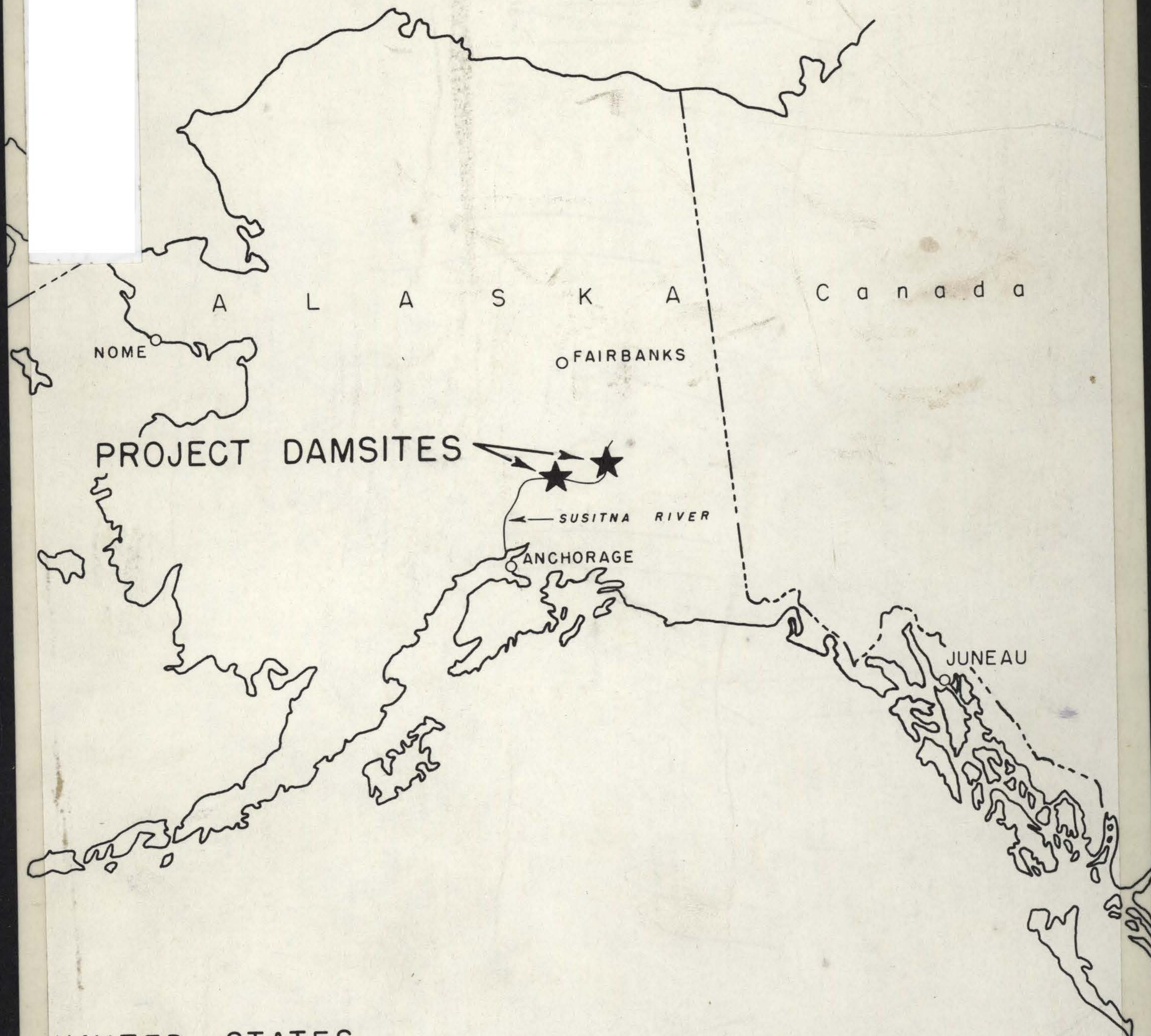
DEVIL CANYON PROJECT Alaska



UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION

REPORT OF THE COMMISSIONER OF RECLAMATION

U. S. Department of the Interior,
Bureau of Reclamation,
Washington, D.C., March 6, 1961.

THE SECRETARY OF THE INTERIOR.

SIR: This is my proposed report on a plan of development for the Devil Canyon Project, Alaska. It is based upon and includes the attached report of the District Manager, Juneau, Alaska, dated May 1960, and reports of the Fish and Wildlife Service, Bureau of Mines, Bureau of Land Management, National Park Service, Corps of Engineers of the Department of the Army, and Forest Service of the Department of Agriculture, as well as letters from various agencies of the State of Alaska, all of which are appended to the District Manager's report. The investigation and the report on this potential project were made in accordance with the provisions of the Act of August 9, 1955 (69 Stat. 618).

The proposed Devil Canyon Project is essentially a single-purpose hydroelectric power development, designed to meet present and anticipated future power and energy requirements for domestic, municipal, and industrial purposes in south-central Alaska. There is no opportunity for realizing substantial multiple-purpose benefits through water resource developments for agriculture, municipal, or industrial water supply, flood control, navigation, recreation, or fish and wildlife. However, detailed studies of the fish and wildlife resources affected by the project would be conducted, as necessary, after project authorization, in accordance with the Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 U.S.C. 661, et seq.). Such reasonable modification in the authorized project facilities would be made by the Secretary as he may find appropriate to conserve and develop these resources. The preservation and propagation of fish and wildlife would be a purpose of the project.

The project will consist of two major dams and reservoirs on Susitna River, a powerplant, and transmission lines and appurtenant facilities to deliver power and energy to Fairbanks, Anchorage, and other load centers. The largest structure will be Devil Canyon Dam, a high concrete arch dam, rising 635 feet above its foundation and forming a reservoir with a total storage capacity of 1,100,000 acre-feet. This site, about 14.5 miles upstream from Gold Creek station on the Alaska Railroad, possesses many advantages for development of hydroelectric power, but the storage capacity is not adequate to control the runoff of Susitna River. Therefore, a second dam is proposed for construction about 115 miles upstream near Denali, where a much larger reservoir (5,400,000 acre-feet total capacity) can be created with a comparatively low (219 feet) earthfill dam.

A powerplant is proposed at the toe of Devil Canyon Dam to utilize the average head of 538 feet to generate hydroelectric power. The ultimate installed capacity of that plant would be 580,000 kilowatts, in eight units of 72,500 kilowatts each. From the powerplant two 230-kilovolt transmission lines would be built, extending about 160 miles southward to Anchorage and about 190 miles northward to Fairbanks. Through this system about 2,755,000,000 kilowatt-hours of salable firm energy would be made available annually.

The cost of constructing these works, under prices as of April 1960, is estimated at $498,874,000, all of which would be allocated to power.

The Devil Canyon Project is economically justified. Direct benefits would exceed the costs in the ratio of 1.32 to 1 over a 50-year period of analysis and in the ratio of 1.72 to 1 over a 100-year period of analysis. The local, State, and nationwide indirect or secondary benefits attributable to bringing a large block of power and energy at comparatively low cost into this potentially rich but undeveloped region have not been evaluated in monetary terms and therefore are not reflected in the above ratios.

Should this project be authorized for construction, an adequate survey would be conducted to determine if deposits of valuable minerals of possible commercial or strategic significance exist within the reservoir sites. Should any be found, methods will be devised to protect or salvage such deposits.

The District Manager's report anticipated that the facilities of the Devil Canyon Project would be installed by stages as the power market develops. The analysis assumes that the fifth or last stage of construction would be completed by the end of the 12th year of project operation. Sale of the firm power output of the project at an average rate of 7.89 mills per kilowatt-hour at the load centers would permit the amortization of the entire Federal investment of $564,675,000, including interest during construction, within 50 years of the date the last stage of construction is completed.

The projection of total energy load for the Devil Canyon Project power market area presented in the District Manager's report shows the entire firm energy output of the project would be absorbed by 1982. This projection, which we believe to be reasonable, has been used as the basis for selection of the sizes and timing of the construction of the five proposed stages of development, which in turn establishes the basis for the repayment analysis above discussed.

Power and energy generated at the Devil Canyon Powerplant would be delivered through a transmission system, which is part of the project plan, to all load centers in the Railbelt area and interconnected centers.

This area includes the two largest cities in the State, Anchorage and Fairbanks, and many smaller communities, military installations, and commercial and industrial enterprises. By virtue of its relatively well developed transportation facilities, the vast area which it serves as a market center, and the rich natural resources with which it is endowed, the Railbelt area is the center of population expansion in the State. The great preponderance of presently farmed land and of potential agricultural lands in the State are within the power market area. This area, therefore, has natural assets of national importance which can be expected to support a large and varied industrial and agricultural economy and a population many times the existing one. One of the major factors now preventing realization of this potential is the present high cost of electrical energy.

Alaska, and the Railbelt area in particular, from a strategic or national defense standpoint, is of paramount importance to the Nation. The numerous military installations which now have their own sources of power may be expected to utilize Devil Canyon power for expanding requirements or for replacement of present facilities as they become obsolete, with consequent savings to the United States.

The Devil Canyon Project is the catalyst needed to spark the economic expansion of the Railbelt area. To assure its effectiveness in this role, the large block of power and energy which it can provide must be made available at the lowest possible rates. In order to encourage and promote progress in the development of Alaska's resources, which is extremely important to the Nation as well as to Alaska, we feel that certain departures from the Bureau's usual criteria for setting power rates are justified here.

Accordingly, an alternative analysis was prepared, assuming that (1) the fifth or last stage of construction would be completed in the 15th year of project operation, (2) payment of interest during construction would be waived, and (3) no interest payments would be required on the investment during the 15 years of the power market development period. This study reveals that the amortization with interest of the remaining unpaid investment can be achieved within 50 years after the 15-year development period utilizing a power rate of 6.0 mills per kilowatt-hour. This 6-mill power rate is substantially lower than any existing or immediately foreseeable alternative rates in the market area and should be low enough to promote greater use of electricity by present consumers and to encourage the establishment of industrial enterprises to develop the rich natural resources of the area.

Pertinent to the above analysis is the conservative approach exercised in estimating the cost of constructing the $134,000,000 Denali Dam and Reservoir. Because of the perma-frost and other unusual conditions encountered at the site, exceptional allowances were made to assure that the cost estimate is adequate. There is reasonable expectancy, however, that more detailed studies will reveal that actual construction can be accomplished at a significantly lower cost. Should this occur, it would offset, in comparable measure, the waiving of the return of interest during construction and during the power market development period.

The Devil Canyon Project, if built in accordance with the plan proposed in this report, will be of great importance to the State of Alaska and to the Nation, and will be in harmony with the purposes declared by the Congress in passing the Act of August 9, 1955, "... for the purpose of encouraging and promoting the development of Alaska ..." This purpose can best be accomplished by making a plentiful supply of power available at rates which would encourage industrial and commercial enterprises.

Accordingly, I recommend that the alternative repayment plan discussed above be adopted, thereby providing for firm energy to be delivered anywhere in the Railbelt area at wholesale rates of about 6 mills per kilowatt-hour. With this exception, I concur in and adopt the recommendations of the District Manager as set forth on page 95 of his report for the development of this project.

I recommend you approve and adopt this as your proposed report on the Devil Canyon Project, Alaska, and authorize me to transmit copies of the report in your behalf to the Governor of Alaska and the heads of interested Federal departments and agencies for information and comment, as required by the Act of August 9, 1955 (69 Stat. 619), and to the Governor for the views and recommendations of the head of the agency exercising administration over the wildlife resources of the State, in accordance with the Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 U.S.C. 661 et seq.).

Respectfully,

/s/ Floyd E. Dominy

Commissioner

Enclosures

Approved and adopted: March 25, 1961

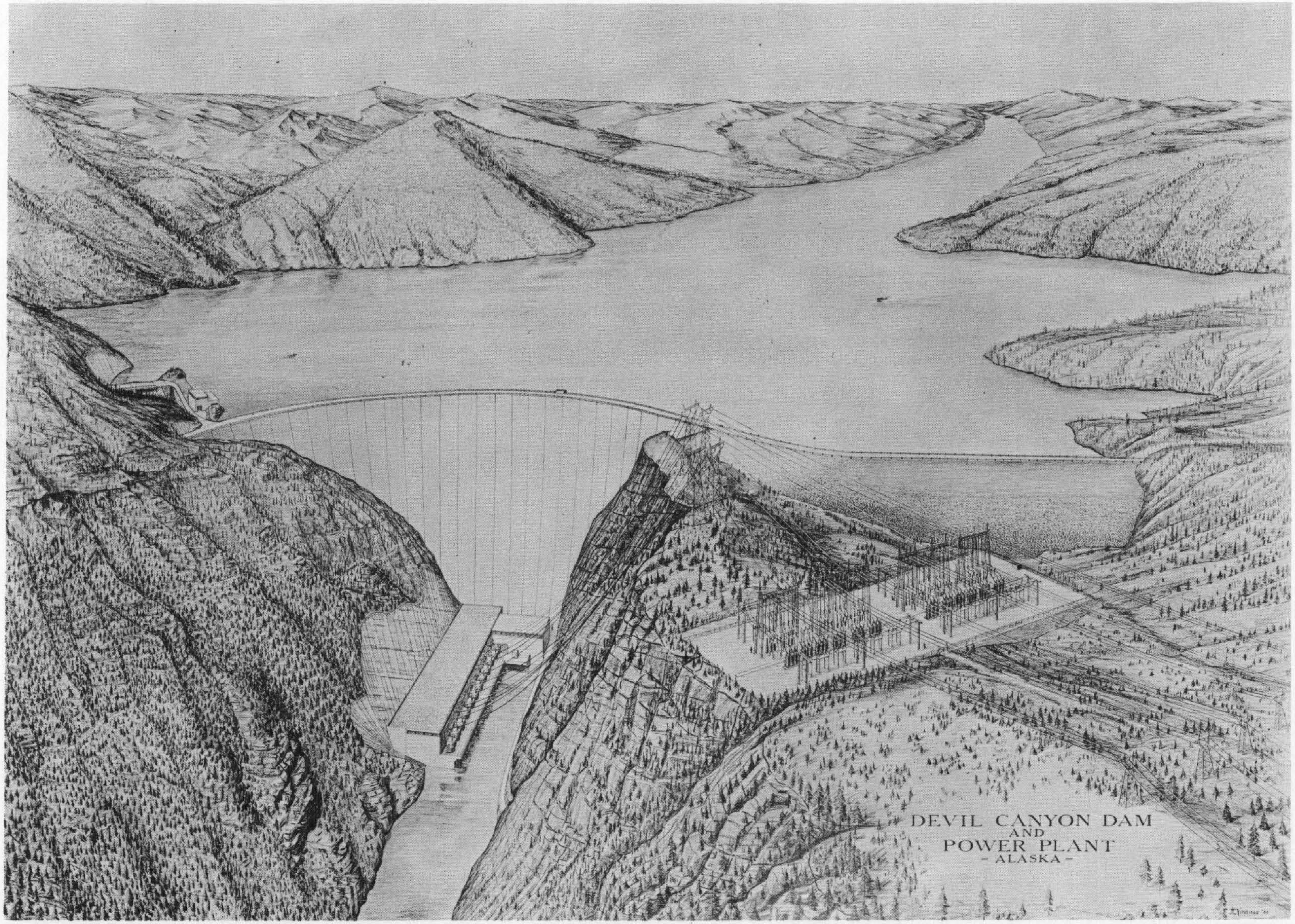
/s/ James K. Carr
Acting Secretary of the Interior

DEVIL CANYON PROJECT
ALASKA

FEASIBILITY REPORT

MAY 1960

BUREAU OF RECLAMATION
ALASKA DISTRICT
JUNEAU, ALASKA



DEVIL CANYON DAM WILL RISE 635 FEET ABOVE ITS FOUNDATION. ULTIMATE POWERPLANT CAPACITY - 580,000 KILOWATTS.

SUMMARY

Devil Canyon Project

<u>Location</u>: On the mainstem of the Susitna River in Southcentral Alaska, approximately midway between Anchorage and Fairbanks.

<u>Authorized</u>: Act of August 9, 1955 (69 Stat.618) and appropriation acts authorizing expenditures by the Bureau of Reclamation for engineering and economic investigations, and for related reports, for the development and utilization of the water resources of Alaska.

<u>Plan</u>: Construct a thin arch concrete dam 635 feet above foundation at Susitna River mile 134. Build a powerplant near the base of the dam along the right abutment. Install a total of 580,000 kilowatts of generating capacity in four stages. Construct an earth, sand and gravel-fill dam at river mile 248 to be 290 feet high above bottom of cutoff trench. Construct two 230,000-volt, single-circuit, wood pole transmission lines from the switchyard to a substation near Fairbanks and two 230,000-volt, double-circuit, steel tower lines to a substation near Anchorage.

<u>Project Features</u>:

<u>Dam - Devil Canyon - Concrete Arch</u>

Crest elevation, feet (msl)	1,455
Height above foundation, feet	635
Height above normal river water surface, feet	565
Crest length, feet	1,370
Base width of crown, feet	136.2
Crest width, feet	20
Radius of upstream face at crest, feet	700

<u>Dam - Devil Canyon - Concrete Thrust Block</u>

Height, feet	100
Crest length, feet	225

Dam - Devil Canyon - Earth Dike

Crest elevation, feet (msl)	1,461
Maximum height above original ground, feet	200
Crest Length, feet	775
Crest width, feet	30

Dam - Denali - Earth, Sand, and Gravel Fill

Crest elevation, feet (msl)	2,564
Height above bottom of cutoff trench, feet	290
Height above river-bed, feet	219
Crest length, feet	2,050
Maximum base width, feet	1,840
Crest width, feet	40

Spillway - Devil Canyon

Type	Gated
Crest elevation, feet (msl)	1,391
Number of radial gates	2
Gate height, feet	59
Gate length, feet	40
Spillway tunnel diameter (tapered), feet	48-41
Maximum discharge capacity, second-feet	142,000

Spillway - Denali

Type	Glory hole
Crest elevation, feet (msl)	2,552
Conduit diameter, feet	19
Maximum discharge capacity, second-feet	18,600

Reservoir - Devil Canyon

Normal full pool elevation, feet (msl)	1,450
Maximum water surface elevation, feet (msl)	1,455
Minimum water surface elevation, feet (msl)	1,275
Surface area at elevation 1,450 acres	7,550
Initial active storage capacity, acre-feet	807,000
Initial inactive storage capacity, acre-feet	293,000
Active capacity after 50-yr. sedimentation, acre-feet	765,000
Active capacity after 100-yr. sedimentation, acre-feet	725,400

Reservoir - Denali

Normal full pool elevation, feet (msl)	2,552
Maximum water surface elevation, feet (msl)	2,562
Minimum water surface elevation, feet (msl)	2,386
Surface area at elevation 2,552, acres	61,000
Initial active storage capacity, acre-feet	5,300,000
Initial inactive storage capacity, acre-feet	100,000
Active capacity after 50-yr. sedimentation, acre-feet	4,770,000
Active capacity after 100-yr. sedimentation, acre-feet	4,260,000

Hydrology

	Devil Canyon	Denali
Drainage area, square miles	5,810	1,260
Average annual runoff (1950-59), acre-feet	6,848,000	2,545,000
Maximum annual runoff (1956), acre-feet	7,954,550	3,354,890
Minimum annual runoff (1950), acre-feet	5,538,950	1,957,520

Powerplant

Capacity installed - initial stage (3 units), kilowatts	217,500
Capacity installed - third stage (2 units), kilowatts	145,000
Capacity installed - fourth stage (2 units), kilowatts	145,000
Capacity installed - fifth stage (1 unit), kilowatts	72,500
Capacity installed - total (8 units), kilowatts	580,000
Average head, feet	538
Design head, feet	530
Maximum operating head, feet	570
Minimum operating head, feet	395
Average head loss, feet	5
Average tailwater elevation, feet (msl)	875
Annual firm output (ultimate), kilowatthours	2,900,000,000

Switchyard

Transformer capacity installed - initial stage, kilovolt-amperes	380,000
Transformer capacity installed - third stage, kilovolt-amperes	180,000
Transformer capacity installed - fourth stage, kilovolt-amperes	180,000
Transformer capacity installed - total, kilovolt-amperes	740,000

Transmission Lines, Devil Canyon to Anchorage

Ultimate number of lines	2
Voltage, volts	230,000
Number circuits per line	2
Type construction	Steel tower
Conductor size, MCM -- ACSR	954
Length per line, miles	157.5

Transmission Lines, Devil Canyon to Fairbanks

Ultimate number of lines	2
Voltage, volts	230,000
Number circuits per line	1
Type construction	Wood pole
Conductor size, MCM -- ACSR	795
Length per line, miles	193

Anchorage Substation

Transformer capacity installed - initial stage, kilovolt-amperes	275,000
Transformer capacity installed - fourth stage, kilovolt-amperes	275,000
Transformer capacity installed - total, kilovolt-amperes	500,000

Fairbanks Substation

Transformer capacity installed - initial stage, kilovolt-amperes	75,000
Transformer capacity installed - fourth stage, kilovolt-amperes	75,000
Transformer capacity installed - total, kilovolt-amperes	150,000

Construction Costs: (April 1960) Total Plant Accounts

Devil Canyon Dam and Reservoir	$142,081,000
Denali Dam and Reservoir	133,917,000
Devil Canyon powerplant	115,096,000
Devil Canyon switchyard	9,464,000
Devil Canyon - Anchorage transmission lines	49,740,000
Devil Canyon - Fairbanks transmission lines	21,241,000
Anchorage substation	12,003,000
Fairbanks substation	6,749,000
Devil Canyon general property	7,753,000
Denali general property	830,000
Total Construction Cost	$498,874,000
Interest during construction	28,216,000
Total Federal Investment	$527,090,000

Construction Costs: Total investment by stage

Stage one	$308,480,000
Stage two	141,480,000
Stage three	12,590,000
Stage four	53,190,000
Stage five	11,350,000
Total	$527,090,000

Annual Revenue Deductions

Operation and maintenance (ultimate)	$ 1,910,000
Provisions for replacements (ultimate)	400,000
Total	$ 2,310,000

Power Rates:

Cost of generation, mills/kilowatthour	6.09
Cost of transmission, mills/kilowatthour	1.80
Total rate for firm energy, mills/kilowatthour	7.89

Repayment - 62-year totals:

Revenues	$1,214,073,750
Revenue deductions	133,850,000
Net Revenues	$1,080,223,750
Interest	515,061,572
Principal	564,675,000
Earned Surplus	$ 487,178

Benefits and Costs:

	50-yr. Life	100-yr. Life
Average annual benefits	$26,024,000	$27,847,000
Average annual costs	19,722,000	16,150,000
Benefit-cost ratio	1.32 to 1.00	1.72 to 1.00

C O N T E N T S

C O N T E N T S

CONTENTS

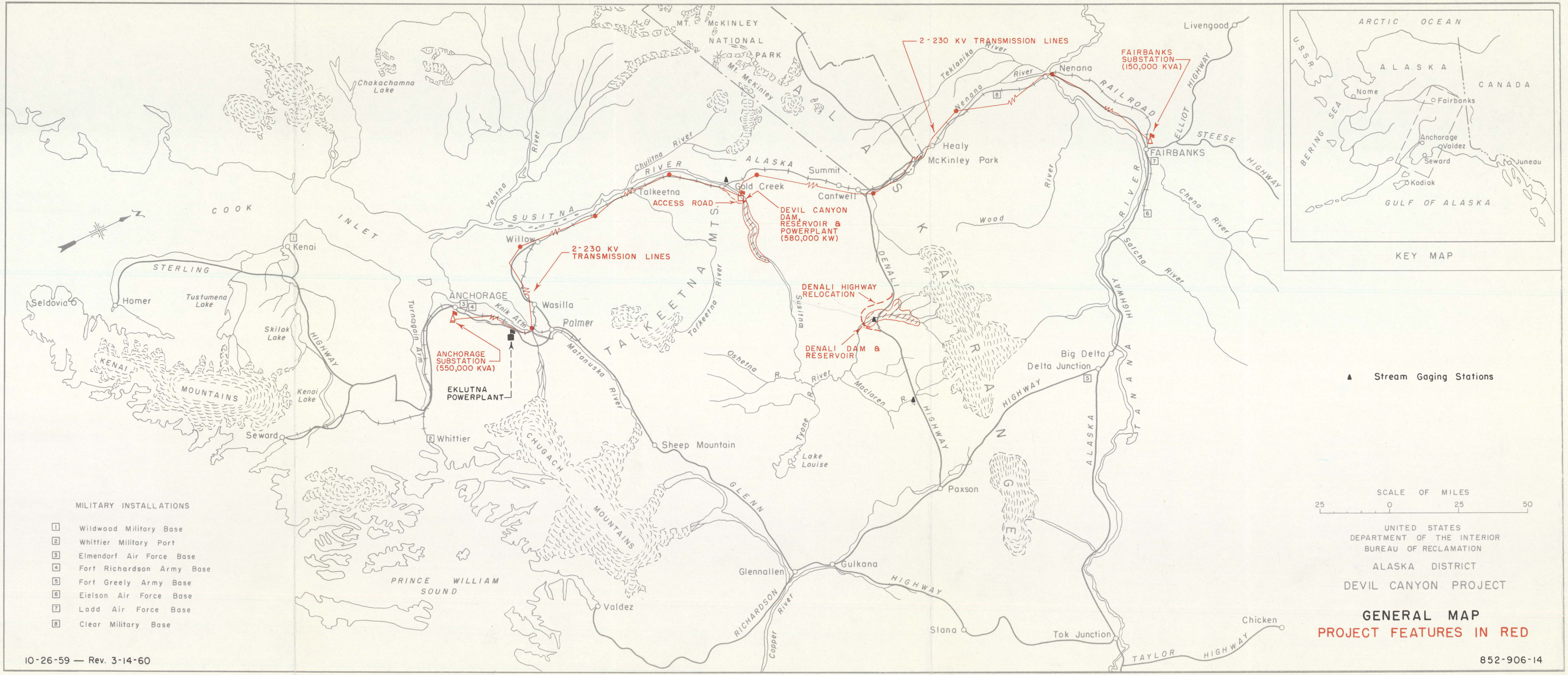
C O N T E N T S

LIST OF PHOTOGRAPHS

LIST OF CHARTS AND MAPS

L I S T O F P R I N C I P A L T A B L E S

A P E N D I X E S


UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
ALASKA DISTRICT
DEVIL CANYON PROJECT
GENERAL MAP
PROJECT FEATURES IN RED
852-906-14
10-26-59 — Rev. 3-14-60
MILITARY INSTALLATIONS
1 Wildwood Military Base
2 Whittier Military Port
3 Elmendorf Air Force Base
4 Fort Richardson Army Base
5 Fort Greely Army Base
6 Eielson Air Force Base
7 Ladd Air Force Base
8 Clear Military Base
Stream Gaging Stations
SCALE OF MILES
25 0 25 50
KEY MAP
ARCTIC OCEAN
U.S.S.R.
ALASKA
CANADA
Nome
Fairbanks
BERING SEA
Anchorage
Valdez
Seward
Juneau
Kodiak
GULF OF ALASKA
2-230 KV TRANSMISSION LINES
FAIRBANKS SUBSTATION (150,000 KVA)
DEVIL CANYON DAM, RESERVOIR & POWERPLANT (580,000 KW)
ACCESS ROAD
DENALI HIGHWAY RELOCATION
DENALI DAM & RESERVOIR
ANCHORAGE SUBSTATION (550,000 KVA)
EKLUTNA POWERPLANT
MT. McKINLEY NATIONAL PARK
Mt. McKinley
Chakachamna Lake
COOK INLET
Livengood
Nenana
Healy
McKinley Park
Summit
Cantwell
Gold Creek
Talkeetna
Willow
Wasilla
Palmer
ANCHORAGE
Kenai
Homer
Seldovia
Seward
Whittier
Sheep Mountain
Glennallen
Gulkana
Valdez
Slana
Tok Junction
Chicken
Paxson
Big Delta
Delta Junction
FAIRBANKS
Lake Louise
Tustumena Lake
Skilak Lake
Kenai Lake
STERLING HIGHWAY
KENAI MOUNTAINS
CHUGACH MOUNTAINS
TALKEETNA MTS.
ALASKA RANGE
PRINCE WILLIAM SOUND
GLENN HIGHWAY
RICHARDSON HIGHWAY
DENALI HIGHWAY
ALASKA HIGHWAY
TAYLOR HIGHWAY
STEESE HIGHWAY
ELLIOT HIGHWAY
RAILROAD
SUSITNA RIVER
Chulitna River
Yentna River
Teklanika River
Nenana River
Wood River
Chena River
Salcha River
TANANA RIVER
Matanuska River
Talkeetna River
Oshetna R.
Maclaren R.
Tyone River
Copper River
Turnagain Arm
Knik Arm

GPO 994274

CHAPTER I

TRANSMITTAL

To: Commissioner

From: District Manager

Subject: Feasibility Report on Devil Canyon Project, Alaska

This report outlines the physical plan and financial aspects of developing the Devil Canyon Project to supply hydroelectric power to Anchorage and Fairbanks and to other areas along and near the Alaska Railroad. The project includes two storage reservoirs on the Susitna River, one powerplant, and facilities to transmit power to load centers.

The report describes extensive feasibility studies of project features and economic aspects. A specific course of action is recommended.

AUTHORITY FOR REPORT

Authority for this report and the prior field investigations and office studies is contained in the Act of August 9, 1955 (69 Stat. 618). The Act authorizes the Secretary of the Interior to investigate and report to the Congress on the development and utilization of the water resources of Alaska. Investigations prior to the above date were authorized by the Department of the Interior appropriation acts for each fiscal year.

INVESTIGATIONS

Investigations of water resource development of the Susitna River were begun by the Bureau of Reclamation in Fiscal Year 1950. These early investigations are described in the "District Manager's Reconnaissance Report of June 1953 on Susitna River Basin, Alaska". That report outlined an ultimate plan of development as a general guide for further investigations. The report also recommended that particular attention be given to the urgency of investigating the Devil Canyon Project.

Detailed studies of Devil Canyon Project were started in Fiscal Year 1953. Field work included surveys, surface geologic investigations, and core drilling of dam and powerplant sites. Office studies were made of power markets, water resources and use, plan of development, project costs, and financial feasibility. These investigations have been performed in sufficient detail to provide a reasonable basis for determining the engineering and economic feasibility of the project. More detailed investigations will be required prior to construction to define more precisely the best design and the probable costs of some project features.

PLAN OF DEVELOPMENT

Devil Canyon Project is named for the major potential structure. Devil Canyon Dam would be located on the Susitna River 14.5 miles upstream from the Gold Creek station on the Alaska Railroad. A concrete arch dam would raise the stream's water surface about 565 feet and would impound initially about 1,100,000 acre-feet of water. A 580,000-kilowatt powerplant would be located on the right abutment.

Denali Dam would be located on the Susitna River about 115 miles above Devil Canyon Dam and 15 miles below the Denali Highway Bridge. It would be an earth, sand and gravel-fill structure with a crest 2,050 feet long, rising 219 feet above streambed. The 5,400,000-acre-foot reservoir, in conjunction with Devil Canyon Reservoir, would almost fully regulate the flows of Susitna River for use by Devil Canyon Powerplant. There would be no powerplant at Denali Dam.

Power produced at Devil Canyon Powerplant would be supplied to Anchorage and Fairbanks by about 350 miles of 230-kilovolt transmission line. Project power would be used on the Kenai Peninsula, by Anchorage and towns in the Matanuska Valley, by communities along the Alaska Railroad, and by Fairbanks and towns as far east as Delta Junction.

FINANCIAL DATA

The completed project is estimated to cost $498,874,000 to build. In addition, simple interest that would accumulate on annual appropriations during construction would amount to $28,216,000. Total capitalized project cost to be repaid would be $527,090,000.

The annual cost of operation and maintenance would be $1,910,000 for full development. Provisions for periodic replacements would impose an additional annual revenue deduction of $400,000.

In order to pay all annual operation, maintenance and replacement costs as well as amortize project investment in each stage within 50 years after its completion a unit power rate of 7.89 mills per kilowatt-hour would need to be charged. This rate applied to a net salable firm output of 2,755,000,000 kilowatt-hours would realize annual revenues amounting to $21,736,950 upon full utilization of project power.

Analyzed over a 50-year economic life project feasibility is indicated by a benefit-cost ratio of 1.32 to 1.0. For a 100-year economic life this ratio increases to 1.72 to 1.0. Project benefits were determined by estimating cost of power from a similar sized steam powerplant located at the Matanuska coal field.

Indirect benefits were not used in determining the benefit-cost ratios but they are believed to represent a substantial economic factor. The availability of a large block of relatively low cost power would not only lead to a decrease in the cost of living and a lesser cost of doing business but would also remove one of the major obstacles to industrialization. The high voltage transmission tie between the major load centers of Anchorage and Fairbanks would benefit military as well as public utility systems.

ACKNOWLEDGMENTS

The assistance of many Federal and State agencies and local groups and individuals has been invaluable to the investigation of the Devil Canyon Project. Their cooperation and help are gratefully acknowledged.

Water supply data, weather data, power use statistics, area economic factors and information, and resources evaluation represent the type of basic data supplied by others and essential to project feasibility determination.

CHAPTER II

GENERAL DESCRIPTION

The southern coast of Alaska forms a great crescent, sweeping from the Alaska Peninsula and Kodiak Island on the west, past the Kenai Peninsula and Prince William Sound, to the Alexander Archipelago in Southeastern Alaska. Centrally located in this great arc is the City of Anchorage, the State's largest and fastest growing community. The Alaska Railroad passes through Anchorage on its path from the seaport of Seward to Fairbanks, north of the Alaska Range. This railbelt area is the hub of Alaska and the locale of the Devil Canyon Project.

THE PROJECT AREA

The Devil Canyon Project Area comprises that part of south-central Alaska throughout which power from project facilities would be distributed and sold. The area includes all of the Kenai Peninsula except the extreme southern and eastern tips. Moving north of the peninsula, it narrows to a strip about 80 miles wide, with the Alaska Railroad located approximately in the center. The area widens on the eastern side along the Denali Highway to the town of Paxson. Moving north from Paxson, the boundary lies east of the Richardson Highway and Delta Junction. The northern boundary of the market area is an arc roughly 50 miles north of and paralleling the highway between Delta Junction and Nenana. The power market area is further described in Chapter IV.

The major project works would be located in a strip along the main stem of the Susitna River from the headwaters to the Gold Creek station on the railroad. Denali Dam would be constructed near the upper end of this reach and Devil Canyon Dam and Powerplant near the lower end.

PHYSICAL FEATURES

The power market area extends about 400 miles from south to north and includes a wide range of geographic and climatic conditions.

Geography

The Susitna River Basin is centrally located in the power market area. The Susitna River, one of the major rivers of Alaska, heads at several glaciers on the southern slopes of the Alaska Range. Mountains in this area rise over 13,000 feet. The Susitna River drains a large plateau area to the east and southeast before entering the canyon section near the mouth of Oshetna River. The MacLaren River is the principal headwater tributary. Steep, narrow canyons typify the westward-flowing section of the river to a point just below the Devil Canyon damsite. Numerous tributaries then join the Susitna River in its southward journey to tidewater at Cook Inlet, the chief ones being the Chulitna, Talkeetna, and Yentna Rivers. The maximum elevation in the Susitna River Basin is 20,269 feet at the summit of Mt. McKinley, the highest point in North America.

Anchorage lies near the mouth of Knik Arm, a northwesterly extension of Cook Inlet. Near the head of Knik Arm, the famed Matanuska Valley nestles between the Chugach Mountains on the south and the Talkeetna Mountains on the north. The town of Palmer is the busy center of valley farm life.

South of Anchorage and Turnagain Arm lies the Kenai Peninsula. A relatively low plain borders Cook Inlet on the northwest side of the peninsula. On the southeast side the Kenai Mountains, which constitute about two-thirds of the peninsula area, rise to more than 6,000 feet above sea level. The most important towns are Homer and Kenai on the west coast, Whittier on the east coast and Seward on the southeast. Seward is the southern terminus of the Alaska Railroad.

The Tanana River, a tributary of the Yukon, drains the area north of the Susitna River Basin and the Alaska Range. The Nenana River, a chief contributor to flow of the Tanana, heads on the southwestern slopes of the Alaska Range not far from the headwaters of the Susitna River. The river flows through the Alaska Range in the Nenana Canyon and then emerges on an extensive plain before joining the Tanana River. Broad Pass, the divide between the Susitna and the Tanana, is, at elevation 2350, the lowest pass through the Alaska Range. Fairbanks, the chief city of interior Alaska, situated on the banks of the Chena River, another Tanana tributary, is 473 miles by rail from Seward.

Climate

The climate of the power market area falls roughly into three different zones: (1) a zone dominated almost entirely by maritime influences; (2) a zone of transition from maritime to continental climatic influences; and (3) a zone dominated by continental climatic conditions. Most of the area lies in the transition zone.

Only the southeastern and eastern portions of the Kenai Peninsula are in the maritime zone, which is characterized by small temperature variations, high humidities, considerable cloudiness, and abundant precipitation. Climatological records at Seward and Whittier are the only data in the power market area that are typical of the maritime zone.

The transitional zone embraces all of the portion of the power market area that is tributary to Cook Inlet. This includes the balance of the Kenai Peninsula, the Matanuska Valley, and the Susitna River Basin. In general, this zone marks an area where the maritime influences decline progressively from south to north. The change from a maritime to a semi-continental type climate is rather abruptly apparent in the Matanuska Valley and other areas north of the Chugach Mountains. The transition is more gradual on the western Kenai Peninsula and in the lower Susitna Valley because of the pronounced maritime influences that occasionally move northeastward from the open sea area through Cook Inlet.

Mean temperatures gradually decrease from Homer in the south to Talkeetna in the Susitna Valley, whereas temperature ranges increase over the same area. Maximum temperatures in the transitional zone normally range in the high 80's, with minimums in some sections lower than -40°F. No temperature records are available for the upper Susitna River Basin, but it is probable that the extremes in this area exceed the figures shown above.

Precipitation is fairly high along the western border of the power market area in the transition zone. Anchorage and the Matanuska Valley, however, are sheltered by the Chugach and Kenai Mountains and receive only one-half as much precipitation as Homer and Talkeetna. Most of the precipitation occurs during the late summer and fall months.

No long-term records are available to indicate the climate of the project development area in the upper Susitna River Basin. A short period of record at a station near the Denali Highway bridge across the Susitna River indicates that the climate of this area is more similar to that of the region near McKinley Park than it is to that of the middle or lower Susitna River Basin. For the short period of record, both temperatures and precipitation average less than at Talkeetna.

The dominant continental climatic zone of the power market area lies north of the Alaska Range. The region is remote from open ocean areas, and surrounding topographic barriers prevent the inland movement of air influenced by marine factors.

Maximum temperature readings exceed 85°F. almost every summer. The most striking aspect of this region is the great range in temperature, with Fairbanks recording an extreme range of 165°F. The annual range at Fairbanks equals or exceed 135°F. in almost every year.

Precipitation is relatively light, with annual totals averaging between 10 and 15 inches. The heaviest rainfall months are usually June, July, and August. Widespread precipitation of consequence seldom occurs in this well sheltered area; precipitation during the growing season is usually of the local shower type.

Table II-1 summarizes climatological data recorded at several stations in the power market area.

HISTORY AND SETTLEMENT

Recorded history of the area dates from 1778, when Captain James Cook became the first white man to visit the body of water that now bears his name. Disappointed in his search for the elusive northwest passage, Captain Cook turned his boats around and so established the name of Turnagain Arm.

In 1788 the Russian-American Fur Trading Company established two small settlements on the west coast of Kenai Peninsula. Except for some minor agricultural colonization in the Homer area in 1793, peninsular activity was very limited until the salmon canning industry was established in the 1880's. Discovery of placer gold on

TABLE II-1

SUMMARY OF CLIMATOLOGICAL RECORDS

Station	Ground Eleva-tion (Feet)	Years of Record	Temperature (Degrees F.) Maxi-mum	Mini-mum	Mean January	Mean July	Mean Annual	Average Annual Precipi-tation (Inches)	Average Annual Snowfall (Inches)	Average Length of Growing Season (Days)
Maritime Zone										
Seward	76	33	88	-20	24.2	56.5	39.5	69.92	84	134
Transition Zone										
Anchorage	92	37	92	-38	13.0	57.3	35.3	14.27	64	119
Homer	67	20	80	-18	22.6	52.8	37.3	25.22	47	106
Matanuska Agr. Exper. Station	150	34	91	-41	13.1	57.6	35.8	15.96	47	109
Talkeetna	345	30	91	-48	8.5	57.3	33.3	29.92	118	76
Continental Zone										
Big Delta	1268	16	91	-63	-5.6	59.5	27.6	11.63	36	107
Fairbanks	436	42	99	-66	-9.8	60.9	26.2	11.92	60	96
McKinley Park	2092	26	89	-54	3.8	54.9	25.8	14.42	76	62

the Kenai in 1896 induced a wave of prospecting and the town of Homer was founded in that same year.

The city of Seward was established in 1903 as a supply center and tidewater terminus for the Alaska Central Railroad. This railroad, financed by private capital, was built only 79 miles on its proposed way to the Matanuska coal mines and the Fairbanks gold fields.

Federal construction of the Alaska Railroad was authorized in 1914. The route of the Alaska Central Railroad was purchased, and contruction began in 1915. Plagued by wartime financial problems and lack of skilled labor, the railroad crept northward toward its destination at Fairbanks. President Harding came to Alaska in 1923 to drive the last spike. In 1943 a 14-mile spur was constructed to link the military port of Whittier with the main line of the railroad.

Under the impetus of the Alaska Railroad, Anchorage came into being as a construction camp in 1914. The city's existence depended for many years on the railroad, a little farming, some gold mining, and two small coal mines in the Matanuska field.

Then came the Matanuska Colony in 1935. The Federal Government sent 200 families from Minnesota, Wisconsin, and Michigan to farm in the Matanuska Valley only 50 miles northwest of Anchorage. This influx of settlers was an economic boon to Anchorage, as well as to Palmer, which to that time had been little more than a railroad siding.

The Susitna River Basin was only vaguely known when the Eleventh Census (1890) first took official cognizance of the region. A few prospectors passed through the region, but there were no permanent white settlements. After the discovery of gold in the Klondike area of northwestern Canada, an exploration party traveled up the Susitna River and across Broad Pass into the Nenana River drainage, looking for a possible route to the interior; the trail was never used extensively. Except for a small village of traders, trappers, and prospectors at Talkeetna, there was no permanent settlement prior to construction of the Alaska Railroad.

Fairbanks, more than any other city in the power market area, owes its origin to gold. After prospecting for two years, Felix Pedro made a rich strike of placer gold in 1902. The winter of 1902-3 brought stampeders to the new mining center, many of them from the declining Klondike camps. By 1909 the city claimed more than 3,000 inhabitants. Completion of the Alaska Railroad provided further economic stability for Fairbanks.

Political changes in Alaska had little effect on the history of the power market area. Gathering war clouds in 1939, however, foretold significant changes in the entire Territory and particularly in the Railbelt. In June 1940 the first contingent of a few hundred American troops arrived in Anchorage, then a quiet town of about 3,500 persons. The troops were housed in tents until permanent facilities were constructed. This was the beginning of a construction boom that has continued with intense, although varying, activity up to the present time.

Although military personnel and construction workers continued to pour into Anchorage, the civilian population did not increase significantly, owing to the evacuation of many civilians after December 8, 1941, and the subsequent invasion of the Aleutian Islands. However, the steady influx of construction workers brought the population back up to 9,000 by the end of the war. In July 1948 the population of Anchorage was estimated at 19,000, a growth of 570 percent during and immediately following the war years. Military activity and population growth at Fairbanks was similar, although less spectacular.

The railbelt area outside of Anchorage and Fairbanks experienced much less of a boom during the war years. Influenced by the growth of Anchorage, the population of the Kenai Peninsula and the Matanuska Valley showed a slow but steady rise. Some communities near Fairbanks similarly reflected the growth of that city. Many small settlements, such as those along the railroad in the Susitna and Nenana Valleys continued life in much the same manner as before the war.

POPULATION

The estimated population of the project area, including military personnel, has increased as follows:

1929	9,000
1939	14,400
1950	58,900
1956	129,000
1957	131,000
1958	113,000
1959	125,000

The population decrease in 1958 was the direct result of withdrawing about 12,000 troops from Alaska, most whom came from the power market area. A comparison of number of utility customers, school enrollment, available housing, and similar factors, for 1958 and 1959, indicates that a substantial portion of this decrease had been made up in 1959.

COMMUNITY DEVELOPMENT

The chief urban communities in the power market area are Anchorage, Fairbanks and Seward. Visitors to Alaska are often surprised to learn that cities and towns in the 49th state provide community facilities comparable to those in cities and towns of corresponding size and situation in other states. The relative isolation of Alaskan municipalities may contribute to a deficiency of some services, such as a shortage of electric energy, or to a greater than average supply of some services, such as amusement and recreation facilities.

Anchorage

Anchorage is the largest and probably the most modern city in Alaska. The city itself is bordered by several suburban developments, all of which are included in the Greater Anchorage area. In recent years many suburban areas have been annexed to the city.

The 1950 census showed a population of 11,254 within the Anchorage city limits and 32,060 in the Anchorage District, which includes a few thousand outside the Greater Anchorage area. These figures include military personnel permanently residing in the area.

To a greater extent than for most other Alaskan cities, it is very difficult to estimate the population of Anchorage. This is

ANCHORAGE - ALASKA'S LARGEST CITY.

due largely to the greater yearly fluctuation in population, which in time is due to the movement of construction workers in at the beginning and out at the end of the construction season. Educated guesses of population subsequent to the 1950 census are therefore based on trends in employment, school enrollment, utility services, excess of births over deaths and similar indexes. The average annual population of the Greater Anchorage area, including both civilian and military, was estimated to be 78,000 in 1957. The transfer of military personnel in late 1957 and early 1958 caused a substantial reduction in total population. By 1959 the population was again increasing but was still probably slightly less than it was in 1957.

Anchorage is the primary trading center for the southern portion of the power market area. Here can be procured most of the goods and services that are obtainable in cities of 100,000 persons in other states. Anchorage is also becoming a wholesale supply center for much of interior Alaska.

For several years following World War II, Anchorage suffered from a severe housing shortage. Recently, however, the supply has been adequate, although the quality of much available housing is substandard.

Owing to rapid growth, local governments have had difficulty in keeping pace with necessary expansion of streets, sewers, and water systems. Progress is good in the city but slow in the suburbs. The electric utilities, however, are relatively current on domestic connections throughout the area.

The Anchorage Independent School District encompasses the Greater Anchorage area. The facilities of the school district are of excellent quality and high educational standards are maintained. Because of a chronic shortage of classroom space, the district is continuing to construct new schools to serve a constantly increasing student enrollment. On-base schools are provided by major military establishments. The Anchorage Community College, an extension of the University of Alaska, offers junior college courses on a night school basis. Alaska Methodist University, a 4-year liberal arts college with an ultimate planned enrollment of 1,000, is scheduled to open its doors to students in the fall of 1960.

A 74-bed general hospital for public use is located in Anchorage. Construction is expected to start in 1960 on a 140-bed replacement for this hospital, with expansion to 300 beds now in the planning stage. Construction of a large state mental hospital is also expected to start in 1960. Anchorage is the site of a 395-bed hospital for the exclusive use of Alaska natives - Aleuts, Eskimos, and Indians.

The City Planning Commission in a 1956 economic report, listed the following services available:

Churches	40
Newspapers - daily	2
- weekly	1
Radio stations	3
Television stations	2
Movie theaters	4
Hotels and motels	31

Anchorage has a modern library, a municipal auditorium, and many varied recreation and cultural facilities. The city is governed by a council and a city manager; it maintains efficient police and fire departments, and all utilities are municipally owned and operated. In addition, the many private businesses and services characteristic of a city of this size are available in Anchorage.

The Chugach Electric Association, an R.E.A. cooperative, supplies electric power to the suburbs and to small areas within the city limits. Each suburb has a volunteer fire department but depends on the State Highway Patrol for police protection. Central water and sewer systems are lacking in large areas of the suburbs.

Fairbanks

Located about 120 miles south of the Arctic Circle, the Greater Fairbanks area includes the city of Fairbanks and considerable suburban development, much of which has been annexed to the city in recent years.

Much of the area, but little of the population, of the Fairbanks District is outside the Greater Fairbanks area. Total population of the Greater Fairbanks area in 1957 was about 33,000. As was the case with Anchorage, the 1959 population probably does not exceed this figure.

FAIRBANKS - DISTRIBUTION CENTER FOR 230,000 SQUARE MILE AREA.

Fairbanks, the State's second largest city, is the distribution center for 230,000 square miles of the interior. Both wholesale and retail trade have shown substantial growth in the last ten years.

The city operates all utilities, including power, telephone, water and sewer systems. Because of cold weather and permafrost, underground utilities are placed in large conduits that also enclose steam pipes to keep the water and sewer pipes from freezing. The Golden Valley Electric Association, an R.E.A. cooperative, supplies power to outlying areas. The city, which is governed by a council and a city manager, operates police and fire departments.

Fairbanks supports two radio stations, two television stations and two newspapers - one daily and one weekly. Two theaters, office buildings, large multi-unit apartment houses, an up-to-date hospital, several medical clinics, and many fine hotels and motels - all are typical of modern Fairbanks.

School enrollment in six elementary and two secondary schools exceeds 4,500. The two major military bases provide additional elementary schools on base. All major religious faiths are represented. The University of Alaska, the "farthest north" institution of higher learning in the world, is located at College, 3 miles west of Fairbanks. It attracts students from most states of the union and from many foreign countries. Residents of Fairbanks support many and varied cultural and recreational activities.

Seward

In 1950 the Seward recording district had a population of 2,708, of which 2,114 lived in the city of Seward. The estimated 1957 population of the Seward trading area was 3,500.

Incorporated in 1912, Seward is governed by an elected mayor and city council; daily operations are in charge of a city manager. All utilities except telephone service are owned and operated by the city.

Seward boasts a bank, a weekly newspaper, excellent hotel accommodations, modern schools, one general hospital and one hospital for chronic diseases, and all the usual stores, shops, and services that go to make up a thriving community. Until 1958, the State of Alaska operated a large tuberculosis sanitarium at Seward.

Matanuska Valley

The Matanuska Valley is a small rural community centered around the town of Palmer. In 1950 the population of the Palmer and Wasilla Districts, which consist primarily of the Valley, was 3,108. The Valley population in 1957 was about 6,000.

Palmer, which incorporated as a city in 1951, operates its own telephone and water systems, as well as a police force and a volunteer fire department. Electric power is supplied to the city and to the rest of the Valley by the Matanuska Electric Association, an R.E.A. cooperative. The Matanuska Telephone Association, a cooperative organization, provides telephone service to the rural areas of the Valley.

Palmer is well supplied with professional, retail, craft, and service facilities, including a bank, a public library, a 25-bed hospital and seven churches. Many other small businesses are located close to the city and scattered throughout the Valley. The Palmer Independent School District provides both elementary and secondary educational facilities for the Valley. The State also operates an elementary school at Wasilla.

Palmer is the trading center for the entire Valley and for communities along the Alaska Railroad at least as far north as Talkeetna. The Valley is well-covered by a network of good roads; nearly every farm has access, within a short distance, to a gravelled road leading to Palmer. The paved Glenn Highway provides easy access from Palmer to Anchorage, 48 miles distant. It also facilitates travel by Anchorage residents to resorts or cabins on the numerous lakes in the Valley.

Other Railbelt Areas

Many smaller communities are scattered throughout the power market area. Most of these are small villages which include only residences and provide no community facilities. Some, however, are trading centers for small areas and, as such, have stores and varied service establishments. The State of Alaska operates schools in many villages in the Railbelt area.

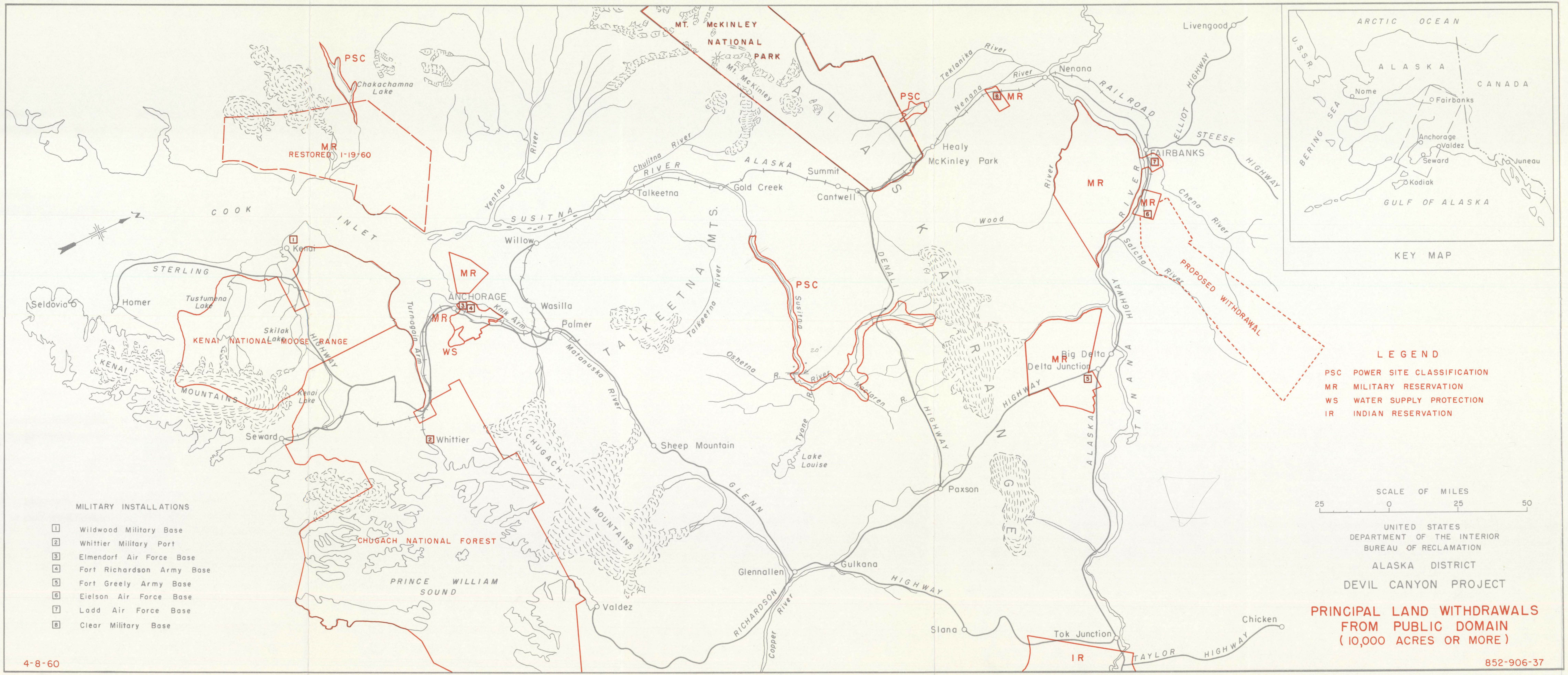
Homer, with a population of 307 in 1950, is one of the more important of these small communities. It is the trading center of the southern section of the Kenai lowlands, an area which has shown considerable agricultural expansion in the last few years. Electricity is supplied by the Homer Electric Association, an R.E.A. cooperative. The many businesses and facilities include two hotels, a dry-cleaning plant, self-service laundry, bakery, theater, bank, radio station, and various shops and stores. A berry processing plant, several small sawmills, and three small fish processing plants add to the general economy of the area. Harbor facilities are available for small craft and for large freighters. The first-class airport can accommodate DC-3's.

Kenai is a typical fishing village, with the usual marine supply and repair shops. Harbor facilities are adequate for fishing boats to dock at the two large salmon canneries, but deep draft vessels cannot be accommodated. The airport can handle DC-3's. Kenai has about the same stores and services found at Homer, except for the radio station. The Kenai Power Company, a private utility, is the power source for the community. The Wildwood Military Base, a communications center, has helped make the village one of the fastest growing communities on the peninsula. Similar to the Homer area, however, the greatest expansion is occurring in the outlying areas.

Several villages on the Kenai Peninsula have attained a population of 100 since 1950, spurred on by the completion of the Sterling Highway. A general store, filling station, and possibly a lunch counter, supply local needs, with required additional services being provided by the larger trading centers.

Whittier exists primarily because of the military port facilities, constructed during World War II. One of the largest sawmills in Alaska is located here. The 1950 population of Whittier was 627. All community facilities, including those for civilian inhabitants are supplied by the military.

There are many villages along the Alaska Railroad as it wends its way up the Susitna River and then down the Nenana River. Most of these exist only in connection with operating and maintaining the railroad. Others, however, serve other purposes as well. For example, McKinley Park is the headquarters for Mt. McKinley National Park, and Healy is a coal mining center.



UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
ALASKA DISTRICT
DEVIL CANYON PROJECT
PRINCIPAL LAND WITHDRAWALS
FROM PUBLIC DOMAIN
(10,000 ACRES OR MORE)
852-906-37
4-8-60
LEGEND
PSC POWER SITE CLASSIFICATION
MR MILITARY RESERVATION
WS WATER SUPPLY PROTECTION
IR INDIAN RESERVATION
MILITARY INSTALLATIONS
1 Wildwood Military Base
2 Whittier Military Port
3 Elmendorf Air Force Base
4 Fort Richardson Army Base
5 Fort Greely Army Base
6 Eielson Air Force Base
7 Ladd Air Force Base
8 Clear Military Base
SCALE OF MILES
25 0 25 50
KEY MAP
ARCTIC OCEAN
U.S.S.R.
ALASKA
CANADA
BERING SEA
GULF OF ALASKA
Nome
Fairbanks
Anchorage
Valdez
Seward
Kodiak
Juneau
MT. McKINLEY NATIONAL PARK
Mt. McKinley
MR RESTORED 1-19-60
PSC
Chakachamna Lake
PROPOSED WITHDRAWAL
KENAI NATIONAL MOOSE RANGE
CHUGACH NATIONAL FOREST
PRINCE WILLIAM SOUND
COOK INLET
ALASKA RANGE
TALKEETNA MTS.
CHUGACH MOUNTAINS
KENAI MOUNTAINS
Livengood
Nenana
Healy
McKinley Park
Summit
Cantwell
Gold Creek
Talkeetna
Willow
Wasilla
Palmer
ANCHORAGE
Kenai
Homer
Seldovia
Seward
Whittier
Valdez
Sheep Mountain
Glennallen
Gulkana
Paxson
Slana
Tok Junction
Chicken
Big Delta
Delta Junction
FAIRBANKS
Lake Louise
Tustumena Lake
Skilak Lake
Kenai Lake
ALASKA RAILROAD
STERLING HIGHWAY
GLENN HIGHWAY
RICHARDSON HIGHWAY
DENALI HIGHWAY
ALASKA HIGHWAY
STEESE HIGHWAY
ELLIOT HIGHWAY
TAYLOR HIGHWAY
SUSITNA RIVER
TANANA RIVER
Chulitna River
Yentna River
Talkeetna River
Oshetna R.
Maclaren R.
Tyone R.
Copper River
Matanuska River
Teklanika River
Nenana River
Chena River
Salcha River
Wood River
Knik Arm
Turnagain Arm

GPO 994274

CHAPTER III

AREA ECONOMY AND RESOURCES

The power market area encompasses about 40,000 square miles of land. However, several large military reservations within this area eliminate sizable tracts from economic development. Additional millions of acres are restricted in use by other Federal withdrawals. Many of these such as National Forests, Water Supply Protection, and Power Site Classification do not preclude public land use but rather reserve it for that type of development for which it is best suited. Drawing No. 852-906-37 illustrates the major Federal withdrawals within or near the project power market area.

The economic history of the power market area has been fashioned from a variety of resources, including mining, agriculture, fishing, timber, and government expenditures for transportation and military activities. In recent years, military payrolls and construction of defense facilities have been the most important contributors to the area's economy. These activities will continue to be significant, but they will probably decrease in relative importance as other factors expand.

The long-range effect of Statehood on the economy is difficult to appraise. It is expected that the State government will take steps to encourage and promote the growth of activities that will use the State's natural resources.

Economic resources or activities whose influence may be felt directly in the power market area are discussed even though they may lie outside the area which will use project power.

Precise economic data are lacking for the power market area as a whole and for some component parts of it. However, data are available in separate analyses of major portions of the power market area, covering the Kenai Peninsula, the Matanuska Valley, the Greater Anchorage Area, and Fairbanks and contiguous area. These data, most of which are for the late 1950's, have been combined, where feasible, to indicate approximately the impact of various factors on the economy of the power market area as a whole.

In the following discussion certain industries or activities are described as basic or nonbasic. Basic activities are those which can increase the total income available within an area by applying available resources to produce goods, services, or capital primarily for export to markets outside the area. Nonbasic activities comprise the internal trade in goods, personal services, and capital within the area. The "outside" money income from basic activities provides the purchasing power spent in the area for nonbasic activities. These dependent or service activities are restricted by local demand and income levels, but respond to variations in income received from outside the area. Whether an activity is basic or nonbasic depends in some measure on the size of area which is being considered. For example, agriculture in the Matanuska Valley is a basic industry when only the Valley is considered, because most of the product is exported. The same agricultural development would be nonbasic from the standpoint of the power market area, because the production is utilized almost entirely within the power market area and little is exported.

MILITARY

Eight important military installations are located in the power market area. These are listed below by number as shown on the General Map, Drawing No. 852-906-14:

1. Wildwood Military Base near Kenai
2. Whittier Military Port
3. Elmendorf Air Force Base near Anchorage
4. Fort Richardson Army Base near Anchorage
5. Fort Greely Army Base near Big Delta
6. Eielson Air Force Base near Fairbanks
7. Ladd Air Force Base near Fairbanks
8. Clear Military Base south of Nenana

Each base makes a significant contribution to the economy of the local area in which it is situated. Collectively, they are important to the entire power market area.

The estimated military population in all Alaska on July 1, 1958, was 35,000, a decrease of 12,000 from the figure 12 months previous. A substantial majority of this personnel is based in the Railbelt area. Families of these service men and civilian employees of the military establishments constitute a significant part of the civilian population in the power market area.

Data compiled by the Anchorage City Planning Commission indicate the importance of defense expenditures to the Railbelt economy. Personnel employed on military installations in the Greater Anchorage area in 1958 included 15,800 military and 3,000 civilian. Total payroll for these employees was $72,000,000. In addition, local purchases by military installations for supplies and transportation exceeded $37,000,000 in the same year.

Specific data such as these are not available for the Kenai Peninsula and the Greater Fairbanks area. There is little doubt, however, that military spending in both those areas is a major factor in the economy, particularly for Fairbanks.

The figures listed above do not include any expenditures for military construction, which further adds to the economy of the power market area. This item is subsequently discussed under Construction.

The future impact of military activities on the Railbelt area is difficult to predict. The type of installation may change significantly, owing to rapid technological development. The strategic importance of the establishments, however, will probably not permit sharp decreases in expenditures. On the other hand, no large increase in activity is assumed.

Military activities are classed as basic activities for the power market area, because they increase the total income available within the area. Because the military establishments are engaged primarily in defense of the continental United States, this industry may be thought of as utilizing the resource of "strategic location" to export "protection" to the southern 48 states.

GOVERNMENT

Civilian employment by the Federal government provides the second largest economic base for the power market area. It will remain relatively important until other elements of the civilian economy can develop more fully.

Data for the Greater Anchorage area illustrates the significance of Federal civilian employment. The most important agencies are the Federal Aviation Agency, the Public Health Service (Department of Health, Education, and Welfare), the Post Office Department, and the Alaska Railroad (Department of the Interior). These agencies (excluding the Alaska Railroad, which is included under Transportation) and other Federal agencies in the area, paid wages totaling more than $11,500,000 in Fiscal Year 1957; almost half of this was paid by the Civil Aeronautics Administration, predecessor of the FAA. Local purchases by these same agencies exceeded $2,000,000 in F.Y. 1957. These agencies furnish essential services, and their contribution to the local economy can be expected to increase as the population grows.

The State and local governments poured more than $9,000,000 into the Greater Anchorage economy in 1957, of which less than one-fourth was from the State. This ratio would not apply to the Greater Fairbanks area, because of the State-operated University of Alaska at College. As with Federal agencies, expenditures by the State and local governments provide a stable source of employment and income and will increase as the need for services expands.

Most of the Federal agencies in the power market area furnish services for the State as a whole and for the rest of the states. The State and local governments, on the other hand, are largely engaged in providing services to the Railbelt area. Governmental activities are therefore both basic and nonbasic.

TRANSPORTATION

As implied by the term "Railbelt", transportation is an important economic activity of the power market area. Other forms of transportation are fully as significant as rail, which operates entirely within the study area. Air, water, and highway transportation link the area with other parts of the world.

Air

Because of its location Alaska, and especially Anchorage, is an air crossroads. Three foreign airlines have recently established transpolar routes through Anchorage from Europe to Asia, and two other lines are actively considering such routes. For several years, one U. S. airline has stopped at Anchorage on regular flights to and from the Orient. Jet airplanes will soon be used for these intercontinental flights.

Four domestic airlines provide flights from the continental United States to Anchorage or Fairbanks. Most of the flights originate in Portland or Seattle. Weekly passenger service is now available from New York and Minneapolis to Anchorage, and jet planes will soon be flying to that city from Washington, D. C. Jet flights from Seattle to Fairbanks began on March 1, 1960.

Intra-Alaska air transportation is vital to the existence of many communities in the State, because of limited surface facilities. Several intrastate scheduled airlines and scores of certified common carriers, commercial contract carriers, and bush pilots carry passengers, mail and freight over mountains, rivers, and frozen wastes all year long. These carriers not only link the communities within the power market area but also provide service from the main airports at Anchorage and Fairbanks to all of western and northern Alaska, including such faraway places as Attu, Nome, and Barrow.

Because of this great need for and use of air transportation, Alaska boasts the world's highest per capita flight mileage. Similarly, Alaskan use of air freight is about 200 times as great as in the rest of the United States on a per capita basis. Alaskans' airmindedness is further demonstrated by the prevalence of private craft used for business and recreation; there is one private plane for every 165 inhabitants. One-fourth of the seaplanes in the world are in Alaska, and 20 percent of those are based in the Anchorage area.

A modern system of airways to facilitate this air traffic is administered by the Federal Aviation Agency. Airports and seaplane facilities are available throughout the area. Modern, efficient airports at Anchorage and Fairbanks, built and operated by the FAA, are of intercontinental express classification.

Figures for passenger traffic and freight into and out of the Anchorage International Airport reflect both the activity and growth of air transportation:

	Passengers In and Out	Freight In and Out
1953	97,776	7,241 tons
1955	138,722	12,049 tons
1957	178,443	29,455 tons 1/

1/ Abnormal increase due to heavy shipments for military construction.

During Fiscal Year 1955, the two civilian airports at Anchorage handled 285,195 operations, making it the fourth busiest air center in the nation, outranked only by Chicago, Detroit, and New York.

The future of air transportation for the area is extremely bright. Commercial flying over the North Pole is in its infancy, and the Anchorage International Airport appears destined to become one of the most important in the world. Service to the hinterland from both Anchorage and Fairbanks will gradually expand as the resources of the area are developed.

Air transportation is both a basic and a nonbasic industry. To the extent that services are performed for the benefit of areas outside the power market area, it is basic and provides additional money income. Much of its activity is transporting goods and services within the power market area; to this extent, it is a service industry.

Water

Most of the freight destined for the power market area is handled by three companies competing on sea routes between the Pacific Coast and Alaska. Except during the brief salmon-canning season, northbound cargo makes up 75 to 95 percent of the total revenue tonnage. When not hauling the salmon pack, ships return from Alaska almost empty. As in the case of air carriers, this customary lack of return cargo contributes to higher freight tariffs.

Two of the companies operate steamships and the third uses barges towed by ocean-going tugs. Full use is made of unitized cargo and loaded trailer vans to permit better use of hold and deck space and to reduce necessary handling. One line recently completed a study of facilities to run loaded railroad cars directly on to special ships, from which they would run directly on to the Alaska Railroad, thus eliminating load handling at both trans-shipping points. This plan has been dropped for the present because of unexpectedly high initial construction costs.

Terminal facilities within the power market area for ocean-going vessels are available at three main ports: Seward, Whittier, and Anchorage. The extensive port facilities at Whittier are under military control and cannot generally be used for civilian freight. Outside the power market area the port of Valdez provides terminal facilities for transhipment via the Richardson Highway to Fairbanks.

The principal civilian port is Seward, which serves the interior by means of the Alaska Railroad and the highway system. Five wharves, the largest of which belongs to the Army, are available at Seward.

The port of Anchorage is usually closed to navigation from late November to April 1 because of ice conditions in Upper Cook Inlet and Knik Arm. Although the waterway seldom freezes solid because of the 30-foot tidal range, navigation through the ice floes is difficult. The chief dock, which is leased by the Alaska Railroad to the U. S. Army, can accommodate only one ocean-going vessel at a time. Owing to the restricted water depth and the extreme tidal range, barges are used to breast vessels out from the dock; this necessitates double handling of the cargo.

The City of Anchorage, however, is striving to become the main seaport of Alaska. An $8,000,000 port improvement program, financed by municipal bonds, is now under construction. The initial development will consist of a single general cargo berth and necessary unloading and warehouse facilities, with ultimate expansion to a 3-berth wharf. Special facilities, such as coal loading equipment and a tanker terminal, are also envisioned.

This port will undoubtedly attract much of the commerce now passing through the port of Seward. It will considerably reduce the amount of civilian cargo now hauled by the Alaska Railroad and various truck lines between Seward and Anchorage. Such shipping will not be eliminated, however, because the Anchorage port will operate only 8 months each year and not all shippers will choose to use the Anchorage facility in preference to Seward.

Estimated water-borne freight shipments to the Greater Anchorage area amounted to 582,000 tons in 1954, increasing to 708,000 tons in 1956. Petroleum products accounted for over half the tonnage in 1956, as well as for most of the increase. Grocery and food products were 65,000 tons in both 1954 and 1956. Passenger service to Railbelt ports has not been available since 1954.

Completion of the port of Anchorage will encourage more ocean shipping to Alaska. An even greater spur would be a reduction of freight rates. This may not be possible in any significant amount until a steady source of backhaul is developed in the State. However, a small reduction in freight rates might make possible the economic production of an export product.

A small amount of river transportation originates within the power market area. A private concern operates from Nenana, where transhipment is made from the Alaska Railroad to ports on the Tanana and Yukon Rivers. The company uses its own cargo vessels as well as riverboat facilities leased from the Railroad. The vessels operate from May until September, supplying missionaries, miners, prospectors, traders, trappers, fishermen, and natives living on the inland waterways.

Highway

Alaska's development is retarded by the inadequacy of her highway system. New auto routes are needed to aid in developing remote areas, linking communities whose growth has been stunted by inaccessibility and creating new towns. The power market area, however, is more fortunate than the rest of the State in being fairly well covered with a primary road system. These highways are shown on the General Map, Drawing No. 852-906-14.

The main highways are: The Richardson Highway, an important trucking artery from the port of Valdez to Fairbanks; the famous Alaska Highway, providing a direct route to Fairbanks from the continental United States; the Glenn Highway, leading from the Alaska Highway to Anchorage; and the Seward-Anchorage and Sterling Highways connecting on the Kenai Peninsula with Anchorage. These roads are open all year and most of them are paved. During the summer, tourists can drive directly to Mount McKinley National Park over the recently opened Denali Highway.

A secondary road system connects farming and mining areas to the primary network. Further extension of this secondary system is essential to the economic growth of the Railbelt area.

Highway freight bound for the power market area over the Alaska Highway totaled 7,588 tons in 1957; outbound freight was 4,049 tons. Although no data are available, intra-Alaska highway freight shipments are believed to be substantial. In addition to trucking over the Richardson Highway from Valdez, trailers brought into Seward and Anchorage by barge are taken by highway to points as far away as Fairbanks. Some general cargo brought into Anchorage by boat is also transhipped by truck rather than by rail.

Passenger traffic has shown impressive gains. Almost 90,000 persons used the Alaska Highway in 1957, a 16-percent increase over the preceding year. Regular scheduled bus service goes from mainland United States to Anchorage and Fairbanks. Other bus companies operate within the power market area.

Use of highways is sure to increase as the new State grows. More and more tourists will drive north over the Alaska Highway. New roads contribute to expansion of existing areas and development of new ones. A highway from Willow to Talkeetna is now in the final planning stage; this road will eventually be extended through McKinley Park to Nenana. A road extending westward from Fairbanks to Nome is also under consideration.

Rail

The Alaska Railroad is owned by the United States and is operated by the Department of the Interior. The railroad links the main ports of Seward and Whittier with Fairbanks over 470 miles of mainline track; 60 miles of branch trackage serve such areas as the Matanuska Valley and Eielson Air Force Base. Daily freight service is available from Seward and Whittier to Anchorage and Fairbanks. In summer, passenger trains make six weekly runs in both directions between Anchorage and Fairbanks; in winter, two or three trips a week each way. Passenger service is not available between Anchorage and Seward. The railroad is completely modern.

During the 5 years ending June 30, 1958, the Alaska Railroad hauled an average of slightly less than 1,500,000 revenue tons per year, of which about 55 percent was for the military. The average ton-mile freight revenue was about $0.057, or four times the U. S. private railroad average. In Alaska, as in other frontier areas, one-way freight hauling is expensive.

Future prospects for the Alaska Railroad are not so bright as for other forms of transportation. The increase in use of the railroad will probably be proportionately less than for air, sea, and highway, as these latter means become more popular.

A rail link from the continental United States through Canada to Alaska has long been envisioned as a possible development. This dream has recently been given further impetus by the work of the Alaska International Rail and Highway Commission. This Commission was established by Congress in 1956 to make a thorough study of the economic and military need for additional highway and rail transportation facilities between continental United States and central Alaska. A private research institute employed by the Commission is studying the economic advantages of such additional facilities, as well as the most feasible routes. The Commission's final report is due on June 1, 1961.

CONSTRUCTION

Construction has been the largest single contributor to Alaska's private economy for more than a decade. Expenditures for

MODERN STREAMLINERS PLY THE ALASKA RAILROAD'S 470 MILES OF MAINLINE TRACK.

military construction have been a significant factor in developing the present basic economy of the power market area.

Construction trends in the Greater Anchorage area are indicative of the importance of both military and private construction. Total construction expenditures reached a peak of $79,120,000 in 1952, gradually decreasing to $39,080,000 in 1957. Military construction handled by the Alaska District Engineer totaled $48,450,000 and $25,540,000 in these same years.

Spending by other individual governmental agencies and the private sector of the economy has been variable. For example, expenditures for private housing were large during the early 1950's, relatively small for almost 3 years, and then rose again. In general, however, non-military spending has held fairly steady.

Time and again, dire predictions have been made that defense activities would be drastically curtailed. Nevertheless, the technologies of defense - with seemingly high degrees of obsolescence - have continued to create a need for substantial construction activity. The change from heavy construction to elaborate electronic equipment has merely changed the type of personnel required. Important defense construction is expected to continue for several years, continuing to fortify the State's economy while it establishes much needed diversified industry.

The task of improving and extending the State's road system will require increasing heavy expenditures for highway construction. The cities of Anchorage and Fairbanks and the independent school districts for those communities must continue their large construction programs to keep pace with the rising demand for services. Construction of new housing will continue for some time to provide for population increases and to replace substandard housing. Commercial construction should maintain a low but fairly steady level.

Local contractors, particularly in the Anchorage area, have gradually been increasing their share of the total construction work performed. This means that generally much more of the construction expenditure is of direct benefit to the area's economy, because more of the workers will remain as year-round residents, eliminating a large portion of the migratory labor pool. More money is thus put back into circulation locally. Anchorage construction firms are also successfully competing with companies from the continental United States for Alaskan contracts outside the Railbelt area.

MANUFACTURING

Although manufacturing is increasing in importance to the power market area, it makes only a minor contribution to the economic base. None of the industry can be considered as heavy manufacturing; one large sawmill and a few salmon canneries are the closest to this category. Most of the light manufacturing plants are located in the Anchorage area.

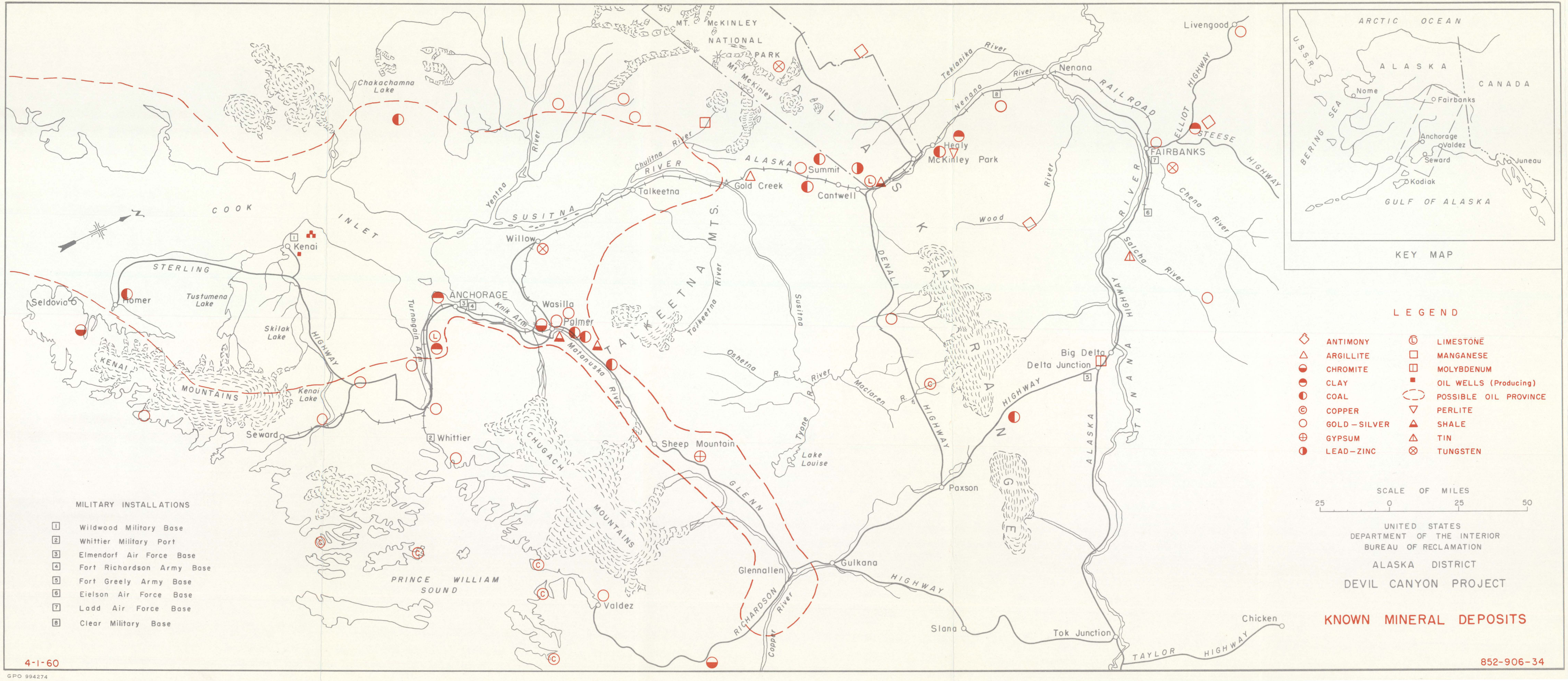
Printing and engraving and small food processing plants make up the bulk of the light manufacturing enterprises. Others include cement products, metal products, clothing accessories, and furniture and bedding.

This light manufacturing is chiefly a nonbasic industry, inasmuch as most of the product is consumed locally, rather than exported from the power market area. Nevertheless, these small industries are economically important because they supply needs which would otherwise have to be filled from outside sources. Expansion of this type of manufacturing is very desirable and is expected to continue.

Industries are attracted to a new location by plentiful natural resources, low prevailing wages, transportation advantages, or nearby markets. Unfortunately, Alaska has been able to offer only the first: minerals, fish, furs, and timber. Labor and transportation costs are still high; the permanent population provides only a small consumer market; and an industrial market is almost nonexistent.

Some of these disadvantages may be offset by providing cheap and abundant electric power at suitable industrial locations. Low-cost power at a tidewater site would be a strong inducement to a heavy industry such as aluminum or chemicals. No firm proposal for delivering such low-cost power in adequate quantities has yet been made.

Potential industries which would utilize natural resources of the Railbelt are discussed under the various resources. Another type of industrial development would utilize imported materials to produce goods for local consumption. A fundamental limitation is the relatively small market in western Alaska. The smallest plant of economic size might have a larger capacity than the Alaskan market would require, whereas transportation costs would severely restrict such an Alaskan industry seeking to serve markets in other states. Considering these restrictions, the opportunities for manufacturing for the present are best fitted to products which can


KNOWN MINERAL DEPOSITS
UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
ALASKA DISTRICT
DEVIL CANYON PROJECT
LEGEND
ANTIMONY
ARGILLITE
CHROMITE
CLAY
COAL
COPPER
GOLD-SILVER
GYPSUM
LEAD-ZINC
LIMESTONE
MANGANESE
MOLYBDENUM
OIL WELLS (Producing)
POSSIBLE OIL PROVINCE
PERLITE
SHALE
TIN
TUNGSTEN
SCALE OF MILES
25 0 25 50
KEY MAP
ARCTIC OCEAN
U.S.S.R.
ALASKA
CANADA
BERING SEA
Nome
Fairbanks
Anchorage
Valdez
Seward
Juneau
Kodiak
GULF OF ALASKA
MILITARY INSTALLATIONS
1 Wildwood Military Base
2 Whittier Military Port
3 Elmendorf Air Force Base
4 Fort Richardson Army Base
5 Fort Greely Army Base
6 Eielson Air Force Base
7 Ladd Air Force Base
8 Clear Military Base
MT. McKINLEY NATIONAL PARK
Mt. McKinley
Chakachamna Lake
COOK INLET
Kenai
STERLING HIGHWAY
Tustumena Lake
Skilak Lake
Seldovia
Homer
KENAI MOUNTAINS
Kenai Lake
Seward
ANCHORAGE
Turnagain Arm
Knik Arm
Whittier
Wasilla
Palmer
Willow
Talkeetna
SUSITNA RIVER
Yentna River
Chulitna River
TALKEETNA MTS.
Talkeetna River
Matanuska River
ALASKA RAILROAD
Gold Creek
Summit
Cantwell
Healy
McKinley Park
Nenana
Nenana River
Teklanika River
ALASKA RANGE
DENALI HIGHWAY
Susitna River
Oshetna R.
Maclaren R.
Tyone River
Lake Louise
Sheep Mountain
GLENN HIGHWAY
CHUGACH MOUNTAINS
PRINCE WILLIAM SOUND
Valdez
Glennallen
Gulkana
RICHARDSON HIGHWAY
Copper River
Paxson
Big Delta
Delta Junction
Slana
Tok Junction
Chicken
TAYLOR HIGHWAY
ALASKA HIGHWAY
TANANA RIVER
Salcha River
Wood River
FAIRBANKS
Chena River
ELLIOT HIGHWAY
STEESE HIGHWAY
Livengood
4-1-60
852-906-34
GPO 994274

be profitably produced on a small scale for local use and products which are only partially manufactured and can be completed by local plants.

A small steel mill is currently under consideration for the Fairbanks area. The proposed mill would consist of two plants - a melt plant and a rolling mill. The melt plant would be built around an electric arc furnace utilizing local scrap. Because of the lack of Alaskan markets for scrap, it is relatively cheap, which would offset the cost of other materials which would have to be shipped. The principal output of the mill would be reinforcing steel bars, but other steel products could also be fabricated.

MINING

Gold, more than anything else, made Alaska famous. The yellow metal, however, is yielding its prominent place to other minerals, such as coal, construction materials, and oil, not only in the State as a whole, but also in the power market area.

Metals

Since 1902, when Felix Pedro "struck it rich" near Fairbanks, more than $230,000,000 of placer gold has been mined from the area served by the Alaska Railroad. By far the greatest portion of this was produced in the Fairbanks District. In 1958 the total value of gold and silver production at placer mines in the Railbelt area was about $3,500,000. As in several previous years, a negligible amount of gold was produced at lode mines. Most silver was a byproduct of gold mining.

Gold mining has been caught for several years in a squeeze between the fixed price and rising operating costs. Large blocks of ground previously classed as ore have become economically submarginal. According to its annual reports, a major producer in the Fairbanks area does not expect to operate beyond 1963 or 1964. Thus, the industry that contributed largely to the early settlement and development of Alaska may become a casualty of inflation and changing economic conditions. This is somewhat ironical, because geologists suspect that many of Alaska's gold deposits are yet to be discovered.

Deposits of at least 9 metals other than gold and silver are reported to occur in the power market area: Antimony, chromium, copper, lead, manganese, molybdenum, tin, tungsten, and zinc. The present production of these miscellaneous metals is negligible. The most significant total production has been $2,300,000 worth of chromite ore and concentrates produced since 1943 on the Kenai Peninsula near Seldovia. Most of this went to the Government stockpile. Mining has ceased, at least temporarily, because the purchase program has expired.

Except in those relatively small areas easily accessible to transportation, prospecting for metals other than gold has been very desultory. Systematic investigation of the many geologically favorable areas undoubtedly will result in the discovery of additional deposits of commercially important minerals. With the proper economic conditions, development of and production from these deposits would be profitable.

Construction Minerals

Production of sand, gravel, and stone has recently come to the fore as a major mineral industry of the Railbelt. Because these materials are used primarily by the construction industry, their output fluctuates as the amount of construction varies. The materials are used mainly to build roads and airfields, although considerable amounts are required in concrete structures and by the Alaska Railroad for track ballast. Production of sand, gravel, and stone in the Railbelt was valued at about $2,800,000 in 1958.

The use of other native nonmetallic minerals for construction purposes has been negligible. Suitable raw materials are available in accessible locations, but economic conditions have prevented use except on a minor scale. A new brick plant, utilizing local clays and featuring a downdraft kiln, has recently begun operation in Anchorage. Bulk cement is imported by barge and distributed from a storage plant in Anchorage. The region now consumes about 300,000 barrels annually, less than one-third the capacity of the more economical sized plants. An Alaskan cement plant would have to be very efficient to compete with the comparatively cheap bulk cement imports. Primary ingredients for cement manufacture are available near Cantwell station on the Alaska Railroad. Normal growth of the State, plus the extra cement requirements of major construction projects, such as Devil Canyon Dam and Powerplant, may soon provide the additional demand to justify utilization of local raw materials.

Mineral Fuels

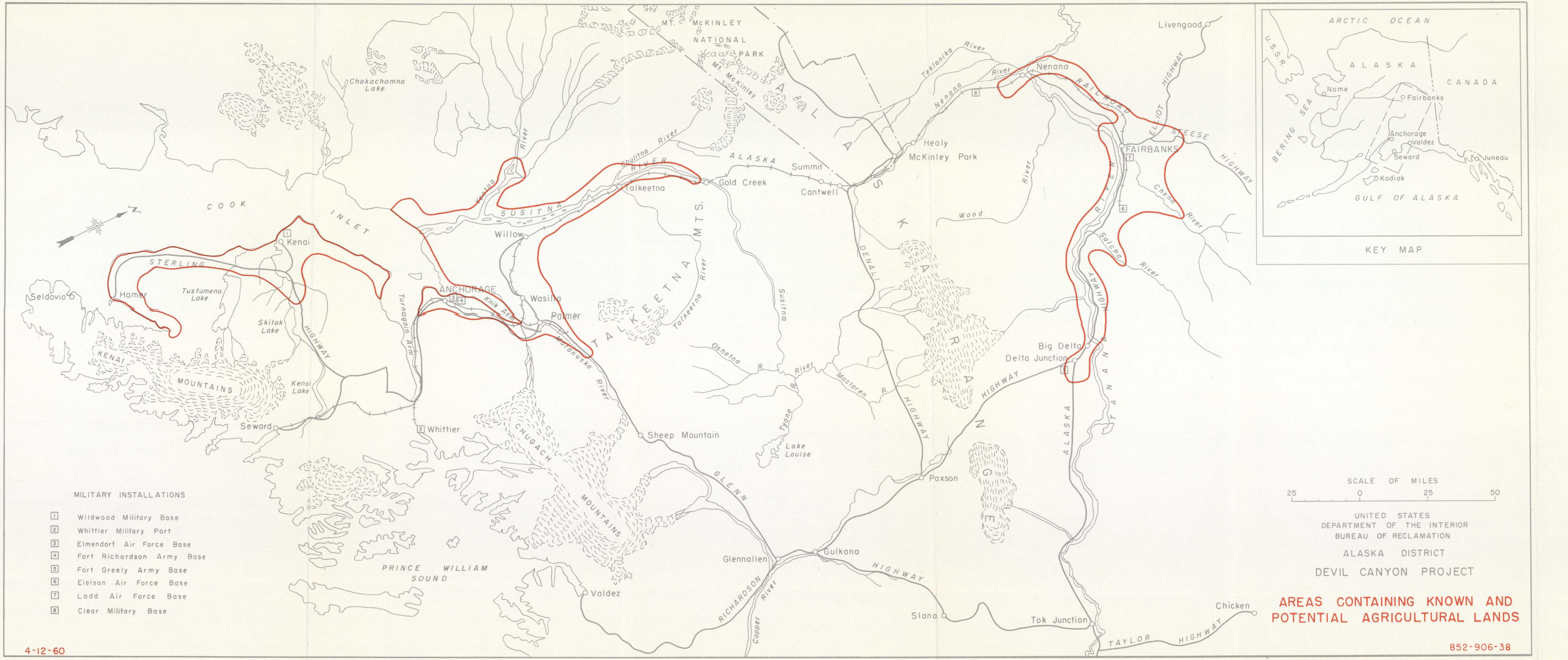
The $6,900,000 worth of coal mined in 1958 accounted for over half the value of mineral production from the Railbelt area. An estimated 70 percent of the coal production was sold for heat and power at military bases. The major coal mines are in the Matanuska field near Palmer and the Nenana field near Healy. Very little coal is mined outside the Railbelt. Recent reconnaissance drilling in the Beluga River area 60 miles west of Anchorage indicates that at least one large bed may be suitable for mining by opencut methods. This field might provide a favorable site for a minemouth powerplant to generate power for transmission to the Anchorage area.

Future demand for Railbelt coal might be unfavorably affected by construction of a large hydroelectric project such as Devil Canyon. On the other hand, it may be enhanced by the development of export markets or the perfection of processes which use coal as a source of organic chemicals, fertilizers, high-B.t.u. gas, liquid fuels, oils, fats, waxes, and paving materials.

Discovery of oil on the Kenai Peninsula in 1957 touched off a land boom similar to the early gold rushes. Exploratory activity was intensified over a large part of Alaska, including the Railbelt. The degree of this activity is indicated by the amount of money spent in the entire State in 1959. Drilling and producing costs amounted to $13,940,000, and exploration expenditures totaled $16,714,000. A large portion of these totals were spent in the power market area. Several million acres are now under oil and gas lease in the area.

By April 1, 1960, six producing wells had been brought in on the northwestern Kenai Peninsula. The efficient rate of production is at least 3,000 barrels per day. Plans are now being made to construct in the near future a pipeline from the oilfields to the coast, where storage facilities and a marine dock will be built. Because most of the companies now searching for oil have their own tidewater refineries, crude oil will probably be sent to those plants in the first years after a major discovery. It will be many years before Alaskan oil consumption will have increased enough to support a refinery in the new State. Japan and Australia, with expanding industrial bases and rising standards of living, are potential markets for Alaska's crude and refined oil production.

Natural gas has been discovered in connection with several oil fields. The largest known field is the Gubik Gas Field on the


AREAS CONTAINING KNOWN AND POTENTIAL AGRICULTURAL LANDS
UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
ALASKA DISTRICT
DEVIL CANYON PROJECT
SCALE OF MILES
25 0 25 50
KEY MAP
ARCTIC OCEAN
ALASKA
CANADA
U.S.S.R.
BERING SEA
GULF OF ALASKA
Nome
Fairbanks
Anchorage
Valdez
Seward
Juneau
Kodiak
MILITARY INSTALLATIONS
1 Wildwood Military Base
2 Whittier Military Port
3 Elmendorf Air Force Base
4 Fort Richardson Army Base
5 Fort Greely Army Base
6 Eielson Air Force Base
7 Ladd Air Force Base
8 Clear Military Base
MT. McKINLEY NATIONAL PARK
Mt. McKinley
ALASKA RANGE
TALKEETNA MTS.
KENAI MOUNTAINS
CHUGACH MOUNTAINS
COOK INLET
PRINCE WILLIAM SOUND
Chakachamna Lake
Tustumena Lake
Skilak Lake
Kenai Lake
Lake Louise
Turnagain Arm
Knik Arm
Seldovia
Homer
Kenai
Seward
Whittier
ANCHORAGE
Wasilla
Palmer
Willow
Talkeetna
Gold Creek
Summit
Cantwell
Healy
McKinley Park
Nenana
FAIRBANKS
Livengood
Big Delta
Delta Junction
Paxson
Sheep Mountain
Glennallen
Gulkana
Valdez
Slana
Tok Junction
Chicken
STERLING HIGHWAY
ALASKA RAILROAD
GLENN HIGHWAY
RICHARDSON HIGHWAY
DENALI HIGHWAY
ALASKA HIGHWAY
TAYLOR HIGHWAY
ELLIOT HIGHWAY
STEESE HIGHWAY
SUSITNA RIVER
Susitna
Yentna River
Chulitna River
Talkeetna River
Matanuska River
Oshetna R.
Tyone River
Maclaren R.
Teklanika River
Nenana River
Wood River
Chena River
Salcha River
Copper River
TANANA RIVER
4-12-60
852-906-38

GPO 994274

Arctic Slope. Some consideration has been given to piping this gas about 465 miles to Fairbanks, where it would be used for heating and generation of electric power. Development of this project does not appear likely in the near future.

Natural gas has also been found in commercial quantities on the Kenai Peninsula. One exploratory well and two development wells have been shut in, awaiting gas marketing facilities. Anchorage has already made tentative arrangements with a private firm for a franchise to supply natural gas to the city.

Summary

In the early years, mining in the Railbelt was primarily for gold. Recently, coal production has gained pre-eminence, with stone, sand, and gravel becoming more important. The brightest future appears to be for oil production. Many different minerals have been reported to occur in the Railbelt area, as shown on Drawing No. 852-906-34.

Construction of access roads to remote areas would greatly facilitate prospecting and would advance the discovery of additional mineral locations. In general, however, economic conditions must become more favorable to encourage the search for and development of new mineral deposits. A dependable supply of low-cost power (2-5 mills per kilowatt-hour) would be an inducement to establish Alaskan mineral industries which might compete with firms from the mainland states.

AGRICULTURE

From its very modest beginning several decades ago, Alaska's agriculture slowly but surely has grown to assume important proportions in the State's economy. In contrast to the few acres cleared by early gold miners, there are now modern farms employing the latest techniques. The main centers of present agricultural production are the Matanuska Valley near Anchorage and the Tanana Valley near Fairbanks.

The Matanuska Valley had been successfully farmed for many years before the Matanuska Colony was established in 1935. Both before and after this date, the farms were small and many were only

POTATOES, CABBAGE AND LETTUCE ARE THE PRINCIPAL ROW CROPS IN MATANUSKA VALLEY.

part-time or subsistence enterprises. Clearing costs were so high that only a few acres a year could be brought into production. Farms are slowly being consolidated, increasing the proportion of full-time farms. About 13,500 acres were cropped in the Matanuska Valley in 1958. The major types of farming are dairy, potato, potato-vegetable, and small poultry. Most of the farm products are marketed in the Anchorage area through the Matanuska Valley Farmers Cooperating Association.

Permafrost creates special problems to be overcome by the successful farmer in the Tanana Valley. After land is cleared and stripped for cultivation or structures, subsidence due to melting may occur in fields or under buildings or roads. Pits that develop in fields cleared for crops require occasional leveling, adding to the high expense of clearing. Permafrost also complicates drainage and farm water supplies. Farming is the main source of livelihood for relatively few families. Potatoes are the leading cash crop, with commercial dairy and poultry farms contributing substantially to the local farm economy. The intensive growing season with long hours of sunlight favors growing grain. The Tanana Valley Farmers Cooperative Association assists the farmers with the many marketing and supply problems. The military installations at Ladd and Eielson Fields purchase large quantities of produce.

A major problem affecting agricultural development in Alaska is the inadequacy of financial assistance for farm settlement and improvement. Potential Alaska farmers seldom have enough capital to obtain the necessary equipment to clear and cultivate lands, and sustain their families for the long period that occurs before any income can be derived from farming. Land clearing is still the hardest and most expensive problem facing the new settler. Some financial aid is being provided, but more is needed.

Efficient farming and proper agricultural development in Alaska has been retarded by lack of information concerning land capability, utilization, and availability. Recent studies by the Soil Conservation Service and reconnaissance surveys by the Bureau of Land Management indicate that the Railbelt includes large areas of land suitable for agricultural production. The major areas are the Kenai Peninsula lowlands, the Matanuska Valley lowlands, the lower Susitna Valley, and the Tanana Valley. Table III-1 summarizes the results of these land capability surveys, as well as data on present land utilization in the main agricultural areas of the Railbelt. Drawing No. 852-906-38 shows the areas in the Railbelt that contain known and potential agricultural lands. In 1959, good unclaimed land in accessible locations could be found only in the Susitna and Tanana

Valleys. In addition to the farms shown in Table III-1, there is in the Railbelt a total of 935 agricultural homesteads which the occupants intend to farm but have not yet reported significant commercial sales.

Table III-1

Agricultural Land in Railbelt Area

Area	Known cultivable land (1000 ac.)	Estimated additional cultivable land (1000 ac.)	Land cropped in 1958 (acres)	Number farms in 1959 Full-time	Part-time
Kenai Peninsula Lowlands	185	47	1,801	10	25
Anchorage area	18	0	1,126	5	35
Matanuska Valley Lowlands	131	27	13,556	115	120
Lower Susitna Valley	79	19	75	2	5
Tanana Valley	332	113	4,294	23	68
Total	745	206	20,852	155	253

Various agencies are conducting research programs to provide basic information for establishing and maintaining a permanent and efficient agricultural industry in Alaska. These programs include such items as livestock requirements, prospective products and markets, and technical problems of development. Other work includes improvement of grains, grasses, and pasture lands; control of insects, plant diseases and weeds; soil management; and adaptation studies of fruits and berries. As part of these research studies, the University of Alaska, in cooperation with the U. S. Department of Agriculture, operates agricultural experiment stations at Palmer and College. The Bureau of Reclamation is cooperating with the Department of Agriculture in studying the feasibility of irrigating crops in the Matanuska Valley. Precipitation is usually deficient early in the growing season, and irrigation might be economically desirable to assist crops in getting an early start. The Soil Conservation Service is also studying the desirability of irrigation in the Tanana Valley.

Alaska's present total retail food bill is estimated at $120,000,000 annually. The retail value of commercial farm sales and home consumption is estimated at about $10,000,000 in 1959. Alaska is therefore about 8 percent self-sufficient in farm-produced foodstuffs. In contrast to this, a realistic goal is 25 percent self-sufficiency by 1975. This goal is justified by economic considerations, and no climatic or environmental limitations bar its attainment. It is estimated that there will be 810 farms by 1975, of which 430 will be in the Matanuska Valley and 300 in Tanana Valley.

FORESTRY

Forests of the power market area are of two general types: the southern coastal forests and the interior forests. The resources of these forests have scarcely been touched.

The predominant commercial species of the southern coastal forest are western hemlock and Sitka spruce, with the former predominating. Most of these stands occur in the Chugach National Forest, which generally covers the Prince William Sound area. The hemlock-Sitka spruce combination is also found in a thin belt along the western coast of the Kenai Peninsula as far north as the town of Kenai. West of the Kenai mountains and a few miles inland from Cook Inlet, the coastal type forest gives way to sparse white spruce and birch forests of non-commercial value. Much of this area was burned over in 1946 to such an extent that natural reseeding has not taken place.

Several commercial sawmills produce lumber primarily from the spruce, with an annual output of about 10,000,000 board feet. One of the largest mills in Alaska is located at Whittier. The smaller mills, many of which are portable, supply local demands. A treating plant, now under construction at Whittier, will have capacity to handle annually about 5,000,000 board feet of poles, piling, ties, and timbers. Much of this will be hemlock, which is little utilized at present. Output of the plant will be sold in Alaska.

The interior forests consist principally of white spruce and Alaska white birch, typically occurring in a mixture. These forests are widely scattered throughout the interior of Alaska, mainly along the lower slopes of the river valleys on the better drained soils and benchlands.

White spruce has been the most widely used timber of the interior forests. Approximately 50 small rough sawmills and a few finishing mills cut white spruce for rough construction lumber, house logs, piling, and the like. Select logs, if properly seasoned, can provide reasonably good inside finish lumber suitable for local use. Total annual production of these small mills, many of which are portable, is about 13,000,000 board feet. It is not expected that white spruce lumber could be economically exported from Alaska. Nevertheless, it should continue to serve, in part, a growing local market. In order to capture a larger share of the market, local mills must furnish a more constant supply of lumber. It must be well manufactured, graded, and air-dried; a fair percentage must be planed and kiln-dried.

Alaska white birch occurs both as a mixture with white spruce and in relatively pure stands. It is a hardwood of fine, even texture and is suitable for furniture, wood veneer, plywood, fine grade flooring, paneling, and dimension stock. The wood is similar to that of the valuable birch species found in the northern Great Lakes states. Past utilization of Alaska birch has been relatively minor.

Expanded utilization of the forest resources appears to center around the Alaska birch, to supplement or replace the rapidly disappearing birch stands of Wisconsin, northern New York, and southern Canada. Tests of Alaska birch from relatively pure stands indicate quality comparable with the yellow birch of the northern Lake states.

The major markets for birch are in the furniture industry, with centers at Grand Rapids, Michigan, and Los Angeles, California. The overland distance to Grand Rapids is so long that Alaska birch might not be able to compete in that market. Los Angeles, however, appears to be a natural market for Alaska birch because the city is far from the birch producing areas of Wisconsin and New York and is located on an established water transportation route from Alaska. The Alaska Railroad and shipping lines have recently established favorable freight rates for lumber shipments from Alaska to the mainland states.

After a lumbering operation for Alaska birch has become firmly established, the next step would be to develop a small hardwood manufacturing industry within the State. This would be especially attractive in the case of furniture for local use, because of the high cost of shipping furniture to Alaska. Birch paneling and flooring are other potential products.

A gross area of about 90,000 acres known as the Talkeetna Birch Stand has been inventoried. This stand occurs on the east side of the Susitna River just south of the Talkeetna River. The average volume per acre is slightly less than 2,000 board feet of commercial birch having a breast-high diameter of 8 inches or more. Application has been made to include this stand in a forest land withdrawal.

Other birch stands presently unknown as to volume and quality exist on the northwest side of Knik Arm, west of the Susitna River, and in the Tanana Valley east of Fairbanks. Some of these stands may be of higher volume and quality than the presently accessible Talkeetna stand. The Knik stand, however, is partially homesteaded, and is therefore less desirable for commercial development.

Other major obstacles which hinder the development of the forest resource are the lack of inventory of many areas, high risk of forest fire, and lack of forest access roads.

The trees of the interior forests make excellent pulp and form a vast potential pulp-wood reserve. If economic conditions become more favorable, the interior forests may play an important role in the rapidly expanding pulp industry.

COMMERCIAL FISHERIES

The commercial fishing industry of the power market area is centered around Cook Inlet and Resurrection Bay (the latter is generally considered a part of the Cook Inlet fisheries). For the most part it can be considered a basic industry, since the bulk of the product is shipped outside the area.

The industry is of major importance to the economy of the Kenai Peninsula, constituting one of the principal sources of employment.

Salmon are the most important species caught and account for a major part of the industry's dollar value. Principal gear employed in salmon fishing are gill nets and beach seines. Traps were also operated in Cook Inlet until 1959. The majority of the fishermen are local residents.

Other local species of importance are halibut, crab and shrimp. Clams are also plentiful in many areas along Cook Inlet, but their use is primarily domestic.

Most of the salmon catch is canned for shipment outside. Other methods of processing are quick freezing and smoking, the latter principally for local consumption. In general, crab meat and halibut are quick frozen for shipment while shrimp are both canned and frozen.

The sea fisheries are also important for their contribution as a local food source. Annual personal use fishing, crabbing and clamming do not reflect in recorded catches but represent a significant value in the local areas.

Over the past 10 years the first wholesale value of the Cook Inlet salmon case pack has averaged about $7,300,000. An annual average of about $2,700,000 of this wholesale value represents payments to fishermen. The crab catch for the past 9 years has represented an additional average annual value to the fishermen of about $140,000. The relative commercial value of other species is minor with the exception of shrimp which are fast growing in importance.

It is believed by the fisheries agencies that by proper management the salmon runs can be increased. Also there exist potential fisheries for species not currently being utilized. Processing of fish wastes, particularly for pet foods and possibly fertilizer, also offers development possibilities. Therefore it is anticipated that production of fishery products will increase in subsequent years.

SPORT FISH AND WILDLIFE

Hunting and fishing for sport constitute an industry of considerable importance to the power market area. A substantial part of this industry can even be considered as basic. Out-of-state hunting and fishing parties and even Alaska residents from other areas contribute significantly to the new money brought in. Furthermore, Alaska is becoming increasingly popular with big game hunters and trophy seekers. Quite generally hunting and fishing forays to much of the interior, northern and western sectors of Alaska are outfitted at Anchorage or Fairbanks.

There is no accurate measurement of the value of sport fishing and hunting to the area. However, the annual investment in gear, food supplies, lodging, guide service and transportation equipment and costs alone probably amounts to several million dollars. This added to the value of fish and game as a local food supply source points up the importance of this natural resource.

The most important big game species found in the area are moose, caribou, black, brown, and grizzley bear. Dall sheep and mountain goat are also hunted, however their generally isolated habitat discourages all but the most ardent sportsmen.

Small game to be found are the snowshoe hare, upland game birds such as ptarmigan and grouse, and many species of migratory waterfowl.

Sport fishing for salmon is both a saltwater and fresh water activity. Cutthroat, rainbow, Dolly Varden and Lake trout are abundant in many fresh water streams and lakes. Grayling are another species of game fish greatly sought after throughout the area. Northern Pike are found in the water courses of the northeastern part of the power market area.

Trapping provides, in general, only a supplemental winter income to those who still pursue this occupation. Principal fur bearers are beaver, land otter, mink, marten, fox, lynx and muskrat. Wolves and wolverine are trapped and hunted for both their pelt and a bounty.

TOURISM AND RECREATION

Only a few years ago a vacation trip to Alaska was a major undertaking, generally limited to those with large resources. Today, although still not inexpensive, Alaska travel has been brought within the means of many. As a result, tourism has become an important Alaskan industry that is receiving considerable attention. It is a basic industry that brings new money into the power market area and is therefore very desirable.

Precise figures on revenue from the tourist trade are not available. In 1957, visitors to Alaska and intra-Alaska vacationists spent an estimated $29,000,000 on transportation, service, and retail trade. Probably one-third of this amount was spent in the power market area.

Alaska offers many scenic attractions for the sightseer and photographer: towering mountains, luxuriant forests, coastal

MOUNT McKINLEY - HIGHEST PEAK ON NORTH AMERICAN CONTINENT.

glacier fields, fiords, lakes, and volcanoes. The sportsman can select big-game hunting, sports fishing, mountain climbing, or winter sports. Anchorage holds a "Fur Rendezvous" in February; Fairbanks sponsors a winter carnival and dog-team races in March and a "Golden Days" celebration in July. Anchorage is the gateway to popular hunting and fishing areas on the Alaska Peninsula. Fairbanks serves as operating base for visitors to the Arctic, the Yukon River, the Seward Peninsula, and many colorful Eskimo towns.

Mount McKinley National Park was established in 1917 for two principal purposes - to include the highest mountain in the North American continent and its associated peaks, and to protect the extraordinary wildlife native to the region. The McKinley Park Hotel, located at the entrance of the park at McKinley Park Station, is operated under concession and is open from mid-June to mid-September. There are splendid views of Mount McKinley from a road which extends 89 miles across the park.

The need for recreational facilities is expected to increase manyfold during the next quarter century. In order to meet the anticipated use, a well-rounded system of public parks should be developed. These could start with simpler types such as view overlooks, picnic areas, and campgrounds, with subsequent expansion to more elaborate facilities. The Statehood Enabling Act (72 Stat. 339) grants the new State the right to select, within 25 years, 400,000 acres of National Forest Land and 400,000 acres of other public lands, all of which shall be adjacent to established communities or suitable for prospective community centers and recreational areas.

Venture capital is required for new motels, hotels, restaurants, service stations, and commercial recreation developments at strategic locations. As new roads are built, added conveniences for travelers must be provided in outlying areas. Sites with specific attractions, such as hot springs, can expect a growing requirement for resort-type facilities centered around a modern lodge or comparable accommodations. Since many tourists do not come to Alaska in their own automobiles, there will be an increasing need for local area transportation facilities, such as rental automobiles and sightseeing buses.

CHAPTER IV

POWER DEMAND AND SUPPLY

Markets for project power would consist primarily of residential, commercial, small industrial, and other utility type loads in the power market area, which extends from Homer and Seward on the south to Fairbanks on the north. The project would also supply requirements of large industries which could reasonably be expected to locate in the area when a large block of relatively low cost power becomes available.

Utility loads are now served chiefly by municipal systems and R.E.A. cooperatives. High cost of generation and shortage of supply discourage greater use of electric power. Construction of Devil Canyon Project would remove these major restraints, resulting in a tremendous increase in use of power. Even with the new generating capacity now under construction, a power shortage will probably occur by 1965. Completion of Devil Canyon Project by 1969 is an urgent need for the Railbelt area.

AREA OF POWER USE

The power market area encompasses a land area of about 40,000 square miles, roughly one-fifteenth the total area of Alaska. It includes the "Railbelt", a strip of land contiguous to and served by the Alaska Railroad, and adjoining areas that probably would be served by project power. This area, equal in size to the State of Virginia or Kentucky, contains about 55 percent of Alaska's present population.

For this study, the power market area is divided into three parts: The Kenai Area includes all of Kenai Peninsula except the southern tip; the Anchorage Area extends from Whittier at the northern end of the peninsula to the Summit station on the Alaska Railroad; and the Fairbanks Area extends from Summit and Paxson to a line about 50 miles north of Delta Junction, Fairbanks, and Nenana.

The power market area includes those areas presently, or proposed to be, supplied by existing utility systems and the areas that would probably be served by Devil Canyon Project, such as the Denali Highway.

PRESENT POWER SUPPLY AND USE

Both power supply and use are divided into two general classifications, military and nonmilitary. With a few minor exceptions, all military loads are supplied by military powerplants. A few small, isolated military posts are supplied by local utilities, and Fort Richardson and Elmendorf Air Force Base purchase nonfirm energy from Eklutna Project. Military generating capacity is not ordinarily available for nonmilitary uses; however, interties between military and civilian systems exist in the Anchorage and Fairbanks areas, and the Bureau of Reclamation has interchange agreements with the military at Anchorage.

Nonmilitary Utility Systems

Central station power is presently distributed by three municipally owned utilities, four REA-financed cooperatives, and three private power companies. In 1959 the REA cooperatives served about 55 percent of all customers, municipal utilities served 44 percent, and private utilities about 1 percent.

Source of Supply

The largest single source of utility power supply is the Federally owned and operated 30,000-kilowatt Eklutna Project near Anchorage. Completed by the Bureau of Reclamation in 1955, this is presently the only source of firm hydroelectric power in the power market area.

The aggregate installed capacity of all utilities, including Eklutna Project, was 81,725 kilowatts in 1959. Of this total, only 75,870 kilowatts was firm capacity. About 39 percent of this total firm capability is hydro, 43 percent is steam, and 18 percent is diesel.

Chugach Electric Association, an REA-financed cooperative at Anchorage, is building a 15,000-kilwatt hydro plant near Kenai Lake on the Kenai Peninsula. This Cooper Lake Powerplant, to be completed in 1961, will operate primarily as a peaking plant, integrated with CEA's 14,500-kilowatt steam plant in Anchorage.

Table IV-1 shows the installed capacity and firm capacity for each type of generation for all significant utility sources in the power market area. The table includes 1959 capacity plus the 15,000-kilowatt hydro plant now being constructed; no other utility capacity is scheduled for addition after 1961.

Table IV-1

Utility Generating Capacity
(To be available in 1961)

Area	Installed Capacity (kw.)				Firm Capacity (kw.)			
	Hydro	Steam	Diesel	Total	Hydro	Steam	Diesel	Total
Kenai	1/ 0	0	5,410	5,410	1/ 0	0	5,180	5,180
Anchorage	1/ 45,000	14,500	7,790	67,290	1/ 45,000	14,500	7,790	67,290
Fairbanks	5,625	18,000	400	24,025	0	18,000	400	18,400
Total	50,625	32,500	13,600	96,725	45,000	32,500	13,370	90,870

1/ CEA's 15,000-kw. Cooper Lake Project, to be completed in 1961, will supply both Kenai and Anchorage areas. Included in Anchorage area figures.

Cost of Supply

Present costs of power generation by utilities in the powermarket area are rather high. The wholesale rate for energy from Eklutna Project is 10.8 mills per kilowatt-hour. The latest estimate of cost of power from the 15,000-kilowatt Cooper Lake Project delivered in Anchorage is about 11.0 mills. Average cost of steam generation at a normal load factor is about 20 mills. Diesel generation costs range from a low of about 24 mills per kilowatt-hour to unit rates of 30 mills or more.

Power Use

Average use per customer, as well as total power use, has increased substantially in the last few years. Records of power sales by utilities in the power market area show that the average use per residential customer increased from 2,480 kilowatt-hours in 1953 to 4,090 kilowatt-hours in 1959. During the same period, the number of customers increased from 20,400 to 25,800.

Average commercial customer use rose from 13,780 kilowatt-hours in 1953 to 19,460 in 1959. The number of customers increased about 28 percent to a total of 3,870 in 1959.

Total energy consumption for farms, street lighting and other municipal use, public buildings, small industries, and miscellaneous use was 42,000,000 kilowatt-hours in 1959 compared to 16,500,000 kilowatt-hours in 1953. Small industries accounted for about 60 percent of this use.

Table IV-2 summarizes the historical utility loads, showing both annual kilowatt-hour use and approximate coincidental December peak kilowatts for the three subareas in the power market area. The table shows gross utility generation, which includes sales, distribution losses, transmission losses, and powerplant use. Two additional recorded loads were purposely omitted from this table. These were the power requirements of the Fairbanks Exploration Company, who operate several gold dredges in the Fairbanks area, and the purchase of Eklutna nonfirm energy by the military. These requirements were not considered to be general utility loads. The Placer Gold Mining Company is the only large industry for which data are available on power use. Consumption decreased from 35,400,000 kilowatt-hours in 1953 to 18,800,000 kilowatt-hours in 1959. Military purchases of nonfirm energy from Eklutna Project averaged 14,200,000 kilowatt-hours in 1957, 1958 and 1959. These uses occur primarily during the summer and contribute only a few hundred kilowatts to the coincidental December peak.

Retail Power Rates

Nearly all retail rate schedules in the power market area are based on a sliding scale, so that the average unit cost decreases as more energy is used. Residential rates in both the Anchorage and

Table IV-2

Historical Utility Loads

Calendar Year	Energy Use (1,000 kw.-hr.) Kenai Area	Anchorage Area	Fairbanks Area	Total	Annual Increase	Percent Annual Increase	Area December Peaks (kw.) Kenai Area	Anchorage Area	Fairbanks Area	Total	Power Market Coincidental Peak (98% of total)
1951	3,961	55,440	22,300	81,701			1,010	12,800	1/		
1952	5,101	74,940	26,325	106,366	24.665	30.2	1,160	16,800	1/		
1953	6,082	100,960	33,467	140,599	34,143	32.1	1,290	21,200	7,900	30,390	29,800
1954	6,329	110,020	37,769	154,118	13,609	9.7	1,390	24,700	8,900	34,990	34,300
1955	7,001	122,898	43,124	173,023	18,905	12.3	1,530	27,400	9,900	38,830	38,100
1956	8,207	140,624	49,335	198,166	25,143	14.5	1,870	32,500	10,800	45,170	44,300
1957	9,959	152,911	51,496	214,366	16,200	8.2	2,300	33,800	11,600	47,700	46,800
1958	11,746	166,508	52,903	231,157	16,791	7.8	2,500	36,400	11,900	50,800	49,800
1959	13,534	183,832	59,331	256,697	25,540	11.0	2,800	40,400	13,000	56,200	55,100

1/ Not available

Fairbanks areas provide an inducement for electric water heating up to a specified monthly block. Electric space heating is not encouraged, principally because of the short supply of power.

Table IV-3 shows the cost of 250 kilowatt-hours per month residential use for the major electric utilities in the power market area. This table also compares the cost of average residential use for each utility in 1958.

Military Systems

Most of Alaska's major military bases are in the power market area. The largest of these are Elmendorf Air Force Base and Fort Richardson near Anchorage and Ladd and Eielson Air Force Bases near Fairbanks. Other major bases in the power market area are Fort Greely near Big Delta, Clear military base south of Nenana, Wildwood military base near Kenai, and the military port of Whittier. Several isolated Nike and radar sites are scattered throughout the general area.

Source of Supply

Six of these major bases have steam power generating facilities to supply their electric power needs. This will also be true of the base now being constructed at Clear. Steam is used for general heating purposes at those bases which have steam powerplants. Nearly all bases have some diesel generating capacity; diesel is the only means of producing power at Wildwood and the smaller military bases. The only use of hydroelectric generation by the military is the purchase of Eklutna nonfirm energy by Elmendorf Air Force Base and Fort Richardson.

Power Requirements

No actual military power requirement statistics are available; however, estimates have been made of the capacity needs of most bases. On an average, actual utilization is about 50 percent of

Table IV-3

Retail Power Costs for Residential Use

Area and Utility	Cost of 250 kw.-hr. per mo.		Cost of average use per customer - 1958		
	Total (dollars)	Cost per kw.-hr. (cents)	Average annual use (kw.-hr.)	Average annual cost (dollars)	Cost per kw.-hr. (cents)
Kenai Area					
City of Seward	13.50	5.40	2,906	169.20	5,82
Homer Electric Assn.	17.50	7.00	1,553	151.92	9.78
Kenai Power Co.	28.80	11.52	888 1/	116.16	13.08
Anchorage Area					
City of Anchorage	10.00	4.00	4,199	141.60	3.37
Chugach Electric Assn.	10.00	4.00	4,408	145.32	3.30
Matanuska Electric Assn.	13.00	5.20	3,755	174.96	4.66
Fairbanks Area					
City of Fairbanks	17.50	7.00	2,848	206.64	7.26
Golden Valley Electric Assn.	17.75	7.10	3,351	228.60	6.82

1/ For year 1957; data for 1958 not available installed generating capacity. Table IV-4 lists the principal military establishments by area, their generating capacity by type, and estimated capacity requirements. If a military system includes both steam and diesel capacity, the diesel is used as standby only. It is estimated that in 1961 there will be an excess of about 49,000 kilowatts of steam capacity and about 22,000 kilowatts of unused diesel capacity at military establishments.

Table IV-4 shows the above data as it was in 1959 and as it will be upon completion in 1961 of two military powerplants now under construction. A 22,500-kilowatt coal-fired steam plant will be a part of the Clear military base, and a 2,000-kilowatt nuclear reactor is being installed at Fort Greely.

The only electrical interconnection between military bases is that between Elmendorf Air Force Base and Fort Richardson, which is for emergency use only. Elmendorf and Fort Richardson have an agreement with the Bureau of Reclamation for purchase of nonfirm energy from Eklutna Project.

Based on the estimated capacity used and an average annual load factor of 60 percent, the energy requirement of the bases listed in Table IV-4 was about 300,000,000 kilowatt-hours in 1959. In 1961 it will be about 360,000,000 kilowatt-hours.

FUTURE POWER REQUIREMENTS AND SUPPLY

Power needs were projected in three separate classifications: general utility, large industrial, and military. Because of the increasing interdependence between the Kenai, Anchorage, and Fairbanks areas, projections were made for the power market area as a whole rather than for the three subareas individually. In all projections it was assumed that Devil Canyon power would be available in 1969 at a delivered wholesale rate of 6 to 8 mills per kilowatt-hour.

General Utility Requirements

This classification includes the usual utility loads such as residential, commercial, farm, municipal, public and government

Table IV-4

Military Generating Capacity and Estimated Utilization

(1959 and 1961)

Area and base	Installed capacity (kw.) Steam	Diesel	Total	Estimated utiliza-tion (%)	Capacity used (kw.)
Kenai Area					
Wildwood	0	1,500	1,500	70	1,000
Anchorage Area					
Elmendorf	31,500	1,600	33,100	55	18,200
Fort Richardson	18,000	9,640	27,640	50	13,800
Whittier	6,500	0	6,500	35	2,300
Subtotal	56,000	11,240	67,240		34,300
Fairbanks Area					
Ladd	10,000	5,000	15,000	50	7,500
Eielson	23,500	5,500	29,000	50	14,500
Fort Greely (1959)	3,000	0	3,000	70	2,100
Fort Greely (1961)	5,000 1/	0	5,000 1/	50	2,500
Clear (1961)	22,500 1/	0	22,500 1/	40	9,200
Subtotal (1959)	36,500	10,500	47,000		24,100
Subtotal (1961)	61,000	10,500	71,000		33,700
Total (1959)	92,500	23,240	115,740		59,400
Total (1961)	117,000	23,240	140,240		69,000

1/ Additions to be in operation by 1961 include a 2,000-kw. nuclear reactor at Fort Greely and a 22,500-kw. coal-fired steam plant at Clear.

agency, and small industrial. Two separate projections were made; one a projection of the historical total load growth pattern, and the other a projection by customer classification. The financial analysis is based on an extension of the historical total load growth pattern, using an average rate of increase adjusted to reflect probable changes due to availability of project power.

Projection by Load Growth Pattern

The historical utility loads were analyzed to study the effect of economic conditions on the growth trend. Table IV-2 shows the percent of annual increase in energy use by years from 1951 through 1959. The abnormally high rates in 1952 and 1953 were undoubtedly due to the rapid buildup of defense establishments. Military construction programs were at their peak. Federal and local agencies, as well as housing and commercial enterprise, were expanding at a fast pace to provide the multitude of facilities and services required. Nearly all construction and expansion in the area were the direct results of the military programs.

By 1954, military construction programs were well past their zenith and tapering off rapidly. The military program was principally concerned with operating and maintaining the major bases. Civilian facilities had caught up with, and in some cases exceeded, the demands.

The construction industry as a whole continued to decline in 1955 and 1956. However, an increasing percentage of construction work was performed by local contractors, thus increasing the industry's value to the local economy. This, coupled with further diversification of the basic economy, contributed to higher rates of increase in power use.

The withdrawal of 12,000 troops from Alaska began during the latter part of 1957. The economic effect of reducing the population of the power market area by an estimated 18,000 persons was reflected in lower rates of increase during both 1957 and 1958.

Population showed a substantial increase in 1959, although it still was less than in 1957. The detrimental effects of the carpenters' strike in 1959, which shut down the bulk of construction through most of the season, are not apparent in the percent increase of power use over 1958. It is reasonable to assume, however, that the percent of increase would have been higher than 11.0 percent, if there had been no strike.

The average annual rate of increase from 1951 to 1959 was 15.4 percent. However, 1952 and 1953 should be excluded because of the abnormally high rates due to the unusual amount of military activity. The average annual increase of 10.6 percent from 1953 to 1959 is believed to represent a reasonable average growth rate for the power market area.

The base for utility expansion is the recorded use in 1959. It was assumed that service area expansion will be a portion of the annual load increase. Therefore, unrecorded loads outside listed utility service areas were neglected in the base.

There is reason to believe that power use in 1960 may be as much as 11.5 to 12.0 percent greater than in 1959. The Alaska Methodist University at Anchorage will open in 1960. A new 13-story, 250-room hotel in Anchorage will have 110 rooms completed and ready for occupancy in June 1960. Golden Valley Electric Association will be serving 200 to 300 new customers in the Big Delta area, including three Federal agencies that will require an aggregate of nearly 750,000 kilowatt-hours per year. Several new commercial establishments will be completed. Anchorage and Fairbanks are scheduled to spend nearly $15,000,000 on city improvements. The overall construction program will be considerably greater and more accelerated than normal, owing to the curtailment in 1959 of much construction originally scheduled for that year.

The recent change in Alaska's political status has aroused great interest in the new state. This interest has been expressed not only by individuals, tourists, and the public in general, but also by many large firms and investors. It is too early to gage the interest generated in industry and investment capital, but it is reasonable to assume that some of it may develop into more tangible evidence.

Considering all aspects of the potential market for power, the average rate of load growth over the next several years should not be less than the 10.6 percent of the past 6 years. The availability of project power is expected to encourage an even higher rate for a few years. Electric space heating alone should account for a substantial increase in average use.

As power use increases to a total of several hundred thousand kilowatts, the annual rate of increase will probably decline slightly. However, it should not be less than 10.0 percent during the period required to build up a full load on Devil Canyon Powerplant.

In projecting the utility requirements based on the load growth pattern, the following conditions were assumed:

(1) Utility loads include residential, commercial, farm, municipal, public and government agency, and small industrial requirements, plus the losses and powerplant use incurred in supplying them.

(2) Devil Canyon Project will begin supplying power in 1969.

(3) The load will increase by the following annual percentages:

1960	11.8 percent
1961-68	10.6 percent
1969-72	11.0 percent
1973	10.8 percent
1974	10.6 percent
1975	10.4 percent
1976	10.2 percent
1977-82	10.0 percent

(4) The load factor will increase gradually to about 55 percent by 1968 and then remain at that value; thus peak demand will not increase quite as rapidly as energy use during the next few years.

The results of projecting the utility requirements based on the load growth pattern are summarized in the second columns of Tables IV-5 and IV-6.

Projection by Customer Classification

The projection by customer classification was based on a population forecast, estimated population-to-customer ratios, and estimated future average use per customer in each classification. Utility distribution losses, as well as transmission losses and powerplant use, were added to estimated sales to obtain total utility load.

The projection by the customer classification method resulted in total utility loads comparable to but slightly greater than those obtained by the load growth pattern method. The former method is probably less accurate because of the several forecasts that were required for component items; it is also less conservative. It was therefore rejected, and the projected requirements based on the load growth pattern method were used in the financial analysis.

Derivation of estimated future loads by the customer classification method are described in detail in Appendix A, Power Demand and Supply.

Large Industrial Requirements

The past and present high cost of doing business in Alaska, high freight rates, and lack of an adequate power supply have discouraged large industries from locating in the power market area. Present non-military generating plants and those under construction will not meet the estimated general utility requirements past 1964, much less offer a dependable supply for large industries. Devil Canyon Project would alleviate this situation substantially.

The cost of project power would not be low enough to provide, by itself, an incentive for industry to locate in the power market area. However, the following considerations make it reasonable to assume that some industrialization would follow project construction:

(1) A fairly large block of power would be available for industrial use at a reasonable cost.

(2) The power market area and adjoining areas contain a wide variety of minerals, timber, and other resources.

(3) Large areas of suitable land with no competitive uses are available at little or no cost.

(4) The power market area contains a tremendous water resource that is relatively unused at present. The time may be very near when this resource, coupled with low cost land and power, will be the deciding factor in locating industries.

Very little potential industrial development can be specifically discussed. Placer gold mining has been the major industrial power use in the past. This load has been gradually declining in recent years. It is estimated that the load will continue to decrease and will substantially cease to exist by 1965.

Demands for power at coal mines will depend chiefly on the need for coal at steam powerplants. All existing powerplants plus those presently under construction will not be able to supply the estimated demand from 1965 until project power would be available in 1969. This deficiency is assumed to be met by construction of additional steam plants. After 1969 use of steam generation will be drastically reduced in favor of less costly project power. Use of power at coal mines is estimated to reach a peak of 10,000,000 kilowatt-hours annually in 1968 and thereafter reduce to 5,000,000 kilowatt-hours a year.

The small electric steel mill at Fairbanks is assumed to begin operation in 1965. Initial energy requirements are estimated at 8,000,000 kilowatt-hours for a 7-month season, increasing to 30,000,000 for full-year and expanded operation in 1969, when project power would be available.

Even though major oil fields are discovered in the power market area, power requirements of the oil industry are expected to be very small. Requirements were estimated to increase from 1,000,000 kilowatt-hours for pumping in 1963 to 5,000,000 kilowatt-hours in 1969. Even if a small refinery were built, power requirements would be relatively small.

Interest has been shown from time to time in developing the birch forests near Talkeetna, a nitrate fertilizer plant in the Kenai Peninsula, and a cement plant near Windy. A small pilot birch mill at Talkeetna was operated one year by a Washington firm and then abandoned. No specific proposals on any of these developments are now available to the public.

In spite of the lack of specific proposals, availability of project power is expected to have a significant effect on industrial development in the area. It was assumed that enough large industrial development will take place in the next 22 years to represent a load of 695,000,000 kilowatt-hours by 1982, corresponding to a peak load of 100,000 kilowatts at an 80 percent load factor, based on December peak.

The estimated future energy and capacity requirements for large industrial loads are shown in Tables IV-5 and IV-6, respectively.

Military Requirements

Table IV-4 shows the estimated military power requirements in 1961 as 69,000 kilowatts. Assuming an annual load factor of 60 percent, energy use would be 360,000,000 kilowatt-hours per year. No change in this demand was forecast for subsequent years.

Fuel costs for small steam unit generation were estimated to be about 10 mills per kilowatt-hour. Power requirements that would not be a hyproduct of steam heating were assumed to be supplied from Devil Canyon Project. This demand was estimated at about 40 percent of total military use, or 150,000,000 kilowatt-hours annually. Allowing 5 percent for transmission losses and powerplant use, a gross project generation of 158,000,000 kilowatt-hours would be required.

Total Projected Requirements and Supply

Table IV-5 combines the energy load projections for the three general classes and shows the portion of the total load that would be supplied by Devil Canyon Project. Table IV-6 shows similar data for the total peak load. These data are shown graphically in Drawings No. 852-906-35 and 852-906-36, respectively, which also depict the sources of supply to serve the load.

The firm capacity of existing utility generating facilities plus proposed additions will be 90,800 kilowatts in 1961 (see Table IV-1). This capacity will be adequate to meet projected peak utility requirements (not including large industrial) only through 1964 and will be short by more than 42,000 kilowatts in 1968. Additional capacity must be programed for construction in the near future in order to avert a serious power shortage.

The potential 46,000-kilowatt Bradley Lake Project on the Kenai Peninsula would not supply the Fairbanks area; it is doubtful if this project could be completed in time to prevent a power shortage

Table IV-5

Projection of Total Energy Load

Devil Canyon Power Market Area

Unit: Million kilowatt-hours

Calendar Year	Nonmilitary Loads					Military load supplied by project	Total load supplied by project
	Utility	Large industrial	Total	Supplied by utility	Supplied by project		
1960	287	22	309	309	-	-	-
1961	317	22	339	339	-	-	-
1962	351	19	370	370	-	-	-
1963	388	16	404	404	-	-	-
1964	429	14	443	443	-	-	-
1965	474	19	493	493	-	-	-
1966	524	21	545	545	-	-	-
1967	580	22	602	602	-	-	-
1968	641	25	666	666	-	-	-
1969	711	42	773	270	503	158	661
1970	789	51	840	270	570	158	728
1971	876	60	936	270	666	158	824
1972	972	75	1,047	270	777	158	935
1973	1,077	99	1,176	270	906	158	1,064
1974	1,191	137	1,328	270	1,058	158	1,216
1975	1,315	184	1,499	270	1,229	158	1,387
1976	1,449	242	1,691	270	1,421	158	1,579
1977	1,594	305	1,899	270	1,629	158	1,787
1978	1,753	384	2,137	270	1,867	158	2,025
1979	1,928	463	2,391	270	2,121	158	2,279
1980	2,121	542	2,663	270	2,393	158	2,551
1981	2,333	616	2,949	270	2,679	158	2,837
1982	2,566	695	3,261	519	2,742	158	2,900

Table IV-6

Projection of Total Peak Load

Devil Canyon Power Market Area

Unit: kilowatts

Calendar Year	Nonmilitary loads					Military load supplied by project	Total load supplied by project	Project load factor (percent)
	Utility	1/ Large industrial	Total	Supplied by project	Supplied by project			
1960	61,000	1,170	62,170	62,170	-	-	-	-
1961	67,000	1,170	68,170	68,170	-	-	-	-
1962	74,000	1,160	75,160	75,160	-	-	-	-
1963	82,000	1,150	83,150	83,150	-	-	-	-
1964	90,000	1,130	91,130	91,130	-	-	-	-
1965	99,000	1,160	100,160	100,160	-	-	-	-
1966	109,000	1,200	110,200	110,200	-	-	-	-
1967	121,000	1,200	122,200	122,200	-	-	-	-
1968	133,000	3,000	136,000	136,000	-	-	-	-
1969	147,000	5,000	152,000	55,000	97,000	30,000	127,000	59.4
1970	164,000	6,000	170,000	55,000	115,000	30,000	145,000	57.3
1971	182,000	8,000	190,000	55,000	135,000	30,000	165,000	57.0
1972	202,000	10,000	212,000	55,000	157,000	30,000	187,000	57.1
1973	222.000	13,000	235,000	55,000	180,000	30,000	210,000	57.8
1974	247,000	19,000	266,000	55,000	211,000	30,000	241,000	57.6
1975	273,000	26,000	299,000	55,000	244,000	30,000	274,000	57.8
1976	301,000	34,000	335,000	55,000	280,000	30,000	310,000	58.1
1977	331,000	43,000	374,000	55,000	319,000	30,000	349,000	58.5
1978	364,000	55,000	419,000	55,000	364,000	30,000	394,000	58.7
1979	400,000	66,000	466,000	55,000	411,000	30,000	441,000	59.0
1980	440,000	77,000	517,000	55,000	462,000	30,000	492,000	59.2
1981	484,000	88,000	572,000	55,000	517,000	30,000	547,000	59.2
1982	531,000	100,000	631,000	81,000	550,000	30,000	580,000	57.1

1/ December peak, coincidental with utility peak. Actual peak would occur in summer in early years.

in the Anchorage area. No other hydroelectric project of adequate capacity could be constructed by 1965. Therefore, it is assumed that additional steam generating capacity would be installed to supply the deficiency until Devil Canyon Powerplant is on the line.

Upon completion of Devil Canyon nonproject power sources would probably continue to supply about 55,000 kilowatts and 270,000,000 kilowatt-hours of nonmilitary load, distributed as follows:

Plant	Type	Peak (kw.)	Energy (kw.-hr.)
Eklutna	Hydro	30,000	143,000,000
Cooper Lake	Hydro	15,000	53,000,000
Other 1/	Steam	10,000	74,000,000

1/ Includes only powerplant capacity which also supplies heating loads.

Devil Canyon Project, upon completion of the first stage in 1969, would assume a gross load of 127,000 peak kilowatts and 661,000,000 kilowatt-hours annually. Of these totals, 30,000 kilowatts and 158,000,000 kilowatt-hours are estimated to be military loads. Additions to the project would be installed as required by the energy and peak load requirements. Devil Canyon Powerplant's 580,000 kilowatts would be fully utilized by 1982.

Load Characteristics

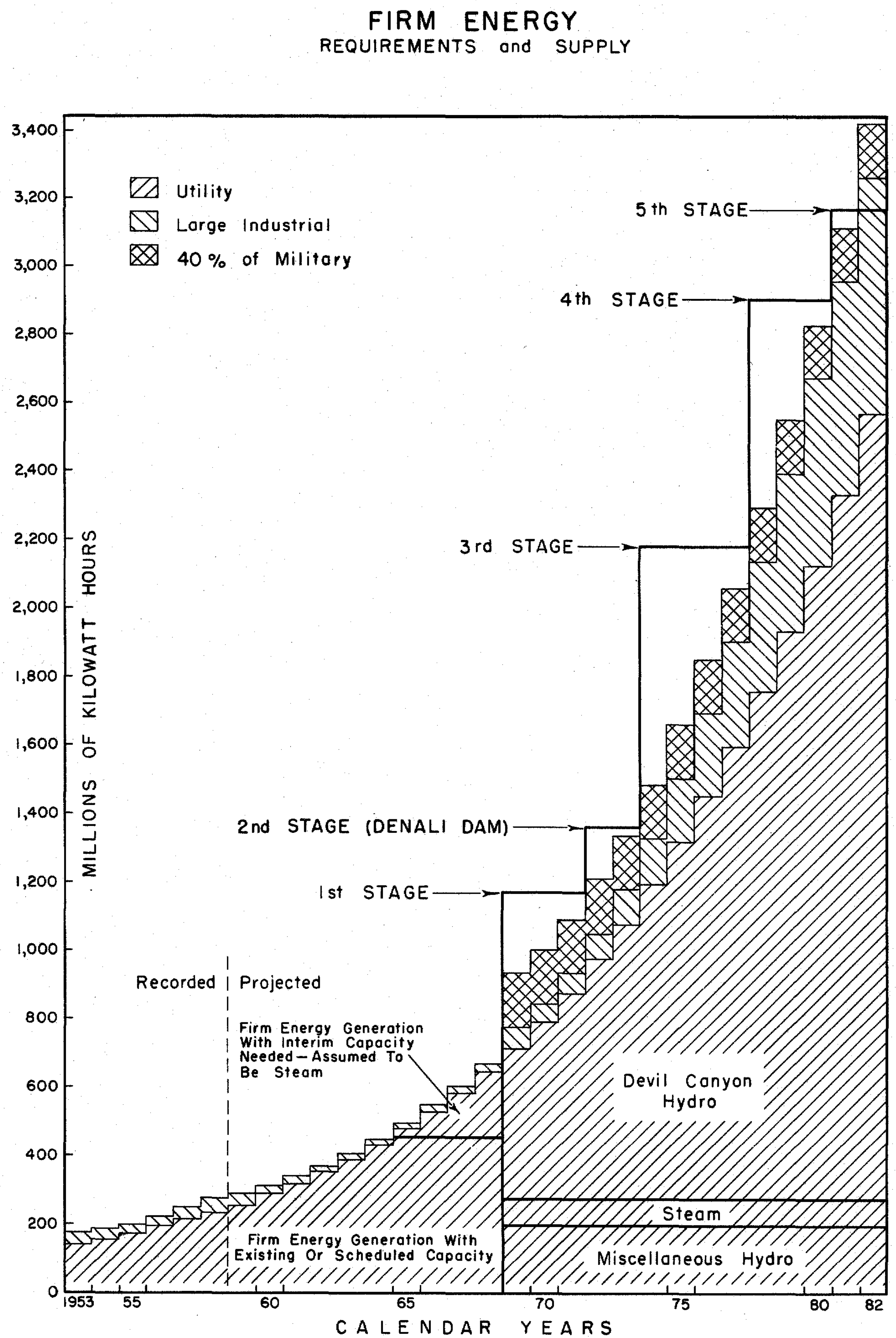
Table IV-7 summarizes the characteristics of the load which would be supplied by Devil Canyon Project. These data are based on records of utilities in the power market area.

Table IV-7

Load Characteristics

Devil Canyon Project

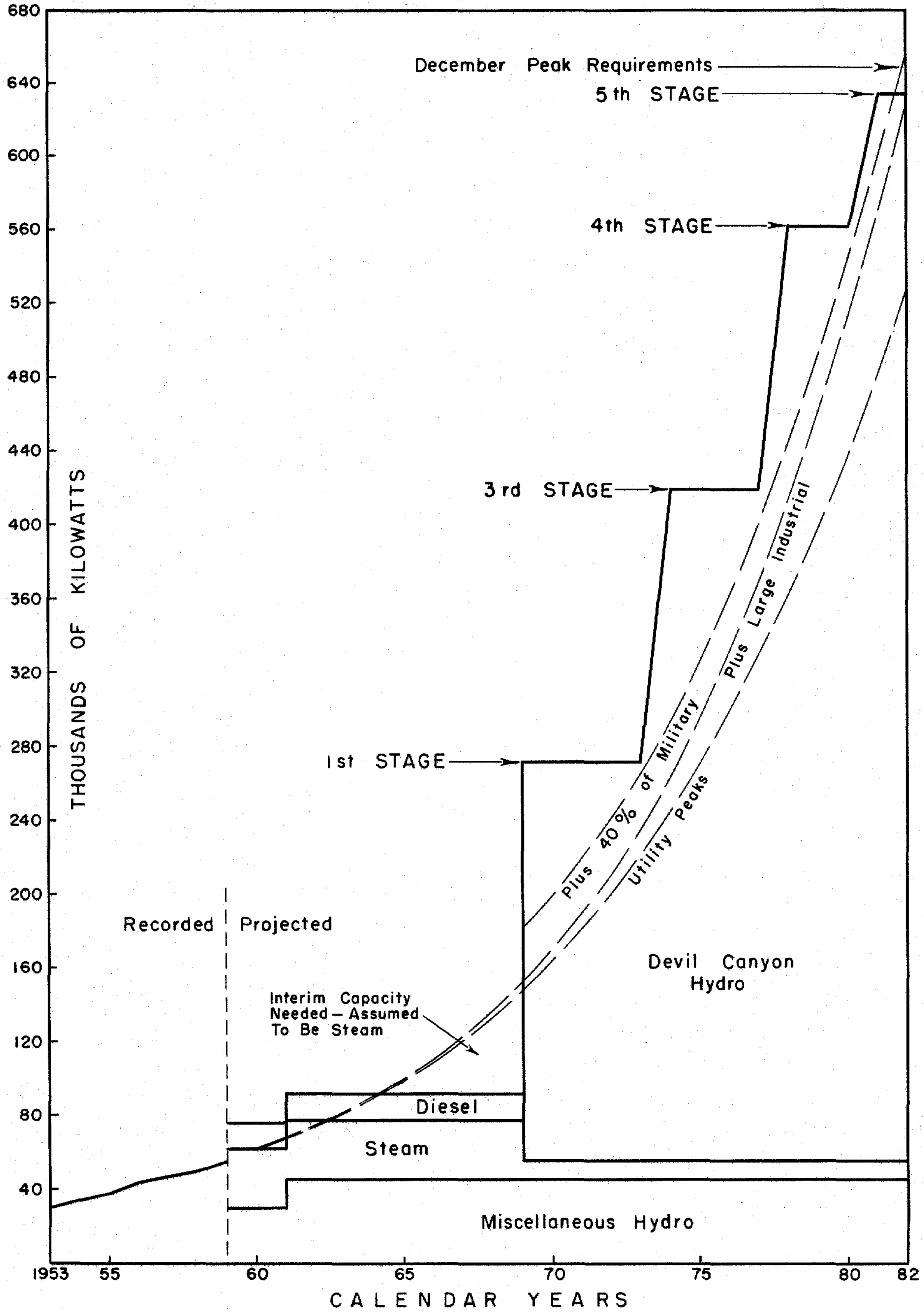
Month	Monthly Load Distribution (percent of annual total)	Monthly Peak Load (percent of annual peak)
January	9.3	89
Feburary	8.1	87
March	8.3	81
April	7.7	71
May	7.6	67
June	7.2	63
July	7.4	68
August	7.7	71
September	8.0	81
October	8.9	89
November	9.4	94
December	10.4	100



4-7-60

852-906-35

FIRM PEAKING CAPACITY
REQUIREMENTS and SUPPLY



4-6-60

852-906-36

CHAPTER V

W A T E R   A N D   P O W E R

Potential energy production at Devil Canyon Powerplant was based on records of Susitna River runoff. Capacities of Devil Canyon and Denali Reservoirs were selected to provide economic regulation of this runoff. Reservoir and power operation studies were run to estimate the potential energy output. Installed and dependable capacities of the powerplant were also determined.

WATER RESOURCES

The Susitna River is the source of water for the Devil Canyon Project. The stream heads in glaciers on the southern slope of the Alaska Range, and the basin includes a large area of lakes in the Tyone River Basin.

Historical Runoff

There are only three stream gaging stations in the upper Susitna River Basin, all established by the U. S. Geological Survey. Susitna River at Gold Creek, 14.5 river miles below Devil Canyon damsite, was established in August 1949. Susitna River near Denali began operation in May 1957; it is 13.5 river miles above Denali damsite, near the Denali Highway bridge. Maclaren River near Paxson is located one-quarter mile below the bridge on Denali Highway; the station was placed in operation in June 1958. All three stations are currently operated by the Geological Survey, and continuous records through September 1959 are available.

The water supply studies for Devil Canyon Project were based on the runoff records of Susitna River at the Gold Creek gage for the period October 1949 through September 1959. Records of Susitna River runoff near Denali were extended to cover this same period by correlation with runoff at the Gold Creek station. Because of the relatively short period of concurrent record, this relationship is poorly defined. A longer record of Susitna River runoff near Denali will be needed for future feasibility studies of Denali Dam.

The paucity of precipitation and stream gaging stations does not permit a very precise determination of runoff at intermediate points between the Denali and Gold Creek gages. Therefore, a straight-line relationship between drainage area and incremental runoff was used. A percentage of incremental runoff between the Denali and Gold Creek gages based on the corresponding increment of drainage area was added to the recorded and estimated runoff at the Denali gage to obtain estimates of historical runoff at the two damsites. The estimated historical runoff of the Susitna River at Devil Canyon damsite and Denali damsite is shown in Tables V-1 and V-2, respectively.

Period of Study

Reservoir and power operation studies were made for the period from October 1949 through September 1959. The minimum annual runoff during this period occurred in water year 1950 and the maximum in 1956. For project operation the critical period was the water years from 1949 through 1952, with reservoir storage being at a minimum in 1952. Firm energy was limited to possible production during this period.

A rough multiple correlation of McKinley Park temperature and precipitation data with Susitna River runoff at Gold Creek indicated that runoff in 1946 and 1947 would have been low, but not lower than in 1950 and 1951. Further multiple correlation studies should be made to determine the critical period more precisely for future feasibility studies of storage requirements above Devil Canyon Reservoir.

Water Rights

The constitution of the State of Alaska provides that surface and subsurface waters are reserved to the people for common use, except mineral and medicinal waters, and are subject to appropriation. "Priority of appropriation shall give prior right. Except for public water supply, an appropriation of water shall be limited to stated purposes and subject to preferences among beneficial uses, concurrent or otherwise, as prescribed by law, and to the general reservation of fish and wildlife."

HYDROGRAPHIC DISCHARGE DATA

Table V-1

Run-off of *Susitna River at Devil Canyon Damsite* Unit *1000 A.F.* Drainage Area *5810* Sq. Miles

YEAR	OCT.	NOV.	DEC.	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEPT.	TOTAL	PERCENT MEAN
49											1439.05	878.61		
1949-50	366.01	144.31	83.05	59.19	41.01	41.85	48.56	666.52	1103.37	1341.55	1179.13	464.50	5538.95	
51	222.11	72.63	63.43	55.33	42.68	42.65	90.34	816.82	1172.09	1339.62	1167.46	1198.68	6283.84	
52	322.04	153.13	109.62	92.37	53.93	50.74	51.33	313.03	1854.23	1565.55	1240.91	812.44	6619.32	
53	474.38	195.39	98.08	63.43	42.68	47.30	90.25	1121.76	1555.04	1198.45	1222.31	857.41	6966.48	
54	323.90	117.34	86.64	75.03	52.08	44.94	68.95	1004.60	1432.31	1208.05	1548.96	724.11	6686.91	
55	310.43	153.97	118.09	103.49	73.00	63.43	67.00	539.20	1705.30	1635.13	1527.96	801.74	7098.74	
56	285.96	106.10	75.03	56.48	52.32	54.18	53.00	1026.53	1912.16	1845.88	1455.52	1031.39	7954.55	
57	335.56	170.45	123.59	98.08	78.18	69.24	67.01	797.56	1723.16	1382.87	1218.51	1114.90	7179.11	
58	476.21	221.90	188.42	113.55	68.25	66.33	85.98	744.45	1459.71	1350.28	1319.87	426.63	6521.58	
59	279.81	120.85	87.42	83.58	68.05	56.44	64.00	958.78	1674.47	1468.12	1820.76	949.34	7631.62	
TOTAL														
MEAN	339.64	145.61	103.34	80.05	57.22	53.71	68.64	798.92	1559.18	1433.55	1370.14	838.11	6848.11	
PERCENT														

Table V-2

Run-off of Susitna River at Denali Damsite Unit 1000 A.F. Drainage Area 1264 Sq.Miles

YEAR	OCT.	NOV.	DEC.	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEPT.	TOTAL	PERCENT MEAN
49											764.61	197.10		
1949-50	61.08	22.42	12.85	7.57	5.46	5.51	6.88	129.13	290.20	712.48	622.47	81.47	1957.52	
51	34.00	11.24	8.78	7.32	5.56	5.56	14.26	174.40	329.25	711.42	615.17	350.61	2267.57	
52	56.36	21.12	16.44	14.39	7.23	7.02	7.06	51.10	922.40	832.65	655.46	174.12	2765.35	
53	85.85	30.40	14.76	8.78	5.57	6.80	14.25	300.74	633.68	633.07	642.10	190.12	2566.12	
54	56.48	17.87	13.08	11.40	7.11	5.71	10.07	246.40	527.53	637.44	821.29	147.83	2502.21	
55	53.74	21.18	17.92	15.11	11.27	8.78	9.94	100.33	774.34	870.82	813.38	172.49	2869.30	
56	46.55	15.28	11.40	7.39	7.12	7.24	7.17	254.37	979.46	987.33	774.09	257.49	3354.89	
57	57.24	26.92	18.28	14.76	11.60	10.09	9.94	171.28	790.46	731.98	640.92	295.62	2779.09	
58	103.74	48.01	29.01	19.50	11.89	10.83	17.71	115.47	560.16	613.89	461.33	132.33	2123.87	
59	72.33	29.32	15.00	11.95	9.07	6.45	6.94	163.93	603.04	573.80	571.34	200.73	2263.90	
TOTAL														
MEAN	62.74	24.38	15.75	11.82	8.19	7.40	10.42	170.72	641.05	730.49	661.76	200.28	2544.98	
PERCENT														

No prior rights of public or private use of water from the Susitna River have been established.

POWER GENERATION

Power would be produced by a powerplant at Devil Canyon Dam. Devil Canyon Reservoir would partially regulate the inflows below Denali Dam, and Denali Reservoir would almost fully regulate its inflows.

Operating Plan

On the average, 64 percent of the annual runoff at Devil Canyon damsite occurs during the months of June, July, and August, and 88 percent from May through September. Reservoir capacity would therefore be needed to store water in excess of the needs for power generation in the months of high runoff and release it during months of less than average runoff. Devil Canyon Reservoir, however, would not be large enough to provide the necessary capacity, so an upstream reservoir would be necessary. Denali Reservoir has been included in the project plan for this purpose.

About 54 percent of the annual inflow between Denali and Devil Canyon damsites occurs during June, July, and August, and 84 percent from May through September. In order to make the best use of the reservoir capacity and power head at the Devil Canyon site, the following operating plan was adopted:

(1) Perfect ability to forecast inflows was assumed. Although this would not be possible under practical operating conditions, a reasonably accurate forecasting procedure can be developed. The effect of forecast error on the results of the theoretical operation studies would not be significant.

(2) Devil Canyon Reservoir was kept full during the winter, so that the powerplant would operate under the maximum possible power head. During this period, water was withdrawn from Denali Reservoir to supplement the natural flows at the powerplant.

(3) Devil Canyon Reservoir was drawn down enough each spring to provide sufficient space to store the portion of the inflow originating below Denali Dam during the period of high runoff that was not released for power generation. If this surplus flow was greater than the active reservoir capacity, the reservoir was drawn down to minimum operating level, and some water was spilled. During this period of drawdown and refill at Devil Canyon Reservoir, no water was released from Denali Reservoir. This period varied from year to year with the variations in monthly runoff, but on the average it was from April through September. The entire active capacity of Devil Canyon Reservoir was used in 8 out of the 10 years of study.

(4) Under this operating plan, Devil Canyon Reservoir provided only seasonal regulation of inflows below Denali Dam. Denali Reservoir provided seasonal regulation, as well as holdover capacity to store water in years of high runoff and release it in years of low runoff.

Reservoirs

Sedimentation

Estimates of sediment inflow into the reservoirs were based on results of periodic sampling of suspended sediment in Susitna River at the Gold Creek station. Suspended sediment sampling data from other interior Alaska streams and three samples at the Denali station were also used in estimating sediment inflow to Denali Reservoir. These sediment records were obtained by the U. S. Geological Survey.

Without any upstream storage, the average annual sediment inflow to Devil Canyon Reservoir was estimated at 6,440 acre-feet; after Denali Reservoir is built, this would reduce to 2,530 acre-feet. The estimated average annual sediment inflow to Denali Reservoir is 11,400 acre-feet.

Devil Canyon Reservoir

At normal full pool elevation of 1,450 feet, Devil Canyon Reservoir would have a total initial capacity of 1,100,000 acre-feet, of which 807,000 acre-feet would be active storage. In order not to exceed the allowable variation of head on the turbines, the minimum operating level would be 1,275 feet, the bottom of active capacity.

Assuming that Denali Dam would be placed in operation 10 years after Devil Canyon Dam is completed, the estimated sediment accumulation in Devil Canyon Reservoir would reduce the active capacity to 765,000 acre-feet after 50 years and 725,400 acre-feet after 100 years. The power market study shows that Denali Reservoir would be required only 3 years after Devil Canyon Powerplant begins operation. However, the changes in active reservoir capacity caused by this revised schedule would be negligible.

The capacities at the end of 50 years were used in the reservoir and power operation studies.

Denali Reservoir

Denali Reservoir would have a total initial capacity of 5,400,000 acre-feet at normal full pool elevation of 2,552 feet. This total includes the active capacity required to regulate the runoff at Denali Dam during the period of study plus 1,140,000 acre-feet for sediment accumulation during 100 years.

The initial active capacity of Denali Reservoir would be 5,300,000 acre-feet, decreasing to 4,770,000 acre-feet at the end of 50 years and to 4,260,000 acre-feet after 100 years. The 50-year capacities were used in the reservoir and power operation studies.

Power Operation

Evaporation

There are no records of evaporation in the Susitna River Basin. Records taken at Palmer and College indicate that evaporation from a free reservoir surface would average about 13 inches annually. Net evaporation losses should not exceed one-half foot on the basis of full reservoirs. This would be equivalent to annual evaporation losses of 3,800 acre-feet at Devil Canyon and 30,500 acre-feet at Denali, or 0.6 percent and 1.2 percent of the average annual runoff at the respective damsites. The errors in estimated runoff are possibly much greater than these percentages, so reservoir evaporation was disregarded in the operation studies.

Power Head

With an average tailwater elevation of 875 feet, the average net head on Devil Canyon Powerplant would be 538 feet. Average head losses were estimated at 5 feet. Based on this average loss, the maximum operating head would be 570 feet and the minimum operating head, 395 feet. The turbine design head would be about 530 feet.

Reservoir Releases

Controlled releases from Denali and Devil Canyon Reservoirs would be for power generation only. Water would be released through Devil Canyon Powerplant to provide energy in accordance with the monthly load distribution shown in Table IV-7. Releases would be made from Denali Reservoir as previously described under Operating Plan. Continuous releases for power would be sufficient to maintain fish life below the powerplant.

Releases required for firm energy are based on an 80 percent overall efficiency at Devil Canyon Powerplant for all heads.

Operation Studies

Reservoir and power operation studies were started with full reservoirs at the beginning of October 1949 and carried through September 1959. Energy output was selected as the maximum that could be attained and still permit the reservoirs to refill near the end of the study.

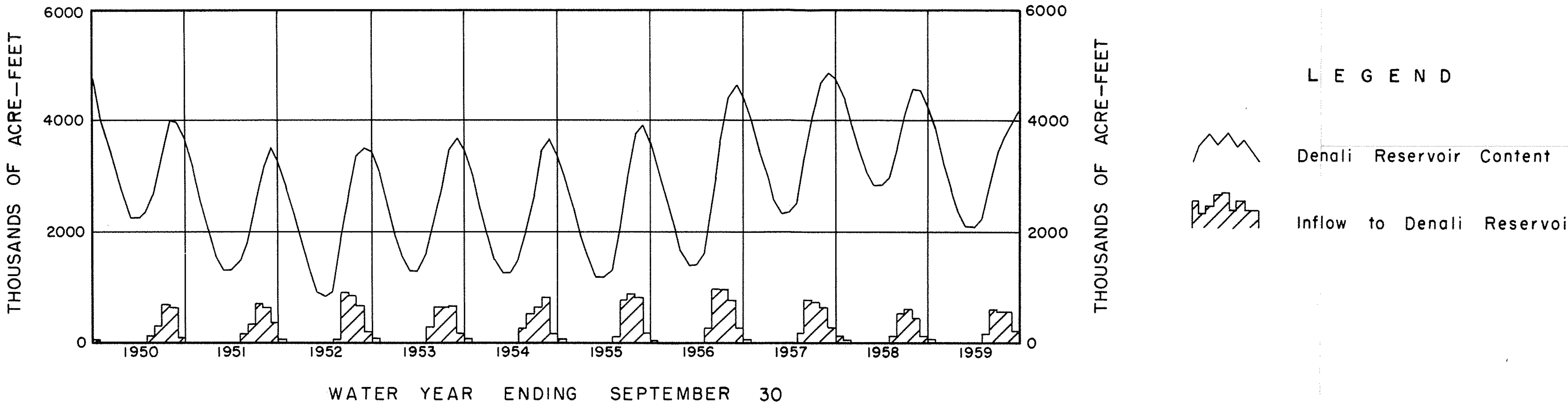
The project operation study included Devil Canyon Reservoir and Powerplant and Denali Reservoir, operated as previously described. Reservoir capacities after 50 years of sediment deposition were used in this study. Total capacity was 950,000 acre-feet at Devil Canyon and 4,850,000 acre-feet at Denali. Owing to lack of sufficient active capacity, Devil Canyon Reservoir spilled in every year except two. Denali Reservoir refilled with a small spill in 1957. Additional capacity in Devil Canyon Reservoir to regulate these spills would be too expensive to be justified economically. If energy output were increased to utilize part of these spills, intolerable shortages in peaking capacity would be incurred and Denali Reservoir would not refill during the period of study. Gross generation of Devil Canyon Powerplant was 2,900,000,000 kilowatt-hours annually. The nonfirm energy with this development would average about 133,000,000 kilowatt-hours annually. No benefits are shown for this potential revenue.

The operation study is summarized in Table V-3 and is shown graphically in Drawings No. 852-906-32 and -33.

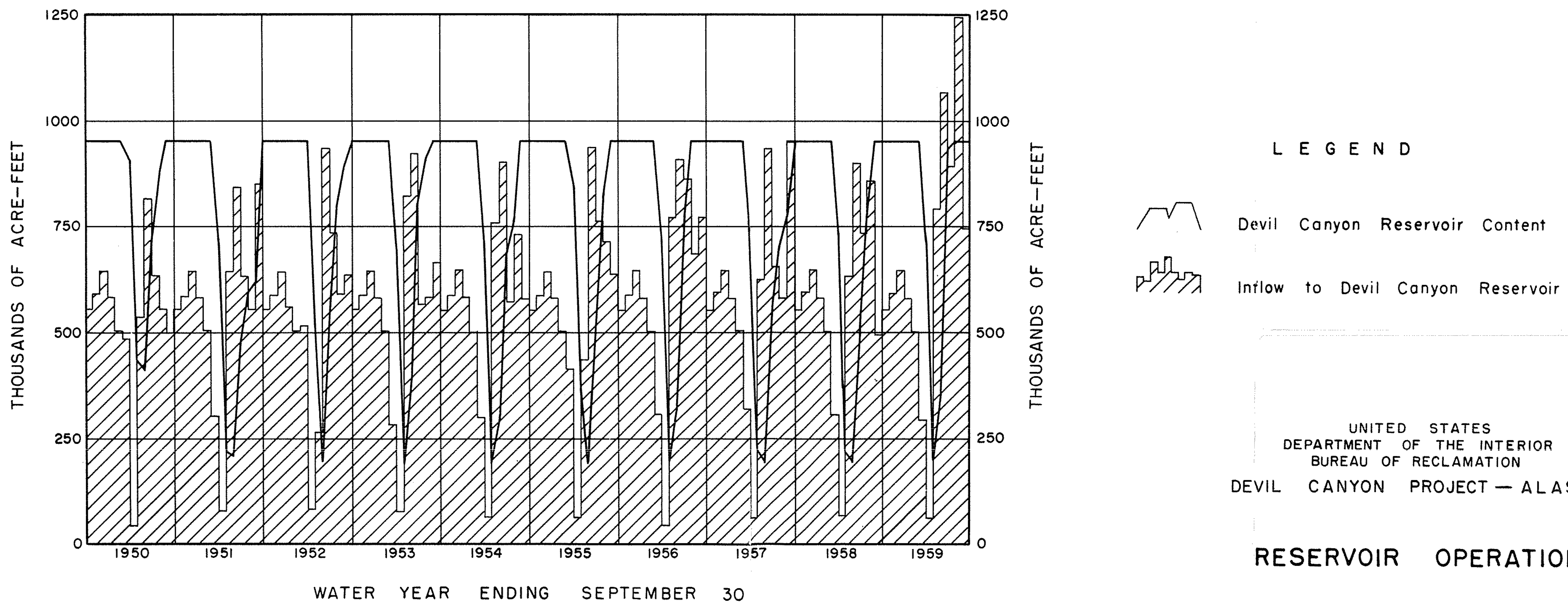
The potential output of Devil Canyon Powerplant without any upstream storage would be about 900,000,000 kilowatt-hours annually, as determined from a separate reservoir and power operation study. This output was compared with the power market study to decide when Denali Reservoir would be required to increase the Devil Canyon Powerplant output to keep pace with the load growth. Very little sediment would be deposited in Devil Canyon Reservoir during the first few years of operation; therefore, the initial total capacity of 1,100,000 acre-feet was used in this study. Because of the small active capacity compared to total inflow, large spills would occur from June through September each year, permitting generation of substantial quantities of nonfirm energy. As there would be no significant market for nonfirm energy during the years that the load is building up, the potential nonfirm output at Devil Canyon Powerplant during this period was not computed.

Energy Output and Powerplant Capacity

The optimum energy output of Devil Canyon Powerplant, as determined by the project operation study, would be 2,900,000 kilowatt-hours annually. The installed capacity of Devil Canyon Powerplant would be 580,000 kilowatts.



RESERVOIR OPERATION



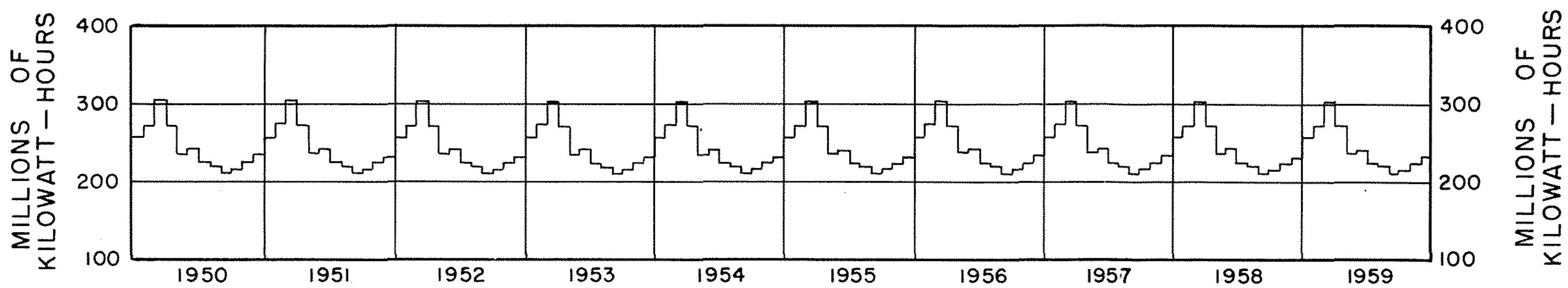
RESERVOIR OPERATION

4-19-60

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
DEVIL CANYON PROJECT — ALASKA

RESERVOIR OPERATION

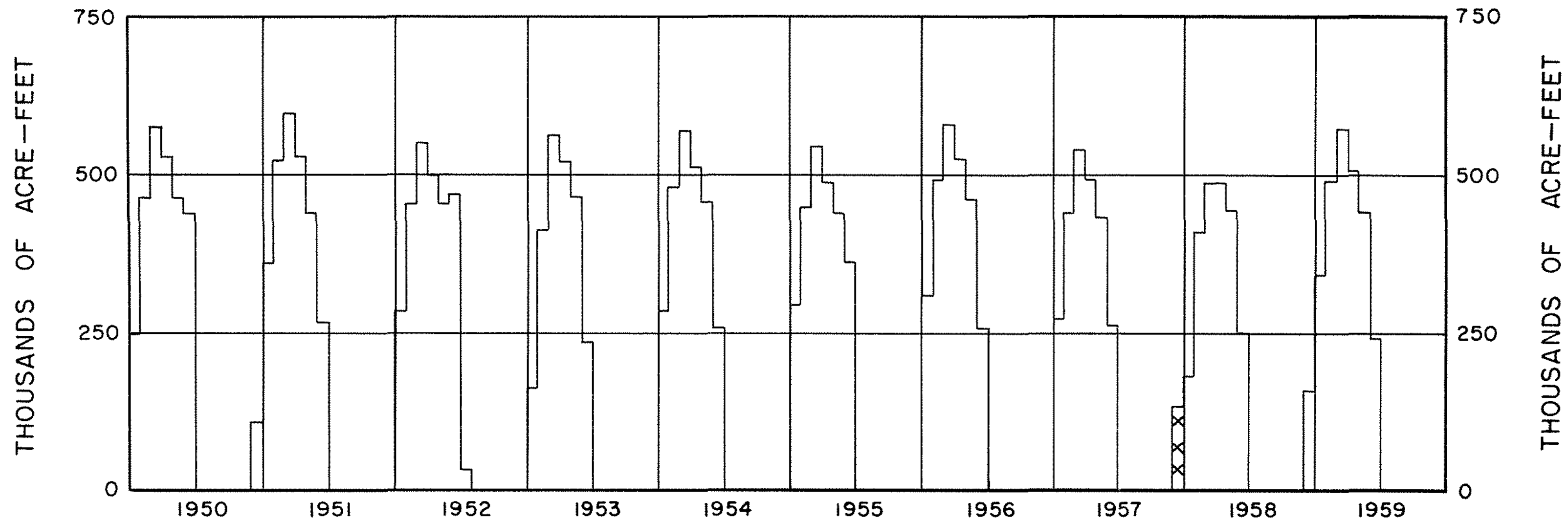
852-906-32



ENERGY OUTPUT

LEGEND

Devil Canyon Energy Output

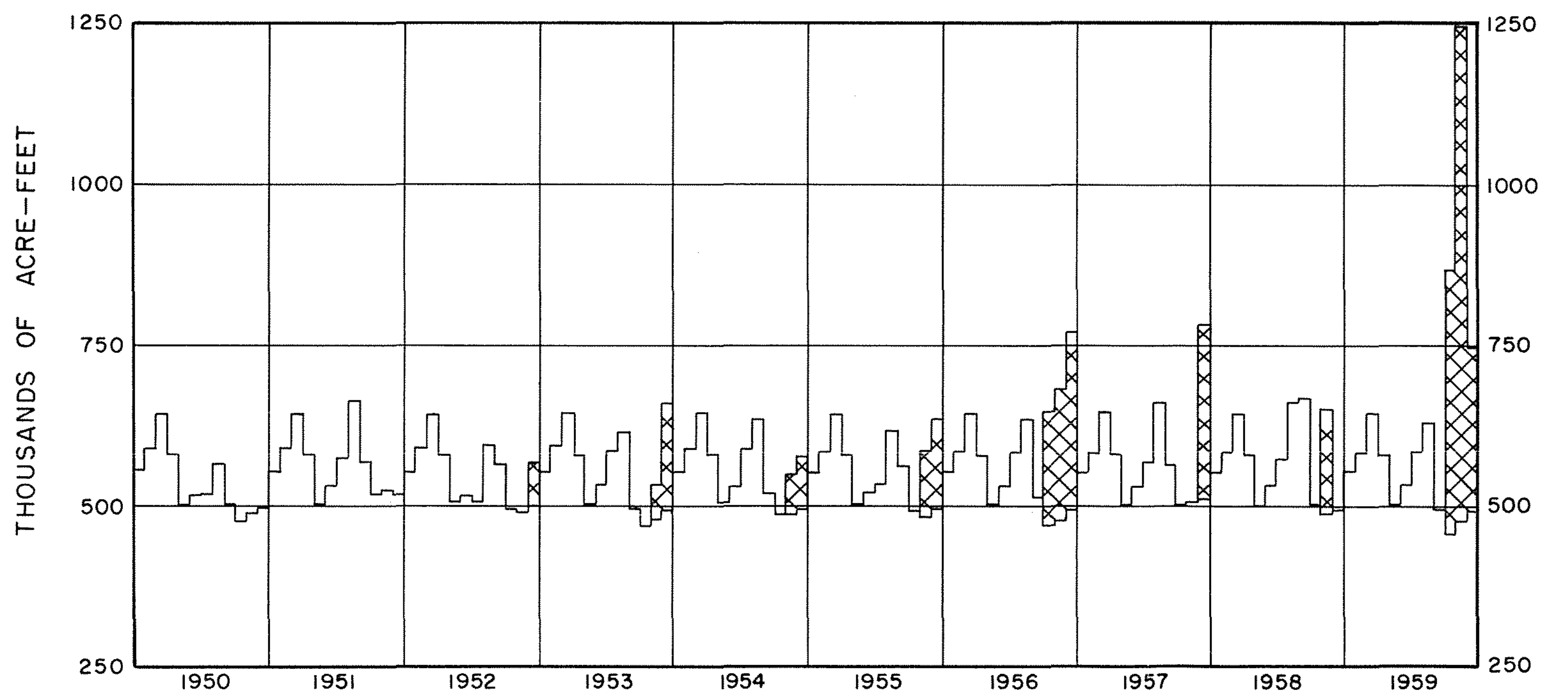


WATER RELEASE

LEGEND

Release at Denali

Spill at Denali



WATER YEAR ENDING SEPTEMBER 30

WATER RELEASE

LEGEND

Devil Canyon Power Release

Spill at Devil Canyon

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION

DEVIL CANYON PROJECT — ALASKA

WATER RELEASE and ENERGY OUTPUT

4-20-60

852-906-33

GPO 994274

Table V-3

Annual Summary

Reservoir and Power Operation Study

Unit: 1,000 acre-feet (unless otherwise shown

Year ending Sept. 30	Denali Reservoir					Inflow, Denali to Devil Canyon	Devil Canyon Reservoir and Powerplant					
	Inflow	Release	Spill	Content end of year	Mini-mum content		Total inflow	Release for firm power	Spill	Content end of year	Mini-mum content	firm energy (million kw.-hr.)
				4850						950		
1950	1958	2835	0	3973	2243	3581	6416	6416	0	950	412	2900
1951	2268	2739	0	3502	1306	4016	6755	6755	0	950	205	2900
1952	2765	2752	0	3515	879	3854	6606	6536	70	950	185	2900
1953	2566	2372	0	3709	1295	4400	6772	6548	224	950	185	2900
1954	2502	2568	0	3643	1252	4185	6753	6610	143	950	185	2900
1955	2869	2585	0	3927	1186	4229	6814	6579	235	950	185	2900
1956	3355	2632	0	4650	1390	4600	7232	6572	660	950	185	2900
1957	2779	2447	132	4850	2342	4400	6979	6709	270	950	185	2900
1958	2124	2461	0	4513	2814	4398	6859	6689	170	950	185	2900
1959	2264	2606	0	4171	2052	5368	7974	6536	1438	950	185	2900
Mean	2545	2600	13	-	-	4303	6916	6595	321	-	-	2900

Dependable Capacity

The project operation study indicates that Devil Canyon Powerplant could supply all peak loads except for shortages of 16,000 kilowatts (4.1 percent) during May in four years. Peak requirements were computed by applying the percentages in Table IV-7 to the installed capacity of 580,000 kilowatts. This inability to meet peak loads was due to the reduced power head at the end of April. These shortages would not be serious, and Devil Canyon Powerplant is considered capable of providing the dependable capacity required for peak loads associated with a firm energy output of 2,900,000,000 kilowatt-hours annually.

If additional reservoir capacity is constructed between Denali and Devil Canyon Dams, less capacity would be required in Devil Canyon Reservoir to regulate inflow below the next dam upstream. This would make it possible to maintain Devil Canyon Reservoir full during more months of the year, and the drawdown in other months would be less. Under these potential ultimate conditions, there would be no shortage in peaking capacity.

CHAPTER VI

PLANS AND ESTIMATES

Field and office studies have been performed as the basis for selecting the adopted plan of development for Devil Canyon Project. Designs and estimates of project features have been prepared in sufficient detail to provide a reasonable estimate of total project cost.

PLAN OF DEVELOPMENT

Devil Canyon Dam and Powerplant, the main project features, would be constructed on the Susitna River 14.5 miles upstream from the Gold Creek station on the Alaska Railroad. The dam would form a reservoir to regulate partially the inflow below Denali Dam and would create head on the powerplant.

Denali Dam would be located about 115 miles above Devil Canyon Dam. Because of the relatively small reservoir capacity behind Devil Canyon Dam, most of the runoff regulation is provided by Denali Reservoir. This reservoir is also necessary to prolong the life of Devil Canyon Reservoir by storing most of the sediment transported by the Susitna River above Devil Canyon.

The transmission system would include a switchyard at Devil Canyon Powerplant, transmission lines to Anchorage and Fairbanks, and substations at those two cities.

The project would be constructed for the sole purpose of generating hydroelectric power. It would be, however, only the first step in an ultimate project which would develop all the potential power head between Denali and Devil Canyon Dams. At least two other potential power sites have been located between the two project dams.

Development for purposes other than power is not necessary or is not feasible at the present time. The lower Susitna Valley is a potential agricultural area that may ultimately utilize water for irrigation. If this becomes the case, water may be supplied more economically from some source other than the Susitna River. Even if diversion from the Susitna River is the most desirable plan, construction of Devil Canyon Project would not significantly hinder or assist irrigation development.

Present flood damage below Devil Canyon Dam is so small that eliminating it would not justify inclusion of flood control space in Devil Canyon Reservoir. Normal operation of the project for power, however, might result in some reduction in flood damage. There is no demand to regulate the Susitna River for navigation or for municipal and industrial water supply. Recreational use of project reservoirs may become important in the future. Development for this use need not be undertaken until the demand arises; nothing in the proposed plan would preclude or hinder such future use.

The adopted plan of project development is based on feasibility studies of Devil Canyon facilities and reconnaissance studies of Denali Dam and Reservoir. These investigations indicated that a powerplant at Denali Dam is not economically justified at the present time. Additional runoff data, water supply studies, field surveys, geologic investigations, structure designs, cost estimates, and economic studies will be needed to select the final plan for developing the Denali site. However, the present studies have been prepared in sufficient detail and with adequate allowance for unknown or partially known factors to indicate that the project can be built and is economically feasible.

DEVIL CANYON DAM, POWERPLANT, AND RESERVOIR

Devil Canyon Dam, Powerplant, and Reservoir are the key features of the project. They would constitute the initial stage of project construction. The feasibility design of Devil Canyon Dam and Powerplant is shown on Drawings No. 852-D-6 and 852-D-7.

Dam

Devil Canyon Dam would be a concrete arch structure rising 635 feet above the foundation. The crest would be 1,370 feet long at elevation 1,455, which is 565 feet above the normal river water surface. A concrete thrust block would support the high arch on the left abutment. The earth and rockfill dike required in a saddle on the left abutment would tie into the thrust block.

Spillway

A gated spillway, located on the right abutment, would discharge 142,000 cubic feet per second at a maximum water surface elevation of 1,455 feet. This flow, combined with 8,000 cubic feet per second passing through the powerplant (four units operating), would protect against the inflow design flood, which has a peak of 150,000 cubic feet per second and a 15-day volume of 2,000,000 acre-feet.

Outlet Works

A permanent outlet would be installed in the dam at elevation 1,018 to supply downstream demands while the reservoir is filling and when the powerplant might be shut down. Maximum required releases would be 2,000 cubic feet per second. During the filling period, water would be released through a temporary gate in the diversion tunnel until the reservoir water surface reaches elevation 1,018.

Powerplant

Devil Canyon Powerplant would be located on the right canyon wall just below the dam. Total powerplant capacity would be 580,000 kilowatts, divided among eight 72,500-kilowatt units. Initial installation would be three units. Other units would be added as required by the increase in power load.

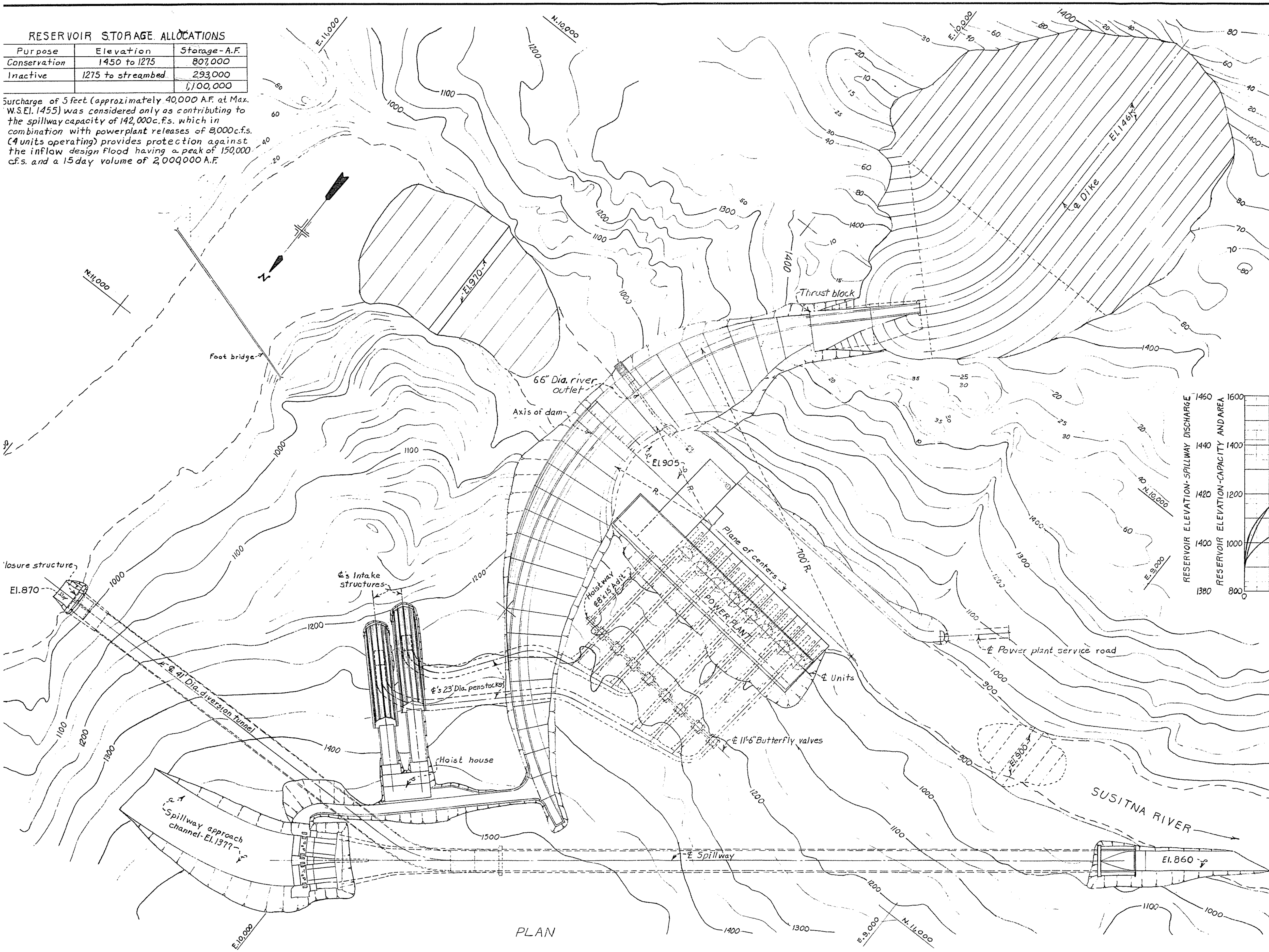
Reservoir

Devil Canyon Reservoir would extend 29 miles up the Susitna River. At normal full pool elevation of 1,450 feet, the reservoir would have a water surface area of 7,550 acres and an initial capacity of 1,100,000 acre-feet. The entire reservoir area is in the public domain and has been withdrawn from entry under a power site classification; no right-of-way would have to be purchased. Much of the reservoir area is covered with timber and brush, which would have to be cleared. There are no existing facilities that would require relocation.

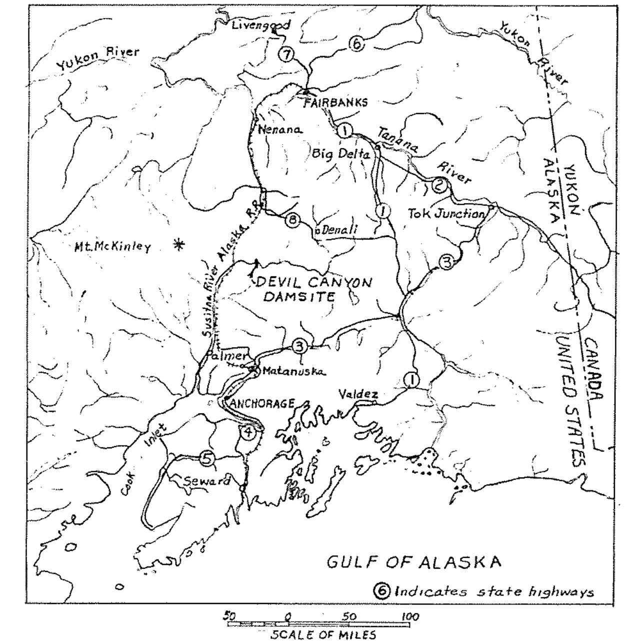
RESERVOIR STORAGE ALLOCATIONS

Purpose	Elevation	Storage - A.F.
Conservation	1450 to 1275	807,000
Inactive	1275 to streambed	293,000
		1,100,000

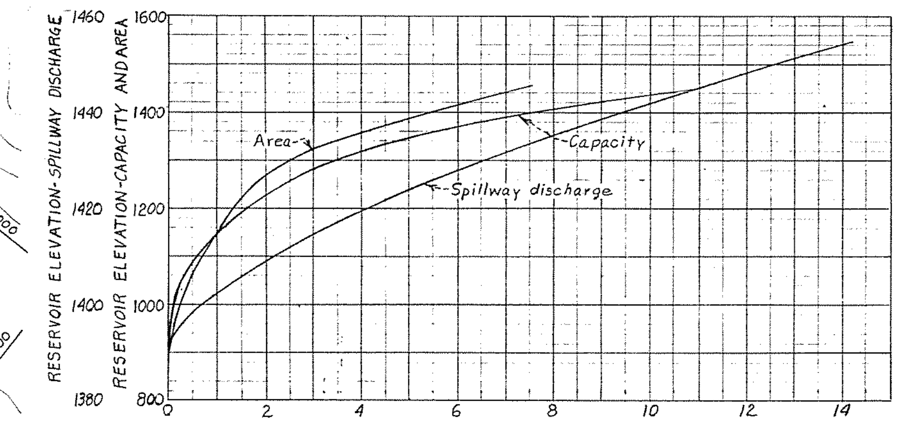
Surcharge of 5 feet (approximately 40,000 A.F. at Max. W.S. El. 1455) was considered only as contributing to the spillway capacity of 142,000 c.f.s. which in combination with powerplant releases of 8,000 c.f.s. (4 units operating) provides protection against the inflow design flood having a peak of 150,000 c.f.s. and a 15 day volume of 2,000,000 A.F.



PLAN



LOCATION MAP



AREA, CAPACITY, AND SPILLWAY DISCHARGE CURVES

NOTE

Topography taken from Dwg. 852-D-5.

SCALE OF FEET

6-28-60 D. REVISED NOTE UNDER RESERVOIR STORAGE ALLOCATIONS CHART

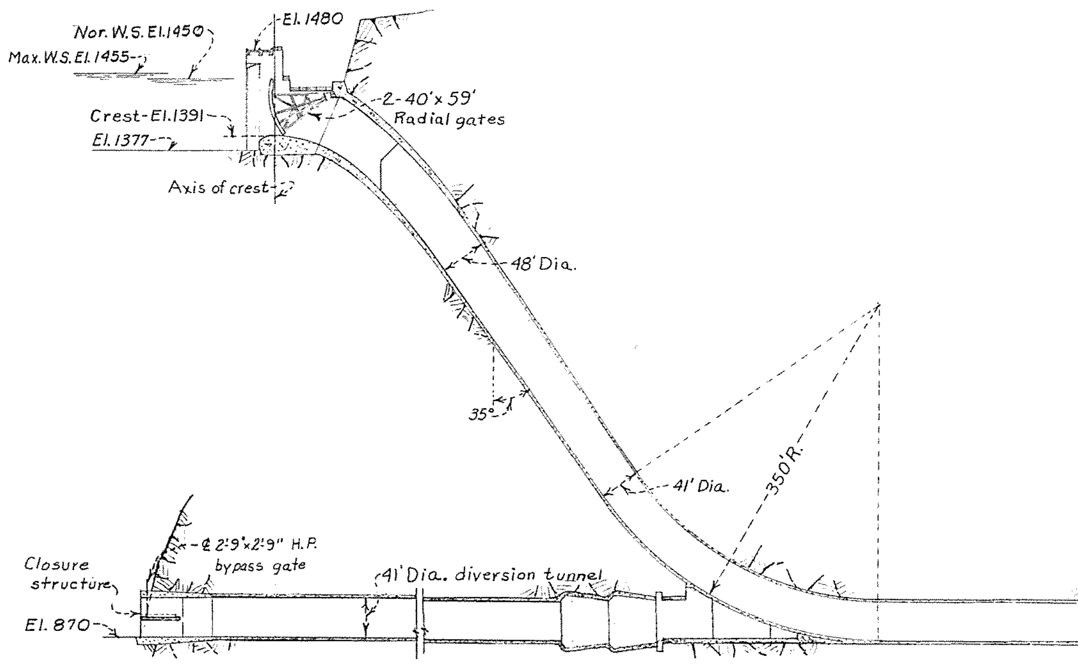
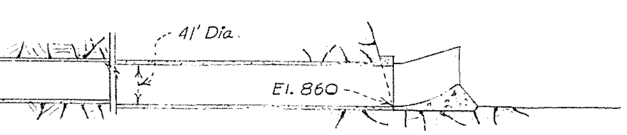
UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
DEVIL CANYON PROJECT - ALASKA

DEVIL CANYON DAM AND POWER PLANT
FEASIBILITY ESTIMATE DRAWING

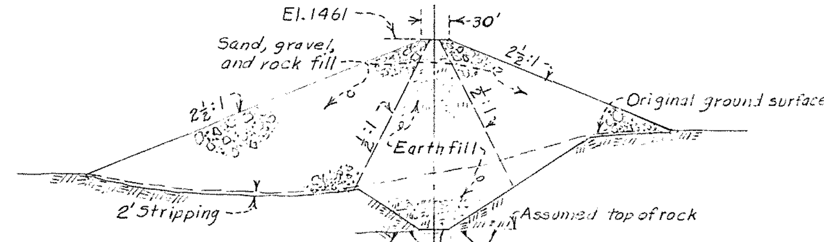
DRAWN E.A.L. SUBMITTED
TRACED RECOMMENDED
CHECKED APPROVED ASST. COMM. AND CHIEF ENGINEER

DENVER, COLORADO, MARCH 1, 1960 SHEET 1 OF 2 | 852-D-6

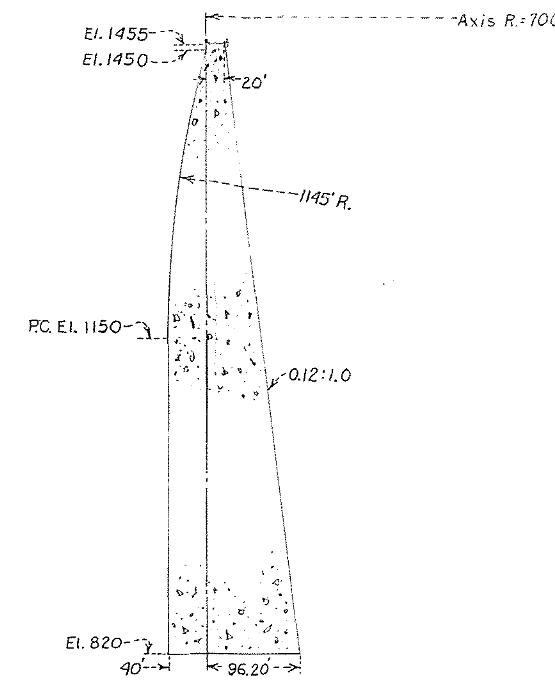
GPO 839473

SECTION THRU SPILLWAY

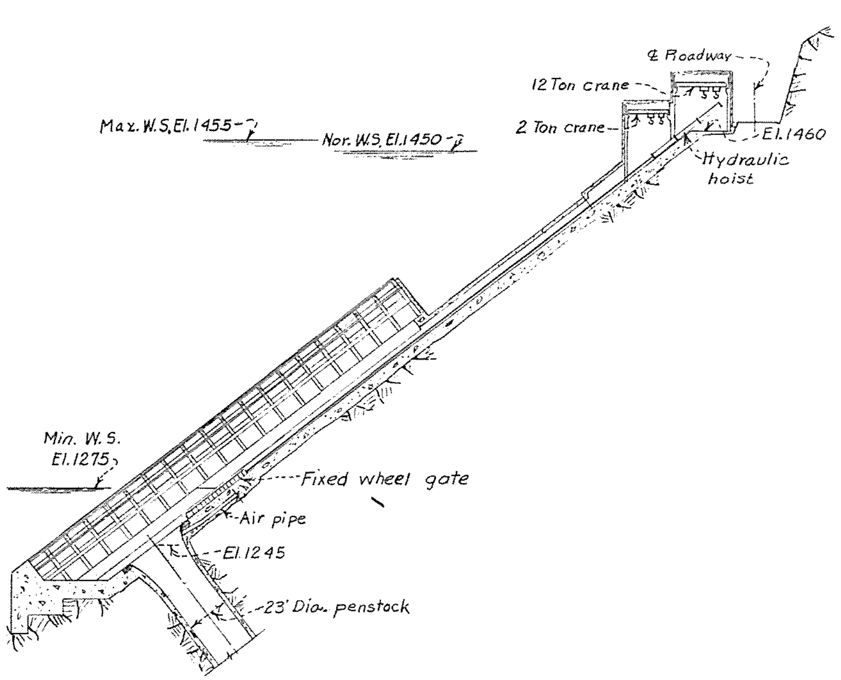


SECTION THRU DIKE

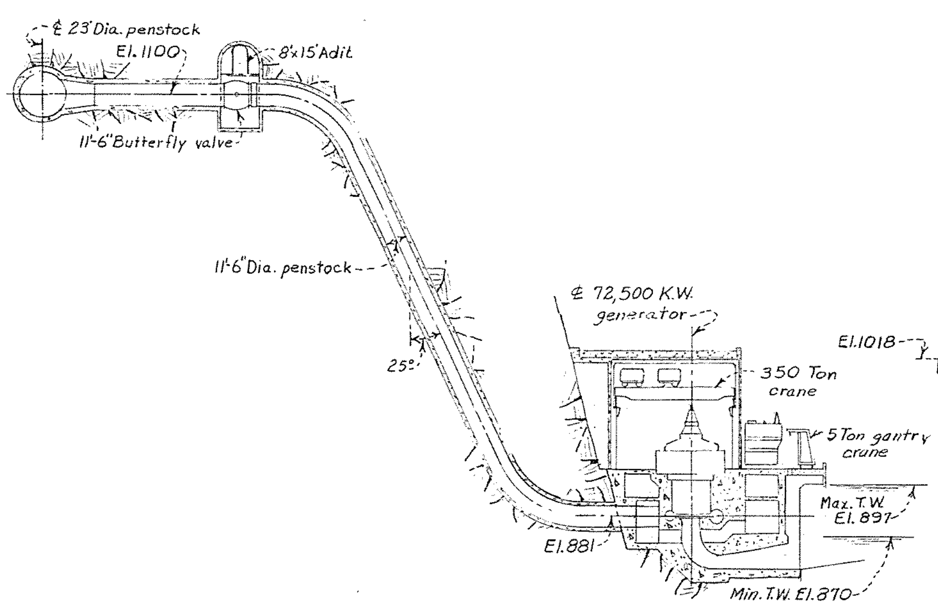


CROWN SECTION OF DAM

100 0 100 200 300
SCALE OF FEET

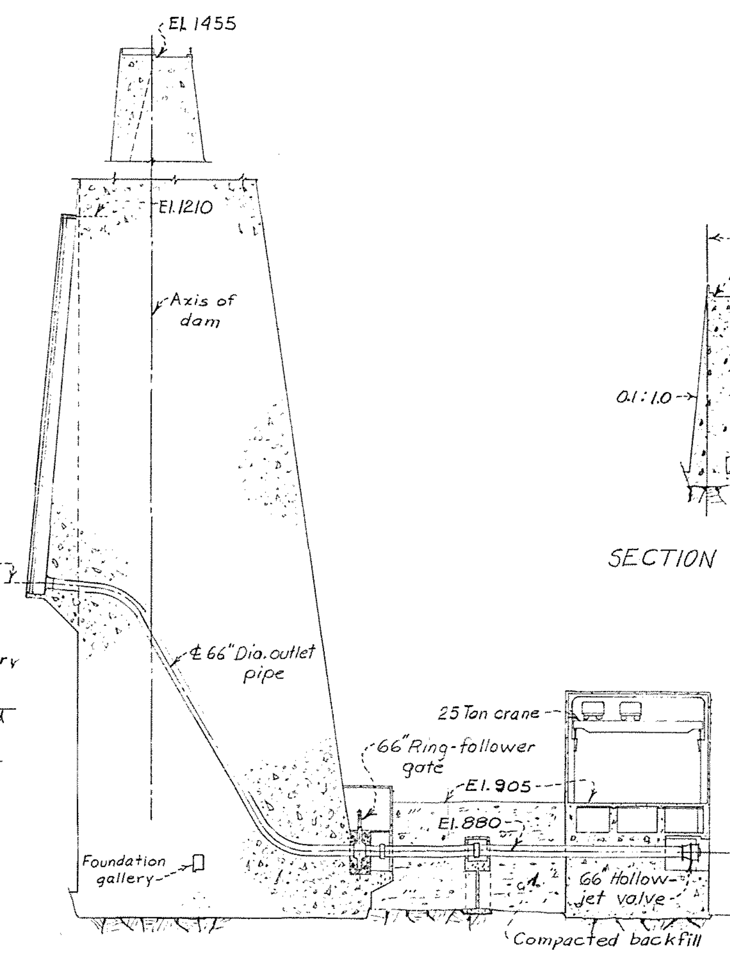


SECTION THRU INTAKE STRUCTURE

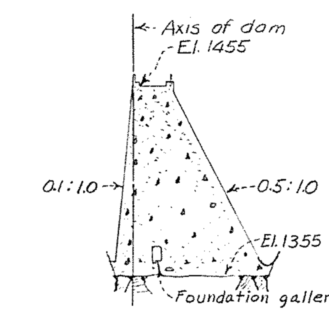


SECTION THRU PENSTOCK AND POWER PLANT

50 0 50 100 150
SCALE OF FEET



SECTION THRU OUTLET WORKS



SECTION THRU THRUST BLOCK

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
DEVIL CANYON PROJECT- ALASKA

DEVIL CANYON DAM AND POWER PLANT
FEASIBILITY ESTIMATE DRAWING

DRAWN E.A.L.	SUBMITTED O.J. Rice
TRACED	RECOMMENDED L.J. Pauls
CHECKED E.L.M., E.R.D.	APPROVED Grant Bloodgood, ASS'T. COMM. AND CHIEF ENGINEER
DENVER, COLORADO, MARCH 1, 1960 SHEET 2 OF 2	852-D-7

GPO 837620

Other Facilities

Since there are no communities near the dam site, a permanent government camp would be required to house operating personnel. Residences for a staff of 75 persons, together with the necessary streets and utilities, would be located on the left abutment. Facilities for collection, treatment, and storage of domestic water would be constructed. Sanitary sewers and a treatment plant would also be required.

A 16-mile road would provide access from the Gold Creek station on the Alaska Railroad to the Devil Canyon community. Access to the powerplant would be by one mile of service road from the community and 7,000 feet of tunnel on the left abutment.

Temporary facilities, in addition to the permanent community, would be required to serve an estimated total of 200 government workers during construction of Devil Canyon Dam and Powerplant. Housing would be supplied by trailers and transa-houses. Major buildings would include an administration building, laboratory, warehouse, garage, and fire station. Transportation, tools, and other equipment are also included. The estimated cost of service facilities includes credits for earnings from house rent and for salvage value at the end of the construction period.

Geology - Devil Canyon Damsite

Abutments of the damsite are almost devoid of overburden. The rock is a metamorphosed argillite and graywacke; hard, quartzose, fine grained, complexly fractured and broken by three joint sets. The site appears to present no major geological problems for dam construction.

The rock in the right abutment spillway and diversion tunnels appears competent. The earth dike required on the left abutment saddle will be founded on a deep, highly compact, partially pervious glacial deposit. Although a surface powerhouse is considered at the toe of the right abutment, the geological situation appears excellent for an underground powerhouse within the abutment. Geological and laboratory studies were performed to provide adequate data for feasibility designs and estimates.

Ample supplies of concrete aggregate are available close to the dam. Impervious materials can be obtained only by selective processing of glacial debris in the general area. Suitable riprap for the earth dike can be obtained in adequate quantities from talus deposits in the area, or by quarrying bed rock.

There are several suitable camp sites within three miles of the damsite. The compacted moraine deposits should provide adequate bearing for any usual type of camp buildings. An excellent water supply can be obtained from nearby Cheechacho Creek.

Locating suitable construction materials to build the access road from Gold Creek should present no problems. Extensive sources of materials can be obtained along the route.

DENALI DAM AND RESERVOIR

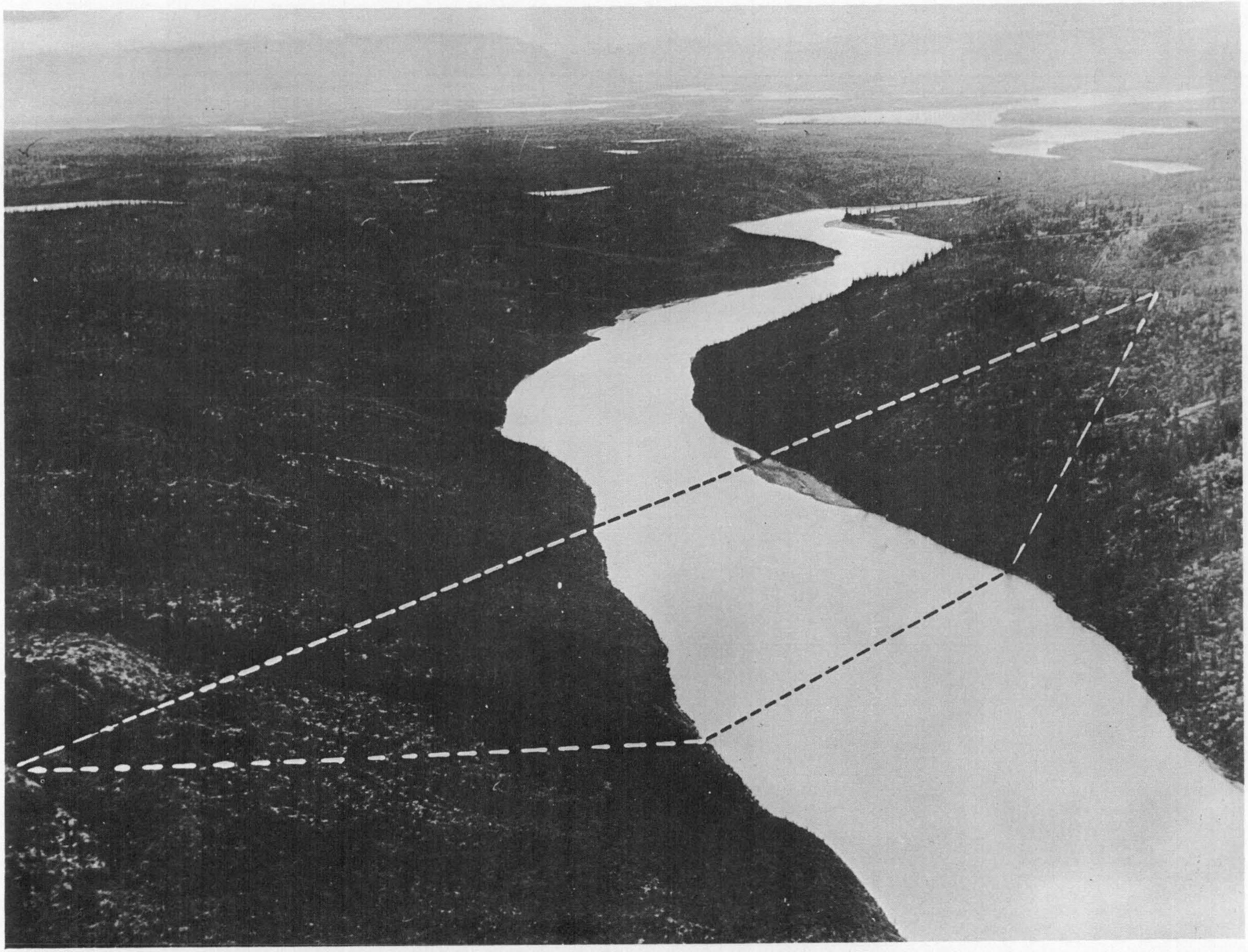
On the basis of available data, Denali Dam has been selected as the best potential structure to impound water upstream from Devil Canyon Reservoir. The reconnaissance design of Denali Dam is shown on Drawing No. 852-D-4 and the description of the structures presented in the following paragraphs are based on that design. Because of the problems that may be encountered in constructing a dam on the border of the permafrost region, an unusual amount of field exploration and possibly field research will be required prior to preparation of the final design. The final design therefore may differ considerably from that shown on the drawing. Construction of the dam may be complicated by the possible requirement for special treatment of the impervious embankment materials. During the advance planning stage of the investigations, alternative damsites will be studied in an attempt to locate a more favorable site.

Dam

Denali Dam would consist of a rolled earthfill core with sand and gravel fill both upstream and downstream. The upstream face would be protected by a layer of riprap. The crest elevation of 2,564 would be 290 feet above the bottom of the cutoff trench and 219 feet above the river bottom. The dam would be 2,050 feet long at the crest.

Spillway

An ungated glory-hole spillway would be located in the dam on the right side of the stream channel. It would discharge 18,600 cubic feet per second at a maximum water surface of 2,562 feet. This flow, combined with 655,000 acre-feet of surcharge, would protect against the inflow design flood, which has an estimated peak of 30,000 cubic feet per second and a 5-month volume of 3,728,000 acre-feet.



DENALI DAM WILL IMPOUND 5,400,000 ACRE-FEET OF WATER.

Outlet Works

The outlet works would pass through the dam on the left side of the river channel. Control and emergency gates would be provided. The outlets would discharge 24,600 cubic feet per second at the normal full pool elevation of 2,552 feet. After 100 years of operation, sediment would be deposited at the dam to an elevation of 2,386 feet; the sill of the outlet works was therefore set at this elevation.

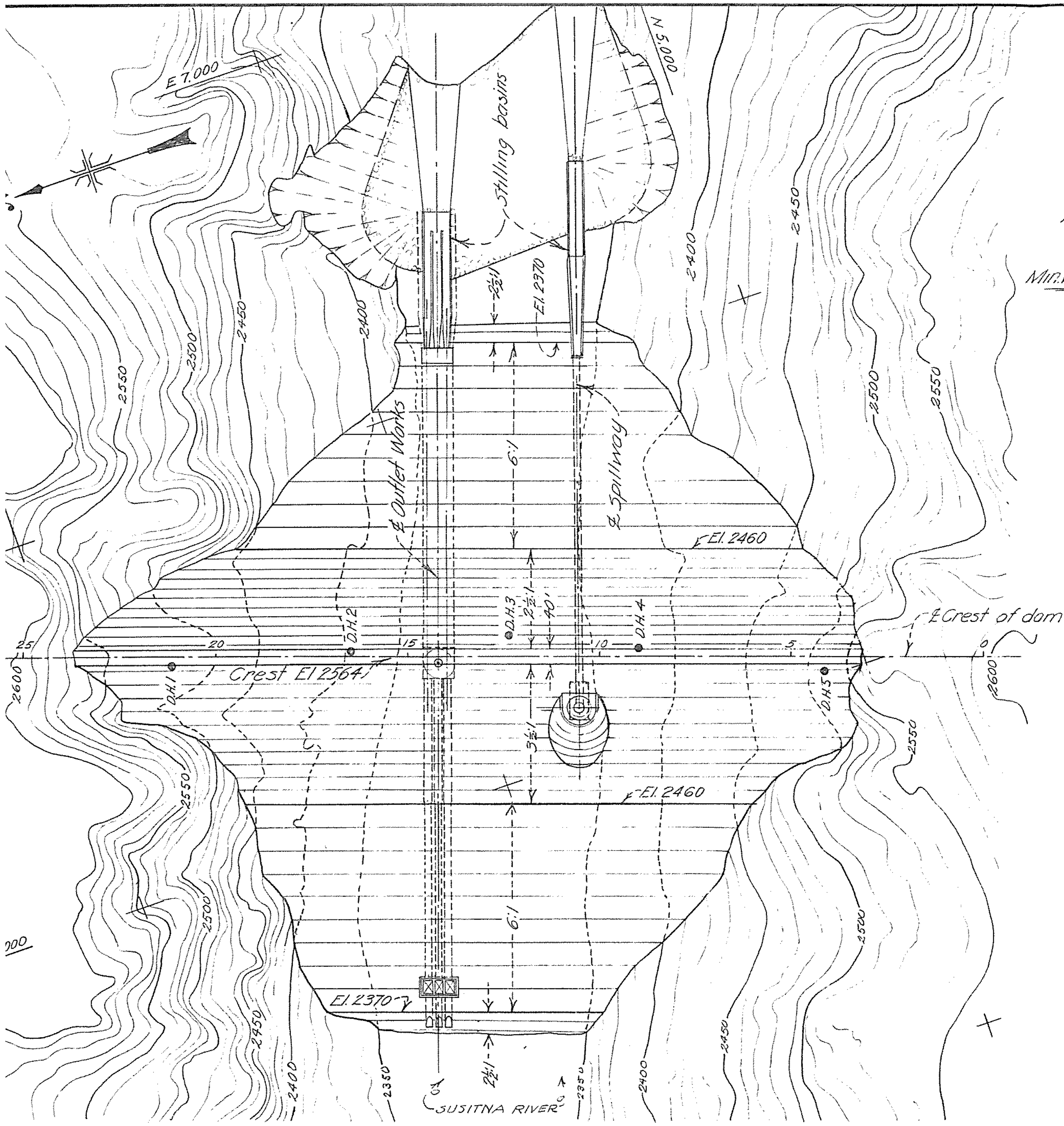
Reservoir

Denali Reservoir would be about 25 miles long, extending upstream to within 7 river miles of Susitna Glacier. Normal full pool elevation would be 2,552 feet; total initial capacity would be 5,400,000 acre-feet, including 1,140,000 acre-feet for 100-year sediment deposition. About 61,000 acres of land would be inundated. Some of this area would have to be cleared of a light to medium growth of trees and brush. The entire reservoir is in the public domain and has been withdrawn as a power site. A few mining claims near the upper end of the reservoir might be flooded; the status of these claims would have to be investigated.

Denali Highway now crosses the Susitna River in the reservoir basin. It is proposed to relocate this highway to cross the river on Denali Dam. The relocation would be 38 miles long, increasing the total length by 16 miles. Denali Highway has been placed on the primary system and will be reconstructed to primary road standards at some future time. The cost estimate for the relocation was based on the difference between the cost of improving the 22 miles of present road to primary standards and the cost of building 38 miles of new road to the same standards. Actual cost to the project of this relocation would depend in part on the status of the proposed improvement to primary road standards at the time the final relocation agreement is made. A low-grade road to some placer mines above the reservoir would also be replaced.

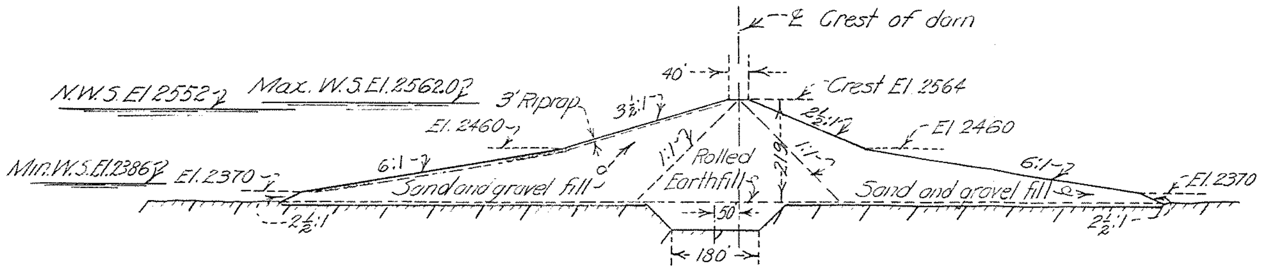
Other Facilities

No large permanent community would be located at Denali Dam, because only a small operating force would be required. Residences and necessary permanent utilities would be built. The relocated Denali Highway would provide access to the damsite and the residences.

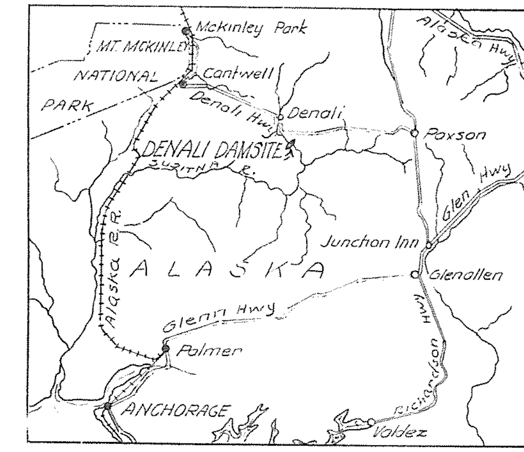


GENERAL PLAN

200 100 0 200 400



MAXIMUM SECTION



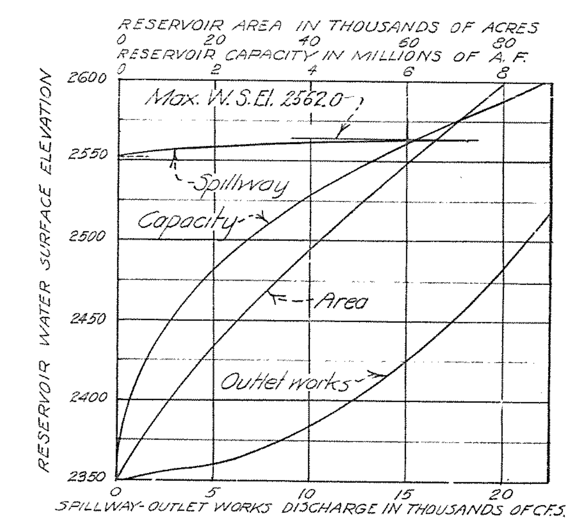
LOCATION MAP

RESERVOIR ALLOCATION

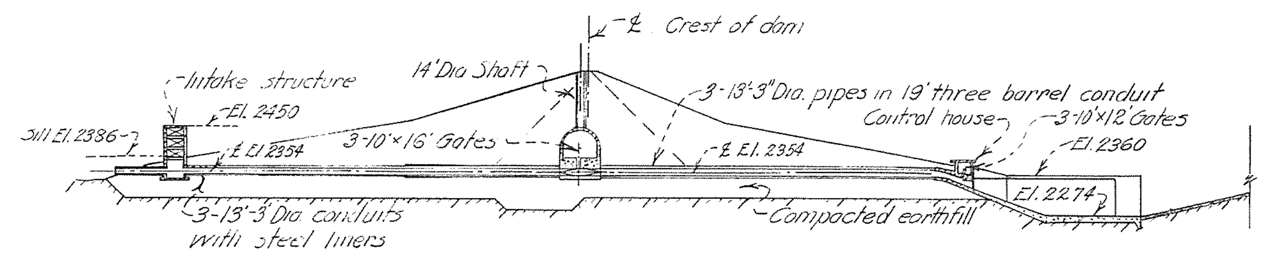
PURPOSE	ELEVATION	STORAGE ACRE FEET
Conservation	2386 to 2552	5,300,000
Dead	2345± to 2386	100,000
Total storage capacity		5,400,000*

* Includes 1,140,000 a.f. for sediment

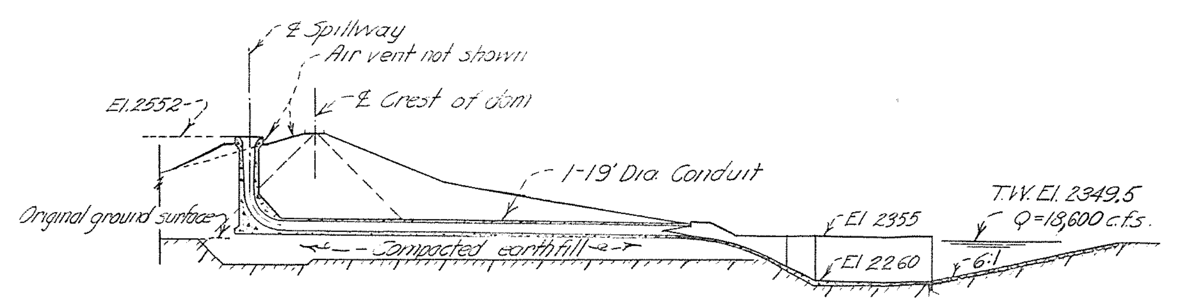
A surcharge of 655,000 a.f. (Max. W.S. El. 2562.0) with a spillway discharge of 18,600 c.f.s. protects against the inflow design flood (peak - 30,000 c.f.s., 5 month volume 3,728,000 a.f.)



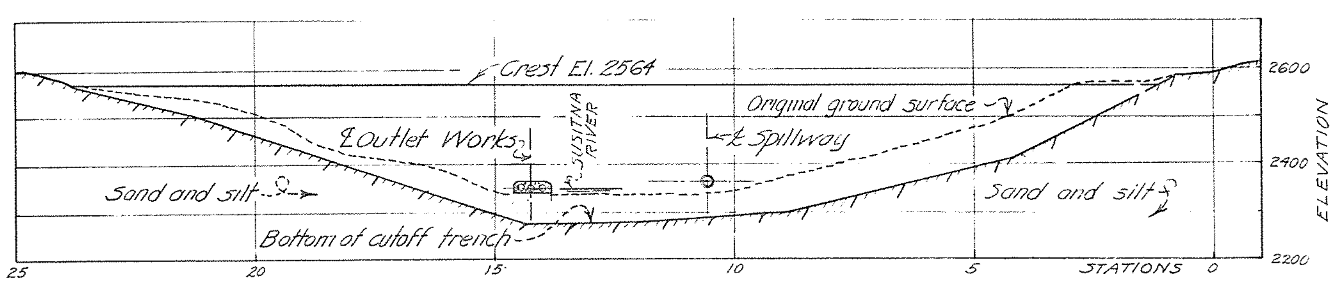
AREA-CAPACITY-DISCHARGE CURVES



PROFILE ON ℄ OUTLET WORKS



PROFILE ON ℄ OF SPILLWAY



PROFILE ON ℄ OF DAM

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
DEVIL CANYON PROJECT - ALASKA

DENALI DAM
(WITHOUT POWER)
RECONNAISSANCE DESIGN DRAWING

DRAWN W.S.H. SUBMITTED O.L. Rice
TRACED RECOMMENDED L.G. Puls
CHECKED RWB/EH APPROVED Grant Bloodgood ASST. COMM. AND CHIEF ENGR.
DENVER, COLORADO FEB. 4, 1960 852-D-4

Temporary housing, streets, water system, sewage treatment facilities, and other utilities would serve the estimated 125 government employees during the construction period. Other service facilities would be similar to those provided for Devil Canyon Dam and Powerplant.

Geology - Denali Damsite

The damsite is in a broad valley created by glaciation. Bedrock is believed to be more than 200 feet in depth below the axis. The glaciation has resulted in knob-and-kettle topography with the depressions filled by small lakes having no apparent inlet or outlet. The moraines deposited by the glacier are composed of heterogeneous lenses of silt and clayey silts. Glacial outwash channels dissected the moraines and left a deposit of sand and gravel.

The glacial deposits underlying the dam axis are composed of rock flour with large lenses of sand and, occasionally, of silt. This material is very compact owing to glacial loading. However, permafrost at the site will affect its bearing capacity. The four drill holes in the abutments showed permafrost from the surface to depths of about 100 feet. No permafrost was found in a 176 foot drill hole placed in the center of the river.

Pervious materials and concrete aggregate are plentiful. The glacial moraines are the only local sources of impervious embankment materials. Riprap can be obtained from processing of the fine-grain moraine deposits, from processing of extensive talus deposits along the Paxson-Cantwell Highway, or from an outcrop of metaandesite about 1.5 miles downstream from the dam axis.

TRANSMISSION SYSTEM

A transmission system would be required to carry electric power from Devil Canyon Powerplant to the major load centers at Anchorage and Fairbanks. This system would include transformers, switching gear, and transmission lines.

The step-up transformers at Devil Canyon Powerplant would be placed on the powerplant deck. The switchyard would be located on the left abutment. The capacity of these facilities would be 740,000 kilovolt-amperes.

Two 230-kilovolt, double-circuit, steel-tower transmission lines would extend the 157.5 miles from Devil Canyon Switchyard to the Anchorage Substation. The Devil Canyon-Fairbanks transmission line would consist of two 230-kilovolt, single-circuit, wood-pole lines, each 193 miles long.

Capacities of the Anchorage and Fairbanks Substations would be 550,000 and 150,000 kilovolt-amperes, respectively.

DESIGN AND CONSTRUCTION PROBLEMS

The two project dams would both be located in remote areas. Problems of access to the sites, housing, communications and climate require special consideration.

Accessibility

The Alaska Railroad passes within 16 miles of the Devil Canyon damsite at the station of Gold Creek. A 16-mile jeep road, constructed by the Bureau of Reclamation, extends from the Railroad station of Gold Creek to the damsite. This could be used for temporary access, until a suitable construction access road is developed. Approximately one mile of additional surface road and 7,000 feet of tunnel would be required for access to the powerplant.

The Denali damsite is located within five miles of the Denali Highway which junctions with the Alaska Railroad at Cantwell, about 80 miles to the west. The present jeep access road to the damsite would be improved for a construction road and upon completion of the dam, would become a part of the Denali Highway.

Relocation

The principal relocation necessitated by construction of the project would be the 22 miles of the Denali Highway that would be flooded by the Denali reservoir. The 38 miles of new highway construction would utilize the dam to cross the Susitna River.

Rights-of-Way

The major features of the project would be located on public domain except for a portion of the transmission lines. The lands required for the reservoirs and dams were withdrawn under Power Site Classification Number 443, and filed February 20, 1958 in accordance with Section 24 of the Federal Water Power Act. This withdrawal included all lands above the damsite and below elevation 2,600 feet for Denali dam and reservoir and all lands above the damsite and below elevation 1,500 feet for the Devil Canyon dam and reservoir.

Prior to construction, public lands required for transmission lines would be withdrawn. In addition it will be necessary to obtain easements or acquire right-of-way for about 20 miles of privately-owned lands.

Housing

There are no existing housing facilities near either damsite. Permanent facilities for operation and maintenance personnel would therefore need to be constructed. Temporary housing, including utilities would also be built for the Government construction employees.

Communications

It is proposed that communication to and from all project works would be by radio or radio-telephone.

PROJECT COSTS

Project costs are composed of the Federal investment in project features, the annual cost of operating and maintaining the project, and providing for periodic replacements of worn out equipment.

Construction Costs

Feasibility cost estimates have been prepared for all project features except the Denali Dam and Reservoir. The cost estimate for the latter feature is of reconnaissance grade.

The project would be developed in five stages. A detailed breakdown of construction costs is shown on the Official Estimate (PF-1) following this page. In summary, the cost of each stage is estimated as follows:

Stage 1	$288,590,000
Stage 2	134,747,000
Stage 3	12,434,000
Stage 4	51,899,000
Stage 5	11,204,000
Total Construction Cost	$498,874,000

Included in this total construction cost are investment in project features, cost of service facilities required during construction and permanent facilities required to operate the project. The cost of project investigations is also included.

Total Federal investment would include the above construction cost plus simple interest on expenditures during construction. Upon completion of all stages of construction, an estimated $28,216,000 of interest computed at 2½ percent will have been added to construction costs making a total investment of $527,090,000.

Operation and Maintenance

The annual cost of operation and maintenance would increase as each stage is completed. It is planned that the powerplant would be fully attended with a personnel requirement at the project of 75 employees. In addition, line crews would be stationed in the vicinity of Nenana and Palmer. The estimated annual cost of operation and maintenance can be summarized as follows:

1st to 4th year	$ 930,000
4th to 6th year	1,020,000
6th to 10th year	1,290,000
10th to 13th year	1,820,000
13th year on	1,910,000

Form PF-1
(3-57)
Bureau of Reclamation

OFFICIAL
ESTIMATE
SUMMARY
($1,000)

Project: DEVIL CANYON

Date of Estimate: April 20, 1960

Prepared by: Stephen Welty Approved by:

Cost Classification	DESCRIPTION	Quantity	Unit Cost	Total Estimate	Labor and materials by contractor	Materials and supplies by Govt.	Labor by Government Forces	Service Facilities	Investigations, Engineering and Other Costs	Previous Official Estimate
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
	SUMMARY									
01.01	Devil Canyon Dam and Reservoir			142,081	124,235			2,700	15,146	
01.02	Denali Dam and Reservoir			133,917	114,932			3,890	15,095	
11.01	Devil Canyon Powerplant			115,096	65,104	33,285		1,589	15,118	
13.01	Devil Canyon-Anchorage Line No. 1			24,854	21,728	22		447	2,657	
13.02	Devil Canyon-Fairbanks Line No. 1			10,732	9,347	7		192	1,186	
13.03	Devil Canyon-Anchorage Line No. 2			24,886	22,218	22			2,646	
13.04	Devil Canyon-Fairbanks Line No. 2			10,509	9,347	7			1,155	
13.05	Fairbanks Substation			6,749	1,205	4,225		48	1,271	
13.06	Devil Canyon Switchyard			9,464	2,210	5,500		81	1,673	
13.07	Anchorage Substation			12,003	2,300	7,400		86	2,217	
15.01	Devil Canyon General Property			7,753	6,756				997	
15.02	Denali General Property			830	733				97	
	TOTAL			498,874	380,115	50,468		9,033	59,258	

GPO 994751

Form PF-1
(3-57)
Bureau of Reclamation

OFFICIAL
ESTIMATE
INITIAL STAGE
($1,000)

Project: DEVIL CANYON

Date of Estimate: April 20, 1960

Sheet 2 of 7

Prepared by: Stephen Welty   Approved by:

Cost Classification (1)	DESCRIPTION (2)	Quantity (3)	Unit Cost (4)	Total Estimate (5)	Labor and materials by contractor (6)	Materials and Supplies by Govt. (7)	Labor by Government Forces (8)	Service Facilities (9)	Investigations, Engineering and Other Costs (10)	Previous Official Estimate (11)
01	RESERVOIRS AND DAMS									
.01	Devil Canyon Dam and Reservoir			142,081	124,235	-		2,700	15,146	
.32	Clearing Lands				8,770					
.35	Dams				113,270					
	.01--Dam Structure and Dike				(90,584)					
	.02--Spillway				(21,700)					
	.03--Outlet Works				(986)					
.50	Roads, Railroads and Bridges				2,195					
	.01--Access Road to Dam				(2,125)					
	.02--Service Road to Spillway				(70)					
11	POWERPLANTS - HYDRO									
.01	Devil Canyon Powerplant			90,181	58,945	18,280		1,589	11,367	
.33	Structures and Improvements				23,863	250				
.36	Waterways				22,954	7,900				
	.01--Power Features in Dam				(22,824)	(7,760)				
	.02--Powerplant Items				(130)	(140)				
.41	Turbines and Generators				3,422	8,240				
.48	Accessory Electrical Equipment				665	1,070				
.49	Miscellaneous Equipment				420	820				
.50	Roads, Railroads and Bridges				7,621					
13	TRANSMISSION LINES, SWITCHYARD AND SUBSTATION									
.01	Devil Canyon-Anchorage Line No. 1			24,854	21,728	22		447	2,657	
.30	Land and Rights					22				
.32	Clearing				378					
.52	Towers and Fixtures				15,350					
.54	Overhead Conductors and Devices				6,000					
.02	Devil Canyon-Fairbanks Lines No. 1			10,732	9,347	7		192	1,186	
.30	Land and Rights					7				
.32	Clearing				347					
.53	Poles and Fixtures				4,780					
.54	Overhead Conductors and Devices				4,220					
.05	Fairbanks Substation			2,908	500	1,820		48	540	
.33	Structures and Improvements				50	50				
.51	Station Equipment, Electric				450	1,770				
.06	Devil Canyon Switchyard			4,838	1,120	2,785		81	852	
.33	Structures and Improvements				160	105				
.51	Station Equipment, Electric				960	2,680				

Form PF-1
(3-57)
Bureau of Reclamation

OFFICIAL
ESTIMATE
INITIAL STAGE
($1,000)

Project: DEVIL CANYON

Date of Estimate: April 20, 1960

Prepared by: Stephen Welty   Approved by:

Sheet 3 of 7

Cost Classification	DESCRIPTION	Quantity	Unit Cost	Total Estimate	Labor and materials by contractor	Materials and Supplies by Govt.	Labor by Government Forces	Service Facilities	Investigations, Engineering and Other Costs	Previous Official Estimate
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
13	TRANSMISSION LINES, SWITCHYARD AND SUBSTATION (Continued)									
.07	Anchorage Substation			5,243	940	3,255		86	962	
.33	Structures and Improvements				110	105				
.51	Station Equipment, Electric				830	3,150				
15	GENERAL PROPERTY									
.01	Devil Canyon Community			7,758	6,756				997	
.32	Clearing Lands				95					
.33	Structures and Improvements				6,661					
	TOTAL STAGE			288,590	223,571	26,169		5,143	33,707	

GPO 994781

Form PF-1
(3-57)
Bureau of Reclamation

OFFICIAL
ESTIMATE
SECOND STAGE
($1,000)

Project: DEVIL CANYON

Date of Estimate: April 20, 1960

Prepared by: Stephen Welty Approved by:

Sheet 4 of 7

Cost Classification	DESCRIPTION	Quantity	Unit Cost	Total Estimate	Labor and materials by contractor	Materials and Supplies by Govt.	Labor by Government Forces	Service Facilities	Investigations, Engineering and Other Costs	Previous Official Estimate
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
01	RESERVOIRS AND DAMS									
.02	Denali Dam and Reservoir			133,917	114,932	-		3,890	15,095	
.31	Relocation of Existing Property				4,088					
	.01--Relocation of Denali Highway				(4,078)					
	.02--Relocation of Road to Denali Placer Mines				(10)					
.32	Clearing Lands				13,685					
.35	Dams				97,159					
	.01--Dam Structure				(36,240)					
	.02--Spillway				(16,337)					
	.03--Outlet Works				(44,582)					
15	GENERAL PROPERTY									
.02	Denali O and M			830	733	-			97	
	TOTAL STAGE			134,747	115,665	-		3,890	15,192	

GPO 994751

Form PF-1
(3-57)
Bureau of Reclamation

OFFICIAL ESTIMATE

THIRD STAGE
($1,000)

DEVIL CANYON

Date of Estimate: April 20, 1960

Prepared by: Stephen Welty Approved by:

Sheet 5 of 7

Cost Classification	DESCRIPTION	Quantity	Unit Cost	Total Estimate	Labor and materials by contractor	Materials and supplies by Govt.	Labor by Government Forces	Service Facilities	Investigations, Engineering and Other Costs	Previous Official Estimate
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
11	POWERPLANTS - HYDRO									
.01	Devil Canyon Powerplant			9,778	2,421	5,905		-	1,452	
.41	Turbines and Generators				2,281	5,490				
.48	Accessory Electric Equipment				140	415				
13	TRANSMISSION LINES, SWITCHYARD AND SUBSTATION									
.05	Fairbanks Substation			250	60	140		-	50	
.33	Structures and Improvements				10	10				
.51	Station Equipment, Electric				50	130				
.06	Devil Canyon Switchyard			1,644	310	1,040		-	294	
.33	Structures and Improvements				35	25				
.51	Station Equipment, Electric				275	1,015				
.07	Anchorage Substation			762	190	430		-	142	
.33	Structures and Improvements				30	25				
.51	Station Equipment, Electric				160	405				
	TOTAL STAGE			12,434	2,981	7,515		-	1,938	

Form PF-1
(3-57)
Bureau of Reclamation

OFFICIAL
ESTIMATE
FOURTH STAGE
($1,000)

Project: DEVIL CANYON

Date of Estimate: April 20, 1960

Sheet 6 of 7

Prepared by: Stephen Welty Approved by:

Cost Classification (1)	DESCRIPTION (2)	Quantity (3)	Unit Cost (4)	Total Estimate (5)	Labor and materials by contractor (6)	Materials and Supplies by Govt. (7)	Labor by Government Forces (8)	Service Facilities (9)	Investigations, Engineering and Other Costs (10)	Previous Official Estimate (11)
11	POWERPLANTS - HYDRO									
.01	Devil Canyon Powerplant			9,839	2,451	5,930		-	1,458	
.41	Turbines and Generators				2,281	5,490				
.48	Accessory Electric Equipment				170	440				
13	TRANSMISSION LINES, SWITCHYARD AND SUBSTATIONS									
.03	Devil Canyon - Anchorage Line No. 2			21,592	19,278	22		-	2,292	
.30	Land and Rights					22				
.32	Clearing Lands				378					
.52	Towers and Fixtures				15,350					
.54	Overhead Conductors and Devices				3,550					
.04	Devil Canyon - Fairbanks Line No. 2			10,509	9,347	7		-	1,155	
.30	Land and Rights					7				
.32	Clearing Lands				347					
.53	Poles and Fixtures				4,780					
.54	Overhead Conductors and Devices				4,220					
.05	Fairbanks Substation			3,026	530	1,930		-	566	
.33	Structures and Improvements				60	60				
.51	Station Equipment, Electric				470	1,870				
.06	Devil Canyon Switchyard			2,556	635	1,470		-	451	
.33	Structures and Improvements				100	65				
.51	Station Equipment, Electric				535	1,405				
.07	Anchorage Substation			4,377	745	2,825		-	807	
.33	Structures and Improvements				75	75				
.51	Station Equipment, Electric				670	2,750				
	TOTAL STAGE			51,899	32,986	12,184		-	6,729	

GPO 994751

Form PF-1
(3-57)
Bureau of Reclamation

OFFICIAL
ESTIMATE
FIFTH STAGE
($1,000)

Project: DEVIL CANYON

Date of Estimate: April 20, 1960

Sheet 7 of 7

Prepared by: Stephen Welty Approved by:

Cost Classification (1)	DESCRIPTION (2)	Quantity (3)	Unit Cost (4)	Total Estimate (5)	Labor and materials by contractor (6)	Materials and Supplies by Govt. (7)	Labor by Government Forces (8)	Service Facilities (9)	Investigations, Engineering and Other Costs (10)	Previous Official Estimate (11)
11	POWERPLANTS - HYDRO									
.01	Devil Canyon Powerplant			5,298	1,287	3,170		-	841	
.41	Turbines and Generators				1,217	3,005				
.48	Accessory Electric Equipment				70	165				
13	TRANSMISSION LINES, SWITCHYARD AND SUBSTATIONS									
.03	Devil Canyon - Anchorage Line No. 2			3,294	2,940	-		-	354	
.54	Overhead Conductors and Devices				2,940					
.05	Fairbanks Substation			565	115	335		-	115	
.33	Structures and Improvements				20	20				
.51	Station Equipment, Electric				95	315				
.06	Devil Canyon Switchyard			426	145	205		-	76	
.33	Structures and Improvements				25	15				
.51	Station Equipment, Electric				120	190				
.07	Anchorage Substation			1,621	425	890		-	306	
.33	Structures and Improvements				70	65				
.51	Station Equipment, Electric				355	825				
	TOTAL STAGE			11,204	4,912	4,600		-	1,692	

GPO 994751

Provisions for Replacements

Annual provisions for replacements were determined on a modified sinking fund basis at $2\frac{1}{2}$ percent interest. This annual project cost would occur as follows:

1st to 4th year	$180,000
4th to 6th year	180,000
6th to 10th year	230,000
10th to 13th year	360,000
13th year on	400,000

CONSTRUCTION SCHEDULE

The data and studies summarized in this report were adequate to determine the physical feasibility of the selected plan of development and a reasonable estimate of project cost. However, an orderly scheduling of preconstruction activities is essential to selecting the optimum plan of development and the best designs for project structures. After the project is authorized, about two years should be allowed for advance planning and preconstruction activities on Devil Canyon Dam and Powerplant. Construction funds would be used to finance this work as soon as they become available.

One field season would be required to obtain the necessary additional information on foundation conditions and construction materials at Devil Canyon damsite. Field data on the access road from Gold Creek station would also be obtained. Further detailed studies are needed to select the most economical design for Devil Canyon Dam and Powerplant. Preliminary layouts indicated a good possibility of placing the powerplant underground; this will be given further consideration in making comparative layouts, schemes, and estimates.

The access road from Gold Creek station to the Devil Canyon site would be constructed during preconstruction work on Devil Canyon Dam. The Devil Canyon community would be built immediately thereafter.

The first stage of Devil Canyon Project would consist of Devil Canyon Dam, the entire powerplant structure, installation of three generating units, necessary equipment in the switchyard, one transmission line to Anchorage and one line to Fairbanks, and necessary facilities in the Anchorage and Fairbanks substations. Construction of this initial stage would take about $6\frac{1}{2}$ years, with the first generating unit going on the line shortly before the end of the sixth year. The estimated schedule for this stage is shown on the control schedule, Form PF-2.

Completion of the entire project would probably take place in four additional stages. The timing of these stages would depend on the actual growth of the power load. The estimated growth of the load and time of installing the additional stages are shown on Drawings No. 852-906-35 and 852-906-36 in Chapter IV, Power Demand and Supply. The facilities included in each of the last four stages are described briefly below.

The second stage would be construction of Denali Dam and Reservoir and appurtenant facilities, such as road relocations and facilities for operating personnel. Detailed investigations and preconstruction activities will be required prior to starting this construction.

During the third stage two more generating units would be installed in Devil Canyon Powerplant, along with additional facilities in the switchyard and both substations.

The fourth stage would include two more units in the powerplant and additional transmission facilities. The second Devil Canyon-Fairbanks transmission line would be completed. The steel towers for the Devil Canyon-Anchorage Line No. 2 would be erected and one circuit would be strung. Additional equipment would be installed in the switchyard and substations.

In the fifth and final stage of development, the eighth unit would be installed in the powerplant, and the second circuit would be strung on the Devil Canyon-Anchorage Line No. 2. With the addition of facilities to the switchyard and both substations, the proposed development would be complete.

PROJECT FORMULATION

A reconnaissance investigation of the Susitna River Basin published in a report of that name in June 1953 was the basis for selecting the Devil Canyon project as the initial development.

LEGEND: Types of Activity

Preconstruction   Construction

LINE NO.	CLASS AND ACCOUNT	PROGRAM ITEM	QUANTITY	UNIT	ESTIMATED TOTAL	TOTAL TO JUNE 30, 60	FISCAL YEARS FIRST	SECOND	THIRD	FOURTH	FIFTH	SIXTH	SEVENTH	BALANCE TO COMPLETE	ESTIMATED COMPLETION DATE	LINE NO.
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	
1		POWER DEVELOPMENT	580,000	KW									72,500 KW	507,500 KW	19th Dec. Yr.	1
2																2
3	108	CONSTRUCTION PROGRAM														3
4	01.01	Devil Canyon Dam and Reservoir	1,100,000	A.F.	142,081,000	224,390	900,000	3,063,000	8,335,000	15,000,000	30,000,000	37,500,000	38,320,000	8,738,610	8th Feb. year	4
5	01.02	Denali Dam and Reservoir	5,400,000	A.F.	133,917,000	207,870								33,709,130	11th Dec. year	5
6	11.01	Devil Canyon Powerplant	580,000	K.W.	115,096,000	139,230	250,000	4,150,000	4,200,000	5,000,000	9,000,000	24,250,000	28,000,000	40,106,770	19th Dec. year	6
7	13.01	Devil Canyon - Anchorage, 230 KV	157.5	Mi.	24,854,000	39,200	50,000	200,000	350,000	800,000	4,000,000	11,500,000	7,914,800			7
8		Transmission Line No. 1														8
9	13.02	Devil Canyon - Fairbanks, 230 KV	193	Mi.	10,732,000	16,670	50,000	200,000	300,000	500,000	2,000,000	5,500,000	2,165,330			9
10		Transmission Line No. 1														10
11	13.03	Devil Canyon - Anchorage, 230 KV	157.5	Mi	24,886,000									24,886,000	19th Dec. year	11
12		Transmission Line No. 2														12
13	13.04	Devil Canyon - Fairbanks, 230 KV	193	Mi	10,509,000									10,509,000	16th Dec. year	13
14		Transmission Line No. 2														14
15	13.05	Fairbanks Substation	150	mva	6,749,000	4,050				100,000	600,000	1,250,000	953,950	3,841,000	19th Dec. year	15
16	13.06	Devil Canyon Switchyard	740,000	kva	9,464,000	7,210				150,000	1,000,000	2,000,000	1,680,790	4,626,000	19th Dec. year	16
17	13.07	Anchorage Substation	550	mva	12,003,000	7,660				200,000	1,250,000	2,250,000	1,535,340	6,760,000	19th Dec. year	17
18	15.01	Devil Canyon General Property			7,753,000	12,170	200,000	4,648,000	2,892,830							18
19	15.02	Denali General Property			830,000	1,255						250,000	300,000	278,745	8th June year	19
20																20
21		TOTAL CONSTRUCTION COST			498,874,000	659,705	1,450,000	12,261,000	16,077,830	21,750,000	47,850,000	84,500,000	80,870,210	233,455,255		21
22																22
23		Consolidated Expenditures and Credit			– 659,705	-659,705										23
24																24
25		TOTAL EXPENDITURES			498,214,295	0	1,450,000	12,261,000	16,077,830	21,750,000	47,850,000	84,500,000	80,870,210	233,455,255		25
26																26
27		TOTAL OBLIGATIONS			498,214,295		1,450,000	12,261,000	16,077,830	21,750,000	47,850,000	84,500,000	80,870,210	233,455,255		27
28																28
29																29
30																30
31																31
32																32
33																33

Notes:

Recommended: ______________________ (Project Head) ______ (Date)

Recommended: ______________________ (Regional Director) ______ (Date)

Recommended: ______________________ (Director of Programs & Finance) ______ (Date)

Approved: ______________________ (Commissioner) ______ (Date)

Revised: 8/19/60 (Date)   SHEET 1 OF 1 SHEETS

Form PF-2   April 1955

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION

CONTROL SCHEDULE
FOR THE
DEVIL CANYON PROJECT
PROJECT OR UNIT

Alaska District (OFFICE)   5/12/60 (DATE)   Alaska (REGION)

☐ GENERAL INVESTIGATIONS   ☐ OPERATION & MAINTENANCE
☑ CONSTRUCTION   ☐ OTHER

GPO 994751

Preliminary investigation of designs and costs for dam heights to elevations 1,430, 1,455, and 1,480 feet indicated the optimum Devil Canyon dam crest elevation to be about 1,455 feet. This elevation will be further refined prior to construction.

The Denali dam height was principally determined by the amount of reservoir capacity needed to provide regulation and hold-over storage for maximum power output at Devil Canyon powerplant.

Reconnaissance estimates of combined power output were made assuming powerplants at both Devil Canyon dam and Denali dam. Completion of the feasibility cost estimates for Devil Canyon and reconnaissance cost estimates for Denali indicated power facilities at Denali would increase the overall unit power cost above that required for the facilities proposed in this report. Further investigations of Denali, however, will again consider this possibility in the light of more complete water supply and field data.

This report is based on a feasibility investigation of the Devil Canyon dam and powerplant and a reconnaissance investigation of the Denali dam.

CHAPTER VII

F I N A N C I A L   A N A L Y S I S

The Devil Canyon Project is proposed as a single purpose hydroelectric power development. Foreseeable flood control benefits which might be realized are insignificant. Recreation and sport fisheries improvements that may result from such a development are considered incidental.

All costs of operation maintenance, replacement and amortization of investment would be borne by application of a 7.89 mill rate per firm kilowatthour.

A 50 year, 1.32 to 1.00 benefit-cost ratio bears out the project's economic feasibility. Analyzed over a 100 year economic life the benefit-cost ratio is 1.72 to 1.00.

PROJECT DEVELOPMENT

It is proposed that the project be developed in stages so far as practical to avoid investment in facilities that would not be utilized for several years. This stage development can be summarized as follows:

1st stage construction (available 1st year operation)
- Devil Canyon dam and powerhouse
- 3 - 72,500 kw generating units
- 380,000 kva switchyard capacity
- 275,000 kva Anchorage Substation capacity
- 75,000 kva Fairbanks Substation capacity
- 1 - double circuit, 230-kv, steel tower transmission line to Anchorage
- 1 - single circuit, 230-kv, wood pole transmission line to Fairbanks

2nd stage construction (available 4th year operation)
- Denali dam

3rd stage construction (available 6th year operation)
- 2 - 72,500 kw generating units
- 180,000 kva switchyard capacity

4th stage construction (available 10th year operation)
- 2 - 72,500 kw generating units
- 180,000 kva switchyard capacity
- 275,000 kva Anchorage Substation capacity
- 75,000 kva Fairbanks Substation capacity
- 1 - double circuit, 230-kv, steel tower transmission line to Anchorage - (string only one circuit)
- 1 - single circuit, 230-kv, wood pole transmission line to Fairbanks

5th stage construction (available 13th year operation)
- 1 - 72,500 kw generating unit
- String second circuit on 4th stage, 230 kv, steel tower transmission line to Anchorage

PROJECT REPAYMENT

The project, when fully developed, will be able to produce 2,900,000,000 kilowatt-hours of firm energy annually.

If this total annual potential could be used every year from the first year on, an average unit rate of 7.59 mills per kilowatt-hour would suffice. However, the power market study indicates a probable 13-year development period before full utilization of project power. This delay in use necessitates increasing the average unit rate to 7.89 mills per kilowatt-hour in order to repay investment allocation to each stage within 50 years.

Annual Revenues

All revenue would be derived from sale of firm energy. Although the project has a firm capability of 2,900,000,000 kilowatt-hours it is estimated that five percent of this, or 145,000,000 kilowatt-hours, would be used in operating the project and lost in transmission. The ultimate net annual salable energy is therefore 2,755,000,000 kilowatt-hours. It is not assumed however that this total amount of energy could be sold every year of project operation.

The power market study indicates the following annual sales probability of project power:

Year of Operation	Project Sales Kilowatt-hours	Gross Revenue at 7.89 Mills per Kilowatt-hour
1st	628,000,000	4,954,920
2nd	692,000,000	5,459,880
3rd	783,000,000	6,177,870
4th	888,000,000	7,006,320
5th	1,011,000,000	7,976,790
6th	1,155,000,000	9,112,950
7th	1,318,000,000	10,399,020
8th	1,500,000,000	11,835,000
9th	1,698,000,000	13,397,220
10th	1,924,000,000	15,180,360
11th	2,165,000,000	17,081,850
12th	2,423,000,000	19,117,470
13th	2,695,000,000	21,263,550
14th through 62nd	2,755,000,000	21,736,950

Annual Revenue Deductions

Annual revenue deductions fall into three general classifications: Operation and maintenance, provisions for replacements, and amortization of investment.

Operation and Maintenance

The annual cost of operation and maintenance is made up of the cost of labor and material normally required to keep the project operating in good condition. This cost increases with each stage of development due to the added facilities.

Distinction is made between cost of operating and maintaining the generation plant, transmission plant and administrative and general expenses. These costs created by the five stages of development are summarized as follows:

Stage	Generation Plant $	Transmission Plant $	Administrative and General $	Total $
1st	370,000	440,000	120,000	930,000
2nd	450,000	440,000	130,000	1,020,000
3rd	590,000	530,000	170,000	1,290,000
4th	720,000	860,000	240,000	1,820,000
5th	790,000	870,000	250,000	1,910,000

Provisions for Replacements

During the payout period of the project, it will be necessary to replace some major parts or facilities. Funds for such foreseen replacements are provided by a 50-year modified sinking-fund at 2.5 percent interest. By stages this represents the following annual revenue deduction:

First through third year	$180,000
Fourth through fifth year	180,000
Sixth through ninth year	230,000
Tenth through twelfth year	360,000
Thirteenth through sixty-second year	400,000

Amortization of Investment

Capitalized project costs include construction costs and interest during construction. The latter is compiled at the annual rate of 2½ percent simple interest on cumulative construction investment.

Since the project is to be developed in stages, a proportionate share of construction costs of dams, waterways, powerplants and related facilities is allocated to each generating unit. This allocated cost is then carried at simple interest until the unit is installed.

Upon completion of each stage of construction, project investment costs allocated to that stage must be amortized within a 50-year period at a compound interest rate of 2.5 percent.

Investment and costs to be repaid within 50 years, for each stage of development may be summarized as follows:

Stage	Project Investment Plant in Service, End of Year Total $	Undeferred $	Allocation From Prior Stages $	Simple Interest on Allocated Costs $	Cost to be Repaid in 50 yrs. @ 2.5% $
1	308,480,000	173,180,000	0	0	173,180,000
2	141,480,000	57,280,000	0	0	57,280,000
3	12,590,000	12,590,000	87,800,000	8,449,000	108,839,000
4	53,190,000	53,190,000	87,800,000	17,229,000	158,219,000
5	11,350,000	11,350,000	43,900,000	11,907,000	67,157,000
Tot	[illegible]527,0[illegible]0,000	307,590,000	219,500,000	37,585,000	564,675,000

Average Rate

The only source of revenue is sale of project firm power, therefore the unit power rate must be sufficient to pay all annual revenue deductions. An average rate of 7.89 mills per kilowatt-hour will meet this requirement. This rate would be the same at both Anchorage and Fairbanks and would apply to wholesale energy delivered to utilities at sub-transmission voltages.

This rate consists of the cost of generation, 6.09 mills per kilowatt-hour, and cost of transmission, 1.80 mills per kilowatt-hour.

Average Rate & Repayment Study

The entire analysis of project repayment is demonstrated on the Preliminary Average Rate and Repayment Study following this page. The 62-year totals of project operation can be summarized as follows:

Total Sales, Thousands of Kilowatt-hours	153,875,000
Total Revenues	$1,214,073,750
Operation & Maintenance Expenses	$ 110,950,000
Provisions for Replacements	$ 22,900,000
Total Operating Revenue Deductions	133,850,000
Net Revenues	$1,080,223,750
Interest (Compound) @ 2.5 Percent Per Annum	$ 515,061,572
Principal Payment	$ 564,675,000
Surplus at End of 62nd Year	$ 487,178
Total Repayment & Surplus	$1,080,223,750

Benefit-Cost Analysis

Direct project benefits and costs were analyzed for an economic life of 50 years and for one of 100 years. Benefits are determined by the cost of power from the most likely alternative to Devil Canyon project development.

DEVIL CANYON PROJECT
PRELIMINARY POWER SYSTEM AVERAGE RATE AND REPAYMENT STUDY
AVERAGE POWER RATES USED TO COVER REVENUE DEDUCTIONS AND THE RETURN OF COSTS TO BE BORNE BY POWER

ALASKA DISTRICT
DEVIL CANYON PROJECT

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
		Sales of Electric Energy Thousands of Kilowatt-hours			Operating Revenues			Operating Revenue Deductions				Investment Repayment from Power Revenues Interest Bearing-Allocation to Commercial Electric Plant — Plant in Service at End of Year									
												Compound Interest Bearing				Simple Interest Bearing					
Year of Study	Fiscal Year	Firm	Nonfirm	Total Columns 3 & 4	Firm 7.89 Mills $	Nonfirm --- $	Total Columns 6 & 7 $	All Other Operation and Maintenance Expense $	Provisions for Replacements $	Total Columns 9 & 10 $	Net Revenues Columns 6 – 11 $	Interest 2.5% $	Principal $	Commercial Electric Plant $	Balance to be Repaid $	Interest 2.5 Percent Cumulative $	Deferred Repayment $	Allowable Unpaid Balance $	Earned Surplus Cumulative $	Fiscal Year	Year of Study
0	1969													308,480,000	173,180,000		135,300,000	308,480,000		1969	0
1	1970	628,000	0	628,000	4,945,920	0	4,954,920	930,000	180,000	1,110,000	3,844,920	4,329,500	(484,580)	308,480,000	173,664,580	3,382,500	135,300,000	312,347,080	0	1970	1
2	1971	692,000		692,000	5,459,880		5,459,880	930,000		1,110,000	4,349,880	4,341,614	8,266	308,480,000	173,656,314	6,765,000	135,300,000	315,721,314		1971	2
3	1972	783,000		783,000	6,177,870		6,177,870	930,000		1,110,000	5,067,870	4,341,408	726,462	449,960,000	230,209,852	10,147,500	219,500,000	459,857,352		1972	3
4	1973	888,000		888,000	7,006,320		7,006,320	1,020,000		1,200,000	5,806,320	5,755,246	51,074	449,960,000	230,158,778	15,635,000	219,500,000	465,293,778		1973	4
5	1974	1,011,000		1,011,000	7,976,790		7,976,790	1,020,000	180,000	1,200,000	6,776,790	5,753,969	1,022,821	470,999,000	337,974,957	12,673,500	131,700,000	482,348,457		1974	5
6	1975	1,155,000		1,155,000	9,112,950		9,112,950	1,290,000	230,000	1,520,000	7,592,950	8,449,374	(856,424)		338,831,381	15,966,000		486,497,381		1975	6
7	1976	1,318,000		1,318,000	10,399,020		10,399,020	1,290,000	230,000	1,520,000	8,879,020	8,470,784	408,236		338,423,145	19,258,500		489,381,645		1976	7
8	1977	1,500,000		1,500,000	11,835,000		11,835,000	1,290,000	230,000	1,520,000	10,315,000	8,460,579	1,854,421	470,999,000	336,568,724	22,551,000	131,700,000	490,819,724		1977	8
9	1978	1,698,000		1,698,000	13,397,220		13,397,220	1,290,000	230,000	1,520,000	11,877,220	8,414,218	3,463,002	541,418,000	491,324,722	8,614,500	43,900,000	543,839,222		1978	9
10	1979	1,924,000		1,924,000	15,180,360		15,180,360	1,820,000	360,000	2,180,000	13,000,360	12,283,118	717,242	541,418,000	490,607,480	9,712,000	43,900,000	544,219,480		1979	10
11	1980	2,165,000		2,165,000	17,081,850		17,081,850	1,820,000	360,000	2,180,000	14,901,850	12,265,187	2,636,663	541,418,000	487,970,817	10,809,500	43,900,000	544,219,480		1980	11
12	1981	2,423,000		2,423,000	19,117,470		19,117,470	1,820,000	360,000	2,180,000	16,937,470	12,199,270	4,738,200	564,675,000	550,389,617	0	0	564,675,000		1981	12
13	1982	2,695,000		2,695,000	21,263,550		21,263,550	1,910,000	400,000	2,310,000	18,953,550	13,759,740	5,193,810		545,195,807					1982	13
14	1983	2,755,000		2,755,000	21,736,950		21,736,950	1,910,000	400,000	2,310,000	19,426,950	13,629,895	5,797,055		539,398,752					1983	14
15	1984											13,484,969	5,941,981		533,456,771					1984	15
16	1985											13,336,419	6,090,531		527,366,240					1985	16
17	1986											13,184,156	6,242,794		521,123,446					1986	17
18	1987											13,028,086	6,398,864		514,724,582					1987	18
19	1988											12,868,114	6,558,836		508,165,746					1988	19
20	1989											12,704,144	6,722,806		501,442,940					1989	20
21	1990											12,536,074	6,890,876		494,552,064					1990	21
22	1991											12,363,802	7,063,148		487,488,916					1991	22
23	1992											12,187,223	7,239,727		480,249,189					1992	23
24	1993											12,006,230	7,420,720		472,828,469					1993	24
25	1994											11,820,712	7,606,238		465,222,231					1994	25
26	1995											11,630,556	7,796,394		457,425,837					1995	26
27	1996											11,435,646	7,991,304		449,434,533					1996	27
28	1997											11,235,863	8,191,087		441,243,446					1997	28
29	1998											11,031,086	8,395,864		432,847,582					1998	29
30	1999											10,821,190	8,605,760		424,241,822					1999	30
31	2000											10,606,045	8,820,905		415,420,917					2000	31
32	2001											10,385,523	9,041,427		406,379,490					2001	32
33	2002											10,159,487	9,267,463		397,112,027					2002	33
34	2003											9,927,801	9,499,149		387,612,878					2003	34
35	2004											9,690,322	9,736,628		377,876,250					2004	35
36	2005											9,446,906	9,980,044		367,896,206					2005	36
37	2006											9,197,405	10,229,545		357,666,661					2006	37
38	2007											8,941,666	10,485,284		347,181,377					2007	38
39	2008											8,679,534	10,747,416		336,433,961					2008	39
40	2009											8,410,849	11,016,101		325,417,860					2009	40
41	2010											8,135,446	11,291,504		314,126,356					2010	41
42	2011											7,853,159	11,573,791		302,552,565					2011	42
43	2012											7,563,814	11,863,136		290,689,429					2012	43
44	2013											7,267,236	12,159,714		278,529,715					2013	44
45	2014											6,963,243	12,463,707		266,066,008					2014	45
46	2015											6,651,650	12,775,300		253,290,708					2015	46
47	2016											6,332,268	13,094,682		240,196,026					2016	47
48	2017											6,004,901	13,422,049		226,773,977					2017	48
49	2018											5,669,349	13,757,601		213,016,376			564,675,000		2018	49
50	2019											5,325,409	14,101,541		198,914,835			392,495,000		2019	50
51	2020											4,972,871	14,454,079		184,460,756			392,495,000		2020	51
52	2021											4,611,519	14,815,431		169,645,325			391,495,000		2021	52
53	2022											4,241,133	15,185,817		154,459,508			334,215,000		2022	53
54	2023											3,861,488	15,565,462		138,894,046			334,215,000		2023	54
55	2024											3,472,351	15,954,599		122,939,447			225,376,000		2024	55
56	2025											3,073,486	16,353,464		106,585,983					2025	56
57	2026											2,664,650	16,762,300		89,823,683					2026	57
58	2027											2,245,592	17,181,358		72,642,325			225,376,000		2027	58
59	2028											1,816,058	17,610,892		55,031,433			67,157,000		2028	59
60	2029											1,375,786	18,051,164		36,980,269			67,157,000		2029	60
61	2030											924,507	18,502,443		18,477,826			67,157,000	0	2030	61
62	2031	2,755,000	0	2,755,000	21,736,950	0	21,736,950	1,910,000	400,000	2,310,000	19,426,950	461,946	18,477,826	564,675,000	0	0	0	0	487,178	2031	62
TOTALS		153,875,000	0	153,875,000	1,214,073,750	0	1,214,073,750	110,950,000	22,900,000	133,850,000	1,080,223,750	515,061,572	564,675,000	564,675,000	0	0	0	0	487,178	TOTALS	

NOTES

Column 3 – The completed project will provide 2,755,000,000 kilowatt-hours of salable firm energy annually.

Column 6 – All firm energy will be sold at an average rate of 7.89 mills per kilowatt-hour.

Column 9 – All other electric operation and maintenance expenses will total an estimated $1,910,000 annually upon completion of the project. This estimate, based on the Bureau's past experience, is made up of production plant expense – $790,000, transmission plant expense – $870,000 and administrative and general expenses – $250,000.

Column 10– Provisions for replacements are computed on a modified sinking fund basis for a 50-year period at 2.5 percent interest. For full development, annual provisions are computed as follows:

FPC Account Number	Item	Construction Cost	Provision for Replacement
321	Structures and Improvements	$ 35,815,000	$ 1,430
322	Reservoirs, Dams, Waterways	242,445,000	710
323	Turbines and Generators	36,886,000	104,900
324	Accessory Electric Equipment	3,669,000	29,610
325	Miscellaneous Equipment	1,447,000	1,270
343	Station Equipment	25,399,000	218,540
345	Poles and Fixtures	10,852,000	40,310
	Total		$396,770
	Use		$400,000

Column 15– All construction costs are allocated to production of power. Total commercial electric plant in service investment would be the following:

Construction Cost – Stage 1	$288,590,000
Construction Cost – Stage 2	134,747,000
Construction Cost – Stage 3	12,434,000
Construction Cost – Stage 4	51,899,000
Construction Cost – Stage 5	11,204,000
Total Construction Cost	$498,874,000
Interest During Construction	28,216,000
Total Federal Investment	$527,090,000
Interest on Deferred Repayment Investment	37,585,000
Total Commercial Electric Plant	$564,675,000

Column 17 – Simple interest would be charged on deferred repayment investment. As these deferred repayment funds are reclassified to plant in service accounts, accumulated interest charges thereon would also be capitalized.

Column 18 – A proportionate share of construction costs of dams, waterways, powerplants and related facilities is allocated to each generating unit. These allocated costs are then capitalized at the time the units are installed. Project investment costs are allocated as follows:

Stage	Total Project Investment	Undeferred Investment	Allocated Investment
1	$308,980,000	$173,180,000	$173,180,000
2	141,480,000	57,280,000	57,280,000
3	12,590,000	12,590,000	87,800,000
4	53,190,000	53,190,000	87,800,000
5	11,350,000	11,350,000	43,900,000
Totals	$527,090,000	$307,590,000	$219,500,000

Column 20 – Net revenues in the 62nd year would complete amortization of project costs and provide a surplus of $487,178.

Prepared by: [signature] Date: 5/18/60

Recommended: George S. Bensch
Electrical Engineer

Approved: Daryl L. Roberts
District Manager

Cost of Power from Alternate Source

It was assumed that the most likely alternate power development that would provide a comparable block of power would be a coal-fired steam plant. Such a plant would probably be located at the mine mouth. Since the Anchorage area poses the largest load center, the Matanuska coal fields are assumed to be the location for such a development.

The Devil Canyon project would perform two distinct functions. It would supply electric power and energy to the power market area and provide a transmission grid that would tie all utility systems in the area together. To be comparable, the alternate source must also serve these two functions.

It has been assumed that such a plant would be built jointly by more than one consumer owned utility. Since the Anchorage-Palmer area is the largest load center, a probable combination would be the City of Anchorage, Chugach Electric Association and Matanuska Electric Association. On this basis part of the financing would probably be from REA loans and part raised through sale of Municipal bonds. For this study it was assumed that an average interest rate of 3 percent would apply.

Basic plant data would be an ultimate generating capacity of 580,000 kilowatts with an annual net sales of 2,755,000,000 kilowatt-hours. Other data assumed are as follows:

Fuel Heat Rate BTU/pound of coal	11,000
Cost of Fuel $/ton (Average 1958 value of Matanuska Coal)	$ 12.18
Powerplant Investment $/KW	262
Transmission Plant Investment $/KW	135

The transmission plant would include switchyard, two transmission lines to both Anchorage and Fairbanks, and substations at Anchorage and Fairbanks.

The unit costs of steam power were developed as follows:

	$/KW-yr.
Fixed costs - powerplant (5.25%)($262)	13.76
Fixed costs - transmission plant (5.25%)($135)	7.08
Operation and Maintenance charges (excluding fuel)	
Generation plant	3.57
Transmission plant	1.68
Subtotal	26.09
Average rate per kilowatt-hour (excluding fuel)	5.22 mills
Cost of fuel per kilowatt-hour	5.55 mills
Total unit cost per kilowatt-hour	10.77 mills

Direct Benefits

Primary benefits of the Devil Canyon project are equal to the market cost of a similar block of energy from the most likely alternate source. The cost of this alternative power would be about 10.77 mills per kilowatt-hour.

It is assumed that the power market for the alternate source development would be the same as that for Devil Canyon. On this basis the average annual sale of energy and its worth at a 10.77 mill rate would be as follows:

	50-yr. Life	100 yr. Life
Average annual sales KWH	2,416,300,000	2,585,650,000
Average annual worth (benefits)	26,024,000	27,847,000

Costs:

For purposes of project justification, all project revenue deductions were converted to average annual costs for a 50-year and a 100-year economic life. These costs can be summarized as follows:

	50-yr. Life	100-yr. Life
Average annual operation & maintenance	1,760,000	1,835,000
Average annual provisions for replacements	362,000	680,000
Average annual payment to interest & principal	17,600,000	13,620,000
Total average annual costs	19,722,000	16,135,000

Benefit-Cost Ratios

The benefit-cost ratios reflect only primary benefits. The benefits, costs and ratios summarize as follows:

	50-yr. Life	100-yr. Life
Total average annual benefits	26,024,000	27,847,000
Total average annual costs	19,722,000	16,135,000
Benefit-cost ratio	1.32 to 1.00	1.72 to 1.00

Indirect Benefits

Any benefit accruing to the locale, state or nation from development of the Devil Canyon project, and which is not determined by the production cost of alternate source power, is called an indirect benefit. Although such benefits are not used in the analysis of project feasibility, they do represent a substantial economic factor. The most important of these are difficult to evaluate.

Among benefits listed as indirect would be the lower cost of living due to the lower cost of electricity; the decrease in cost of doing business in the area; the probable greater diversification of the economic base of the area resulting from availability of a large block of reasonably priced power, and the value of a dependable high voltage transmission system to tie the principal load areas together.

Each of these benefits as well as many others not listed would have a notable effect on the local and State economy

Availability of electric power is one of the most important ingredients to the expansion of any area's social and economic structure. Conversely, the lack of electric power is one of the greatest deterrents to such expansion.

CHAPTER VIII

REPORTS OF OTHER AGENCIES

Various Federal and State agencies are vitally interested in Devil Canyon Project, either because of the effect the project would have on their fields of interest or because of the effect their operations might have on the project. Reports were requested from those agencies that were considered to have the major interest. Reports obtained from some agencies were also valuable in preparing Chapter III, Area Economy and Resources. All these reports of other agencies are appended at the end of this report and are summarized briefly in this chapter.

The United States Fish and Wildlife Service has been conducting studies of the project area intermittently since 1952. Their appended report, concurred in by the Alaska State Department of Fish and Game, discusses the possible effects of project development on fish and wildlife which utilize the waters or lands involved. No evidence has been found which would indicate that anadromous fish migrate through or above Devil Canyon. However, project development could have some effect on downstream migrations and spawning. It is recommended that the project design incorporate facilities for maintaining a live stream at all times below Devil Canyon dam. Releases from Denali reservoir for fish would only be required during the period October to April. Neither of the reservoirs created will suitably replace waterfowl nesting and rearing habitat destroyed by inundation. It is possible, however, that they will be well utilized during periods of bird migration. A large portion of the Denali impoundment area is presently used as winter range by the Nelchina caribou herd. Movement patterns of the herd, however, indicate loss of this range will not seriously affect the species. Some loss of small game and fur animal habitat will also result from project construction.

The Bureau of Mines report discusses the mineral production and mining activities in the area under the probable influence of the project. Gold and coal have been the most important mineral products; however, gold production is gradually decreasing and may become negligible unless economic conditions change. Construction minerals, on the other hand, are becoming more important. Oil and natural gas have been discovered on the Kenai Peninsula, but the production potential is yet unknown. Favorable geological formations indicate that additional discoveries in other parts of the Railbelt may be expected.

The Bureau of Land Management report describes the forest resources of public domain lands in the power market area. The typical interior forest is a mixture of white spruce and Alaska white birch, although pure or near pure stands of each may occur. Cottonwood, aspen, black spruce, and tamarack also occur but are of no commercial importance. Small portable sawmills, concentrated in the Anchorage and Fairbanks areas, supply part of the local demand for lumber. Annual harvest is a small percentage of the potential annual cut. Spruce can continue to supply part of the local market, but only the birch offers promise of entering into the export market.

The National Park Service report mentions the very limited recreational use of the proposed reservoir areas at the present time. This minor interest is due principally to the relative isolation and difficult access to most of the area concerned. It is not likely that development of the project will have any marked effect on the recreational potentialities of this wilderness. The wide annual fluctuation of the reservoirs will limit their value for recreation purposes. Some loss to scenic value of the upper Susitna valley might be experienced when Denali reservoir is partially empty. This is not believed to be of significant importance however. Further investigations of the archeological values of the Denali reservoir area are warranted. Preliminary archeological investigations of the Devil Canyon reservoir area however indicate little or no early human use and settlement.

A letter from the Corps of Engineers points out that present flood damage is caused by ice jams in the spring. Damage occurs primarily to the Alaska Railroad and is estimated to average $8,000 annually. Assignment of benefits to flood control would require that reservoir space be reserved and operated in accordance with rules and regulations prescribed by the Chief of Engineers. The prospective flood control benefits are too small to justify inclusion of flood control as a project purpose. The District Engineer therefore suggests that any reduction in flood damage obtained from normal operation of the project for power be described and included as an incidental benefit.

The forest resources of that part of the Chugach National Forest which lies in the Railbelt are reported on by the Forest Service. The Kenai working circle can support a cut of about 15,000,000 board feet annually; possibly an equal amount can be brought in economically by water from the Prince William Sound working circle. Three large sawmills in the area have an annual capacity of about 22,000,000 board feet, with an approximate cut of 8,500,000 board feet in 1958. Two portable mills added 500,000 board feet. Total value in 1958 was about $855,000. A new treating plant at Whittier will handle 5,000,000 board feet annually. The abundant scenic, hunting, and fishing resources of the Kenai area assure a growing increase in recreational use.

The University of Alaska cooperates with the U. S. Department of Agriculture in maintaining an Agricultural Experiment Station and Extension Service. The report of this agency discusses the availability of land in the Railbelt that is suitable for agricultural production. Alaska is less than 10 percent self-sufficient in farm-produced foodstuffs. A realistic goal is 25 percent self-sufficiency by 1975. With almost a million acres of known or estimated cultivable land in the Railbelt area, there are no climatic or environmental limitations that would prevent attaining this goal. Continued surpluses in the continental United States, however, militate against opening new farmlands, even in small amounts and at the end of long supply lines. An accompanying letter presents data on potential irrigation in Alaska. By the year 2000, about 40,000 acres might be profitably irrigated applied at a rate of about 5 or 6 inches per year.

CHAPTER IX

CONCLUSIONS AND RECOMMENDATIONS

CONCLUSIONS

The plan of development of the Devil Canyon project, as proposed in this report, is feasible. The plan is not complex and all costs are allocated to the production of power.

Denali Reservoir is an essential feature of the plan of development for two reasons: (1) To provide the additional storage capacity required to regulate the Susitna River runoff for near-optimum energy output, and (2) to prolong the useful life of Devil Canyon Reservoir by storing most of the sediment transported by the Susitna River.

The area that would be served by the project has more than tripled its utility power requirements in the past 8 years. Estimates of future load growth forecast a shortage of power by 1965 despite availability of powerplants presently under construction.

Annual power requirements are now increasing in such magnitude that it is no longer practical nor desirable to build small capacity plants. Even a development the size of Devil Canyon is expected to be fully loaded within a few years after its completion.

In the power market area it is not a question of who should be permitted to develop such a hydroelectric project. It is rather a question of who is able to do so. The existing utility systems are unable to finance a construction cost of this magnitude. No private proposal for a major power development appears likely.

The 1.32 to 1.00 benefit-cost ratio demonstrates the economic feasibility of Devil Canyon project development. A strong and more diverse economy in Alaska would not only serve the best interests of the State but of the Nation as well. Availability of a large block of power is a primary need in sustaining and expanding the economic growth of Alaska. Development of Devil Canyon project would bring about an interconnected power system capable of serving the entire railbelt area and do much to help satisfy this growing need.

RECOMMENDATIONS

It is recommended that:

1. The plan of development proposed in this report be approved.

2. The Devil Canyon Project, Alaska, be authorized for construction and operation by the Secretary of the Interior for the purpose of hydroelectric power development, substantially in agreement with the plans set forth in the report, with such modifications of, omissions from, or additions to the work as the Secretary may find necessary to carry out the purpose of the project.

Following authorization of the project by the Congress, it is further recommended that:

1. Funds be provided to expedite the advance planning investigations for the project.

2. Construction of the initial stage be undertaken at the earliest possible date.

3. That additional detailed studies of fish and wildlife resources affected by the project be conducted as necessary after the project is authorized in accordance with the Fish and Wildlife Coordination Act, 48 Stat. 401, as amended: 16 U.S.C. 661 et seq.; and that such reasonable modifications in the authorized project facilities be made by the Secretary as he may find appropriate to conserve and develop these resources.

4. That Federal lands and project waters in the project area be open to free use for hunting and fishing so long as title to the lands and structures remains in the Federal Government, except for sections reserved for safety, efficient operation, or protection of public property.

5. That leases of Federal land in the project area reserve the right of free public access for hunting and fishing.

Daryl L Roberts

Alaska District Manager

CHAPTER X

SUPPLEMENTAL ANALYSIS

A supplemental analysis is required by Senate Resolution 148, 85th Congress. The following sections supply the requested information in corresponding sections of the resolution.

SECTION 1

The project, described in detail in Chapter VI, Plans and Estimates, would have an economic life in excess of 100 years. Periodic replacements normal to project operations would maintain, in good repair, equipment with a shorter economic life. Studies of 100-year sediment deposition in the reservoirs indicate active capacity in Devil Canyon reservoir will still be 90 percent of initial active capacity after 100 years operation. Denali reservoir would retain 80 percent of its initial active capacity. There is no reason to believe that the dams and powerhouse structure will not endure for 100 years or more.

SECTION 2

The estimated costs of construction, operation, maintenance and replacements are illustrated and explained in Chapter VI, Plans and Estimates, and Chapter VII, Financial Analysis. They are based, for the most part, on the Bureau's past experience with such costs.

SECTION 3

Benefit-cost ratios were determined for both 50-year and 100-year project economic lives. Using primary benefits (the only ones to which monetary values could be assigned) ratios developed were 1.32 to 1.00 for 50 years and 1.72 to 1.00 for 100 years. Benefits, costs and their relationship are discussed in Chapter VII, Financial Analysis.

SECTION 4

Intangible indirect benefits that would accrue from project development are believed to be of considerable magnitude. Although the project would be single-purpose, generation of power, the availability of such a block of power would help to fill this primary need of modern economic, industrial and social progress. Indirect benefits are further discussed in Chapter VII, Financial Analysis.

SECTION 5

It is believed that the optimum plan of development of the project has been proposed. Future upstream dams would fully regulate the river runoff above Devil Canyon permitting that reservoir to eventually be maintained full at all times. This in turn would permit some additional firm generation at Devil Canyon. This factor was considered in determining the rated head for turbines.

SECTION 6

All project costs are allocated to the production of power. There is no opportunity for significant use for other purposes.

SECTION 7

As proposed, the project would be constructed and operated by the Bureau of Reclamation. Interest in the Bureau's investigations program and particularly in development of the Susitna River has often been expressed by local individuals and groups. This is evidenced by past advances to the Bureau of funds and assistance for stream gaging and other investigations requirements by public utility systems in the area. For several years resolutions passed at the annual meeting of the Alaska Rural Electric Cooperative Association have urged the Bureau to continue its investigations of the Susitna River leading to a request for Congressional authorization of Devil Canyon Project.

The dire need for a large dependable source of power is recognized throughout the power market area.

SECTION 8

Since all costs are allocated to power the single repayment schedule involved is included in Chapter VII, Financial Analysis.

SECTION 9

No taxes would be forgone by Federal development. There is no proposal for private power development of this magnitude. The benefit-cost analysis in Chapter VII discusses the alternative to project development.

APPENDED REPORTS OF OTHER AGENCIES

United States Department of the Interior
Fish and Wildlife Service
Juneau, Alaska

A Detailed Report on Fish and Wildlife Resources affected by the DEVIL CANYON PROJECT Alaska

May 1960

ALASKA REGION
(REGION 5)

ADDRESS ONLY
THE REGIONAL DIRECTOR

UNITED STATES
DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE
BUREAU OF COMMERCIAL FISHERIES

BOX 2021
JUNEAU, ALASKA

May 2, 1960

Memorandum

To: District Manager, Bureau of Reclamation
Juneau, Alaska

From: Regional Director, Bureau of Commercial Fisheries
Juneau, Alaska

Regional Director, Bureau of Sport Fisheries and Wildlife
Juneau, Alaska

Subject: Devil Canyon Project, Susitna River Basin, Alaska

This is our detailed report of our studies concerning effects of the Devil Canyon Project upon the fish and wildlife resources. Both facilities of the project, the Devil Canyon Dam and Reservoir and the Denali Dam and Reservoir, are located in the Susitna River Basin of south-central Alaska. This report has been prepared in accordance with the Fish and Wildlife Coordination Act, 48 Stat. 401, as amended; 16 U.S.C. 661 et seq.

We have studied the fish and wildlife resources in connection with this project for effects as well as with a view toward mitigating those losses which may result from project construction and operation. Further, we have explored the possibilities for enhancement of these resources. This letter, which briefly summarizes our findings and contains our recommendations, is supported in detail by the attached substantiating report.

Big game, small game, fur animals, waterfowl, and both resident and anadromous fish will be affected by project construction. Approximately 61,000 acres of land will be inundated, most of which is moose range. Although the Nelchina caribou herd presently utilizes the impoundment area as winter range, only about 33,000 acres is considered to be of good quality for this usage. Movement patterns of the herd are such that it is believed the species will not be seriously affected by project development and operation.

Some loss of small game and fur animal habitat is expected in the project area. Harvest of these species, which is presently light, due primarily to inaccessibility, may increase in adjacent areas with project development as a result of improved access.

Some waterfowl nesting and rearing habitat will be destroyed by inundation. Similar habitat will probably not develop around the reservoir perimeters due to fluctuating water levels. It is possible that the two impoundments will receive more use by migrating birds than the water bodies destroyed by inundation.

Fish present in the project area will be affected in a variety of ways. Below the Devil Canyon and Denali damsites, alteration of natural stream flow and temperature patterns will produce unknown effects on the fish present in these areas.

At Devil Canyon, the planned operational releases are considered adequate to preserve fish habitat. During the period of dam construction, initial reservoir filling, and in the event of an unforeseeable cessation of power production, however, water releases will be necessary to preserve the downstream fishery. Therefore, a recommendation for minimum flows is made. These minimum flows, as well as power flows during project operation, should be released gradually to avoid flushing or scouring the channel. The Susitna River below the Devil Canyon Dam serves as a migration route for salmon ascending to the spawning tributaries. Releases of water either colder or warmer than normal stream temperatures could affect the attraction of salmon to such tributaries. The Bureau of Reclamation should explore the feasibility of modifying the intake structure to permit drawing water from selected temperature strata in the Devil Canyon Reservoir.

Under project operation, no water releases are planned from the Denali Dam from about April to September of each year, depending on runoff and power requirements. Stream dewatering in this section could be deleterious to summer fish usage. However, it is believed that fish populations here are minimal due to the turbidity of the Susitna River. Also, this section of stream is located very close to the headwaters and thus there are few tributaries above the damsite to which fish movement may occur in summer months. For these reasons, no minimum release during the period from

April through September, inclusive, is requested from the Denali Dam. Winter habitat will probably improve in this area as a result of increased flows. If the Denali Reservoir proves to be relatively clear in the winter, enhancement of this area as fish habitat may result. During the period of construction, initial reservoir filling, and project operation, a minimum flow is recommended from October through March, inclusive, to maintain the downstream fishery. These minimum flows, as well as the flows for power during project operation, should be released gradually to avoid the flushing or scouring of the channel.

Loss of stream habitat through inundation will be partially offset by creation of two large reservoirs. However, the plan of operation indicates rather wide fluctuations in the impoundment levels and these fluctuations will probably limit fish production. Also, since glacial silt tends to remain in suspension, it is probable that these waters will be turbid. The degree of turbidity is impossible to predict at this time, although it may be generalized that the greater the turbidity, the less productive the waters will be of fish life.

Investigations of the Fish and Wildlife Service both above and below the Devil Canyon damsite failed to reveal any evidence that anadromous fish migrate through or above Devil Canyon. Therefore, no recommendation for a fish ladder or other fish passage device is included. However, the possibility exists that the Louise, Susitna, and Tyone Lake system, as well as certain other lakes in the basin, could sustain a red salmon run. Also, the many clear-water streams tributary to the Susitna River above Devil Canyon damsite may possess a potential for spawning and rearing of other salmonine species. Additional studies to determine potential spawning areas are planned by the Fish and Wildlife Service in the future. Should these studies indicate a reasonable probability that the area can be developed for production of anadromous fish, and should it appear justified economically, then some type of fish passage facility may be recommended for Devil Canyon Dam at a later date.

This report and the following recommendations have been endorsed by the Alaska Department of Fish and Game as indicated in the letter to us dated May 6, 1960 from Acting Commissioner Walter Kirkness of that Department, a copy of which is appended to the substantiating report.

In order to minimize adverse effects to fish and wildlife resources with project development and operation, it is recommended that:

1. During project development, reservoir filling and operation, a minimum flow of not less than 2,000 c.f.s. be maintained at all times in the Susitna River below the Devil Canyon Dam. However, should the initial reservoir filling occur during the period October through April, inclusive, only 1,000 c.f.s. would be required.

2. During the period of construction, reservoir filling and project operation a minimum flow of not less than 150 c.f.s. be maintained in the Susitna River below the Denali Dam for the period October through March, inclusive.

3. Abrupt changes in the volume of water discharged be avoided at both dams; such changes should be made gradually or in a series of slight increases or decreases.

4. The following language be incorporated in the recommendations of the report of the District Manager of the Bureau of Reclamation:

    a. "That additional detailed studies of fish and wildlife resources affected by the project be conducted as necessary after the project is authorized in accordance with the Fish and Wildlife Coordination Act, 48 Stat. 401, as amended; 16 U.S.C. 661 et seq.; and that such reasonable modifications in the authorized project facilities be made by the Secretary as he may find appropriate to conserve and develop these resources."

    b. "That Federal lands and project waters in the project area be open to free use for hunting and fishing so long as title to the lands and structures remains in the Federal Government, except for sections reserved for safety, efficient operation, or protection of public property."

    c. "That leases of Federal land in the project area reserve the right of free public access for hunting and fishing."

5. The report of the District Manager, Bureau of Reclamation, include the preservation and propagation of fish and wildlife resources among the purposes for which the project is to be authorized.

The analysis of project effects as set forth in the substantiating report is based on engineering data available April 12, 1960. The Fish and Wildlife Service should be advised of any changes in engineering plans so that the effects of such changes on the fish and wildlife resources of the project area may be determined.

Very truly yours,

By - Dan H. Ralston
URBAN C. NELSON
Regional Director
Bureau of Sport Fisheries
and Wildlife

John T Gharrett
JOHN T. GHARRETT
Regional Director
Bureau of Commercial
Fisheries

SUBSTANTIATING REPORT

TABLE OF CONTENTS

LIST OF TABLES AND FIGURES

PREFACE

1. This is a detailed report concerning the probable effects of the Devil Canyon Project upon the fish and wildlife resources of the project area. The overall project consists of two primary features; the Devil Canyon Dam and Reservoir, and the Denali Dam and Reservoir. These features are considered as separate facilities throughout this report. Engineering data and operational plans on which this report is based were obtained from the Bureau of Reclamation on April 12, 1960.

2. Fish and Wildlife field investigations have been conducted intermittently in the project area since 1952 and, in part, concurrently with Bureau of Reclamation feasibility studies. The fish and wildlife resources that will be affected by the Devil Canyon and Denali features are discussed as they would probably exist without and with project development.

3. No major water development project exists in a subarctic location which will provide a basis for predicting the effect of the Devil Canyon project on the fish and wildlife resources. Further, only limited information concerning life histories and populations of the various species involved is available. Thus, only generalized predictions of project effects are possible.

4. Appreciation is expressed to the many members of the various branches of the Bureau of Sport Fisheries and Wildlife and the Bureau of Commercial Fisheries for supplying needed information during the preparation of this report.

5. Since January 1, 1960, the State of Alaska has assumed control of the fish and wildlife resources of the new State. Staff members of the Alaska Department of Fish and Game have indicated a desire and willingness to contribute further information in the continuation of studies of this project.

6. Previous reports prepared by the U. S. Fish and Wildlife Service that pertain to the Devil Canyon and Denali features are as follows:

> A Preliminary Report on Fish and Wildlife Resources in Relation to the Susitna River Basin Plan, Alaska. 1952

A Progress Report on the Fishery Resources of the Susitna River Basin, Alaska. 1954

A Progress Report on the Wildlife Resources of the Susitna River Basin, Alaska. 1954

Progress Report, 1956 Field Investigations, Devil Canyon Damsite, Susitna River Basin, Alaska. 1957

Progress Report, 1957 Field Investigations, Devil Canyon Damsite and Reservoir Area, Susitna River Basin, Alaska. 1959

1958 Field Investigations, Denali and Vee Canyon Damsites and Reservoir Areas, Susitna River Basin, Alaska. 1959

INTRODUCTION

Purpose of the Project

7. The purpose of the Devil Canyon Project will be to provide power to interior and south-central Alaska. Ultimate power capacity of the Devil Canyon Project will be 580,000 kilowatts; however, the initial capacity will be limited to 217,500 kilowatts.

Location of the Project

8. Devil Canyon Project, consisting of two dams and reservoirs, will be located in south-central Alaska, about midway between the two population centers of Anchorage and Fairbanks. More specifically, the Devil Canyon damsite is located on the Susitna River 14.5 miles upstream from the Alaska Railroad section at Gold Creek or at river mile 134. This development will provide the source of power generation. The Denali damsite will be located on the Susitna River at mile 248, or 15 miles below the Denali Highway crossing of the Susitna River. The reservoir formed by this dam will provide for water storage and regulation of flows to be utilized downstream at the Devil Canyon site.

DESCRIPTION OF THE AREA

Physical Features

9. The Susitna River Basin lies in south-central Alaska, north of the farthest inland projection of Cook Inlet between latitudes 61° - 64° north and longitudes 146° - 153° west (Fig. 1). The total drainage of the basin comprises about 19,300 square miles of relatively uninhabited lands. The basin is bordered on the south by the waters of Cook Inlet and the Talkeetna Mountains, on the east by the Talkeetna Mountains and the Copper River plateau, and on the west and north by the Alaska Range.

10. The main stem of the Susitna River from its source in the Alaska Range to its point of discharge into Cook Inlet is about 275 miles long. It flows southward from the Alaska Range for about 60 miles; thence, in a general westerly direction through the Talkeetna Mountains for about 100 miles, and then south for the remaining 115 miles to its mouth at Cook Inlet.

11. Principal tributaries of the lower basin have as their origin glaciers high in the surrounding mountain ranges. These streams are for the most part turbulent in the upper reaches and slower flowing in the lower regions. Most of the tributaries carry a heavy load of glacial silt.

12. The Yentna River, one of the largest tributaries, begins in the mountains of the Alaska Range, flows in a general southeasterly direction for approximately 95 miles and enters the Susitna River 24 miles upstream from its mouth.

13. The Talkeetna River has its origin in the Talkeetna Mountains. It flows in a westerly direction and discharges into the Susitna River 80 miles upstream from its mouth.

14. The Chulitna River heads in the Alaska Range and flows in a southerly direction, joining the Susitna River opposite the Talkeetna confluence.

15. Principal tributaries of the upper Susitna drainage are the Oshetna, Tyone, and Maclaren Rivers. For the most part, these tributaries have numerous feeder streams that drain many clear-water lakes.

Figure 1. Susitna River Basin, Alaska

16. Stream flow in the Susitna Basin is characterized by a high rate of discharge from May through September and by low flows from October through April. High discharges are caused by snow melt, rainfall, and glacial melt. Streams carry a heavy load of glacial silt during the summer. During the winter when low temperatures retard water flows, streams are silt free.

17. The Alaska Range to the west and north, and the Talkeetna Range to the east make up the high perimeter of the lower Susitna River Basin. The Alaska Range is made up of sedimentary rocks, some of which have been metamorphosed and intruded by granitic masses. The Talkeetna Mountains are primarily granitic. The floor of the lower basin is largely covered with glacial stream deposits.

18. The upper basin, predominantly mountainous, is bordered on the west by the Talkeetna Mountains, on the north by the Alaska Range, and on the south and east by the flat Copper River plateau. Valleys are floored with a thick fill of glacial moraines and gravels.

19. The climate of the Susitna Basin is rather diversified. The latitude of the region gives it long winters and short summers with great variation in the length of the daylight between winter and summer.

20. The lower Susitna Basin owes its relatively moderate climate to the warm waters of the Pacific on the south and the barriers of surrounding mountains. The summers are characterized by moderate temperatures, cloudy days, and gentle rains. The winters are cold and the snowfall is fairly heavy. Talkeetna, representative of the lower basin, has an annual mean temperature of 33.2°F., and an average annual precipitation of 28.85 inches.

21. The upper Susitna Basin, separated from the coast by high mountains, has a somewhat more severe climate than the lower basin. The nearest weather station at Mount McKinley Park has an annual mean temperature of 27.5°F., and an annual precipitation of 14.44 inches.

22. Spruce, birch, aspen, cottonwood, willow, and alder are found throughout the lower basin up to about 2,000 feet. These are interspersed with low muskeg vegetation on the floor of the

basin and grassy meadows on higher benches. Understory of timbered areas consists of moss, ferns, high and low bush cranberry, devil's club, wild rose, blueberry, currants, grass, and wildflowers. Above timberline, thickets of alder and willow occur interspersed with grassy meadows. Above this zone vegetation consists of moss, lichens, and wildflowers.

23. Spruce occurs throughout the upper basin up to the 2,500- to 3,000-foot timberline. Low, scrubby, black spruce grows on the poorly drained bottomland, while the larger white spruce is found on better drained sites. Dwarf birch is distributed throughout the upper basin, and willow occurs along water bodies. White birch and alder occur in limited amounts. The understory includes blueberry, low-bush cranberry, Labrador tea, crowberry, fireweed, mosses, and lichens. Muskeg is interspersed throughout the bottomland and tundra is present throughout better drained areas.

24. Mount McKinley National Park, containing about 3,030 square miles and second in size only to Yellowstone National Park, lies some 50 miles to the northwest of the project area. It was created by an act of Congress in 1917 and has as one of its objectives the protection of the great herds of mountain sheep and caribou in this portion of the Alaska Range. Mount McKinley, the highest mountain in North America, is the principal scenic feature of the park. This lofty peak rises 20,269 feet above sea level, and soars some 17,000 feet above the surrounding forested plateau; it is the only mountain in the world to rise so high from its own base.

25. The Denali Game Reserve, extending from the north side of the Denali Highway to the crest of the Alaska Range and from the eastern boundary of the Maclaren River drainage westward to a point 10 miles east of Cantwell, was established in 1957. Currently, the reserve is closed to the taking of big game animals.

Commercial Features

26. The population of the basin is chiefly concentrated along the railbelt with scattered settlements of trappers and miners throughout the entire basin. The proposed project features are located approximately midway between Anchorage and Fairbanks,

the two largest cities in the State. It has been estimated that these two areas contain about 125,000 people or about 60 percent of the entire State's population.

27. The Alaska Railroad is the only overland means of transportation through the lower Susitna River Basin. The Denali Highway passes through the headwater portion of the upper Susitna Basin. Although other secondary roads are being developed, access to remote areas is still possible only by air and boat travel.

28. Economic activities are chiefly centered in the lower 100 miles of the basin along the railbelt. The commercial fishery utilizing the Susitna salmon runs is located in Cook Inlet. Placer and lode gold, tungsten, and construction materials are produced in this lower area, but only in limited quantities. Coal and other minerals are present but have received little attention due to high development costs. Much of the basin is under lease by oil interests. Portions of the lower basin are suited for agriculture and forest industries, which still await full development.

PLAN OF DEVELOPMENT

Engineering Features - Devil Canyon

29. Devil Canyon damsite, located on the Susitna River at mile 134 (Fig. 2), will be the initial development. The dam, rising 635 feet above its foundation and 565 feet above the normal water surface of the river (Fig. 3), will be of a concrete-arch design. Although the ultimate installed power capacity will be 580,000 kilowatts, the initial capacity will be 217,500 kilowatts.

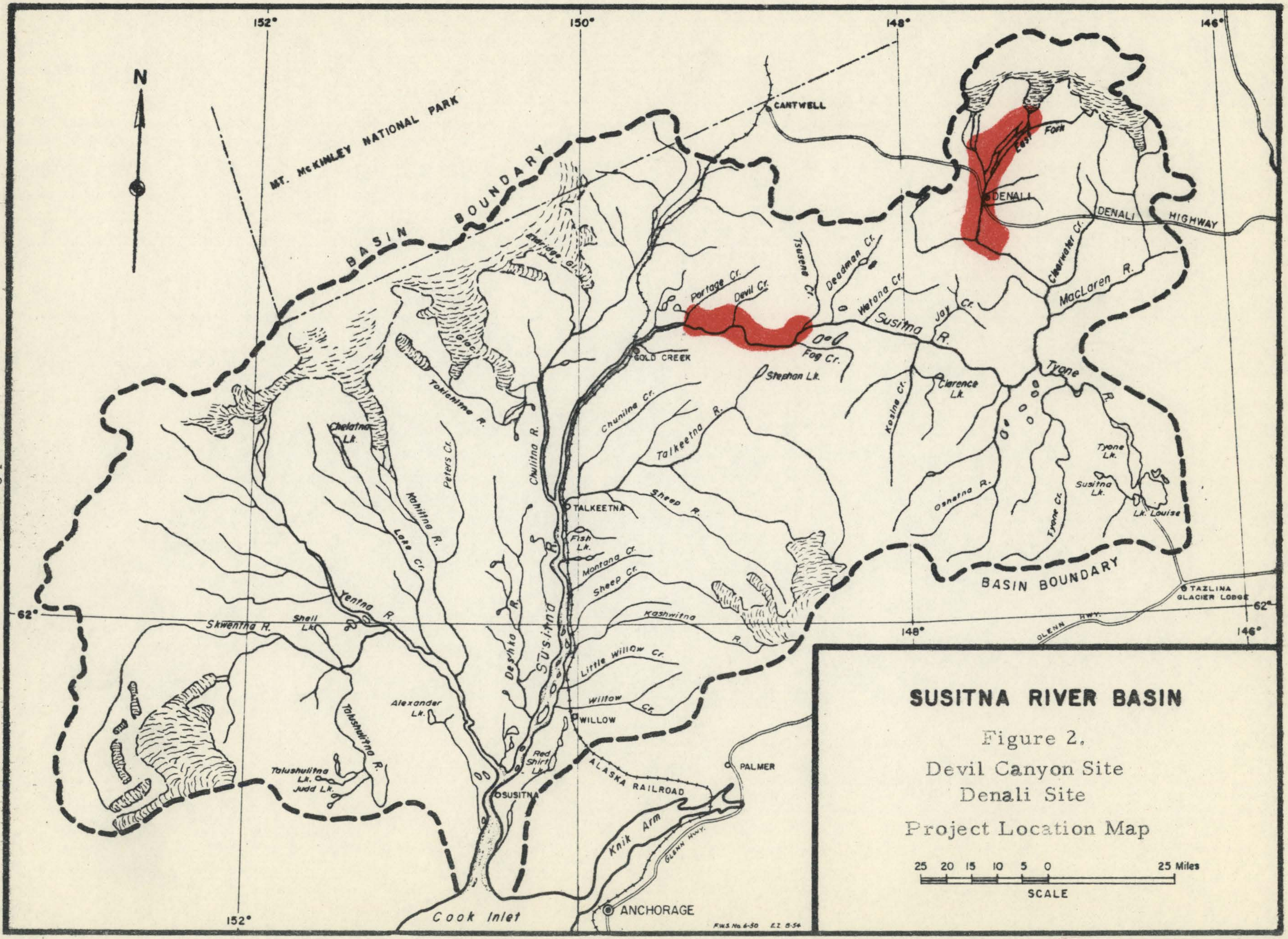
30. The reservoir will be about 29 miles long and between 0.25 and 0.75 mile wide. At a normal full pool water surface elevation of 1,450 feet, it will have a surface area of 7,550 acres and an initial total capacity of 1,100,000 acre-feet. During a 100-year period, the average minimum operating pool level is estimated at 1,284 feet m.s.l. At this level, the reservoir would have a capacity of 205,000 acre-feet and a surface area of about 1,900 acres. The dead storage pool will have an initial surface area of 2,100 acres and a storage capacity of 293,000 acre-feet, at an elevation of 1,275 feet.

Engineering Features - Denali

31. The Denali Dam will be an earth and sand/gravel structure about 290 feet in height above the bottom of the cutoff trench and 219 feet above the river bed. Its location will be approximately 15 miles downstream from the Susitna River crossing of the Denali Highway, or at river mile 248 (Fig. 2). With normal full pool water surface elevation of 2,552 feet, a reservoir 2 to 6 miles wide and about 25 miles long will be created. This will cover about 61,000 acres and store 5,400,000 acre-feet of water (Fig. 4). For a 100-year period, the average minimum operating pool level would be 2,484 feet m.s.l.; at this elevation, the reservoir will cover 34,000 surface acres and contain 1,650,000 acre-feet. Initially, 100,000 acre-feet of water will remain in the dead pool, which will cover 300 acres at an elevation of 2, 3~~68~~86 feet. The dead pool storage will decline to zero over a 100-year period, due to sedimentation.

Operation - Devil Canyon

32. Maximum monthly power releases from the Devil Canyon Dam will occur during December when an average of 10,525 c.f.s.



SUSITNA RIVER BASIN

Figure 2.
Devil Canyon Site
Denali Site
Project Location Map

U. S. B. R. Photo

Figure 3. View of proposed Devil Canyon Damsite, showing rapids and river gorge.

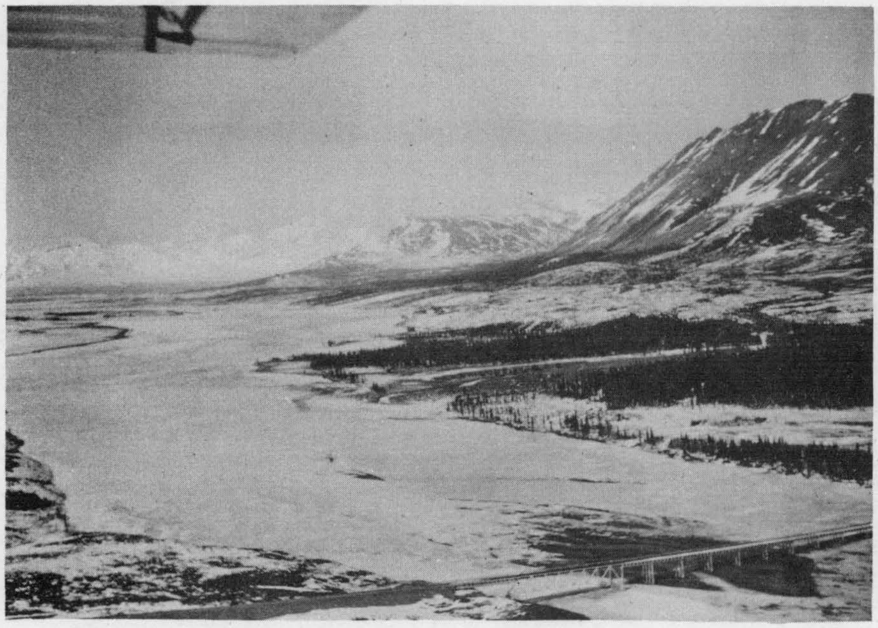


Photo by Jack Lentfer

Figure 4. Upper section of Denali impoundment area looking north from Denali Highway bridge crossing of Susitna River to headwater glaciers.

will be discharged. Minimum monthly power releases averaging 7,930 c.f.s. will occur during July. The average annual release will be 9,125 c.f.s.

Operation - Denali

33. Water will be stored in the Denali impoundment during spring and summer for release in the fall and winter. Only incremental flows will occur for about a six-month period in that section of the Susitna River between the two impoundments. The month of maximum discharge will be December when an average of 9,400 c.f.s. will be released. The average release from the Denali Dam during the period of operation will be 6,800 c.f.s.

34. Salient features of engineering and operation are presented in Table I.

TABLE I

PERTINENT ENGINEERING AND OPERATING DATA
DEVIL CANYON AND DENALI DAMS AND RESERVOIRS

	Devil Canyon	Denali
Height of Dam (feet above foundation and bottom of cutoff)	635	290
Maximum Pool Elevation (feet m.s.l.)	1,455	2,562
Surface Area (acres)	7,750	65,000
Storage Capacity (acre-feet)	1,140,000	6,055,000
Normal Full Pool Elevation (feet m.s.l.)	1,450	2,552
Surface Area (acres)	7,550	61,000
Storage Capacity (acre-feet)	1,100,000	5,400,000
Average Min. Op. Elevation (feet m.s.l.)	1,284	2,484
Surface Area (acres)	1,900	34,000
Storage Capacity (acre-feet)	205,000	1,650,000
Top of Dead Pool Elevation (feet m.s.l.)	1,275	2,3~~68~~ 86
Surface Area (acres)	2,100	300
Storage Area (acre-feet)	293,000	100,000
Average Min. Monthly Release (c.f.s.)	7,930 (July 1)	-0- (April-Sept)
Average Max. Monthly Release (c.f.s.)	10,525 (Dec)	9,400 (Dec)
Average Release (c.f.s.)	9,125 1/	6,800 (when releases are made)

1/Does not include spills

FISHERY

General

35. During the warmer months of the year, the Susitna River is silt-laden throughout its entire course due to its glacial origin. Sport fishing is thereby limited to the clear-water tributaries and areas in the main Susitna River near the mouths of these tributaries. The principal fresh-water sport fish present in the Susitna Basin are rainbow and lake trout, Dolly Varden char, and grayling. Other species of lesser importance are burbot, sucker, sculpin, and two species each of stickleback and whitefish. King, red, pink, chum, and coho salmon are found in varying abundance in major tributaries of the Susitna River below the Devil Canyon damsite. During the past 10 years, the first wholesale value of the Cook Inlet salmon case pack has averaged over $7,300,000 annually. Of this, the Susitna River system is estimated to produce annually 38 percent or about $2,774,000.

36. Sport fishing pressure in the Susitna Basin is light, with the primary limitation being that of access. Many lakes and rivers afford landing sites for float-equipped aircraft, and fishermen using this method of transportation are frequently rewarded with limit or near-limit catches. The Alaska Railroad, the primary means of access to the lower basin, parallels the Susitna River from Nancy at railroad mile 181 to Gold Creek at railroad mile 263, and crosses many fine fishing streams tributary to the main river. During the summer season, trains make unscheduled stops at these streams to accommodate fishermen. The completion of the Denali Highway in 1957 opened the upper Susitna Basin to fishermen. The Tyone River, originating at Lake Louise and flowing northwest to the Susitna River, is proving increasingly popular with boat fishermen.

Without the Project - Devil Canyon

37. The areas affected by this proposed project feature are best discussed when considered as two separate sections; from the confluence of the Susitna, Talkeetna, and Chulitna Rivers at river mile 85, upstream to the Devil Canyon damsite at river mile 134, a distance of 49 river miles, and the Devil Canyon impoundment area about 29 river miles in length (Fig. 5).

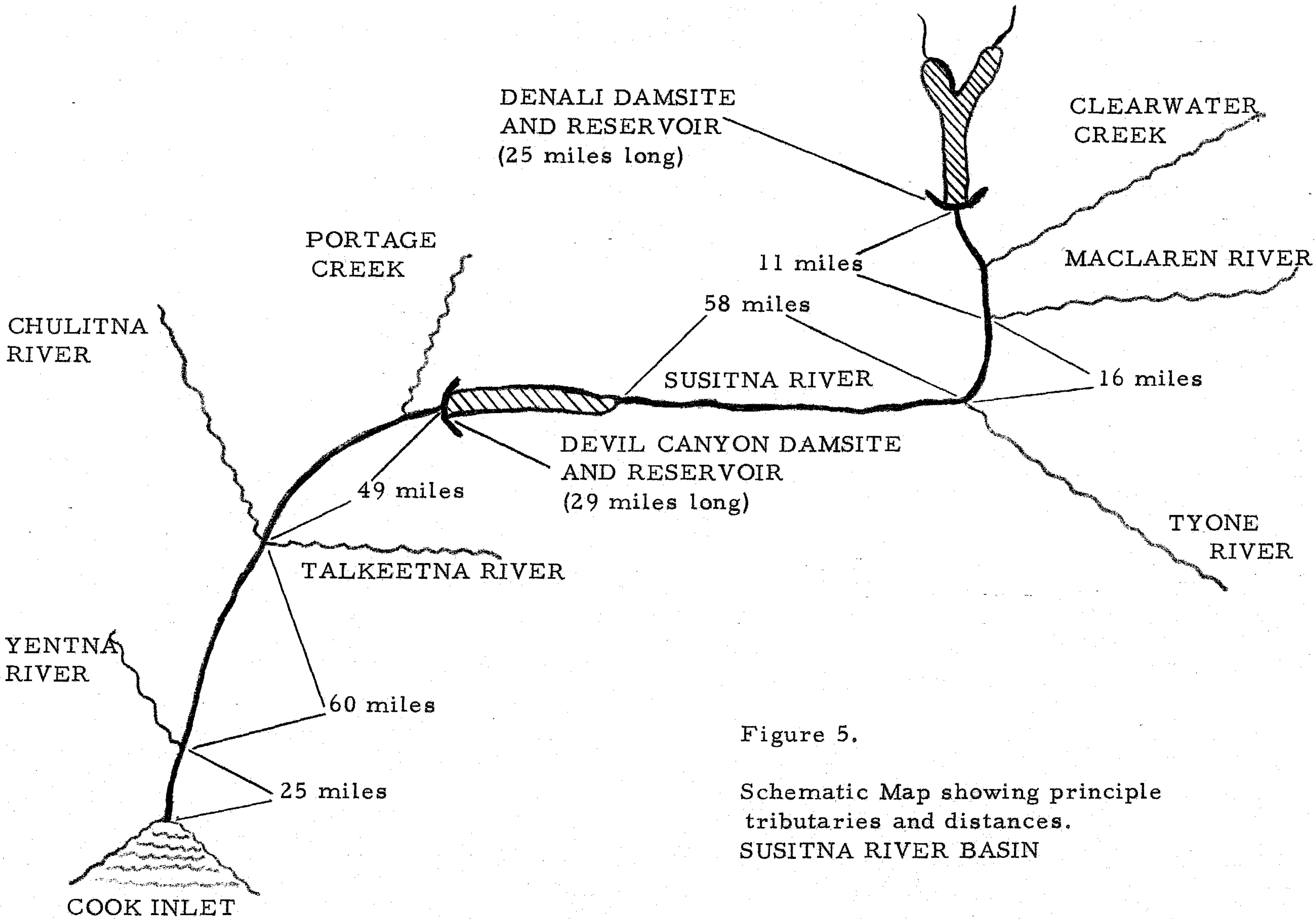


Figure 5.

Schematic Map showing principle
tributaries and distances.
SUSITNA RIVER BASIN

38. That section of the Susitna River downstream from Devil Canyon to its confluence with the Talkeetna and Chulitna Rivers is fed by a few clear tributary streams which furnish habitat for rainbow trout, grayling, lake trout, Dolly Varden char, and burbot, and spawning and rearing grounds for the five species of Pacific salmon. Portage Creek, 3 miles below the damsite, is the last tributary upstream on the Susitna River where significant numbers of spawning salmon have been noted. It is not known how extensively the main stem Susitna below the damsite is utilized for spawning, but such usage is probably light due to the silt-laden water and the relatively muddy, sandy nature of the channel. Sport fishing between the damsite and confluence of the Susitna, Talkeetna, and Chulitna Rivers is limited to the mouths of a few clear-water tributaries. It is presumable that no significant changes in either fish spawning or sport fishing will occur without the project.

39. The Devil Canyon impoundment area is a rugged, narrow canyon with several rapids and a few clear-water tributaries, the largest being Fog Creek and Devil Creek. Grayling, whitefish, burbot, suckers, and cottids occur in these tributaries and in the main river. Due to a paucity of sizeable tributary streams and remoteness of the area, sport fishing is practically non-existent. Little change is anticipated in fish populations or fishing pressures without project development.

40. Investigations conducted by the Fish and Wildlife Service intermittently from 1952 to 1958 failed to reveal the presence of adult or young salmon above the proposed Devil Canyon damsite. No actual waterfalls or physical barriers have been observed in or above the Devil Canyon area which would preclude salmon from utilizing the drainage area above the damsite. However, the most logical reason for the absence of salmon from the area is the probability of a hydraulic block resulting from high water velocities for several river miles within Devil Canyon (Fig. 6). It is doubtful that the area above Devil Canyon will become accessible to and utilized by anadromous fish without project development.

Without the Project - Denali

41. In the Denali area, the affected sections are considered in two parts; the area from the head of the Devil Canyon Reservoir to the Denali damsite at river mile 248, for a distance of 85 main stem miles, and the Denali impoundment area, which is about 25 miles long.

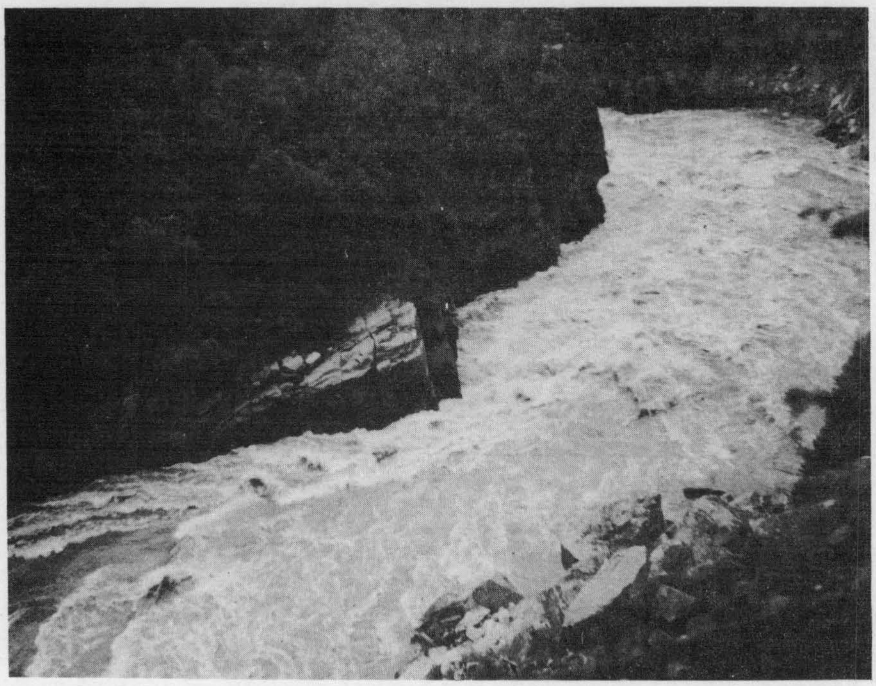


Photo by Dick Hensel

Figure 6. Possible hydraulic barrier to ascending salmon several miles above Devil Canyon Damsite. Note slide lower right.

42. From the Devil Canyon Reservoir upstream to the Denali impoundment, several tributaries enter the Susitna River. The largest of these are the Maclaren River, which is glacially turbid, and the Oshetna and Tyone Rivers which are clear. Smaller streams include Deadman, Watana, Kosina, Jay, Goose, Coal, and Clearwater Creeks. In this section of the Susitna, only burbot have been captured during the summer. Clear tributary streams contain grayling, whitefish, burbot, suckers, and cottids. Lake trout are present in certain of the tributary drainages which contain deep lakes. Fishing pressure on the mainstem Susitna is negligible and limited to the mouths of some of the clear-water tributaries. It is expected that this pressure will show only a slight increase without the project.

43. In the Denali impoundment area, the major tributaries to the Susitna River are Raft, Butte, Windy, and Valdez Creeks which are clear and Boulder Creek which is turbid. The clear streams contain grayling, whitefish, burbot, suckers, and cottids. Lake trout are found in some of the small lakes adjacent to the river. Anadromous fish are not present. Stream fishing, principally for

grayling, is not extensive and is generally confined to the mouths of clear tributaries. Sand Lake, easily accessible from the Denali Highway, is fished for lake trout. Opening of the Denali Highway has provided access to this area and establishment of tourist facilities and trails portends increasing fishing pressure.

With the Project - Devil Canyon

44. In that area from the confluence of the Susitna, Chulitna, and Talkeetna Rivers to the damsite at Devil Canyon, it is doubtful that any significant changes to the sport fishery will occur. However, the Susitna River in this area serves as the migration route for salmon ascending to the spawning tributaries. Releases of water, either colder or warmer than normal stream temperatures, could affect the attraction of salmon to such tributaries. Possible flushing and scouring action that would occur as a result of sudden changes in discharge from the Devil Canyon Reservoir may alter production of insects and other fish food.

45. From available records of water contribution of the Susitna, Chulitna, and Talkeetna Rivers, it appears that the project will have no effects to the anadromous fish runs or sport fish below this confluence to the river's mouth at Cook Inlet.

46. In the reservoir to be formed by the Devil Canyon Dam, it is doubtful that any significant effects will be sustained by the fishery resources. Inundation of the lower portions of clear-water tributaries may have a limited detrimental effect on some species. However, this may be offset by elimination of falls near the mouths of some of these streams which will be flooded, thereby permitting increased fish movement and utilization. Although the reservoir will improve access, fluctuating water levels and turbid waters will limit both fish production and fishing pressure.

With the Project - Denali

47. In the area from the Devil Canyon impoundment upstream to the Denali damsite little change in the overall fishery is anticipated, even though water will not be released from the Denali Reservoir from April through September. This will result in virtual dewatering of the 11 miles of the Susitna River between the dam and the mouth of the Maclaren River. This section currently

contributes little to game fish production. Under project development, it may serve as a wintering area for fish. Reduced flows will have less effect on fish movement and food production below the mouth of the Maclaren River, and these effects will become progressively less severe downstream as each tributary adds more water.

48. Fall and winter flows in this section of the Susitna River may consist of turbid glacial water stored in Denali Reservoir, in contrast to the normal clear water at this time of year. This possible change from clear to turbid water could affect the wintering habitat with attendant effects to the fish species utilizing the river. Should releases from the Denali Reservoir be relatively clear, winter fish habitat may improve since flows will be substantially increased. Improvement is particularly likely if these releases are controlled to minimize fluctuations.

49. The Denali Reservoir will inundate 25 miles of the Susitna River, several small lakes, and 13 miles of the lower portions of several clear-water streams which presently support an expanding sport fishery. However, the middle stretches of these streams will become accessible due to the availability of the reservoir for boat travel and float-plane landing. The Bureau of Reclamation estimates that only about 14 percent of the inflow will be glacial, with the remaining percentage being snow-melt runoff and spring-fed waters. Retention of water in the reservoir throughout the summer months will permit some warming to occur. The degree of turbidity to be expected from the glacial inflow is not known; however, observations elsewhere indicate that glacial silt tends to remain in suspension rather than settle out. Further observations generally indicate that turbid lakes are not only less productive of fish life than clear lakes, but less attractive to sportsmen. Therefore, the degree of turbidity will partially determine the fishery productivity and utilization of the impoundment area. Fluctuating water levels will further limit fish life by restricting food production in the shoal areas of the reservoir.

WILDLIFE

Without the Project - Devil Canyon

50. The dominant vegetative cover throughout the Devil Canyon impoundment area is spruce. Low bottomland along the main river and the tributaries supports black spruce-aspen stands. White spruce occurs on the steep side hills in conjunction with paper birch, dwarf birch, black spruce, and occasional stands of aspen and cottonwood. Dwarf birch is present in the rolling country on each side of the canyon, while willow occurs infrequently throughout the entire area. The understory includes blueberry, low-bush cranberry, narrow-leaved Labrador tea, crowberry, fireweed, mosses, and lichens.

51. Game populations are limited in number along the steep canyon walls which comprise most of the area to be flooded. A few moose and black and grizzly bear are present. Segments of the Nelchina caribou herd periodically range throughout the impoundment area. However, at no time of the year are caribou resident to the area nor is the area located on any recently-utilized migration route.

52. A limited number of spruce grouse inhabit the area. Ptarmigan would probably be present during peak population periods.

53. Beaver, present in sloughs along the river, are probably the most abundant fur bearers. Other species of fur animals present in sparse numbers include land otter, mink and fox. Wolves occasionally travel through the area. Other fur bearers that may be present are lynx, marten, wolverine and muskrat.

54. Waterfowl use of the area is limited to a few mergansers which nest in tributaries to the Susitna River.

55. Hunting and trapping in the impoundment area are virtually non-existent due to inaccessibility and low populations of wildlife. This condition can be expected to remain without project development. Even with road building and settlement of the region, game species would probably not be sought in the impoundment area due to low numbers and difficulties associated with hunting the steep canyon walls and traveling on the relatively turbulent Susitna River.

Without the Project - Denali

56. The upper section of the Denali impoundment includes extensive river bottomland containing abundant sedge and willow vegetation. Below the mouth of Valdez Creek, the area narrows with sedge and willow in the river bottom, and spruce, dwarf birch, and a heath plant formation composed of blueberry, low-bush cranberry, Labrador tea, and crowberry on the side hills. The impoundment area spreads out below the mouth of Butte Creek and contains lakes, potholes, and marshes, separated by higher well-drained land. Spruce and dwarf birch occur throughout with heath plants and lichens as an understory on the better drained sections, and sedge and willow along water bodies.

57. The Denali impoundment area supports a moose population of slightly less than one moose per square mile throughout all seasons of the year. Without the project, and based on moose productivity studies elsewhere in Alaska, the moose population will probably increase for the next several years and then stabilize at a higher density level.

58. The Denali impoundment area is located within the range of the Nelchina caribou herd, estimated to number over 50,000 animals. Scattered bands and stragglers may occur anywhere throughout the range, including the impoundment area, at any time of the year. However, the principal calving and summering grounds lie outside the impoundment area to the south. Historically, wintering grounds for the main segment of the Nelchina herd have been the Lake Louise Flats. An unexplained, westward shift in winter range use has been evident in recent years. As many as 20,000 caribou have been observed in Monahan Flats for limited periods. This is an area of about 400 square miles which comprises about 2 percent of the total Nelchina caribou range. That section of the impoundment area north of Valdez Creek includes the eastern one-eighth of Monahan Flats. Intermittent caribou utilization of the Monahan Flats, which includes the northern section of the impoundment area, will probably continue without project development. Sedge and lichens, which are highly important winter food plants for caribou, are generally in better condition in this locale than in areas utilized by wintering caribou in past years. Therefore, Monahan Flats is a desirable wintering area. The remainder of the impoundment area is utilized less by caribou than this northern section.

59. The southern half of the impoundment area is in one of the most popular big game hunting regions in the State, due to its accessibility from the recently completed Denali Highway and the availability of moose and caribou close to the road. The northern half of the Denali impoundment is part of the Denali Reserve, an area now closed to hunting. This reserve extends east and west for 80 miles and is situated on the north side of the Denali Highway. Several moose are harvested each year from within and adjacent to the open section of the project area. Without project development, hunting pressure for moose in the open areas will increase. Should recurrent suggestions to open the Denali Reserve and/or an either-sex moose season be adopted by the Alaska Department of Fish and Game, additional increases in the moose harvest will follow.

60. That section of the project area lying south of the Denali Highway is part of a region which receives rather intensive hunting for caribou during the first part of the season. The harvest, which varies from year to year depending on the distribution and movement of the caribou, would probably not be increased either by further liberalization of the present limit (3 caribou) or extension of the season. Hunting pressure, however, is expected to increase without project development. Should the Denali Reserve be opened to big game hunting, hunting pressure for caribou could be expected in the northern half of the impoundment area.

61. The area supports both black and grizzly bear; their harvest is mainly incidental to other big game hunting.

62. Spruce grouse, ptarmigan, and snowshoe hare, whose numbers fluctuate periodically, are present throughout the area but have not been abundant in recent years. Hunting for these species has been light and generally incidental to big game hunting. Hunting pressure may be expected to increase somewhat with an increase in human population, but harvest will still be largely dependent upon bird numbers.

63. Wolves, red fox, wolverine, beaver, muskrat, and land otter are present in the area. Other fur bearers possibly present include mink, marten and coyote. The present annual fur harvest probably does not exceed 20 beaver taken by one or two year-round residents near the Denali Highway crossing of the Susitna River. The potential fur yield is far greater than this and, with increased settlement, trapping would probably increase substantially.

64. The impoundment area furnishes nesting and rearing habitat for waterfowl. Species nesting in the area include the trumpeter and whistling swan, Canada goose, scaup, baldpate, green-winged teal, mallard, pintail, bufflehead, goldeneye, old squaw, harlequin, shoveller, canvasback, white-winged scoter, and American merganser. Migrant waterfowl use the area for feeding and resting during both spring and fall flights.

65. Waterfowl hunting at present is negligible. Without project development, the area would continue to furnish nesting, rearing, and resting habitat. Hunting pressure may increase with an increase in human population.

With the Project - Devil Canyon

66. Limited amounts of moose, caribou, bear, spruce grouse, and fur animal habitat will be inundated and destroyed. Fluctuating water levels and the precipitous topography of the area will preclude creation of new game habitat. Access to the area will be improved by a road from the Alaska Railroad section at Gold Creek to the damsite and by creation of the 29-mile long reservoir, which will furnish a surface for boat and plane operation. This improved access will undoubtedly attract some hunters and, perhaps, trappers, and result in an increased yield of the presently lightly harvested game of the surrounding area.

With the Project - Denali

67. About 61,000 acres of land will be inundated. Most of this is moose habitat, the use of which varies according to the season. Since it is unlikely that the surrounding area can support the displaced animals, the moose population of the impoundment area will be lost. With project development, a new road will be constructed around the lower half of the reservoir. This road, as well as the lake itself, which will afford boat and plane operation, will add to the accessibility and harvest of moose from the range surrounding the project area.

68. About 33,000 acres of good caribou winter range, which receives intermittent winter use by the Nelchina caribou herd, will be destroyed by inundation. An additional 28,000 acres of less valuable range, which receives intermittent use throughout the year, will also be inundated. Although substantial numbers of

caribou occasionally use this overall area, the range that will be destroyed is apparently not of major importance when compared with other segments of the Nelchina range. No main caribou travel routes will be inundated. Improved accessibility as a result of project development will probably increase the caribou harvest in the surrounding area.

69. Spruce grouse, ptarmigan and snowshoe hare habitat will be inundated and lost by project development.

70. A minor hazard to game animals may be created if a series of ice shelves is formed around the perimeter of the reservoir as water is drawn down during the winter.

71. Inundation will destroy fur bearer habitat and areas used by waterfowl for nesting and rearing. A fluctuating waterline will preclude creation of alternate habitat around the reservoir shoreline to replace these losses. The impoundment will furnish increased resting areas for waterfowl, particularly during the fall migration. With a lake for boat and float-plane operations, the area will probably become increasingly important for waterfowl hunting as the population of Alaska increases.

DISCUSSION

72. The Devil Canyon Project, if constructed, will result in relatively insignificant losses to the fishery resources of the Susitna River Basin.

73. Reservoirs formed as a result of the Devil Canyon and Denali Dams will inundate about 54 miles of the main stem Susitna River, a minimum of 15 miles of clear-water tributaries, and some lake habitat. Fluctuating water levels in both reservoirs will limit maximum development of impoundments for fish habitat. A further restriction to optimum fishery habitat development will be the turbid waters caused by glacial silt runoff. The degree of this turbidity cannot be predicted on the basis of available data; however, fishery production will decrease in proportion to turbidity. Although access will be improved by project development, only limited increases in sport fishing are anticipated where the clear-water tributaries enter the impoundments. It is anticipated that the paucity of clear streams, the fluctuating water levels, and the presence of better fishing in adjacent areas will preclude high usage of the impoundments by anglers.

74. If water released from Devil Canyon Dam for power generation is different in temperature from that of the natural river, the attraction and migration of salmon and other fish to the tributaries between the confluence of the Susitna, Chulitna, and Talkeetna Rivers and the dam may be altered. Limited spawning and other fish usage of this area would be reduced by the introduction of cooler water, while warmer waters would result in increased fish food production and fish utilization in this area. For these reasons, water releases should be made, if feasible, from a reservoir level that corresponds as nearly as possible to normal or warmer than normal river temperatures.

75. The releases indicated in the Bureau of Reclamation Operating Plan for the Devil Canyon Dam will be adequate to sustain fish habitat in the Susitna River downstream from the project. However, during dam construction, reservoir filling, and throughout the life of the project, flows of not less than 2,000 c.f.s. should be maintained. If the initial reservoir filling occurs during the period October through April, inclusive, the minimum flow requirement would be 1,000 c.f.s. Sudden changes in water discharge should be avoided to prevent scouring of the channel.

76. Stream ecology and fish life will be modified in the 85 miles of the Susitna River between the Devil Canyon Reservoir and the Denali Dam. The plan of operation calls for water above Denali Dam to be impounded during the spring and summer and to be released during the fall and winter. Changes will be most profound in the 11 miles of the Susitna River from the Denali Dam to the Maclaren River. However, during the summer months when such flows will be stored, this section of stream apparently receives little usage by fish; therefore, this summer dewatering may be of little consequence. Below the Maclaren River, it is most likely that summer fish usage increases. Water records indicate that incremental flows from the various tributaries in this section are normally greater than the flow of the Susitna River at Denali Dam. Even without flow in the Susitna River from Denali Reservoir, the amount of water from the tributaries is believed adequate to sustain fish habitat and fish life.

77. During the fall and winter months, flows between Denali Dam and Devil Canyon Reservoir will exceed normal flows without the project. Such increases will probably be of benefit to wintering fish populations in the Susitna River, particularly if the flow from Denali Dam is relatively clear. However, if this water is glacially turbid, it may be of less value than the normally clear water which currently occurs.

78. Although minimum year-round releases from the Denali Dam would probably reduce the changes in the stream habitat, such alteration of habitat without minimum flows will not be particularly adverse to the fishery resources. Therefore, minimum flows are not required during spring and summer months when the project is in operation. In order that fish habitat may be preserved during the construction and initial filling period and project operation, flows of not less than 150 c.f.s. should be maintained from October through March. When the project is fully operational, flows released from the dam for power generation downstream at Denali will be adequate to maintain the winter fish habitat.

79. Although there have been two reports of fish above the Devil Canyon Dam that could have been salmon, no verified report exists of salmon above this site. A strong probability exists that a hydraulic block (comprised of swift water for several miles) prevents the movement of anadromous fish to the Susitna River drainage above the Devil Canyon damsite. It may be that, with some

special water condition which might exist periodically, an occasional salmon is able to traverse the area. There are no indications, however, that any significant numbers of salmon or other anadromous fish will be blocked by construction of the Devil Canyon Dam; therefore, no fish ladder or other fish facility is recommended for inclusion in the plans for the Devil Canyon Dam at this time.

80. Above the Devil Canyon damsite, there are many clearwater tributaries and lake systems that may be utilized by salmon for spawning and rearing purposes. Elimination of the hydraulic block by inundation together with some type of fish-handling device might make it possible to bring the middle and upper Susitna drainage area into salmon and steelhead trout production. Detailed studies will be conducted to determine the feasibility and opportunities for enhancement features to utilize these potential spawning areas.

81. Limited amounts of wildlife habitat will be destroyed by inundation with attendant losses to the wildlife species dependent on these habitats. Because of generally low populations and poor accessibility, these losses are considered to be of a minor nature. The topography of the reservoir perimeters as well as the season, duration, and severity of fluctuating water levels in the two reservoirs make mitigation of such limited losses by development of replacement habitat improbable. It is possible that, as a result of project construction and operation, access to currently remote areas will improve with increased utilization of the game and fur species by hunters and trappers.

STATE OF ALASKA
DEPARTMENT OF FISH AND GAME
229 ALASKA OFFICE BUILDING JUNEAU, ALASKA
C. L. ANDERSON, COMMISSIONER

STATE OF ALASKA
WILLIAM A. EGAN
GOVERNOR

May 6, 1960

Mr. John T. Gharrett, Regional Director
Bureau of Commercial Fisheries

and

Mr. Urban C. Nelson, Regional Director
Bureau of Sport Fisheries and Wildlife
U.S. Fish and Wildlife Service
Box 2481, Juneau, Alaska

Gentlemen:

The Department has reviewed the report of the U.S. Fish and Wildlife Service dated May 4,1960 concerning the Bureau of Reclamation's planned Devil Canyon Project on the Susitna River Basin. We agree with your findings as to the effect of the project on fish and game, and concur in the recommendations for the protection of these resources as outlined in this report.

Sincerely,

ALASKA DEPARTMENT OF FISH & GAME

Walter Kirkness

Walter Kirkness,
Acting Commissioner

WK:kp

UNITED STATES
DEPARTMENT OF THE INTERIOR
Bureau of Mines
Region 1

Mining Industry in the Area influenced by the Proposed Susitna River Hydroelectric Project

INTRODUCTION

Hydroelectric power from the proposed Devil Canyon-Denali Project on the Susitna River will be available for distribution throughout the so-called Railbelt region, which includes the area adjacent to the Alaska Railroad between Fairbanks and Seward as well as the Big Delta, Kenai Peninsula, and Prince William Sound areas. Mineral resources, especially gold, played a major role in the economy of the region since the discovery of the gold placers near Fairbanks in 1902.

The Alaska Railroad was built to connect the thriving mining camps of the Fairbanks and Yukon River placer mining districts with ocean transportation at Seward. Completed in 1923, the railroad offered dependable service and reasonable freight rates that were of great assistance to the mining industry in reaching and maintaining a paramount position in the region's economy. The development of a dependable supply of low-cost power will have a similar beneficial effect on present and potential mineral industries.

The construction and operation of extensive defense establishments has replaced mining as the basic activity in the Railbelt but many men are still employed by the mineral industry; a large amount of capital is invested in dredges and other mining plants. Principal products of the mining industry are gold (placer), coal, and sand and gravel from large, widely distributed deposits.

Except for the above-mentioned commodities, comparatively little is known of the mineral production potential of the region; because of inaccessibility and difficult prospecting conditions, large areas remain unexplored. This condition prevails to a large extent in the reservoir areas included under both the Devil Canyon and Denali dams.

The Denali reservoir site includes at least a part of the Valdez Creek gold placer deposits which have yielded slightly over a million dollars in gold since their discovery in 1904. Production from the Valdez Creek district[1] in recent years has been negligible.

1/ Ransome, Alfred L., Kerns, William H., Names and Definitions of Regions, Districts, and Subdistricts in Alaska: Bureau of Mines Inf. Circ. 7679, 1954, 91 pp.

Economic conditions rather than exhaustion of the deposits are believed to be responsible for the lack of activity. The recent completion of the new Denali Highway has greatly improved access to the Valdez Creek district and will reduce operating costs as well as stimulate prospecting.

No mineral production has been recorded from the area to be inundated by the proposed Devil Canyon dam or from the immediate vicinity of the reservoir site. However, access to this area is particularly difficult and little prospecting has been done.

Because of the above-mentioned conditions a comprehensive evaluation of the mineral resources of the region, including possible deposits that would be inundated by the proposed reservoirs, would require extensive field investigations; this report, therefore, is necessarily limited to the following general discussion of mineral production and mining activities in the area under the probable influence of the proposed project.

MINERAL PRODUCTION

Although now in decline, gold (largely from placers) has been the principal mineral product of the Railbelt. The total production of placer gold is given by region in table 1, "Placer gold production from the area served by the Alaska Railroad up to and including 1958."

Copper production, formerly an important factor in the economy of the Prince William Sound district, is presently nil. The present production of miscellaneous metals such as lead, zinc, antimoney, and tungsten is negligible throughout the Railbelt as well as elsewhere in Alaska.

Coal production in the Matanuska and Healy fields has been expanded to meet rapidly increasing military and civilian requirements.

The greatly accelerated construction of Alaskan highways under the Federal Aid Program promises to elevate the production of sand and gravel to a position of major importance throughout Railbelt. Table 2 gives the mineral production (including sand and gravel) from the area served by the Alaska Railroad up to and including 1958.

MINING

Gold

Virtually all significant lode gold operations in the Railbelt have been suspended because of present unfavorable economic conditions. In the gold-placer fields, only the more efficient and lower cost operations are still in production

In 1959 five dredges were active in the Fairbanks area, one in the Fortymile district, and one dredge in the Circle district. Several small placer mines continue to work.

The major producer in the Fairbanks area uses a combination of steam and hydropower to generate electricity for the operation of dredges and auxiliary facilities. The hydropower is a recent development financed by private capital and utilizing the Davidson Ditch as a source of water.

Gold lode and placer deposits are widely distributed throughout the region; placer deposits are especially extensive in the Fairbanks district. Proven reserves of placer gold are being rapidly depleted, however, and a large potential reserve is becoming a submarginal resource because of the constantly increasing cost of producing a fixed-price commodity. The survival of the gold mining industry, therefore, depends on a better price and/or lower costs such as may result from improved processes, cheaper power and a more stabilized economy throughout the region.

Coal

Coal-bearing formations extend over extensive areas throughout the region and coal reserves are known to be large. The coal, all of which is of Tertiary age, ranges in rank from lignite to high-volatile C bituminous[2/] -- depending on the degree of metamorphism. Extensive deposits occur in the Nenana and Matanuska fields, throughout large areas along the Beluga River and on the Kenai Peninsula.

The Matanuska field is currently the principal source of coal for the Anchorage area. This coal is classified as high-volatile B and C bituminous. The coal requirements of the Fairbanks area are now supplied from mines on Healy and Lignite Creeks in the Nenana field. These coals are mainly sub-bituminous B in rank although some

2/ Coal classification, types of coal, etc., is discussed in Mineral Facts and Problems, Bureau of Mines Bull. 556, pp 116-17.

Table 1. Placer gold production from the area served by the Alaska Railroad up to and including 1958

District	Region	To and including 1936 (U.S.G.S. Bull. 907)	1937-58 (incl.)	To and including 1958
Anchorage, Valdez Creek, Yentna-Cache Creek, and Prince William Sound 1/	Cook Inlet-Susitna	$3,731,000	$2,889,000 2/	$6,620,000 2/
Moose Pass, Hope, Seward Turnagain Arm, Homer Girdwood	Kenai Peninsula	2,213,000	57,000 2/	2,270,000 2/
Bonnifield, Fairbanks, Delta River, Hot Springs, Kantishna, Rampart, Tolovana	Yukon River	120,244,000	102,381,000 2/	222,625,000 2/
Total		$126,188,000	$105,327,000 2/	$231,515,000 2/

1/ Prince William Sound district is in Copper River region; old records show it in Cook Inlet-Susitna.

2/ Includes placer silver.

Table 2. Value of mineral production from the area served by the Alaska Railroad, up to and including 1958

Commodity	To and including 1936 (U.S.G.S. Bull. 907)	1937-58 (incl.)	Total to and including 1958
Gold:			
Placers	$126,188,000	1/$105,327,000	1/$231,515,000
Lodes	12,517,000	2/ 14,537,000	2/ 27,054,000
Subtotal	138,705,000	1/2/ 119,864,000	1/2/ 258,569,000
Silver (mainly from alloys with gold)	845,000	(3/)	845,000
Chromite			4/ 2,227,000
Copper (Prince Wm. Sound)			37,511,000
Coal	9,835,000	73,405,000	83,240,000
Sand and gravel			5/ 23,110,000
Miscellaneous, including lead, antimony, tungsten, copper and other	225,000	6/ 494,000	6/ 719,000
Total			406,221,000

1/ Includes placer silver.
2/ Includes lode silver, copper, lead, and zinc marketed from lode gold deposits.
3/ Included with gold.
4/ First recorded production in 1943.
5/ Includes production 1951-1958 only; prior years' production figures included in published records with "Miscellaneous".
6/ Antimony only; all other miscellaneous included with lode gold.

beds are sub-bituminous C. Coal from beds cropping along the shores of Cook Inlet (Kenai Peninsula) was utilized by whaling ships enroute to the Arctic Ocean and by early Russian settlements in that area; there are no mines in operation on the Peninsula at the present time.

Comparatively little is known of the deposits in the Beluga River area although recent reconnaissance drilling by the Bureau of Mines indicates that at least one large bed (over 50 feet thick) may be suitable for mining by open-cut methods. The Beluga River and Kenai coals are similar in rank to those of the Healy Creek district of the Nenana field.

Total production of coal from the region is valued at over $83 million; most of this has been produced within the last 20 years. Subsequent to 1942, the construction of numerous large military bases in the Railbelt and the resultant increase in civilian establishments required a rapid expansion of coal producing facilities. At present, the industry employs more than 200 men in surface and underground operations. Most of the coal is used in centrally located plants for the generation of electricity and heat for distribution to both military and civilian establishments. A small, steadily decreasing amount is used for domestic heating purposes.

Future demand for Alaskan coals may be enhanced by the development of export markets or by the perfection of processes currently under study -- some of which are now being used on an industrial scale -- which use coal as a source of organic chemicals, fertilizers, high-B.t.u. gas, liquid fuels, oils, fats, and waxes.

Minerals of Construction

Sand and gravel is abundant throughout most of the Railbelt region and deposits usually are locally available to supply the needs of the construction industry. The building of roads and airfields constitutes the principal use of these materials, although considerable amounts are used in concrete structures and by the Alaska Railroad for track ballast. Demand may be expected to increase sharply because of accelerated highway construction under the Federal highway aid program and because of continued growth of both military and civilian facilities throughout the region.

With the exception of sand and gravel, the use of native nonmetallic minerals for construction purposes has been negligible.

Raw materials suitable for the manufacture of cement, lightweight aggregate (haydite) and clay products are available in quantity at various reasonably accessible locations throughout the Railbelt, but economic conditions have prevented utilization except on a minor scale. Some brick have been produced from local clays. A new brick plant featuring a downdraft kiln has recently been placed in operation in Anchorage; common, roman and fire brick are manufactured for the local market.

Cement in bulk is now imported by tank barge and distributed from a plant in Anchorage. Present consumption of the region is about 300,000 barrels annually, which is less than one-third the capacity of the more efficient-sized cement manufacturing plants. Because of the high costs inherent to Alaskan operations, a plant of the greatest possible efficiency would be essential to provide the necessary competition with the comparatively cheap bulk cement imports. Normal growth of the new State plus the extra cement requirements of major construction projects, such as hydroelectric dams, may soon provide additional demand justifying utilization of local raw materials.

Copper

Alaska has produced a large amount of copper, principally from the fabulous Kennicott mines but a substantial amount has also been produced from the Prince William Sound district (table 2) which will be under the remote influence of the proposed power development. This district contains numerous copper prospects as well as several potentially large deposits that are presently submarginal in grade but which might be profitably exploited under more favorable economic conditions.

In the larger known deposits, comparatively small amounts of copper occur associated with usually massive concentrations of iron-sulfide minerals (pyrite, pyrrhotite and marcasite). These minerals, which contain from 46 to 60 percent iron and from 39 to 53 percent sulfur, are becoming increasingly important sources of sulfur, sulfur products, and iron. Under favorable economic conditions such as may be stimulated by the continued growth of heavy industry in the Pacific Northwest and the Orient, exploitation of the Prince William Sound copper-iron-sulfur deposits will become commercially feasible. The availability of cheap, dependable power would be a major factor in the development of successful mining, milling and local smelting operations.

Miscellaneous Minerals

High-grade antimony ore has been produced from mines in the Kantishna and Tolovana districts. Several deposits appear to have substantial reserves; however, high mining and transportation costs and fluctuating markets have handicapped production and have retarded both exploration and development of the deposits.

Tungsten deposits in the Gilmore Dome and adjacent areas near Fairbanks produced some high-grade ore during World War II. The granitic-metamorphic contact zone in which the deposits occur extends over a considerable area which has not been adequately investigated.

More than $2.25 million in chromite ore and concentrates (table 2) have been shipped from mines on the Kenai Peninsula near Seldovia (Red Mountain) since 1943. Practically all of the shipments were to the Government stockpile. The area contains a potentially large resource of low-grade chromite-bearing material as well as a substantial tonnage of metallurgical-grade chromite.

In addition to the above-mentioned metals prospects of lead, zinc, and manganese have been reported from various areas throughout the Railbelt but there has been little or no production of these metals. Except in those relatively small areas easily accessible to transportation, prospecting in the Railbelt region for metals other than gold has been very desultory. Systematic investigation of the many geologically favorable areas undoubtedly will result in the discovery of additional deposits of commercially important minerals.

Petroleum and Natural Gas

The discovery of oil on the Kenai Peninsula in 1957 resulted in a land leasing boom and intensified drilling activity over a large part of Alaska, including the Railbelt region. By November, 1959, three producing oil wells had been brought in on the Kenai Peninsula and several others were reported to have substantial reserves of gas. The Kenai field is in the early stages of development and the production potential is as yet unknown. Geological formations favorable to the existence of oil are known to underlie large areas in and adjacent to the Railbelt region and additional discoveries may be anticipated.

UNITED STATES
DEPARTMENT OF THE INTERIOR
Bureau of Land Management

Forest Resource of The Devil Canyon Project Power Market Area

Most of the forest lands within the power market area of the Devil Canyon Project are currently on public domain lands. The major exception being the Kenai Peninsula where roughly the eastern half of this area is within the Chugach National Forest and the northwestern one-third is within the Kenai National Moose Range.

The altitudinal limits of tree growth are usually between 2000 and 3000 feet, with the better stands occurring along the streams and better drained bench lands. Within the area under consideration there are vast areas above the limit of tree growth, as well as extensive areas of muskeg which support a forest cover of very low density.

The distribution, composition, density and volume of the forests within the Area are largely a result of fires, with 80 percent of the forest cover having been burned over one or more times within the last 60 years. These fires in some areas have resulted in denudation; in other areas a complex mosaic of forest types has resulted.

The typical interior forest stand is a mixture of white spruce and Alaska white birch. The spruce-birch type is loosely defined as containing any admixture of the two species but usually is about evenly distributed on the basis of stem count (not volume) per acre. The spruce-birch type is found throughout interior Alaska on the better drained soils and benchlands. In this type, the birch is usually of moderate size and runs from medium to heavy cull--the dominance and competition of the spruce apparently weakening the birch and making it susceptible to the inroads of forest diseases. Too, forest fires cause heavier damage to the white birch than to the heavier-barked white spruce. The spruce-birch type, within its range, is a sub-climax forest type, but has maintained itself over wide areas due to prevalence of wildfires.

The white spruce type--pure spruce or near-pure spruce stands--are typically found as the limits of tree growth in altitude, latitude, and longitude are approached. Pure spruce stands of limited extent may occur on the lower benchlands. At the lower elevations, the spruce type will contain excellent merchantable timber, but as the limits of growth are approached the trees become shorter, occur in more open stands, are branchy and of generally poor commercial quality. In the absence of fire the white spruce type becomes the climax type.

Alaska white birch, both reproduction and immature timber, is often found as pure type. It may appear as the first cover crop after a forest fire but frequently succeeds the quaking aspen. The white birch type soon supports a heavy understory of spruce and, as the stand reaches maturity, eventually becomes a white spruce-white birch type. Mature stands of the white birch type are limited in their occurence to certain areas in the Cook Inlet-Susitna River region and Tanana Valley. In these regions, the white birch has reached maturity and over-maturity in pure or near pure stands; however, white spruce is rapidly encroaching on the stands due to their over-maturity.

Inventory has been accomplished on a gross area of approximately 90,000 acres of birch timber known as the Talkeetna Birch Stand. This stand parallels the railroad at the east side of the Susitna River from the Kashwitna River to the Talkeetna River. The average volume per acre is slightly less than 2000 board feet of commercial birch having a diameter breast high of 8 inches or more. No more than 10 percent of the volume is suitable for manufacture of veneer. When Alaska birch is exploited it is felt that the major production will be in specialty products such as furniture stock, flooring, paneling and various items of woodenware.

One abortive sale of birch for export from Alaska was issued in the Talkeetna Stand in 1958. With the growing scarcity of birch in northeastern U. S., it appears to be but a matter of time before it will become economically feasible to develop the Talkeetna and other birch stands in Alaska.

Other birch stands presently unknown as to volume and quality exist on the northwest side of Knik Arm, the Shell Hills, Peters Hills, and in the Tanana Valley east of Fairbanks. It is felt that some of these stands may be of higher volume and quality than the presently accessible Talkeetna stand.

The cottonwood type (with associated types spruce-cottonwood and birch-cottonwood) is found along the stream courses. It is typically found on the rich bottom lands and river bars which are subject to more or less frequent flooding. The type, collectively, is important and covers a large acreage; however, on any individual stream the cotton-wood is typically found as a narrow belt along the river banks. Commercially, therefore, the cottonwood has no present market importance.

The aspen type is frequently found as the first cover crop on burned-over areas. The type may occur over extensive areas but the trees are short lived, subject to heavy decay, are small in diameter and have no present commercial importance.

The black spruce type is of no commercial importance and is the scrub species of the interior forests. It is found on wet lands and muskegs. In the Tanana Valley tamarack may be found in admixture--rarely is tamarack found in pure stands of even limited extent.

Approximately 16 million board feet of forest products have been sold from the public domain lands of Interior Alaska annually. The greater part of this volume is harvested within the power market area. This harvest is but a small percentage of the potential annual cut. The present utilization of the Interior forests is entirely dependent upon local consumption demands, no timber is exported. The commercial logging industry, therefore, is typified by small, portable mills which are large enough to satisfy the purely local demand and yet easy to move from one timber stand to another. The heaviest concentration of sawmills is in the Anchorage and Fairbanks areas, where the population and demand are the greatest. In these areas, the extensive logging of the past 50 years combined with the deep inroads of forest fires during the same period has seriously depleted the more easily accessible stands of merchantable timber. Loggers are now having to go farther afield, away from the roads, and at greater costs to them in order to obtain satisfactory timber.

Presently the majority of lumber used in Alaska is imported from the other States. The preference for outside forest products stems mainly from the failure of local industry to provide the amount and quality of timber at the time and place needed.

Aside from certain structural grades the forests of the power market area could supply a good deal of the lumber required by both civilian and military consumers. In fact, the common grades of local spruce are equal to or better than those of fir or hemlock shipped in because the spruce knots are both small and tight. However, most of the small mills in the power use area only operate sporadically, usually as a sideline, producing rough, green lumber which lacks uniformity in manufacture. Local retail dealers are reluctant to stock local material, supply and quality both of which are uncertain. Before local mills can capture a share of the market now going to outside sources, a more constant supply of lumber must be furnished; it must be well manufactured, graded and at least air dried. Also provisions must be made for planing and kiln drying of a fair percentage of output.

Although birch offers promise of entering into the export market, it is not expected that any of the other species will play a substantial role in lumber export. Spruce in lumber form has no intrinsic qualities which would favor it over softwood timbers grown in the other states. However, spruce, as well as birch, aspen and cottonwood make excellent pulp. Those species form a vast potential pulp-wood reserve. With the advent of a favorable economic climate for industrial development the forests of the interior of Alaska are destined to play an important role in the rapidly expanding pulp industry.

UNITED STATES
DEPARTMENT OF THE INTERIOR
National Park Service

PROJECT REPORT
on the
RECREATION ASPECTS
OF THE
DEVIL CANYON PROJECT
Susitna River, Alaska
April, 1960

Field investigation of this project by the National Park Service has not been feasible, due to limited funds and personnel. This report is, therefore, based on materials of record, and on personal knowledge on the part of individuals, gained during the Alaska Recreation Survey, conducted by this Service since 1949.

PURPOSE

The purpose of the Devil Canyon Project is, primarily, the production of hydroelectric power to serve the Kenai Peninsula, Anchorage, the Railbelt, Fairbanks, and Big Delta. Flood control and water conservation would be secondary purposes.

LOCATION OF MAJOR FEATURES

The proposed project is located in southcentral Alaska. The major features are the Devil Canyon and Denali Dams, on the Susitna River, a powerplant at Devil Canyon Dam and transmission lines to Anchorage and Fairbanks, with distribution to contiguous areas.

Devil Canyon Dam would be located 14.5 miles above Gold Creek, a station on the Alaska Railroad, while Denali Dam would be approximately 115 miles upstream and about 15 miles south of the Denali Highway crossing of the Susitna.

GENERAL DESCRIPTION AND OPERATING PLAN

The proposed Devil Canyon Dam would be a concrete arch structure rising 560 feet above the river. The reservoir impounded would approximate 1,100,000 acre-feet, with a surface area of 7,550 acres. Of this total capacity, 807,000 acre-feet would be active storage. Normal full pool elevation would be 1,450 feet, while elevation at the top of the dead and inactive storage would be 1,275. Thus a drawdown of 175 feet may be anticipated.

The Denali Dam would be of earth and rock fill construction, rising 219 feet above the river bed. The Denali Reservoir would approximate 5,400,000 acre-feet, with a surface area of 61,000 acres. Of this total active, or conservation, storage would amount to 5,300,000 acre-feet, with an initial allocation for dead storage of 100,000 acre-feet. Normal full pool elevation would be 2,552 feet, while elevation at the top of the inactive storage would be ~~2,368~~ 2,386 feet, representing a fluctuation of 184 feet. At this lowest level, the initial water surface would be 3,000 acres. This would decrease rather rapidly, and would disappear after 100 years of sedimentation.

Controlled releases from both reservoirs would be for power generation only. Denali would be used as a storage reservoir, for replenishment of Devil Canyon, from which continuous releases would be made. Ordinarily, releases from Denali would be during the months from October to March. All inflow to that reservoir would be held in storage during the rest of the year. With the combination of releases from Denali and flow from tributaries below the Denali Dam, Devil Canyon would fill in September and remain full through February, with its lowest stage in April or May.

CLIMATE

Moderate temperatures prevail throughout the Susitna Basin during the summer months, with the July maximum averaging about 70°, with July minimum averaging about 47°. The Devil Canyon Project, being in the middle and upper part of the Basin, might expect to experience a somewhat lower average.

The freeze-up would start early in October, in the Denali region, and would reach Devil Canyon perhaps about a month later. Break-up would probably come in late April.

TOPOGRAPHY

The Devil Canyon section of the Susitna is V-shaped, characterized by high, steep canyon walls which rise more than 500 feet above the river. At the upper reaches of the Basin, the portion relating to Denali Dam and Reservoir, topography is more gentle, which would result in a broad area of water at upper reservoir levels.

VEGETATION

The Devil Canyon section appears to be sparsely covered with tree growth, mainly spruce. The upper reaches of the reservoir, and the plateau country to the north and south, support the muskeg-tundra botanical association characteristic of that latitude.

Very little timber grows in the Denali section, being replaced by muskeg-tundra. At Monahan Flat, to the north and west of the proposed Denali Dam, there is a fair stand of scrub spruce.

ARCHEOLOGICAL VALUES

An archeological investigation of the Devil Canyon section indicates that it is obvious that no settlement would be found in the bottom of the canyon except for a few temporary camps. The canyon is steep and the flow of the river is too fast, to encourage human use and settlement.

The upper valley, which would be inundated by Denali Reservoir, has not been investigated adequately. An old winter trail, or sled road, crosses the valley in the vicinity of the abandoned mining camp of Denali, and this travel route may have been in use long ago. More complete investigation is warranted in this area.

ACCESSIBILITY

The Devil Canyon section is now relatively inaccessible. The Alaska Railroad serves Gold Creek, some fifteen miles below the dam site. A public access road is proposed to the dam site, but no other access is contemplated. Since Gold Creek is served only by railroad, public automotive access to the Devil Canyon Dam would be practically precluded.

As regards Denali Dam and reservoir, it is proposed to reroute the Denali Highway to cross the dam. This highway extends from Paxson, on the Richardson Highway to the east, to and through Mt. McKinley National Park to the west. Opened to the public in 1958, this road is already receiving considerable use, with the prospect of rapid and continuous increase in traffic.

PRESENT RECREATION FACILITIES AND USE

The entire area embraced in the Devil Canyon Project is a vast wilderness, except for the narrow strip across the upper valley which is affected by the Denali Highway.

The zone served and influenced by the Alaska Railroad, known as "The Railbelt", lies some 15 river miles to the west of Devil Canyon Dam.

There are no installed recreation facilities in this region and, except for the Denali Highway, travel is so difficult as to practically eliminate recreation use.

Hunting and, to a lesser degree fishing, is available from the highway zone. And the numerous lakes of the region are accessible by float planes. These natural lakes furnish better fishing than may be anticipated in Denali reservoir because of extreme fluctuation. This fact tends to obviate justification of that reservoir on the ground that in itself it would contribute to recreation.

POTENTIAL RECREATION USE

The upper Susitna Basin is a vast wilderness without roads or trails but with many scores of natural lakes suitable for landing float planes. The proposed reservoir would not change this situation to any degree. As Alaska's population grows and her economy develops, demand for and use of such wilderness will certainly increase. However, it is difficult to foresee any marked contribution to recreation by the Devil Canyon Project. The steep sided, inaccessible Devil Canyon Reservoir will contribute chiefly through regulation of stream flow, thus tending to improve fish habitat by reducing seasonal fluctuation in the river below. This would probably benefit the Railbelt but would have no effect on the reservoir and its surrounding lands.

The Denali Reservoir cannot be expected to contribute to recreation. On the contrary, the magnificent scenery available along the Denali Highway would be spoiled to a degree were this large, widely fluctuating reservoir interposed between the highway and the inspiring grandeur of the Alaska range.

CONCLUSION

This report is, perforce, of a general nature. Without extensive field investigation, it is not possible to present specific or detailed discussion. Should the project proceed to a more detailed stage ofplanning, the National Park Service should exert every effort to obtain more precise information.

On the basis of available source material, it appears that the Devil Canyon Project will not add to the recreation potentialities of the Upper Susitna. The scenic values of the Upper Valley, which includes some of the finest vistas in Alaska, might actually be affected adversely by the Denali Reservoir. In such a vast country, however, such effect would probably be of minor importance.

U.S. ARMY ENGINEER DISTRICT, ALASKA
Corps of Engineers
P.O. Box 7002
Anchorage, Alaska

1-15-60

Mr. Daryl L. Roberts, District Manager
U. S. Department of the Interior
Bureau of Reclamation
P. O. Box 2567
Juneau, Alaska

Dear Mr. Roberts:

Your letter dated October 21, 1959, requesting an evaluation of Flood Control Benefits that could be attributed to the Devil Canyon Project has been under study.

The area downstream from your proposed project is sparsely populated and with the exception of the Alaska Railroad contains little valuable development that would be subjected to flood damage. Because the Alaska Railroad sustains the major damages occurring in the plain, that agency has been contacted to ascertain the extent of annual average damage. The answer received is enclosed and indicates an average annual damage of $8,000.

Since the inflow below the project is small and the damages are brought about by ice jams in the spring, when the reservoirs are low, it should be possible to control the runoff until the danger of ice jams has passed. High water unaccompanied by ice causes negligible damage, making large volumes spilling at a later date possible without harm. Complete control of the stream would provide a maximum of $8,000 prevention of damages which could be used as flood control benefits.

However, since prevention of damage to the railroad as a project purpose requires dependable storage of spring runoff, assignment of benefits from flood control to the project or projects would require that an appropriate amount of the usable storage of the proposed reservoirs be specifically allocated to flood control, or to a joint purpose which included flood control. The flood control benefits would be computed on the basis of the storage so assigned. The reserved space must then be operated in accordance with rules and regulations to be prescribed by the Chief of Engineers.

Attributing benefits to possible future development are considered impractical because of the high degree of uncertainty inherent in such an estimate. In addition, if such future damages could be evaluated, the amount would have to be adjusted to an average annual value by Present Worth methods. After the adjustment, the benefits would probably be insignificant.

The amounts of maximum releases, and the storage that would have to be available specifically for flood control, would have to be determined. Project costs would have to be allocated to the specific purpose to insure that the benefits were sufficient to carry the separable or incremental costs of including it in the project.

If less than the total storage necessary were set aside, the $8,000 benefits would have to be reduced to reflect the lesser control. But even partial elimination of annual damages would require planned flood storage reservations and annual operation for this purpose.

In view of the minor amounts of prospective flood control benefits and the expense and problems connected with their attainment, it is believed that there is insufficient reason to justify inclusion of flood control as a project purpose. It is therefore suggested that the limited flood control obtained from the normal operation of the project be cited and included as an incidental project benefit.

If you wish to prepare a full scale study in order to establish the reservoir storage and operation limits and cost allocation necessary to establish flood control as a project purpose, this office will be pleased to provide any assistance you may need.

Very truly yours,

/s/ W. C. Gribble, Jr.

W. C. GRIBBLE, JR.
Colonel, CI
District Engineer

1 Incl
Cy ltr ARR

cc: North Pacific Division

UNITED STATES
DEPARTMENT OF THE INTERIOR
The Alaska Railroad
Post Office Box 7-2111
Anchorage, Alaska

November 17, 1959

The District Engineer
U. S. Army Engineer District, Alaska
Corps of Engineers
Post Office Box 7002
Anchorage, Alaska

Refer to: File No. NPAGP

Attn: Captain F. A. Wolak

Dear Sir:

We have received your letter of inquiry as to the annual flood damage occurring to the Railroad as a result of the flooding of the Susitna River.

The Susitna causes the Railroad very little damage except in the Spring run-off, between the first and last of May. Ice jams accumulate between Mile 261 on the Railroad and Mile 235 which causes a damming effect. This, in turn, causes the flooding of the Railroad and embankment washing. Generally, we are out of service approximately twelve hours each year, and our corrective cost amounts to about $8,000 per annum.

If there is anything further we can furnish on this matter, please let me know.

Very truly yours,

/s/ R. H. Anderson

R. H. Anderson
General Manager

UNITED STATES
DEPARTMENT OF AGRICULTURE
Forest Service

December 11, 1959

REPORT FOR BUREAU OF RECLAMATION ON RAILBELT AREA OF THE CHUGACH NATIONAL FOREST:

The railbelt area includes that part of the Chugach National Forest that lies on the Kenai Peninsula from Seward to Anchorage. It is approximately 1,300,000 acres in size and supports a stand of white spruce, black spruce, cottonwood, birch, Sitka spruce, and western hemlock. At the present time only Sitka spruce, hemlock, and white spruce are being used in commercial quantities.

The commercial timber lies along the river bottoms, tidal flats, and up the rugged slopes to an elevation of approximately 1000 feet. The quality is good enough for sawmill use, pulp, piling, house logs, and some veneer cutting.

Inventory of timber stands are incomplete but it is thought the Kenai working circle can support a cut of approximately 15 million board feet annually in perpetuity under the present multiple use program of management. An additional substantial amount can economically be brought in by water from the Prince William Sound working circle to possibly more than double this amount. The deep water ports and railheads facilities at Whittier, Anchorage, and Seward make them well situated for wood using industries.

The following table shows the sawmill locations, their potential capacity, annual cut, and the value of their products in 1958:

Location	Approximate annual B. F. capacity	Approximate annual cut 1958 B. F.	Approximate value 1958
Seward	6 million	1 million	$ 95,000
Seward	6 million	1½ million	142,500
Whittier	10 million	6 million	570,000
2 portable mills	½ million	½ million	47,500
Totals	22½ million	9 million	$ 855,000

If the installed mills had operated at their full capacity, the value of their total product would have been slightly over 2 million dollars.

A new treating plant, now under construction at Whittier, will have a capacity for handling approximately 5 million B. F. of poles, piling, ties and timbers, annually. Most of the treated material will be sold locally in Alaska. It is difficult to estimate the value of its output at this time or estimate how fast the industry will grow. However, it is felt that as the State grows, this industry is bound to expand.

Very little hemlock is being processed at the present time. As the merchantable stands of Sitka spruce become harder to procure, it will, in all probability, force more hemlock onto the market as it has done in other parts of the Pacific Coast states. The present market price for hemlock lumber in Alaska precludes its manufacture in any great quantities at this time. However, the treating plant at Whittier plans, at present, to treat hemlock poles, piling, and ties. The ties and timbers will be sawn in an existing local mill, and it will increase the use of hemlock by possibly several million feet annually in the near future.

There are various economic reasons why more timber is not cut and processed in Alaska at present. Trees are a renewable resource and when managed under a sustained yield program, afford a perpetual supply of raw material. Therefore, it is felt that the timber industry is bound to expand in the foreseeable future to be one of Alaska's foremost, permanent, and stable industries.

The recreational resource of the Kenai area has just begun to be developed. The glaciers, lakes, streams, and scenic views make it a tourist paradise. The abundant fish, moose, and rare Dall sheep make it an unique area that attracts sportsmen from all over the world to hunt and fish. As more and more tourists, campers, and sportsmen use these recreational resources it means that more campgrounds, stores, service stations, restaurants, picnic areas, and public services will be required to take care of this lucrative trade brought in by these people. In 1958 the recreational use increased 18 percent on the Kenai over the 1957 use, according to the annual visitors' report compiled each year. Preliminary estimates indicate the 1959 total may exceed a 20 percent increase over last year's use. It is a use of a resource that is growing phenomenally all over Alaska and already ranks near the top in annual income for the state, yet from all indications it will continue to increase in astounding proportions.

UNIVERSITY OF ALASKA
in cooperation with the
UNITED STATES DEPARTMENT OF AGRICULTURE

AGRICULTURE

Alaska's railbelt includes a large acreage of potential agricultural land (Table 1). Soil studies conducted by the Soil Conservation Service and reconnaissance surveys by the Bureau of Land Management give an estimate of about a million acres. By 1959, accessible good land in satisfactory site locations could be found only in the Susitna Valley and Tanana Valley. The most publicized entries were being made on the west side of the Susitna River opposite Talkeetna and in the Willow Creek region east of the Susitna -- both remote from markets, roads, and services.

If agriculture expands in step with Alaska's predicted population growth, the acreage put to use in growing foodstuffs will not make much impression on this reservoir of farm land. A four-fold expansion relative to present markets will not bring full utilization of Alaska's cultivable acres.

A locally supported population is considered highly desirable from the standpoint of national defense. National emergencies will disrupt shipping and bring food scarcities to Alaska.

Alaska's total annual retail food bill is estimated at $120 million. Of this, $30 to $40 million worth might be grown in the State, chiefly in the railbelt market area. In contrast, the retail value of commercial farm sales and home consumption is estimated at about $10 million in 1959. Alaska is therefore 8 percent self-sufficient in farm produced foodstuffs. Excluding resident military forces, and including fish and game in the feed base, the civilian population is 15 to 18 percent self-sustaining.

The magnitude of farm sales in the railbelt area is shown in Table 2. It is emphasized that these values are in terms of what the farmer realizes and do not reflect retail values.

Agriculture will slowly expand through the efforts of individual rather than group planning. Market opportunities will not be fully exploited for a variety of reasons, most cogent of which is the lack of profit motive at the producer level. Some vertical integration, with decision making assumed at the retail level, may lead to more orderly marketing of vegetables and poultry. Producing units will slowly expand in size and volume as homestead holdings are consolidated. A realistic goal may be 25 percent self-sufficient by 1975. No climatic or environmental limitations bar atainment of this goal, which is justified by all economic considerations. Among these is the need for reducing reliance on long sea or land supply lines, especially in view of Alaska's strategic importance to the continent as a whole.

A major factor impeding the development of Alaska's food industry is the continuing agricultural revolution in the other States. Fewer acres were cropped in 1955 than in 1920. In that year the expansion of cropland abruptly halted, terminating an activity that had begun with the founding of the Nation, and had long been recognized as an integral socio-economic characteristic of the United States. Since 1920 population has climbed steadily upward, from 105 million to 165 million in 1955. In 1955 the per capita acreage of cropland reached a low of 2.4 acres and the country was plagued with surpluses. Agricultural surpluses are still a major problem. Opening new farmlands even in insignificant acreages and at the end of long supply lines, runs counter to national trends, attitudes, policies and action programs.

REFERENCES

_________ FARM PRODUCTION-ALASKA-1956, Alaska Agri. Expt. Station and Alaska Department of Agriculture, Palmer

_________ FARM PRODUCTION-ALASKA-1957, Alaska Agri. Expt. Station and Alaska Department of Agriculture, Palmer

_________ FARM PRODUCTION-ALASKA-1958, Alaska Agri. Expt. Station and Alaska Department of Agriculture, Palmer

_________ AGRICULTURAL STATISTICS, 1958, U. S. Department of Agriculture, Washington, D. C.

Jorgenson, Harold, FARM LANDS, unpublished report. Bureau of Land Management, U. S. Department of the Interior, Washington, D. C., September 1954.

Marschner, F. J., LAND USE AND ITS PATTERNS IN THE UNITED STATES, Agriculture Handbook No. 153, U. S. Department of Agriculture, Washington 25, D. C. April 1959.

Table 1. Agricultural land in Alaska's railbelt area, and estimated occupancy

		Kenai Peninsula lowlands	Anchorage area	Matanuska Valley (1) lowlands	Lower Susitna Valley	Tanana Valley(2)	RAILBELT TOTAL
Estimated total area (6)	1,000 acres	9,000	319	2,526	1,208	14,516	27,569
Surveyed lands (3)	1,000 acres	339	33	480	216	558	1,626
Known Cultivable land (3)	1,000 acres	185	18	131	79	332	745
Known uncultivable land (3)	1,000 acres	154	15	349	137	226	881
Estimated additional cultivable land (4)	1,000 acres	47	None (7)	27	19	113	206
Land cropped in 1958	acres	1,801	1,126	13,556	75	4,294	20,852
	Present and expected occupancy						
Full-time farms, 1959	number	10	5	115	2	23	155
Part-time farms, 1959	number	25	35	120	5	68	253
Agricultural homesteads, 1959 (5)	number	235	43	287	45	325	935
Number of farms by 1975 (6)	number	60	None (7)	430	20	300	810

(1) Including the Chugiak, Little Susitna and Wasilla areas.

(2) Including Fairbanks vicinity, Chena River area, Big Delta-Salcha area, and Fairbanks-Nenana area

(3) Acres covered by Soil Conservation Service surveys as of 1956, confined to most readily accessible and the best farming lands.

(4) Unpublished estimates of Bureau of Land Management (1955) and Alaska Agricultural Experiment Station.

(5) Occupants intend to farm but have not yet reported significant commercial sales.

(6) From report of Alaska Soil Conservation Needs Committee, November 18, 1959, calculated on basis of 100 cropland acres per farm.

(7) Farmland is expected to be diverted to urban uses.

Table 2. - Volume of commodities sold from railbelt farms, and on-farm value, by farm areas for 1958 (From farm production statistics, Alaska Agricultural Experiment Station and Alaska Division of Agriculture). No commercial sales have yet been reported from the Susitna Valley

Item		Kenai Peninsula 1956	Kenai Peninsula 1958	Anchorage Area 1956	Anchorage Area 1958	Matanuska Valley 1956	Matanuska Valley 1958	Tanana Valley 1956	Tanana Valley 1958	Railbelt Area 1956	Railbelt Area 1958
Milk	1,000 pounds	403	200	366	124	11,050	12,198	984	1,422	12,803	13,944
	1,000 dollars	56.6	20.0	38.2	13.0	1,189.0	1,281.9	93.3	152.8	1,377.1	1,467.7
Eggs	1,000 dozen	46	66	89	104	91	75	16	66	242	311
	1,000 dollars	46.5	65.7	89	88.7	86.5	63.6	15.9	62.5	237.9	280.5
Pork, beef, poultry	1,000 pounds	22	48	68	171	89	101	35	39	214	359
	1,000 dollars	9.6	20.8	32.3	66.3	36.9	40.7	14.1	20.0	92.9	147.8
Potatoes	tons	142	203	1,445	1,625	2,757	3,117	3,013	2,677	7,357	7,622
	1,000 dollars	17.1	20.2	173.3	156.2	330.8	253.8	370.6	236.2	891.8	675.4
Cabbage, lettuce, celery	tons	7	20	39	49	379	339	55	98	480	506
	1,000 dollars	1.4	5.0	8.3	12.1	92.9	91.5	11.1	12.8	113.7	121.4
Carrots, radishes	tons	3	12	15	20	169	241	8	49	195	322
	1,000 dollars	0.5	5.1	2.5	9.2	28.7	60.1	1.8	12.6	33.5	87.0
Other*	tons	4	7	27	18	107	31	2	27	140	83
	1,000 dollars	2.0	3.7	11.9	12.0	34.8	14.3	1.0	18.2	49.7	48.2
TOTAL**	1,000 dollars	133.7	140.5	355.5	357.7	1,799.6	1,816.2	507.9	515.1	2,796.6	2,829.0

* Includes other vegetables, greenhouse vegetables, and nursery production.

** Totals do not reconcile because of rounding.

ALASKA AGRICULTURAL EXPERIMENT STATION
UNIVERSITY OF ALASKA
in cooperation with
UNITED STATES DEPARTMENT OF AGRICULTURE

September 11, 1959

Mr. Daryl L. Roberts, District Manager
Alaska District Headquarters
Bureau of Reclamation
P. O. Box 2567
Juneau, Alaska

Dear Mr. Roberts:

Here is a brief summary of present farm irrigation:

	Matanuska Valley	Tanana Valley	Kenai Peninsula	Total
Number of systems in 1959	13	5	1	19
Number of acres covered	270	80	8	358
Acre-inches applied	4	5	2	4

Home owners and gardeners in Anchorage, Palmer and Fairbanks are using considerable water on lawns and gardens. Estimated acreages watered are 380, 14 and 195, respectively. Use rates appear to be around 8 inches total during the entire gardening season, judging from Palmer's experience.

About 2 percent of Alaska's cleared farm acres were irrigated in 1959. We estimate that 40 percent of all cleared acres (or 6,800) might be economically irrigated.

We also estimate that the current market for local foodstuffs justify 40,000 cleared now, and perhaps 80,000 cleared acres in 1975.

If Alaska's population grows as many people expect, in 40 years there will be a minimum of 150,000 cleared acres needed. Of these perhaps, 40,000 might be profitably irrigated. Use rates, judging by present experience, will be between 5 and 6 acre-inches.

These are academic figures. Development will actually depend on the interaction of many complex factors.

Sincerely yours,

/s/ Allan H. Mick

ALLAN H. MICK
Director