U. S. DEPARTMENT OF THE INTERIOR

Geological Survey

Preliminary Report On

Water-Power Resources of

Little Susitna River and Cottonwood Creek, Alaska

Fred F. Lawrence
March, 1949
Tacoma, Washington

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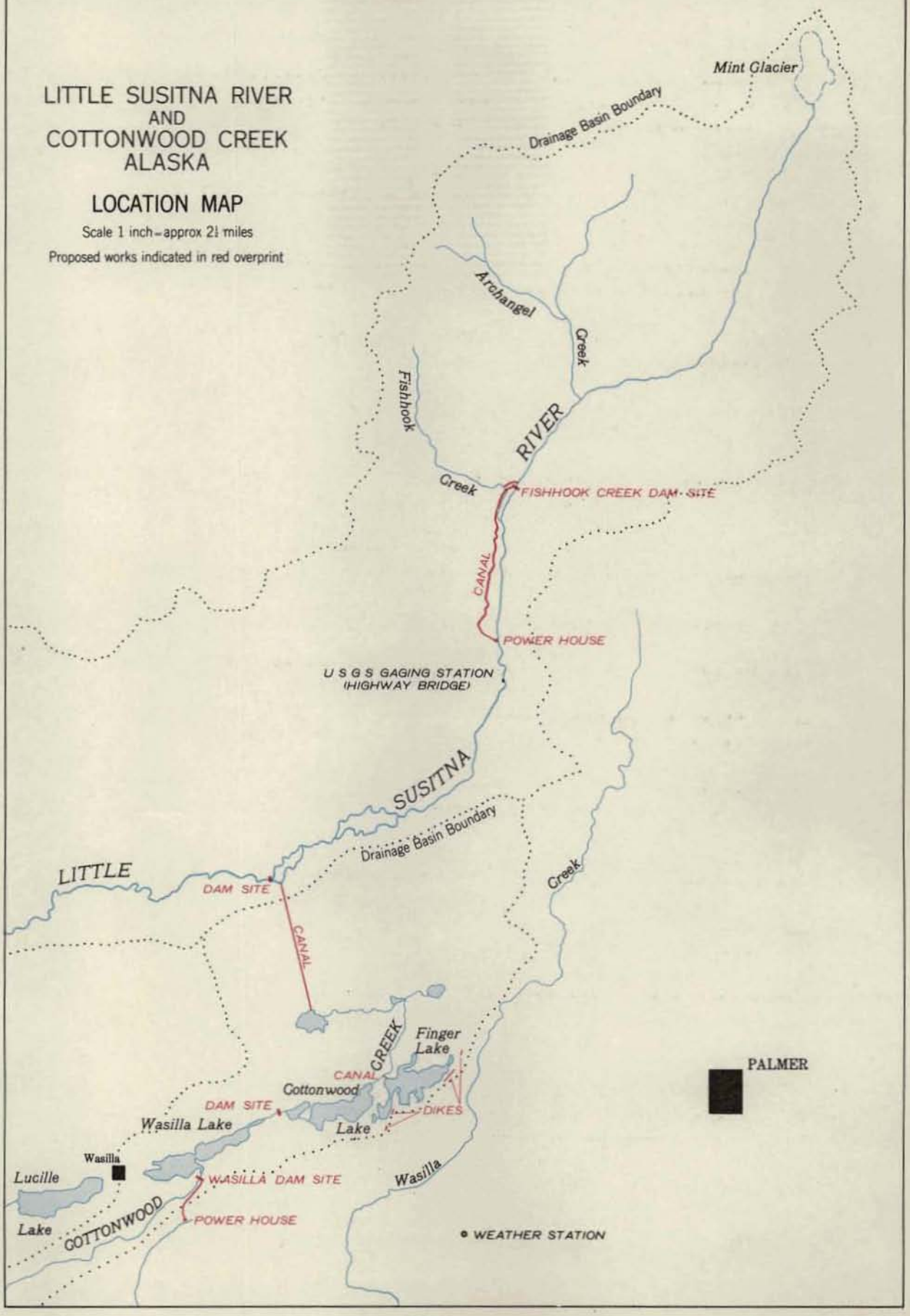
ILLUSTRATIONS

LITTLE SUSITNA RIVER AND COTTONWOOD CREEK ALASKA

LOCATION MAP

Scale 1 inch = approx 2½ miles

Proposed works indicated in red overprint



SUMMARY

A diversion and conduit type of power development on Little Susitna River utilizing the unregulated flow of the river would have developed 374 horse-power 100 percent of the time, 636 horse-power 90 percent of the time, and 4100 horse-power 50 percent of the time during the period October 1, 1947 to September 30, 1948. This development would consist of a diversion dam near the mouth of Fishhook Creek, approximately 3 miles of canal, 2200 feet of pressure conduit, and a power house half a mile upstream from the highway bridge at the mouth of Little Susitna canyon.

By diverting the flow of Little Susitna River through three miles of canal into Cottonwood Creek and constructing a dam 25 feet high at the lower end of Cottonwood Lake, a short channel between Cottonwood and Finger Lakes, a dam 10 feet high at the outlet of Wasilla Lake, half a mile of canal below Wasilla Lake and 1000 feet of pressure conduit to a power house on an unnamed stream one mile southeast of Wasilla, 960 horsepower could have been developed continuously in 1948, generating over 6,000,000 kilowatt hours.

INTRODUCTION

Purpose and Scope: The purpose of this report is to present an estimate of the water-power potentialities of Little Susitna River and Cottonwood Creek, Alaska, and to furnish a basis on which to classify the public land involved as to its power value.

Field investigations were made by the author from April to September, 1948.

The report covers only that portion of the Little Susitna River east of the Seward Meridian to a point one mile above Archangel Creek.

The stream above this point is too small and too steep to have any power value, while west of the Seward Meridian the stream flows through open country and has no reservoir or power sites.

Acknowledgments: The author is indebted to Mr. W. C. Mau, Manager of the Matanuska Electric Association for his assistance in the field, and to Mr. Arthur Johnson for his helpful suggestions and criticism during the preparation of the report.

Previous Investigations: C. E. Ellsworth and R. W. Davenport, Hydraulic Engineers for the U. S. Geological Survey investigated Little Susitna River in 1913.[1/] They made miscellaneous stream flow measurements on

1/ Ellsworth, C. E., and Davenport, R. W., U. S. Geological Survey Water-Supply Paper 372, p. 372, 1915.

Little Susitna River, Archangel Creek, and Fishhook Creek. A summary of the power being generated for gold mines was listed and the potential power analyzed.

There have been numerous investigations of the geology of this region by various members of the Geological Survey. S. R. Capps has prepared a detailed summary and bibliography of this work.[2/] Capps has also written

2/ Capps, S. R., Geology of the Alaska Railroad region: U. S. Geological Survey Bull. 907, 1940.

in more detail of the Geology of the Willow Creek Mining District[3/] of

3/ Capps, S. R., The Willow Creek region: U. S. Geological Survey, Bull. 607, 1915

which the upper Little Susitna River basin is an important part.

The Matanuska Electric Association made a reconnaissance survey of part of the Little Susitna River in 1947 to investigate the storage possibilities of the stream. A transit stadia survey was run from the

highway bridge near the mouth of the canyon, to the mouth of Fishhook Creek. This study indicated that the cost of any storage would be excessive.

Maps and Surveys: A topographic map of Little Susitna River from the highway bridge at the mouth of the canyon to a point one mile above Archangel Creek, and the area surrounding Wasilla, Cottonwood, and Finger Lakes was made by the author during the 1948 field season. The scale of this survey was 1:24,000 (1" = 2000 ft.) with a contour interval on the lakes portion of 10 feet and on the river portion of 20 feet. This map which is the basis for all storage computations in this report, was made by plane table methods. The horizontal control for the lake portion of the survey was based on the two U. S. Coast & Geodetic Survey triangulation stations, "Co-op" at Palmer, and "Wasilla" near Wasilla, supplemented by an excellent net of public land surveys. The survey on Little Susitna River had no horizontal control but was based on a carefully run plane table traverse along the road which follows the river. Vertical control for the lake survey was based on the U. S. Coast & Geodetic Survey bench mark at Wasilla. A closed circuit of plane table levels was run from this bench mark around the three lakes. Plane table bench marks and numerous supplementary points were established as this line was run and were used to control the mapping. Vertical control for the survey of Little Susitna River consisted of a single line of plane table levels from a point northeast of Finger Lake, on the above line, to a fourth order bench mark set by the Corps of Engineers, U. S. Army, on Little Susitna River above Archangel Creek. The closure on this latter bench mark was 1.7 feet and was not adjusted. These maps are now in preparation and will be published in two sheets, presumably in 1949. They will be available from the U. S. Geological Survey, Washington 25, D. C. A list of all

the bench marks used on the survey including plane table bench marks set by the U. S. Geological Survey is available at the office of the U. S. Geological Survey, 410 Federal Building, Tacoma 2, Washington.

Other maps used in the preparation of this report were: Matanuska and Idaho Peak Quadrangles, each to the scale of 1:62,500. The contour interval on the Matanuska Quadrangle was 50 feet and on the Idaho Peak Quadrangle 100 feet. Both maps are published by the Army Map Service, Washington, D. C.; Alaska Map 25, "Seward To The Matanuska Coal Fields," and Alaska Map 26, Matanuska Coal Fields to Yanert Fork." Both maps are on a scale of 1:250,000 with a contour interval of 200 feet. They are published by the U. S. Geological Survey, Washington 25, D. C.

GEOGRAPHY

Little Susitna River rises in the Talkeetna mountains about 60 miles northeast of Anchorage, Alaska. The main stream has its source in Mint Glacier, a small ice field of about 400 acres area, with its terminus at about 4,500 foot elevation. See Plate II-A. The river flows in a generally southwesterly direction through a typical "U" shaped glacial valley for about 17 miles to the south edge of the Talkeetna mountains. See Plate III. For the last mile before leaving the mountains, the valley becomes quite confined with two narrow constrictions as possible dam sites. Archangel Creek, draining an area to the north and west, empties into the river about ten miles downstream from Mint Glacier. See Plate II-B. Fishhook Creek, draining an area to the west enters the river about three miles further downstream. These two streams are the only tributaries of any size. After leaving the mountains the river turns southwest to the valley of Susitna River. It then turns south, parallel to Susitna River, and flows into Knik

Little Susitna River, Alaska

Looking north (upstream) from end of road about 1½ miles east of mouth of Archangel Creek. Mint glacier in background. (Lawrence photo L-4858, July 12, 1948)

Archangel Creek, Alaska

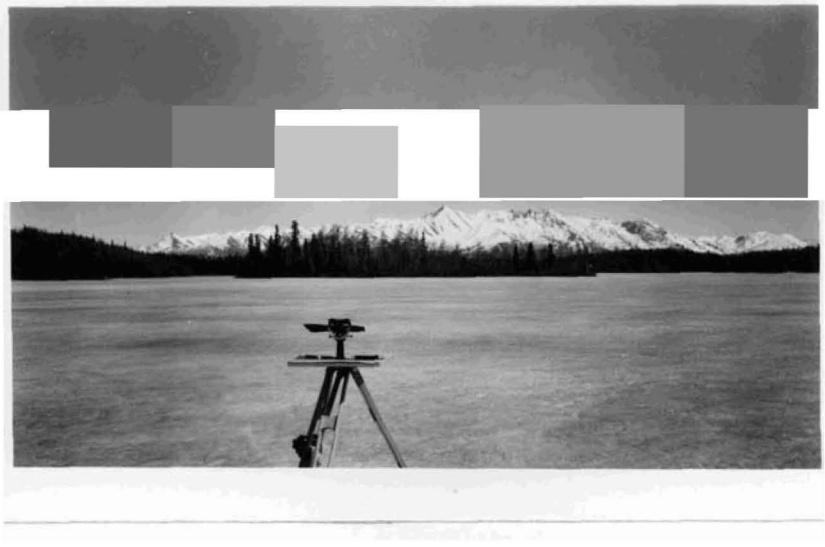
Looking upstream from bridge about 1000 feet above mouth. (Lawrence photo L-4867, July 12, 1948)

Little Susitna River, Alaska

Looking upstream from point on road about 2 miles upstream from gaging station at steel highway bridge. (Lawrence photo L-4882, July 15, 1948)

Little Susitna River, Alaska

Looking downstream (west) from wooden bridge about one mile upstream from mouth of Archangel Creek. (Lawrence photo L-4860, July 12, 1948)



A

Cottonwood Lake, Alaska

Looking northeast across frozen surface of lake. Talkeetna mountains in background. (Lawrence photo L-4821, Apr. 28, 1948)

B

Wasilla Lake, Alaska

Looking northeast from point on Matanuska-Wasilla road near southwest corner of lake. Talkeetna Mountains in background. V notch to right of center is Little Susitna River canyon. (Lawrence photo L-48124, Sept. 2, 1948)

Arm, reaching tidewater eight or ten miles east of the mouth of Susitna River. The area of the entire basin is 416 square miles. The table below shows the areas of the various subdivisions of the basin as measured on the Idaho Peak and Matanuska Quadrangles:

Drainage Basin Areas
Little Susitna River

Section of Basin	Area Square Miles
Above Archangel Creek	23.7
Archangel Creek basin	17.3
Above Fishhook Creek	46.8
Fishhook Creek Basin	8.3
Above steel highway bridge at mouth of canyon (U. S. Geological Survey gaging station)	61.3

Between Little Susitna River and Knik Arm lies the outwash plain of the Talkeetna mountains, sloping from the mouth of Little Susitna River canyon, at an elevation of about 900 feet, to sea level in a distance of about 13 miles. This area, to a large extent terminal moraine of Matanuska Glacier, is studded with small lakes. Cottonwood Creek Basin lies entirely within this morainal area and drains an area south of Little Susitna River and west of Wasilla Creek. Cottonwood Creek heads in several small lakes at elevations between four hundred and five hundred feet and flows southwest through Cottonwood and Wasilla Lakes to Knik Arm. See Plate II, A - B. The basin area at the gaging station three quarters of a mile below Wasilla Lake is approximately twenty-five square miles. Finger Lake, which has no surface inlet or outlet, lies to the east of Cottonwood Lake and is separated from Cottonwood Creek by a narrow steep ridge which at its lowest point is only twelve feet above the water surface of Finger Lake. The table following shows the elevations of various parts of Cottonwood Creek basin and the water surface areas of the lakes.

Cottonwood Creek Basin, Alaska		
	Elev. Feet	Area Acres
Headwaters	400 to 500	
Finger Lake	337	380
Cottonwood Lake	325	320
Wasilla Lake	322	360
Water surface at gaging station	309	

Lucille Lake lies southwest of Wasilla Lake with a water surface elevation of 314 feet. The low point in the divide between Wasilla Lake and Lucille Lake is in the town of Wasilla at elevation 333 feet. See Plate V-A. The Alaska Railroad runs through this divide and the low point is in the railroad drainage ditch. Running generally east from a point about one mile south of the outlet to Wasilla Lake is a rather abrupt escarpment. The top of this bluff is about elevation 320, and the bottom 200 feet. A small stream, flowing in the neighborhood of 1 second-foot at the time of the survey, flows along the toe of this slope being fed by numerous small springs in the gravel hillside. This stream flows directly into Knik Arm to the south. The Alaska Railroad enroute from Matanuska to Wasilla, climbs this hill on a long side hill cut at a grade of about 1 percent, reaching the top about a quarter of a mile south of Cottonwood Creek bridge. The entire railroad cut is in gravel. See Plate VI. The possibility of diverting Little Susitna River into these three lakes and developing power at this escarpment will be discussed later in this report.

The agricultural area at the head of Cook Inlet is locally known as "The Matanuska Valley." Its boundaries are somewhat indefinite but generally speaking, it is bounded on the north by the Talkeetna mountains, on the east by the Chugach range, on the south by Knik River

A

Wasilla, Alaska
Talkeetna Mountains in background. (Lawrence photo L-48125, Sept. 2, 1948)

B

Palmer, Alaska
Chugach Range in background. (Lawrence photo L-4856, June, 1948)

A

Wasilla Power Site

Looking west from a point in Sec. 11, T. 17 N., R. 1 W., on Matanuska-Wasilla road. Cut banks on right indicate position of Alaskan Railroad. The highest cut in center of picture is at the approximate location of the proposed Wasilla power site. (Lawrence photo L-4801, April 24, 1948)

B

Alaska Railroad Bridge

Cottonwood Creek crossing about one mile east of Wasilla. View is downstream on Cottonwood Creek. Wasilla power site is about one-half mile east or to the right. (Lawrence photo L-4827, April 24, 1948)

and Knik Arm of Cook Inlet. The west boundary is probably best described as the east edge of the swampy area west of Wasilla. The area between Eagle River and Knik River from the Chugach Range to Cook Inlet is considered by some to be part of "The Valley." Little Susitna River flows across the northwest corner of this region from the mouth of the canyon to the edge of the swampy area near Houston, and Cottonwood Creek basin is entirely within the area. Geographically the entire drainage basin of the Matanuska river is part of the Matanuska Valley, but the term, as it is used locally, excludes that portion upstream from Sutton. Allen H. Hick, Soil Scientist at the Agricultural Experiment Station near Palmer says "The total area of the Matanuska Valley has been estimated at from 310,000 to 325,000 acres. Of this total area about 60,000 acres are tillable. In 1948 it is estimated that approximately 5,630 acres were actually producing cultivated crops. Perhaps another 800 acres is slashed for clearing. In addition to land actually cultivated, about 6,500 acres of land were pastured. See Plate VII.

Palmer, an unincorporated community of about 700 people, is the supply center of this region. See Plate V-B. It is the headquarters of the Cooperative which markets the products of farms and of the Rural Rehabilitation Administration under whose sponsorship many of the farm units were established in 1935. Palmer provides stores and services equal to many much larger communities. These include schools, churches, a newspaper, Chamber of Commerce, Telephone Company, a power system, water system, a system of sewers, two hotels, several restaurants, a well equipped hospital, a doctor, dentist and veterinarian, law offices and a bank, department stores, grocery stores, meat market, bakery, cold storage plant and several garages. Telegraph service is provided by The Alaskan Railroad as well as twice daily passenger and mail service

A

Typical Matanuska Valley Farm

Located northeast of the northeast corner of Finger Lake. (Lawrence photo L-48126, Sept. 2, 1948)

B

Hay field near Palmer, Alaska

Note R.E. A. power distribution arrangement. (Lawrence photo L-48120, Sept. 2, 1948)

to Anchorage. Bus service to Anchorage and Fairbanks is available. An airport was under construction in 1948 and provided facilities for small planes.

The Alaska Road Commission has constructed and maintains a system of roads reaching nearly every farm and homestead in the valley, as well as the Glenn Highway connecting Anchorage with the north and east, and a road to Willow at the mouth of Willow Creek on Susitna River. This road follows Little Susitna River from a point about two miles south of the mouth of the canyon to Little Susitna Lodge between Fishhook and Archangel Creek. There the road turns west up Fishhook Creek to Hatchet Pass, at an elevation of about 4,000 feet, between Little Susitna River and Willow Creek. This pass is only open about 3 months of the year. Side roads from this road traverse the upper valley of Little Susitna River to Gold Mint Mine four miles upstream from Little Susitna Lodge, Archangel Creek to Fern Mine, Reed Creek to Snowbird Mine, and Fishhook Creek to Independence and Gold Cord Mines.

The main line of the Alaskan Railroad follows Knik Arm from Anchorage to Matanuska at the mouth of Matanuska and Knik Rivers. At Matanuska the railroad turns west passing through Wasilla and Houston gradually turning north into the Susitna River valley which it follows to Broad Pass. A branch line serving Palmer and the coal mines at Jonesville connects with the main line at Matanuska.

The United States Department of Agriculture operates an experimental farm between Matanuska and Wasilla.

Within the Little Susitna River basin mining is the only activity of importance and in 1948 only development work was being carried on at

the mines. See Plate VIII. If the price of gold should be increased the mines would probably resume operations.

A few cattle have been pastured in the Little Susitna River basin above Archangel Creek. That part of T. 19 N., R. 1 E. which lies within the basin of Little Susitna River is now reserved for grazing by the Alaska Rural Rehabilitation Cooperation, but has not been used for this purpose recently.

For a more detailed account of the geography of the Matanuska Valley the reader is referred to an article by W. A. Rockie, 4/ in the Geographical Review. An excellent description is presented including several fine photographs.

4/ Rockie, W. A., A Picture of Matanuska: The Geographical Review, vol. 23, No. 3, July 1942, pp 353 - 371, 1942.

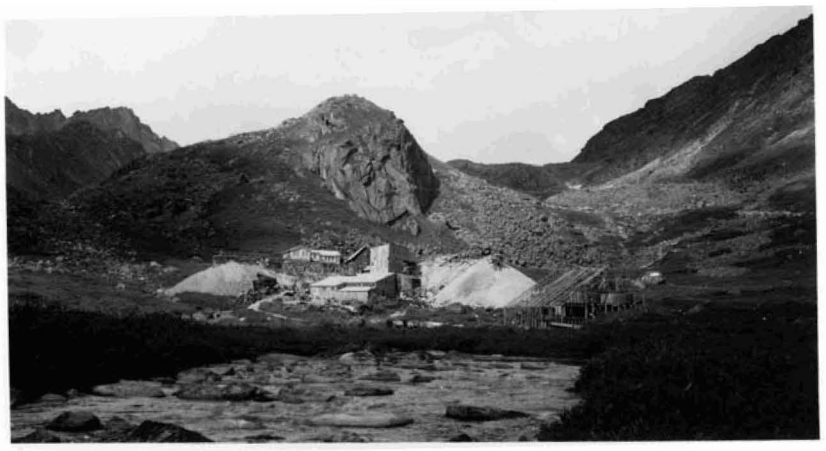
HISTORY

The shores of Cook Inlet were first explored by James Cook in 1778 and further exploration of the shore line was made in 1786 and 1794. In 1834 a Russian expedition ascended Susitna River but obtained little geographic data. Russian maps published in 1860 showed the general location of the Susitna and Matanuska Rivers but it is not known whether this information was based on explorations or on reports from the natives. Discovery of gold on Turnagain Arm of Cook Inlet in 1888 brought many settlers to the country who prospected the Matanuska and Susitna River basins, but no published records of such explorations are available. In 1898 survey parties of the U. S. Geological Survey traversed the valleys of Susitna and Matanuska Rivers and for the first time exploratory type of topographic maps were made available of this region. Placer gold was discovered in the Willow Creek Mining District, which includes

A

Fishhook Creek, Alaska

Independence mine near head of Fishhook Creek. (Lawrence photo L-4873, July 12, 1948)



B

Archangel Creek, Alaska

Fern mine near head of Archangel Creek. (Lawrence photo L-4871, July 12, 1948)

the Upper Little Susitna River basin, in 1897 and the first gold quartz lode was located in 1906. Gold lode mining has since completely overshadowed placer mining in this area. See Plate VII.

The first white settlers, other than miners and prospectors, arrived in the Matanuska Valley in 1911. During the next five years some five hundred homesteaders located in the valley. In 1929 about 100 families were brought into the valley by the Alaskan Railroad and in 1935 two hundred more families were moved into the valley by the Federal Government. Since 1946 many more settlers have moved into the area, mainly veterans taking advantage of favorable homestead laws.

Prior to the construction of the Alaskan Railroad all transportation to this area was via Knik, a town near the head of and on the west side of Knik Arm of Cook Inlet. Ships generally anchored near the mouth of Ship Creek which is near the present site of Anchorage, and lightered passengers and freight north to Knik. Supplies were transported overland from Knik by wagon road to the Upper Little Susitna basin and Willow Creek. The Alaskan Railroad was completed in 1923 and from then on all passenger and freight were transferred from the ships to the railroad at Seward. Knik quickly became a ghost town, being replaced by Wasilla and later by Palmer as a supply center for the mines.

The population of the Matanuska Valley is increasing rapidly, but exact figures or even reliable estimates are not obtainable and probably will not be available until after the census of 1950.

WATER SUPPLY

Climatology: The climate in the Matanuska Valley is characterized by rather long, cold winters and short cool summers, with a mean annual

A

Little Susitna River near Palmer, Alaska
U. S. Geological Survey gaging station. Looking downstream from steel highway bridge. (Lawrence photo L-48107, Aug. 18, 1948)

B

Little Susitna River, Alaska
Looking downstream from point on road about two miles north of steel highway bridge at mouth of canyon.

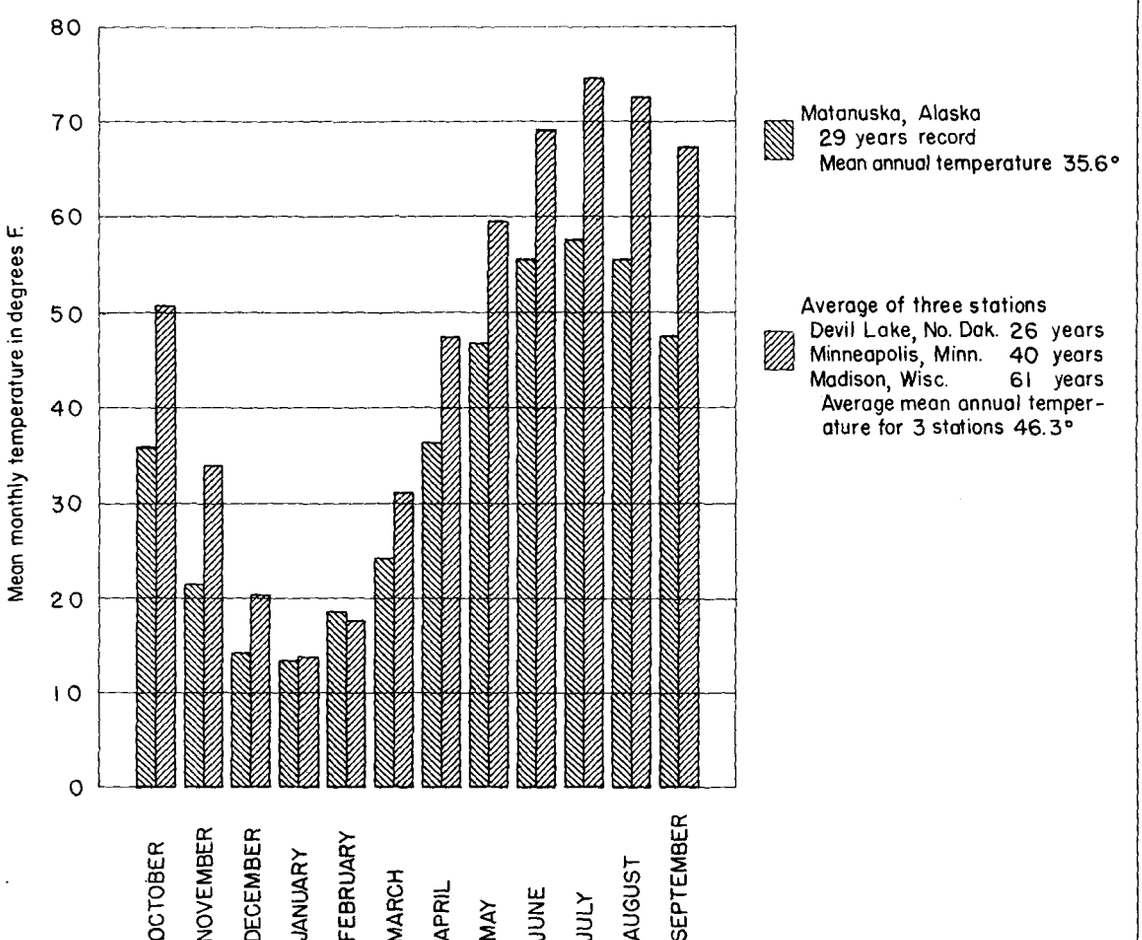
temperature of 36°. Temperatures during December, January and February are comparable to those in North Dakota, Minnesota, and Wisconsin but during the rest of the year temperatures are considerably lower than for any part of the United States proper excepting some high mountain areas. Figure 1 shows the comparison of mean monthly temperatures for Matanuska, Alaska and an average of three stations in the North Central part of the United States.

Although the summers are cool the long hour of daylight, over 19 hours between sunrise and sunset in June, make the raising of hardy vegetables and hay a profitable enterprise. The rapid growth promotes premium quality in the truck crops. See Plate VII-B.

Because of the short record of runoff from Little Susitna River and Cottonwood Creek it would be very desirable to obtain precipitation data, representative of the region, extending back several years. Records for two stations, one at the experimental station near Palmer, elevation 166 feet, and the other at Talkeetna, elevation 345, a station on the Alaskan Railroad about fifty miles northwest of the Little Susitna River headwaters, have been examined. The station at Matanuska is representative of conditions in the Cottonwood Creek basin but not for the Upper Little Susitna River. However, since it is only about fifteen miles south of the mouth of Fishhook Creek, it is by far the closest station. Talkeetna, although farther away, is in the mountains and may be more representative of conditions in the Upper Little Susitna River basin. The record at Matanuska began in 1918 but was intermittent for four years from 1932 to 1934. Prior to October 1, 1948 twenty-seven full water years record was available. The record at Talkeetna began in 1923, five years are incomplete, and twenty-one years record was available on October 1, 1948.

TEMPERATURE COMPARISON

MATANUSKA VALLEY, ALASKA
WITH
NORTH CENTRAL UNITED STATES



Thus fairly complete weather data is available at these two spots but there is little consistency between them and probably little consistency between either and the Upper Little Susitna River basin. The following table shows the comparisons for the water year, October 1, 1947 to September 30, 1948.

Precipitation at Matanuska	12.66 inches	83 percent normal
Precipitation at Talkeetna	34.73	115 percent normal
Runoff from Upper Little Susitna River basin	51.4	
Runoff from Cottonwood Creek below Wasilla	8	

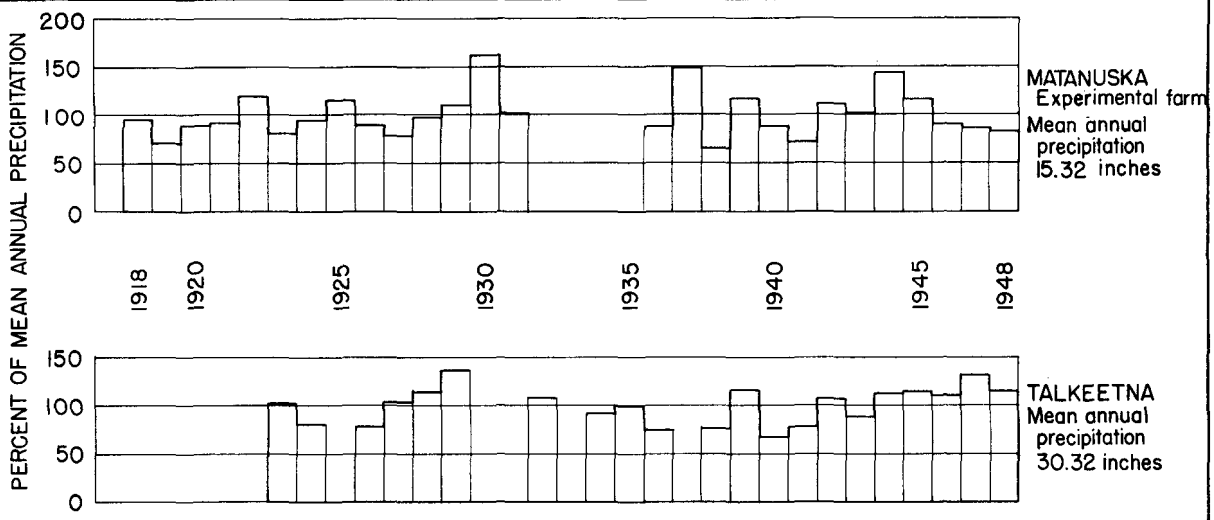
Figure 2 shows the index of wetness, the average distribution of rainfall, and the monthly precipitation for the water year 1948 for these two stations.

The precipitation at the lower elevations in the Matanuska Valley is about fifteen inches a year. It increases with altitude toward the north and based on the one year's runoff record for the Little Susitna River must be over 60 inches per year on the higher elevations of the basin.

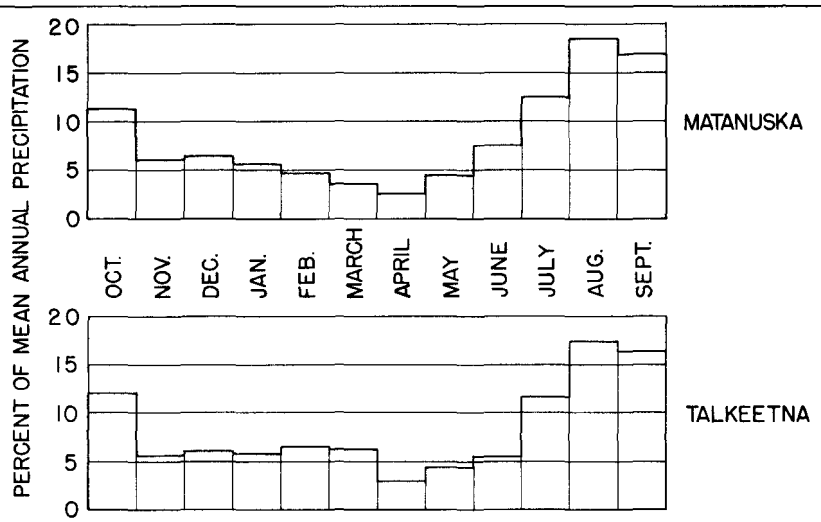
Runoff: There is only one gaging station on Little Susitna River. It is in the SW¼, NW¼, Sec. 26, T. 19 N., R. 1 E., on the left bank downstream side at the Steel Highway Bridge near the mouth of the canyon. See Plate IX. The record began on July 17, 1947 and the gage was installed on August 18, 1947 as a staff gage. The water stage recorder was installed on August 16, 1948. Prior to the installation of the recorder, gage height readings were made intermittently by employees of the Matanuska Valley Electric Association and during the period May 2 to August 16, 1948 by the author. Stream flow measurements and computations of records were by the Water Resources Division, of the U. S. Geological Survey.

The record during the winter months is weak, being based on gage

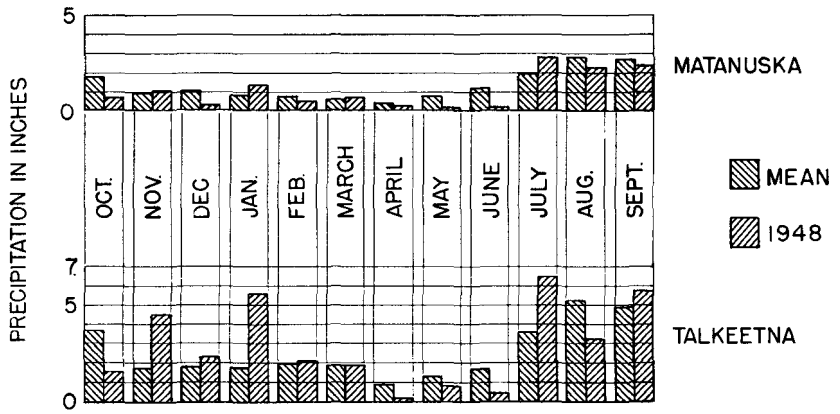
PRECIPITATION DATA



INDEX OF WETNESS



ANNUAL DISTRIBUTION OF PRECIPITATION



COMPARISON OF PRECIPITATION IN 1948 WITH MEAN

heights obtained at six weeks to two months intervals and a comparison with the more complete records on South Fork Campbell Creek and Ship Creek. All computations for power in this report are based on a daily discharge record for the period October 1, 1947 to September 30, 1948. A hydrograph of daily discharge and flow duration curve are shown in Figure 3 and Figure 4. The total runoff for the period was 84,474 second-foot days or 167,500 acre-feet. The drainage area above the gage is 61 square miles or 39,040 acres giving a total runoff of 51 inches. Mean monthly discharge, runoff in acre-feet, and runoff in inches are shown in the table below:

Little Susitna River near Palmer, Alaska
October 1, 1947 to September 30, 1948.

Month	Mean Discharge c.f.s.	Runoff Inches	Runoff Acre-feet
Oct.	204	3.85	12,540
Nov.	86.3	1.58	5,135
Dec.	70.9	1.34	4,359
Jan.	45.1	0.85	2,773
Feb.	28.2	0.50	1,622
Mar.	21.1	0.40	1,297
Apr.	14.4	0.26	857
May	235	4.44	14,450
June	670	12.26	39,870
July	488	9.22	30,000
Aug.	630	11.91	38,740
Sept.	267	4.88	15,890
	231 (mean)	51.49	167,530

A gaging station was established on Cottonwood Creek near Wasilla on July 17, 1947. It is a staff gage on the Highway Bridge about three quarters of a mile below Wasilla Lake and it is in the NE¼, SW¼, Sec. 11, T. 17 N., R. 1 W., Seward Meridian. See Plate X. Since no observer was available only occasional gage heights and their accompanying discharges have been obtained. From these the following table of approximate mean monthly discharges for the year October 1, 1947 to September 30, 1948 was prepared. It will be noted that there is remarkably little

A

Cottonwood Creek near Wasilla, Alaska

Wasilla-Matanuska road crossing about 3/4 mile downstream from Wasilla Lake. U. S. Geological Survey staff gage is on center pier of bridge. (Lawrence, photo L-4816, April 24, 1948)

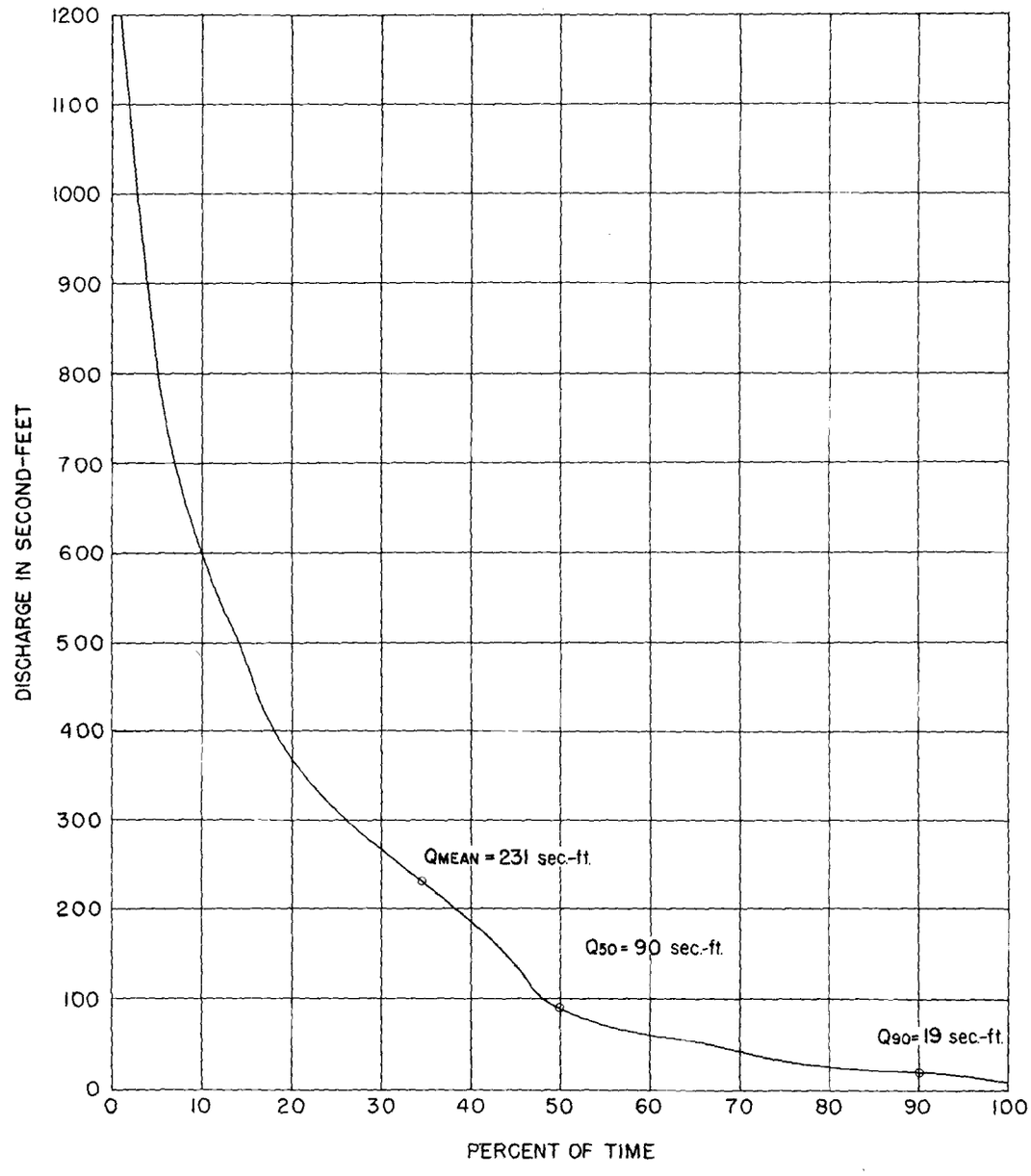
B

Cottonwood Creek near Wasilla, Alaska

Looking upstream from railroad bridge about one mile east of Wasilla. Highway bridge with U.S.G.S. staff gage in background. Lawrence Photo L-4828, May 3, 1948)

DAILY FLOW DURATION CURVE

LITTLE SUSITNA RIVER NEAR PALMER, ALASKA
OCTOBER 1, 1947 TO SEPTEMBER 30, 1948



variation in the flow throughout the year. While the boundary for the drainage area tributary to Cottonwood Creek at the gage is about 25 square miles or 16,000 acres. Thus the runoff was 8.6 inches or 68 percent of the precipitation which occurred at Matanuska during the water year 1948.

Cottonwood Creek near Wasilla, Alaska
October 1, 1947 to September 30, 1948

Month	Mean discharge c.f.s.	Flow Acre-feet
Oct.	22	1,350
Nov.	19	1,130
Dec.	18	1,110
Jan.	17	1,040
Feb.	16	920
Mar.	15	920
Apr.	14	830
May	13	800
June	12	710
July	14	860
Aug.	14	860
Sept.	15	890
		11,420

Estimates of Flow: There is insufficient data to allow any reliable estimates as to how the runoff for the year 1948 compared with what will occur in the future. It appears that 1948 was not an extreme year in any way. Precipitation at Matanuska was 83 percent normal; at Talkeetna 115 percent normal. The winter temperatures were above normal which probably indicates that winter runoff from both Cottonwood Creek and Little Susitna River was above normal. The power computations in this report should be used more as an indication of probable power available than as exact fixtures.

Quality of Water: During the summer months the water of Little Susitna River is slightly turbid, probably from rock flour from the Mint Glacier at its headwaters. During the winter the water is clear.

It was reported that all fish life in the stream had been killed in years past by mine waste, possibly cyanide from concentrating processes. See Plate VIII. The mines have not been operating since before the war and small native trout are now plentiful. However, if a favorable change in the price of gold should occur the mines would resume operation and this type of pollution would again become a problem, particularly for any irrigation development. Salmon do not run in this stream.

Cottonwood Creek receives most of its flow from ground water and is unpolluted except for domestic waste from a few farms. Salmon run up the stream and fingerlings are plentiful in Cottonwood and Wasilla lakes in the spring. Provision to pass the salmon would be required at any dam constructed on the stream.

WATER UTILIZATION PLAN

The extremely uneven distribution of runoff for Little Susitna River together with the lack of storage within the basin limits the possible uses. Ellsworth and Davenport 5/ suggest a diversion and conduit

5/ Ellsworth, C. E. and Davenport, R. W., U. S. Geological Survey Water-Supply Paper 372, p. 372, 1915.

plan utilizing part of the head between Fishhook Creek and the mouth of the canyon, which head is about 600 feet. An analysis of such a project is included in the section on power in this report.

It would be possible to divert the flow of the river at a point four or five miles below the mouth of the canyon into the Cottonwood Creek basin. A canal something over three miles long would be required. Storage could be developed in Wasilla, Cottonwood, and Finger Lakes (see Plate IV) and the water diverted from Cottonwood Creek about one-half mile below Wasilla Lake to a power house about 125 feet lower on a

small unnamed stream about a quarter of a mile to the south. See Plate VI.

While no controlled studies of the value of irrigation on the farm lands in this region have been made the possibility of utilizing a part of the flow of Little Susitna River for this purpose should not be overlooked. The primary demand for irrigation water would probably come during June at a time when the river was high with melted snow.

It seems probable that a market could be developed for considerable amount of secondary power during the summer months for pumping irrigation water from wells on those farms where the ground water was near the surface.

STREAM REGULATION

There is no natural surface storage in the Little Susitna River basin with the exception of the ice field known as Mint Glacier, at the head of the main stem. See Plate II-A. The stream is only slightly turbid during the summer months, indicating little movement of this ice.

Ellsworth and Davenport have pointed out 6/ that "high up in these

6/ Ellsworth, C. E., and Davenport, R. W., U. S. Geological Survey Water-Supply Paper 372, p. 372, 1915.

valleys the slopes are heavily strewn with coarse glacial debris, broken rock, and talus. The large percentage of voids in this formation affords an excellent reservoir for the summer water supply. Ice forms in these spaces during the winter, and by gradually thawing away in the summer it is an important factor in the distribution of the stream flow." See Plate VIII.

No storage has been developed in the basin, but the narrow constriction near the mouth of the canyon has been the subject of much

discussion as a possible dam site. See Plate XI. A capacity table of the storage which would be developed by a dam at this site is shown below:

Little Susitna River
Reservoir Capacity Table
Dam Site in unsurveyed Sec. 23, T. 19 N., R. 1 E

Elev. Feet	Area Acres	Capacity Acre-Feet
1036 water surface	0	0
1040	0	0
1060	3	30
1080	6	120
1100	8	260
1120	17	510
1140	27	950
1160	40	1620
1180	52	2540
1200	69	3750
1220	84	5280
1240	99	7210
1260	118	9380
1280	140	11,960
1300	166	15,020

Because of the steep stream gradient and the narrow valley the storage developed is very small, and the cost per acre foot would be exorbitant. It appears that there are no feasible storage sites within the Little Susitna River basin.

It has been suggested that a portion of the flow of Little Susitna River could be diverted to the Cottonwood Creek basin and storage obtained in Wasilla, Cottonwood, and Finger Lakes. See Plate IV. The map of Matanuska Quadrangle shows a minimum straight line distance of about 3 miles between Little Susitna River at elevation 600 and Cottonwood Creek at elevation 450. The area between these streams was not mapped but a reconnaissance indicates that a canal could be built at reasonable cost. See Plate XII-A.

Storage so developed would be used to augment the natural flow of

A

Little Susitna River, Alaska

Looking upstream from point on highway about one mile above steel highway bridge at gaging station. Proposed power house would be in background. (Lawrence photo L-48110, Aug. 18, 1948)

B

Little Susitna River, Alaska

Looking upstream in canyon section about one mile above gaging station. (Lawrence photo L-4881, July 14, 1948)

A

Cottonwood Creek, Alaska

Bogard road crossing about one mile upstream from Cottonwood Lake. View is upstream. (Lawrence photo L-4809, April 25, 1948)

B

Wasilla Creek, Alaska

Palmer-Willow road crossing about 4 miles northwest of Palmer and three miles northeast of Finger Lake. View is upstream. (Lawrence photo L-4806, April 25, 1948)

Cottonwood Creek, the combined flow being diverted about one half mile south of Wasilla Lake to a power plant in Sec. 14, T. 17 N., R. 1 W.

Three possible schemes to utilize these lakes for storage will be discussed in this report:

1. Storage in Wasilla Lake and Cottonwood Lake by one dam to raise the lake levels to elevation 330.

2. Storage in all three lakes by two dams. One to raise Wasilla Lake to elevation 325 and a second to raise Cottonwood and Finger Lakes to elevation 340.

3. Storage in all three lakes by two dams, one to raise Wasilla Lake to elevation 325, and a second to raise Cottonwood and Finger Lakes to elevation 350.

A detailed discussion of each scheme follows.

Scheme No. 1: A dam in Sec. 11, T. 17 N., R. 1 W. across Cottonwood Creek near the Alaska Railroad Bridge would raise the level of Wasilla Lake and Cottonwood Lake to elevation 330, and develop 6,800 acre feet of storage. This would bring the water level up to within 3 feet of the divide between Wasilla Lake and Lucille Lake to the west in the town of Wasilla and would require relocating the Alaska Railroad for about one-half mile. The reservoir would inundate about 850 acres of land, some of which is under cultivation, one summer resort, and a short stretch of the road between Palmer and Wasilla. It would isolate one farm house near the dam site. A thorough study of the affect of raising the lake on the ground water table and possible excessive leakage should be made prior to any construction. There are several springs along the hillside below the railroad south of Wasilla Lake, and raising the lake might increase their flow to the extent of jeopardizing the railroad track. See Plate VI-A.

Scheme No. 2: A dam in Sec. 11, T. 17 N., R. 1 W. across Cottonwood Creek would raise Wasilla Lake to elevation 325, provide storage of about 1730 acre-feet, and permit diversion into a canal to the power site. Another dam in Sec. 6, T. 17 N., R. 1 E. at the outlet of Lower Cottonwood Lake would raise Cottonwood Lake and Finger Lake to elevation 340, and provide storage of 9080 acre-feet, or a total storage of 10,800 acre-feet. Cottonwood Lake and Finger Lake are separated by a saddle, elevation 349 and a cut approximately 100 feet long to about elevation 330 would be required to put the two lakes at the same level. No estimates of the storage in Finger Lake between its present elevation of 337 and elevation 330 has been included in these computations. There is a saddle in Sec. 34, T. 18 N., R. 1 E. between Finger Lake and Wasilla Creek. Its elevation is 338 and the distance between the 340 contours is about 200 feet. A low dike would be required at this point.

The raising of Wasilla Lake to elevation 325 would not require relocating of the Alaska Railroad and would result in less leakage from the reservoir. Only about 140 acres adjacent to Wasilla Lake would be inundated with practically no damage to roads or buildings.

Raising Cottonwood Lake and Finger Lake to elevation 340 feet would create a leakage problem, but in this case the loss of water would be the primary consideration for there is little likelihood that such leakage would cause any damage.

With a reservoir elevation of 340 feet, 398 acres of land around the shores of Cottonwood and Finger Lakes would be inundated. In 1948 there was no development on Cottonwood Lake and only two farms and one summer cottage on Finger Lake, none of which would be damaged by raising the lake 3 feet. See Plate XIII-A.

A

Uncleared land on south side of Cottonwood Lake. The elevation of the land in the photo is between 5 and 10 feet above lake surface. (Lawrence photo L-4842, May 12, 1948)

B

Newly cleared land. Road from Wasilla to Little Susitna River about 3 miles north of Wasilla Lake. (Lawrence photo L-48116, Aug. 26, 1948).

Scheme No. 3: This is essentially Scheme No. 2 with the water level of Cottonwood and Finger Lakes raised to 350. The control of Wasilla Lake would be the same as would the channel between Cottonwood and Finger Lakes. Storage in Wasilla Lake would be 1730 acre-feet, and storage in Cottonwood Lake and Finger Lake would be 21,300 acre-feet, or total storage in the three lakes of 23,000 acre-feet. There are three saddles along the south side of Finger Lake with elevations between 340 and 350. These with the saddle elevation 338, mentioned for Scheme No. 2, would require four dikes varying from about 7 feet to about 15 feet in height, with an aggregate length of between 1500 and 2000 feet. The leakage problem, would, of course, be considerably more serious than for Scheme No. 2 and should be thoroughly investigated prior to any construction. One group of farm buildings on the southwest end of Finger Lake would be inundated as would a summer cottage on the north side of the lake. Seven hundred acres would be inundated of which not over 10 are under cultivation.

Summary of Storage

	Wasilla Lake		Cottonwood & Finger Lake		
Scheme	Elev. Feet	Storage Acre-Feet	Elev. Feet	Storage Acre-Feet	Total Storage Acre-Feet
1	330	6800	-	-	6,800
2	325	1730	340	9,080	10,800
3	325	1730	350	21,300	23,000

The water to utilize this storage would come from Little Susitna River in a canal. The size of the canal and the amount of storage to be utilized are of course interdependent.

The table below shows the relationship between size of canal from Little Susitna River to Cottonwood Creek, storage necessary, and discharge which would be available 100 percent of the time at the outlet of Wasilla Lake. These figures were computed from the discharge record of Little Susitna River for the period October 1, 1947 to September 30, 1948 and assume that the entire flow of Little Susitna River up to the capacity of the canal would be diverted, that the flow at the point of diversion is the same as at the gage, that no losses will occur from leakage or evaporation, that 10 second-feet of the natural flow of Cottonwood Creek can be diverted for power.

Canal Capacity Second-feet	Storage Required Acre-feet	Regulated discharge available 100 percent of time second-feet	Regulated discharge including Cottonwood Creek second-feet
100	11,300	70	80
150	18,650	90	100
200	26,800	110	120

It will be noted that several factors affecting the flow have been disregarded including leakage from the two canals and the reservoirs, evaporation from the reservoir, storage below existing lake levels particularly on Finger Lake and variation in the flow of Cottonwood Creek. The discharge records on which the figures are based are so short as to make any conclusions not too reliable. Data on which to estimate the affects of these factors is meager and since they will tend to compensate it seems best not to evaluate them numerically. As has been previously pointed out, it will be necessary to by-pass sufficient flow in Cottonwood Creek to care for downstream settlers and for fish life.

WATER POWER

Undeveloped Power Sites: The cost of storage within the Little Susitna

River basin would be prohibitive but there is a possibility of developing power by diversion and conduit using the natural flow of the stream. Five hundred forty feet of head could be developed by constructing a low diversion dam near the mouth of Fishhook Creek where the river surface elevation is 1540 feet, about three miles of canal or covered conduit, and about 2200 feet of pressure conduit. The power house would be located about one-half mile upstream from the highway bridge at a point near where the 1,000 foot contour crosses the river. See Plate XI-A. Allowing 20 feet for loss of head in the canal and conduit the net head would be 520 feet.

The stream flow data for the following analysis is based on one year's record from October 1, 1947 to September 30, 1948. During the low water period gage heights were obtained only on November 7, January 27, February 26, April 26 and May 2. The records have been obtained from these gage heights and a comparison with the flow on Ship Creek and South Fork Campbell Creek near Anchorage. Additional records may change the picture considerably.

The flow duration curve, Figure 4, obtained from these records, shows the following flows:

100 percent of the time	10 second-feet
90 percent of the time	17 second-feet
50 percent of the time	110 second-feet

The drainage area above the gage is 61 square miles, the area between Fishhook Creek and the gage is 6.2 square miles, so that using a straight line comparison, the flow of Little Susitna River at the mouth of an including Fishhook Creek would be about 90 percent of the flow at the gage. Using the formula H.P. = .08 QH, which allows 70 percent overall efficiency, the following power should have been available in 1948 for 520 feet of head and 90 percent of the above flows.

100 percent of the time	374 horsepower
90 percent of the time	636 horsepower
50 percent of the time	4100 horsepower

The construction of such a plant should not offer any great difficulty. The dam would need only be high enough to allow installation of diversion works. It would have to be designed to by-pass rather high peak flows, the magnitude of which is completely unknown, but which might be as great as 10,000 second-feet. Fishhook Creek would be turned into Little Susitna River near the point where it now turns parallel to the river and upstream from the proposed dam. The canal would follow the right (west) bank along moderately steep hillside, crossing several gullies with very steep banks, to a point above the power house site. About 2200 feet of pressure conduit would carry the flow to the generators. The major problem would be the operation of a canal during the winter, and on this point rests the feasibility of the project, but since water runs in a small natural channel all winter it would seem that it should run in a canal. See Plate XIV-A.

There is only one settler along the stream between Fishhook Creek and the proposed power house. See Plate XIII-B. Since this home is supplied with domestic water from a spring which runs all winter, it is probable that no objection would be raised to diverting the entire flow of the stream for power purposes. Although the water year 1948 was fairly normal insofar as precipitation was concerned the winter temperatures were considerably above normal. It seems probable the flows during the cold weather months were higher than usual and that the power available most years might be considerably less than indicated above.

Power could be developed at the escarpment south of Wasilla Lake by diverting the flow of Cottonwood Creek below the lake. Since this

A

Little Susitna River, Alaska
Looking upstream from point near mouth of Fishhook Creek. Channel is covered with ice and snow. (Lawrence photo L-4825, May 2, 1948)

B

Little Susitna River, Alaska
Snow slide from east bank nearly covering prospector's cabin on west bank. 2.2 miles upstream from gaging station at steel highway bridge. (Johnson photo J-4715, Feb. 28, 1947)

flow is too small to be of any practical use it has been suggested that Little Susitna River be diverted four or five miles downstream from the canyon and carried in a canal about three miles long to the headwaters of Cottonwood Creek. Storage could then be developed in Wasilla, Cottonwood and Finger Lakes. This subject is discussed in detail under "Stream Regulation." The power house would be located on a small unnamed stream in Sec. 14, T. 17 N., R. 1 W. The tail race elevation would be at elevation 200. With an average lake level in Wasilla Lake of 322 feet and a 2 foot loss in intervening hydraulic structures the available head would be 120 feet.

Utilizing storage in Wasilla, Cottonwood and Finger Lakes as previously discussed power could have been developed in 1948 as shown in the table below.

Canal Capacity second-feet	Storage Required acre-feet	Regulated Discharge 100 percent of time second-feet	Horsepower 100 percent of time	Kilowatt hours per year at 70 percent eff.
100	11,300	80	770	5,000,000
150	18,650	100	960	6,250,000
175	22,600	110	1055	6,900,000
200	26,800	120	1150	7,500,000

The amount of storage to be made available will depend on further geologic investigations of the reservoir area.

Market for power: There is a critical shortage of power in the Palmer-Anchorage region. The Matanuska Electric Association, an R.E.A. Cooperative, purchases power from the city of Anchorage at the Eklutna plant and distributes the power throughout the Matanuska Valley. A plant located near Wasilla which would operate automatically or by remote control would be very desirable for this organization if power could be generated at a reasonable cost.