Preliminary Report On

Water Power Resources

of

Eklutna Creek, Alaska

by

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The physical characteristics of Eklutna Creek are favorable for the development of water power. Storage to equalize the stream flow can readily be provided in Eklutna Lake, which lies at an altitude of 870. The entire fall to sea level can be developed by the construction of an eight mile pipe line or a five mile tunnel. Storage of about 150,000 acre-feet is sufficient for regulation of the stream flow in most years, and can be provided by a range in lake stage of between 40 and 50 feet. About 15,000 K.W. can be developed 100% of the time and about 18,000 K.W. 50% of the time. These figures, however, must be considered as preliminary as the water supply data on which they are based is somewhat uncertain.

INTRODUCTION

Purpose and scope of the investigation

Eklutna Creek is well suited to use as a source of power, because of the character of its basin. Eklutna Lake, at an altitude of 868 feet, offers an excellent storage site and its proximity to tidewater makes it possible to develop a large amount of head. For this reason the United States Geological Survey made an investigation during the 1947 field season to determine the amount of power available and to examine the public lands that will be affected by any development.

The field investigations by the Geological Survey included mapping Eklutna Lake and bordering hillsides to an altitude of 950 feet on a scale 1:12,000 (1 inch = 1,000 feet) with 10 foot contour interval; mapping Eklutna Creek from outlet of Eklutna Lake downstream 4 miles on a scale of

1:24,000 (1 inch = 2,000 feet) with a 20 foot contour interval; and mapping Eklutna Lake dam site on a scale of 1:4,800 (1 inch = 400 feet) with a 10 foot contour interval. Preliminary maps have been prepared of the lake and the dam site and are included as Plate 2 and Plate 3 in this report.

Geologic examinations were made of the Eklutna Lake dam site, a proposed conduit route along the creek and a proposed tunnel route through the mountain between Eklutna Lake and Knik Arm.

Prior to the work by the Geological Survey the Anchorage Public Utilities, in February, 1947, made soundings of Eklutna Lake to determine storage capacity that could be developed by drawing down the lake below its natural level. The author accompanied the party making the soundings, acting mainly in an advisory capacity as a representative of the Geological Survey. A map showing under-water contours based on the soundings was prepared by Mr. Larry Dahner who also did the field work to determine the location of the soundings as well as the lake shore. This map and supporting data has been furnished the Geological Survey.

Acknowledgments

The Anchorage Public Utilities, through its board members and various employees, gave much helpful cooperation and assistance in the work carried on. Boats and motors were furnished for the field parties while working on the lake. A truck was also furnished for the use of the field parties when needed. Records of stream flow and other data were gladly furnished.

Geography

Eklutna Creek has its source in the Chugach Mountains, flows generally northwestward and empties into Knik Arm, about 27 miles northeast of Anchorage, near the village of Eklutna. The basin is long and narrow, having a length of about 27 miles and a maximum width of 10 miles. The main tributary is Thunder Bird Creek, which enters Eklutna Creek 2 miles above its mouth. The area of the entire basin is 172 square miles, the portion above the Anchorage Public Utilities Diversion Dam is 140 square miles, and the portion above the outlet of Eklutna Lake is 119 square miles. In the present study only the portion of the basin above Thunder Bird Creek is considered.

The most prominent feature in the basin is Eklutna Lake, which is 7 miles long, has a maximum width of a mile and an area of slightly over 5 square miles. The topography of the basin is rugged. Altitudes vary from sea level to 8,000 feet. The distribution of area with respect to altitude is shown below.

Altitude (feet)	Area below indicated altitudes, Eklutna Creek above diversion dam		Area below indicated altitudes, Eklutna Creek above outlet of Eklutna Lake	
	Area Sq. miles	% of total	Area Sq. miles	% of total
1000	15.1	10.8	10.3	8.7
2000	38.0	27.2	24.4	20.4
3000	56.6	40.5	39.4	33.0
4000	83.6	59.7	63.9	53.5
5000	118.8	85.0	98.2	82.2
6000	135.8	97.0	115.1	96.6
7000	139.3	99.6	118.6	99.4
8000	139.9	100.0	119.2	100.0

There is one large glacier and several small glaciers, in the basin, the run-off from which all enters Eklutna Lake. The total glacier area is 6.2 square miles.

The Alaska Railroad crosses Eklutna Creek 0.8 miles above the mouth and the Anchorage-Palmer highway crosses 1.4 miles above the mouth. A road extends from the latter to the outlet of Eklutna Lake.

A map of the Eklutna Creek basin is shown as Plate 1.

Geology

Geologic conditions, as related to power development, were examined by Mr. A. F. Bateman, Jr., and Dr. F. F. Barnes, both of the Geological Survey. The former examined a proposed dam site at the outlet of Eklutna Lake and the latter examined a proposed tunnel route for diverting water from the lake to a power house location near tidewater. Reports have been prepared by each on the subjects indicated.

Climate

The Eklutna Creek basin ranges in altitude from sea level to 8,000 feet and it is presumed that the usual variation in climatic conditions due to variation in altitude exist. Records of temperature and precipitation are available at only one point in the basin, at the power plant at an altitude of only 27 feet. Other stations near the basin are also at low altitudes. Table 1 shows data on temperature and precipitation at Anchorage, Eklutna, and Matanuska.

A study of the table shows that the monthly mean temperature is below freezing from November through March. The maximum monthly mean occurs in July with June and August values fairly close to the same amount. August values are slightly greater than the June values. The minimum temperatures occur during December and January.

August has the greatest monthly mean precipitation with September, July and June next in order. The precipitation during this four month period is over half, about 54% of the annual value. April has the least monthly mean precipitation. Values for February, March and May are also low. The four month period, February through May accounts for only about 15% of the annual precipitation. The distribution of precipitation and within the year is clearly reflected in the run-off distribution.

Factors affecting hydraulic structures

As shown in Table 1. monthly mean temperatures are below freezing for five months of the year. Ice conditions and other effects of low temperatures must therefore, be recognized in the design of hydraulic structures.

Although Eklutna Creek is not within the usually accepted areas of perma frost, frozen ground was noted during the latter part of June. Whether or not this remains frozen the entire year is not known but its existence and possible effects must be considered.

Strong winds with resulting high waves frequently occur on Eklutna Lake. Proper protection against wave action must therefore be provided.

The tidal range in Knik Arm is about 30 feet. If a power house is located on tidewater it may be necessary to keep the tailrace somewhat above the higher high tide level to avoid ice conditions. If ice conditions could be overcome part of the head within the tidal range could be utilized by the use of a properly designed draft tube.

The available stream flow records, temperature, and precipitation records, all indicate that high discharges occur only during the period of June through September or early October. It does not seem likely that the operation of spillway gates would be necessary during periods of ice cover.

No provision for fishways will be necessary.

SUMMARY OF CLIMATE AT LOCALITIES NEAR EKLUTNA LAKE

	Eklutna	Matanuska	c/ Anchorage
Latitude	61°27'	61°34'	61°13'
Longitude	149°20'	149°16'	149°50'
Altitude .... feet	27	166	132
Length of record .... years	4	b/ 28	d/ 28
Annual mean precipitation .. inches	18.57	15.90	14.56
Monthly mean precipitation ..inches			
January	1.34	.86	.84
February	.59	.74	.67
March	.71	.58	.55
April	.24	.44	.41
May	.81	.72	.50
June	a/ 1.42	1.22	.70
July	a/ 2.01	1.98	1.63
August	a/ 3.85	2.92	2.60
September	a/ 2.82	2.66	2.58
October	a/ 1.40	1.79	2.18
November	a/ 1.04	.95	1.04
December	a/ .73	1.04	.86
Annual mean snowfall ....inches	43.2	e/ 45.2	e/ 58.0
Annual mean temperature .... °F	37.1	35.8	35.0
Monthly mean temperature ... °F			
January	16.3	13.8	11.6
February	25.3	19.4	18.6
March	25.4	24.3	23.7
April	35.8	36.5	35.4
May	a/ 48.2	46.9	45.0
June	a/ 57.2	54.4	53.5
July	a/ 58.8	57.6	57.0
August	a/ 56.6	55.6	55.6
September	a/ 49.0	47.8	47.8
October	a/ 35.4	36.4	36.0
November	a/ 19.1	22.0	22.4
December	a/ 13.9	14.0	13.3
Highest temperature .... °F	90	84	92
Lowest temperature .... °F	- 35	- 36	- 36

a/ 5 yr. record
b/ Records incomplete for 1932, 1933, 1934, 1935.
c/ Weather station moved from Ship Creek to Airfield in 1922.
d/ 30 yr. temperature record.
e/ No record for 1936.

WATER SUPPLY

A record of the flow of Eklutna Creek at the diversion dam, located 3 miles above the mouth, has been obtained in connection with the operation of the power station since October, 1929. This record, however, is not a gaging station record in the usual meaning of the term but is a compiled record made by totaling the flow through the power house, the flow over the diversion dam, and at times leakage around a sluice gate in the dam. The flow through the power house has been based on a manufacturer's rating of the turbines showing the theoretical relation between power generated and water required. The flow over the diversion dam is based on a theoretical rating curve but, so far as known, has never been checked by current meter measurements. The leakage around the sluice gate has been estimated. The record is based on observations about every third day and is not a daily record.

The Water Resources Branch of the Geological Survey installed a gage on Eklutna Creek just below the outlet of Eklutna Lake in November, 1946. Daily gage readings have been obtained since then by an employee of the Anchorage Public Utilities. Several discharge measurements have been obtained but to date (July, 1947) a sufficient range in stage has not been covered to allow for a reliable correlation between the flow at this station and that recorded at the diversion dam.

A record of flow on "Eklutna River at mouth of Canyon" was obtained from January, 1924 through October, 1927, the results of which are shown on a graph in the files of the Anchorage Public Utilities. The exact location at which this record was obtained is not known but it was apparently downstream from the mouth of Thunder Bird Creek. The extent of current meter measurements and gage height observations on which the foregoing record is based is not known. In view of these uncertainties this record has not been used in the water supply analysis for this report.

The record of discharge at the diversion dam for the 17 year period, October, 1929 through September, 1946, has been used as the basis for the water supply analysis in this report. The discharge at the outlet of Eklutna Lake has been considered as 85% of that recorded at the diversion dam, the drainage area at the lake outlet being 85% of that at the diversion dam. This relationship may vary appreciably during different times of the year due to variations in altitude, snow cover, glacial run-off, temperature and precipitation. Until a correlation is established between the flow at the lake outlet and the diversion dam the drainage area relation seemed the most logical to use. As previously stated the record at the diversion dam is a compiled record and has not been checked by current meter measurements. Until an adequate correlation can be developed between the record at the recently established gaging station at the lake outlet and the record at the diversion dam the figures on water supply given in this report must be considered as preliminary and subject to change when more adequate data becomes available.

Seasonal variation in stream flow

The mean monthly and mean annual discharge at the diversion dam for the period October 1, 1929 to Sept. 30, 1946 is shown in Table 2. This table shows that there is a marked variation from year to year and a very pronounced variation within each year.

The maximum annual mean of 514 second feet in 1940 is more than double the minimum annual mean of 239 second feet in 1943. The maximum mean monthly flow was in August for eleven years of the record and in July for six years. The minimum mean monthly flow was in March for 10 years, in February for six years and was the same for both months in one year.

As shown by the mean values in Table 2 July and August account for about half of the annual flow and the four month period June to September accounts for about three-fourths. The three month period of January through March has less than 5% of the annual flow and the five month period of December through April has less than 10%. This pronounced variation in distribution throughout the year makes storage regulation necessary for any satisfactory power development.

The distribution of flow with respect to time is shown by the duration curve in Figure 1.

Annual Yield and Minimum Flow

The seventeen year record at the diversion dam gives a fairly good indication of flows that may be expected on this stream. It must of course, be recognized that lesser minimum flows and greater maximum flows may be encountered as the length of record increases. As shown in Table 2 the mean for the period is 406 second feet. The annual means vary from a minimum of 239 second feet to a maximum of 514 second feet. The minimum of 239, occurring in 1943, was unusually low as the next lowest value was 339 which occurred in 1942. The two lowest years of record were therefore in consecutive years, making this a critical period for water supply.

Table 2 shows minimum monthly means of 18, 20 and 22 second feet, occurring in January, February and March, 1932. These values, however, were the flows through the power house only and may not truly represent the actual flow at the diversion dam. The value of 36 second feet in March, 1934 is

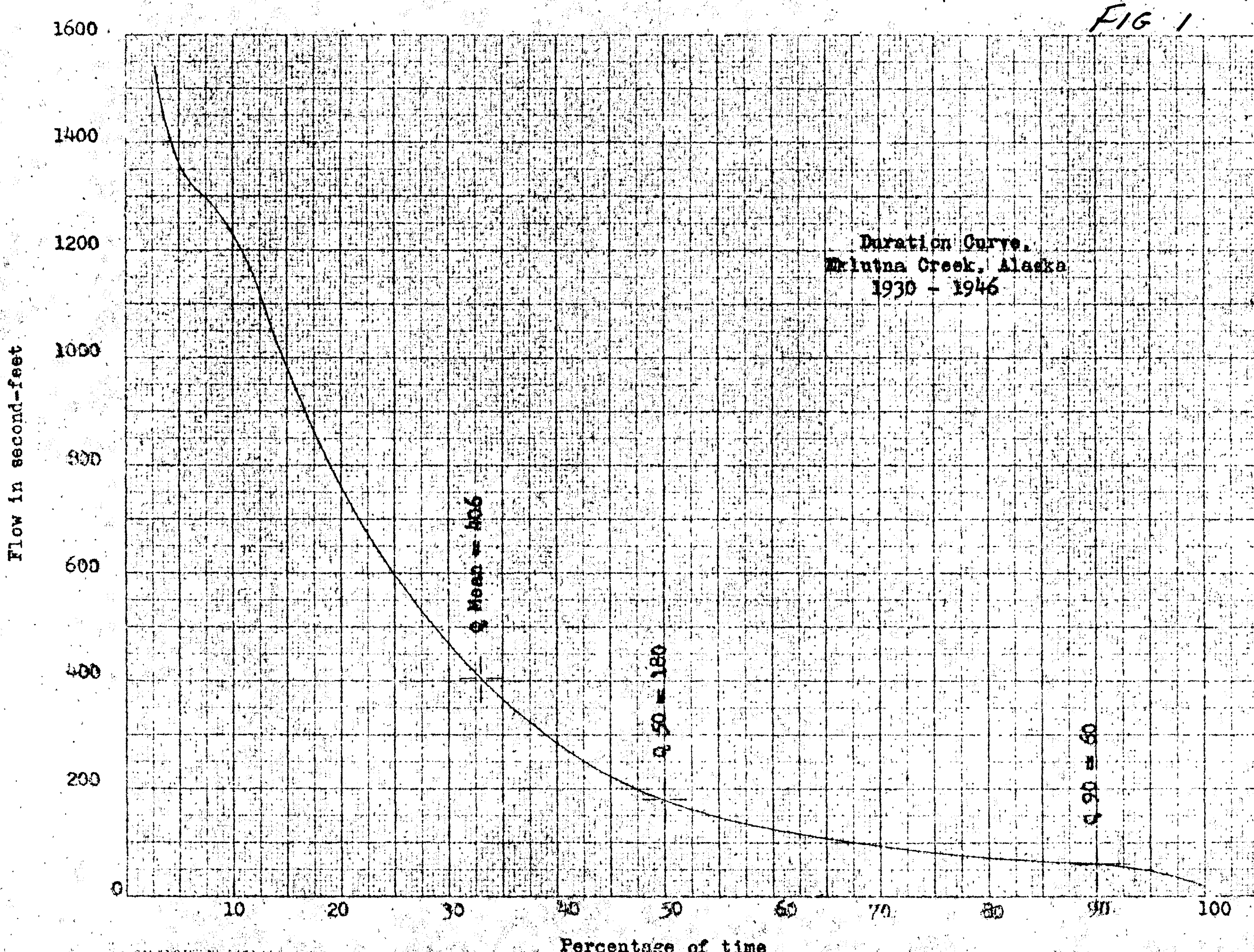


FIG 1
Duration Curve.
Eklutna Creek, Alaska
1930 - 1946
Flow in second-feet
Percentage of time
Q Mean = 406
Q 50 = 180
Q 90 = 60
1600
1400
1200
1000
800
600
400
200
0
10
20
30
40
50
60
70
80
90
100

probably a more reliable value.

The minimum values shown, however, may not be true minimums as water is being drawn from storage during these periods, thus increasing the natural flow. A further analysis of minimum flows would require a record of lake stages in order to correct for draft from storage. Such records, however, are not available.

As previously stated, the values of discharge at the lake outlet are estimated as being equal to 85% of the values shown at the diversion dam. Using this conversion factor the mean annual flow at the lake outlet is 345 second feet, the maximum annual mean 437 second feet and the minimum annual mean 203 second feet. The estimated monthly mean values at the lake outlet are shown in Table 3.

Magnitude, duration, and frequency of floods

Eklutna Creek is not subject to floods in the usual sense of the term. It does have a very definite high water period in July and August of each year, which coincides with the period of maximum mean monthly temperature and precipitation. The maximum recorded discharge at the diversion dam during the period of record is shown in the following table:

Year	Date	Max. Disch. in c.f.s.
1930	Aug. 9	1850
1931	Aug. 18	1910
1932	Aug. 24	2210
1933	Aug. 1	1401
1934	July 31	1731
1935	-	-
1936	Sept. 3	1588
1937	Sept. 2	1528
1938	Sept. 14	1496
1939	Aug. 5	1489
1940	Aug. 30	1665
1941	July 19	1850
1942	July 23	1039

Year	Date	Max. Disch. in c.f.s.
1943	Aug. 22	952
1944	Aug. 4	3098
1945	Aug. 13	1971
1946	July 4	1678

The foregoing values are understood to represent natural flow as during high water periods all the gates in the dam at the lake outlet are kept open so there is no regulation of the lake outflow.

The maximum value recorded was 3,098 second feet on August 4, 1944. This represents a run-off of 22.2 second feet per square mile. Using this same value of unit run-off the maximum discharge at the lake outlet would have been 2,650 second-feet. It seems probable that the intensity of run-off at the lake outlet would be somewhat greater than at the diversion dam due to the fact that a larger percentage of the drainage area is at the higher altitudes which would normally have greater precipitation. The glaciers and snow fields in the higher altitudes would also tend toward a greater intensity of run-off.

During the 17 year period of record the maximum recorded discharge was above 2,000 second-feet only twice, 3098 second-feet in August, 1944 as above mentioned and 2210 second-feet in August, 1932.

The date of the maximum discharge varied from the earliest on July 4, 1946 to the latest on September 14, 1938. The average date of maximum discharge is August 12.

Prior Water Rights

The Anchorage Public Utilities has a license from the Federal Power Commission covering the present plant and includes certain storage rights on Eklutna Lake. Further development by the Anchorage Public Utilities would require an amendment to the present license.

River Control

Eklutna Creek has a comparatively long period of low flow each year so that storage is necessary to fully utilize the available water supply. Eklutna Lake is the only storage site within the basin. This site is described under the heading of Storage Sites.

Table 2

Summary of Monthly mean discharge, in second feet, of Eklutna Creek at Anchorage Public Utilities diversion dam near Eklutna, Alaska, 1930-1946.

Climatic Year	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Year
1929-30	453	221	120	61	50	64	80	166	418	1099	1360	904	419
1930-31	236	86	80	60	80	100	132	245	527	1410	1500	623	427
1931-32	152	174	64	a/ 18	a/ 20	a/ 22	b/ 104	156	386	1022	1537	594	356
1932-33	131	184	98	142	65	69	127	212	454	1022	1140	411	341
1933-34	73	102	50	38	39	36	329	212	520	1234	1412	618	391
1934-35	271	224	251	106	75	58	70	84	c/ 570	c/ 1200	c/ 1500	c/ 800	437
1935-36	c/ 300	c/ 230	c/ 260	130	c/ 85	c/ 65	c/ 75	90	679	1301	1408	842	457
1936-37	220	269	126	64	64	78	287	402	844	1214	981	1164	478
1937-38	283	174	125	c/ 65	c/ 60	c/ 60	c/ 90	130	414	768	1122	1198	376
1938-39	416	347	170	66	79	75	54	400	667	1310	1302	656	465
1939-40	606	266	78	66	55	80	83	354	643	1316	1526	1274	514
1940-41	544	129	83	66	66	55	56	79	968	1205	1203	535	419
1941-42	180	111	115	97	73	61	52	483	718	838	541	785	339
1942-43	422	111	160	118	108	86	58	77	290	310	884	224	239
1943-44	198	241	138	119	111	106	116	218	982	1414	1801	512	499
1944-45	244	112	115	115	112	92	68	170	689	1243	1203	307	376
1945-46	280	131	122	130	129	57	39	187	766	1330	846	430	374
Maximum	606	347	260	142	129	106	329	483	982	1414	1801	1274	512
Minimum	73	86	50	a/ 18	a/ 20	a/ 22	39	77	290	310	541	224	239
Mean	295	183	127	86.5	74.8	68.5	107	204	620	1132	1251	699	406

a/ Through power house only
b/ April 18-30
c/ Estimated

Summary of estimated monthly mean discharge, in second feet, of Eklutna Creek at outlet of Eklutna Lake, near Eklutna, Alaska, 1930-46.

Climatic Year	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Year
1929-30	385	188	102	52	42	54	68	141	355	934	1156	768	356
1930-31	201	73	68	51	68	85	112	208	448	1198	1275	530	363
1931-32	129	148	54	15	17	19	88	133	328	869	1306	505	303
1932-33	111	156	83	121	55	59	108	180	386	869	969	349	289
1933-34	62	87	42	32	33	30	280	180	442	1049	1200	525	333
1934-35	230	190	213	90	64	50	60	71	484	1020	1275	680	372
1935-36	255	196	221	110	72	55	64	76	577	1106	1197	716	389
1936-37	187	229	107	54	54	66	244	342	717	1032	834	989	406
1937-38	241	148	106	55	51	51	76	110	352	653	954	1018	319
1938-39	354	295	144	56	67	64	46	340	567	1114	1107	558	396
1939-40	515	226	66	56	47	68	71	131	547	1119	1297	1083	437
1940-41	462	110	71	56	56	47	48	67	823	1024	1023	455	356
1941-42	153	94	98	82	62	52	44	411	610	712	460	667	288
1942-43	359	94	136	100	92	73	49	65	246	264	751	190	203
1943-44	168	205	117	101	94	90	99	185	835	1202	1531	435	424
1944-45	207	95	98	98	95	78	58	144	586	1057	1023	261	319
1945-46	238	111	104	117	110	48	33	159	651	1130	719	366	317
Maximum	515	295	221	121	110	90	280	411	835	1202	1531	1083	437
Minimum	62	73	42	15	17	19	33	65	246	264	460	190	203
Mean	250	156	108	72	64	58	91	173	527	962	1063	594	345

The monthly values in the above table were derived by taking 85% of the corresponding values in Table 2. The drainage area at the lake outlet is 85% of that at the diversion dam.

STORAGE SITES

Developed Sites

The Anchorage Public Utilities, as part of its power development, has a dam at the outlet of Eklutna Lake which regulates the lake through an 8 foot range in stage, from 860 to 868. The capacity within this range is 25,600 acre-feet. This storage is drawn on primarily during the winter and early spring months for use in the power house 8 miles downstream from the lake.

Undeveloped Sites

The only possibility of developing additional storage is by increasing the capacity of Eklutna Lake. This can be done by constructing a dam to raise the lake level above its present maximum stage, by drawing down the lake level below its present minimum stage, or by a combination of two methods.

Figure 2 shows area and capacity cruves for Eklutna Lake. These curves show the area and capacity above the 800 foot contour. It does not seem probable that any plan of development would draw the lake down that low. However, from these curves the available capacity for any selected operating range can readily be determined. Data on area and capacity are also shown in Table 4.

A study of the discharge record for the 17 year period shows that regulation between the annual low flow periods would have provided mean flows ranging from a minimum of 201 second-feet, in only 4 years. The maximum storage required for the year to year regulation was 148,000 acre-feet.

Regulating from year to year, allowing for no carry over storage, the flow for 50% of the time would have been 350 second-feet and for 90% of the time 265 second-feet.

A flow of 300 second-feet could have been maintained during the entire period of record with a maximum storage of 160,000 acre-feet. Storage in excess of 100,000 acre-feet was only required in 3 other years of the 17 year period to maintain this flow. C arry over storage would have been required in 1933, 1942 and 1943.

Reference to Figure 2 and Table 4 shows that a storage capacity of 150,000 acre-feet could be provided by raising the lake 42 feet or 40 feet above the present low and high stages of 860 and 868 or by drawing it down 51 or 49 feet below these same stages. In other words raising the lake level about 40 feet or drawing it down about 50 feet will provide sufficient storage for regulating the stream flow. Storage development by raising the lake would provide a mean head of about 40 feet more than development by drawdown, or approximately 5% of the total available head.

For the purpose of this report a continuous regulated flow of 300 second feet is assumed as available and a regulated flow of 350 second-feet for 50% of the time.

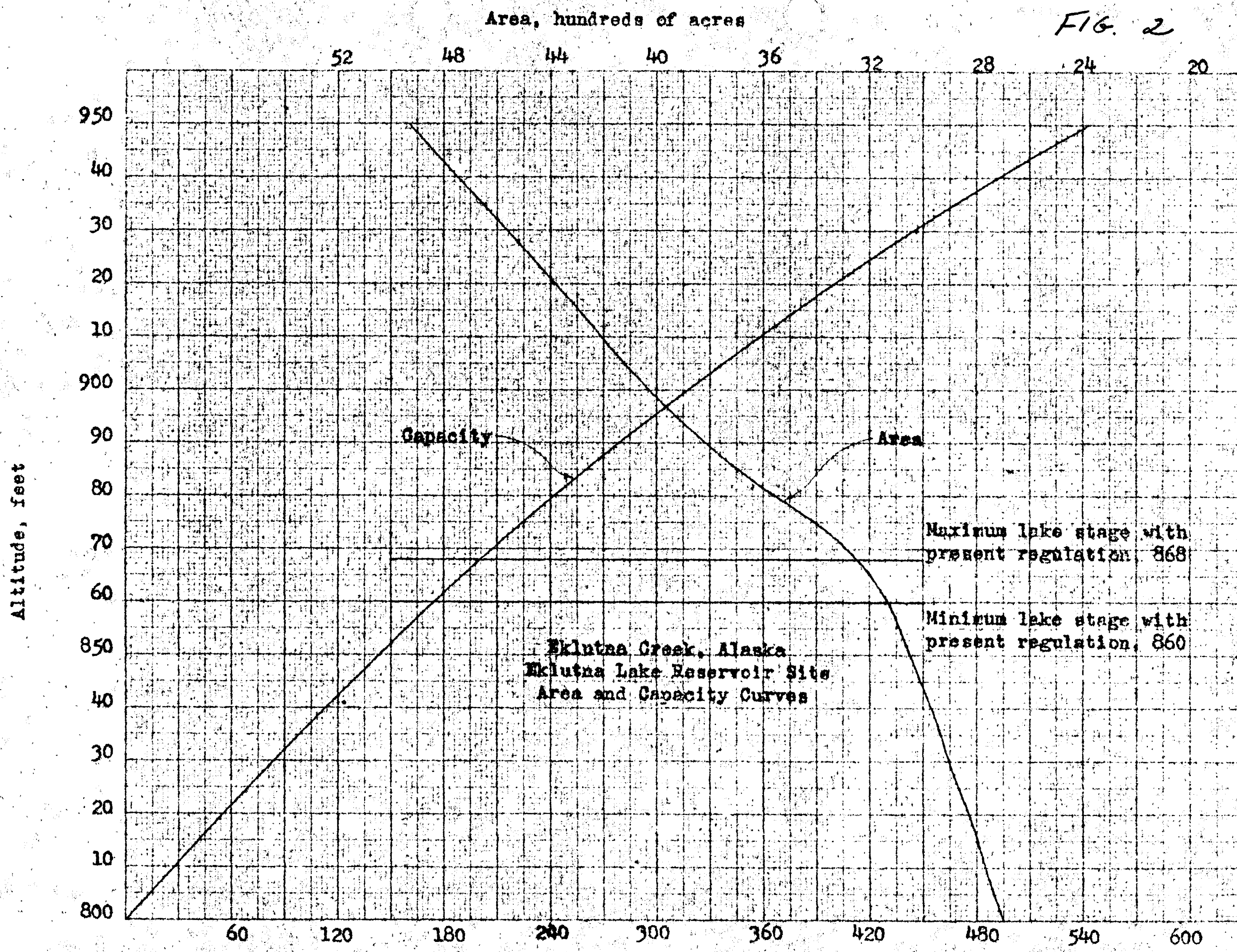
EKLUTNA LAKE RESERVOIR SITE

Areas and Capacities

Altitude (feet)	Area (Acres)	Capacity between successive altitudes (acre-feet)	Capacity above 800 (acre-ft.)	Capacity above 860 (acre feet)	Capacity below 860 (acre feet)	Capacity above 868 (acre feet)	Capacity below 868 (acre feet)
800	2699		0	–	174,500	–	200,100
		27,340					
810	2768		27,340	–	147,200	–	172,800
		28,020					
820	2837		55,360	–	119,100	–	144,700
		28,700					
830	2903		84,060	–	90,440	–	116,000
		29,380					
840	2972		113,400	–	61,060	–	86,660
		30,100					
850	3049		143,500	–	30,960	–	56,560
		30,960					
a/ 860	3143		174,500	0	0	–	25,600
		25,600					
b/ 868	3256		200,100	25,600	–	0	0
		40,910					
880	3562		241,000	66,500	–	40,910	–
		36,860					
890	3810		277,900	103,400	–	77,770	–
		39,240					
900	4038		317,100	142,600	–	117,000	–
		41,240					
910	4211		358,400	183,800	–	158,200	–
		43,000					
920	4388		401,400	226,800	–	201,200	–
		44,780					
930	4569		446,100	271,600	–	246,000	–
		46,620					
940	4754		492,800	318,200	–	292,600	–
		48,460					
950	4937		541,200	366,700	–	341,100	–

a/ Minimum lake level with present regulation
b/ Maximum lake level with present regulation

FIG. 2


Area, hundreds of acres
52
48
44
40
36
32
28
24
20
950
40
30
20
10
900
90
80
70
60
850
40
30
20
10
800
Altitude, feet
Capacity
Area
Maximum lake stage with present regulation, 868
Minimum lake stage with present regulation, 860
Eklutna Creek, Alaska
Eklutna Lake Reservoir Site
Area and Capacity Curves
60
120
180
240
300
360
420
480
540
600

19a

WATER POWER

Developed Sites

The Anchorage Public Utilities has the only developed power site in the basin. Water is diverted from Eklutna Creek at a point 3 miles above the mouth into an 1800 foot tunnel which terminates in the penstocks, leading to the power house, which is located about 1 mile from the village of Eklutna. During periods of low flow storage water is released from Eklutna Lake and flows down Eklutna Creek to the diversion dam which is 8 miles from the lake outlet. The turbines are at altitude 27 and the crest of the diversion dam at altitude 259, giving a gross head of 232 feet. There are two 1,000 K. W. generators installed.

A 27 mile transmission line leads from the plant to Anchorage where most of the power is used. The Palmer area is also supplied from this plant.

The plant was built in 1929 by Mr. Frank I. Reed at which time one generator was installed. The second unit was installed in 1935. The plant was purchased by the City of Anchorage in 1943.

This plant uses a maximum of about 140 c.f.s. and only utilizes 232 feet of the 860 feet of fall in Eklutna Creek.

Undeveloped Sites

This report considers only one site, the Eklutna Lake power site for development. The plan for this site contemplates development of sufficient storage in Eklutna Lake to fully utilize the available stream flow, and utilizing the entire fall between the lake and tidewater by carrying the storage water from the lake through a pipe line down the valley of Eklutna Creek to a power house near the present one or by a tunnel through the mountain between Eklutna Lake and Knik Arm to a power house located about

4 miles northeast from the village of Eklutna. The latter method of development is considered preferable as the operation and maintenance of a tunnel would be less expensive then a pipe line, there would not be the danger of flow stoppage due to freezing and there would be an appreciable difference in the loss of head between the pipe line and tunnel, the difference being in favor of the tunnel.

The loss in head for several sizes of pipe and quantity of flow are shown in the following table. These figures are based on a formula developed by[a] Mr. Scobey for wood stave pipe. The formula conforms with the

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a/ Urquhart's Civil Engineering Handbook, p. 321

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average of a large number of experiments but individual experiments varied as much as 30 per cent both plus and minus. Consequently, head losses may be greater than shown in the following table.

Diameter of pipe, feet	Flow in second-feet	Loss of head in feet per mile
6	300	19.1
6	350	25.2
6	400	31.8
7	300	9.2
7	350	12.0
7	400	15.4
8	300	4.86
8	350	6.39
8	400	8.13

The required slope for a tunnel will of course depend on its size and whether or not lined. Due to the needs for convenience in construction a tunnel would undoubtedly have a considerably larger area than any pipe line that would be considered. A 9 foot wood stave pipe would require a slope of about 3 feet per mile for a flow of 400 second feet. This figure has been taken as the head loss in a tunnel.

In arriving at the potential power of this site the following assumptions have been made. Storage will be developed by the construction of a dam at the lake outlet, regulating the lake between elevations 870 and 910. The mean elevation for determining available head has been taken as 890. Water would be diverted from the lake either by a pipe line or a tunnel to a power house site located on tidewater. The power house elevation has been taken as 20 in order to be above high tide levels, thus giving a gross head of 870 feet. The pipe line would be 7 feet in diameter, laid on sufficient slope to allow a flow of 400 second-feet. It would be at least 8 miles long and thus have a head loss of 120 feet. The tunnel would be 5 miles long and have a head loss of 15 feet. The potential power has been computed by the formula, Horsepower = (0.08)(Q)(H) Q= the flow in second-feet and H the head in feet.

Potential Power at Eklutna Lake Power Site

With pipe line diversion

Head (feet)	Regulated flow, (Second-feet) continuous	50% of time	Horsepower continuous	50% of time	Kilowatts continuous	50% of time
750	300	350	18,000	21,000	13,430	15,670

Potential Power at Eklutna Lake Power Site

With tunnel diversion

Head (feet)	Regulated flow (Second-feet) continuous	Regulated flow (Second-feet) 50% of time	Horsepower continuous	Horsepower 50% of time	Kilowatts continuous	Kilowatts 50% of time
855	300	350	20,520	23,940	15,310	17,860

EKLUTNA CREEK BASIN, ALASKA

PLATE 2

48-12

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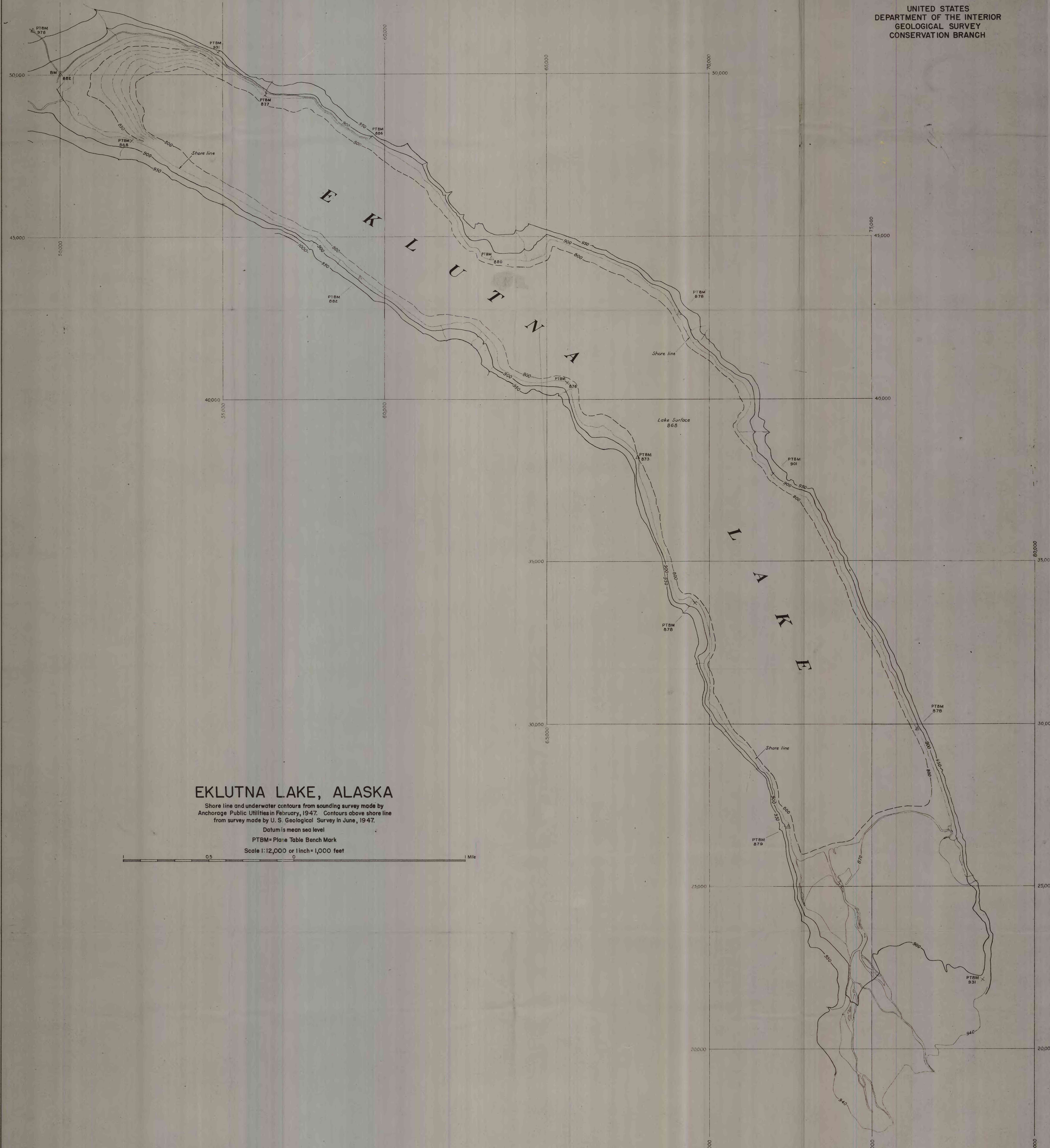


EKLUTNA LAKE, ALASKA

Shore line and underwater contours from sounding survey made by Anchorage Public Utilities in February, 1947. Contours above shore line from survey made by U. S. Geological Survey in June, 1947.

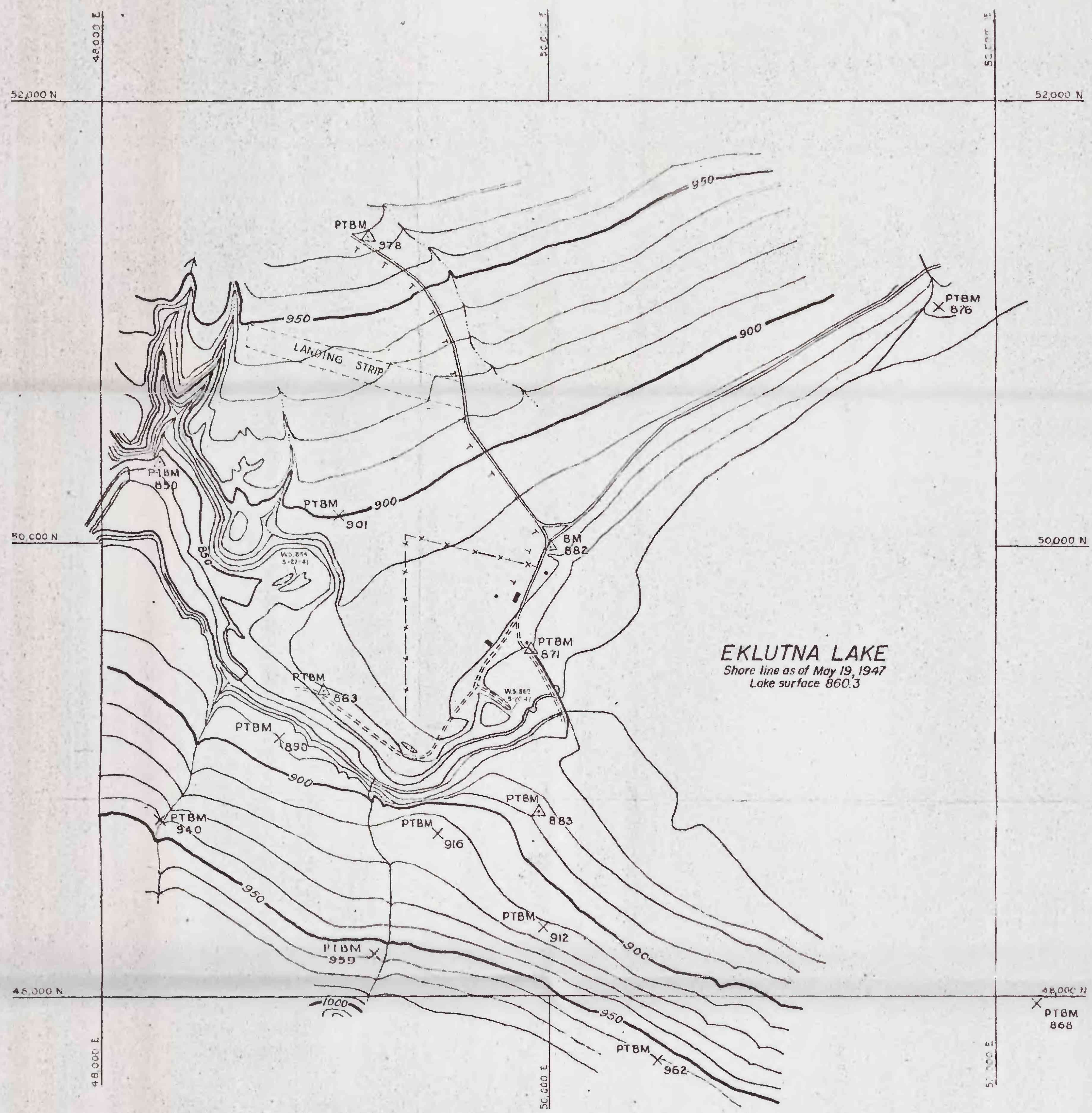
Datum is mean sea level

PTBM = Plane Table Bench Mark

Scale 1:12,000 or 1 inch = 1,000 feet

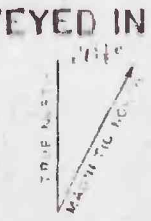
1 — 0.5 — 0 — 1 Mile

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
CONSERVATION BRANCH



EKLUTNA LAKE DAM SITE

SCALE 1 INCH=400 FEET
CONTOUR INTERVAL 10 FEET
DATUM IS MEAN SEA LEVEL
TOPOGRAPHY BY ARTHUR JOHNSON
SURVEYED IN 1947



APPROXIMATE MEAN
DECLINATION 1947

COORDINATES SHOWN ARE ON ASSUMED DATUM
PTBM = PLANE TABLE BENCH MARK