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HYDROLOGY OF LOON CREEK, WISCONSIN

by

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1971

HYDROLOGY OF LOON CREEK, WISCONSIN

By

Warren A. Gebert

U.S. Geological Survey

Administrative Report

Prepared in Cooperation with Burnett County

through

University Extension--University of Wisconsin

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HYDROLOGY OF LOON CREEK

by W. A. Gebert

This hydrologic study of Loon Creek was initiated to determine the feasibility of a proposed reservoir system. The work was done by the U.S. Geological Survey in cooperation with Burnett County through the University Extension--The University of Wisconsin Geological and Natural History Survey.

The following data were collected and interpreted for special areas of hydrologic interest in the Loon Creek watershed.

Streamflow.--A continuous-recording gaging station was established on Loon Creek downstream from the proposed damsites (Site "I" in figure 1). Daily streamflow records from June 4, 1970, through November 5, 1970, are listed in table 1.

A seepage run was made July 8, 1970, on Loon Creek and Spring Creek. The measured discharges are shown in table 2. Also, a series of discharge measurements was obtained at two upstream locations, one on Loon Creek and one on Spring Creek. The results of the measurements are listed under E and C in table 3.

Monthly mean discharge values were estimated for Loon Creek by correlating the recorded discharge at the Loon Creek gaging station and the recorded discharge at two other gaging stations in the area. One station is Bashaw Brook near Shell Lake (not shown on map), which is a gage that has recorded open-water streamflow since 1964, and the other is the Namekagon River near Trego gage (not shown on map), which has been in operation since 1928. The monthly mean discharge recorded at these stations was transferred through the relation line to estimate the discharge of Loon Creek for 1964-70 (Table 4). Based on the seepage run of July 8 and the miscellaneous measurements obtained at the two upstream locations, about half the streamflow at the gaging station comes from Spring Creek and the other half from the main stem of Loon Creek.

The proposed reservoir system would have two dams on Loon Creek; one just below the confluence of Spring Creek and Loon Creek creating Lake "B" (planned elevation 968 feet), and one just upstream creating Lake "A", planned elevation 981 feet, (fig. 1). The inflow to each lake would be about half the flow at the Loon Creek gaging station. The estimated average mean inflow for each lake is shown in table 4. Each lake would have a mean annual inflow of about 4.5 cfs (cubic feet per second) which is equal to about 3,300 acre feet annually.

The flow recorded at the Loon Creek gaging station was almost entirely ground-water runoff for the period of operation. Most of the water came from the present lake system in the upper part of the Loon Creek watershed.

The present pattern of ground-water movement will be altered by the construction of the proposed reservoirs, but the quantity should not be reduced materially. As the proposed Lake "A" begins to fill, the ground-water gradient between Loon Lake and Loon Creek will be reduced, and in consequence the ground-water flow into Lake "A" will decrease. This will cause the water elevation of Loon Lake to rise until it reaches the elevation (981 feet) of the Loon Lake spillway and begins discharging into Lake "A". If Lake "A" were filled to its normal elevation of 981 feet, the entire inflow would be derived from water passing over the spillway.

Ground-water Flow.--Present and future ground-water conditions were evaluated by preparation of two potentiometric maps. A map of present (Oct. 21-23, 1970) conditions (fig. 2) was prepared using water levels in seven U.S. Geological Survey observation wells (table 5), numerous wells that had been installed by N. E. Isaacson and Assoc., and lake-surface elevations from U.S. Geological Survey topographic maps. The second map (fig. 3) represents the probable potentiometric surface after construction of the dams and complete filling of the lakes.

The amount of seepage from the reservoirs was computed using Darcy's law which is expressed as $Q = TIL$. Q is the quantity of water discharged in a unit of time, T is the transmissivity of the aquifer, I is the hydraulic gradient, and L is the length of the cross sectional area through which the water moves, measured normal to the direction of flow.

The transmissivity of the aquifer, a fairly uniform, medium grained, clean sand, was estimated by solving Darcy's law for T. The contours on the potentiometric map (fig. 2) were used with the discharge values from the seepage run on July 8. The discharge at the Loon Creek gaging station was about the same on July 8 as on October 21-23, 1970, the period of the potentiometric map. Solving the equation yields a T value of 63,000 gpd per ft (gallons per day per foot) for a reach on Loon Creek and 62,500 gpd per ft for a reach on Spring Creek.

A transmissivity of 63,000 gpd per ft was used to compute the seepage since this value represents the rate at which the aquifer transmitted water during an actual seepage condition. However, this value may be low because Loon, Cadott, and Shoal Lakes have acquired a natural seal of silt deposits on the lake bottoms. A new reservoir may initially have a considerably higher T value.

The computed seepage losses for the normal lake levels are:

	Average Seepage (cfs)	Annual Seepage (acre-feet)
Seepage from north side Lake "A"	3.5	2,500
Seepage from southwest side Lake "A"	5.1	3,700
Seepage from northwest side Lake "B"	2.5	1,900

Water Quality.--A water sample was taken at the Loon Creek gaging station site on October 9, 1970, when the discharge was 18.0 cfs. The results of the laboratory analysis are:

Total hardness = 67 milligrams per liter

Total nitrates (NO_3) = 0.7 milligrams per liter

Total phosphorous (PO_4) = 0.05 milligrams per liter

Conductance = 130 micromhos per cm at 25°C

Color = 30 cobalt units

This analysis indicates that the proposed reservoirs would initially have about the same general water quality as the existing lakes in the area.

Conclusion.--The following is a brief summary of the estimated inflow and losses for the proposed reservoirs:

Lake "A"

Average annual inflow:	
From upstream system =	3,300 acre-feet
Average annual losses:	
Seepage from north side =	2,500 acre-feet
Seepage from southwest side =	3,700 acre-feet
Evaporation from lake surface =	800 acre-feet
Seepage through dam (estimated to be similar to present Loon Lake Dam) =	700 acre-feet
Total losses =	7,700 acre-feet
Balance: Average annual deficiency =	4,300 acre-feet

Lake "B"

Average annual inflow:	
From upstream system =	3,300 acre-feet
Seepage from southwest side Lake "A" =	3,700 acre-feet
Seepage through Lake "A" dam =	700 acre-feet
Total =	7,700 acre-feet

Lake "B" (continued)

Average annual losses:

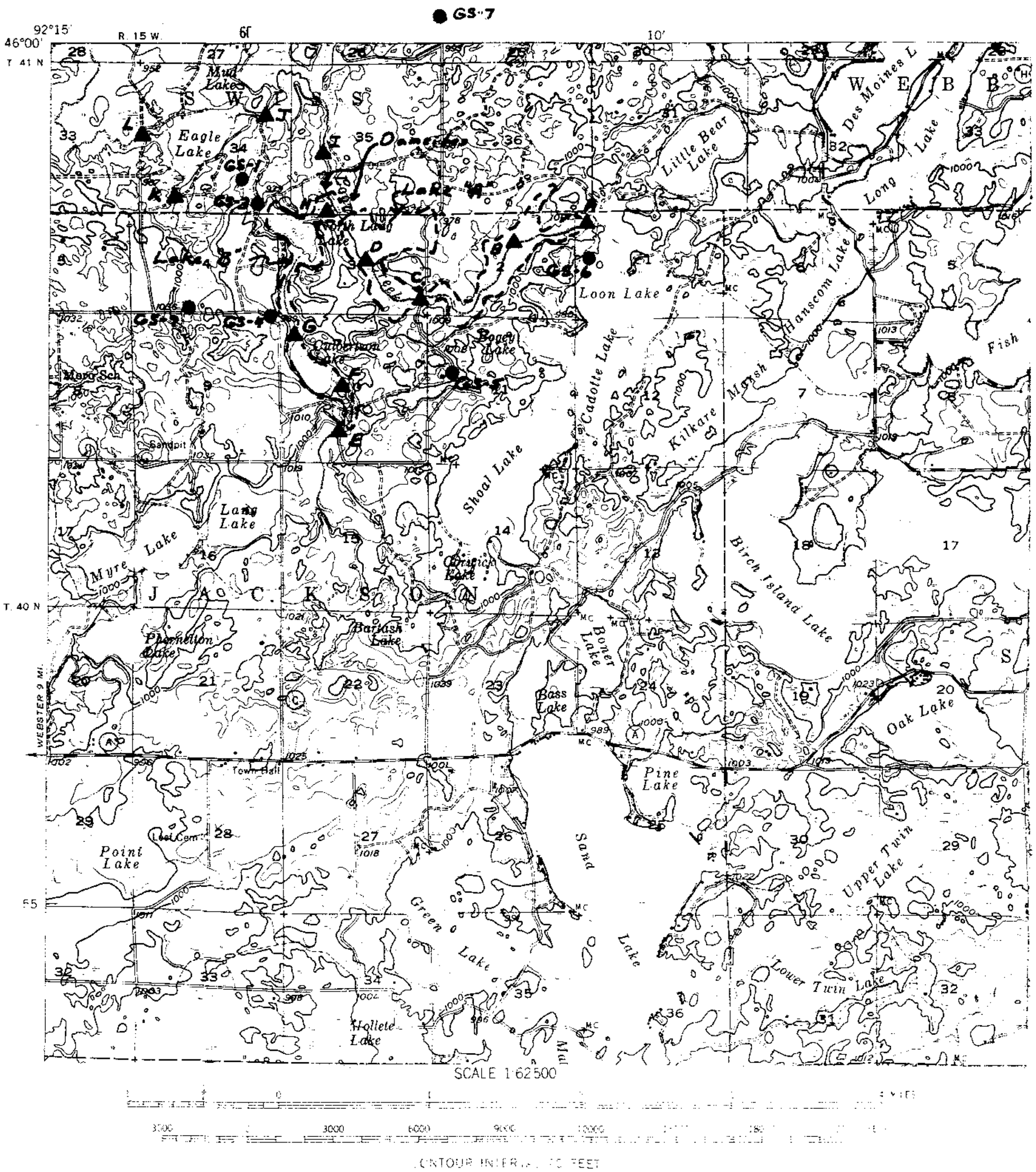
Seepage from northwest side =	1,900 acre-feet
Evaporation from lake surface =	200 acre-feet
Seepage through the two dams in Lake "B" (estimated same as Lake "A" Dam) =	1,400 acre-feet
Total losses =	3,500 acre-feet
Balance: Average annual surplus =	4,200 acre-feet

The above summary illustrates that Lake "A" would not be able to maintain a full pool, while Lake "B" would have a surplus of 4,200 acre-feet if Lake "A" were filled to its planned level.

The seepage losses and gains listed in the summary are based on the assumption that the reservoirs would be filled to the planned elevations. Therefore, the computed seepage losses are maximum and would decrease with lower reservoir elevations. The inflow to Lake "B" from Lake "A" also would decrease with lower reservoir elevations at Lake "A". If Lake "B" were the only lake planned in the development, there would be a seepage loss from Lake "B" to Loon Creek. In that case, it is very unlikely that Lake "B" would be able to maintain its planned elevation.

An approximate reservoir-operation study was made to estimate how full Lake "A" would be with average inflow. During years of average inflow, Lake "A" probably would reach a maximum elevation of 972 feet in May and then recede until the following spring runoff period. The minimum elevation would be about 967 feet in the winter.

When the study was started, there was some concern that the water level in low lying areas adjacent to the reservoirs may be raised high enough to impair the area for some uses. The possible increase in the water table elevation, if the reservoirs were filled to their normal elevation, can be determined by observing the difference in the potentiometric surfaces between Figure 2 and Figure 3. It appears that the water table might be raised to a maximum of 20 feet in some areas immediately adjacent to Lake "A".



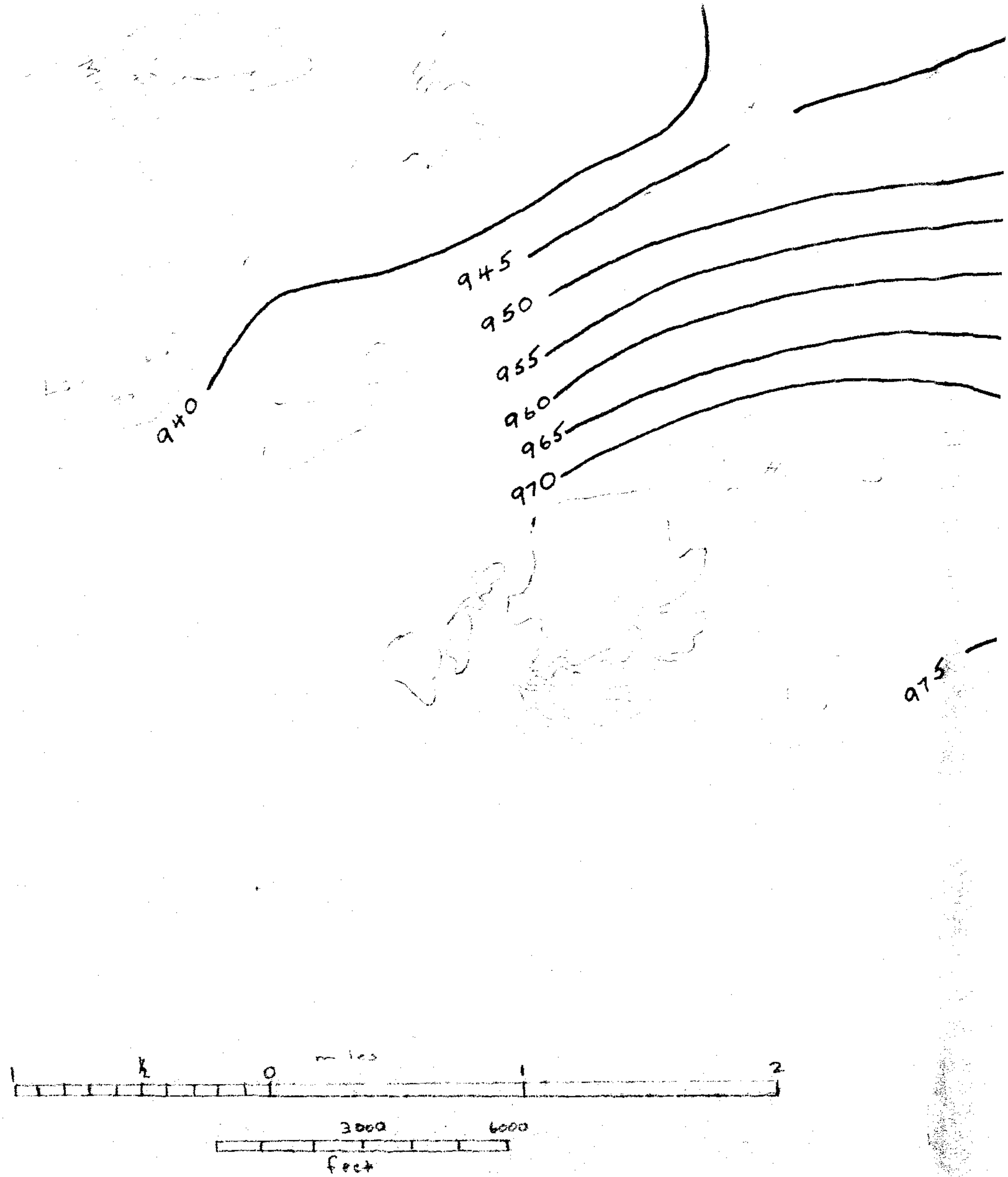
EXPLANATION

▲ E Streamflow measuring location and letter identification

O GS-3 Observation wells and number

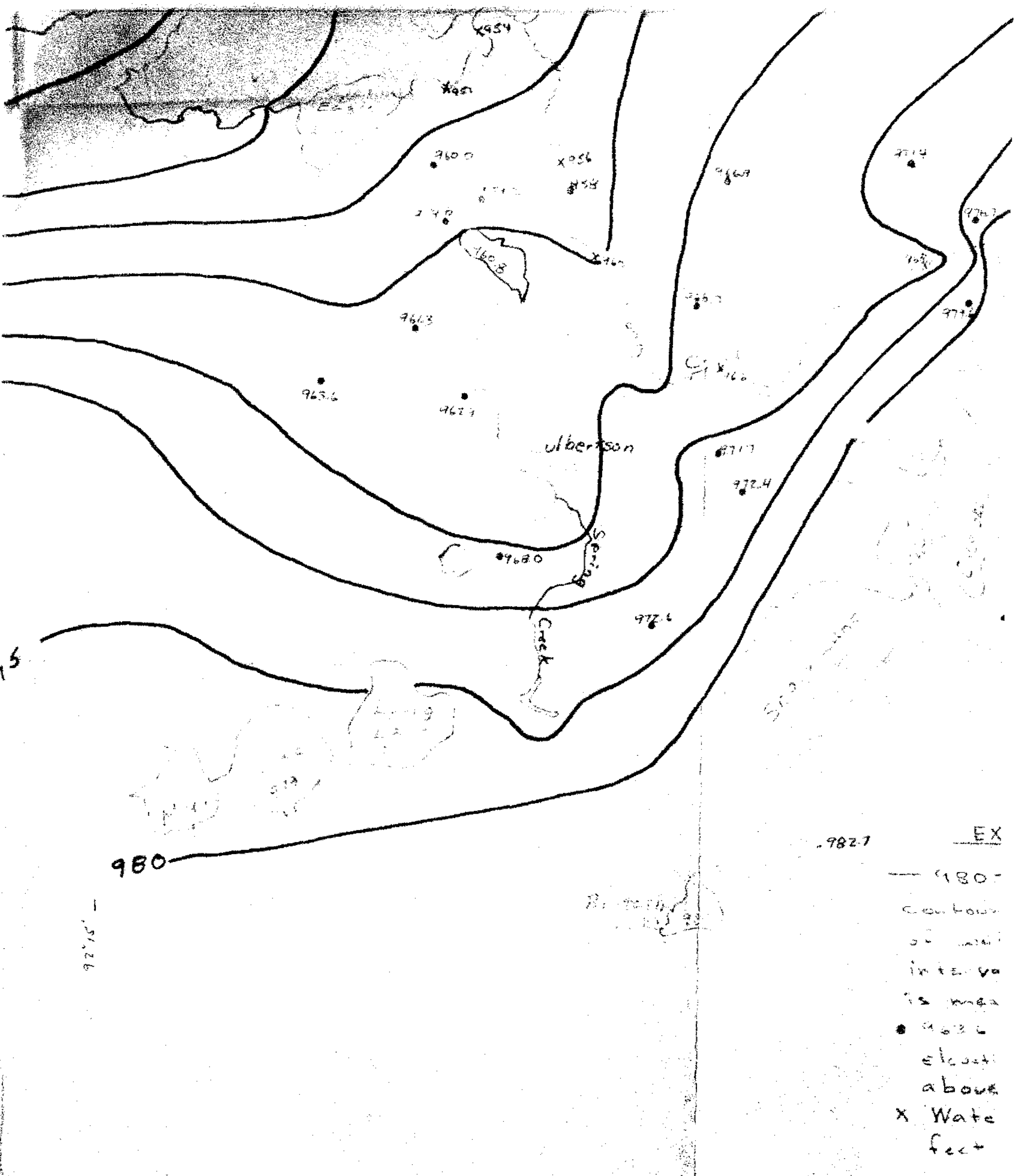
Figure 1.--Area map of Loon Creek

Base from U.S. Geological Survey Hertel quadrangle, 1955



POTENTIOMETI
OF THE ESTIMATEI

Base From U.S. Geological Survey Hertel 1956, Webb Lake 1955, Webster 195

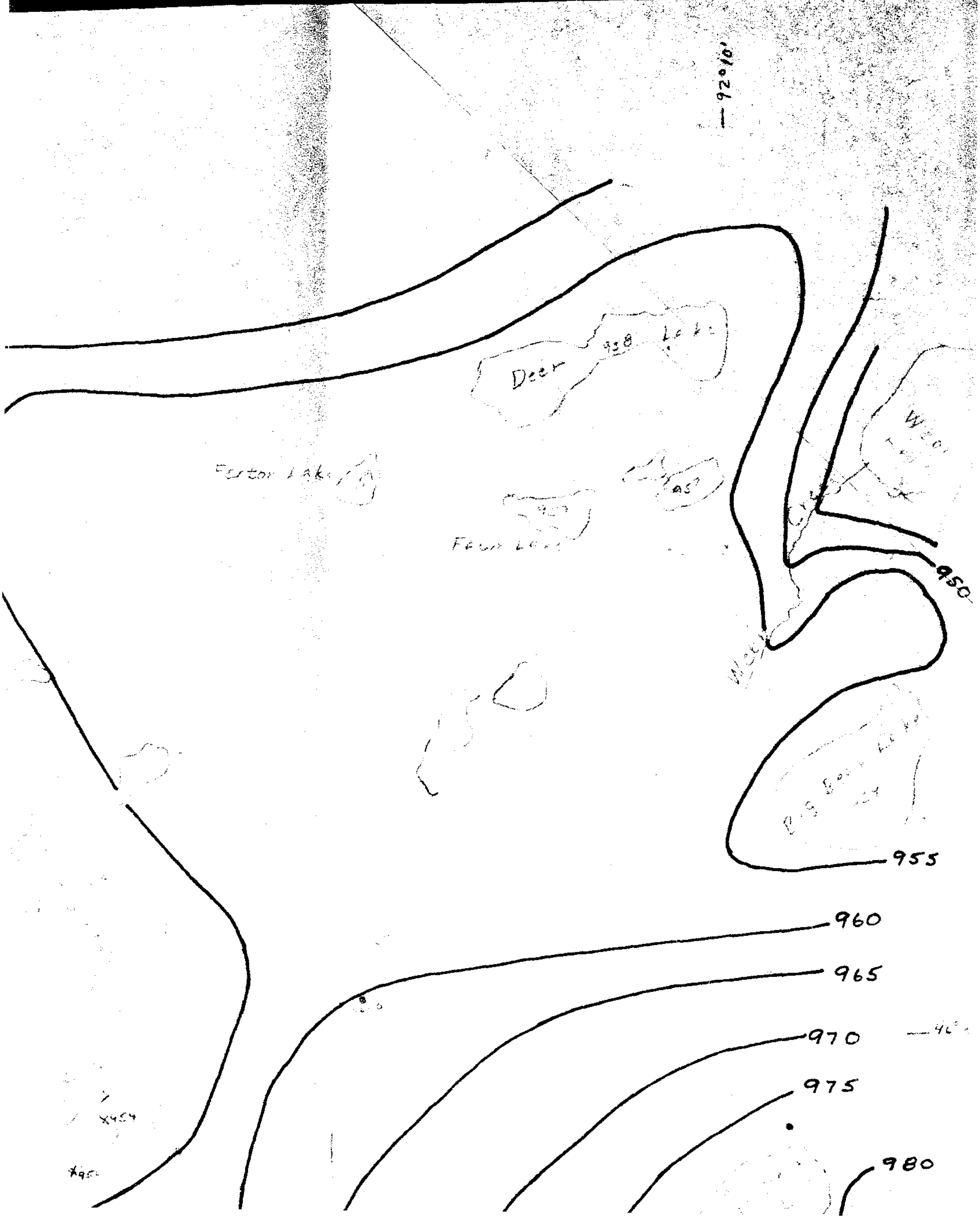


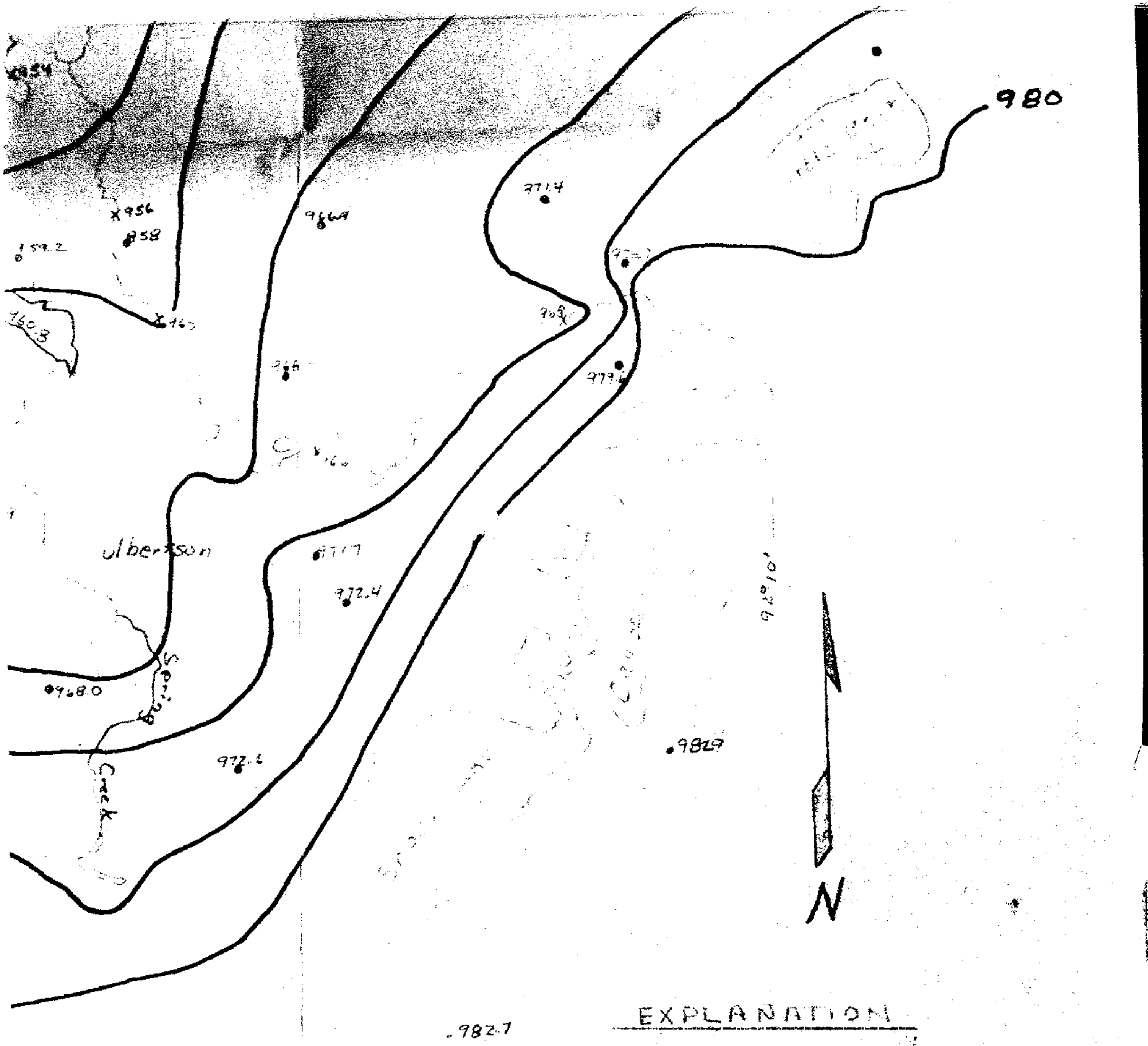
ETRIC MAP OF LOON CREEK AREA
ATED WATER TABLE FOR OCT. 21-23 1970

1962 quadrangles.

947
945
940
92°20'


92°15'
947


92°10'
Deer
958
950
955
960
965
970
975
980



EXPLANATION

—— 980 —— Potentiometric contour showing elevation of water table. Contour interval is 5 feet. Datum is mean sea level.

• 963.6 Observation well showing elevation of water table in feet above mean sea level.

X Water surface elevations in feet above mean sea level.

REEK AREA

OCT. 21-23 1970

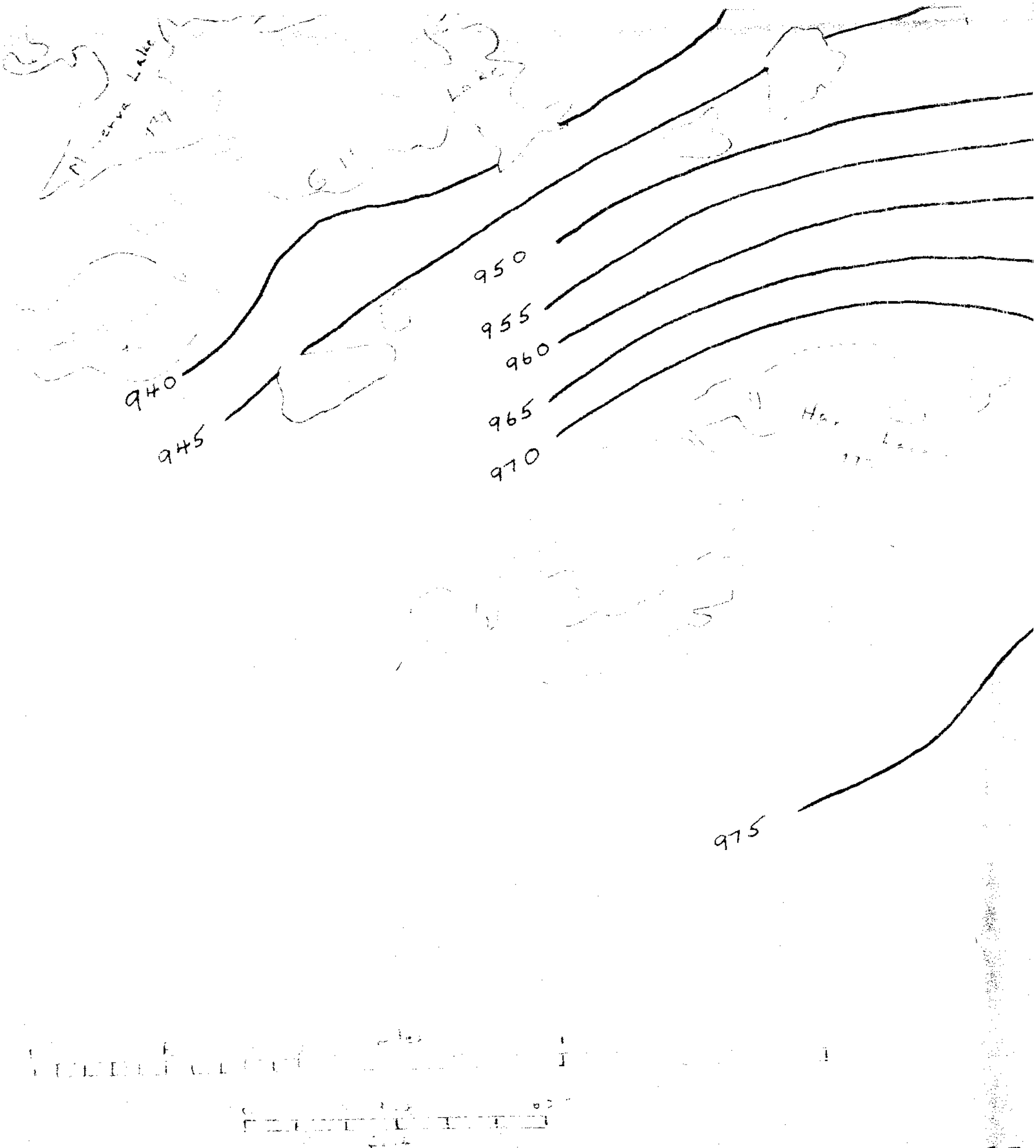
gles.

Figure 2

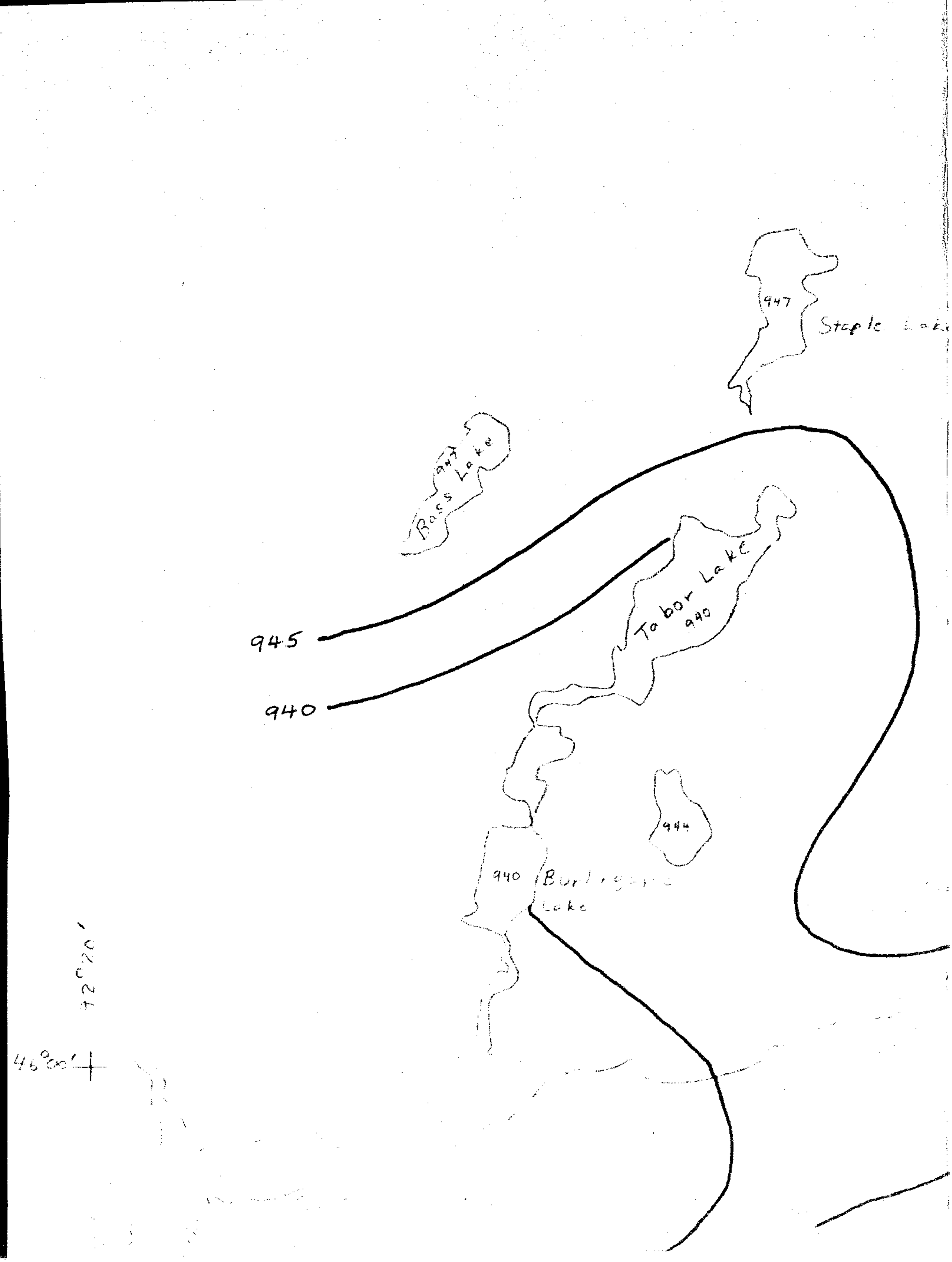
ESTIMATED
AT

Figure 3

OF LOON CREEK AREA SHOWING THE ESTIMATED
: WITH PROPOSED RESERVOIRS AT
AL OR PLANNED ELEVATIONS

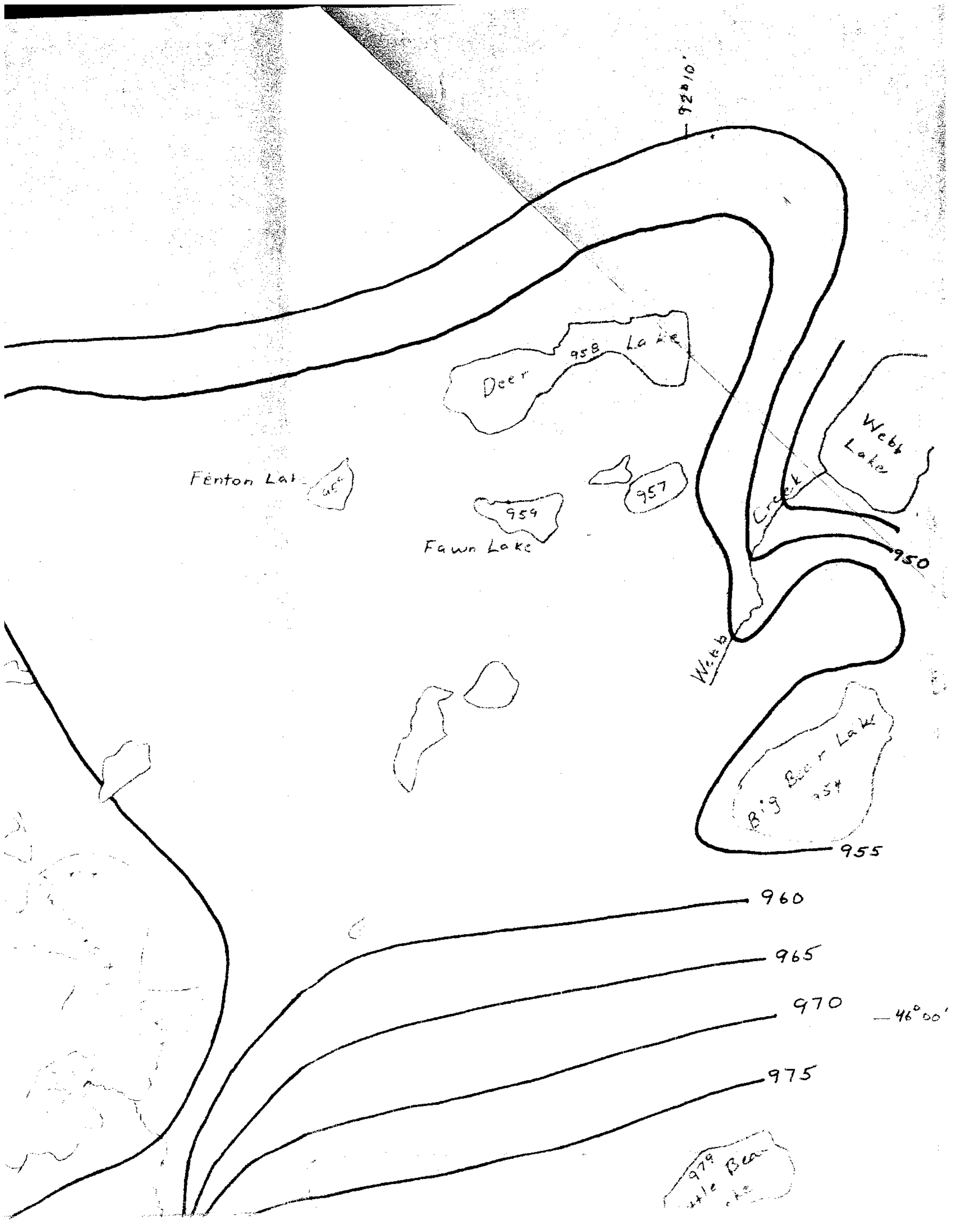


POTENTIOMETRIC MAP OF
WATER TABLE
NORMAL



947
Staple Lake
947
Bass Lake
Tabor Lake
940
945
940
944
940
Burlingame
Lake
72°20'
46°00'

92°15'
947
Staple Lake
Tabor Lake
940
944
Eagle Lake



92°10'
Deer
958
Lake
Fenton Lak
959
Fawn Lake
957
Webb
Lake
Creek
950
Webb
Big Bear Lake
955
960
965
970
46°00'
975
979

Table 1

UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
WATER RESOURCES DIVISION

File Number { Washington 5-3350.10 / District

Used rating table dated 10/29/70

Gage heights used to half tenths between ...... and ...... feet; hundredths below and tenths above these limits.

Gage Read to .... Once / Twice a Day by ....

Day	April Gage height	April Discharge	May Gage height	May Discharge	June Gage height	June Discharge	July Gage height	July Discharge	August Gage height	August Discharge	September Gage height	September Discharge	Day
1							3.62	6.8	3.61	6.5	3.58	5.6	1
2							3.59	5.9	3.59	5.9	3.63	7.0	2
3							3.56	5.2	3.57	5.4	3.68	8.4	3
4					3.64	7.3	3.57	5.4	3.58	5.6	3.64	7.3	4
5					3.64	7.3	3.57	5.4	3.57	5.4	3.63	7.0	5
6					3.65	7.6	3.57	5.4	3.56	5.2	3.63	7.0	6
7					3.65	7.6	3.57	5.4	3.60	6.2	3.61	6.5	7
8					3.63	7.0	3.69	8.6	3.88	13.1	3.58	5.6	8
9					3.62	6.8	3.64	7.3	3.71	9.1	3.59	5.9	9
10					3.62	6.8	3.60	6.2	3.66	7.9	3.66	7.9	10
11					3.59	5.9	3.59	5.9	3.64	7.3	3.63	7.0	11
12					3.60	6.2	3.57	5.4	3.61	6.5	3.60	6.2	12
13					3.72	9.4	3.60	6.2	3.60	6.2	3.59	5.9	13
14					3.66	7.9	3.64	7.3	3.58	5.6	3.61	6.5	14
15					3.66	7.9	3.60	6.2	3.68	8.4	3.75	10.2	15
16					3.89	13.2	3.58	5.6	3.66	7.9	3.69	8.6	16
17					3.81	11.7	3.56	5.2	3.64	7.3	3.69	8.6	17
18					3.73	9.6	3.56	5.2	3.63	7.0	3.67	8.1	18
19					3.70	8.9	3.58	5.6	3.63	7.0	3.65	7.6	19
20					3.67	8.1	3.58	5.6	3.61	6.5	3.65	7.6	20
21					3.65	7.6	3.56	5.2	3.61	6.5	3.65	7.6	21
22					3.61	6.5	3.57	5.4	3.63	7.0	3.61	6.5	22
23					3.59	5.9	3.57	5.4	3.63	7.0	3.60	6.0	23
24					3.58	5.6	3.57	5.4	3.62	6.8	3.66	7.9	24
25					3.61	6.5	3.57	5.4	3.61	6.5	3.68	8.4	25
26					3.73	9.6	3.56	5.2	3.61	6.5	3.69	8.6	26
27					3.69	8.6	3.60	6.2	3.59	5.9	3.64	7.3	27
28					3.65	7.6	3.60	6.2	3.58	5.6	3.60	6.2	28
29					3.64	7.3	3.65	7.6	3.58	5.6	3.59	5.9	29
30					3.63	7.0	3.66	7.9	3.58	5.6	3.58	5.6	30
31							3.64	7.3	3.56	5.2			31
						7.8		6.0		6.7		6.9	

9-192-a. July 1937

Daily Gage Height, in Feet, and Discharge, in Second-Feet, of Loon [redacted] Creek

Near Danbury June 4, 1970 through Nov. 5, 1970 **for** [redacted]

Drainage Area ______ **Square Miles. Water-Stage Recorder** ______ **Ratio** ______ :

Max. G. H. ______ ft. at ______ on ______ (G. H. ______ ft.) Max. Disch. ______ Sec.-ft. at ______ on ______

Min. G. H. ______ ft. on ______ (G. H. ______ ft.) Min. Disch. ______ Sec.-ft. on ______

Day	October 1970 Gage height	October 1970 Discharge	November Gage height	November Discharge	December Gage height	December Discharge	January Gage height	January Discharge	February Gage height	February Discharge	March Gage height	March Discharge
1	3.58	5.6	3.86	13								
2	3.58	5.6	3.82	12								
3	3.58	5.6	3.83	12								
4	3.58	5.6	3.81	12								
5	3.57	5.4	3.76	10								
6	3.59	5.9										
7	3.71	9.1										
8	4.24	17.5										
9	4.33	18.5										
10	4.21	17.2										
11	4.02	15										
12	3.93	14										
13	3.84	12										
14	3.77	11										
15	3.73	9.6										
16	3.70	8.9										
17	3.70	8.9										
18	3.69	8.6										
19	3.67	8.1										
20	3.67	8.1										
21	3.66	7.9										
22	3.65	7.6										
23	3.66	7.9										
24	3.74	9.9										
25	3.73	9.6										
26	3.77	11										
27	4.01	15										
28	3.92	14										
29	3.84	12										
30	3.83	12										
31	3.85	13										
Total												
Mean		10.3										
Second-feet per square mile												
Run-off in inches												
Run-off in acre-feet												

Calendar year

Table 2.--Discharge of Loon Creek and Spring Creek During Seepage run July 8, 1970

Site		Discharge (cubic feet per second)
A	Loon Creek	0.73
B	Loon Creek	1.42
C	Loon Creek	2.35
D	Loon Creek	3.54
E	Spring Creek	1.90
F	Spring Creek	2.08
G	Spring Creek	3.11
H	Spring Creek	3.92
I	Loon Creek	7.70 Gaging Station
J	Loon Creek	7.02
K	Tributary	0.09
L	Loon Creek	15.3

Location of each site shown by letter designation on figure 1.

Table 3.--Discharge of Loon Creek and Spring Creek

	Site				
Date	"E" Spring Creek at Loon Lake Road (cfs)	"C" Loon Creek at Loon Lake Road (cfs)	"I" Loon Creek at gaging station (cfs)	"J" Loon Creek upstream from Eagle Lake (cfs)	"L" Loon Creek downstream from Eagle Lake (cfs)
5/25/70	4.51	4.67	12.0	-	-
6/ 3/70	2.70	4.31	10.5	-	-
6/22/70	-	-	7.74	-	-
7/ 8/70	1.90	2.35	7.70	7.02	15.3
8/10/70	2.09	2.31	7.45	-	12.5
9/11/70	2.36	2.69	5.93	7.27	9.11
10/ 9/70	5.27	6.85	18.0	-	-
11/ 6/70	2.66	3.23	8.43	-	-

Location of each site shown by letter designation on figure 1.

9-220 c
(Oct. 1951)

Table 4

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
WATER RESOURCES DIVISION

Sheet ______ of ______ Sheets

Estimated
Monthly and annual discharge, in cfs, of Loon Creek XXXXX near Danbury
[Drainage area, ______ square miles]

10—26489-6 U.S. GOVERNMENT PRINTING OFFICE

Water Year	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Annual	MEAN
1964	4.3**	4.3**	3.7**	3.7**	3.7**	4.6**	11.2**	19.0**	6.6**	6.4*	6.8*	8.6*	82.9	6.9
1965	7.1*	4.6**	3.7**	3.7**	3.7**	4.6**	23.0**	20.0*	10.2*	9.8*	7.5*	9.5*	107.4	8.9
1966	9.9*	6.1**	10.0**	6.5**	6.5**	14.5**	18.0**	9.7*	8.3*	7.7*	7.7*	6.9*	111.8	9.3
1967	9.4**	7.0**	5.9**	6.1**	6.1**	6.5**	21.5*	9.1*	15.5*	7.4*	7.5*	7.1*	109.1	9.1
1968	8.9*	7.0**	5.9**	5.4**	4.8**	13.6*	10.2*	9.4*	11.5*	14.9*	8.9*	9.5*	110.0	9.2
1969	13.5*	11.5**	9.9**	10.2**	9.4**	12.5*	27.0**	16.5**	8.9*	8.8*	7.5*	7.6*	143.0	11.9
1970	9.8*	8.1**	7.2**	6.4**	5.7**	7.1**	10.1*	8.9*	7.8	6.0	6.7	6.9	91.2	7.6
Total	62.9	48.6	46.3	42.0	39.9	63.4	121.0	92.6	68.8	61.0	52.6	56.1	755.4	63.2
Mean	9.0	6.9	6.6	6.0	5.7	9.0	17.3	13.2	9.8	8.7	7.5	8.0	107.8	9.0
Estimated Inflow to Lake "A"														
Mean	4.5	3.4	3.3	3.0	2.8	4.5	8.6	6.6	4.9	4.4	3.8	4.0	53.9	4.5
Estimated Inflow to Lake "B"														
Mean	4.5	3.5	3.3	3.0	2.8	4.5	8.7	6.6	4.9	4.3	3.7	4.0	53.9	4.5

* Estimated by correlation with recorded discharge at Bashaw Brook near Shell Lake

** Estimated by correlation with recorded discharge at Namekagon River near Trego

Mean	4.5	3.4	3.3	3.0	2.8	4.5	8.6	6.6	4.9	4.4	3.8	4.0	53.9	4.5
Estimated Inflow to Lake "B"														
Mean	4.5	3.5	3.3	3.0	2.8	4.5	8.7	6.6	4.9	4.3	3.7	4.0	53.9	4.5

* Estimated by correlation with recorded discharge at Bashaw Brook near Shell Lake

** Estimated by correlation with recorded discharge at Namekagon River near Trego

Table 5.--Loon Creek Area - Ground-Water Levels

Well Number	Elevation of top of casing (feet) above mean sea level	Date Oct. 23, 1970 Water Level (feet) below land surface	above mean sea level	Nov. 6, 1970 Water Level (feet below land surface	above mean sea level
GS 1	964.62	4.64	959.98	-	-
GS 3	966.78	7.20	959.58	-	-
GS 4	1,024.73	61.80	962.93	61.72	963.01
GS 5	1,018.51	46.10	972.41	-	-
GS 6	992.52	12.81	979.71	-	-
GS 7	971.07	9.97	961.10	-	-
GS 9	984.97	21.38	963.59	21.29	963.68

Location of each well shown on figure 1.