overuse of the area. This consideration led to the finding that recreation was a resource which could affect the access decision but that potential impacts to fish and wildlife as a result of recreation activities were the more significant concern. This finding led to the conclusion that recreation resources is of relatively low overall importance in the access route decision, and the relatively high importance of wildlife and fisheries resources.

Aesthetics: Aesthetic considerations are largely related to those of recreation, and were determined to have less weight in the overall decision making process than recreation. However, it was determined that aesthetic considerations did influence the route decision-making process as there was a difference in relative merit of the various

plans under consideration based on aesthetic factors. Some portions of routes under study would help maintain high aesthetic quality in other areas while other portions of the various routes considered could lead to an overall deterioration in the aesthetic quality of the area. For this reason, it was determined that aesthetics should be analyzed from the perspective of each plan's potential for allowing for retention of the area's high aesthetic quality. It was determined, however, that aesthetics was implicitly considered in the recreation analyses to some degree. Aesthetics therefore, was ranked as the least important resource category in the overall decision making process.

Land Use: Land use impacts were determined to be among the most important in influencing the overall environmental impact of the access alternatives. In a discussion of the nature of the land use impacts of access road development by project scientists and engineers, however, it was concluded that land use concerns were largely reflected in other resource categories except for ownership patterns. For example, the importance of maintenance of a high quality area for hunting and fishing land use was largely reflected in the fish and wildlife and botanical resource analyses. It was also implicitly recognized in the discussion of recreation resources. Therefore, land use analyses need not be weighted as heavily in the overall decision making process as if they had to reflect the overall importance of land use to the access road decision. Consequently, land use was ranked as the fourth most important factor, behind botanical and wildlife resources, fisheries resources, and socioeconomics.

Summary of Ranking: Environmental resource categories were divided into two categories, depending on their role in determining the recommended access plan. The first category included those environmental determinants which influenced the route selection process. These determinants were further subdivided and prioritized according to the importance of each in selection of a preferred access

route. Table 3-1 listed these determinants and their relative importance in influencing the access plan decision. The second set of environmental attributes listed in the bottom portion of Table 3-1 are those which need not be separately considered in the decision making process. They do not need to be considered because they are incorporated into one of the other categories, can be avoided through site specific design mitigation measures, or are generally of lesser importance. These findings, as determined through the group process described above, serve to prioritize environmental impacts and help in defining the overall objective function used in determining how well each access alternative meets the goal of minimizing environmental impacts.

3.3 ENVIRONMENTAL EVALUATION CRITERIA FOR AFFECTED RESOURCES

Criteria for evaluating environmental concerns were developed, recognizing impacts of two types: those caused by physical construction of the road and its use during construction, and those caused by public use of the roads and attendent possibility of egress to adjacent land. The first of these categories is determined by construction practices and conditions along the selected route. The second category is dependent on the policy adopted for public use after construction. For purposes of this study, it has been assumed that regardless of the route selected, it would be closed to public use during construction, and would be left open for unrestricted use once construction is complete. Other access policy options include use on a controlled or permit-type basis or the establishment of passive or active controls to limit use. Although the purpose of this report is not to perform a detailed study of public use options, it is recognized that public access is an important issue. The environmental sensitivity of various impacts to public access policy is considered in Section 5, where the effect of adopting a controlled access policy is discussed.

3.3.1 Wildlife and Botanical Resources

The primary wildlife and botanical resource issues of concern relative to project access pertain to the effects of this access on wildlife resources of the project area. Although vegetation impacts will occur, the primary issues of concern relate to impacts on vegetation as a component of wildlife habitat rather than as a botanical resource in itself. Therefore, in this evaluation, impacts on vegetation are treated in the context of the impacts on wildlife resources which they produce.

The direct loss of vegetation resulting from access road or railroad development will produce a major loss of wildlife habitat as large areas will be affected and few, if any, species will benefit from the habitat provided by the access road or railroad in themselves. This direct loss of habitat will be the impact of greatest concern to small bird and mammal populations in the project area. Therefore, the quantities of the various vegetation types lost are considered important criteria for consideration in comparing the impacts of alternate access plans.

All vegetation types represent important habitat to some wildlife species. An attempt could be made to develop an index of habitat quality for each vegetation type, considering the habitat requirements of all species or at least a subjectively determined important group of species. Then these indices could be multiplied by the areas of each vegetation type lost and the products summed to derive an overall index of habitat quality and quantity for each access plan (a form of HEP analysis). However, as demonstrated by Terrestrial Environmental Specialists (1981), the differences in the quantities of habitats lost due to the various access plans overwhelm the differences in the qualities of the habitats lost within each plan. Therefore, the quality of habitats lost due to the presence of roads or railroads is not considered as a criterion for comparing the impacts of alternative access plans, except, in a general sense, in terms of wildlife concentration areas and special use areas.

Another exception to the above discussion is in the case of wetlands. Wetlands have high ecological and hydrological value and are protected by a number of federal and state of Alaska regulations. Therefore, the area of wetlands potentially impacted by each access plan is considered an important criterion.

Although the habitat loss impact is of importance to the larger birds and mammals, of greater concern are: (1) the disturbance effects associated with road use; (2) increased hunting, disturbance impacts, and habitat degradation associated with increased human use of areas adjacent to the road; (3) the movement barrier which the road may produce for certain mammals; (4) mortalities resulting from vehicle collisions; and (5) the increased potential for natural resource and recreational development and human settlement of areas adjacent to the road.

Species of concern, relative to these impacts because of their importance and because of their abundance in areas within the vicinity of the two alternate routes considered in detail in this report, are the large raptors, furbearers, black and brown bears, moose, and caribou.

Although direct quantitative measures of the impacts discussed above are not available for comparing alternate routes, indirect measures of the extent of many of these impacts on large birds and mammals are provided by: (1) the length of each access route and (2) the amount of area along each route that would become more accessible following road development. These measures are quantified and used as criteria for alternate route evaluation. The evaluation, however, is modified by a qualitative assessment of known wildlife concentration or special use areas along each route.

3.3.2 Socioeconomic (TO BE INSERTED)

3.3.3 Fisheries

Both direct and indirect impacts to fisheries resources could occur along any of the alternate routes. Direct impacts could occur as a result of adverse changes in water quality due to erosion, increased turbidity, disturbance of streambeds, and potential spills of oil and toxic chemicals. Indirect effects would include increased public access, which would increase fishing pressure. Criteria to evaluate environmental impacts are influenced by mitigation measures that have been identified in Exhibit E of the FERC License Application and can be summarized as follows:

Impact	Mitigation Measure
Construction runoff, increased sedimentation, and turbidity	Erosion control during construction
Disturbance of streambeds by equipment	Avoid crossings of spawning beds, use low contact pressure vehicles, perform construction during periods of low potential impact
Blockage to migrating fish	Proper design and sizing of culverts, bridges, and crossings

With the adoption of the mitigation measures described above and favorable construction conditions (e.g., limited rainfall during periods when there are large areas of bare soil exposed), impacts of access road construction would be very limited. Ideal conditions, however, do not always occur, so there is an inherent risk factor associated with each potential impact. Therefore, relative comparisons were made among the routes based on the potential risk of impact to fisheries resources, assuming conditions are not always ideal. The comparisons were developed based on the following criteria, which can be applied equally to all routes.

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- o Number of streams crossed - this implies a need for instream construction work and increased access

- o Distance that route parallels streams - any construction or use of a road that is just upslope from a stream implies a greater potential for erosion, with runoff and sediment passing into adjacent streams, and increased access

- o Type of soils, slope and need for cut and fills - steep terrain, unconsolidated soils and need for cuts and fills can affect the extent of erosion and sedimentation

- o Significance of fisheries resources in streams adjacent to each route - streams that contain significant or important resources that could be disrupted by the road access must be identified and included in the evaluation

- o Potential for indirect effects through increased public access increased access can alter and severely impact native fish populations

3.3.4 Land Use

Because the project area is essentially undeveloped, land use considerations affecting selection of an access plan relate primarily to land status and management actions rather than effects on existing land uses. Avoidance of disruption of existing land uses was an important factor in locating the alignments of the respective access plans, but is a relatively minor factor in comparing the two plans. The substantive land use criteria used in the comparative evaluation of the two access plans were as follows:

- o accordance with landowner preference;

- o consistency with land use plans and management actions; and

- o compatibility of induced land use changes with desired conditions.

The importance of landowner preferences stems from the undeveloped nature of the project area, current land status, and the marked effect that a particular access plan could have on various ownership interests. Much of the project area is in the process of being conveyed from federal ownership to state or Native ownership. Both of these ownerships, and particularly the Native organizations, can be generally classified as favoring access to their lands for the purpose of opening them for development. An access plan that accomplished this goal would be viewed favorably by these groups, while a plan that did not provide access for development would likely be opposed.

The second criterion relates to the influence that the alternative access plans could have on the current or future land use plans of federal, state, or local agencies. While such plans are not likely to directly address the Susitna project or its access system, the access road decision could potentially have a major bearing on the implementation on those plans.

The third criterion, involving the induced land use changes associated with the respective access plans, relates to the broader cross-disciplinary issue of introducing access to a large undeveloped area. This criterion is necessarily somewhat ambiguous, however, due to the subjectivity involved in evaluating increased access to a given area. The increased human use resulting from improved access can be estimated to some extent, but assessment of the desirability of such increased use depends upon individual or organizational preferences.

3.3.5 Recreation

Construction of any road to the Watana and Devil Canyon Dam site areas will open additional portions of the Susitna basin for recreational development. The extent of recreational activity will be influenced by the policies adopted regarding public use of the access road during the construction and operational phases of the project and the use of personal vehicles by construction workers. Recreational use of the

project area will also be affected by the availability of other recreational resources similar to those of the Susitna basin and recreational demand within the state. Such information is important in projecting impacts but is independent of access road selection and is not analyzed in this report.

In order to differentiate between the potential impacts of the proposed routes, criteria were formulated that relate to use of the project area and recreational user demand.

The criteria applied to the impact assessment in Section 4 are the following:

- o the size and extent of the project area made accessible by the access road;
- o the number of recreational opportunities developed;
- o the diversity of recreational opportunities developed;
- o travel time from major population centers, e.g. Anchorage and Fairbanks, to the project area; and
- o willingness of the population to travel the distance to the project area.

A recreation plan was developed and is presented in the FERC License Applicaton. The purpose of the plan is to satisfy the recreation demands created by project construction and public access to the Susitna Basin as well as to compensate for recreation opportunities foregone within the vicinity of the Watana and Devil Canyon damsite and reservoir. Foregone opportunities, such as those associated with river-running, are also intended to be compensated for, although their use extends beyond the actual damsite and reservoir area. While the recreation plan identifies site-specific recreation opportunities, the opportunities within the project area are actually unlimited. The criteria listed above were formulated to address the potential impacts of the selected access road on all recreation resources within the Susitna Basin.

3.3.6 Aesthetics

An assessment of the existing aesthetic resources of the Susitna Project landscapes is presented in Chapter 8 of Exhibit E of the License Application submitted to FERC. Landscape character types, classifications of unique physiographic landscape units, were evaluated according to both their aesthetic value and absorption capability, the capability of the landscapes to absorb physical change.

Using this analysis framework, the significance of impacts to visual resources depends on the absorption capability ratings, effect on potential viewers, and engineering criteria employed during the design and construction phases of the roadway development.

Criteria used to determine absorption capability ratings are based on the physical alteration of existing landform, waterform, and vegetative landscape features as well as the effect on viewers of the landscape. Generally, landscapes having a greater variety of physical features can absorb moderate landscape alterations with minimal impacts. In such cases, visual contrast with the form, line, texture, or color of the natural landscape is less evident.

Impacts upon the viewers of the landscapes are assessed from two perspectives: impacts to the potential visual experience while traveling the access road, and visual impacts created due to the construction of the access road which, itself, may be viewed from other viewpoints. It is recognized, however, that impacts to viewers in the remote areas to be traversed by any access alternative, is largely dependent on the roads ability to be visually absorbed into the landscape.

There are roadway engineering design and construction criteria that will be significant factors in determining the degree of visual impact caused by access road construction. These include road alignment specifications, landform and vegetation modification requirements, the size and shape of man-made structures, and their degree of contrast with

the natural environment. There is also the positive aspect of increasing the accessibility of scenic landscapes that were previously inaccessible due to their remote locations. This consideration should, however, be given only limited importance in distinguishing between routes because this positive effect will be felt regardless of the route adopted. Futher, avoiding negative impacts of imcompatible road development will greatly affect whether users of the access road have positive visual experiences. Therefore, emphasizing the compatability of each plan with the landscape implicitly incorporates the positive and negative effects of each plan into the analysis.

3.4 RESOURCE AGENCY, NATIVE ORGANIZATION, AND PUBLIC COMMENTS

3.4.1 Agency Comments

The Alaska Power Authority has actively encouraged the participation of federal, state, and local agencies in the Susitna Hydroelectric Project planning activities. As a part of this open planning process, comments

have been solicited on virtually all aspects of the project. Selection of the project access route has received considerable attention from the agencies. Throughout the planning process, agencies have been concerned about both short term (construction) and long term (operations) impacts that access road development would have on the project area. The opening up of a new access corridor into previously remote and undeveloped areas in the Susitna Basin has been a major concern of the resource agencies since project conception. Agencies have also been concerned with the fact that construction access provided by any road into the Watana project site could ultimately lead to the development of a new recreation area readily accessible from metropolitan Anchorage and, to a lesser degree, Fairbanks. In light of this general concern, agencies have provided numerous comments on the various access alternatives studied by the Alaska Power Authority. /The number of comments received on the access alternatives is large and it would be impractical to print all the letters received which pertain to the access roads. Instead, comments have been summarized and are presented in Table 3-2. This comment summary includes comments on many documents, some of which do not apply directly to this report; nevertheless, these and all other comments in Table 3-2 provide insight into agency perspectives on the access issue. Comments received by agencies were considered by specialists involved in the analysis of each resource category and by management personnel involved in the overall decision-making process.

3.4.2 Native Organization Comments

Native organizations currently hold, or are in the process of obtaining, land throughout the project area. In general, Native groups favor access alternatives which provide access to their lands so they can be developed and managed in accordance with management plans. For this reason, access to the south side of the Susitna River is strongly supported by Native organizations. The South Plan is most favored in this regard because it provides access to the largest amount of acreage of the four plans considered. All other plans could provide access to Native lands on the south side of the Susitna River, thereby meeting the basic objectives of

the Native organizations. Comments of Native organizations are shown Table 3-3, which contains letters from Cook Inlet Region Inc., Tyonek Native Corporation and Athna Inc.

3.4.3 Public Comments

Numerous public comments have also been received on the access plan. These comments have been both formally and informally presented in letters, public hearings, and informal meetings with Alaska Power Authority staff and contractors working on the project. As a part of evaluation of public comments, several sources were considered includ those listed in Table 3-4. A representative summary of these comment has been developed and is presented in Table 3-5. This summary revea that opinion is divided regarding which access route is best and that several factors motivate individual responses. In general, access fr the Denali Highway is favored by individuals in the Cantwell area who would welcome the economic development that could result from such an access plan. Others in Cantwell fear that hunting and fishing along Denali route would be seriously affected and have misgivings about th route. The communities of Talkeetna, Trapper Creek, Gold Creek, and others along the Parks Highway appear to be less divided and are generally less enthusiastic about growth induced by the proposed proj and are generally opposed to any project features which would increas impacts to their communities which could change local lifestyle. Whi most residents of Talkeetna, Trapper Creek, and Gold Creek appear to favor access from the Denali Highway, there are those members of the community who would favor a Parks Highway access if it would contribu to local economic growth.

Non-native user groups who currently enjoy the relative isolation of remote areas tend to oppose alternatives which would increase access the Susitna Basin. This feeling is most strongly expressed by certai users of areas south of the Susitna River, which would be affected by Plan South.

TABLE 3-2

SUMMARY OF AGENCY COMMENTS ON ACCESS

AGENCY/SOURCE	ACCESS COMMENT
Alaska Dept. of Fish and Game	
1) Letter dated 15 October 1982	Project may create conditions that would require changes in hunting, trapping and fishing regulations due to improved access.
2) Letter dated 13 January 1983, providing comments on Draft Appendix E - Susitna Hydroelectric Project. Also includes appended reviews	The use of regression equations in calculations of peak and low flows in lieu of actual discharge data of the tributary streams to be crossed by the access road is inappropriate. Improved access and attraction of people to the area will likely precipitate development and increased recreational use of the area. Impacts of individuals other than hunters are almost completely ignored. Does restricting unauthorized traffic mean that project personnel will be allowed to fish and the general public will not be allowed access to the fisheries? This may not be an acceptable form of mitigation during a construction phase that may span 20 years. Orientation of access routes in relation to wildlife concentrations and movement patterns should be considered. Some subpopulations will be more heavily impacted. Mortality and habitat loss from access routes should be added to other impacts affecting the same subpopulations during the same periods. Impacts of road and railroad traffic start at tidewater. Increases in unscheduled traffic on existing roads, particularly the Parks and Denali Highways, are likely to be substantial. Levels should be estimated and impacts assessed. Timing of rail and highway traffic is more important than an average rate. Both seasonal and diurnal patterns should be considered. Scheduling of traffic should be considered as a mitigation measure. Combined effects of access potential of transmission line corridors and access routes should be considered. No alignment of the Denali access road will avoid caribou calving areas completely. Potential cumulative effects of the access routes and impoundments on caribou range should be discussed. Access routes will provide excellent access to tundra habitats. Therefore, human use of areas important to wolverine during summer will increase.

AGENCY/SOURCE	ACCESS COMMENT
Alaska Dept. of Natural Resources	
1) Letter dated 26 March 1981 Susitna Hydro Steering Committee (findings and recommendations)	Recommend coordination between the decision about access road routes and transmission line routes. Systematic decision-making process needs to be laid out for determining an access route to the Susitna dams. Process should be straight forward to allow effective agency participation. Need to consider additional criteria to determine routes. Refer to document entitled "Suitability for Haul Roads" for an example of a more comprehensive list of criteria. Needs to be a clearer understanding and explanation of the decisions regarding the timing and building of access roads vs. FERC approval for the project. Felt that it was necessary for APA to provide an understanding of how decisions, such as identification of gravel sites, spoil sites, stream crossings, construction camp service and maintenance facilities, will be made and how a quality control system will be in effect to ensure that tasks are accomplished in accordance with approvals and designs.
2) Meeting 10 April 1981 with Mr. Al Carson, Deputy Director, Div. of Res. and Development	Some areas are incremental, minor impacts may work together to cause a major impact.
3) Letter dated 5 November 1981 (SHSC)	Access via the Alaska railroad to Gold Creek is environmentally preferable. South side route from Gold Creek to Devil Canyon is preferable. From Devil Canyon to Watana a route on the north side of the river is preferred. Generally prefer a rail mode of access to and within the project site. Three (3) environmentally sensitive areas that should be avoided are: 1) Routes from the Denali Highway 2) The route crossing the Indian River and through wetlands to the Parks Highway 3) The route on the south side of the Susitna River from Devil Canyon to the proposed Watana Dam site The validity of the power-on-line in 1993 assumption/mandate for a pioneer road is questioned. Public access to the dam sites and through the upper Susitna Valley is a complex and controversial subject and should be given a thorough evaluation in the route selection process.

AGENCY/SOURCE	ACCESS
4) Letter dated 4 December 1981	Once definite decisions on the route access is made, those routes and material sites must be examined for cultural resource conflicts and needs for mitigation.
5) Letter dated 5 March 1982 (SHSC)	APA's need to begin construction of a pioneer road prior to FERC licensing of the dams raises some serious public policy issues. Mode of access may well be the determining factor for the extent and type of public access.
6) Testimony dated 16 April 1982	Identify alternatives which will allow the necessary access in a manner which prevents irreversible impacts. Access route decision should be made in conjunction with surrounding landowners, land.
7) Letter dated 15 October 1982	Cultural resource sites must be evaluated in terms of eligibility for inclusion in the National Register of Historic Places. Every effort must be made to mitigate future "adverse effects." In the few expected cases where very large complex sites will be adversely affected, it may be more economical to build a barrier around the sites.
8) Letter dated 3 December 1982	Concerning remaining archaeological work, we feel that two field seasons are preferable to one.
9) Memorandum dated 23 December 1982	A final decision should be made now as to whether the access road to the dam sites will be public or private.
10) Letter dated 13 January 1983	Favor road access from the Parks Highway. If route proposed in Exhibit E is selected, the following design modifications are recommended: - Principal design criteria be the enhancement of scenic values and public safety. Therefore, the high-speed design is inappropriate. - The issue of design standards for upgrading the Denali Highway between Cantwell and the proposed access road merits comment because an upgrade will be necessary to accommodate project related traffic. - Recommend rerouting roads to take advantage of extraordinary vistas. - Should avoid the large wetland in the Brushkana drainage by re-routing to higher ground to the west.

AGENCY/SOURCE	ACCESS COMMENT
Alaska Dept. of Environmental Conservation	
Meeting on 9 April 1981 with Mr. Bob Martin, Regional Environmental Supervisor and Mr. Steve Zrake	This department would like to keep access down because of easier management. May be easier to have just one transportation corridor. It is felt that 2-3 years of data on the smaller feeder streams impacted by roads would be sufficient.
1) Letter dated 21 January 1983	Plan 17 was determined to have greater potential for major environmental impacts, which are as follows: - The Denali Highway to Watana Dam site portion passes through habitat of the Nelchina caribou herd - The Denali Highway to Watana section may affect native grayling streams. Access along the south side of the Susitna River from Watana to Devil Canyon passes through the Stephan Lake region, which is important habitat for moose, caribou, waterfowl and furbearers. Wetlands habitat is crossed south of Devil Canyon.
Dept. of Community and Regional Affairs	
1) Meeting held 7 April 1981 with Mr. Ed Busch, Senior Planner and Mr. Lamar Cotten, Associate Planner	Concern as to whether or not access roads will be open after the project is finished and who will maintain. Concerned if anyone has considered impact to Talkeetna caused by people driving there, parking and taking the train.
U. S. Dept. of Interior - Fish and Wildlife Service	
1) Testimony dated 16 April 1982	With respect to the proposed pioneer road, habitat losses must be justified by the need for a project. The need is proven when the license is issued, not before.
2) Letter dated 17 August 1982	Rail in conjunction with air access preferred. Fish and Wildlife Service continues to endorse the views expressed in the steering committee letter dated 5 November 1981 (see Alaska Department of Natural Resources comments). Denali Highway alternatives (Alt. 17) should not be considered. Nelchina caribou herd could be substantially impacted by an access route from Denali Highway to the Watana camp. The Denali route cuts across valuable moose, brown bear, and black bear habitat between the Watana Camp and Deadman Lake. Numerous small river and tributary crossings could pose extensive problems to virgin grayling fisheries.

AGENCY/SOURCE	ACCESS COMMENT
U.S. Fish and Wildlife Service (cont'd)	A southern routing between dam sites (Alt. 16) could intersect movements of large numbers of brown bears to and from Prairie Creek. The upper Prairie Creek, Stephan Lake and the Fog Lakes region support large year-round moose concentrations. Impacts to furbearers and waterfowl appear to be less avoidable in a southern routing between Watana and Devil Canyon. Any plans to place a road in close proximity to Portage Creek for approximately 1 mile is cause for concern due to the possibility of erosion and hazardous spills.
3) Letter dated 5 October 1982	Assessment of impacts should extend to borrow areas.
4) Letter dated 14 January 1983 with attachments	Use of regression equations in calculations of peak and low flows in lieu of actual discharge data should not be a substitute for the collection of data when sizing culverts for engineering integrity or fish passage. Accurate discharge information on the creeks is needed to insure proper culvert sizing for fish passage. Utilization of culverts rather than bridges could result in more blockages to grayling migration due to beaver activity. We assume that APA has decided on a preferred access plan to Devil Canyon. Whatever it is should be stated. A more complete description should be provided for vegetation north of the Susitna River to the Denali Highway through which the proposed access road is to pass. A brief description is needed to the Viereck and Dyrness hierarchical vegetation classification system for Alaska, levels used for this study, and number of categories mapped (note, this description should cover the vegetation type maps now under preparation). An explanation for the mapping of up to 16 kilometers (km) from the Susitna River and .8 km from the impoundments should be provided. A brief description should be given as to sampling intensity. Whether vegetation dominance within the project area and/or susceptibility to project impacts were considered in study design should be explained. General information on elevation, slope, aspect, and land form should be briefly related here and in subsequent sections of the report to better define areas and their vegetation cover. The prevalence of permafrost, a determining factor in some project impacts, should also be considered.

AGENCY/SOURCE	ACCESS COMMENT
U.S. Fish and Wildlife Service (cont'd)	Successive descriptions of vegetation types by project area should be clarified by defining closed, open, and woodland forests, tall versus low shrublands, and wetlands. The discussion would also be aided by including an overlay of project features on the vegetation map. We recommend the license application include a larger, more readable vegetation map and that quantitative data on how common or uncommon specific vegetation types are, as well as the occurrence of various types relative to elevation or aspect, be presented in the text as well as tables. In so describing the revised vegetation classification, it will be possible to better evaluate potential project impacts on vegetation, and thus wildlife habitats, by project feature. This recommended level of effort applies to the proposed access corridor. Clarify why avoidance of closed forests was termed as a mitigative measure. A mechanism for enforcing prohibition of off-road or all terrain vehicle use should be included. Concerned that a national scenic highway designation for the Denali access route would stimulate public access to the increased detriment of fish and wildlife. Access for construction should be via rail from Gold Creek along the south side of the river to Devil Canyon and access on the north between the two dams. Suggest quantifying current and potential hunter demand and harvests, area moose populations and habitat quality for access route areas. Varying degrees of winter severity and the length of each access link should then be considered in conjunction with the information described above and data on vehicle/moose collisions in other areas of the state. Project railroad use may be a significant impact to wildlife in view of present winter use of four round trips each week. During severe winters, moose may seek cleared roadways as travel corridors and be subject to collisions. The likelihood of beavers using bridges and culverts for damsites more probably represents further negative impacts to beaver due to removal of dams at the wrong time of the year. The maximum design speed of 40 mph should be assured as one means of minimizing the potential for moose/vehicle collisions. Recommend realignment of roads away from riparian corridors and other wetlands valuable in migration and breeding of raptors. Buffer to waterways or wetlands should be a 500-foot minimum width.

AGENCY/SOURCE	ACCESS COMMENT
U.S. Dept. of the Interior - Bureau of Land Management	Instream work should be scheduled to avoid critical spawning times and minimize downstream sedimentation. Estimated recreational vehicle traffic both prior to and after 1993 should be presented. Mitigation for excavation of borrow areas could include the future use of these areas for recreation development. Concerning aesthetic resources: Fish and Wildlife Service is concerned that "avoidance" as a mitigation measure has not been addressed.
1) Meeting held 9 April 1981 with Mr. Art Hostenmar, Mr. Lou Carufel, Mr. Gary Seitz, Mr. Bob Ward, and Mr. John Rego, BLM	Would like to see all three access routes studied.
2) Letter dated 7 January 1982	Concerned that pioneer road is being constructed (proposed) before FERC license is issued. Concerned because the pioneer road would deviate from the location of the final access road, particularly on the south route from Devil Canyon and the Watana site. The route southerly from the Denali Highway seems preferable from the aspect of minimizing disturbance of productive habitat. Control of access, state game laws and project management after construction are tools which can be used to manage the adverse effects of increased recreational opportunities. Both rail and road access will be required for construction. It is improbable that the state can construct a project of this magnitude without some form of readily available public access as a residual product.
U.S. Dept. of the Interior - National Park Service	
1) Letter dated 3 December 1982	The comments of the Advisory Council on Historic Preservation should be solicited without delay.
2) Letter dated 14 January 1983	If normal operation of Watana will minimize the danger now associated with kayaking the unregulated Devil Canyon whitewater, consideration should be given to providing public access to the Susitna below the dam prior to the completion and operation of the Devil Canyon dam. Consideration should be given to providing public access from the project transportation corridor to Portage Creek for fishing and/or kayaking. Status of Stephan Lake - Prairie Creek corridor should be elevated to Phase One implementation.

AGENCY/SOURCE	ACCESS COMMENT
Federal Energy Regulatory Commission	
1) List of Supplemental Information and Clarification Needs Draft Susitna Application Exhibit E	Provide water resources data for access routes.
	Quantify water quality and quantity changes associated with all access routes.
	Provide additional detail on stream crossings in road corridors and on the habitats and fish species likely to be affected by these crossings.
	Estimate the number of hectares of each vegetation type that will be cleared due to access road construction.
	Provide more information describing how erosion will be mitigated where access cuts leave unvegetated slopes.
	Describe implementation of possible management options for limiting off-road vehicle use.
	Archaeological field work (reconnaissance survey of access roads) must be undertaken during the 1983 field season.
Agency Workshop conducted by Acres American	
1) FERC License Application Exhibit E presentation and discussion workshop held 29 November - 2 December 1982	Impacts on private land by individuals gaining access via the project's access road was mentioned as possible impact that should be monitored and mitigated.
	Concern over compatability of the proposed access plan with the Denali Scenic Highway plan.
Susitna Hydroelectric Project Access Plan Recommendation Report, Appendix D, Acres American Aug. 1982.	Assessment was suggested on the long term economic value of having a more appealing access road.
	Recommend lower speed and lower profile for Watana access road.
1) Appendix D.1 Telephone Conversation with Planning Director, Mat-Su Borough, Dated 10 Aug. 1982.	Plan 17 preferred.
	Plan 13 also acceptable.
	Plan 16 is not acceptable.

TABLE 3-3

LETTERS RECEIVED FROM NATIVE ORGANIZATIONS COMMENTING ON ACCESS PLANS

APPENDIX C.3

Ahtna, Inc.

DRAWER G
COPPER CENTER, AK 99573
TELEPHONE 907-822-3476

August 13, 1982

AD-83-A-12

Mr. David Wosniak
Alaska Power Authority
334 W. 5th Ave.
Anchorage, AK 99501

Dear Mr. Wosniak:

In response to recent discussions on access routes to Watana Dome we wish to recommend Corridor # 3 which is the Denali Highway to Watana route. Representatives of Cantwell village have also endorsed this route. We have selected this route based on our analysis of economic and environmental considerations.

Sincerely yours,

Lee R. Adler
Land Manager

LRA:cc

APPENDIX C.1

CIRI COOK INLET REGION INC.

August 13, 1982

Board of Directors
Alaska Power Authority
334 West Fifth Avenue
Anchorage, Alaska 99501

Dear Sirs:

I would like to take this opportunity to clarify Cook Inlet Region, Inc.'s (CIRI) position regarding access routes for the Susitna project.

We concur with the position taken by the villages that access plan 13 is unacceptable. We would support access plan 16 as the best alternative. We also could support access plan 17 with some modifications.

We would support any plan which provides access to the Native land on the south side of the Susitna River. This could require some redesign of the dam to insure that it could act as a roadway.

Thank you very much for the opportunity to address this issue.

Sincerely,

COOK INLET REGION, INC.

Roland Shanks
Manager, Land Administration

RS:mw

APPENDIX C.2

TYONEK NATIVE CORPORATION
912 East 15th Avenue, Suite 200
Anchorage, Alaska 99501
(907) 272-4548

August 13, 1982

Board of Directors
Through Mr. Eric Yould, Executive Director
Alaska Power Authority
334 W. Fifth Avenue
Anchorage, Alaska 99501

Sirs:

The CIRI Village Presidents fully support Access Plan 16 as describes in recent publications and maps provided by the Alaska Power Authority.

Plan 13 as outlined is not an acceptable access route.

Plan 17 as presented might possibly be acceptable with some modifications. These modifications should assure some access to the lands south of the Susitna River. Access to the lands south of the river will only be provided under Plan 17 if the Devil Canyon project is actually constructed. Perhaps another approach might be to provide a dam with a roadway constructed on top of the dam for earlier access as has been alluded to by Mr. John Hayden.

In summary, our Villages will support a road plan which provides access to our lands laying south of the Susitna River.

Plan 16 as presented, or possibly a modified Plan 17 would receive our support.

Sincerely,

B. Agnes Brown
Chairman, CIRI Village Presidents

cc: Cook Inlet Region, Inc.
CIRI Village Presidents

TABLE 3-4

SOURCES OF PUBLIC COMMENTS ON ACCESS ROAD ALTERNATIVES

Title of Report	Author	Date
Susitna Hydroelectric Project Feasibility Report Volume 7, Appendix D Chapter 2, Access Workshops Exhibit 2, ACTION System	Acres American	1982
Access Plan Recommendation Report, "Public Preference"	Acres American	August 1982
Susitna Hydroelectric Project Mid Report to Governor Hammond	Alaska Power Authority	1982
FERC License Application Exhibit E, Chapter 5 Socioeconomics	Acres American	1983
Susitna Hydroelectric Sociocultural Studies Access Report	Stephen R. Braund & Associates	October 1981
Addendum #1		November 1981
"Susitna Hydro Studies" newsletters	Alaska Power Authority	April, June 1982
Public testimony transcript and comments from April 1982 public meetings	Alaska Power Authority	1982

TABLE 3-5

SUMMARY OF PUBLIC COMMENTS ON ACCESS

SOURCE	ACCESS
Susitna Hydroelectric Project Feasibility Report Vol. 7, App. D, Exhibit 1, Public Participation Office Access Report.	Road from Parks Highway to Devil Canyon and Watana sites preferred by 5 individuals. Railroad to Devil Canyon sites; rail spur to Gold Creek preferred by 8 individuals. Roads from both Denali and Parks Highway with a service road between dams was preferred by 5 individuals. Two individuals had no preference.
Susitna Hydroelectric Feasibility Report, Vol. 7, Appendix D, Exhibit 2, Letters from Action System	
1) Letter dated 5 Nov. 1981 from Alaska Sport Fishing Association.	Favor extension of the Denali Highway to the Watana Dam site and a road on the south side to Devil Canyon with a north access link between dam sites. 16 individuals would like to see public access via private vehicles.
2) Miners Questionnaire Dated Feb. and Mar. 1981.	2 individuals were opposed to public access via private vehicles.
3) Game Guide Questionnaire dated Feb. and Mar. 1981.	Answers to the question of which access do you prefer: Corridor 1 = 5 Corridor 2 = 10 Corridor 3 = 9 Rail access = 16 15 individuals would like to see public access by private vehicles. 8 individuals would not want public access by private vehicles.
4) Letter dated 29 Oct. 1981 from Barbara Wright.	First choice - Plan 6, second choice - 7.
5) Letter dated 5 Nov. 1981 from Dale L. Nord.	Oppose Denali Highway to Watana Road. Prefer plan #8.
6) Letter dated 20 Oct. 1981 from Bruce Benson	In favor of rail only access
7) Phone call from Frank Lowe dated 3 Nov. 1981.	Oppose a road from the Parks Highway.
8) Phone call from Cliff Crabtree Dated 5 Nov. 1981.	Indian River people are opposed to access from Hurricane to Gold Creek by road. Prefer rail from Gold Creek to the Devil Canyon site.

SOURCE	ACCESS
Su. Hydo. Feas. Report, Vol 7, Ex. 2 (cont'd)	
9) Visit to Public Participation Office by Barry Moe date 6 Nov. 1981.	In favor of access road from Parks Highway. A road from Talkeetna would be even better.
10) Letter dated 3 Nov. 1981 from Bonita Prudence.	Prefer no access other than rail to our property in the Indian River area near canyon.
11) Letter dated 3 Nov. 1981 from Charmee Weker.	Wants no roads in the Indian River area.
12) Letter dated 1 Nov. 1981 from Alex and Maria Baskous.	Would rather not have a road go near the Indian River.
13) Letter dated 7 Nov. 1981 from Debra Vostry.	Prefer rail spur on south side of river first. Second preference is the third alternative.
14) Letter dated 6 Nov. 1981 from Robert W. Durkee.	Wants no roads in the Indian River area. If there must be a road would prefer a route from the Denali Highway south to the project.
15) Letter dated 7 Nov. 1981 from Helen Barbara Dalke.	Do not want a road in Indian River area. Prefer a rail spur from Gold Creek to the site.
16) Letter dated 3 Nov. 1981 from Jack DiMarchi.	In favor of any access road outside of the Indian River remote parcel area.
17) Letter dated 10 Nov. 1981 from Wallace Watts, Carole Watts and Anne Watts.	Would have preferred a highway from Talkeetna. Prefer the Denali Highway route at present. Oppose other routes.

CHAPTER 4

ROUTE SELECTION ANALYSIS

4.0 DETAILED ROUTE COMPARISONS

4.1 SCOPE

This section contains an analysis of the four candidate access plans evaluated in this study. The preliminary screening process, which eliminated two routes from consideration, and the detailed evaluation of the two better routes (from among the four studied) are presented in this section. Conclusions and recommendations are given in Section 5.

4.2 PRELIMINARY SCREENING

Prior to conducting detailed studies of candidate access plans, a preliminary analysis was conducted of all four alternatives to determine if any of them were clearly inferior to any of the others. This preliminary screening was based on a cursory review of previous access alternative studies, including the discussion provided in the Susitna Hydroelectric Project license application Exhibit B, the "Access Recommendation Report" (Acres American 1982c), and several environmental reports. It was determined that the rail only (Plan 2)and South plan (Plan 16) alternatives did not merit further detailed analysis and were therefore eliminated from further consideration. Rationale for rejection of these alternatives is given in the following paragraphs.

4.2.1 Rail Access Alternative

Rail-only access has received strong support from resource agencies primarily because of the advantages all-rail access would have in limiting public access to presently remote areas of the upper Susitna Basin. While this point is well taken, limited access to the public also results, to a degree, in limited access for the construction contractors. If an all-rail access were to be constructed, the construction contractors would lose a degree of flexibility in delivery scheduling and would lose the opportunity to solicit competitive bids

from both the railroad and truckers for some commodities (like containerized supplies shipped from Anchorage) that might be less expensive to haul up the Parks Highway by truck than on the Alaska Railroad. For example, rates quoted by the Alaska Railroad and Big State Motor Freight for cement hauling from Anchorage to Hurricane or Gold Creek are comparable.

An all-rail access would result in the need for more careful logistics planning. Scheduling of smaller, spot deliveries of goods to meet specific, unforeseen short-term needs becomes more difficult for all-rail as compared to road access. Heavier reliance on airlift for spot delivery of materials and goods at a proportionally higher price is foreseen if a rail-only access is adopted.

The preceding discussion suggests that rail only access is less desirable than road or mixed rail and road access from a construction standpoint. This hypothesis was tested by the Alaska Power Authority during the Feasibility Study process when the Power Authority sent out letters to engineering firms competing for the design contract on the Susitna Hydroelectric Project. These letters, sent to the seven competing firms (all of whom have considerable hydroelectric and large project experience) requested an opinion on the desirability of using a rail only access plan for construction of the Susitna project. Of the firms that responded, five stated that road access was needed while only one firm indicated that the project could be developed with rail only access. The full text of these engineering firms' responses appears in the Access Recommendation Report (Acres 1982c). A summary is given on Table 4-1.

Concerns about an all-rail access described above are important factors in the decision to eliminate all-rail as a viable access alternative, but are not the main reasons for eliminating the rail alternative. In brief, the main reasons for eliminating rail-only access are schedule and constructability.

TABLE 4-1

SUMMARY OF COMPETING DESIGN CONTRACTORS COMMENTS ON ACCESS

SOURCE	ACCESS COMMENT
Susitna Hydroelectric Project Access Plan Recommendation Report Appendix A, Acres American Aug. 1982.	
1) Letter dated 4 Aug. 1982 from Bechtel Civil & Minerals, Inc.	Railroad would cost on the order of twice as much as a road. Railroad would take at least one year longer to build. Once the railroad is in place, no significant negative of contruction would be anticipated. We believe that effective access limitations can be imposed during construction on a road built into Watana, restricting usage to authorized personnel eg. guard posts, gates, etc.
2) Letter dated 6 Aug. 1982 from R.W. Beck and Associated, Inc.	Rail only access would add to scheduling problems, require load size limitations, do away with competitive haul rates and result in cost increases. Getting people to work and live in the camp will be more difficult if they know their only access to the outside is by rail. Air service could be limited by inclement weather. Also, parts and supplies needed on a day by day basis can be handled most efficiently by truck. Road access allows contractor and owner to transport goods independent of the railroad, will allow LTL shipment.
3) Letter dated 8 Aug. 1982 from Gibbs and Hill, Inc.	Road access allows contractor and owner to transport goods independent of the railroad, will allow LTL shipment. If "limited access" wins out, a rail/truck depot should be built a few miles towards the site from the mainline. Road connections will facilitate transportation of families and single men living at the site.
4) Letter dated 9 Aug 1982 from Gibbs & Hill, Inc.	Initially construct 6000' of road at the Watana site such that this portion of the road will be used as a landing strip for DC-3/DC-4 planes.
5) Telegram dated 9 Aug. 1982 from Raymond Kaiser Engineers.	Recommend strongly that rail only not be adopted.
6) Letter dated 6 Aug. 1982 from Harza/Ebasco.	Recommend that there be road access.
7) Letter dated 9 Aug. 1982 from Stone and Webster - TAMS.	Recommend road access; if rail only were used, then special handling equipment to be used between the rail end and construction site would be captive to the project. Rail shipping would take 2-4 times longer. Rail end would require permanently located offloading equipment, provisions for storage of bulk materials and a small community or camp.

The all railroad route (Plan 2) is the least expensive of the all-rail alternatives studied by R&M and is wholly on the south bank of the Susitna River to avoid a major bridge over the river that would probably take 3 years to build. There are, however, still major bridges on the all railroad route studied here, most notably at Chechako Creek. R&M Consultants (1982a) estimated that 18 months would be required to construct a bridge at this site. Without extensive pre-licensing construction work, it would not be possible to satisfactorily support Watana construction during the critical period of diversion tunnel construction without building a major haul road next to the railroad to haul material to the site until completion of the railroad.

There could be significant haul road deviations from the rail right-of-way in the areas of the bridges so that trucks could cross streams by easier temporary bridging further upstream. This could result in the need for two right-of-way permits, depending on the deviation of the haul road alignment. The environmental impact of railroad construction under these conditions might be greater, particularly on fish and wildlife habitats, than if only a road were built.

4.2.2 South Plan

The South Plan was rejected from consideration for both construction schedule and cost reasons. Cost breakdowns for the four major routes studied are presented on Table 4-2. The figures are all from prior reports. An examination of Table 4-2 reveals that the South Plan has the highest Watana Phase construction cost of any of the 3 candidate road routes and involves the most miles of new road construction of any of the alternatives. The South Plan route includes a high level bridge across the Susitna River to the north bank of the river several miles downstream of Watana at the upper end of Devil Canyon. This avoids an approach to Watana from the south through the environmentally sensitive Fog Lakes/Stephan Lake area. The bridge adds significantly to both the construction cost and the duration of construction. It has been estimated that up to 3 years would be necessary to build a permanent

SUMMARY OF ESTIMATED COSTS FROM PREVICUS INVESTIGATIONS
($ x 1,000,000)

	Mileage		Construction Cost	Logistics Cost[1/]	Maintenance	Subtotal	Impact of Compressed Schedule	Total
	Road	Rail						
NORTH - PLAN 13								
Watana	52	0	95	118	5	218	23	241
Devil Canyon	7	0	20	106	2	127	0	127
Combined	59	0	115	224	7	345	23	368
SOUTH - PLAN 16								
Watana	69	0	156	115	7	278	34	312
Devil Canyon	0	0	0	101	3	104	0	104
Combined	69	0	156	216	10	382	34	416
DENALI - PLAN 18								
Watana	61[3/]	0[4/]	80	127	4	211	11	222
Devil Canyon	41	14	120	100	8	228	0	228
Combined	102[2/]	14[4/]	200	227	12	439	11	450
ALL RAIL - PLAN 2								
Watana	0	58	103	112	3	218	—	218
Devil Canyon	0	0	0	102	1	103	—	103
Combined	0	58	103	214	4	321	—	321

1/ Mileage and costs taken from Aeres "Access Recommendation Report".

2/ Includes cost of transportation from Seattle

3/ Includes upgrading 21 miles of Denali Highway and asphalt surfaced roadways.

4/ Includes development within railroad proposed railroad yard at Devil Caynon.

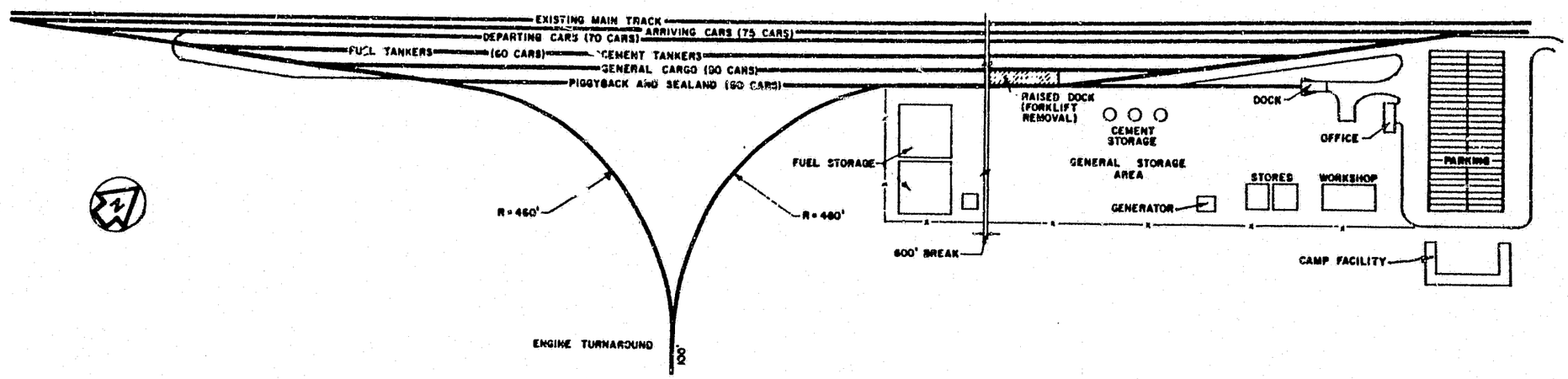
bridge across the Susitna at this site. Temporary access across a temporary low-level or floating bridge could be developed in about 1 year. While a 1-year construction time to initial access could be tolerated from a construction scheduling perspective, other less costly alternatives are available which provide access faster at a more attractive cost. Access over a temporary floating bridge across the Susitna River for the South Plan would probably result in periods of limited access for up to 6 weeks each year for the first two years of construction, when a floating bridge could not be used during the spring break-up.

4.3 PLAN 13 NORTH - PLAN 18 DENALI COMPARISON

The elimination of the All-rail and South plans leave the North plan (Plan 13) and the Denali plan (Plan 18) as the two better routes to be evaluated. A detailed discussion and comparison of these plans is presented in the following paragraphs. Both plans would provide access to the Watana and Devil Canyon project sites. Features of these plans are shown in Figures 4-1 through 4-3. Both plans would also provide access to the south side of the Susitna River following construction. However, because this analysis focuses on those issues which differentiate one plan from the other, factors or segments common to both plans are not emphasized in this analysis.

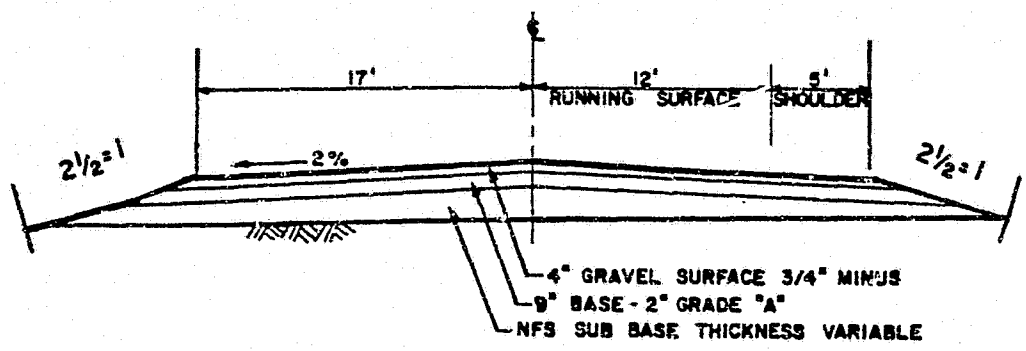
Both plans are evaluated against 11 important route selection factors in the following paragraphs, including:

- Wildlife and Botanical Resources
- Socioeconomics
- Fisheries
- Land Use
- Recreation
- Aesthetics
- Agency, Native and Public Preferences
- Constructability and Schedule
- Impact on overall Susitna Project Construction Schedule
- Maintenance and Reliability
- Costs



TYPICAL RAILHEAD FACILITY

ALASKA POWER AUTHORITY		
SUSITNA HYDROELECTRIC PROJECT		
TYPICAL RAILHEAD FACILITY		
HARZA-EBASCO SUSITNA JOINT VENTURE		FIGURE 2-6



CROSS SECTION

DESIGN DATA

SURFACING: UNPAVED GRAVEL

RUNNING SURFACE: 24 FEET

SHOULDER WIDTH: 5 FEET

GEOMETRIC DESIGN SPEED: 55mph Max.
40mph Min.

MAXIMUM GRADE: 6%

MAXIMUM CURVATURE: 5°

DESIGN LOADING : 80 k axle
(Dam Construction Phase) 200 k Total

ALASKA POWER AUTHORITY

SUSITNA HYDROELECTRIC PROJECT

TYPICAL UNIT SECTION DESIGN

HARZA-EBASCO
SUSITNA JOINT VENTURE

FIGURE 2-5

A proposed railhead facility, such as identified in the FERC License Application, would be needed for any access plan because equipment and material would need to be transferred from rail to road vehicles. The facility shown in Figure 2-6 is proposed for Cantwell, but would also be appropriate for Hurricane, if the North plan were adopted. The proposed railhead facility is adequately sized and appropriately laid out to handle the material and equipment that will be transported to the project site.

2.5 TRANSPORTATION COSTS

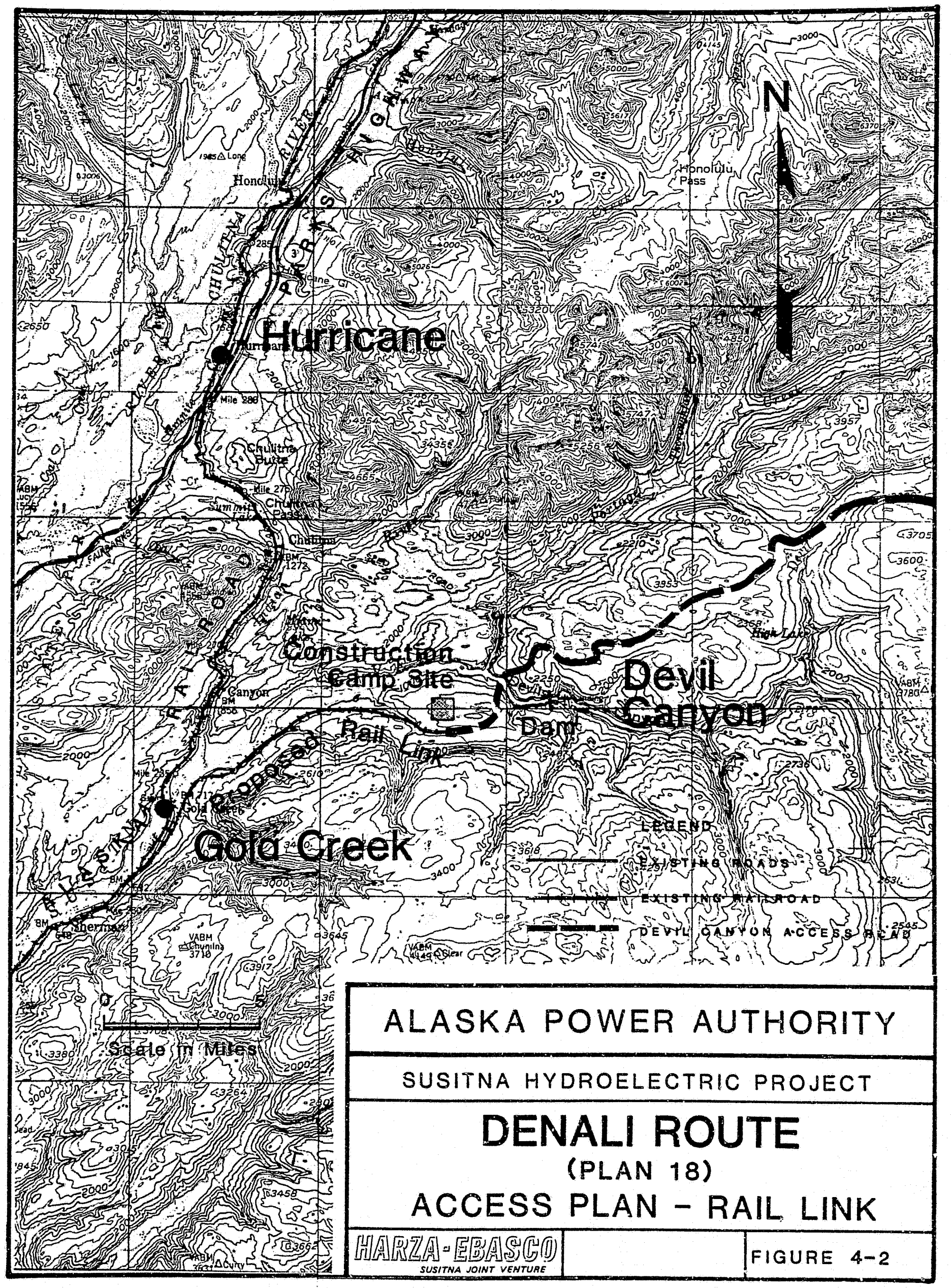
2.5.1 Railroad Rates

New, up-to-date quotes were obtained from the Alaska Railroad for use in this study. Quoted rates per hundredweight (cwt) from Anchorage to Gold Creek and Cantwell are summarized below:

	Gold Creek	Cantwell
Bulk Cement	$1.03/cwt.	$1.45/cwt.
Iron/Steel	$1.97/cwt.	$1.97/cwt.
Equipment & Misc. Items	$1.20/cwt.	$1.54/cwt.
Explosives	$5.71/cwt.	$7.32/cwt.
Fuel	$1.23/cwt.	$1.34/cwt.

Rates to Hurricane via existing rail for the North plan or to Devil Canyon or Watana on new track were computed on a ton-mile basis using the quoted rates as a base.

The economic model used for subsequent analysis of all cost data includes provisions for real escalation of fuel costs. The portion of the appropriate rates above for fuel was estimated using train set data supplied by the Alaska Railroad, cost per engine mile data from Alaska Railroad system averages, and fuel consumption data per gross ton-mile from General Motors Electro-Motive Division, which was the best source of data available.



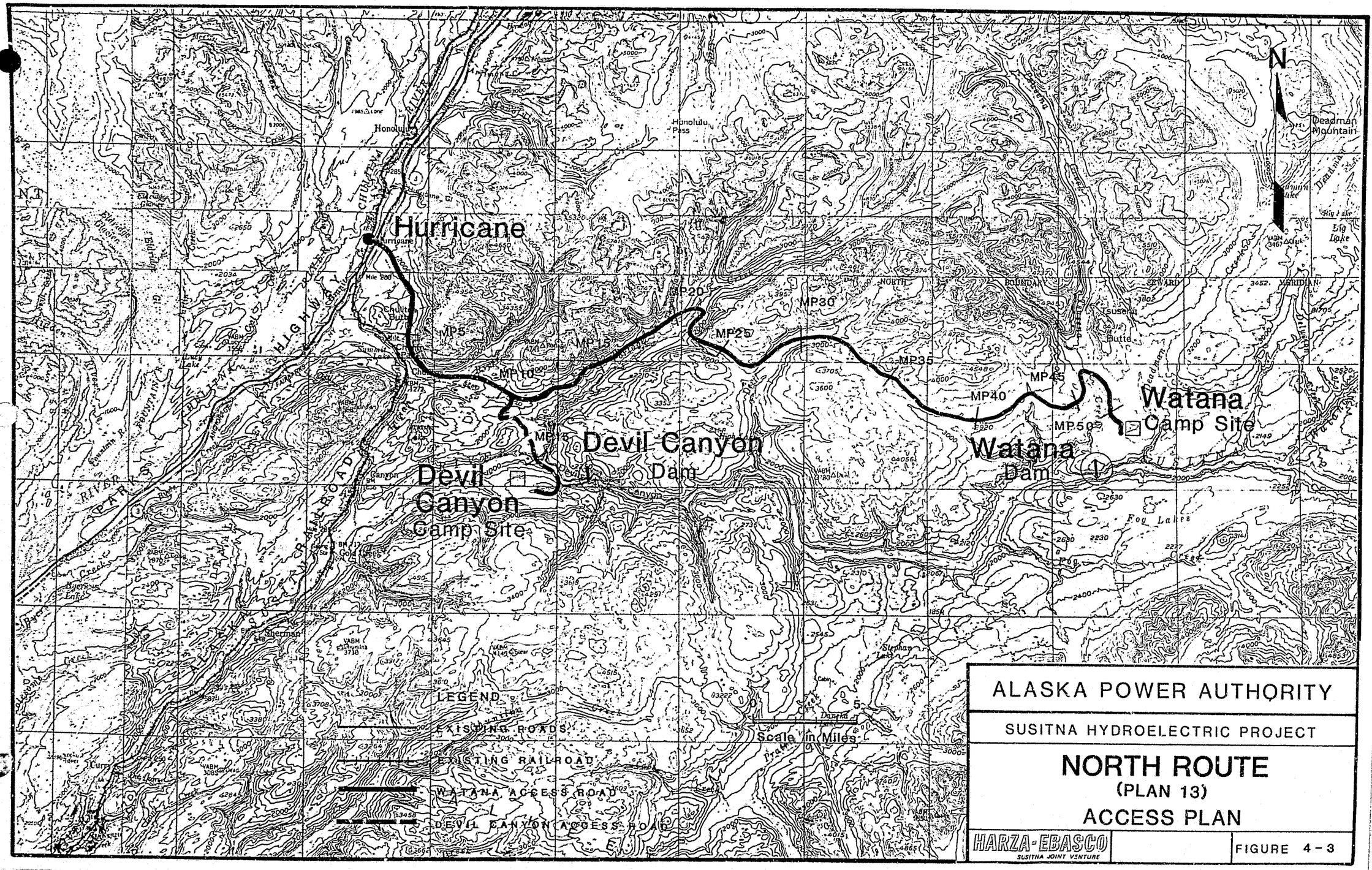
ALASKA POWER AUTHORITY

SUSITNA HYDROELECTRIC PROJECT

DENALI ROUTE
(PLAN 18)
ACCESS PLAN - RAIL LINK

HARZA-EBASCO
SUSITNA JOINT VENTURE

FIGURE 4-2



ALASKA POWER AUTHORITY

SUSITNA HYDROELECTRIC PROJECT

NORTH ROUTE
(PLAN 13)
ACCESS PLAN

HARZA-EBASCO
SUSITNA JOINT VENTURE

FIGURE 4-3

FOLD LENGTH
12 IN
11 IN
8.5 IN
8 IN
AUTO
MANUAL
FEED

LEGEND

EXISTING ROADS

EXISTING RAILROAD

WATANA ACCESS ROAD

DEVIL CANYON ACCESS ROAD

N

Cantwell

Devil Canyon Camp Site

Devil Canyon Dam

Watana Camp Site

Watana Dam

MP5

MP10

MP15

MP20

MP25

MP30

MP35

MP40

0 5

Scale in Miles

ALASKA POWER AUTHORITY

SUSITNA HYDROELECTRIC PROJECT

DENALI ROUTE

(PLAN 18)

ACCESS PLAN

HARZA-EBASCO
SUSITNA JOINT VENTURE

FIGURE 4-1

11 12

FEED

MANUAL

AUTO

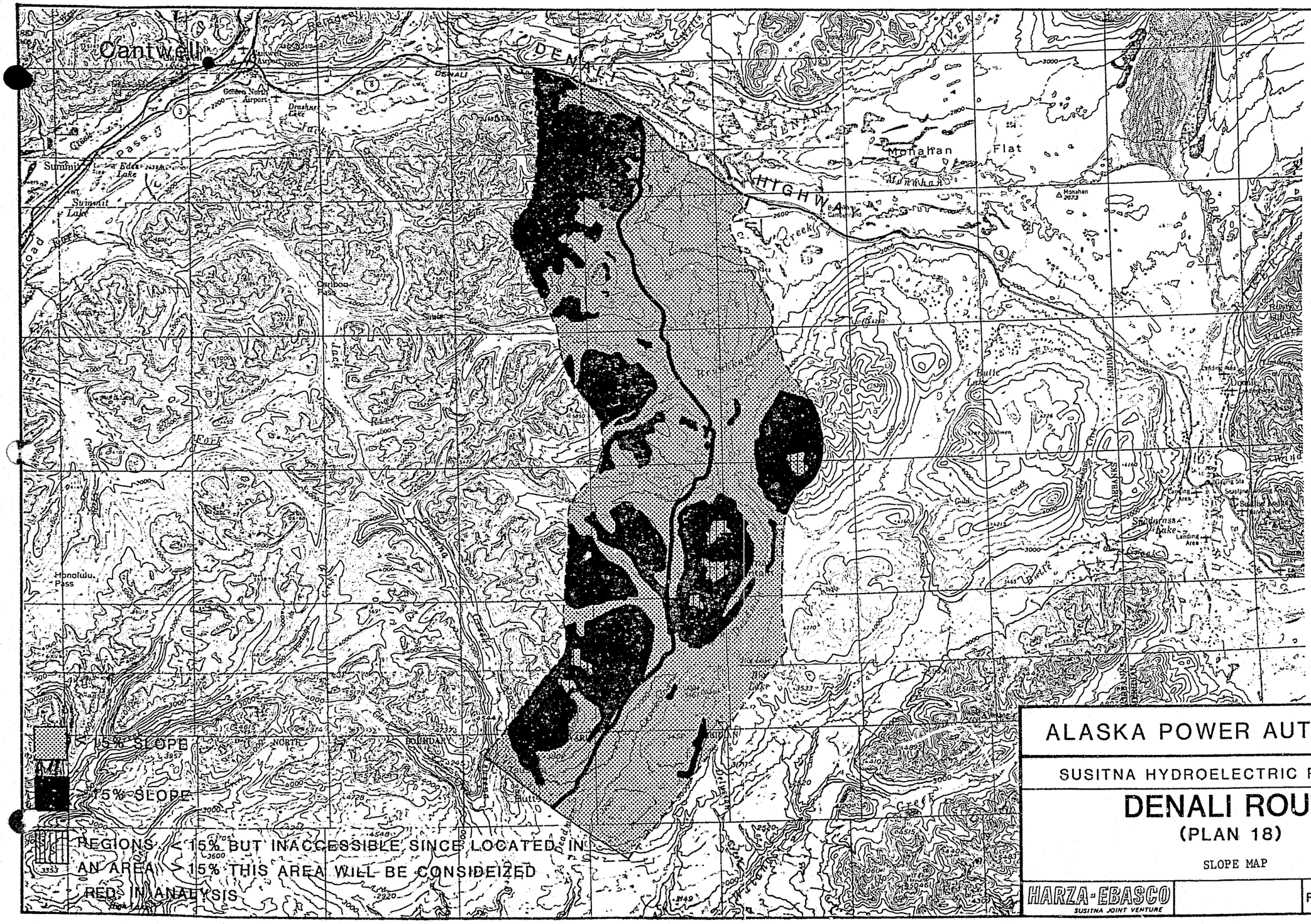
8 IN

8.5 IN

11 IN

12 IN

FOLD LENGTH



15% SLOPE

>15% SLOPE

REGIONS <15% BUT INACCESSIBLE SINCE LOCATED IN AN AREA >15% THIS AREA WILL BE CONSIDEIZED RED IN ANALYSIS

ALASKA POWER AUTHORITY

SUSITNA HYDROELECTRIC PROJECT

DENALI ROUTE
(PLAN 18)

SLOPE MAP

HARZA-EBASCO
SUSITNA JOINT VENTURE

FIGURE 4-6

FOLD LENGTH
12 IN
11 IN
8.5 IN
8 IN

AUTO

MANUAL

FEED

In general, the following sections present impact discussions for each plan and then an overall comparison of the two plans. For some resource categories (e.g., Aesthetics and Recreation), however, where resource considerations are less dependent on the alignments of the various roads for each access plan, general discussions may receive more emphsis than route specific discussions.

4.3.1 Wildlife and Botanical Resources

Denali Plan

Habitat Loss/Modification: Development of the Denali access plan would result in a long-term loss or modification of about 1,110 acres of wildlife habitat due to the presence of the road and railroad. This habitat impact is summarized by vegetation type and route segment in Table 4-3. Shrubland vegetation types represent the majority of this area followed by tundra and forest types in decreasing order of magnitude.

The Denali access plan would result in long-term loss or modification of about 720 acres of potential wetlands due to access road or railroad coverage. This figure is based on the fact that certain (Viereck and Dyrness 1980) vegetation types listed in Table 4-3 represent potential wetlands as defined by Cowardin et al. (1979) and is artificially high (Acres 1983). The figure is also probably high because it does not consider the detailed design of access alignments, which can be used to avoid many wetland areas. However, it is useful for comparison purposes. Borrow material extraction along Deadman Creek may substantially increase the amount of wetland area directly impacted.

A total of about 56 miles of access road and railroad would traverse potential wetlands under the Denali plan. This figure is important because it provides an index of the area of wetlands adjacent to the road and railroad that would potentially be impacted by changes in the hydrologic regime and sedimentation as a result of access road and railroad construction.

TABLE 4-3

APPROXIMATE AREA OF EACH VEGETATION TYPE TO BE CLEARED AND LENGTH OF EACH VEGETATION TYPE TO BE TRAVERSED BY THE DENALI AND NORTH ACCESS PLANS

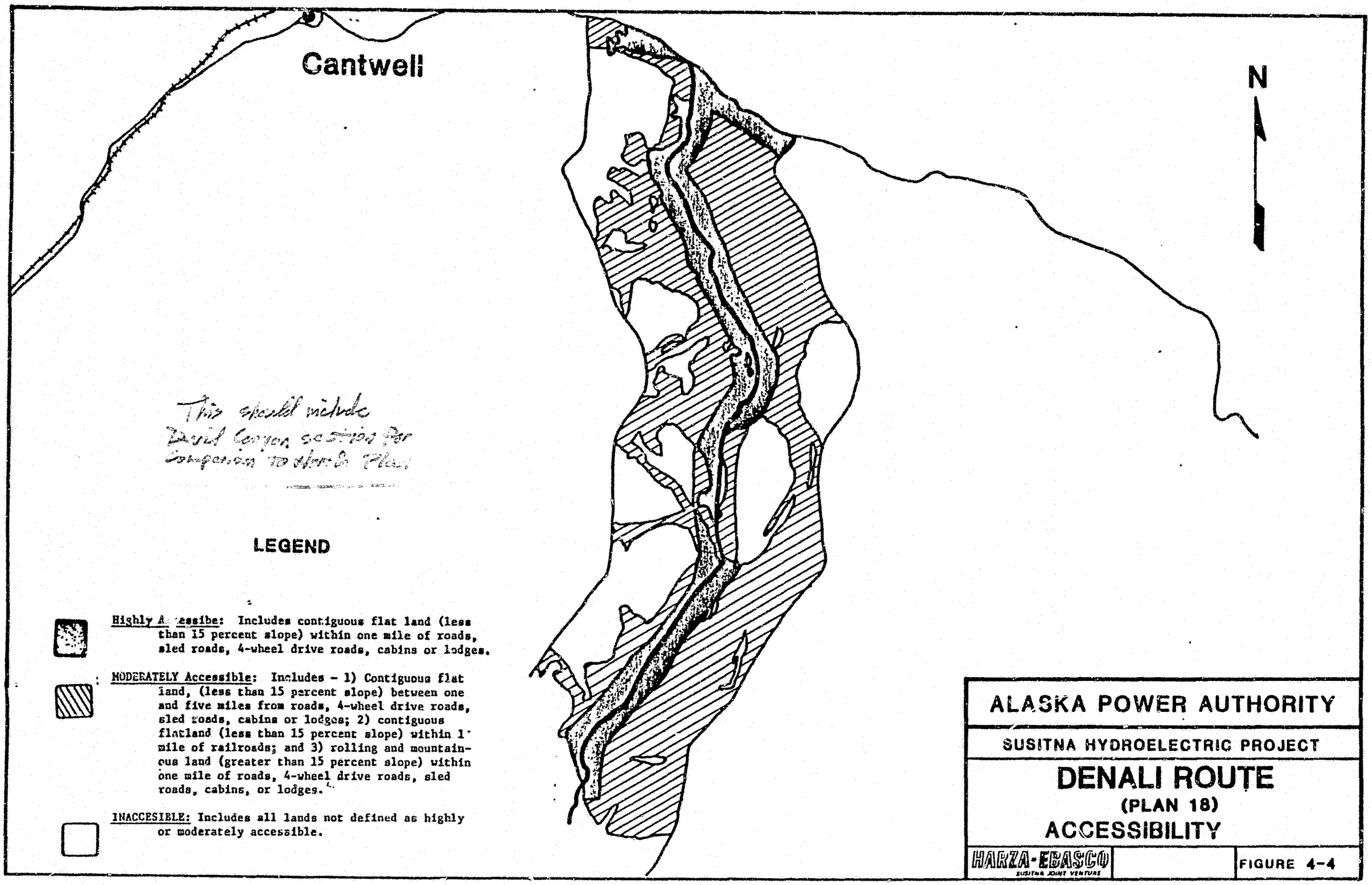
Vegetation Type[a]	Denali Hwy to Watana (road)[b] ac	mi	Watana to Devil Canyon (road)[c] ac	mi	Devil Canyon to Gold Creek (railroad)[d] ac	mi	Total ac	mi	Hurricane to Watana (road)[b] ac	mi	Devil Canyon Spur (road)[b] ac	mi	Total ac	mi
Forest														
Woodland white spruce	–	–	14.2	1.3	–	–	14.2	1.3	90.2	6.2	11.9	0.8	102.1	7.0
Open white spruce[e]	1.5	0.1	39.3	3.6	–	–	40.8	3.7	101.8	7.0	26.3	1.8	128.1	8.8
Woodland black spruce[e]	4.4	0.3	–	–	–	–	4.4	0.3	–	–	–	–	–	–
Open black spruce[e]	–	–	1.1	0.1	3.7	0.6	4.8	0.7	–	–	4.1	0.3	4.1	0.3
Open birch	–	–	–	–	1.5	0.2	1.5	0.2	–	–	2.9	0.2	2.9	0.2
Closed birch	–	–	2.2	0.2	–	–	2.2	0.2	–	–	–	–	–	–
Closed balsam poplar[e]	–	–	–	–	0.7	0.1	0.7	0.1	–	–	–	–	–	–
Open mixed	21.8	1.5	9.8	0.9	14.1	2.3	45.7	4.7	27.6	1.9	–	–	27.6	1.9
Closed mixed	–	–	26.2	2.4	50.0	8.3	76.2	10.7	10.2	0.7	47.4	3.3	57.6	4.0
	27.7	1.9	92.8	8.5	70.0	11.5	190.5	21.9	229.8	15.8	92.6	6.4	322.4	22.2
Shrubland														
Open tall	–	–	19.6	1.8	–	–	19.6	1.8	40.7	2.8	2.9	0.2	43.6	3.0
Closed tall	–	–	54.5	5.0	–	–	54.5	5.0	103.3	7.1	15.3	1.0	118.6	8.1
Low (birch)[e]	194.9	13.4	110.2	10.1	–	–	305.1	23.5	158.5	10.9	1.2	0.1	159.7	11.0
Low (willow)[e]	202.2	13.9	13.1	1.2	–	–	215.3	15.1	24.7	1.7	–	–	24.7	1.7
Low (mixed)[e]	50.9	3.5	58.9	5.4	–	–	109.8	8.9	85.8	5.9	–	–	85.8	5.9
	448.0	30.8	256.3	23.5	0.0	0.0	704.3	54.3	413.0	28.4	19.4	1.3	432.4	29.7
Tundra														
Wet sedge-grass[e]	30.5	2.1	10.9	1.0	2.0	0.3	43.4	3.4	–	–	6.4	0.4	6.4	0.4
Sedge-grass	43.6	3.0	–	–	–	–	43.6	3.0	–	–	–	–	–	–
Sedge shrub	–	–	18.5	1.7	–	–	18.5	1.7	24.7	1.7	–	–	24.7	1.7
Mat and cushion	78.5	5.4	24.0	2.2	–	–	102.5	7.6	26.2	1.8	–	–	26.2	1.8
Grassland	–	–	–	–	–	–	–	–	–	–	2.3	0.2	2.3	0.2
	152.6	10.5	53.4	4.9	2.0	0.3	208.0	15.7	50.9	3.5	8.7	0.6	59.6	4.1
Rock	1.5	0.1	–	–	–	–	1.5	0.1	–	–	–	–	–	–
Unknown[f]	–	–	–	–	–	–			68.4	4.7	–	–	68.4	4.7
TOTAL	629.8	43.3	402.5	36.9	72.0	11.8	1114.3	92.0	762.1	52.4	120.7	8.3	882.8	60.7

[a] Based on Viereck and Dyrness (1980)
[b] Acreage is based on a clearing width of 120 ft.
[c] Acreage is based on a clearing width of 90 ft.
[d] Acreage is based on a clearing width of 50 ft.
[e] Represents potential wetland based on correlating Viereck and Dyrness (1980) vegetation types with the Cowardin et al. (1979) wetland classification system.
[f] Represents area where vegetation has not been mapped between Hurricane and Chulitna Pass.

Increased Access: The Denali plan would require the construction of approximately 80 miles of access road and 12 miles of access railroad (see Table 4-3). These figures can be used as indices of the extent of area subject to increased access as a result of access plan development. However, they do not take into account the existing degree of accessibility of the areas concerned. Therefore, indices for measuring degree of accessibility of the areas concerned were developed, based on the presence of existing roads, railroads, sled roads, 4-wheel drive roads, cabins, and lodges and considering the limitations on access imposed by slope and the Susitna River. As described in Appendix A, areas are classified as highly accessible, moderately accessible, or inaccessible. The relative accessibility of areas along the Denali plan after construction of the Watana access road, are shown in Figure 4-4, while the net change in the accessibility of this area is shown for both the Watana and Devil Canyon projects in Table 4-4. Although these figures are only indices, they more accurately represent the degree of access-related wildlife impacts than simply access route length alone.

Sensitive Areas: In the following paragraphs, sensitive areas along the access routes, where loss or modification of habitat because of increased access may be significant, are discussed.

Large Raptors: One golden eagle and two bald eagle nest sites are likely to be impacted by the Denali plan. The golden eagle nest site is located about 0.3 mile from the access road route near the Devil Canyon dam site and about 0.5 mile upstream from the proposed high bridge across the Susitna River. One bald eagle nest site is located about 0.25 mile from the railroad route across the Susitna River near Gold Creek. It is not feasible to realign the access routes further from these two nest sites due to topographic and engineering considerations. The other bald eagle nest site is located 0.5 mile from the access road route along Deadman Creek. None of these three nest sites would be destroyed, but human disturbance-related impacts would likely have some level of impact ranging from almost none to nest site desertion.



This should include David Canyon section for comparison to Alt. 8 Plan

LEGEND

Highly Accessible: Includes contiguous flat land (less than 15 percent slope) within one mile of roads, sled roads, 4-wheel drive roads, cabins or lodges.

MODERATELY Accessible: Includes - 1) Contiguous flat land, (less than 15 percent slope) between one and five miles from roads, 4-wheel drive roads, sled roads, cabins or lodges; 2) contiguous flatland (less than 15 percent slope) within 1 mile of railroads; and 3) rolling and mountainous land (greater than 15 percent slope) within one mile of roads, 4-wheel drive roads, sled roads, cabins, or lodges.

INACCESIBLE: Includes all lands not defined as highly or moderately accessible.

ALASKA POWER AUTHORITY

SUSITNA HYDROELECTRIC PROJECT

DENALI ROUTE
(PLAN 18)
ACCESSIBILITY

HARZA-EBASCO
SUSITNA JOINT VENTURE

FIGURE 4-4

TABLE 4-4

AMOUNT OF LAND ACCESSIBLE AS A RESULT OF ACCESS ROAD DEVELOPMENT FOR THE DENALI ROUTE (ACRES)

Degree of Accessibility	Watana Project			Devil Canyon Project					
	Existing Conditions from Denali Highway to Watana	After Constr. of Road from Denali Highway to Devil Canyon	Net Change	Existing Conditions from Watana to Devil Canyon	After Constr. of Access Road from Watana to Devil Canyon	Net Change Watana to Devil Canyon	Existing Conditions from Gold Creek to Devil Canyon	After Constr. of Railroad from from Gold Creek to Devil Canyon	Net Change Gold Creek to Devil Canyon Railroad
Highly Accessible	6,830	38,020	31,190	2,110	33,130	31,020	0	0	0
Moderately Accessible	17,940	119,370	101,430	11,130	55,450	44,320	8,960	17,830	8,870
Inaccessible	189,690	57,070	(132,620) 1/	133,190	57,850	(75,340)	18,550	9,680	(8,870)
Total	214,460	214,460	0	146,430	146,430	0	27,510	27,510	0

1/ Values in parentheses are net decrease.

At least five other golden eagle, one gyrfalcon, and one goshawk nest site are known to occur within 1 to 5 miles of the proposed access road. These sites are not likely to be significantly affected by human disturbance impacts.

Furbearers: Development of the Denali plan would result in habitat loss for furbearers; however, of greatest concern would be the resultant increased trapping pressure and increased level of human disturbance. Marten, beaver, muskrat, and red fox are the furbearers likely to be most affected by the increased trapping pressure. Areas of high value to these species that occur along the access routes are the Deadman Creek area, which is of high value to beaver, muskrat, and red fox, and the Jack Long Creek area, which is of high value to beaver and muskrat.

The middle portion of Deadman Creek currently supports about 0.85 active beaver lodges per mile. Even higher densities are supported by the marshy section of upper Deadman Creek (Acres 1983a). The area along the middle portion of Deadman Creek also supports a high concentration of red fox dens, relative to most of the project area (Acres 1983a). Increased trapping pressure resulting from road access may significantly affect these local populations. The increased level of human activity that would occur along the access road in conjunction with trapping would also reduce the habitat quality of the area for red fox. Extraction of borrow material from the valley bottom may negatively impact many beaver colonies and sedimentation and changes in the hydrologic regime resulting from access road construction may also negatively impact beaver in this area.

The proposed railroad would closely parallel Jack Long Creek for several miles near the Devil Canyon railhead facility. This stream and nearby wetlands represent productive beaver habitat (Acres 1983a). Increased trapping and sedimentation resulting from railroad and road construction and operation in this area would negatively impact local beaver populations.

Brown and Black Bears: Brown bear and, to a lesser extent, black bear would be impacted by the Denali plan, primarily through increased hunting pressure and other forms of human disturbance. The access routes avoid good black bear habitat except along lower Deadman Creek, at the Tsusena Creek crossing, near the Devil Canyon dam site, and along the railroad route. Road or railroad construction in these areas could cause abandonment of dens and increased hunting pressure may locally reduce black bear numbers.

Prime brown bear habitat is traversed by both the Denali-Watana and Watana-Devil Canyon segments of the Denali access road route. Several brown bear dens, used by three different bears in 1980 and 1981, were found along the slopes west of upper and middle Deadman Creek and several dens were found at high elevations west of Tsusena Creek (Miller and McAllister 1982, Acres 1983a). Access road construction and operation in these areas would decrease the amount of acceptable denning and feeding area due to human disturbance, and result in higher direct mortality from hunting and nuisance animal control.

Moose: Access road and railroad development under the Denali plan would result in direct moose habitat loss and modification, human disturbance and subsequent avoidance of the access road (effectively increasing the amount of habitat loss), collision mortality, and hunting mortality. Although no major moose concentration areas are crossed by the access routes, apparent concentrations of calving moose were observed in the vicinity of the mouths of Deadman and Tsusena Creeks, and apparent breeding concentrations were observed in the uplands above the mouth of Tsusena Creek (Ballard et al. 1982, Acres 1983c).

Caribou: The northwestern portion of the Nelchina caribou herd range is crossed by the Denali plan, primarily along the Denali-Watana segment. This herd, which presently numbers about 21,000 and has historically been estimated at 71,000, has been important to sport and subsistence hunters because of its size and proximity to population centers (Pitcher 1982). Although the area has not recently been used by many animals from the main Nelchina herd, it currently supports a resident subherd of up to 2,500 caribou (Acres 1983c).

Increased hunting pressure, vehicle collisions, habitat loss, and alterations in caribou movements resulting from access road construction and operation would negatively impact local caribou numbers. Although results of recent studies are somewhat contradictory, caribou appear to be sensitive to road development and use.

Studies have shown that caribou may be reluctant to cross roads with light to moderate traffic levels and that a proportion of the caribou approaching a road may refuse to cross at all (Curatolo et al. 1982). Cows in late pregnancy or cows with calves have been shown to be especially sensitive to disturbance (Calef et al. 1976).

Although it is difficult to predict the effect of the Denali-Watana access route segment on caribou movements, the high volume of traffic expected during and after construction may reduce the extent of caribou use of the area west of the Denali-Watana segment. This factor, in combination with other project-related impacts, may reduce the size of the local subherd and limit the potential for growth of the main Nelchina herd.

North Plan

Habitat Loss/Modification: The North plan would result in a long-term loss or modification of about 830 acres of wildlife habitat due to the presence of the road. This habitat impact is summarized by vegetation type and route segment in Table 4-3. Shrubland vegetation types represent about half of this acreage, while forest types represent most of the remainder and tundra types represent a relatively small area.

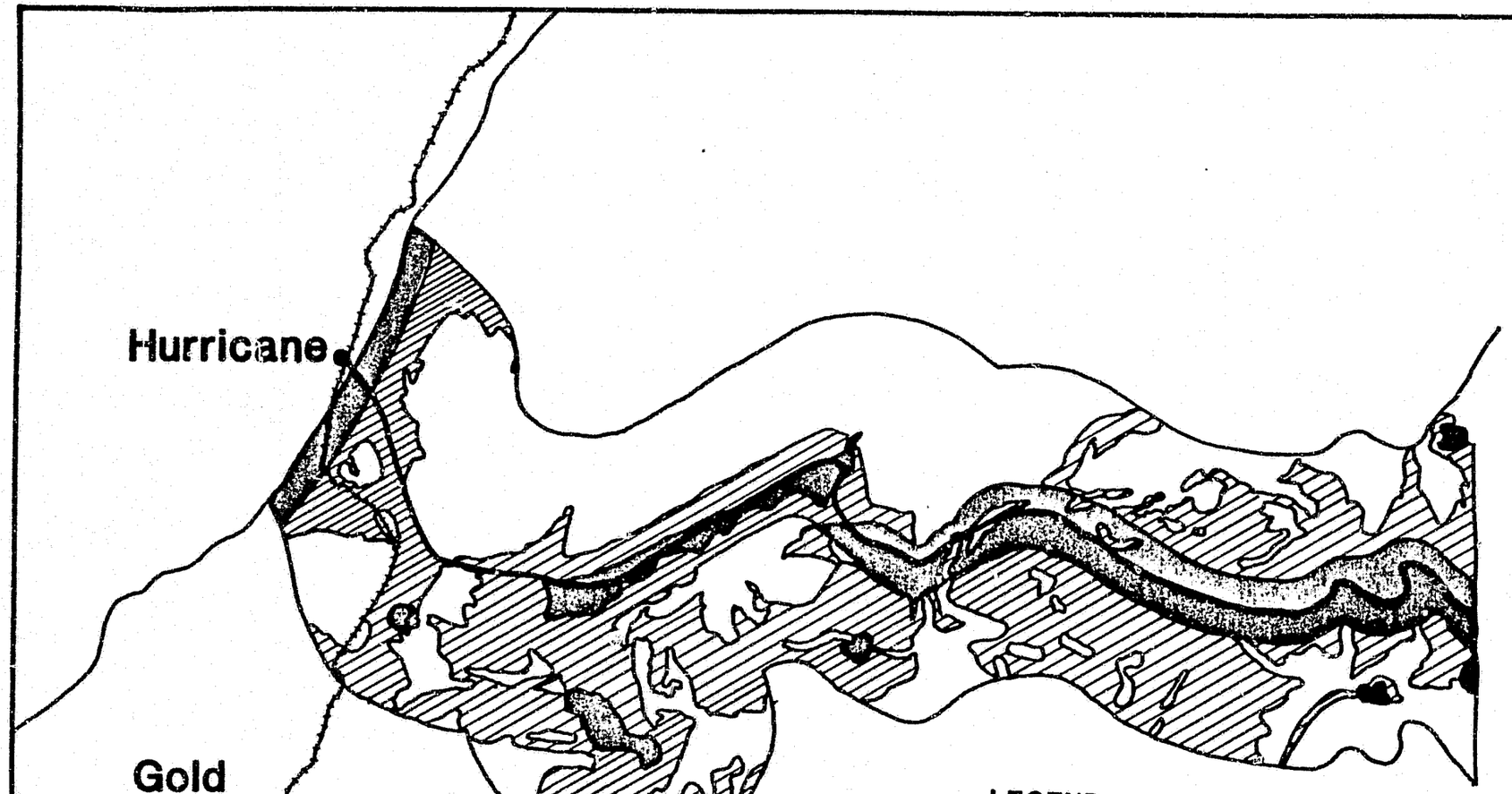
The North plan would result in the long-term loss or modification of about 410 acres of potential wetlands due to access road coverage. This figure is artificially high, as discussed earlier, but is useful for comparison. Extraction of borrow materials along Portage Creek would substantially add to the level of wetland impacts.

Under the North plan, about 20 miles of access road would traverse potential wetlands. This figure represents an index of the area of wetlands adjacent to the road that would potentially be impacted by changes in the hydrologic regime and sedimentation as a result of access road construction.

Increased Access: The North access plan would result in construction of 61 miles of access road (Table 4-5). The areas along the access road that would be subject to increased access are shown in Figure 4-5, while the net change in the accessibility of the area is shown for both the Watana and Devil Canyon projects in Table 4-5. Although these figures represent indices, they indicate the degree of access-related wildlife impacts and thus are useful for comparisons.

Sensitive Areas: In the following paragraphs, those areas along the access routes that are sensitive because habitat loss or modification impacts or impacts due to increased access may be significant are discussed.

Large Raptors: No large raptor nest sites are known to occur within a mile of the North access route. At least six golden eagle, one bald eagle, one gyrfalcon, and one goshawk nest site are known to occur within 1 to 5 miles of the access route. These sites are not likely to be significantly affected by human disturbance impacts.



LEGEND

Highly Accessibe: Includes contiguous flat land (less than 15 percent slope) within one mile of roads, sled roads, 4-wheel drive roads, cabins or lodges.

MODERATELY Accessible: Includes - 1) Contiguous flat land (less than 15 percent slope) between one and five miles from roads, 4-wheel drive roads, sled roads, cabins or lodges; 2) contiguous flatland (less than 15 percent slope) within 1 mile of railroads; and 3) rolling and mountainous land (greater than 15 percent slope) within one mile of roads, 4-wheel drive roads, sled roads, cabins, or lodges.

INACCESIBLE: Includes all lands not defined as highly or moderately accessible.

ALASKA POWER AUTHORITY

SUSITNA HYDROELECTRIC PROJECT

NORTH ROUTE

ACCESSIBILITY

HARZA-EBASCO SUSITNA JOINT VENTURE

FIGURE 4-5

TABLE 4-5

AMOUNT OF LAND ACCESSIBLE AS A RESULT OF ACCESS ROAD DEVELOPMENT FOR THE NORTH ROUTE (ACRES)

Degree of Assessibility	Watana Project			Devil Canyon Project			Total Net Change Both Projects
	Existing Conditions from Hurricane to Watana	After Construction of Road From Hurricane to Watana	Net Change	Existing Conditions Along Spur Road to Devil Canyon	After Construction of Spur Road to Devil Canyon	Net Change	
Highly Accessible	10,080	45,790	35,710	4,130	6,150	2,020	37,730
Moderately Accessible	37,140	117,830	80,690	22,680	29,930	7,250	87,940
Inaccessible	202,250	85,850	(116,400)1/	19,570	10,300	(9,270)	(125,670)
Total	249,470	249,470	0	46,3802/	46,380	0	0

1/ Value in parentheses are net decrease

2/ 21,990 acres is part of Hurricane-to-Watana Dam corridor.

TABLE 4-6

COMPARISON OF THE INCREASE IN THE AMOUNT OF LAND ACCESSIBLE
AS A RESULT OF DEVELOPMENT OF THE DENALI OR NORTH ACCESS PLANS

NET INCREASES FROM EXISTING CONDITIONS (ACRES)

	Denali Plan (Plan 18)			North Plan (Plan 13)		
Degree of Accessibility	Watana Project	Devil Canyon Project	Total	Watana Project	Devil Canyon Project	Total
Highly Accessible	31,190	31,020	62,210	35,710	2,020	37,730
Moderately Accessible	101,430	53,190	154,620	80,690	7,250	87,940

Furbearers: As in the case for the Denali plan, marten, beaver, muskrat, and red fox are the species most likely to be affected by the North plan. Areas of high value to these species that occur along the access route are the Chulitna Pass and Portage Creek areas which represent productive beaver and muskrat habitat. Increased trapping pressure resulting from improved access may occur in these areas but the increase would probably be slight relative to other areas in the vicinity of the project due to the existing level of accessibility and the steep slopes encountered within much of this area. Extraction of borrow material from the valley bottom along Indian River and Portage Creek may negatively impact many beaver and muskrat, however. Also, due to the high potential for significant sedimentation impacts along Portage Creek (which is paralleled for about 9 miles) due to road construction, aquatic furbearer habitat may be sgnificantly degraded along this segment.

Brown and Black Bears: Both brown and black bear would be impacted by the North plan, primarily through increased hunting pressure and other forms of human disturbance. The route traverses much black bear habitat between Hurricane and Portage Creek (including the Devil Canyon spur road) and would pass near a large bear den near Portage Creek. The existing level of accessibility of this area, however, together with the steep slopes along many portions of this segment, suggest that the increase in human access-related impacts to black bears would not be severe. Black bears may also be impacted in the vicinity of the Tsusena Creek crossing.

The Watana-Devil Canyon segment of the North plan would cross prime brown bear habitat in the high country between Devil and Tsusena Creeks. Several dens were found north of the access route and west of Tsusena Creek in this area (Miller and McAllister 1982, Acres 1983c). Access road construction and operation in this area would decrease the amount of acceptable denning and feeding area due to human disturbance. It would also result in higher direct mortality from hunting.

Moose: Access road development under the North plan would result in direct moose habitat loss and modification, human disturbance and subsequent avoidance of the access road (effectively increasing the amount of habitat loss), and collision mortality. Moose impacts would occur along the Hurricane to Portage Creek area segment (including the Devil Canyon spur road). Because this area is already relatively accessible and contains many steep slopes, access-related impacts should not be too severe. Seasonal moose concentrations in the Tsusena Creek drainage and lower Deadman Creek areas, which are presently relatively inaccessible, may be more severly impacted.

Caribou: The North access plan would result in limited caribou impacts. It generally avoids the range of the subherd potentially affected by the Denali access plan and passes through areas only lightly used by the main Nelchina herd.

Comparison

Wildlife impacts, in general, would be greater for the Denali plan than for the North plan. Impacts to large raptors, furbearers, brown bear, and caribou would be highest under the Denali plan, while impacts to black bear and moose are likely to be highest under the North plan. Wetlands impacts and the total amount of habitat loss would also be highest under the Denali plan. Of greatest concern is the increased accessibility to sensitive areas and road traffic along the Denali route which would result from access road construction. Table 4-6 presents a comparison of the increase in the amount of land accessible as a result of the development of the Denali or North access plans. As indicated in that table, the increase in the amount of land accessible to humans is considerably higher if the Denali route is adopted than if the North route is selected.

4.3.2 Socioeconomics

(TO BE INSERTED)

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"SOCIOECONOMICS TO BE INSERTED"

"SOCIOECONOMICS TO BE INSERTED"

4.3.3 Fisheries

Denali Plan

This route crosses a total of 55 streams. (See Table 4-7) Little is known about the species present nor their relative abundances in these streams. The following brief descriptions of known and potential resources along this route is based on information in Exhibit E OF THE Susistna Hydroelectric Project License Application.

Between Cantwell and the Watana Access Road, the major river basins crossed are those of the Nenana and Jack rivers. Fish species that may be present are grayling, northern pike, burbot, whitefish, and sculpin. Tributaries to these streams that may be crossed would potentially contain grayling and sculpin.

Lily Creek, Seattle Creek, and Brush Kana Creek, as well as numerous unnamed streams, are crossed in the Denali Highway to Watana road segment. The species present could be the same as those for the Nenana and Jack rivers. Upper Deadman Creek will also be crossed. This creek, a tributary to the Susitna River, is considered important grayling habitat (ADFG 1982). These grayling are considered significant due to the relatively large size and older age classes that are present . The Watana access road will parallel Deadman Creek for a considerable distance (see Figure 4-1). However, the road will be set back an average of 1/2 mile to reduce accessibility and thus reduce fishing pressure. Additionally, this set back should decrease the risk for impacts due to erosion and sedimentation.

Two major streams that will be crossed in the Watana to Devil Canyon segment are Tsusena and Devil creeks. Devil Creek will be paralleled (see Figure 4-1). These streams contain grayling and may contain cottids, whitefish, longnose suckers, and Dolly Varden.

A crossing of the Susitna River will be made approximately 2 miles downstream of the Devil Canyon damsite. Species present in this river reach include all five species of salmon (chum, chinook, sockeye, coho, and pink salmon) and probably grayling, whitefish, cottids and longnose suckers).

Two streams of importance in the railroad segment between Gold Creek and Devil Canyon (See Figure 4-2) are Jack Long and Gold creeks. Jack Long Creek has relatively small numbers of salmon (See Table 4-8) as does Gold Creek. Other species present are not documented. The railroad will parallel Jack Long Creek (See Figure 4-2).

The Denali Plan will have cut and fills in approximately 5.6 miles of cross slopes greater than 15% (See Table 4-7). Such areas could have a significant potential for runoff and erosion. The amount of excavation for this route ranges from 16,700 cubic yards per mile to about 100,000 (See Table 4-7). The largest average is along the Watana to Denali Highway segment. This implies a greater potential for erosion impacts. Borrow areas which may contain potential spawning gravels, will be taken from upland sites and therefore are of low concern. However, potential borrow areas near Deadman Creek could remove spawning gravels and impact water quality (turbidity and suspended sediments) if not properly sited.

North Plan

This route crosses 30 streams (See Table 4-7). Between Watana and Devil Canyon damsites, the major streams crossed are Tsusena and Devil Creek. Fish species present in these creeks, as mentioned before for the Denali Plan, are grayling and potentially cottids, whitefish,, longnose suckers and Dolly Varden. In addition, Portage Creek, which is paralled for approximately seven miles contains significant numbers of salmon (See Table 4-8).

In the road segment between Devil Canyon and Hurricane, the most significant stream crossed is the Indian River which has runs of salmon (See Table 4-8). This route will require cut and fills in approximately 918 miles of road with slopes greater than 30%. This will potentially require sediment and erosion control. The amount of material to be excavated on each route ranges from 66,000 cubic yards

TABLE 4-7

COMPARISON OF FISHERIES RELATED IMPACT PARAMETERS

Route	No. of Streams Crossed	No. of Important Anadromous Stream Crossings	Miles of Stream Paralleled[a/]		Amount of Material Excavated cu. yds/mi.	Miles of Slope Greater Than 15%	General Types of Soils	Most Significant Fisheries Resources	Potential for Increased Public Access & Indirect Effects
Denali Plan (Plan 18)									
o Denali Highway (upgrade existing road)	10	0	18.3	0.9	16,700	2.0	Mixed Glacial/ Fluvial	Grayling Resources in Deadman Creek - Resident fishes in other streams	Moderate
o Denali Highway to Watana	24	0	35.3	0	100,000	1.2	Ablation Till/ Mixed Glacio-fluvial		
o Devil Canyon to Watana	15	0	20.0	1.5	29,250	2.4	Basal Till/ Colluvium over Bedrock		
o Gold Creek to Devil Canyon (Railroad)	6	0	6.8	3.6	78,000	0	Basal Till		
	55	0	80.4	6.0	223,950	5.6			
North Plan (Plan 13)									
o Hurricane to Indian River	7	1	6.8	0.6	111,500	0.8	Basal Till	Anadromous Salmon spawning areas in Indian River and Portage Creek - Resident fishes in other areas.	Moderate
o Indian River to Watana	21	1	23.7	4.3	150,000	7.9	Basal Till/ Colluvium over Bedrock		
o Indian River to Devil Canyon (Spur road)	2	1	2.7	0.3	66,000	1.1	Basal Till		
	30	3	39.2	5.2	327,500	9.8			

a/ First column corresponds to miles of stream parallel 1.0 miles on each side of the centerline of the routes. This does not include the Susitna River. Second column corresponds to miles of stream parallel and greater than 30% slope.

Table 4-8

INDEX AREA PEAK SALMON SPAWNING COUNTS BY ALASKA DEPARTMENT OF FISH AND GAME -/1 ON MAJOR STREAMS CROSSED BY THE TWO ACCESS ROAD ROUTES (EXCLUSIVE OF SUSITNA RIVER COUNTS)

Denali Plan

o Gold Creek	1981	1982
Chinook	— -/2	142
Pink	0	11
Coho	0	1

o Jack Long Creek	1981	1982
Chinook	—	2
Chum	0	3
Pink	1	21
Coho	0	1

North Plan

o Indian River	1981	1982
Chinook	422	1053
Chum	40	1346
Pink	2	738
Coho	85	101

o Portage Creek	1981	1982
Chinook	659	1253
Chum	0	153
Sockeye	0	4
Pink	0	169
Coho	22	88

-/1 Source = FERC LICENSE APPLICATION EXHIBIT E

-/2 No counts made

per mile to 111,500. Although most of the borrow material for the route will be taken from upland sites if possible, there may be a need for removing materials from the Portage Creek floodplain which increases rish for erosion and runoff, depending on the priximity of the borrow site to the creek. Increased use of the area by fishermen will occur and potential areas of impact could occur along Indian River and Portage Creek.

Comparison

In comparing the two routes from a fisheries perspective, proper construction practices under favorable conditions would avoid or minimize impacts on both routes. In addition, access related impacts are controllable to a large extent through the imposition of stricter fishing regulations and increased enforcement activity. Therefore, if mitigation is effective, the impacts to fisheries on both routes are considered to be low to moderate and to be comparable (See Table 4-7).

Although the Denali Plan crosses more streams and parallels an important fish stream (Deadman Creek) for a considerable distance, it generaly follows relatively flat terrain in which runoff could be more easily controlled than in the North Plan. Further, the number of miles with side slopes greater than 15% is less for the Denali route even though it is longer overall than the Northern route. This fact suggest that impacts will be less on the Denali Route.

Along the Denali route, the major areas of concern associated with fisheries are the grayling of Deadman Creek and potentially the salmon resources of Jack Long and Gold creeks. The salmon resources of Indian River and Portage Creek are considered the major resources of concern along the North Route.

Although the tradeoffs between the two routes amy balance in the long term, the overall potential for long term rish for impact to fisheries resources is slightly higher for the North route due to the higher potential for erosion and runoff, primarily to Portage Creek. Impacts

to Deadman Creek would potentially be significant if the road ran next to the stream. However, because it is set back a distance, both potential erosion problems and accessibility problems will be minimized. The resources of Jack Long and Gold creeks are smaller than Portage Creek or Indian River. Therefore, the numbers of fish potentially affected is smaller in Jack Long and Gold creeks.

4.3.4 Land Use

Denali Plan

Landowner Preferences: The Denali Plan would cross approximately 27 miles of federal land administered by the Bureau of Land Management (BLM). The BLM has proposed to open these lands, which are within the Denali Planning Block, to mineral location and leasing (BLM 1982). To the extent that the Susitna access road might contribute to such development, the BLM would presumably favor the Denali plan. Recreation or other management considerations, however, could affect BLM's preferences.

The State of Alaska will be a major holder of project area land, generally north of the Susitna River, and has a general policy favoring settlement and development of its lands. The Denali plan would conform with this policy.

As stated previously, the primary landowner interest in the configuration of the access plan has come from Native organizations. Large tracts of land along the Susitna River and to the south of it have been or will be conveyed to Cook Inlet Region, Inc. (CIRI) and associated Native village corporations. CIRI and the village corporations have been strong and consistent supporters of any plan providing access to their lands on the south side of the Susitna River, and therefore originally favored the South plan (Plan 16). Because this plan has now been eliminated and the Denali plan provides access to the south side of the river at the Watana damsite, the Denali plan is acceptable to these Native organizations.

Evaluation of landowner preferences concerning the access plan must also consider the positions of Native organizations in the Cantwell area, where the Ahtna Native Regional Corporation and the Cantwell Village Corporation both have significant land selections. These groups favor the Denali plan, due to the positive impet it would provide for development of Native-owned lands in and around Cantwell and along the Denali Highway.

Plan Consistency: The Susitna access system could conceivably influence land use planning efforts at the federal, state, and borough levels. Current or future plans that are relevant to the access decision include BLM plans at the federal level, plans of the Department of Natural Resources (DNR), and the Department of Transportation and Public Facilities (DOT-PF) at the state level, and several planning efforts of the Matanuska-Susitna Borough.

The Denali plan would appear to be consistent with BLM plans for its Denali Planning Block, because it would not interfere with, and would possibly contribute to, the mineral exploration and development activities intended by BLM. However, increased recreational activity and other uses induced by this access plan would create additional future planning and management responsibilities for BLM, and would quite possibly conflict with prospecting and mining activities.

The Alaska DNR has completed a resource assessment and a preliminary resource inventory addressing lands in the project area, but actual land use plans based on these efforts have yet to be developed (Acres 1982c). The Denali route crosses lands selected by the state and would therefore influence planning for those lands, but any more specific effects cannot be established at this time. The Denali plan would be fully consistent with Alaska DOT-PF plans to upgrade the Denali Highway. The Denali Scenic Highway Study could also be a significant planning factor, but BLM (Wrabetz 1983) has indicated that the Denali Highway will not be recommended for designation as a Scenic Highway.

The Matanuska-Susitna Borough is currently in the process of updating its comprehensive plan (Acres 1982c). The existing plan provides little discussion of the Susitna project or the surrounding lands, although the project area is a mixed-use zone consistent with the proposed development. The Mat-Su Borough has also created the Talkeetna Mountains Special Use District, which includes the project area, and provides for planning, zoning, and permitting authority within this district. Much of the Denali plan would be through lands

slated only for mineral development, and for which more complete planning guidelines and procedures have not been established. In general, although the Mat-Su Borough plan provides little guidance on the access question, the Denali plan would not adversely affect planning efforts and is the one preferred by the Mat-Su Borough Planning Director (See Table 3-2).

Native organizations with land selections near the Susitna River have not yet instituted any land use plans or management actions. These organizations have expressed an interest in residential, recreation, mining, and forestry development on their lands.

Induced Land-Use Changes: The Denali plan would create induced land use changes by providing access to a formerly unroaded area. Much of the induced activity would be recreational in nature or subsistence use, but the improved access would also stimulate mineral exploration and demand for residential and commercial recreation development. Many of the affected interests would clearly view the improved access and induced changes as a positive feature, and would probably favor the greatest degree of access. Wildlife and wilderness interests and some other groups would view such changes negatively, and would favor strict access control or a plan providing new access to the smallest possible area. Evaluation of improved access and its associated effects is therefore not an issue with obvious right or wrong answers. However, some evaluative conclusions can be offered by focusing on the size of the area affected, the level of increased activity, and the effect of this activity on existing or desired conditions.

Increased use resulting from access development could extend in either direction of the proposed access roads. Accordingly, the size of the area affected will largely be determined by the length of the access route and ease of access into adjacent areas. The Denali plan, as indicated in the discussion of accessibility in the Wildlife section (Section 4.3.1), would lead to increased access and activity over a large area of undeveloped land.

The goodness or badness of this increased activity is a subjective judgment, indicating that its role in the decision process is unclear. However, it appears that the negative effects associated with access development could be reduced if land and resource management tools are devoloped and implemented.

A final important consideration is the possibility of future access development and its impact. Induced land use changes resulting from the Susitna project and development of the Native-owned lands will almost certainly create a demand for additional road development. If the Denali plan were adopted, this demand might soon make inevitable a road connection westward to Hurricane. This would create a complete road loop through the project area, open the corridor of each access plan to increased use, and provide the greater accessibility to the more populus Anchorage area. Such a development would clearly prevent the use of the fact that access was provided via a dead-end route to control access and land use changes.

North Plan

Landowner Preferences: The North plan would not cross BLM land, but would cross State lands. Development of this plan would generally be consistent with the State's policy favoring settlement and development.

A small amount of Native land would also be crossed by the North route, but the primary concern of the Native organizations is to develop access to the south side of the Susitna River. The North plan, assuming access across Watana Dam, would provide access to this area in accordance with the preferences of the Native organizations.

Plan Consistency: BLM plans would have no affect on development of the North access route because it does not cross BLM administered lands. Also as indicated in the earlier discussion of the Denali plans, land use plans for State lands have not yet been developed so it is difficult to assess plan consistency on State lands.

The Mat-Su Borough, as described earlier, is currently updating its comprehensive plan. Although a plan has not yet been developed, it appears that the North access alternative would provide access in areas that will be subject to the updated comprehensive plan and the provisions of the Talkeetna Mountains Special Use District and, consequently, would be more consistent with logical and orderly planning for development in the Susitna Basin than if it passed through lands slated only for mineral development and which lacked more complete planning guidelines and procedures.

As indicated above, Native organizations near the project area have also not yet adopted any comprehensive land use plans. The North route, however, would provide access to Native lands on the south side of the river and would be consistent with the Native organizations' interest in residential, recreation, mining, and forestry development on their lands.

Induced Land-Use Change: Induced land-use change would result fromm development of the North plan, although a portion of the area is already partially accessible so land use changes would not be as great as on the Denali route. The biggest land use charge would result from the fact that the improved access would increase the ease with which people from Anchorage and nearby communities could reach the project area. As discussed above, the desirability of increased access is a subjective judgment with no clear role in the decision process. It is, however, important to recognize that the area the North plan crosses is already affected by human activity (especially as compared to the Denali route).

The development of the North plan would also provide a reasonable degree of assurance that a loop from the Parks Highway to the Denali Highway would not be constructed. The dead-end acess to Watana would appear to be adequate for the Devil Canyon and Watana projects and there would be no project-related reason to complete the loop up to the Denali Highway. Further, because of the distance, 40 miles, and cost it would appear to be unlikely that a road to the Denali Highway from Watana would be constructed in the near future.

Comparison: Neither the Denali or North plan can be consistently rated as more favorable on the basis of the previously identified land use criteria. The Denali plan appears to be more in accordance with the preferences of project area land owners, while the two plans are comparable, in terms of influence upon existing and future land use plans. The relative merits of the two access plans in regard to their induced land use changes are difficult to establish, but it appears that the changes associated with the North plan would be more compatible with desired conditions. On balance, it must be concluded that neither plan is clearly preferrable from a land use standpoint.

4.3.5 Recreation

Impacts on recreation resources will occur in three phases: during the construction of Watana Dam when the area will be used by project workers; during the construction of Devil Canyon Dam when the Watana access road may be open to the public, and during operations when the complete access road and Devil Canyon railroad spur from Gold Creek may be open to the public. This impact assessment will address the latter two phases because it can be assumed that recreation use of the Susitna Basin by construction workers would be comparable regardless of which access route is selected.

Currently, recreation use of the Susitna Basin is inhibited by limited access. The existing lodges and cabins are very dispersed and activity is at a low level of intensity. Current use of the area is tied closely to the needs of the local population for subsistence use. Access to the area by recreation hunters and fishermen is largely by air. Through questionnaires and workshops, the public has indicated a preference for low to moderate recreational development in response to the Susitna project (Acres 1982b)

The recreation plan, which is included in the FERC License Application, is a proposal to expand existing resources and develop new trails, campsites, primitive camping, shelters, boat ramps and boat storage, and parking areas at the trailheads. The underlying assumption of the recreation plan is that the Denali plan rather than the North plan route, would be selected. Some of the proposed recreational activities could be developed for the North plan, however. The intent of the recreation plan is to maintain the low to moderate intensity of recreational use for a variety of activities that will appeal to a large population. Proposed recreation developments would occur in phases corresponding to the construction and operation phases of the two dams. The results of five methods used to estimate future recreation demand are that 43,000-50,000 recreation user days/year can be expected at the completion of the project. Assumptions used in forecasting demand and a discussion of the uncertainties associated with the project are presented in the FERC License Application, Exhibit E, Chapter 7.

The recreation plan identifies planned recreation resources to meet the needs of the estimated demand and can be counted as positive impacts. Development associated with the tourist industry could occur outside the scope of the recreation plan and result in unanticipated impacts. This type of unplanned development could include second home development, lodges, motels and eating establishments. The extent to which this development occurs depends on changes in land ownership and status within the project area, particularly lands presently owned by the Native corporations. The type and intensity of this resulting development will determine whether these impacts are construed as positive or adverse.

Comparison

Impacts of recreation use on the loss or degradation of scenic quality, wilderness character, and fish and wildlife habitats are difficult, if not impossible, to predict at this time. By applying the criteria listed in Section 3, a comparison of the relative impacts of the Denali and North plans can be made. The major differences between the two plans in terms of recreational resources is the size and extent of the area that would become accessible upon the completion of the project and the travel time from population centers. With the railroad spur from Gold Creek to Devil Canyon site and access road that connects the Devil Canyon to Watana dam sites, the Denali plan will form a loop and will open up more of the Upper Susitna Basin. The loop itself will not be driveable by a car, however, because there will only be rail access from the west. Construction of the North plan will open up a smaller area to the public unless another road were built to connect the access road to the Denali Highway. Access to the project area via the North route will be easier for residents of Anchorage, however.

The difference in travel time from Anchorage between the two access plans is approximately 1-1/2 to 2 hours longer for the Denali plan. The number of people who would be willing to travel 4, but not 6, hours one way is difficult to predict. The travel time plan from Fairbanks to the recreation areas is approximately the same for each plan and is

less important than the recreational demands of the more heavily populated Anchorage area. As a result of the easier accessibility from Anchorage to the project area via the North plan, it is expected that the streams crossed by the road and the back country would be more heavily used. Existing lodges and facilities could be expanded and new ones developed in response to the recreation use. A recreation plan for this area would need to reflect more intensive use. The factor of travel time, however, could balance out the differences in the size of the project area made accessible.

4.3.6 Aesthetics

The major aesthetic consideration related to access road development is the mere fact that a road will be constructed into the highly scenic project area. The development of an access would have both positive and negative effects, regardless of the route selected. Positive effects result from the increased opportunity individuals would have to view this highly scenic landscape. Negative effects result from the fact that the construction of man-made facilities in undeveloped areas could be incompatible with the natural landscape and therefore create high visual impacts themselves.

In general, both the positive and negative impacts can be considered simulanteously by evaluating whether the proposed facilities will be compatible with the existing landscape the ability of the natural landscape to absorb the proposed access development plans will strongly affect the compatibility. Emphasizing potential compatibility is appropriate because it is recognized that the scenic quality in the study area is high along all access routes and that significant views would occur for any route developed. Consequently, the major factor to consider in analyzing each route's potential for taking advantage of positive aspects of road development is whether or not the road or other facility, can be absorbed into the landscape with minimal impact. This is the same concern associated with minimizing potential negative impacts of access road development. Thus, potential for absorption is important in analyzing both positive and negative aspects of access development.

Absorption of roads by landscapes can generally be achieved more readily in flat and rolling terrain than in steep terrain. Road work in mountainous areas will require a greater degree of landscape modification. Specifically because larger cuts and fills will be required. Visual impacts associated with exposed cut and fill sections along a roadway include contrasts in the natural landform, potential contrast with the natural landscape color and texture due to soil disturbance or vegetation removal, and the introduction of man-made structures (e.g., retaining walls, binwalls, culverts, guardrails) into a natural environment.

In flat areas, the road can be absorbed more readily provided obvious man-made features, such as a long straight section of road, are not introduced. A straight road surface across the flat terrain of these landscapes would introduce a significant contrast in form, texture, and color of the natural landscapes due to vegetation removal and soil disturbance.

The following discussion presents information on how the facilities and road segments of the North and Denali plans differ in their effect on aesthetic resources. The compatibility of the features of each plan with the landscape they will be affecting is considered.

Denali Plan

The Denali Plan, as proposed, is the longer transportation route of the two alternatives being considered. This access alternative has the potential for visual impacts to occur more frequently than along the North plan. The first phase of development for the Denali alternative involves providing access from the proposed railhead near Cantwell to Watana. This includes upgrading approximately 21 miles of the Denali Highway and construction of a 42-mile segment of two-lane gravel roadway from the Denali Highway to the Watana camp. This would be followed by a rail and road link to Devil Canyon when that project is constructed. The aesthetic impacts are analyzed by considering impacts of the railhead facility, the Denali Highway upgrade, and the construction of the road from the Denali Highway to Watana.

Cantwell Railhead Facility: A railhead facility will be required near the Cantwell townsite to facilitate unloading and storage of construction equipment being shipped via the Alaska Railroad. A several acre, fenced area will be developed to house fuel storage tanks, a maintenance workshop, unloading dock, modular office and miscellaneous facility structures required to fuel and maintain transport and construction equipment as previously presented in Figure 2-6. Equipment will be transported from the railhead site to the damsite by heavy trucks traveling the access road.

The proposed railhead facility site will be approximately one mile south of Cantwell. It will be constructed immediately adjacent to the east side of the railroad tracks behind a small ridge which exists between the railroad and the Parks Highway.

Visibility of the railhead facility site is anticipated to be minimal, although much of the topography along the Parks Highway in the Cantwell area is relatively flat. The site located behind the ridge is approximately one mile west of the highway. Views of travelers from the highway will be most frequently directed toward the scenic mountains on either side of the highway or for short-term periods toward Cantwell Creek or along the highway corridor. The most significant aesthetic impact which may result from the development of the railhead facility site will be the heavy trucks crossing the Parks Highway enroute to the damsite location and the associated increased noise levels. The location of the reailhead away from Town and the Parks Highway wil keep these impacts to a minimum. Impacts will result from trucks crossing the Parks Highway, but because trucks will cross, rather than travel along the Parks Highway, aesthetic impacts will be limited.

Denali Highway Upgrade: The relationship of the Denali Scenic Highway study to the proposed Denali plan has been identified as an important concern in evaluating the access alternatives. The Bureau of Land Management, in cooperation with other federal and state agencies, has recently assessed the merit of designating the Denali Highway as a Federal Scenic Highway. The recommendation of the Denali Scenic Highway

Feasibility Study, scheduled for release in April 1983, will be that the Denali Highway should not be included as a Federal Scenic Highway under federal regulation (Wrabetz 1983).

Consequently, federal regulation governing the construction or upgrading for future use of Federal Scenic Highways will not apply to the Denali Highway. Despite the fact tha the Denali Highway will not be a federally designated Scenic Highway, aesthetic impacts to it are important because of the Highway's high scenic quality.

It is planned that approximately 21 miles of the Denali Highway, from the Parks Highway to the Watana turnoff, will require upgrading. Aesthetic impacts associated with this construction activity, as well as during construction of the Susitna project, will be primarily related to increased numbers of construction vehicles as well as increases in noise and dust (suspended particulate) levels. During peak periods of construction, there will be an increase in use of the Denali Highway several times above the existing levels. The upgrading of this highway will be coordinated with the Alaska Department of Transportation and Public Facilities and the scenic quality of the 21 miles of upgraded road will be maintained or enhanced.

Denali Highway to Watana: The majority of the proposed new road would traverse the boundary between two distinct landscape character types, the Chulitna Mountains to the west and the Wet Upland Tundra to the east.

Views of the Chulitna Mountain landscapes are quite scenic and are generally composed of rugged glacially carved mountain peaks rising to elevations over 6,000 feet, a number of river drainages and tundra and shrub vegetation species dominating the steep mountain slopes while scattered stands of spruce and deciduous trees line the river drainages.

The Wet Upland Tundra is characterized by flat to rolling topographic relief with frequent bog and wetland areas and low-growing vegetation, typical of tundra environments. Extended open panaromic views of these landscapes are possible due to the absence of vegetation and mountainous

terrain. Approximately the southern one-third of the Phase 1 Denali Highway-Watana segment will traverse the Wet Upland Tundra landscapes. Big and Deadman Lakes, identified as exceptional natural features in Exhibit E of the FERC License Application, are within two to three miles of the proposed road alignment (see Figure 4-1).

The Chulitna Mountains and Wet Upland Tundra landscape character types have been evaluated as having low absorption capability ratings (Exhibit E). The steep and essentially treeless slopes of the Chulitna Mountains and the open extended viewing of the Wet Upland Tundra landscapes increase the potential for visual impacts resulting from roadway construction. The exact nature of the visual impacts, however, will not be as significant as would be expected for a route crossing an area with low absorption because of the location of the route. The alignment chosen largely avoids steep slopes (eliminating the need for large cuts and fills) and contains no long straight sections (reducing the potential for views of incompatible linear features).

Watana to Devil Canyon and the Railroad from Gold Creek to Devil Canyon: The second phase of the Denali access plan, which supports construction of the Devil Canyon project, involves approximately 41 miles of additional roadway construction from Watana to Devil Canyon as well as a 12-mile railroad segment connecting Gold Creek and the Devil Canyon damsite.

The access road in this phase will traverse the Chulitna Moist Tundra Uplands landscape character type. These landscapes have been evaluated as having high aesthetic qualities due to their diversity of physical landscape features. Views of small and large scale topographic relief and a number of streams and lakes are possible throughout this landscape character type. Vegetation varies from tundra to scattered, sparse stands of spruce which occur primarily west of Portage Creek.

This landscape type can be characterized as having a moderate absorption capability. A moderate absorption capability rating reflects the potential for the diverse physical landscape features to absorb and integrate man-made elements with minimal visual impacts.

Providing that the access road alignment is compatible with the existing landform configuration, the most significant visual impacts are likely to result from cut and fill construction techniques and subsequent erosion-related visual impacts. This segment of road will

cross two major creek drainages (Devil and Tsusena Creeks) which introduces man-made elements into the landscape as a result of bridge construction, which could create visual impacts. Although positive viewing experiences of the Chulitna Mountains to the north are possible, views of the immediate foreground distance zones may be dominated by man-made elements. If bridges, culverts or other structural features are not designed properly, the result may be significant visual intrusions upon the natural landscapes.

For the Gold Creek to Devil Canyon railroad, a river valley, 2 to 6 miles wide, is the dominant landscape feature. The river is braided, creating a number of islands and sandbars throughout its primary drainage course. Mixed forests of spruce and deciduous species are common while tundra species dominate the valley's steep sloped banks. Views throughout the Mid Susitna River Valley are generally directed within the river channel bordered by the valley slopes. Views of the frequently snow-capped Chulitna Mountains to the north are possible.

Presently, some man-made elements (e.g., railroad related structures) are evident in sections of this landscape character type. The method of integrating additional railroad structures with those which were previously constructed will partially determine the visual impacts associated with additional railroad construction between Gold Creek and Devil Canyon. Otherwise the development of a railroad in the otherwise undeveloped area should be compatible with the existing landscape.

North Plan

The North plan access alternative consists, during the first phase of road construction, an approximate 50-mile long gravel roadway extending from a turnoff point at the Hurricane townsite to the Watana damsite. A railhead facility, such as described for the Denali plan, would also be required at Hurricane. Aesthetic concerns are not as important with this facility, however, as the rail facility would be located east and out of view of the Parks Highway and would not be visible from any residences. An additional segment of road from a turnoff point along the first access roadway to the Devil Canyon damsite will be constructed during the second phase of road development.

Landscape character types traversed by this route are the Chulitna Moist Tundra Uplands, Portage Lowlands, and the southwest boundary of the Chulitna Mountains. The majority of the visual impacts which are likely to result from the construction of the North plan are similar to the impacts decribed above for the Denali Watana to Devil Canyon road segment. The Denali plan and the North plan share a common route corridor for a portion of this segment.

The Portage Lowlands are an additional landscape character type impacted by the North plan, however, that is not impacted by the Denali plan. The Portage Lowlands are characterized by a distinctively deep and winding tributary canyon of the Susitna River and are bordered by steep slopes. A variety of vegetation types and river bottom terrain contribute to its high aesthetic value.

These landscapes have been assigned a low absorption capability rating. The steep slopes bordering the creek are particularly sensitive to erosion. Therefore, a significant visual impact could result from construction of the North plan access alternative crossing of Portage Creek.

As proposed, this access road will be routed nearer to the base of the Chulitna Mountains than the corresponding segment of the Denali plan alternative. Again, the extent of cut and fill construction that is required for this roadway alignment will be a significant determining factor of the degree of visual impact.

The western segment of this route (from the Hurricane turnoff to the Chultina townsite) may introduce additional visual impacts. These impacts are related to increased visibility of the access route from the the Chulitna and Hurricane townsites, and the Parks Highway near Hurricane.

Comparison

It is expected that the Denali plan would have greater impacts than the North plan during construction because of increased traffic volumes on currently lightly traveled Denali Highway. During operations, the fact that the Denali Plan traverses more open, rolling terrain of high scenic quality than the North plan suggests that Denali plan roads may be more readily absorbed into the landscape than those of the North plan. The North plan, although within an area of high scenic quality, has a greater potential for more incompatible landscape modification, including larger cut and fill slopes and crossings of major or deeply incised stream channels such as Portage Creek and Indian River, than the Denali plan.

Therefore, in spite of the relative differences in the two access plans, they are comparable overall from an aesthetic perspective and it is difficult to determine which route is preferred from an aeathetic perspective.

4.3.7 Agencies, Native Organizations and Public Preferences

(TO BE INSERTED)

4.3.8 Constructability and Schedule

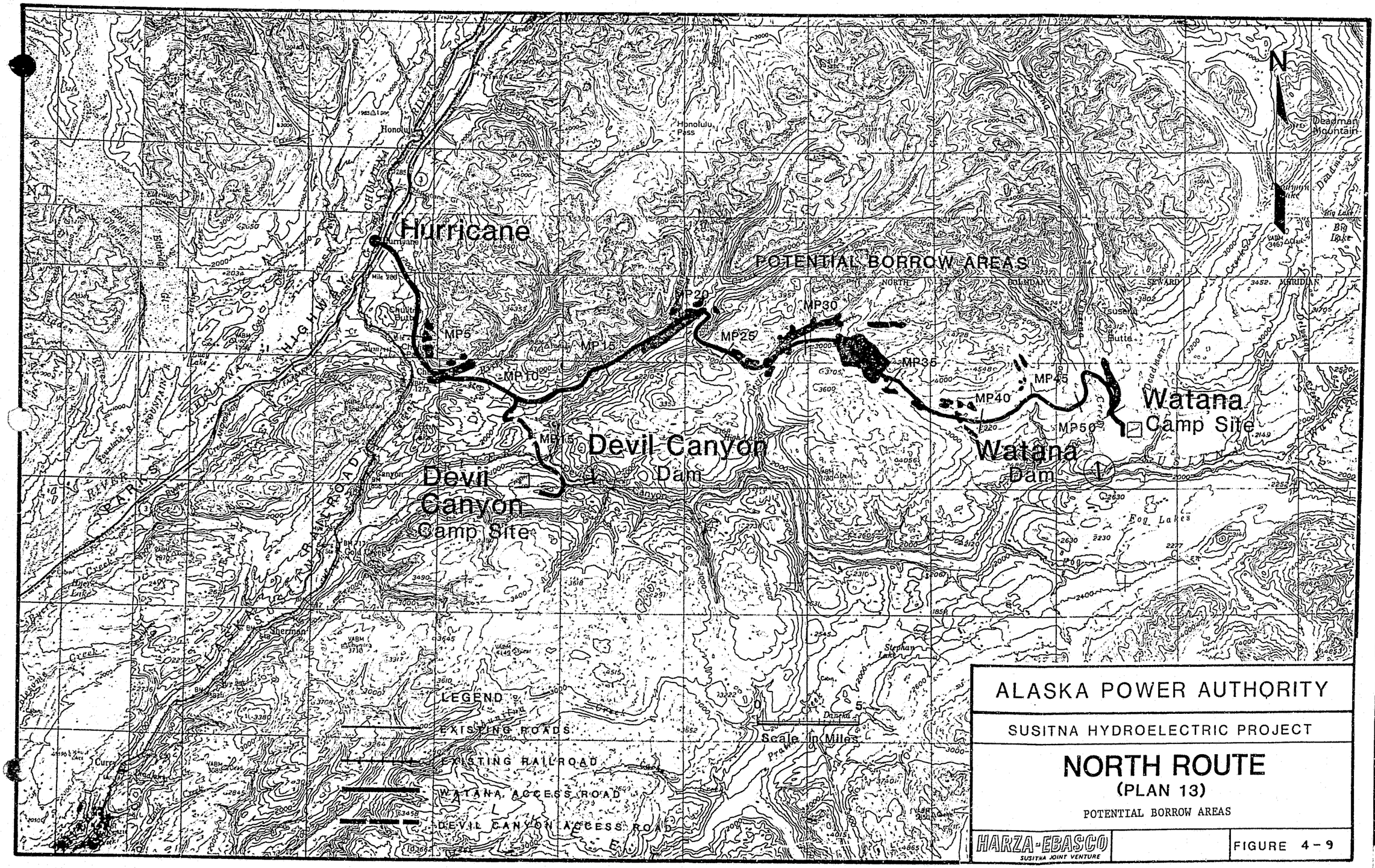
Denali Plan (Plan 18)

According to Acres' estimates, initial access for the Denali plan could be achieved in 6 months. This is a reasonable and perhaps somewhat conservative estimate. The route traversed by this plan is comparatively flat, as can be seen from an examination of the slope maps on Figure 4-6. While the route crosses 45 streams, there are no major stream crossings that would require expensive structures for bridging. From R&M Terrain Analysis maps, borrow material is well distributed along the proposed route and the bearing capacity of the soils is generally good, even when thawed. Of the approximately 40

miles of new road from the Denali Highway to Watana proposed for this plan, borrow would Figure 4-6 goes here have to be obtained from excavations away from the immediate site of construction on about 30% of the route length, or a total of about 12 miles. The areas of low bearing capacity soils (when thawed) are a comparable portion of the route. Borrow from upland terrace deposits, alluvial fans, eskers and ablation morraine is well distributed along the Denali Highway to Watana and Watana to Devil Canyon road segments proposed under this plan. Areas of low thawed bearing capacity soils are well defined and not scattered randomly along the route. There should be little need to develop borrow areas in active floodplain areas. Areas of potentially usable borrow for the Denali plan are mapped on Figure 4-7.

Regardless of which access route is selected, initial general construction mobilization for Watana will probably have to be by snow road to keep within schedule. The Denali Highway to the Watana access corridor is the route presently used for winter haul operations to support the Watana Design Phase field exploration program. A heavy duty snow road could probably be built very quickly along the proposed Denali route. Since most of the route is above El. 3000, the snow road season should extend from December or January to mid-April or later. While this means a somewhat shorter conventional road building season than at lower elevations, the longer snow road season is important for overall early access.

Pre-construction soils investigations to identify areas of low summer bearing capacity would help in identifying those areas of the route that must be completed before any summertime vehicular access could be expected. If these low bearing capacity areas and the stream crossings are finished quickly, using some of the methods for accelerated construction identified in Chapter 2, reduced slow speed traffic, cross-country along the permanent route right-of-way between completed sections of the permanent road should be possible for this route due to the open and comparatively flat terrain.



ALASKA POWER AUTHORITY

SUSITNA HYDROELECTRIC PROJECT

NORTH ROUTE
(PLAN 13)

POTENTIAL BORROW AREAS

HARZA-EBASCO
SUSITNA JOINT VENTURE

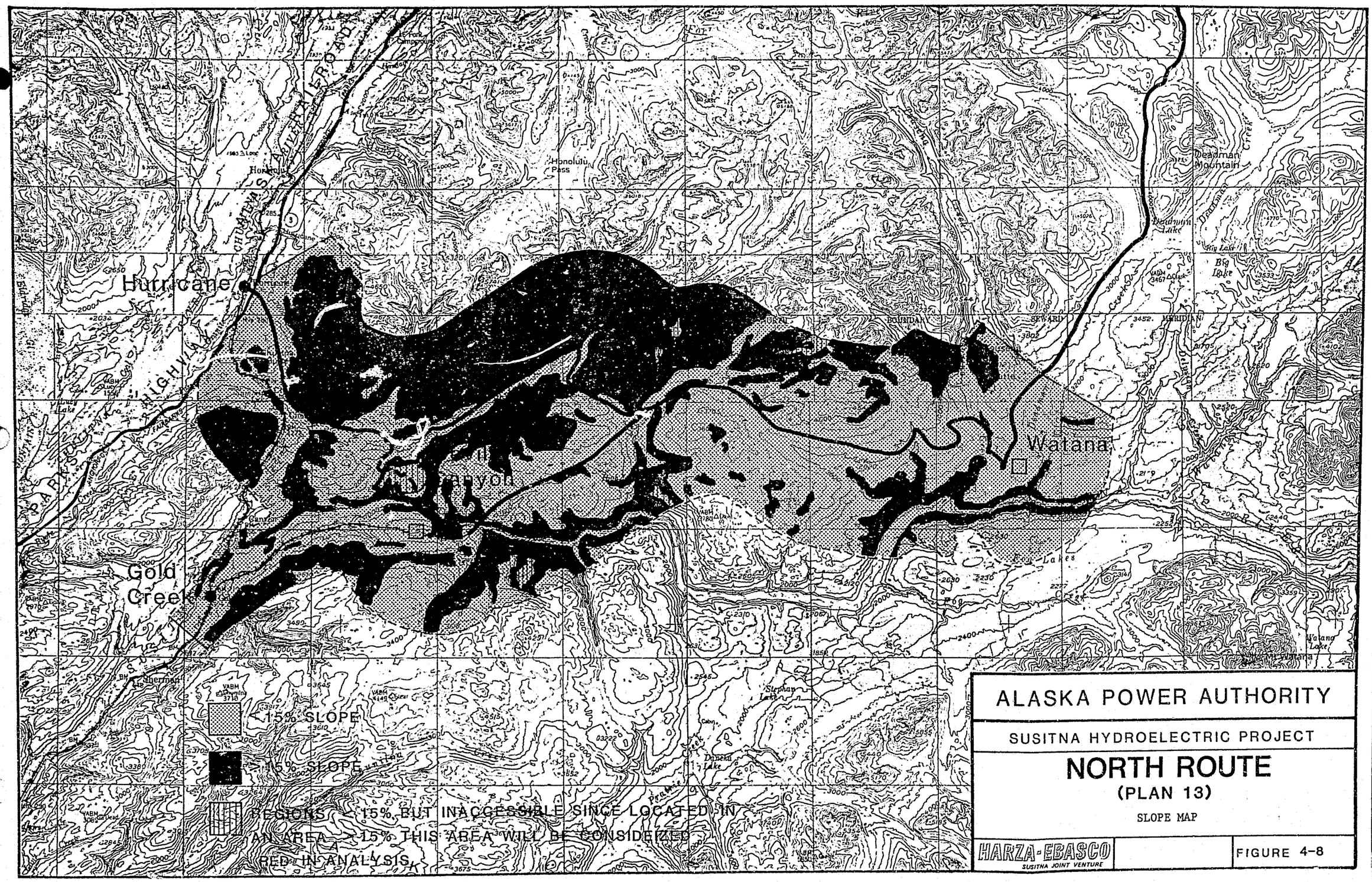
FIGURE 4 - 9

FOLD LENGTH
— 12 IN
— 11 IN
— 8.5 IN
— 8 IN

AUTO

MANUAL

FEED



ALASKA POWER AUTHORITY

SUSITNA HYDROELECTRIC PROJECT

NORTH ROUTE
(PLAN 13)

SLOPE MAP

HARZA-EBASCO
SUSITNA JOINT VENTURE

FIGURE 4-8

North Plan (Plan 13)

According to Acres estimates, initial access along this route should be able to be achieved in 9 months. This means that an all-weather road capable of accommodating conventional 30 mph truck traffic could be built in this period of time. The reason that this route would probably require 3 months longer to construct than Denali plan is that 12 more miles of new road are required for the North plan than for the Denali plan, there are four major stream crossings, and there is more sidehill-type construction. A slope map of the North plan is shown in Figure 4-8. While the North plan crosses 30 streams in all, there are comparatively major crossings at Indian River, Portage Creek, Devil Creek and Tsusena Creek. The largest of the four is at Portage Creek, where the permanent bridge would be a low level structure with perhaps 2-200 foot spans supported on piles. Temporary bridging would be required for cross-country access.

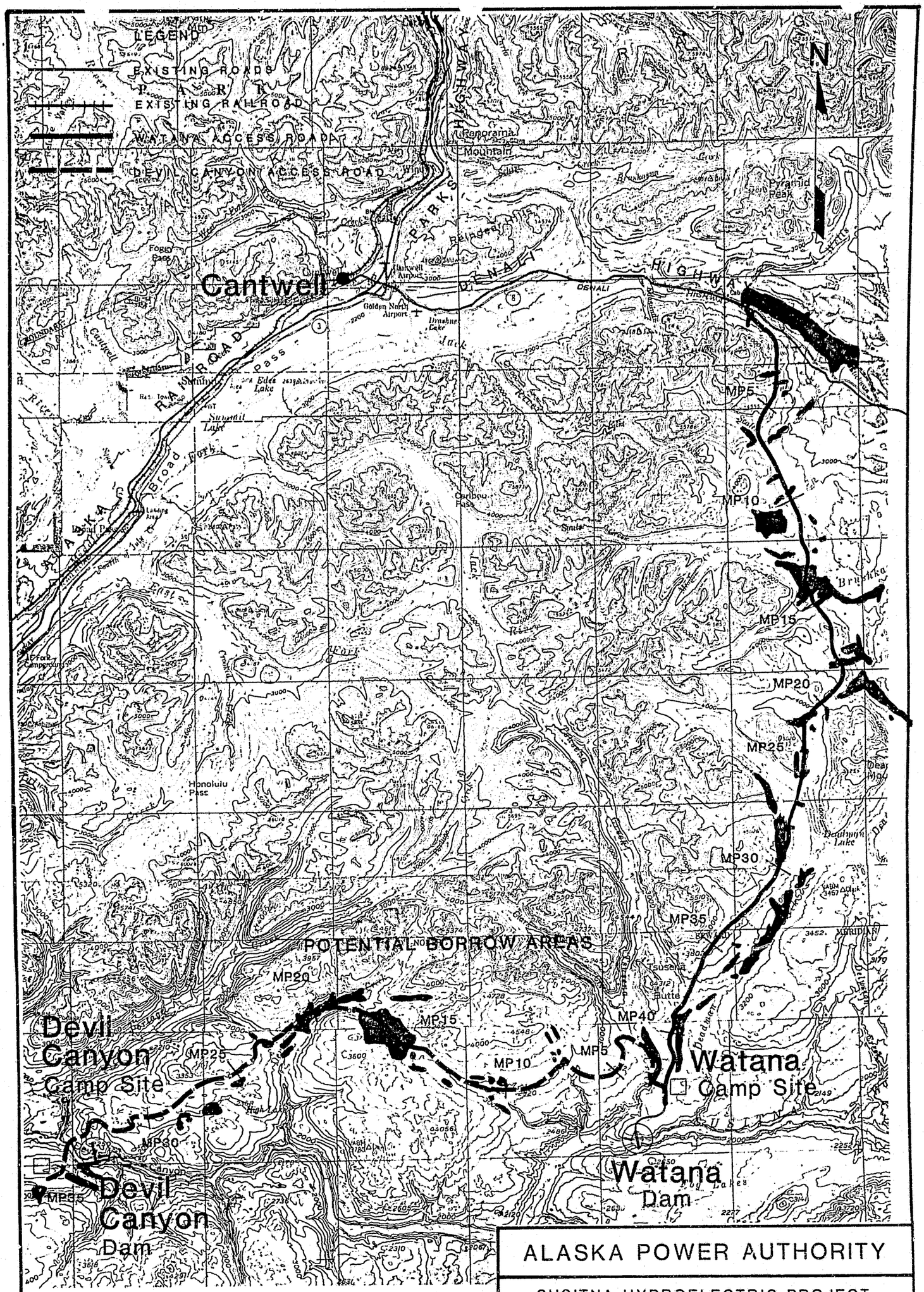
The access scenario for the North plan is similar to that for the Denali plan: mobilize the general contractor on a snow road; stockpile materials at Watana; and begin construction of a permanent access road immediately after spring breakup. Because the North plan route is at a generally lower elevation than the Denali plan, the spring breakup should be slightly earlier. The nature of the terrain, the length of the road, and the vegetation may make it somewhat more difficult to build a snow road along the North plan route even though there may be more snow in this area than along the Denali plan corridor. There is an existing 4-wheel drive road to Portage Creek, however, that could be utilized.

After breakup, there will be a period of very limited access while the first part of the new road is built. Mobilizing temporary bridging increases the length of this limited access period. This could be largely mitigated, however, if some pre-license bridge foundation work were permitted. Work would include only winter pile driving for bridge foundations, using a snow road or helicopter to mobilize the equipment. A pioneer road would not be required. The permanent disturbance caused by this activity should be minimal. If necessary, the piles could be removed and the area could be restored.

Borrow and general soil conditions for the North plan are not quite as favorable as they are for the Denali plan. Of the 52 miles of road on the North plan, slightly more than 50% of the length will pass over ground identified as low thawed bearing capacity material on the R&M Unit Terrain Analysis maps. Most of the 27 miles of route on poor soil is west of Portage Creek and in particular between Hurricane and the Indian River where road construction could be difficult due to wet ground conditions. Figure 4-9 is a map of potentially usable sources of granular borrow for the North plan. From the figure, there is a poor distribution of potentially usable borrow convenient to the route west of Portage Creek in general and between Hurricane and the Indian River in particular. While ample borrow should be available in fan and terrace deposits, there is a chance that borrow pits may have to be developed in the upland portions of the Indian River and Portage Creek floodplains. East of Portage Creek the route traverses better soil and borrow availability improves. This is the portion of the North plan route that is nearly identical to the east half of the Denali plan operator's road from Watana to Devil Canyon.

Conclusions

The Denali plan is preferred from the standpoint of constructability and construction schedule because it should be easier and faster to construct than the North plan. Borrow material is more readily available and there is less likelihood of encountering troublesome soil conditions. The Denali route is generally flatter and more condusive to cross-country movement of conventional and unconventional transportation equipment. The four major bridges and the rougher terrain around Portage Creek are the principal causes of the longer construction schedule for the North plan. The terrain along the Denali plan is generally more condusive to the use of unconventional schedule accelerating techniques than the North plan, with a higher probability of finishing work on schedule or earlier than the North plan. For the North plan, conversely, there appears to be a greater probability of schedule overruns because of the nature of the terrain and the number of major stream crossings.



ALASKA POWER AUTHORITY

SUSITNA HYDROELECTRIC PROJECT

DENALI ROUTE
(PLAN 18)
ACCESS PLAN

HARZA-EBASCO
SUSITNA JOINT VENTURE

FIGURE 4-7

4.3.9 Impact on Overall Susitna Project Construction Schedule

General

There does not appear to be any great risk of unforeseen difficulties during construction of either access road alternative that might delay construction of the entire Watana Project. Because of its longer period of construction, the North plan increases the probability that construction might have to be supported by airlift. Access scenarios for the two candidate routes for general construction schedules "A" and "B" discussed in Section 2.0 are described below.

Schedule "A"

A January 1st mobilization date has been assumed for this schedule (see Figure 2-1).

Denali Plan (Plan 18) - Initial mobilization under this plan would be by snow road or air if a suitable airstrip is constructed during the Watana Design Phase as is presently being considered. The snow road would probably not be usable past about mid-April, after which there would be a period of about 4 to 6 weeks during the breakup when no access road work would be started. The only access to the project during this period would be by air. Assuming that it would take at least 2 additional months before limited cross-country access along the right-of-way could be established, there would be about a 3-month period of interrupted access in the late spring and summer. Logistics requirements for this period are manageable, however, and needs could be met by either airlift or by pre-delivery and stockpiling via the snow road. Cost studies in this report are based on stockpiling, which is considered a reasonable assumption. For Schedule "A", the end of this period would be in about mid-July, after which time limited cross country access should be possible. A passable all-weather "initial access" road should be complete during the

following 4 months before the beginning of the next winter season. If, for some reason, the all weather road is not finished before the end of the construction season, a snow road could be built again in the second winter to support concreting in the diversion tunnels. Good planning, stockpiling, and use of snow roads should avoid heavy dependence on airlift for Denali plan Schedule "A".

North Plan (Plan 13) - Utilization of snow roads and stockpiling for the North plan is similar to the scenario for the Denali plan for Schedule "A." It might not be possible, however, to finish the permanent all-weather road before the start of the second winter season. One to two months of no or very limited ground access might develop in the second spring (1986). Proper planning, pre-delivery and stockpiling practice should be sufficient to avoid the need for extended airlift.

Schedule "B"

Schedule "B" is a much more ambitious diversion schedule than Schedule "A" with more importance placed on timely access. For Schedule "B" to be feasible for either access alternative, there must either be an airstrip suitable for Hercules aircraft built during Watana Design Phase, or some pre-license equipment mobilization and supply stockpiling off a winter snow road must be permitted. The Schedule "B" contract award date is just after the spring breakup in mid-June at the start of the summer construction season. Pre-mobilization of equipment for roadbuilding off a pre-license snow road would be desirable.

Denali Plan (Plan 18) - Assuming that the first 3 months of supplies and equipment are airlifted, the access problem for the Denali plan under Schedule "B" is manageable. The Contractor has nearly 6 months to work on the access road before the onset of the next winter season, when snow road techniques could be used to bridge the gaps between completed sections of the all-weather access road. At worst, in the absence of good planning and stockpiling, there might be a need for 1 month of airlifting during the second season spring breakup.

North Plan (Plan 13) - The access scenario for this plan is similar to that for the Denali plan except that there would be at least a three-month period in the second season when limited cross-country access would prevail due to the longer construction schedule duration for the North plan. Some airlifting might be required during the spring breakup.

Discussion

Either the North plan or the Denali plan is acceptable from a Susitna Project overall construction scheduling perspective for the Schedule "A" scenario above. For the Schedule "B" scenario both plans are marginally feasible. Since the North plan requires a longer construction period and the Schedule "B" case is marginal for either plan, the Denali plan appears to offer more flexibility with less risk. While the risk is small and unquantifiable, there is generally more risk of delay and logistical problems with the North plan. Since the North plan takes 3 months longer to construct than the Denali plan, the worst that could happen in the second construction season while the road is being finished is that 3 months more airlifting would be required for the North plan than for the Denali plan. The cost of this effort is considerably less than the cost of delaying the project for a year.

Regardless of which plan is selected, however, there will be a high dependence on winter snow road hauling. Whichever all-weather access road route is ultimately selected, the Denali plan corridor should be strongly considered as the route for the first season winter road. If Schedule "B" is to be feasible for either access plan, an airfield should be built during design phase, or arrangements should be made for pre-mobilizing on a winter road before receipt of the FERC license.

4.3.10 Maintenance and Reliability

There should be little difference in the extraordinary maintenance required for either route. The main difference in maintenance costs is related to the length of road to be maintained. There may, however, be some slight intrinsic differences in maintenance needs that should be considered as qualitative evaluation factors. In their 1982 "Access Planning Study," R&M Consultants estimated that the North plan should be about 25% more expensive to maintain on a unit-mile basis than the Denali plan. While no rationale is given in the R&M report, the R&M estimate of relative differences between maintenance for the two routes is probably based on terrain and meteorological conditions.

The Denali plan route generally traverses flatter ground than the North plan with less side-hill construction in cuts. While the North plan route is by no means mountainous in an absolute sense, it is more rugged than the Denali plan route. Sidehill cut construction in areas of discontinuous permafrost increases the probability of slumping and sliding of uphill materials onto the road, and increases the probability of lateral instability of the roadway itself. The amount of differential annual maintenance that might be required to repair slumps and slides that might cause temporary road closure on the North plan is difficult to quantify and would probably be a small percentage of total route maintenance. The possibility that the North plan would require more of this type of extra work, however, is a qualitative factor in favor of the Denali plan.

Differences in the degree of difficulty of snow removal operations between the two routes is a factor, like small-scale landslide repair, that is difficult to quantify. It appears, however, that the Denali plan may be easier to keep free of snow than the North plan. The Denali plan road surface will be slightly elevated above the general level of the surrounding, predominantly flat, ground. Wind will tend to help keep snow off the road. Because of the greater preponderance of sidehill construction for the North plan, snow may accumulate in

drifts on the uphill side of the roadway, where it could be difficult to remove. Avalanches, however, do not seem to be a major concern. The natural removal of snow from the Denali plan roadway will probably also be aided by route alignment, which is generally parallel to the prevailing winds in the area (see wind rose diagram, Figure 4-10). The North route also receives more precipation than the Denali route because it is located further south in an area which receives more of the precipation which moves into the area from the south. Therefore, difficulties in maintinaing reliable access resulting from rain and snow will be more pronounced on the North route than on the Denali route.

4.3.11 Costs

Denali Plan (Plan 18)

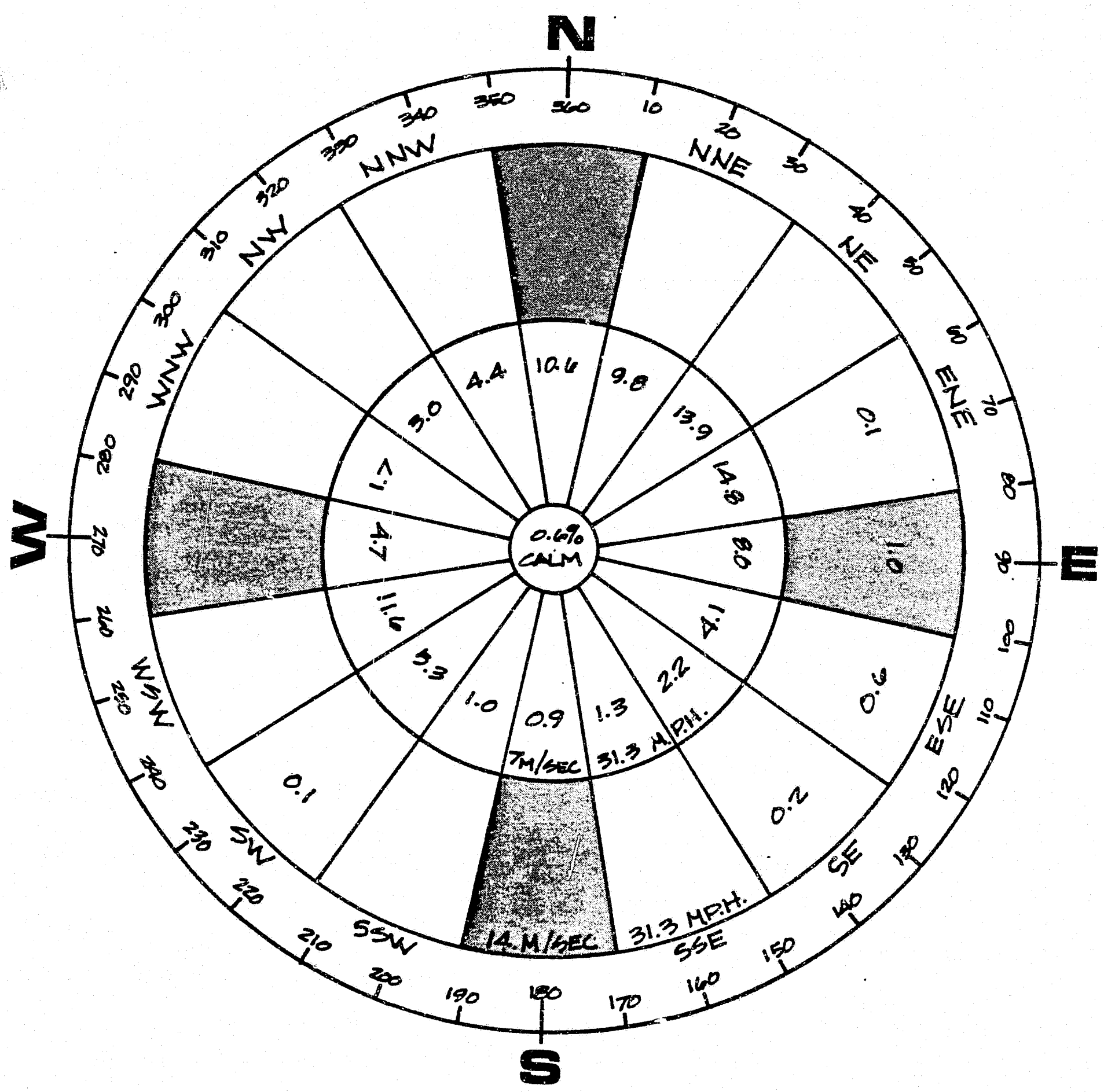
Estimated capital costs (1983 dollars) for the Denali plan access road construction are presented on Table 4-9. Two major changes in the estimate have been made by Harza-Ebasco in the capital cost estimate for the Denali plan Devil Canyon phase construction. First, the Acres estimate contained provision for a $15,000,000 high level bridge over the Susitna River just downstream from the Devil Canyon Dam. This figure was subtracted from the Acres estimate to prepare the figures in Table 4-9. No provision for a similar bridge was included in the Acres North plan estimates even though a high bridge was also envisioned for the North plan (Acres, 1983a Draft Supplement to Feasibility Report, p. 4-6). If a bridge is to be built across the Susitna for both plans, both plans should either be charged for it or neither should be charged. The latter was adopted here since this is a comparative cost study. The Devil Canyon layout will require access to both sides of the river regardless of which access road is built. The emergency spillway, saddle dam and diversion works are on the south bank; the powerhouse and service spillway are on the north. The contractor will require ready access to both banks of the river regardless of which access route is built to facilitate the general construction described above and to install a cableway system for construction of the arch dam.

The second major change is in the cost estimate for the construction of the Watana to Devil Canyon Operator's access road. This road is designed the same as the main construction access roads in the Acres and R&M reports. The the Denali plan Permanent Operator's Road, however, will only be used for daily permanent worker commuting and Figure 4-10 periodic supply of the Devil Canyon Project after construction. The need for a two-lane highway 34 feet wide seems excessive for this purpose. From Exhibit E of the FERC License Application, the permanent workforce for Devil Canyon operations is projected at a total of 25. A roadway 18 feet wide should be more than adequate to support this type of traffic. The proposed 18-foot width is wide enough to permit two vehicles to pass each other from opposite directions, yet narrow enough to result in a significant construction cost savings on the order of about $10,000,000. Worker transportation to and from Anchorage and Fairbanks for this plan could be by rail or bus. Supervisory staff housed in the Watana Permanent Town during Devil Canyon construction could be bused to Devil Canyon. A narrower road might also make it easier to justify public access restrictions during operation phase to prevent the formation of a Denali Highway/Parks Highway traffic circulation loop.

Capital cost estimates from Table 4-9 were combined with maintenance and logistics cost data to compute the present worth of the cost streams for the Denali plan Watana, and Watana plus Devil Canyon scenarios. Costs are briefly summarized below.

Capital Cost (Watana including accelerated schedule costs):	$ 54,597,000
Capital Cost (Devil Canyon):	$ 44,214,000
Watana Phase Present Value of Construction and Logistics Costs:	$111,157,000
Watana plus Devil Canyon Present Value of Construction and Logistics Costs:	$150,751,000

Note that the present value Devil Canyon plus Watana cost assumes that Devil Canyon construction would begin in 1993.



1. OBSERVATIONS ARE 30-MIN. AVERAGES, RECORDED ON THE HOUR.
2. PERIOD OF RECORD = APRIL 8 - MAY 29, 1980.
3. MAX. 15-SEC. GUST RECORDED = 16.5 M/SEC. (36.9 MPH.) - 5/18/80 (FROM EAST).
4. COMPASS BEARINGS GIVEN ARE DEGREES TRUE.

FIGURE 4-10 WATANA AIRSTRIP WIND ROSE

TABLE 4-9
ESTIMATED DENALI ACCESS (PLAN 18) CAPITAL COSTS[1/]
WATANA CONSTRUCTION

Description	Quantity	Units	Price/Unit	Amount
Upgrade Existing Road				
Denali Highway from Cantwell to				
New Road (21 Mile)				
Clearing	17	AC	$5,760.00	$ 97,920.00
Waste Excavation	66,000	CY	4.80	316,800.00
Common Excavation	264,000	CY	4.20	1,108,800.00
Rock Excavation	0	CY	14.40	0.00
Borrow	20,000	CY	6.00	120,000.00
NFS Subbase Material	13,700	CY	8.40	115,080.00
Grade "A" Base Material	51,024	CY	16.80	857,203.00
D-1 Base Material	58,604	TON	21.60	1,265,846.00
Guardrail	3,000	LF	43.20	129,600.00
18" Culverts	4,000	LF	28.80	115,200.00
36" + Culverts	—	LS	55,560.00	55,560.00
Fabric	0	SY	3.00	0.00
Thaw Pipes	100	LF	43.20	4,320.00
Topsoil & Seed	10	AC	3,600.00	36,000.00
Traffic Control Devices	21	MI	18,000.00	378,000.00
Bridges	1,700	SF	180.00	306,000.00
		TOTAL		$4,906,329.00
Road Facilities				
Permanent Road				
Denali Highway to Watana (42 Mile)				
Clearing	748	AC	$5,760.00	$4,308,480.00
Waste Excavation	2,080,300	CY	4.80	9,985,410.00
Common Excavation	2,087,400	CY	4.20	8,767,080.00
Rock Excavation	41,800	CY	14.40	601,920.00
Borrow	0	CY	6.00	0.00
NFS Subbase Material	435,650	CY	8.40	3,659,460.00
Grade "A" Base Material	237,660	CY	16.80	3,992,688.00
D-1 Base Material	99,170	TON	21.60	2,142,072.00
Guardrail	7,000	LF	43.20	302,400.00
18" Culverts	26,350	LF	28.80	758,880.00
36" + Culverts	-	LS	373,680.00	373,680.00
Fabric	12,907	SY	3.00	38,721.00
Thaw Pipes	28,750	LF	43.20	1,242,000.00
Topsoil & Seed	490	AC	3,600.00	1,764,000.00
Traffic Control Devices	42	MI	18,000.00	756,000.00
Bridges	0	SF	180.00	0.00
		TOTAL		$38,692,821.00
		TOTAL WATANA[2/]		$43,599,150.00

TABLE 4-9 (Continued)
ESTIMATED DENALI ACCESS (PLAN 18) CAPITAL COSTS[1/]
WATANA CONSTRUCTION

1/ All base price data from R & M Consultants, Inc. Estimates changed as described in text.

AC-Acre SY-Square Yard MBF-Thousand board Feet
CY-Cubic Yard MI-Mile
LF-Linear Foot LS-Lump Sum

2/ Excluding accelerated schedule costs, estimated at $11,000.00.

TABLE 4-9 (continued)

ESTIMATED DENALI ACCESS (PLAN 18) CAPITAL COSTS[1/]

DEVIL CANYON CONSTRUCTION

Description	Quantity	Units	Price/Unit	Amount
Service Roads (Permanent)				
Devil Canyon to Watana (36 mi)				
Clearing	506	AC	$5,760.00	$2,914,560.00
Waste Excavation	863,438	CY	4.80	4,144,502.00
Common Excavation	901,354	CY	4.20	3,785,687.00
Rock Excavation	93,777	CY	14.40	1,350,389.00
Borrow	88,057	CY	6.00	528,342.00
NFS Subbase Material	238,666	CY	8.40	2,004,794.00
Grade "A" Base Material	130,225	CY	16.80	2,187,780.00
D-1 Base Material	54,342	CY	21.60	1,173,787.00
Guardrail	6,050	LF	43.20	261,360.00
18" Culverts	23,040	LF	28.80	663,552.00
36" + Culverts		LS	294,000.00	294,000.00
Fabric	49,820	SY	3.00	149,460.00
Thaw Pipes	24,435	LF	43.20	1,055,592.00
Topsoil & Seed	286	AC	3,600.00	1,029,600.00
Traffic Control Devices	36	MI	18,000.00	648,000.00
Bridges		LS	2,000,000.00	2,000,000.00
			Total	$24,191,405.00
Permanent Railroad (Including Railhead)				
Gold Creek to Devil Canyon				
Clearing	162	AC	$5,760.00	$933,120.00
Waste Excavation	407,420	CY	4.80	1,955,616.00
Common Excavation	798,405	CY	4.20	3,353,301.00
Rock Excavation	2,200	CY	14.40	31,680.00
Borrow	108,500	CY	6.00	651,000.00
Subballast	171,634	CY	8.60	1,476,052.00
Grade "A" Base Material	4,900	CY	16.80	82,320.00
D-1 Base Material	2,400	TON	21.60	51,840.00
AC Surfacing	2,200	TON	79.20	174,240.00
Dock Lumber	16	MBF	580.00	9,280.00
18" Culverts	4,850	LF	28.80	139,680.00
36" + Culverts	--	LS	46,080.00	46,080.00
Fabric	3,121	SY	3.00	9,363.00
Thaw Pipes	10,100	LF	43.20	436,320.00
Topsoil & Seed	104	AC	3,600.00	374,400.00
Rail Yard Control Devices	--	LS	720.00	720.00
Bridges	0	SF	360.00	0.00
Trackage	73,920	LF	140.00	10,348,000.00
		TOTAL		$20,073,012.00
		TOTAL DEVIL CANYON		$44,214,448.00

TABLE 4-10

ESTIMATED NORTH ACCESS (PLAN 13) CAPITAL COSTS[1/]

WATANA CONSTRUCTION

Description	Quantity	Units	Price/Unit	Amount
Permanent Road				
Hurricane to Indian River (11 Mi)				
Clearing	184	AC	$5,760.00	$1,059,840.00
Waste Excavation	506,450	CY	4.80	2,430,960.00
Common Excavation	462,500	CY	4.20	1,942,500.00
Rock Excavation	0	CY	14.40	0.00
Borrow	258,600	CY	6.00	1,551,600.00
NFS Subbase Material	113,256	CY	8.40	951,350.00
Grade "A" Base Material	61,797	CY	16.80	1,038,190.00
D-1 Base Material	12,894	TON	21.60	278,510.00
Guardrail	10,800	LF	43.20	466,560.00
18" Culverts	6,375	LF	28.80	183,600.00
36" + Culverts	—	LS	70,800.00	70,800.00
Fabric	26,890	SY	3.00	80,670.00
Thaw Pipes	7,175	LF	43.20	309,960.00
Topsoil & Seed	117	AC	3,600.00	421,200.00
Traffic Control Devices	11	MI	18,000.00	198,000.00
Bridges	6,120	SF	180.00	1,101,600.00
			Total	$12,085,340.00
Indian River to Watana Via Upper Portage (41 Mi)				
Clearing	680	AC	$5,760.00	$3,916,800.00
Waste Excavation	1,874,700	CY	4.80	8,998,560.00
Common Excavation	1,859,500	CY	4.20	7,809,900.00
Rock Excavation	82,500	CY	14.40	1,188,000.00
Borrow	482,400	CY	6.00	2,894,400.00
NFS Subbase Material	422,136	CY	8.40	3,545,942.00
Grade "A" Base Material	230,335	CY	16.80	3,869,628.00
D-1 Base Material	48,059	TON	21.60	1,038,074.00
Guardrail	25,700	LF	43.20	1,110,240.00
18" Culverts	24,395	LF	28.80	702,576.00
36" + Culverts	—	LS	448,560.00	448,560.00
Fabric	39,100	SY	3.00	117,300.00
Thaw Pipes	26,595	LF	43.20	1,148,904.00
Topsoil & Seed	432	AC	3,600.00	1,555,200.00
Traffic Control Devices	41	MI	18,000.00	738,000.00
Bridges	37,400	SF	180.00	6,732,000.00
			TOTAL	$45,814,084.00
			TOTAL WATANA[2/]	57,899,424.00

1/ All base price data from Acres American, Inc. Estimates changed as described in text.

2/ Excluding accelerated schedule costs estimated at $23,000,000.

TABLE 4-10 (continued)

ESTIMATED NORTH ACCESS (PLAN 13) CAPITAL COSTS[1/]

DEVIL CANYON CONSTRUCTION

Description	Quantity	Units	Price/Unit	Amount
Indian River to Devil Canyon-South (41 Mi)				
Clearing	100	AC	$5,760.00	$576,000.00
Waste Excavation	270,990	CY	4.80	1,300,752.00
Common Excavation	253,050	CY	4.20	1,062,810.00
Rock Excavation	52,500	CY	14.40	756,000.00
Borrow	156,600	CY	6.00	939,600.00
NFS Subbase Material	72,072	CY	8.40	605,404.00
Grade "A" Base Material	39,325	CY	16.80	660,660.00
D-1 Base Material	8,205	TON	21.60	177,228.00
Guardrail	3,600	LF	43.20	155,520.00
18" Culverts	5,015	LF	28.80	144,432.00
36" + Culverts	-	LS	6,600.00	6,600.00
Fabric	7,330	SY	3.00	21,990.00
Thaw Pipes	5,115	LF	43.20	220,968.00
Topsoil & Seed	59	AC	3,600.00	212,400.00
Traffic Control Devices	7	MI	18,000.00	126,000.00
Bridges	-	LS	2,000,000.00	$2,000,000.00
		Total		$8,966,364.00

North Plan (Plan 13)

Capital cost estimates for the North plan construction are presented on Table 4-10 for both Watana and Devil Canyon construction. Capital cost estimates on Table 4-10 were used along with maintenance and logistics costs developed as described in Section 2.0 to determine the present value (1983 dollars) of the cost stream for Watana Phase only and Watana plus Devil Canyon.

The capital cost in Table 4-10 was slightly modified to account for a transmission line construction cost savings that was treated as a cost credit to the North plan. The present plan with the Denali plan access road is to construct the Watana Project and its transmission line and then, if need be, build the operations road from Watana to Devil Canyon. Under the present plan, the transmission line would be built by helicopter and the operations road, when built, would help to reduce annual transmission line maintenance costs. The North plan road, however, would be built before the Watana transmission line because if the transmission line were then built along the North plan access road, less costly construction methods could be used for the transmission line. Using bid data for the Anchorage-Fairbanks Intertie and Harza-Ebasco experience, the total project savings, accounting for both unit cost savings for construction off a road and the slightly longer transmission line length parallel to the North plan road, would be about $1,000,000.

This overall project savings is made possible by the presence of the North plan road and the amount, therefore, was credited to the North plan capital cost. The savings in transmission line annual maintenance cost, because of the presence of the road, is small ($1500/yr) and was not considered.

Table 4-10, page 1 goes here

Table 4-10, page 2 goes here

Costs are briefly summarized below:

Capital Cost (Watana including accelerated schedule costs):	$ 80,896,000
Capital Cost (Devil Canyon):	$ 9,000,000
Watana Phase Present Value of Construction and Logistics Costs:	$126,600,000
Watana plus Devil Canyon Present Value of Construction and Logistics Costs:	$150,500,000

Note that the present value Devil Canyon plus Watana cost assumes that Devil Canyon construction would begin in 1993.

Comparison

A comparative cost table is presented in Table 4-11.

TABLE 4-11

COMPARATIVE ACCESS COSTS

	Watana		Watana Plus Devil Canyon	
	Total Capital	Present Value of Total Cost Stream	Capital Total	Present Value of Total Cost Stream
Denali (Plan 18)	$54,597,000	$111,157,000	$98,811,000	$150,751,000
North (Plan 13)	$80,896,000	$126,600,000	$88,861,000	$150,500,000

The following facts are evident from the preceding table:

- The North plan is about $15,450,000 more expensive to construct and operate for Watana Phase alone. Note that this figure could nearly double, however, if extensive airlifting is required in the spring of 1986 (second construction season) for the Schedule "B" North access scenario. The Denali plan is preferred, neglecting Devil Canyon.

- The extra $14,400,000 construction cost for North plan Watana only as compared to Denali plan is not counterbalanced by the extra logistics costs for the Denali plan.

- The North plan is slightly less expensive when the combined Watana/Devil Canyon projects are considered together. There is a savings of a few hundred thousand dollars for the North plan over the Denali plan. This is a small sum in view of the accuracy of the estimating data used to develop costs. For the combined Watana plus Devil Canyon case, both plans are essentially identical. The Denali plan could be economically preferred if the concept of a single permanent operator's town for Watana and Devil Canyon were abandoned and the Denali plan operator road could be eliminated.

The conclusions that can be drawn from the above can be slightly altered by considering the effect of a deferred construction of Devil Canyon. If Devil Canyon is deferred to a later date, the present value of the Devil Canyon expenditures decreases. If the start of Devil Canyon construction is delayed by 10 years to 2003, the present values of the two access plan cost streams for Watana plus Devil Canyon are:

North (Plan 13):	$145,500,000
Denali (Plan 18):	$139,206,000

Therefore, if Devil Canyon is deferred by 10 years (±), the Denali plan becomes the favored access plan for both Watana only and Watana plus Devil Canyon construction. Again, however, the cost difference between the two plans is a small percentage of the total cost estimate. The only way that the North plan would be preferred is if it is nearly certain that Devil Canyon will be constructed beginning in 1993.

Combining this with previous data:

- The Denali plan is preferred over the North plan from an economic perspective if only Watana is built.
- If construction of Devil Canyon beginning in 1993 is reasonably certain, the North plan is preferred.
- If delays in Devil Canyon construction startup on the order of 10 years are likely, the Denali plan is preferred.

These conclusions are unlikely to change as a result of reasonable variations in the construction cost estimates, unit logistics costs per ton-mile, fuel escalation or project size for a potentially smaller Watana phase. If adjustments are to be made to the capital cost estimates, the North plan would probably increase more than the Denali plan because the generally poorer soil conditions and lack of well distributed borrow along the North plan route have not been included in the cost estimating base. There are also more bridges and culvert stream crossings which are more difficult to estimate with the data available. This would make the Denali plan more attractive.

Sensitivity analyses of unit logistics costs for the Watana-only scenario indicate that the product of unit cost and tonnage shipped would have to more than triple for the North plan to be equivalent to the Denali plan. The insensitivity of the results to logistics costs is primarily the result of the low cost of rail shipment beyond Hurricane to Carnwell and the small difference in road trucking miles (61 for the Denali plan, 53 for the North plan) from the railheads for the two routes. Most of the cost of road transportation is for loading and unloading time, which is the same for either alternative. There is not much difference in the travel times, and hence only a small difference in the logistics cost.

CHAPTER 5

CONCLUSIONS AND RECOMMENDATIONS

5.0 CONCLUSIONS AND RECOMMENDATIONS

5.1 SELECTION PROCESS

Previous investigators (Gill 1983 and Grestinger 1983) described the access route selection process as long, complicated, and controversial. Further, they acknowledge that there are a number of factors which affected the route selection process and made it difficult to identify a preferred route.

Difficulties in identifying a preferred access alternative in previous studies suggested that a more formal decision analysis approach be employed in the access evaluation process. As a result, Harza-Ebasco investigators considered several approaches for re-evaluating access studies prior to adopting the approach described below. Approaches considered ranged from holding workshops involving engineers and scientists, to completion of a highly quantified analysis where the various objectives and constraints affecting the decision would be quantified and mathematically analyzed. The decision analysis approach selected by the Harza-Ebasco team draws on underlying principals used in multi-objective and goal programming as described by Cohen (1978), Moskowitz and Wright (1979), and other authors. As reported by Moskowitz and Wright (1979), goal programming, a type of multi-objective programming, is best suited for decisions where:

> "Goals, in addition to being conflicting and incommensurable are 'fuzzy'- biological impact, for example"

Further, Moskowitz and Wright state that goal programming:

> "Provides the decision maker with the opportunity to include in problem formulation objectives or goals that are not reducible to a single dimension."

Thus, it is possible to consider goals with disparate units (e.g., dollars and environmental impacts) simultaneously. The manner in which incommensurable goals and objectives can be considered is provided below.

In a fully and formal multi-objective programming application, objectives and constraints are quantified and the objectives are compared and evaluated by formal weighting or ranking approaches. Description of investigations involving more rigorous mathematical analysis are presented by Bruie (1974) and Houck and Cohon (1978). In the present analysis, formal mathematical techniques were not employed because of the complexities and non-quantifiable characteristics of the objectives under consideration. Nevertheless, principals of multi-objective programming were followed in evaluating alternatives.

The central premise of multiple objective decision analysis is that a set of separate and distinct objectives be defined to facilitate analysis of project alternative development schemes. Each separate objective provides the yardstick by which alternatives are measured. For example, one project objective is to minimize costs; this objective is met to varying degrees by alternatives under study depending on the relative cost of each alternative. The extent to which the objective is achieved by one of the alternatives becomes the basis of comparison. Determining and quantifying the extent to which an alternative achieves a specified objective, however, is difficult. On this project, based on the analysis in Sections 3 and 4, nine major objectives were defined. They include:

Engineering

- o Minimize cost of access to Watana project;
- o Minimize cost of access to Watana and Devil Canyon project;
- o Minimize construction difficulties;
- o Minimize impacts on project schedule; and
- o Minimize maintenance to increase reliability

Environmental

- o Minimize wildlife impacts
- o Minimize negative socioeconomic impacts in regard to unwanted changes in lifestyle
- o Maximize healthy economic growth
- o Minimize fisheries impacts

Evaluation of project alternatives will be undertaken examining the extent to which each of these objectives are met.

In order to address the relative achievement of project objectives, a scaling process was established. The process was largely qualitative, although quantification was used to define the extent to which individual goals were achieved whenever possible. The scaling process devised for this analysis was designed to provide the decision maker with greater insight than would have occurred if an ordinal ranking system were employed. For example, under an ordinal ranking approach, no attempt is made to compare the relative degree to which an objective is achieved. Thus, it would be impossible to determine relatively how much better one alternative is than another. Under an ordinal approach, one alternative is either better or worse than another; no attempt is made to indicate how much better or worse one alternative is than the other. To remedy that deficiency a scaling process was employed whereby the alternative which best satisfied the stated objective, defined the scaling benchmark. This benchmark was also assigned to a score of 10 on a scale of 0 to 10. Based on this benchmark, the extent to which an alternative meets a particular objective can be evaluated. For example, if an alternative is far inferior to the benchmark, it would likely be assigned a score of anywhere from 0 to 4 and would be obviously inferior to the benchmark. This can be shown graphically using a bar chart as illustrated in Figure 5-1.

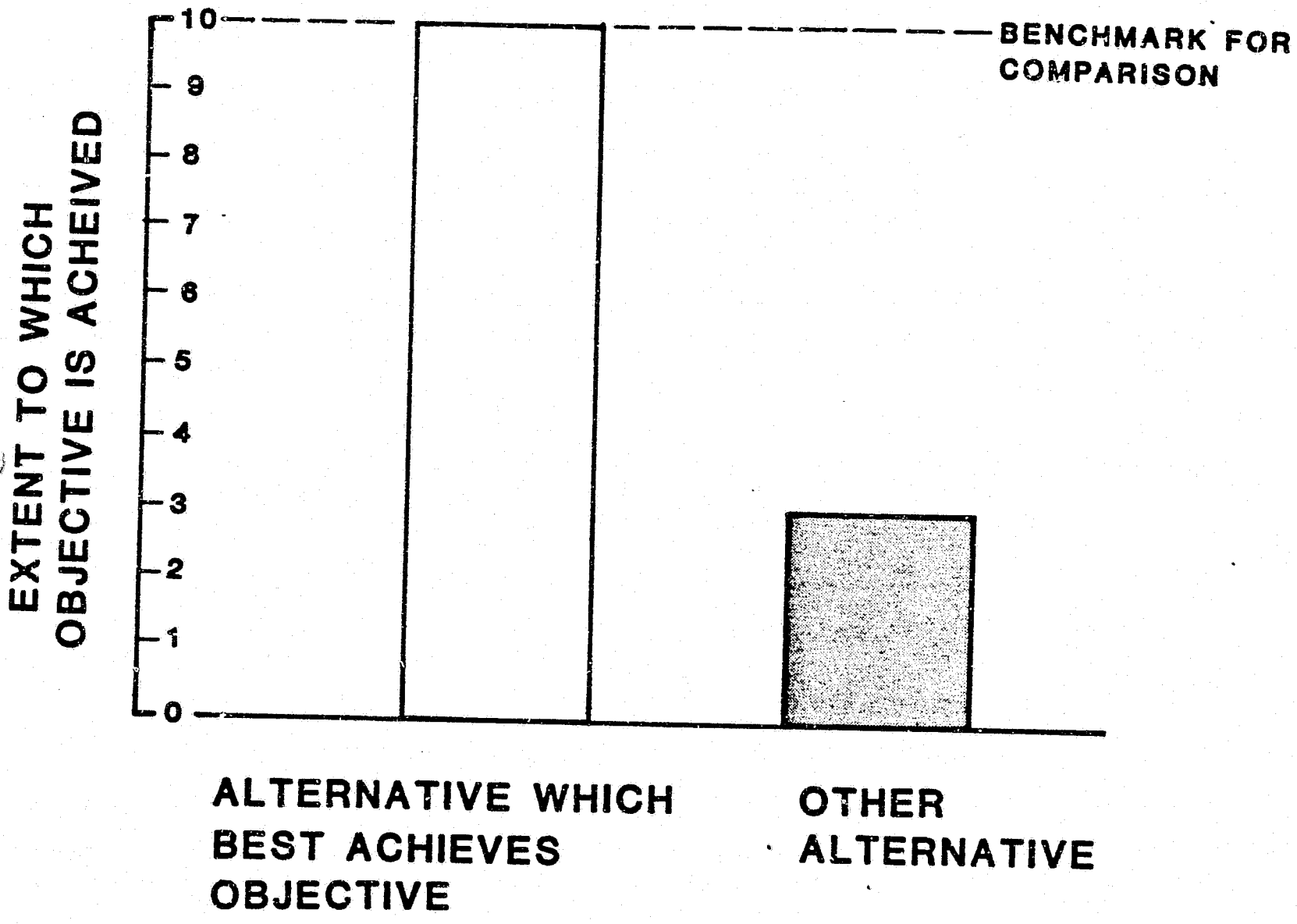


FIGURE 5-1 HYPOTHETICAL EXAMPLE ILLUSTRATING SCALING APPROACH EMPLOYED FOR EVALATION OF ACCESS ALTERNATIVES

Problems with this scaling system arise because it is difficult to quantify the thresholds which distinguish the different values on the scale. Consequently, it is recognized that qualitative criteria are used to define thresholds on the comparative scale when quantitative critiera are not applicable. Comparative criteria were established by the scientist/engineer with expertise in each resource category within an established scale of zero to ten. As described above, ten is assigned to the best alternative while zero is defined as the worst of the set of reasonable alternatives. In this case reasonable alternatives include all access alternatives studied earlier as reported in Acres (1981) and identified by Gill (1983) and Gretzinger (1983).

5.2 ENGINEERING EVALUATION

The relative achievement of the engineering objectives listed in Section 5.1 is presented in Figure 5-2. The scaling process employed in analyzing the level to which objectives were achieved is based on quantative measures for cost (dollars) and schedule (months) objectives. The scaling used for the schedule and maintenance objective functions was based on engineering judgement, considering the factors discussed in Sections 2 and 4.

Information in Figure 5-2 supports the finding that unless it is nearly certain that Devil Canyon will be constructed immediately following completion of Watana, the Denali plan is the preferred access route from an engineering perspective. Project construction could be satisfactorily supported by either route. Plan 18-Denali should be less costly to build, less costly to maintain, and result in the lowest net cost of construction and operation combined. Additional scheduling flexibility with regard to general Watana Project construction start-up is provided by Plan 18 due to its shorter construction period.

TABLE 5-1

ACCESS PLAN COST COMPARISONS

Phase	Plan 18 - Denali		Plan 13 - North	
	1983 Dollars	Present Value[1]	1983 Dollars	Present Value[1]
Watana Phase (1985-1993)				
Total Capital	54,597,000	50,680,000	80,896,000	73,863,000
Construction - Normal Schedule	43,597,000		57,896,000	
Construction - Compression Schedule, Extra Cost	11,000,000		23,000,000	
Total Logistics and Maintenance	73,121,000	60,477,000	63,452,000	52,718,000
Logistics	44,871,000		37,641,000	
Maintenance	26,150,000		21,330,000	
Fuel [2]	5,100,000		4,481,000	
Total Cost	130,718,000	111,157,000	144,348,000	126,581,000
Devil Canyon Phase (1985-1993)				
Total Capital (Construction)	44,214,000	31,891,000	8,965,000	6,515,000
Total Logistics and Maintenance	12,105,000	7,703,000	27,530,000	17,408,000
Logistics	7,445,000		15,838,000	
Maintenance	3,960,000		10,200,000	
Fuel [2]	700,000		1,492,000	
Total Cost	56,319,000	39,594,000	36,495,000	23,923,000
Watana Plus Devil Canyon Total	187,037,000	150,751,000	180,843,000	150,504,000

[1] 3.5% Discount Rate

[2] Fuel costs escalated at 2.5% per year for construction period

3078B

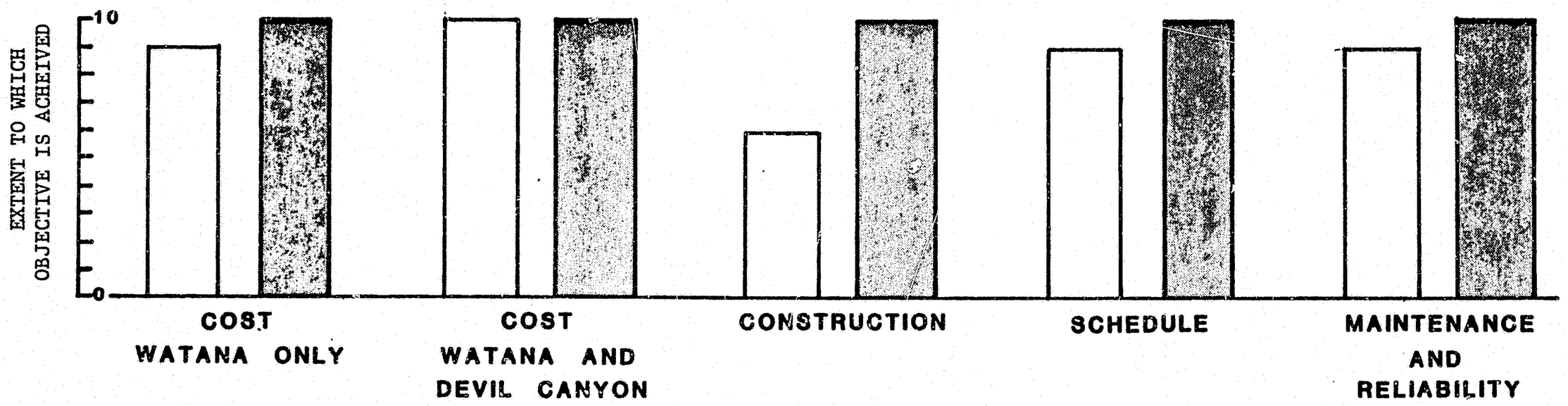


FIGURE 5-2 COMPARISON OF ENGINEERING DECISION FACTORS

It is recognized, however, that other considerations may out-weigh engineering as the prime access route selection factor. If other factors are found to be more important, access via Plan 13-North would be acceptable. Depending on the economic scenario considered, the decision to adopt Plan 13 in favor of Plan 18-Denali would result in increased project expenditures of from 0 to about $15,000,000. If Plan 13-North is adopted, the construction schedule could be eased if some preliminary bridge piling work could be permitted before receipt of the FERC License. Whichever route is selected, permission to construct a pre-license snow road along Plan 18-Denali corridor would be desirable.

5.3 ENVIRONMENTAL/SOCIOECONOMIC EVALUATION

The review of environmental considerations in Section 3 identified wildlife and botanical resources, socioeconomics, fisheries, land use, recreation, and aesthetics as the most important factors potentially affecting the access decision. The discussion in Section 4 compared the access alternatives on the basis of considerations related to these resource categories. An analysis of the Section 4 discussions indicates that there is little in the categories of land use, recreation, and aesthetics to distinguish a preferred access alternative from other alternatives . Rather, the analysis of those considerations reveals the importance of wildlife and botanical, socioeconomics, and fisheries in the decision-making as the former set of categories is strongly affected by the wildlife and botanical resources, socioeconomics, and fisheries concerns. Environmental analysis also revealed the importance of controlling or limiting access during construction and operations. For this reason, the following is an analysis of wildlife and botanical resources, socioeconomics, and fisheries considerations and the changes in impacts resulting from adoption of measures to control or limit access. Environmental impacts would be less if policies are adopted which limit access to the project area during and after construction. Current plans call for no public

access to the site during construction and unrestricted access thereafter. During construction, workers will drive to and from the site in personal vehicles.

An alternative to the access policy described above would be for use of the access road to be limited during and after construction. During construction, workers would be transported to the site in buses and use of environmentally sensitive areas along the route would be restricted. Further, construction vehicle travel could be scheduled to minimize wildlife impacts. Once construction is complete, public use would still occur, but careful steps would be taken to make certain that it occurs in designated areas and at acceptable levels. Alternatives for controlling human access might involve the establishment of a permit system for use of the area and the development of regulations and enforcement procedures to control environmentally degrading activities. The effect that the adoption of these measures would have on environmental considerations related to the access road selection process is included in the following discussion and influenced determination of the alternative which was assigned a score of 10 and best achieved the stated objective. The level to which objectives in the categories of wildlife, socioeconomics, and fisheries are achieved is presented in Figure 5-3 while supporting text for these findings is provided below.

Wildlife and Botanical Resources

Development of Plan 13-North including incorporation of access control mitigation measures (discussed above) during construction and operation would result in the least overall impacts to wildlife and botanical resources both in terms of habitat loss and access-related impacts. This option is therefore rated a 10. Plan 13-North without access control mitigation measures is the second best option, of the four considered (Plan 13 and 18 both with and without mitigation) in terms of minimizing habitat loss and access-related wildlife and botanical resource impacts. Because of the existing level of accessibility

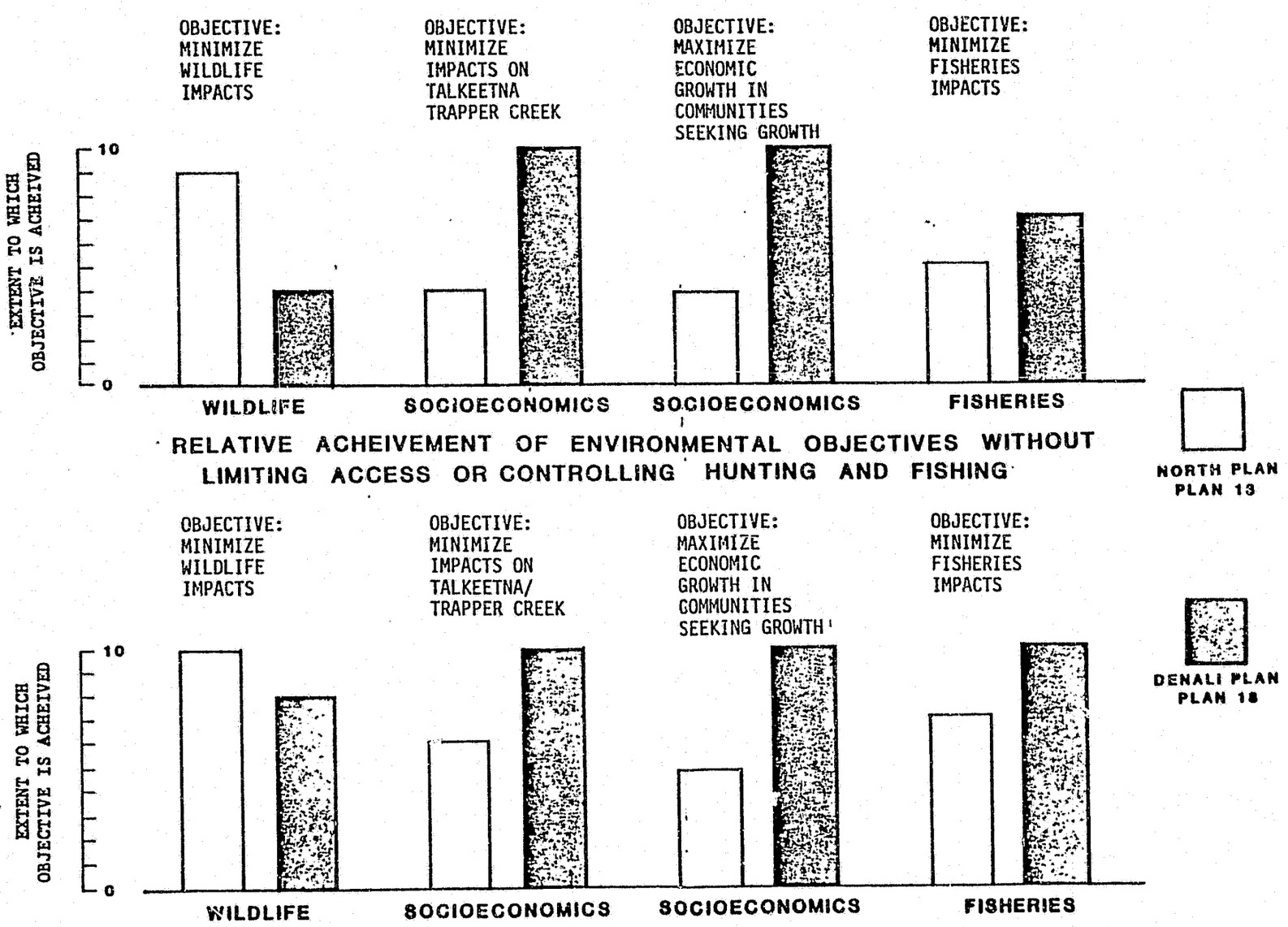


FIGURE 5-3 RELATIVE ACHIEVEMENT OF ENVIRONMENTAL OBJECTIVES

along much of the Plan 13 route, access control mitigation measures would not reduce access-related impacts as much as access control along other feasible access routes. Plan 18-Denali without access mitigation measures would maximize both habitat loss and access-related impacts among the four options considered. The significant differences in existing levels of accessibility and the amounts of inaccessible areas subject to increased access between the two routes, suggests that this option should be rated low relative to both Plan 13-North options. However, this option is considered significantly better from a wildlife and botanical resource standpoint than the access alternative that includes access roads between the Denali Highway and Watana and along the South side of the Susitna River between Watana and Devil Canyon without access mitigation measures. Therefore, this opotion was given the rating of 4. Finally, Plan 18-Denali with access mitigation measures was rated a 7 because the mitigation measures would substantially reduce access-related impacts, although these impacts could still be high relative to Plan 13-North and habitat loss impacts would still be significantly higher than for Plan 13-North.

Socioeconomics (Negative Impacts) - to be completed by W. Hutchinson

Socioeconomics (Healthy Economic Impacts) - to be completed by W. Hutchinson

Fisheries

If no access control mitigation was incorporated, the North plan was assigned a relative value of 5. The rationale for this relatively low number is that the route will require a large amount of excavation per mile, has steep slopes paralleling Portage Creek, and crosses important anadromous fish streams which would be subject to erosion impacts and increased access. This could result in significant impacts to the resources through erosion run-off, sedimentation, and fishing pressure (both legal and illegal). The Denali plan is assigned a value of 8

without mitigation. This route may require significant amounts of excavation in some sections, but the slopes are generally much less steep, implying a lower potential for run-off both during construction and use. Similarly, spills would be easier to contain. Public access would create indirect impacts by causing additional fishing pressure on resident fishes (particularly grayling in Deadman Creek).

With mitigation, a relative value of 7 was assigned to the North route. Even though mitigation measures such as controlled access to relieve fishing pressure, stricter fishing regulations, and increased enforcement can be incorporated, the risk of erosion impacts and the potential severity of these impacts is higher for the North route as compared to the Denali route. Also, soil types along the North route do not appear to be entirely stable, thus potentially enhancing such risks.

The Denali plan was assigned a relative value of 10 with mitigation measures because such measures should be able to minimize access-related impacts along this route and erosion impact potential is low relative to the North route.

5.4 RECOMMENDATION

Based on the information presented above Plan 18-Denali is preferred and is recommended. The two plans are both about equally acceptable when considering all factors. There is no compelling reason to change access plans at this time.

REFERENCES

Acres American, Inc. 1983a. Susitan hydroelectric project draft supplement to the feasibility report. Prepared for Alaska Power Authority. February 1983.

Acres American, Inc. 1983b. Susitna hydroelectric project application for license for major project, Appendix 5.0. Traffic volume assumptions. Prepared for Alaska Power Authority.

Acres American, Inc. 1983c. Susitna hydroelectric project - Federal Energy Regulatory Commission - application for license. Volume 6A (Exhibit E, Chapter 3). Prepared for Alaska Power Authority. Anchorage, Alaska.

Acres American, Inc. 1982a. Susitna hydroelectric project feasibility report. Prepared for Alaska Power Authority. Final draft.

Acres American, Inc. 1982b. Susitna hydroelectric project, task 2, surveys and site facilities. Prepared for Alaska Power Authority. Final draft. March 1982.

Acres American, Inc. 1982c. Susitna hydroelectric project, access plan recommendation report.

Alaska Power Authority. 1983. Susitna hydroelectric project application for license for major project, Vol. 8, Exhibit E. Chapter 8. Aesthetic Resources.

Ballard, W.B., et. al. 1982. Susitna hydroelectric project - Phase I final report - big game studies: moose - upstream. Vol. III. Alaska Department of Fish and Game. Prepared for Alaska Power Authority. Anchorage, Alaska.

Buie, E. 1974. Implementation of multiple objective planning by the soil conservation service. In: E. Michalson, E. Englebert, and W. Andrews (eds). Multiple objectives planning water resources. Vol. 1, pp. 20-23. Idaho Research Foundation, Moscow, Idaho.

Bureau of Land Management. 1982. An amendment to the southcentral Alaska land-use plan for the Denali-Tiekel planning blocks. Draft.

Calef, C.W., E. DeBock, and G. Lortie. 1976. The reaction of barren-ground caribou to aircraft. Arctic 29:201-212.

Cohon, J.L. 1978. Multiobjective programming and planning. Academic Press, New York. 333 pp.

Cowardin, L.M., V. Carter, F.C. Golet, and E.T. LaRoe. 1979. Classification of wetlands and deepwater habitats of the United States. USDI Fish and Wildlife Service FWS/OBS-79-31. Washington, D.C.

Curatolo, J.A. S.M. Murphy, and M.A. Robus. 1982. Caribou responses to the pipeline/road complex in the Kuparuk oil fields, Alaska, 1981. Unpublished report. Alaska Biological Research. Prepared for ARCO Alaska, Inc.

Dortch, B. A. 1983. Vice President, R&M Consultants, Inc. Personal Communication, March.

Fancy, S.G. Movements and activities of caribou near oil drilling sites in the Sagavanirktok River floodplain, Alaska. Accepted by Arctic. (In press).

Frank Moolin and Associates. 1983. Personal Communication with several members of Frank Moolin's Anchorage Office, February and March 1983.

Gill, J. 1983. Resident Manager, Acres American, Inc. Personal Communication, February 28, 1983.

Gretzinger, V. 1983. R&M Consultants Inc., Senior Engineer. Personal Communication, March 3, 1983.

Harza-Ebasco JV. 1983a. General investigation memorandum, Susitna project investigations by the access, transportation, construction camp, and employment training task force. February, 1983.

Houck, M.H., and J.L. Cohon. 1978. Sequential explicitly stochastic linear programming models: a proposed method for design and management of multipurpose reservoir systems. Water Resources Research 14(2):161-169.

Jame, G. 1983. Acres American. Personal Communication, February 28, 1983.

Linstone, H.A., and M. Turoff (eds). 1975. The delphi method techniques and applications. Addison-Wesley Publishing Company, Massachusetts. 620 pp.

Miller, S.D., and D. McAllister. 1982. Susitna hydroelectric project Phase I final report - big game studies: black bear and brown bear. Vol. VI. Alaska Department of Fish and Game. Prepared for Alaska Power Authority. Anchorage, Alaska.

Moskowitz, H., and G.P. Wright. 1979. Operations research techniques for management. Prentice-Hall, Inc.. Englewood Cliffs, New Jersey. 793 pp.

Pitcher, K.W. 1982. Susitna hydroelectric project - Phase I final report - big game studies: caribou. Vol. IV. Alaska Department of Fish and Game. Prepared for Alaska Power Authority. Anchorage, Alaska.

Plummer, J. 1983. Acres American, Inc. Personal Communication, March.

R&M Consultants, Inc. 1982a. Susitna hydroelectric project access planning study. Prepared for Acres American, Inc. January, 1982.

R&M Consultants, Inc. 1982b. Susitna hydroelectric project, task 2 - surveys and site facilities. Prepared for Acres American, Inc. September, 1982.

R&M Consultants, Inc. 1981. Susitna hydroelectric project plan of study, task 2 project access. Prepared for Alaska Power Authority and Acres American, Incorporated. February, 1981.

Stephen R. Braund and Associates. 1982. Susitna hydroelectric project, task 7 - environmental. Prepared for Acres American Incorporated. Final draft March 1982.

U.S. Department of Agriculture, Forest Service. 1979. National forest landscape management, Vol. 2, Chapter 4. Roads Agriculture Handbook No. 483.

Terrestrial Environmental Specialists, Inc. 1981. Subtask 7.14: Environmental analysis of alternative access plans. Susitna Hydroelectric Project Environmental Studies. Prepared for Acres American, Inc. for Alaska Power Authority. Anchorage, Alaska.

Viereck, L.A., and C.T. Dyrness. 1980. A preliminary classification system for vegetation of Alaska. USDA Forest Service General Technical Report PNW-106. Portland, Oregon. 38 p.

Wrabetz, Mike, 1983 Bureau of Land Management Personal Communication, March

APPENDIX A - ACCESSIBILITY INDICIES

The accessibility of areas was mapped and acreages calcultated according to the criteria described below.

Highly Accessibe: Includes contiguous flat land (less than 15 percent slope) within one mile of roads, sled roads, 4-wheel drive roads, cabins or lodges.

MODERATELY Accessible: Includes - 1) Contiguous flat land, (less than 15 percent slope) between one and five miles from roads, 4-wheel drive roads, sled roads, cabins or lodges; 2) contiguous flatland (less than 15 percent slope) within 1 mile of railroads; and 3) rolling and mountainous land (greater than 15 percent slope) within one mile of roads, 4-wheel drive roads, sled roads, cabins, or lodges.

INACCESIBLE: Includes all lands not defined as highly or moderately accessible.