UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

FLOOD OF JUNE 27, 1975 IN CITY OF AMES, IOWA

Prepared in cooperation with the
HIGHWAY RESEARCH BOARD
HIGHWAY DIVISION
IOWA DEPARTMENT OF TRANSPORTATION

Open-file Report
76-128
Iowa City, Iowa
October 1976

ERRATA

Please make the following corrections.

Page	Line	Reads	Should Read
6	28 (footnote)	...summarized in figures 1 and 2,...	summarized in figure 2
19	4	Interstate 25	U.S. Highway 30
	19	July 17, 1975	July 16, 17, 1975 and Sept. 22, 1975
20	Top of figure 12	MATCH LINE FIGURE 6	MATCH LINE FIGURE 13
21	Bottom of figure 13	MATCH LINE FIGURE 5	MATCH LINE FIGURE 12
38	Figure 20	Because of poor legibility the information in figure 20 is reprinted here for reference.	Region I $M = 0.712 + 0.701 \log A + 0.472 \log S + 0.754 \log (P-20)$ $s = 0.915 - 0.0393 \log A - 0.466 \log (P-20)$ $g = -0.40$ Region II $M = -1.410 + 0.786 \log A + 0.241 \log S + 2.623 \log (P-20)$ $s = 1.849 - 0.0408 \log A - 1.442 \log (P-20)$ $g = -0.50$
39	7 (table 8 15 (table 8 footnote)	(from figure 13) Regional skew determined from figure 13.	(from figure 20, Region II) Regional skew determined from figure 20.
40	12	1.6 larger than Q_{100}	1.6 times Q_{100}
	13	1.1 larger than Q_{100}	1.1 times Q_{100}
48	15	Maxima for period of record	Maxima for period of record prior to 1975
51	13	Maxima for period of record	Maxima for period of record prior to 1975

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CONTENTS

TABLES

ILLUSTRATIONS

The following factors may be used to convert the English units published herein to the International System of Units (SI).

Multiply English units	By	To obtain SI units
	-Length-	
inches (in)	25.4	millimeters (mm)
feet (ft)	.3048	meters (m)
miles (mi)	1.609	kilometers (km)
	-Area-	
acres	4,047	square meters (m^2)
square miles (mi^2)	2.590	square kilometers (km^2)
	-Volume-	
gallons (gal)	0.003785	cubic meters (m^3)
cubic feet (ft^3)	.02832	cubic meters (m^3)
cfs-day (ft^3/s-day)	2,447	cubic meters (m^3)
acre-feet (acre-ft)	1,233	cubic meters (m^3)
	-Flow-	
cubic feet per second (ft^3/s)	0.02832	cubic meters per second (m^3/s)
	28.32	cubic decimeters per second (dm^3/s)

FLOOD OF JUNE 27, 1975, IN CITY OF AMES, IOWA

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ABSTRACT

On June 27, 1975, the city of Ames and vicinity sustained severe flooding from Squaw Creek and the South Skunk River. The storm which preceded the flood was not particularly outstanding in its intensity or duration. However, antecedent conditions plus the timing and direction of the storm were "ideally tuned" to cause the flood.

In terms of magnitude of discharge as well as of damages this was the most severe flood on record, with losses estimated by city and Iowa State University officials at over a million dollars. The most unfortunate loss involved the drowning of a young person.

The peak discharge at the Squaw Creek station, 206 mi^2 (534 km^2), was measured at 11,300 ft^3/s (320 m^3/s), which is 1.6 times the 100-year flood. The South Skunk River above the confluence with Squaw Creek, 315 mi^2 (816 km^2), peaked at 5,330 ft^3/s (151 m^3/s). The recurrence interval of this discharge is 6.0 years. The peak discharge on the South Skunk River below the confluence with Squaw Creek, 556 mi^2 (1440 km^2), was 14,700 ft^3/s (416 m^3/s), which is 1.1 times the 100-year flood.

INTRODUCTION

Purpose and scope

On June 27, 1975, parts of the city of Ames and the Iowa State University campus experienced severe flooding frcm Squaw Creek and the South Skunk River. Data collected at gaging stations in the area indicated that peak discharges exceeded previously recorded maxima. In terms of magnitude of discharge as well as of damages, it was probably the most severe flood since at least 1918, which is the earliest flood on record.

Because of the record-breaking proportions of this flood, the streamflow records collected in this vicinity during the flood are of great importance in regard to current studies being made for the development of the area. This is especially true with respect to projects in which volumes of flood flow, rates of flood discharge, and peak stages are essential considerations.

The purpose of this report is to summarize and evaluate all of the information that has been collected pertaining to this flood. The report includes records of stages and discharges during the flood period, a discussion of the meteorologic and hydrologic aspects of the event, some aerial photographs showing the flooded areas, inundation maps, flood-elevation profiles, a discussion of flood frequencies, a brief resume of past floods, and other pertinent data.

The location of the study area is shown in figure 1.

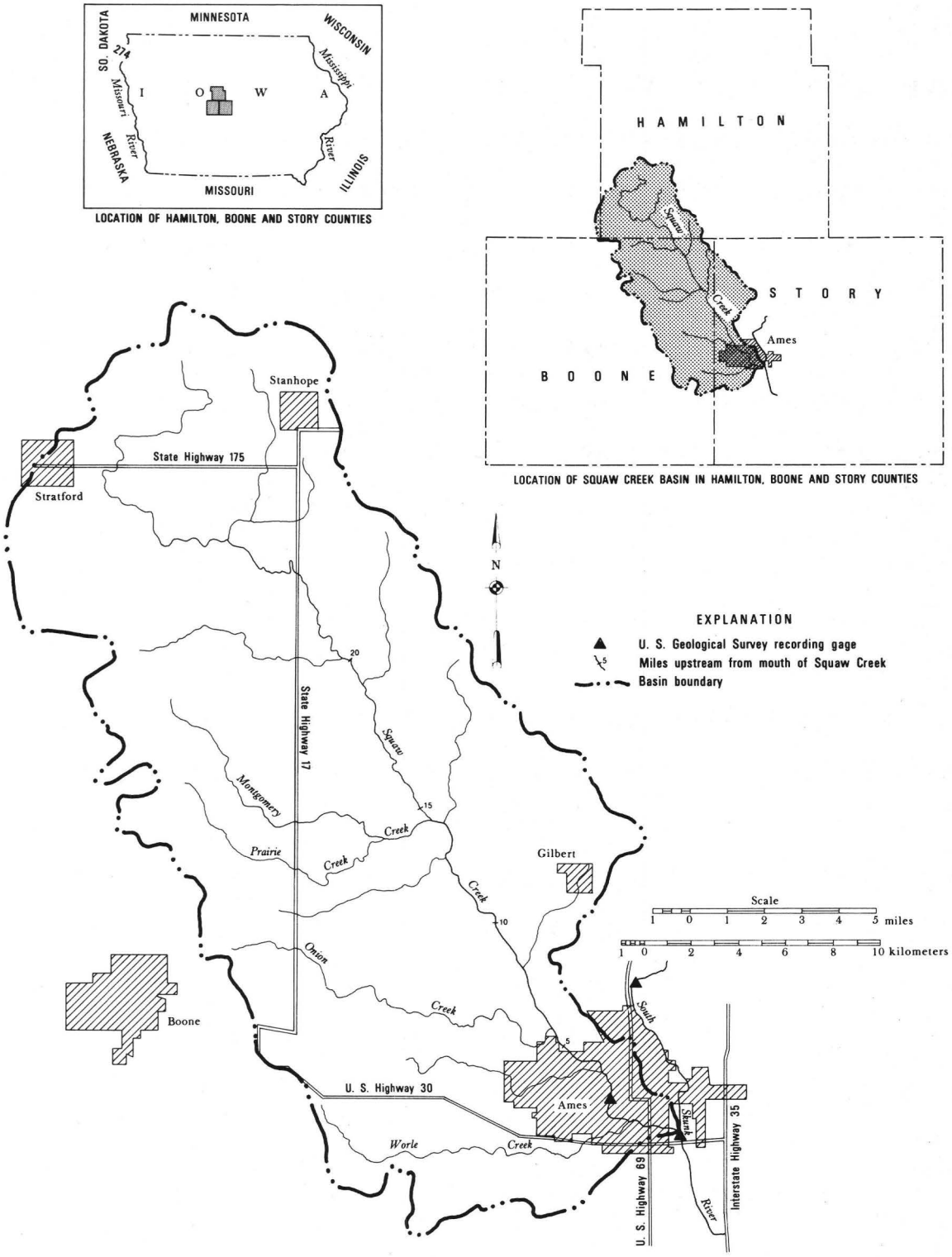

Figure 1. Map of Squaw Creek basin.

Acknowledgments

This report was prepared as part of a cooperative program between the Highway Research Board, Highway Division, Iowa Department of Transportation, and the U.S. Geological Survey. The Iowa Geological Survey, Iowa State University and the city of Ames cooperate with the U.S. Geological Survey in the operation of the gaging stations in the area. Acknowledgment is made to the U.S. Army Corps of Engineers, Rock Island District, for supplying the results of a rainfall "bucket" survey of the area and to the National Weather Service for supplying radar charts and other rainfall information. The base map used in preparing the inundation maps was furnished by the city of Ames.

FLOOD OF JUNE 27, 1975

Precipitation

Table 1 (written commun., M. D. Dougal, 1975) indicates that June 1975 was an abnormally wet period in this general area, with a total precipitation in excess of 13.0 inches (330 mm) recorded during the month. As shown in the table, heavy rains fell over the basin with unusual regularity, saturating the soil to capacity. During the week preceding the flood, rains came about every other day. Data collected by the National Weather Service at other nearby stations indicate that the amount of rainfall accumulated during some of these showers were, at times, larger than the amounts accumulated during the 24 hours preceding this flood.

Table 1.--June precipitation in the Ames-Squaw Creek area, in inches

Date	Ames Water Treatment Plant[1]					Ames Water Pollution control plant[2]	Dougal residence[3]	Fibikar Farm[4]
	2400-0600	0600-1200	1200-1800	1800-2400	for day			
1	0.04	0.02	----	----	0.06	0.04	----	----
2	----	----	0.50	0.45	0.95	0.68	1.25	1.2
3	----	----	----	----	----	0.24	0.13	----
4	0.20	0.01	----	----	0.21	----	----	0.4
5	----	----	----	----	----	----	----	----
6	----	----	----	----	----	----	----	----
7	----	----	----	----	----	----	----	----
8	----	----	----	----	----	1.15	----	----
9	0.64	0.68	0.01	----	1.33	0.26	1.25	1.0
10	----	----	----	0.01	0.01	0.33	----	----
11	0.32	0.23	----	0.06	0.61	0.16	0.75	
12	----	----	0.02	----	0.02	0.05	----	1.4
13	----	----	----	----	----	----	----	----
14	----	0.10	1.70	0.01	1.81	2.28	0.95	0.3
15	----	----	----	----	----	0.14	----	----
16	----	0.46	0.06	----	0.52	1.05	0.41	0.5
17	0.83	----	----	----	0.83	0.34	0.53	
18	----	1.30	0.01	----	1.31	1.33	1.15	0.9
19	----	----	----	----	----	----	----	----
20	----	----	----	----	----	----	----	----
21	----	----	----	0.61	0.61	0.87	0.75	----
22	0.32	----	----	----	0.32	----	----	0.8
23	----	----	0.01	0.44	0.45	0.41	0.50	0.7
24	----	----	----	----	----	1.21[5]	1.20[6]	----
25	1.58	0.04	----	----	1.62	Trace	----	2.6[8]
26	----	----	0.09	2.29	2.38	2.12	2.56[7]	3.3[9]
27	----	----	----	----	----	----	----	----
28	----	----	----	----	----	----	----	----
29	----	----	----	----	----	----	----	----
30	----	----	----	----	----	----	----	----
Total	3.93	2.84	2.40	3.87	13.04	12.66	11.43	13.1

[1] Located at East Fifth and Crawford, near municipal power plant, standard eight-inch non-recording gage.

[2] Located 1/4 mile southeast from intersection of South Duff Ave. with U.S. 30 Bypass, standard eight-inch non-recording gage.

[3] Located at 2704 Kellogg Avenue, east of North Grand Shopping Center, six inch capacity tapered plastic rain gage, 2 in. by 2 in. beveled square opening.

[4] Located in upper part of Squaw Creek basin, S 1/2, SW 1/4, Sec. 12, T83N, R26 W., Dodge Twp., Boone County, fencepost type.

[5] All daily precipitation amounts received at the pollution control plant are reported as of the day prior to the 0800 hours reading. The 1.21 inches was received during the 24 hours prior to 0800 hours of the 25th.

[6] The 1.20 inches was received between late afternoon of the 24th and morning of the 25th, but recorded as of the 24th.

[7] About 0.16 inch received in afternoon shower, remaining 2.40 inches fell between 2100 and 2200 hours on the 26th.

[8] The 2.6 inches was received early morning, June 25th.

[9] Most of the 3.3 inches fell between 2030 and 2200 hours.

In fact, the storm which preceded the flood was not really outstanding in its intensity or duration. However, the prevailing antecedent conditions, plus the timing and the direction with which the showers moved into the basin, were "ideally tuned" to produce the flood.

The following describes briefly the antecedent conditions and the weather events which culminated in the flood of June 27.[1]

During the late hours of June 25 and early hours of the 26th, both the Squaw Creek and the South Skunk River were flowing at bankfull stage or higher as a result of heavy showers which occurred between 0100 and 0600 hours on the 25th. Data indicate that the peak discharge from this storm was reached about noon on the 26th at both the Squaw Creek and South Skunk River gaging stations. At about 1230 hours on the 26th a line of showers with core intensities ranging from 0.5 to 1.0 inches (12.7 to 25.4 mm) per hour began moving toward the Squaw Creek basin. These showers, approaching from the west and traveling in a predominantly easterly direction, crossed the basin in about 1-1/2 hours, from 1330 to 1500 hours (figure 2).

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[1] The data on which this account is based were collected by the National Weather Service and the U.S. Geological Survey. The weather data consist of a series of radar screen images taken at half hour intervals during the 24 hours preceding the flood. From these charts it was possible to determine the general direction and traverse of the storm, the location of the cores, and the rate of rainfall from these cores. The information from these radar charts have been schematically summarized in figures 1 and 2, which include an outline of the Squaw Creek basin. In the figures, each band depicts the approximate location of the raining cores at the indicated times. The intensity of rainfall from these cores ranged from 0.5 to 1.0 inch per hour (or more).

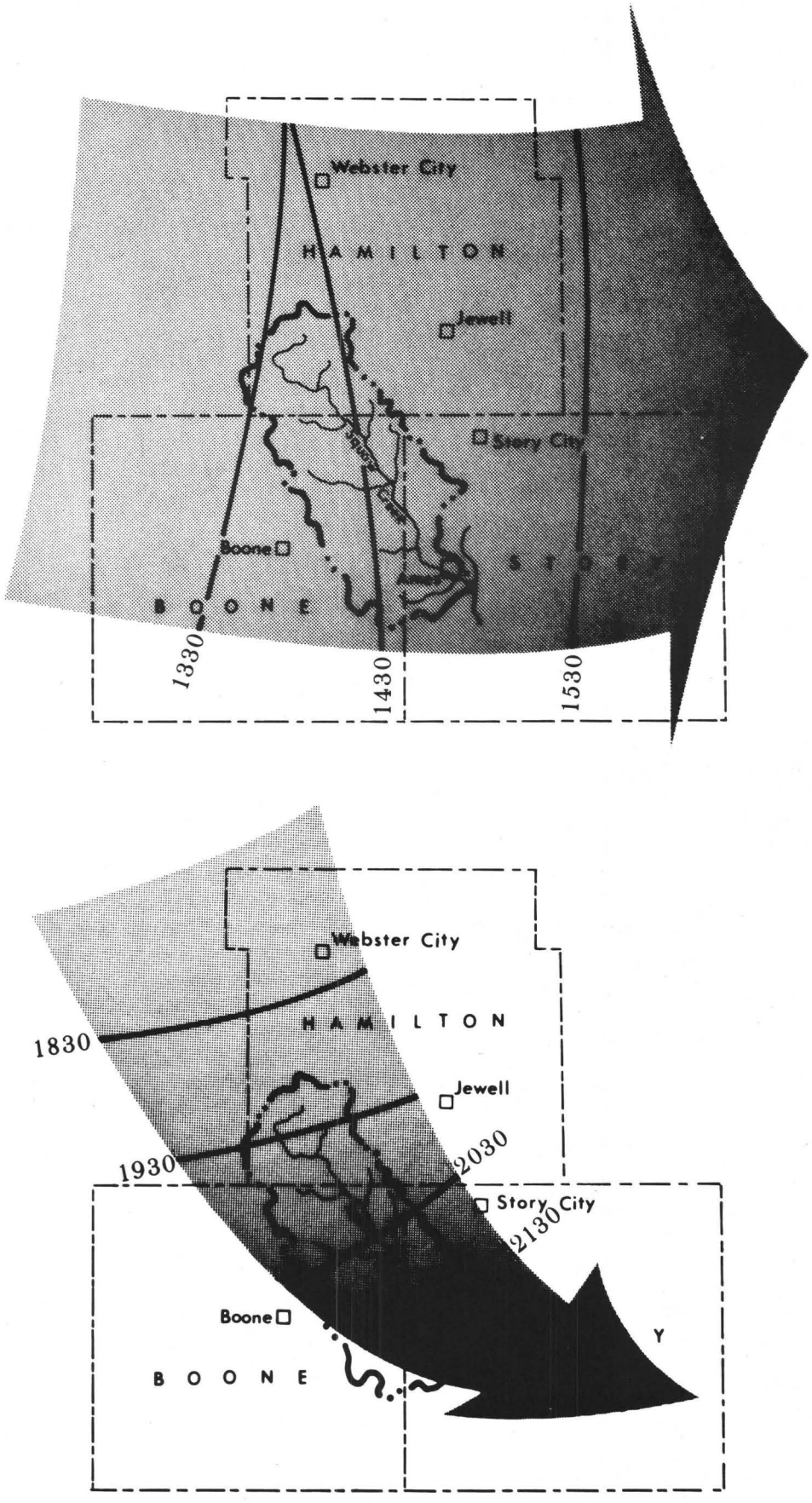

Figure 2. Direction and approximate location of storms at the indicated times on June 26.

This storm alone would have caused significant flooding in this area. However, a few hours later another line of showers approached the basin from the northwest, moving in a predominantly southeasterly direction on a path almost parallel to the main stem of Squaw Creek, and traveled down the basin in about 3 hours (figure 2). The rainfall intensities from the cores ranged from 0.5 to over 1.0 inch (12.7 to 25.4 mm) per hour.

Flood damages

Long-time residents in the area recognize this flood as the most severe in memory, since at least 1918. The most unfortunate and irreparable loss involved the drowning of a young person whose body was found within the Iowa State University grounds near Squaw Creek.

City and University officials estimated the damages in excess of a million dollars. This includes more than $300,000 damages to Iowa State University, $500,000 to Ames businesses, and $200,000 to dwellings. In addition, many hundreds of acres of crops were lost on the flood plains along the streams outside Ames including the wide valley reach extending from Ames to Oskaloosa, Iowa.

The extent to which this area was affected by the flood is illustrated by a number of aerial photographs taken at or near the time of the peak. Captions for each photo describe the vicinity and the time at which the picture was taken.

Figure 3. Flooding in vicinity of confluence of Squaw Creek with South Skunk River upstream of U.S. Highway 30. 1521 hours.

Figure 4. Squaw Creek flooding between South Duff and Walnut Avenues. 1428 hours.

Figure 5. Squaw Creek flooding between Chicago and Northwestern Railway and South Fourth Street. 1428 hours.

Figure 6. Squaw Creek flooding between South Fourth Street and Lincoln Way. 1427 hours.

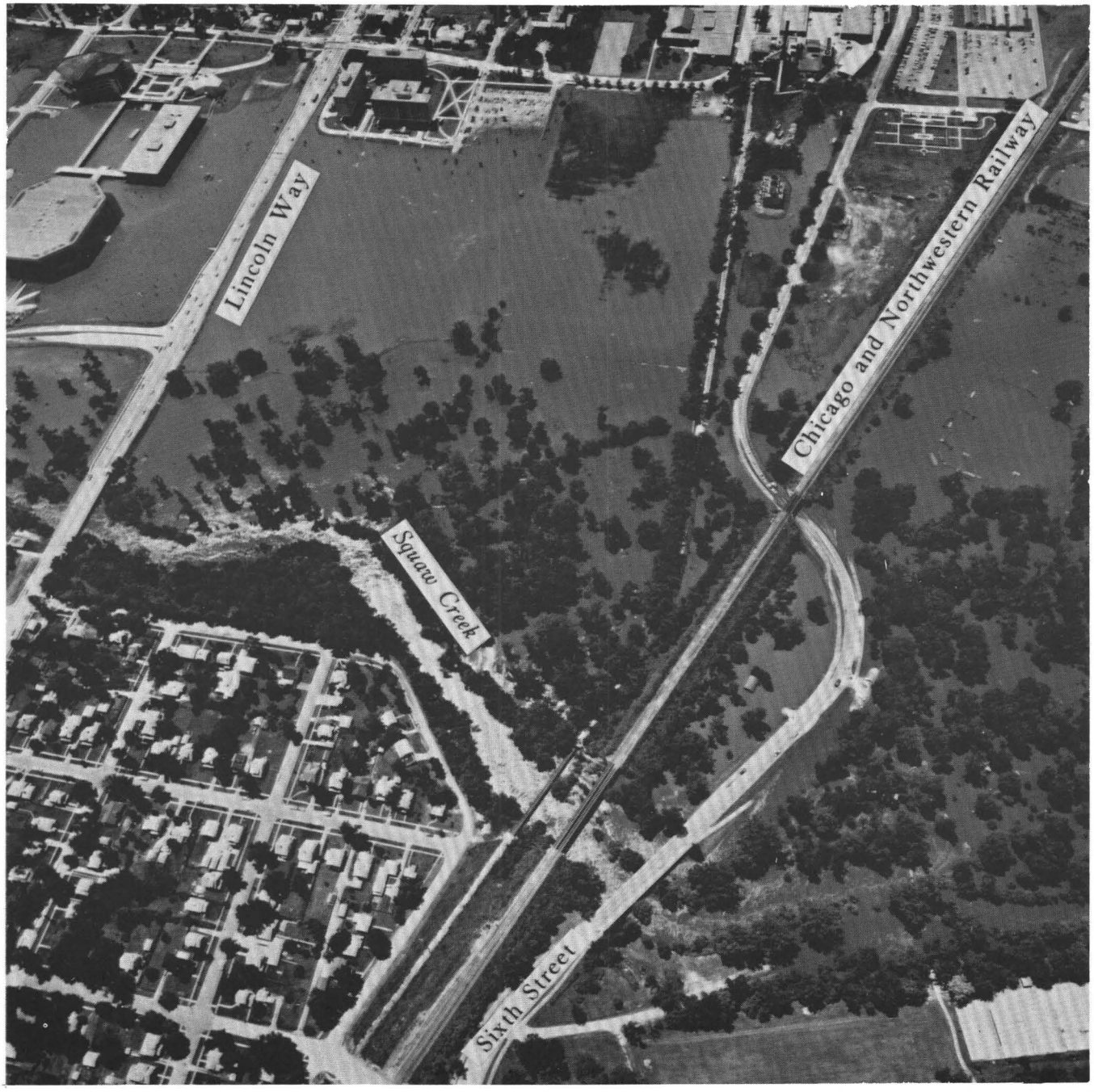

Figure 7. Squaw Creek flooding between Lincoln Way and Sixth Street. 1426 hours.

Figure 8. Squaw Creek flooding between Sixth Street and Thirteenth Street. 1426 hours.

Figure 9. Squaw Creek flooding in vicinity and upstream of Stange Road.

Flood stages and discharges

This section describes briefly the hydrologic information collected by the U.S. Geological Survey during the flood. Records of stage and discharge are presented for the following gaging stations located in the flood area.

05470000 South Skunk River near Ames, Iowa
05470500 Squaw Creek at Ames, Iowa
05471000 South Skunk River below Squaw Creek near Ames, Iowa

Discharge at a gaging station is determined usually by development of a stage-discharge relation from current-meter measurements made at various stages and application of this relation to records of stage. The records of stage for this report were obtained from water-stage recorder installations that provide a continuous graphic or punch-tape record. The information presented for each gaging station consists of a station description, a rating table which shows the relation between the stage and discharge, a tabulation of the mean daily discharges for the month of June, a tabulation of stage and discharge at selected time intervals for the flood period, and a tabulation of annual peaks recorded at each site during the period of record. In addition, the station description contains information such as the location and datum of the gage, size of the drainage area above the gage, and other pertinent information. All of these data are presented in Table 10.

Stage and discharge data at selected time intervals are shown in figures 10 and 11.

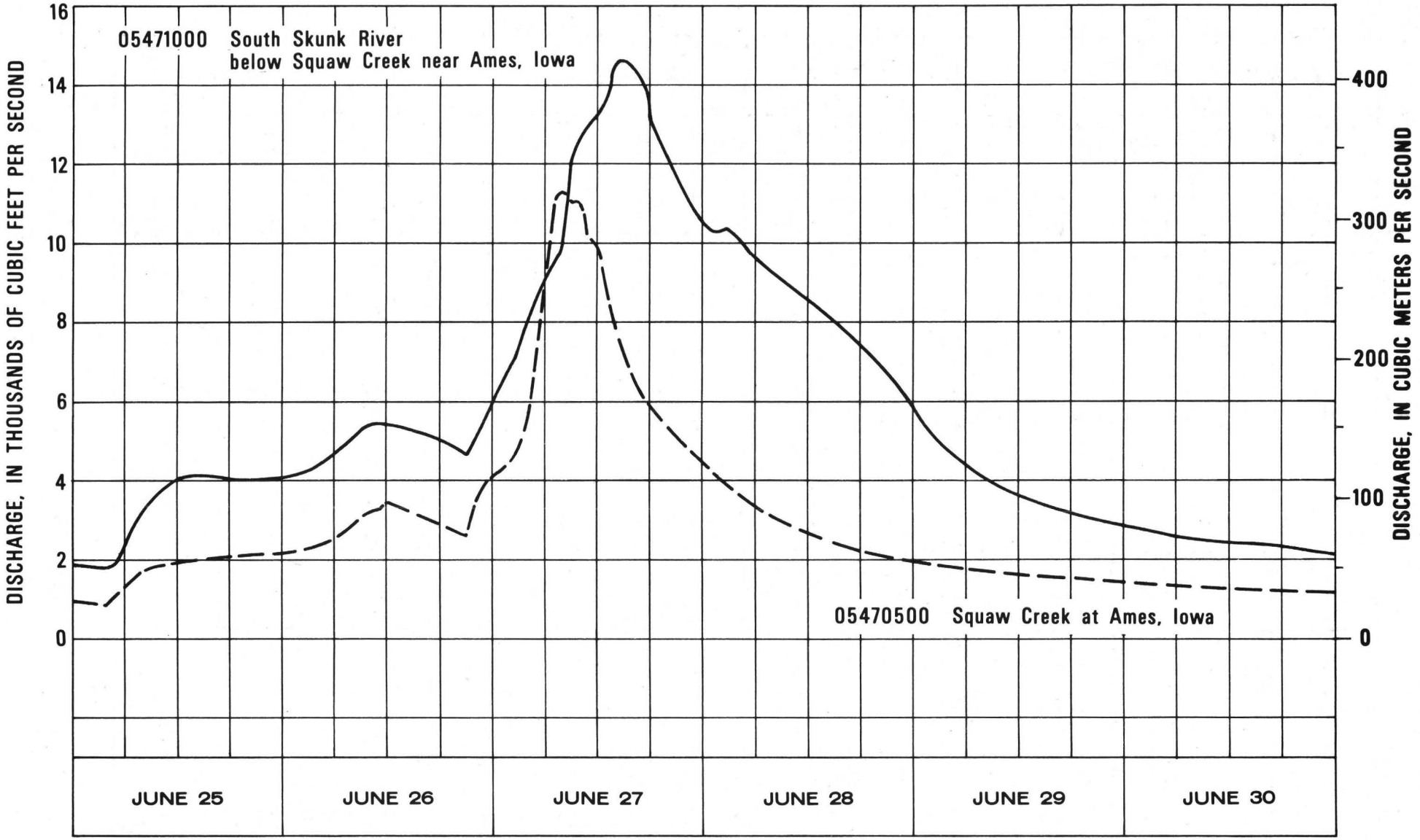

Figure 10. Discharge graphs for flood of June 1975, at the indicated gaging stations.

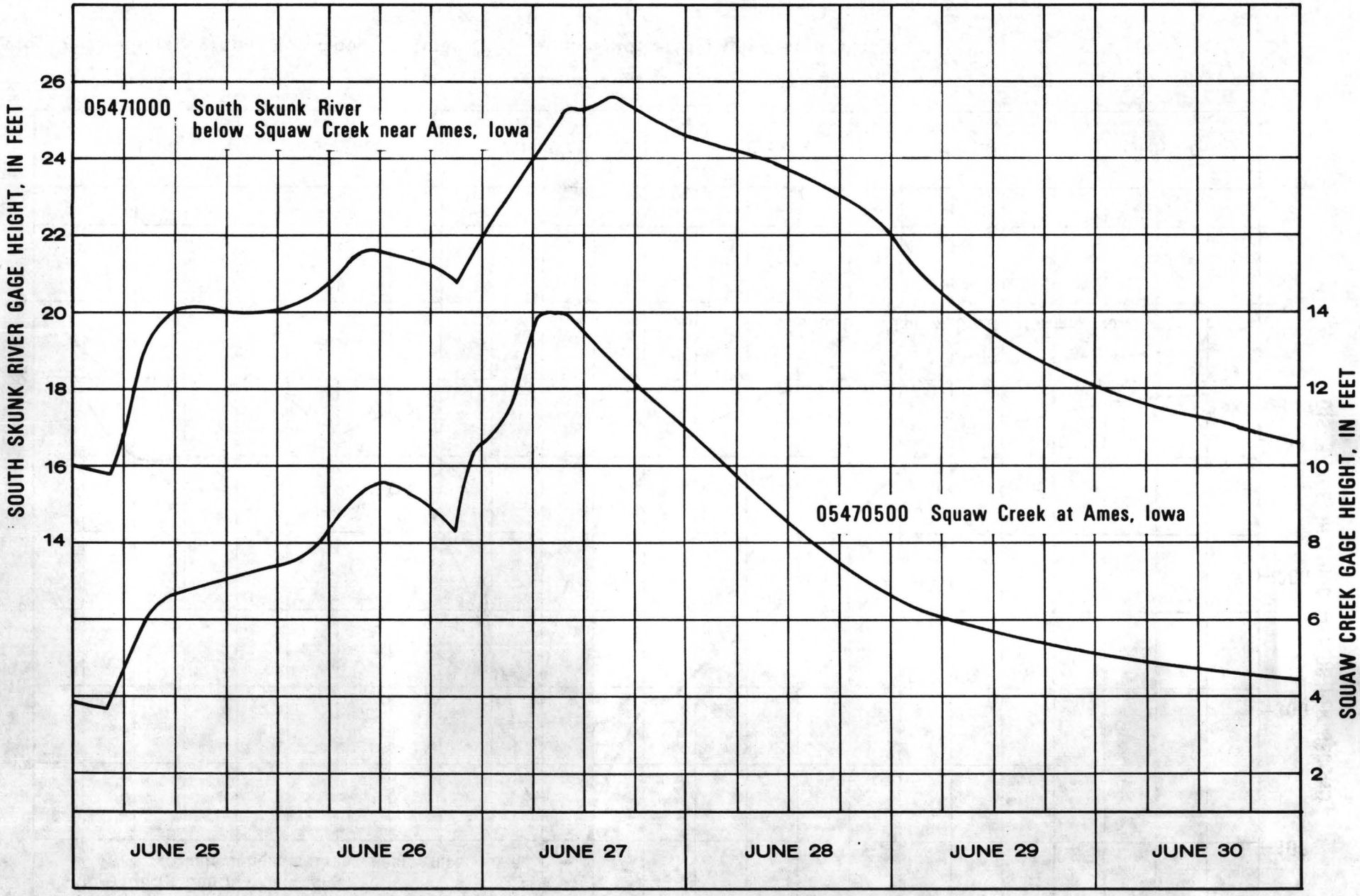

Figure 11. Stage graphs for flood of June 1975, at the indicated gaging stations.

Flood inundation

An outline of the inundated areas is shown in figures 12 and 13. The reach covered in these figures extends from about 1.3 miles (2.09 km) south of Interstate 35 on the South Skunk River to about 2 miles (3.22 km) upstream from Stange Road on Squaw Creek.

Flood profiles

Flood-crest elevations for the June 27, 1975, flood on Squaw Creek and the South Skunk River were obtained at the upstream and the downstream sides of all bridges in the Ames area. Flood-elevation profiles based on these elevations are shown in figures 14 and 15. The reach covered on the Squaw Creek profile is from the mouth up to Stange Road. The reach covered on the South Skunk River profile is from the Interstate 35 Bridge to the U.S. Geological Survey gaging station 5.2 miles (8.37 km) upstream from the mouth of Squaw Creek. The profile for the South Skunk River upstream from Squaw Creek is of a smaller flood which did not crest until a day after the Squaw Creek flood. Also shown for comparison are low-water profiles for July 17, 1975.

FLOOD FREQUENCIES

Admittedly, the following discussion on flood frequencies introduces more detail than is usually warranted for this type of report. However, important decisions in long-range planning and flood plain management are currently being made based on the

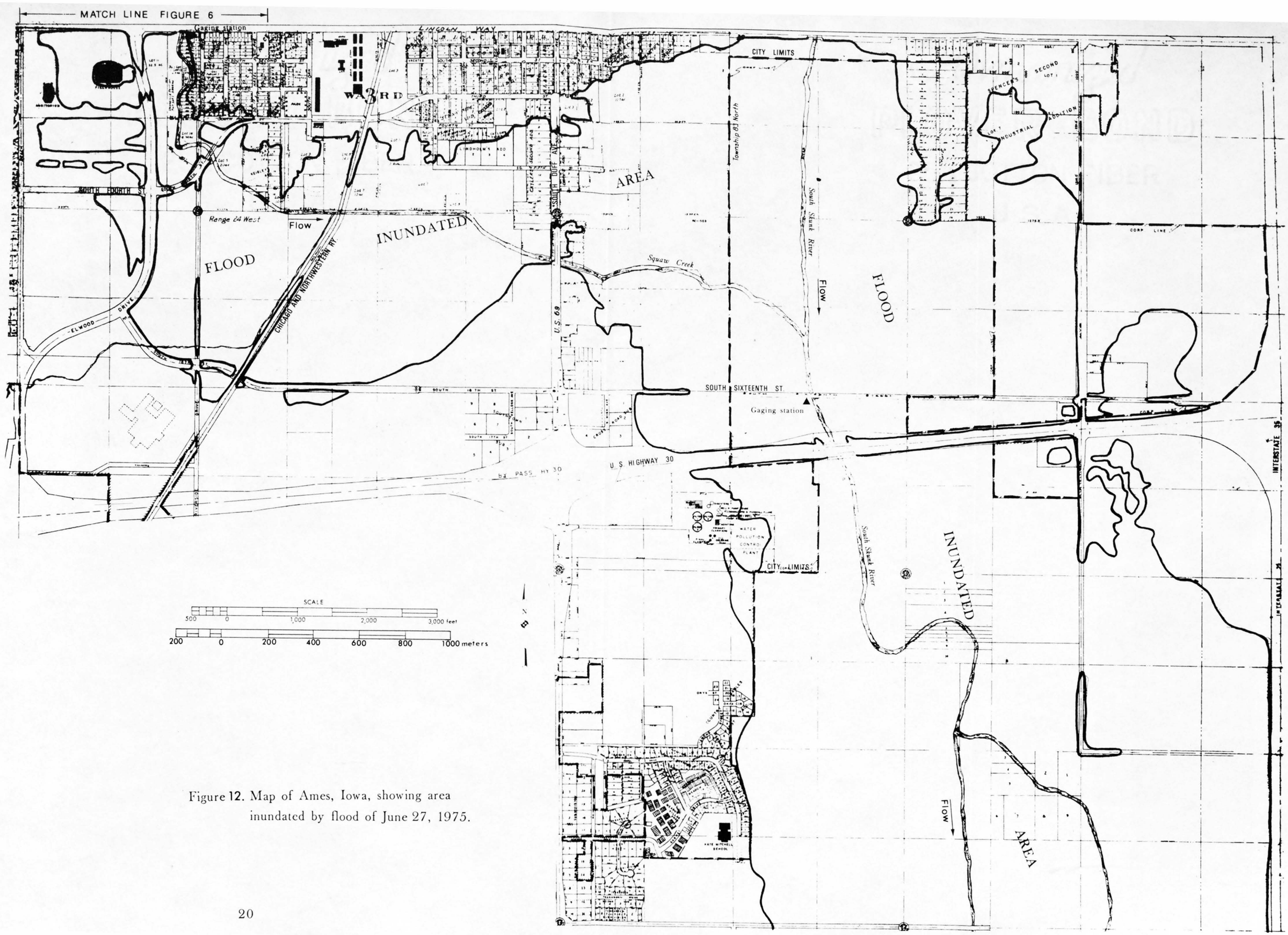

Figure 12. Map of Ames, Iowa, showing area inundated by flood of June 27, 1975.

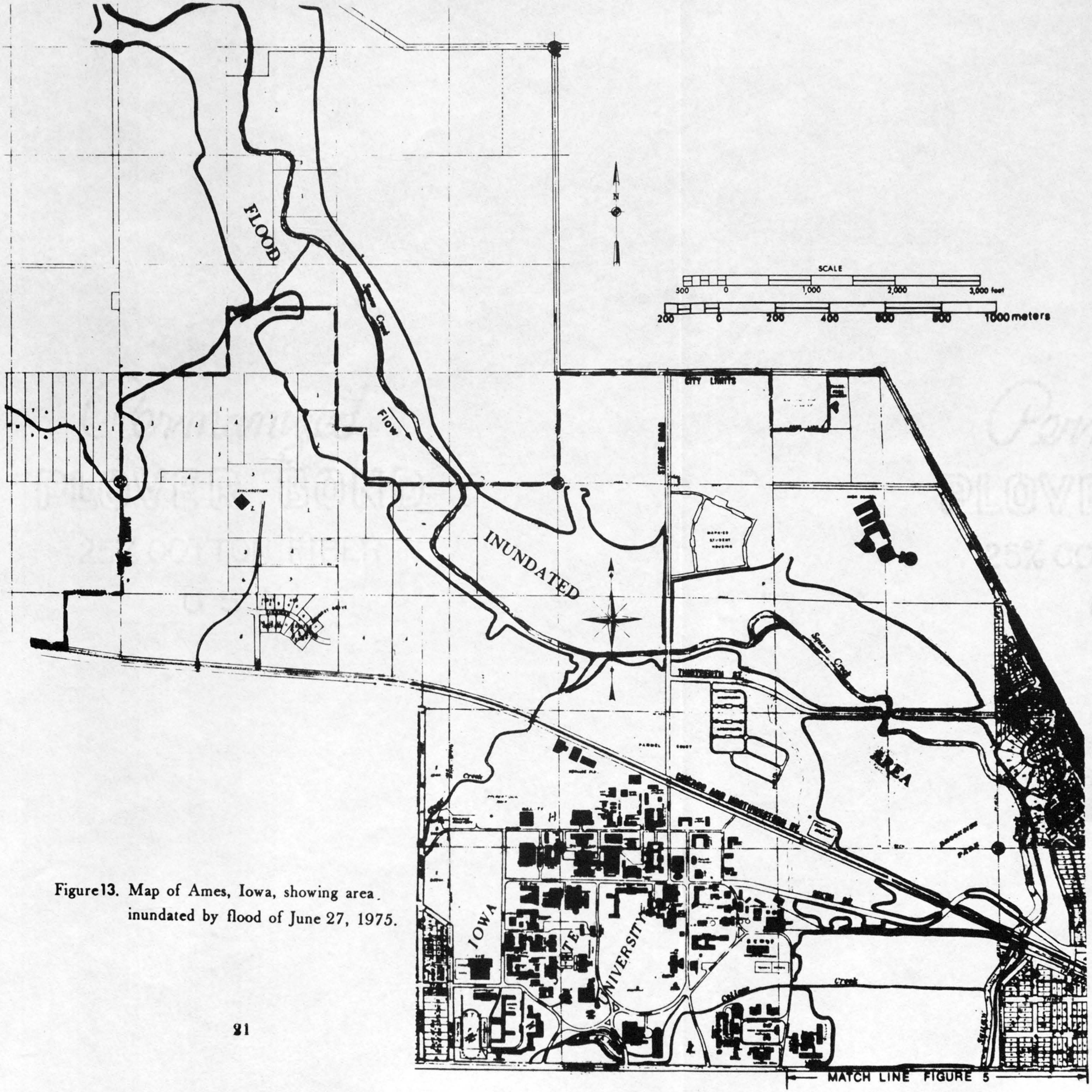

Figure 13. Map of Ames, Iowa, showing area inundated by flood of June 27, 1975.

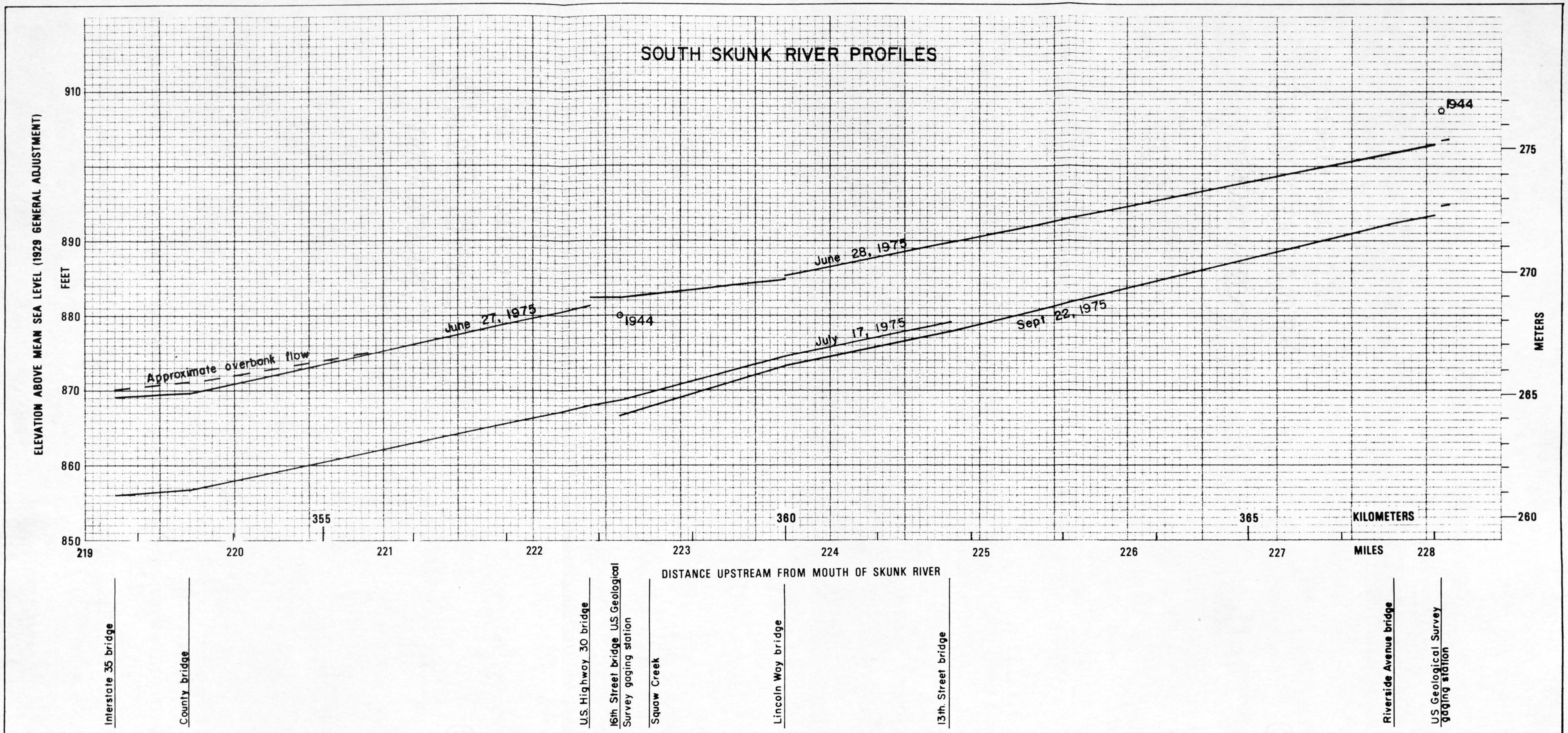

Figure 14. South Skunk River near Ames, Iowa, profiles.

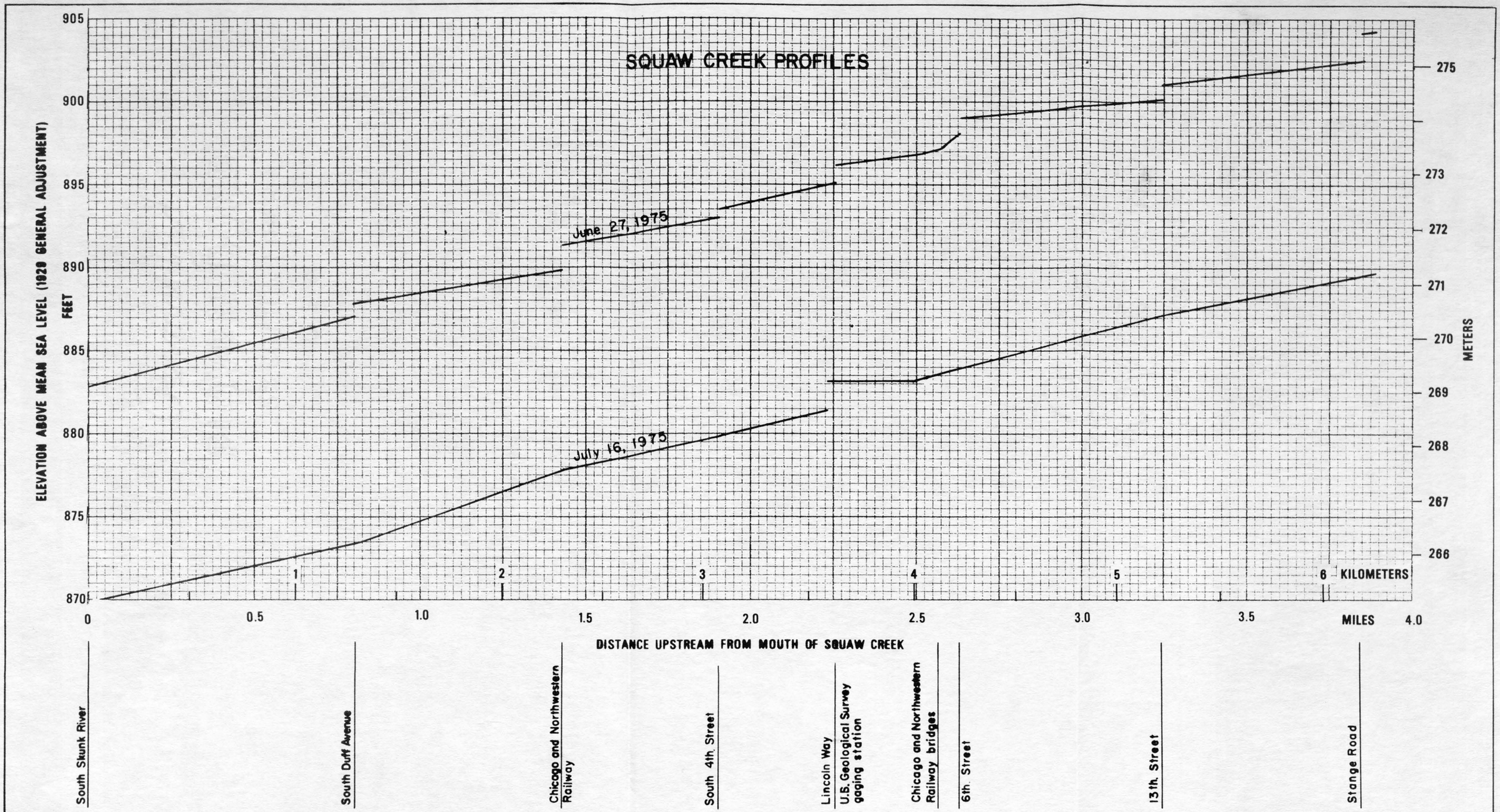

Figure 15. Squaw Creek at Ames, Iowa, profiles.

magnitude and probability of occurrence of the 1975 flood. Consequently, it is felt that the users of this report should be made aware of the "state of the art" at this point, and should be informed of the methods and assumptions under which the flood event in June 1975 has been evaluated.

It is common practice to refer to the flood which is expected to reoccur on the average of, say, once in 50 years, as the 50-year flood. In the past this practice gave some readers a false impression of security by being misinterpreted as the flood which "will occur 50 years from now." Instead it must be kept in mind that the proper concept of a 50-year flood is a flood of such magnitude that the odds are 1 in 50 that it will be equaled or exceeded within any given year. For this reason it is sometimes more convenient and often less confusing to use probability of occurrence in percent rather than the recurrence interval in years. The relation between these two terms is defined by the following expression:

$$P = 100/t \qquad (1)$$

where:

P is the probability of occurrence in percent

t is the recurrence interval in years, which in turn is defined as:

$$t = (n + 1)/m \qquad (2)$$

where:

n is the number of years of record and m is the rank of the event, m = 1 for the largest event in the array, and m = n for the smallest event.

In the following paragraphs, the probability of occurrence of the 1975 peak discharges at each gaging station will be evaluated based on the recorded data and by comparing the results to regional solutions.

Station frequency curves

On the recommendation of the Water Resources Council (1976), a Federal Interagency group, most federal and state agencies have adopted a uniform procedure for flood-frequency analysis, at sites where records of annual peak discharges are available.

The basic method recommended by the council involves the fitting of a Pearson type III distribution to the logarithms of the annual peak discharges at the gaged site. The mechanics of the method involves the computation of the mean (M), standard deviation (s), and the coefficient of skew (g) of the logarithms. These statistics are then used tc compute peak discharges for specific probabilities of occurrence by using the following formula:

$$\log Q_t = M + K_{gt}s \qquad (3)$$

where:

Q_t is the flood discharge corresponding to the recurrence interval (t) in years.

K_{gt} is the Pearson type III distribution variate corresponding to the skew (g) and recurrence interval (t). Values for the variates are found in tables prepared for this purpose by Harter (1969). Condensed versions cf these tables are shown in tables 2 and 3.

Table 2.--K values for positive skew coefficients

Skew Coefficient (g)	Recurrence Interval in Years: 1.0101	1.0526	1.1111	1.2500	2	5	10	25	50	100	200
	Percent Chance: 99	95	90	80	50	20	10	4	2	1	0.5
3.0	-0.667	-0.665	-0.660	-0.636	-0.396	0.420	1.180	2.278	3.152	4.051	4.970
2.9	-0.690	-0.688	-0.681	-0.651	-0.390	0.440	1.195	2.277	3.134	4.013	4.909
2.8	-0.714	-0.711	-0.702	-0.666	-0.384	0.460	1.210	2.275	3.114	3.973	4.847
2.7	-0.740	-0.736	-0.724	-0.681	-0.376	0.479	1.224	2.272	3.093	3.932	4.783
2.6	-0.769	-0.762	-0.747	-0.696	-0.368	0.499	1.238	2.267	3.071	3.889	4.718
2.5	-0.799	-0.790	-0.771	-0.711	-0.360	0.518	1.250	2.262	3.048	3.845	4.652
2.4	-0.832	-0.819	-0.795	-0.725	-0.351	0.537	1.262	2.256	3.023	3.800	4.584
2.3	-0.867	-0.850	-0.819	-0.739	-0.341	0.555	1.274	2.248	2.997	3.753	4.515
2.2	-0.905	-0.882	-0.844	-0.752	-0.330	0.574	1.284	2.240	2.970	3.705	4.444
2.1	-0.946	-0.914	-0.869	-0.765	-0.319	0.592	1.294	2.230	2.942	3.656	4.372
2.0	-0.990	-0.949	-0.895	-0.777	-0.307	0.609	1.302	2.219	2.912	3.605	4.298
1.9	-1.037	-0.984	-0.920	-0.788	-0.294	0.627	1.310	2.207	2.881	3.553	4.223
1.8	-1.087	-1.020	-0.945	-0.799	-0.282	0.643	1.318	2.193	2.848	3.499	4.147
1.7	-1.140	-1.056	-0.970	-0.808	-0.268	0.660	1.324	2.179	2.815	3.444	4.069
1.6	-1.197	-1.093	-0.994	-0.817	-0.254	0.675	1.329	2.163	2.780	3.388	3.990
1.5	-1.256	-1.131	-1.018	-0.825	-0.240	0.690	1.333	2.146	2.743	3.330	3.910
1.4	-1.318	-1.168	-1.041	-0.832	-0.225	0.705	1.337	2.128	2.706	3.271	3.828
1.3	-1.383	-1.206	-1.064	-0.838	-0.210	0.719	1.339	2.108	2.666	3.211	3.745
1.2	-1.449	-1.243	-1.086	-0.844	-0.195	0.732	1.340	2.087	2.626	3.149	3.661
1.1	-1.518	-1.280	-1.107	-0.848	-0.180	0.745	1.341	2.066	2.585	3.087	3.575
1.0	-1.588	-1.317	-1.128	-0.852	-0.164	0.758	1.340	2.043	2.542	3.022	3.489
.9	-1.660	-1.353	-1.147	-0.854	-0.148	0.769	1.339	2.018	2.498	2.957	3.401
.8	-1.733	-1.388	-1.166	-0.856	-0.132	0.780	1.336	1.993	2.453	2.891	3.312
.7	-1.806	-1.423	-1.183	-0.857	-0.116	0.790	1.333	1.967	2.407	2.824	3.223
.6	-1.880	-1.458	-1.200	-0.857	-0.099	0.800	1.328	1.939	2.359	2.755	3.132
.5	-1.955	-1.491	-1.216	-0.856	-0.083	0.808	1.323	1.910	2.311	2.686	3.041
.4	-2.029	-1.524	-1.231	-0.855	-0.066	0.816	1.317	1.880	2.261	2.615	2.949
.3	-2.104	-1.555	-1.245	-0.853	-0.050	0.824	1.309	1.849	2.211	2.544	2.856
.2	-2.178	-1.586	-1.258	-0.850	-0.033	0.830	1.301	1.818	2.159	2.472	2.763
.1	-2.252	-1.616	-1.270	-0.846	-0.017	0.836	1.292	1.785	2.107	2.400	2.670
0	-2.326	-1.645	-1.282	-0.842	0	0.842	1.282	1.751	2.054	2.326	2.576

Table 3.--K values for negative skew coefficients

Skew Coefficient (g)	Recurrence Interval in Years: 1.0101	1.0526	1.1111	1.2500	2	5	10	25	50	100	200
	Percent Chance: 99	95	90	80	50	20	10	4	2	1	0.5
0	-2.326	-1.645	-1.282	-0.842	0	0.842	1.282	1.751	2.054	2.326	2.576
- .1	-2.400	-1.673	-1.292	-0.836	0.017	0.846	1.270	1.716	2.000	2.252	2.482
- .2	-2.472	-1.700	-1.301	-0.830	0.033	0.850	1.258	1.680	1.945	2.178	2.388
- .3	-2.544	-1.726	-1.309	-0.824	0.050	0.853	1.245	1.643	1.890	2.104	2.294
- .4	-2.615	-1.750	-1.317	-0.816	0.066	0.855	1.231	1.606	1.834	2.029	2.201
- .5	-2.686	-1.774	-1.323	-0.808	0.083	0.856	1.216	1.567	1.777	1.955	2.108
- .6	-2.755	-1.797	-1.328	-0.800	0.099	0.857	1.200	1.528	1.720	1.880	2.016
- .7	-2.824	-1.819	-1.333	-0.790	0.116	0.857	1.183	1.488	1.663	1.806	1.926
- .8	-2.891	-1.839	-1.336	-0.780	0.132	0.856	1.166	1.448	1.606	1.733	1.837
- .9	-2.957	-1.858	-1.339	-0.769	0.148	0.854	1.147	1.407	1.549	1.660	1.749
-1.0	-3.022	-1.877	-1.340	-0.758	0.164	0.852	1.128	1.366	1.492	1.588	1.664
-1.1	-3.087	-1.894	-1.341	-0.745	0.180	0.848	1.107	1.324	1.435	1.518	1.581
-1.2	-3.149	-1.910	-1.340	-0.732	0.195	0.844	1.086	1.282	1.379	1.449	1.501
-1.3	-3.211	-1.925	-1.339	-0.719	0.210	0.838	1.064	1.240	1.324	1.383	1.424
-1.4	-3.271	-1.938	-1.337	-0.705	0.225	0.832	1.041	1.198	1.270	1.318	1.351
-1.5	-3.330	-1.951	-1.333	-0.690	0.240	0.825	1.018	1.157	1.217	1.256	1.282
-1.6	-3.388	-1.962	-1.329	-0.675	0.254	0.817	0.994	1.116	1.166	1.197	1.216
-1.7	-3.444	-1.972	-1.324	-0.660	0.268	0.808	0.970	1.075	1.116	1.140	1.155
-1.8	-3.499	-1.981	-1.318	-0.643	0.282	0.799	0.945	1.035	1.069	1.087	1.097
-1.9	-3.553	-1.989	-1.310	-0.627	0.294	0.788	0.920	0.996	1.023	1.037	1.044
-2.0	-3.605	-1.996	-1.302	-0.609	0.307	0.777	0.895	0.959	0.980	0.990	0.995
-2.1	-3.656	-2.001	-1.294	-0.592	0.319	0.765	0.869	0.923	0.939	0.946	0.949
-2.2	-3.705	-2.006	-1.284	-0.574	0.330	0.752	0.844	0.888	0.900	0.905	0.907
-2.3	-3.753	-2.009	-1.274	-0.555	0.341	0.739	0.819	0.855	0.864	0.867	0.869
-2.4	-3.800	-2.011	-1.262	-0.537	0.351	0.725	0.795	0.823	0.830	0.832	0.833
-2.5	-3.845	-2.012	-1.250	-0.518	0.360	0.711	0.771	0.793	0.798	0.799	0.800
-2.6	-3.889	-2.013	-1.238	-0.499	0.368	0.696	0.747	0.764	0.768	0.769	0.769
-2.7	-3.932	-2.012	-1.224	-0.479	0.376	0.681	0.724	0.738	0.740	0.740	0.741
-2.8	-3.973	-2.010	-1.210	-0.460	0.384	0.666	0.702	0.712	0.714	0.714	0.714
-2.9	-4.013	-2.007	-1.195	-0.440	0.390	0.651	0.681	0.683	0.689	0.690	0.690
-3.0	-4.051	-2.003	-1.180	-0.420	0.396	0.636	0.660	0.666	0.666	0.667	0.667

The record of annual peak discharges at a site is only a small sample of the parent population of peak discharges at that site. Therefore, the distribution of the recorded peaks may not be representative of the true parent population, and consequently, the computed mean, standard deviation, and coefficient of skew are only estimates of the population statistics. It follows that these estimates are subject to time sampling errors. This is particularly true with the estimate of the coefficient of skew, which is extremely sensitive, not only to the length of record but to the presence of extreme events. Thus it is difficult to obtain reliable estimates from small samples. For this reason it has been recommended that the skew coefficient computed from the sample be replaced by a regional value. The regional skew for this part of Iowa is -0.50 (Lara, 1974). This value rather than the station skew is used in subsequent calculations.

The flood frequency analyses for each gaging station are summarized in tables 4, 5, and 6. The discharges (Q) in ft^3/s column 1, versus their recurrence interval (t), column 3, are plotted in figures 16, 17, and 18. The solid line which is considered to be the best fit thrcugh the data points identifies the station curve computed by using the parameters listed in table 7. Selected values along this curve for the gaging stations included in this study are shown in table 7. The dashed line curve is the regional frequency curve, which is the subject of a brief discussion in the following paragraphs.

Table 4.--Frequency analysis of annual peaks

05470000 South Skunk River near Ames, Iowa

Q ft^3/s	Rank m	t (n+1)/m	P 100/t	log Q
8,630	1	45.00	2.22	3.9360
8,060	2	22.50	4.44	3.9063
6,550	3	15.00	6.67	3.8162
6,210	4	11.25	8.89	3.7931
5,780	5	9.00	11.1	3.7619
5,330	6	7.50	13.3	3.7267
5,320	7	6.43	15.6	3.7259
5,260	8	5.63	17.8	3.7210
5,230	9	5.00	20.0	3.7185
4,890	10	4.50	22.2	3.6893
4,500	11	4.09	24.4	3.6532
4,380	12	3.75	26.7	3.6415
4,300	13	3.46	28.9	3.6335
4,010	14	3.21	31.1	3.6031
3,820	15	3.00	33.3	3.5821
3,660	16	2.81	35.6	3.5635
3,540	17	2.65	37.8	2.5490
3,490	18	2.50	40.0	3.5428
3,340	19	2.37	42.2	3.5237
3,230	20	2.25	44.4	3.5092
3,150	21	2.14	46.7	3.4983
3,050	22	2.05	48.9	3.4843
3,030	23	1.96	51.1	3.4814
3,000	24	1.88	53.3	3.4771
3,000	25	1.80	55.6	3.4771
2,900	26	1.73	57.8	3.4624
2,890	27	1.67	60.0	3.4609
2,790	28	1.61	62.2	3.4456
2,620	29	1.55	64.4	3.4183
2,580	30	1.50	66.7	3.4116
2,530	31	1.45	68.9	3.4031
2,320	32	1.41	71.1	3.3655
2,270	33	1.36	73.3	3.3560
2,170	34	1.32	75.6	3.3365
1,990	35	1.29	77.8	3.2989

Table 4.--Frequency analysis of annual peaks--Continued

05470000 South Skunk River near Ames, Iowa--Continued

Q ft³/s	Rank m	t (n+1)/m	P 100/t	log Q
1,990	36	1.25	80.0	3.2989
1,820	37	1.22	82.2	3.2601
1,720	38	1.18	84.4	3.2355
1,630	39	1.15	86.7	3.2122
1,340	40	1.13	88.9	3.1271
1,330	41	1.10	91.1	3.1239
980	42	1.07	93.3	2.9912
600	43	1.05	95.6	2.7782
376	44	1.02	97.8	2.5752
			Total =	152.5759
			M =	3.4676
			s =	0.272
			g =	-1.0736

Table 5.--Frequency analysis of annual peaks

05470500 Squaw Creek at Ames, Iowa

Q ft³/s	Rank m	t (n+1)/m	P 100/t	log Q
11,300	1	12.00	8.33	4.0531
4,200	2	6.00	16.7	3.6232
3,650	3	4.00	25.0	3.5623
3,540	4	3.00	33.3	3.5490
3,160	5	2.40	41.7	3.4997
2,970	6	2.00	50.0	3.4728
2,900	7	1.71	58.3	3.4624
2,800	8	1.50	66.7	3.4472
2,500	9	1.33	75.0	3.3979
2,020	10	1.20	83.3	3.3054
1,680	11	1.09	91.7	3.2253
			Total =	38.5982
			M =	3.5089
			s =	0.213
			g =	1.634

Table 6.--Frequency analysis of annual peaks

05471000 South Skunk River below Squaw Creek near Ames, Iowa

Q ft^3/s	Rank m	t (n+1)/m	P 100/t	log Q
14,700	1	24.00	4.17	4.1673
9,260	2	12.00	8.33	3.9666
8,700	3	8.00	12.5	3.9395
8,610	4	6.00	16.7	3.9350
8,550	5	4.80	20.8	3.9320
7,800	6	4.00	25.0	3.8921
7,340	7	3.43	29.2	3.8657
7,310	8	3.00	33.3	3.8639
6,860	9	2.67	37.5	3.8363
6,620	10	2.40	41.7	3.8209
6,380	11	2.18	45.8	3.8048
6,360	12	2.00	50.0	3.8035
6,330	13	1.85	54.2	3.8014
5,520	14	1.71	58.3	3.7419
4,960	15	1.60	62.5	3.6955
4,950	16	1.50	66.7	3.6946
4,780	17	1.41	70.8	3.6794
4,440	18	1.33	75.0	3.6474
3,520	19	1.26	79.2	3.5465
3,340	20	1.20	83.3	3.5237
2,680	21	1.14	87.5	3.4281
1,620	22	1.09	91.7	3.2095
638	23	1.04	95.8	2.8048
			Total =	85.6006
			M =	3.7218
			s =	0.284
			g =	1.729

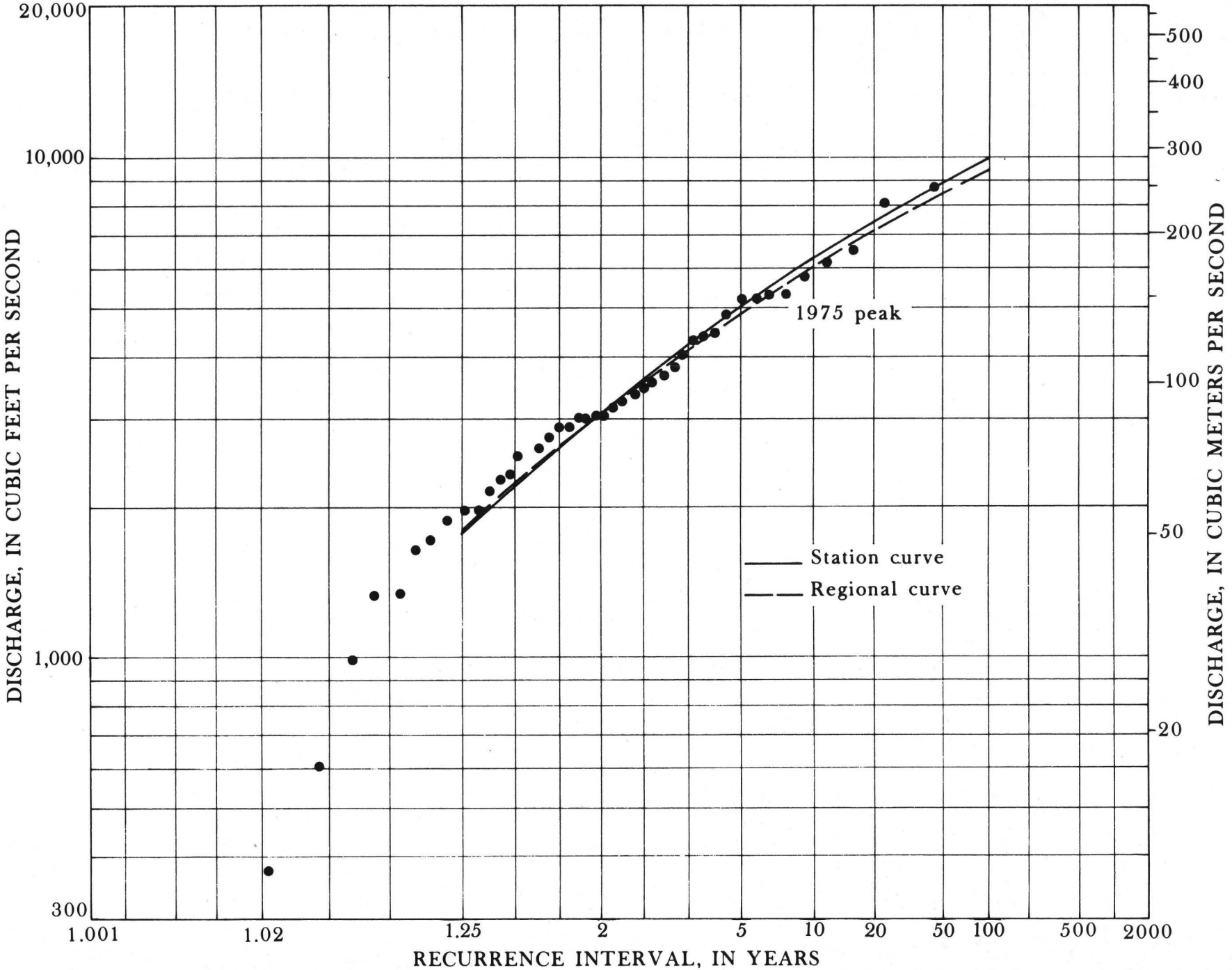

Figure 16. Flood frequency curves for gaging station 05470000South Skunk River near Ames, Iowa.

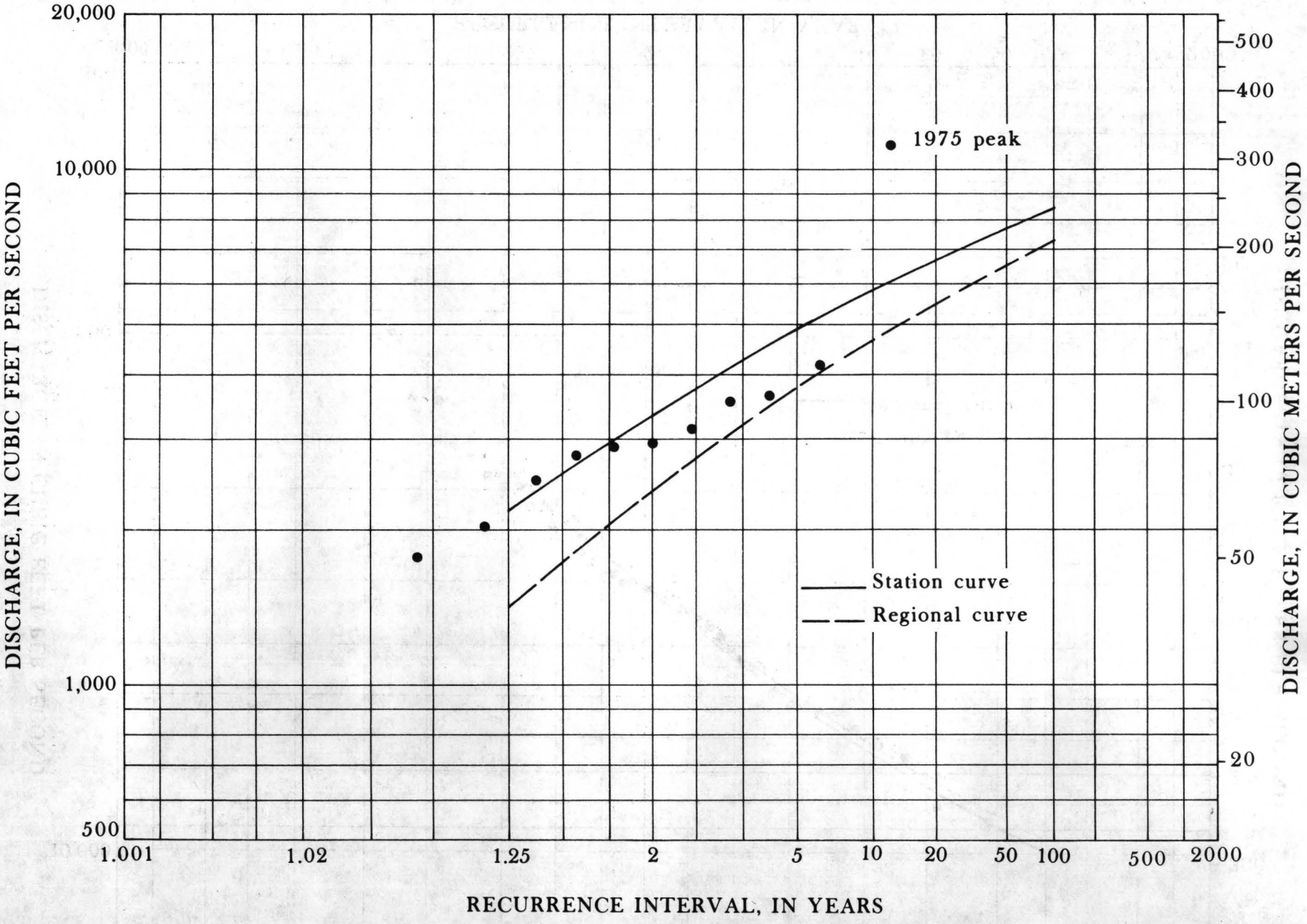

Figure 17. Flood frequency curves for gaging station 05470500 Squaw Creek at Ames, Iowa.

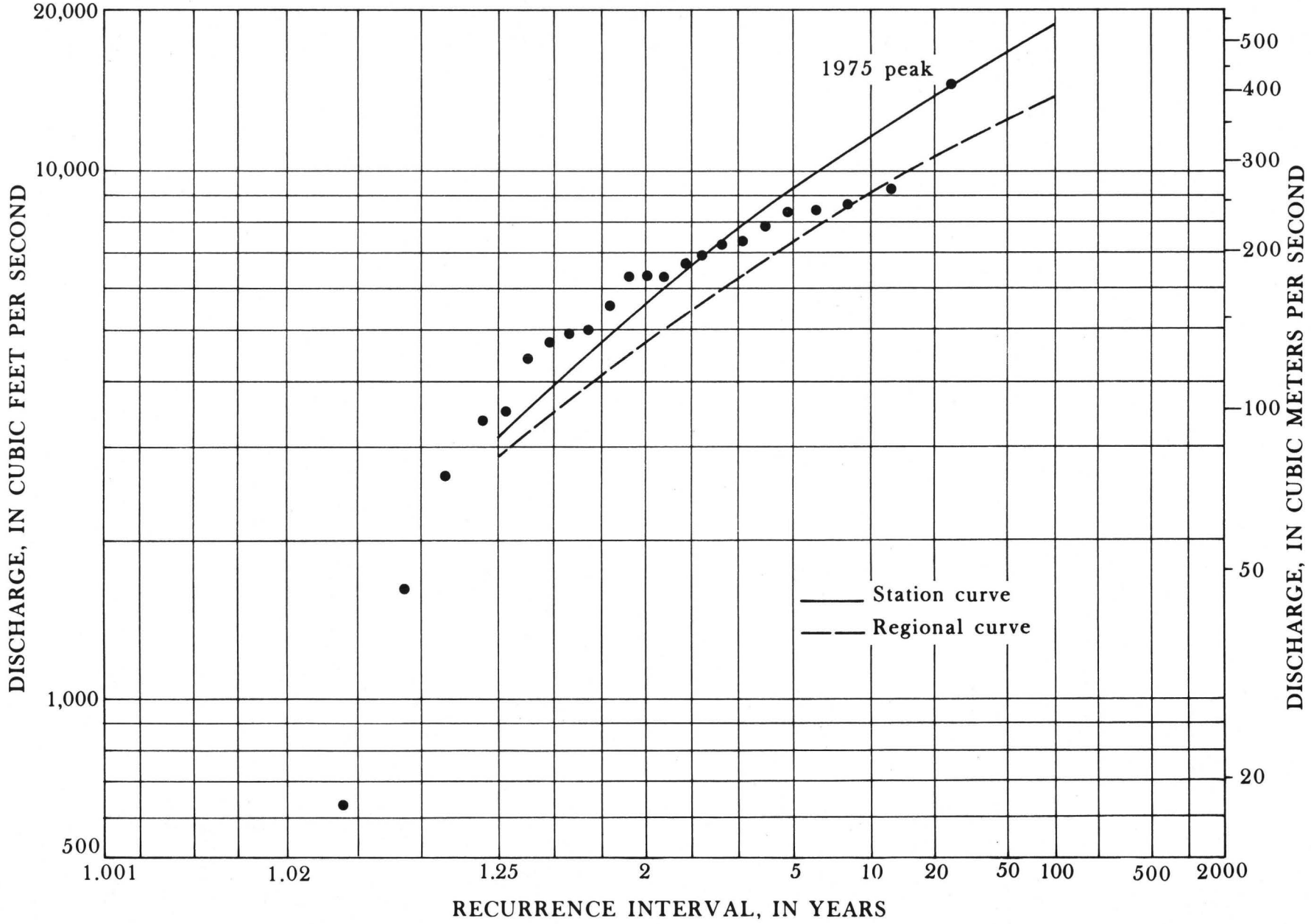

Figure 18. Flood frequency curves for gaging station 05471000 South Skunk River below Squaw Creek near Ames, Iowa.

Table 7.--Discharges in ft^3/s for the indicated recurrence intervals in years, computed using station parameters and regional skew

Model: $\text{Log } Q_t = M + K_{gt}s$[1]

Station number	Station parameters			Recurrence intervals					
	M[2]	s[2]	g	2	5	10	25	50	100
05470000	3.4676	0.272	-.50	3090	5020	6290	7830	8930	9980
05470500	3.5089	0.213	-.50	3360	4910	5860	6960	7720	8420
05471000	3.7218	0.284	-.50	5560	9220	11700	14700	16800	18900

[1] Values of K_{gt} are shown in table 3.
[2] M and s from tables 4-6.

Regional frequency curves

Streamflow records are collected at only a few of the sites where information is needed. For this reason there is a need to interpret and transfer gaging station information to sites where no records are collected. To fill this need techniques have been developed to estimate the flood frequency characteristics of Iowa streams using some physiographic and meteorologic characteristics of the basin as basic data (Lara, 1973, 1974).

Two equally reliable techniques are available to regionalize floods in Iowa. The first method defines mathematical models which relate floods of specific recurrence intervals to physical parameters of the basin (Lara, 1973). Because of the simplicity of its application, this technique has been recommended by the Iowa Natural Resources Council for estimating the magnitude and

frequency of floods in Iowa. For a detailed step-by-step description of the application of this method the reader is referred to Lara (1973).

In the second method, the parameters which control the log-Pearson type III distribution function are related to climatic and physiographic factors. In order to acquaint Iowa users with this method, the following paragraphs will describe briefly the mechanics of its application.

To estimate flood magnitudes and their corresponding recurrence intervals by using regionalized log-Pearson parameters proceed as follows:

a. Determine the size of the drainage area (A), in square miles.

b. Compute the main channel slope (S) in feet/mile. This slope is determined from elevations at points 10 percent and 85 percent of the distance along the channel, between the point of interest and the drainage divide.

c. Determine the mean annual precipitation (P) in inches from figure 19.

d. Determine the hydrologic region from figure 20. From this figure select the regional equations.

e. Compute the mean (M), and the standard deviation (s) and select the regional skew.

f. Enter table 3 and determine K, corresponding to the regional skew and a selected recurrence interval.

g. Substitute the values of M, s and K in the following equation:

$$\log Q = M + s\,(K)$$

h. Take the antilog to obtain the discharge in ft^3/s.

i. Repeat steps f through h for every recurrence interval selected.

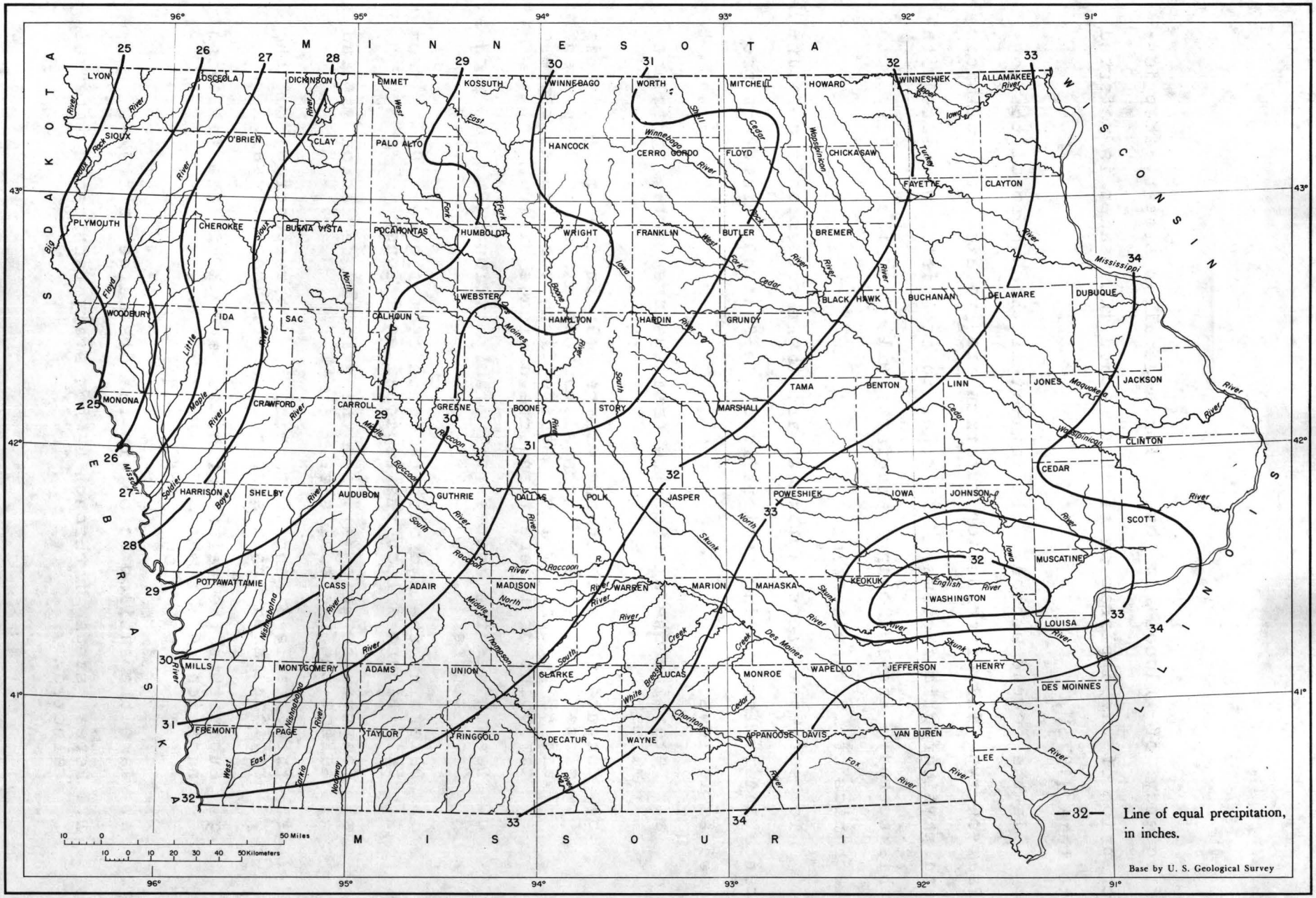

Figure 19. Iowa normal annual precipitation (after Waite, P. J., 1970).

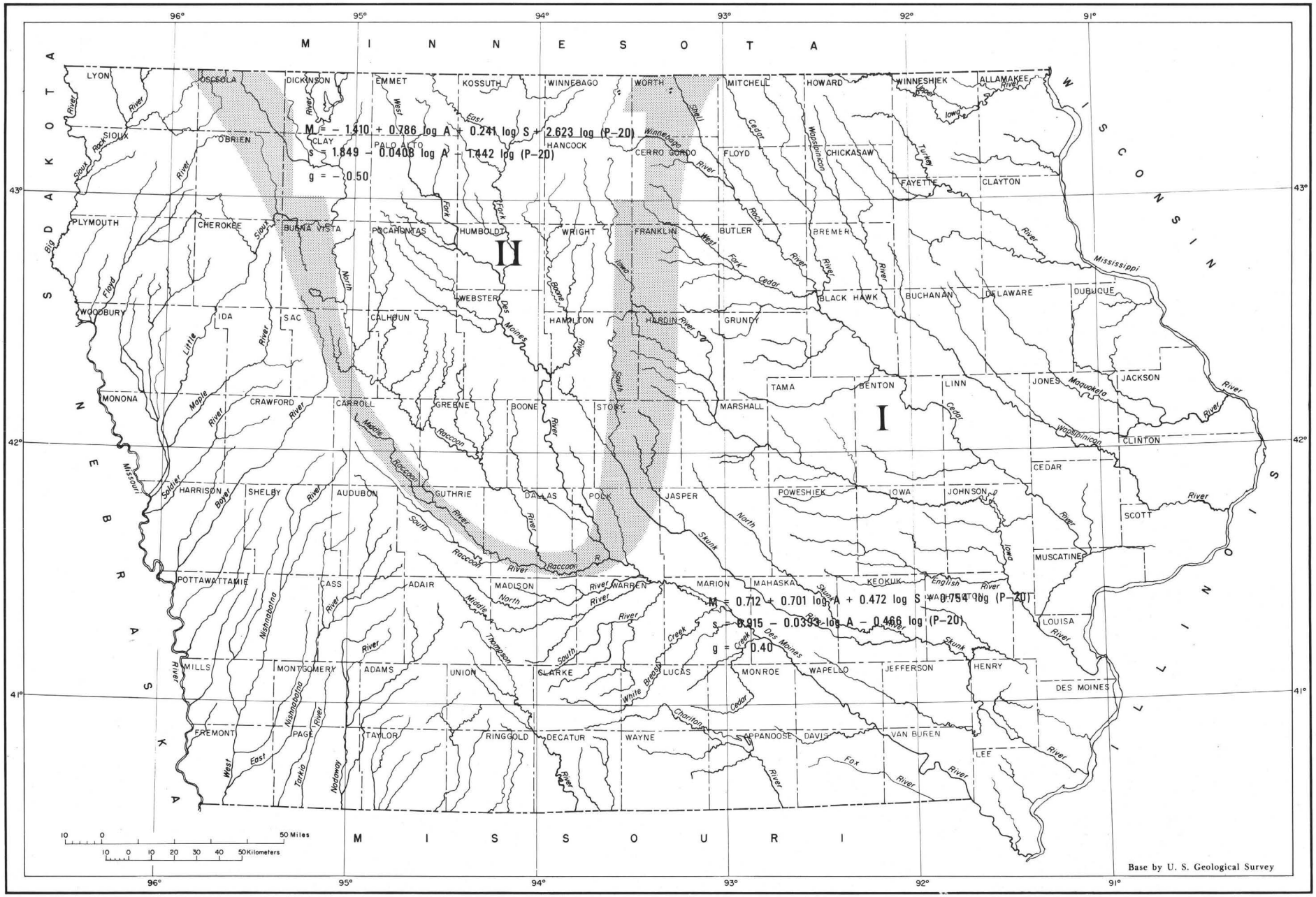

Figure 20. Estimating equations and skews for hydrologic regions of Iowa.

Flood frequency data for the three gaging stations included in this report were computed by following the above procedure (tables 8 and 9). For the purpose of comparison these regional data are plotted alongside the station curves in figures 16, 17, and 18.

Table 8.--Computation of regional parameters

Models: (from figure 13)
$M = -1.410 + 0.786 \log A + 0.241 \log S + 2.623 \log (P-20)$
$s = 1.849 - 0.0408 \log A - 1.442 \log (P-20)$

Station number	A mi^2	S ft/mi	P inches	M	s	g[1]
05470000	315	7.34	30.7	3.4624	0.263	-0.50
05470500	204	8.87	30.9	3.3550	0.259	-0.50
05471000	556	6.63	30.8	3.6563	0.247	-0.50

[1] Regional skew determined from figure 13.

Table 9.--Discharges in ft^3/s for the indicated recurrence interval in years, using regional parameters

Model: $\text{Log } Q_t = M + K_{gt}s$[1]

Station Number	Regional parameters			Recurrence intervals					
	M	s	g	2	5	10	25	50	100
05470000	3.4624	0.263	-0.50	3050	4870	6060	7490	8510	9470
05470500	3.3550	0.259	-0.50	2380	3770	4680	5770	6530	7270
05471000	3.6563	0.247	-0.50	4750	7370	9050	11000	12500	13800

[1] Values for K_{gt} are shown in table 3.

As it was pointed out before, the array of flood events for a single station is a random and often short sample, and may not be representative of the long-term distribution of the flood

events at the site. Therefore, it seems reasonable to assume that considering records for all stations in a hydrologically homogeneous region will tend to reduce the errors associated with non-representative samples. It follows that regional curves may represent improved estimates of the flood characteristics at the gaged site. For this reason the regional curves have been selected as reference to estimate the recurrence interval of the 1975 peaks. Based on the regional frequency curves, the recurrence interval of the 1975 peaks are:

Station No.	Peak	Recurrence interval
05470000	5,330 ft^3/s	6.0 years
05470500	11,300 ft^3/s	1.6 larger than Q_{100}
05471000	14,700 ft^3/s	1.1 larger than Q_{100}

FLOOD HISTORY

The history of floods in this area is summarized and discussed briefly in the following paragraphs which were transcribed in their entirety from a Flood Information report by the U.S. Army Corps of Engineers (1966).

> The most severe floods of record on Skunk River and Squaw Creek occurred in June 1918, May 1944, June 1947, June 1954, August 1954, July 1958, March 1960, and June 1965. Total damages from past floods have been relatively light and there has been no record of loss of life. County records, newspaper accounts, and other sources of information about the most significant floods have been condensed and are presented in the following paragraphs.

Flood of June 1918

> This was one of the earliest floods on record. Runoff from sustained heavy rains resulted in one of the largest recorded floods on Skunk River and Squaw Creek. The flood was produced by the combination of a series of heavy

rainfalls totaling 14 inches within 20 consecutive days. The city of Ames was isolated from all surrounding communities for approximately one week. All roads into the city were closed because of a washed out bridge, or the highway was in such a condition that it was impassable. The Northwestern Railroad stopped all traffic in the vicinity because of weakened embankments under the constant action of the water. Railroad bridges were washed out by flood waters both North and South of the city of Ames, restricting all traffic between the city and Des Moines, Iowa. Gas service was interrupted for one week because of inundation of the gas plant, located within the Skunk River flood plain. It was estimated that the damage to bridges alone was $200,000.

Flood of May 1944

This flood again virtually cut off the city of Ames from all surrounding communities. The storm consisted of heavy winds and 8.21 inches of rain which fell during a 48-hour period. No trains were running on the Northwestern tracks in or out of the city because of weakened bridges and embankments. The underpass to the westbound tracks was completely filled with water and silt. All mail service into the city from the east, west, and south was restricted because of flood waters. Northwestern Bell Telephone Company announced that 1,500 phones were out of order causing exceptionally slow communication to nearby communities. Business houses in Ames suffered the heaviest losses from flood waters in their history. Almost every basement within the city was under inches of water because of inadequate drainage and sewer capacities. Total damage to the area surpassed all previous storm damages.

Flood of June 1947

Heavy rains totaling 5 inches in a 20-hour period caused relatively high flows on both the Skunk River and Squaw Creek. Many families were evacuated from their homes because of high water. Flooding occurred on state-owned lands on both sides of Lincoln Way in the Squaw Creek area, causing damage to agricultural land and crops. The total damage from this flood was much less than that of the two previously recorded floods.

Flood of June 1954

Heavy rains caused Skunk River and Squaw Creek to go over their banks. Squaw Creek flooded over South Riverside Drive, south of the bridge closing the road to traffic.

Water covered several acres of the Squaw Creek flood plain south of Lincoln Way between Ames and the University as shown on Photo No. 1, Exhibit 1. The collection of debris such as that shown on Photo No. 2, Exhibit 1, restricted flow at many locations and was an additional factor that increased the flood stages in some reaches. Squaw Creek flooded over Brookside Park as shown by Photos No. 3 and 4, Exhibit 2, causing light damage to the recreational facilities.

Flood of August 1954

Heavy rains establishing an all-time record of 6 inches in a 12-hour period fell within the Skunk River and Squaw Creek watersheds. Storm sewers were inadequate for the heavy flow of water and sanitary sewage backed into basements in many areas of the city. Several families were moved from their residence because of the high water. The Grand Avenue underpass was closed because of stalled automobiles. The Iowa State University golf course was flooded as shown by Photo No. 5, Exhibit 3. The Squaw Creek flood plain between Ames and the University was again flooded, as was Brookside Park.

Flood of July 1958

Rains totaling 3.11 inches fell in the Skunk River and Squaw Creek watersheds. Residents south of Fourth Street were marooned when Squaw Creek flood waters overflowed South Maple Avenue. Water washed out part of the county road south of Riverside Drive Bridge over Squaw Creek thus stopping all traffic on the road. City work crews were called to remove debris and log jams at many bridges in an attempt to lower water surface levels. Brookside Park was flooded twice during the week.

Flood of March 1960

Water spread over lowlands on both sides of Lincoln Way at the Skunk River crossing and Squaw Creek Bridge. East and West Roads south of Ames, and South Riverside Drive leading to the airport as shown on Photo No. 6, Exhibit 3, were covered by flood waters. Skunk River and Squaw Creek were out of their banks along the entire study area. Sandbag levees were constructed south of Squaw Creek between the channel and Meadow Lane Trailer Court on U.S. Highway #69. Damage to agriculture was light because spring field operations had not begun. Ice jams occurred at almost all bridges.

Flood of June 1965

High water was caused by heavy rains within the watershed, supplemented by already saturated conditions. Damage was mostly restricted to agricultural land. Inadequate storm sewer capacity and interior drainage caused flooding of some commercial and residential developments. Total damage from this flood was considered small, however, it pointed out many locations where a serious flood potential exists.

BENCH MARKS

Bench marks used in determining elevations for this report and other bench marks in the vicinity of the flood inundation areas are listed in the appendix of this report. These bench marks should be an aid to local interests in setting minimum elevations for future development and planning on the flood plains. The bench marks are listed by a number such as 8323-30SE, which, in order, designates the township, range, section number and quarter section in which the bench mark is located. The bench marks in Table 11 are listed starting from the most downstream bench mark and then progressing upstream, first on the South Skunk River and then on Squaw Creek. In the descriptions of the bench marks, the directions "right" and "left" are determined as viewed facing in the direction of flow of the stream. All elevations in the report are based on mean sea level datum, 1929 general adjustment. Conversion to City of Ames datum can be made by subtracting 823.55 feet (251.02 m).

Table 10.--Station data

05470000 South Skunk River near Ames, Iowa

Location.--Lat 42°04'05", long 93°37'02", in NW1/4 SW1/4 sec.23, T.84 N., R.24 W., Story County, on left bank 2.5 miles (4.0 km) north of Ames, 3.5 miles (5.6 km) downstream from Keigley Branch, 5.2 miles (8.4 km) upstream from Squaw Creek, and at mile 228.1 (367.0 km) upstream from mouth of Skunk River.

Drainage area.--315 mi² (816 km²).

Gage.--Water-stage recorder. Concrete control since July 21, 1934. Datum of gage is 893.61 ft (272.37 m) above mean sea level (Iowa Department of Transportation bench mark). Prior to Aug. 25, 1921, nonrecording gage at same site and datum.

Maxima for period of record.--Maximum discharge 8,630 ft³/s (244 m³/s) June 10, 1954, gage height, 13.66 ft (4.164 m); maximum gage height 13.90 ft (4.237 m) May 20, 1944.

Stage-discharge relation.--Defined by current-meter measurements.

Bankfull stage.--11 feet (3.4 m).

Rating table, water year 1975
(gage height, in feet, and discharge, in cubic feet per second)

3.5	335	6.0	2,030
3.8	475	7.0	2,830
4.0	575	8.0	3,630
4.5	890	9.0	4,450
5.0	1,240	10.0	5,350

Mean daily discharge, in cubic feet per second, June 1975

Day	Discharge	Day	Discharge	Day	Discharge	Day	Discharge	Day	Discharge
1	374	7	330	13	905	19	1,520	25	1,870
2	350	8	306	14	700	20	1,140	26	2,020
3	441	9	406	15	666	21	810	27	4,340
4	511	10	610	16	596	22	1,910	28	4,300
5	515	11	791	17	907	23	1,910	29	1,970
6	396	12	1,250	18	1,140	24	1,290	30	1,370

Table 10.--Station data--Continued

05470000 South Skunk River near Ames, Iowa--Continued

Gage height, in feet, and discharge, in cubic feet per second, at indicated time, 1975

Date	Hour	Gage height	Discharge	Date	Hour	Gage height	Discharge
June 25	0200	4.40	1,060	June 27	0600	9.39	4,800
	0400	4.40	1,060		0700	9.32	4,740
	0600	5.13	1,570		0800	9.23	4,660
	0800	5.91	1,960		1000	8.99	4,440
	1000	6.19	2,180		1200	8.85	4,320
	1200	6.08	2,090		1400	8.89	4,350
	1400	5.92	1,970		1600	8.91	4,370
	1600	5.88	1,930		1800	8.80	4,270
	1800	5.83	1,890		2000	8.82	4,290
	2000	5.77	1,850		2200	8.97	4,420
	2200	5.73	1,810		2400	9.28	4,700
	2400	5.71	1,800				
				June 28	0100	9.41	4,820
June 26	0200	5.72	1,810		0200	9.68	5,060
	0400	5.75	1,830		0300	9.82	5,190
	0600	5.79	1,860		0400	9.85	5,220
	0800	5.81	1,880		0500	9.89	5,250
	1000	5.79	1,860		0600	9.92	5,280
	1200	5.72	1,810		0700	9.94	5,300
	1400	5.61	1,720		0800	9.81	5,180
	1600	5.44	1,580		0900	9.75	5,130
	1800	5.30	1,470		1000	9.65	5,040
	2000	5.18	1,370		1100	9.47	4,870
	2200	5.77	1,850		1200	9.29	4,710
	2400	7.87	3,530		1400	8.92	4,380
					1600	8.43	3,970
June 27	0200	8.87	4,330		1800	7.98	3,610
	0400	9.37	4,780		2000	7.53	3,250
	0430	9.42	4,830		2200	7.10	2,910
	0500	9.41	4,820		2400	6.75	2,630

Table 10.--Station data--Continued

05470000 South Skunk River near Ames, Iowa--Continued

Maximum annual peak stages and discharges

Water year	Date	Gage height (feet)	Discharge (ft^3/s)
1921	Sept. 17, 1921	9.2	3,540
1922	Feb. 23, 1922	9.0	3,370
1923	Mar. 28, 1923	6.22	1,670
1924	June 28, 1924	8.21	3,010
1925	Aug. 7, 1925	5.0	905
1926	Sept. 19, 1926	8.26	3,120
1927	Feb. 5, 1927	7.4	2,460
1930	Nov. 24, 1929	11.2	5,230
1933	Apr. 1, 1933	6.47	1,990
1934	Jan. 22, 1934	5.39[1]	600[2]
1935	Mar. 5, 1935	9.0	3,490
1936	Mar. 10, 1936	7.7	2,580
1937	Mar. 6, 1937	8.4[1]	3,000[2]
1938	May 4, 1938	8.3	2,890
1939	Mar. 14, 1939	10.5[1]	3,230[2]
1940	Aug. 13, 1940	7.3	2,320
1941	Sept. 8, 1941	8.6	3,050
1942	Sept. 14, 1942	8.1	2,530
1943	July 31, 1943	10.3	4,500
1944	May 20, 1944	13.9	8,060
1945	June 2, 1945	9.7	4,010
1946	Feb. 5, 1946	7.1	2,270
1947	June 13, 1947	11.95	6,550
1948	Mar. 19, 1948	7.35	2,620
1949	Mar. 4, 1949	10.52[1]	3,000[2]
1950	Mar. 7, 1950	8.86	3,820
1951	Mar. 29, 1951	10.90	5,320
1952	July 9, 1952	5.73	1,630
1953	May 1, 1953	4.71	980
1954	June 10, 1954	13.66	8,630

[1] Affected by ice.
[2] About.

Table 10.--Station data--Continued

05470000 South Skunk River near Ames, Iowa--Continued

Maximum annual peak stages and discharges--Continued

Water year	Date	Gage height (feet)	Discharge (ft^3/s)
1955	Oct. 15, 1954	5.22	1,340
1956	Sept. 4, 1956	3.49	376
1957	June 16, 1957	8.28	3,540
1958	July 4, 1958	7.85	3,150
1959	May 31, 1959	5.83	1,720
1960	Mar. 30, 1960	10.33	6,210
1961	Feb. 23, 1961	5.71	1,990
1962	July 14, 1962	9.02	4,300
1963	Apr. 30, 1963	5.65	1,820
1964	June 22, 1964	5.91	2,170
1965	Apr. 6, 1965	9.43	5,260
1966	Feb. 9, 1966	6.92[1]	2,900[2]
1967	June 8, 1967	6.63	2,790
1968	June 25, 1968	8.74	4,890
1969	July 10, 1969	8.49	4,380
1970	May 13, 1970	5.10	1,330
1971	Feb. 20, 1971	7.67	3,660
1972	Aug. 7, 1972	6.92	3,030
1973	Apr. 16, 1973	7.30	3,340
1974	June 23, 1974	9.61	5,780
1975	June 28, 1975	9.98	5,330

[1] Affected by ice.
[2] About.

Table 10.--Station data--Continued

05470500 Squaw Creek at Ames, Iowa

Location.--Lat 42°01'21", long 93°37'45", in NE1/4 NW1/4 sec.10, T.83 N., R.24 W., Story County, on left bank 65 ft (20 m) downstream from Lincoln Way Bridge in Ames, 0.1 mile (0.2 km) downstream from College Creek, and 1.8 miles (2.9 km) upstream from mouth.

Drainage area.--204 mi² (528 km²).

Gage.--Water-stage recorder and concrete control. Datum of gage is 881.00 ft (268.53 m) above mean sea level (levels by Iowa State University). Prior to Mar. 11, 1925, nonrecording gage at site 0.6 mile (1.0 km) upstream at different datum. Mar. 11, 1925, to Apr. 30, 1927, nonrecording gage at site 65 ft (20 m) upstream at datum about 4 ft (1 m) higher.

Maxima for period of record.--Maximum discharge, 4,130 ft³/s (117 m³/s) July 17, 1922, gage height, 10.7 ft (3.26 m), site and datum then in use, from graph based on gage readings; maximum gage height, 10.74 ft (3.274 m) May 13, 1970.
Flood of June 4,1918, reached a stage of 14.5 ft (4.42 m), from flood marks, site and datum used 1919-25, discharge, 6,900 ft³/s (195 m³/s). Flood of Mar. 1, 1965, reached a stage of 10.7 ft (3.26 m), from graph based on gage readings, at present site and datum, discharge, 4,200 ft³/s (119 m³/s).

Stage-discharge relation.--Defined by current-meter measurements.

Rating table, water year 1975
(gage height, in feet, and discharge, in cubic feet per second)

3.0	540	6.5	1,890	11.0	4,480
3.5	775	7.0	2,040	11.5	5,080
4.0	1,000	8.0	2,430	12.0	5,800
4.5	1,200	9.0	2,930	12.5	6,640
5.0	1,385	9.5	3,230	13.0	7,600
5.5	1,560	10.0	3,580	13.5	9,000
6.0	1,735	10.5	3,990	14.1	11,400

Mean daily discharge in cubic feet per second, June 1975

Day	Dis-charge	Day	Dis-charge	Day	Dis-charge	Day	Dis-charge	Day	Dis-charge
1	326	7	253	13	747	19	1,370	25	1,700
2	316	8	231	14	675	20	881	26	2,890
3	496	9	305	15	715	21	683	27	7,110
4	436	10	379	16	593	22	1,100	28	2,850
5	359	11	778	17	663	23	816	29	1,650
6	288	12	1,060	18	1,110	24	1,150	30	1,280

Table 10.--Station data--continued

05470500 Squaw Creek at Ames, Iowa--Continued

Gage height, in feet, and discharge in cubic feet per second, at indicated time, 1975

Date	Hour	Gage height	Discharge	Date	Hour	Gage height	Discharge
June 25	0200	3.77	897	June 27	0700	13.95	11,000
	0400	3.71	870		0800	14.00	11,300
	0600	4.67	1,270		0900	13.96	11,100
	0800	5.91	1,700		1000	13.96	11,100
	1000	6.40	1,860		1100	13.76	10,200
	1200	6.66	1,940		1200	13.47	8,910
	1400	6.82	1,990		1300	13.30	8,430
	1600	6.92	2,020		1400	13.08	7,820
	1800	7.02	2,050		1500	12.85	7,300
	2000	7.12	2,080		1600	12.39	6,440
	2200	7.27	2,140		1700	12.20	6,120
	2400	7.38	2,180		1800	12.07	5,910
					1900	11.92	5,670
June 26	0200	7.55	2,250		2000	11.73	5,400
	0400	7.78	2,340		2100	11.55	5,180
	0600	8.33	2,580		2200	11.37	4,920
	0800	8.94	2,890		2300	11.22	4,740
	1000	9.30	3,110		2400	11.01	4,490
	1200	9.79	3,430				
	1400	9.46	3,210	June 28	0200	10.61	4,090
	1600	9.29	3,100		0400	10.15	3,700
	1800	8.95	2,900		0600	9.73	3,390
	2000	8.57	2,700		0800	9.30	3,110
	2200	9.55	3,270		1000	8.90	2,870
	2400	10.62	4,100		1200	8.49	2,660
					1400	8.18	2,500
June 27	0100	10.74	4,220		1600	7.78	2,340
	0200	10.95	4,430		1800	7.46	2,210
	0300	11.32	4,860		2000	7.14	2,090
	0400	11.94	5,700		2200	6.91	2,010
	0500	12.72	7,040		2400	6.67	1,940
	0600	13.41	8,730				

Table 10.--Station data--Continued

05470500 Squaw Creek at Ames, Iowa--Continued

Maximum annual peak stages and discharges

Water year	Date	Gage height (feet)	Discharge (ft^3/s)
1918	June 4, 1918	14.5	6,900
1919	Sept.30, 1919	7.96	1,900[1]
1920	Oct. 4, 1919	8.6	2,260
1921	Sept.17, 1921	7.4	1,900
1922	July 17, 1922	10.7	4,130
1923	Sept.28, 1923	6.1	1,340
1924	July 28, 1924	8.8	3,170
1925	Aug. 7, 1925	4.9	791
1926	Sept.19, 1926	10.2	3,610
1927	Oct. 4, 1926	5.8	1,060
1965	Mar. 1, 1965	10.7[2]	4,200
1966	June 12, 1966	10.15	3,160
1967	June 12, 1967	6.92	2,020
1968	June 25, 1968	8.27	2,500
1969	Mar. 20, 1969	9.59	2,970
1970	Mar. 13, 1970	10.74	3,540
1971	Feb. 19, 1971	10.09	3,650
1972	Aug. 2, 1972	5.84	1,680
1973	Apr. 16, 1973	8.69	2,800
1974	June 22, 1974	8.95	2,900
1975	June 27, 1975	14.00	11,300

[1] Maximum for period May to September 1919.
[2] From graph based on gage readings, at present site and datum.

Table 10.--Station data.--Continued

05471000 South Skunk River below Squaw Creek near Ames, Iowa

Location.--Lat 42°00'31", long 93°35'37", in NE1/4 NW1/4 sec.13, T.83 N., R.24 W., Story County, on right bank 15 ft (5 m) downstream from bridge on county highway, 0.2 mi (0.3 km) downstream from Squaw Creek, 0.2 mi (0.3 km) upstream from bridge on U.S. Highway 30, 2 mi (3.2 km) southeast of Ames, and at mile 222.6 (358.2 km) upstream from mouth of Skunk River.

Drainage area.--556 mi^2 (1,440 km^2).

Gage.--Water-stage recorder and concrete control. Datum of gage is 857.10 ft (261.24 m) above mean sea level.

Maxima for period of record.--Maximum discharge, 9,260 ft^3/s (262 m^3/s) Mar. 30, 1960, gage height, 13.20 ft (4.023 m), datum then in use.

Flood of May 19, 1944, reached a stage of 13 ft (4 m), from floodmarks, discharge, 10,000 ft^3/s (283 m^3/s), datum then in use.

Stage-discharge relation.--Defined by current-meter measurements.

Bankfull stage.--12 feet (3.65 m).

Rating table, water year 1975
(gage height, in feet, and discharge, in cubic feet per second)

14.0	1,080	18.0	2,820	23.0	7,430
14.5	1,274	19.0	3,370	24.0	9,230
15.0	1,480	19.5	3,645	24.5	10,500
16.0	1,900	20.0	3,995	25.0	12,000
17.0	2,320	21.0	4,830	25.5	14,300
17.5	2,545	22.0	5,830		

Mean daily discharge, in cubic feet per second, June 1975

Day	Discharge	Day	Discharge	Day	Discharge	Day	Discharge	Day	Discharge
1	647	7	579	13	1,620	19	2,780	25	3,420
2	636	8	509	14	1,440	20	1,990	26	4,910
3	913	9	740	15	1,440	21	1,460	27	11,200
4	972	10	1,010	16	1,200	22	2,760	28	8,520
5	911	11	1,470	17	1,650	23	2,630	29	3,850
6	710	12	2,250	18	2,210	24	2,250	30	2,450

Table 10.--Station data--Continued

05471000 South Skunk River below Squaw Creek near Ames, Iowa--Continued

Gage height, in feet, and discharge, in cubic feet per second, at indicated time, 1975

Date	Time	Gage height	Discharge	Date	Time	Gage height	Discharge
June 25	0200	15.89	1,850	June 27	0900	25.02	12,100
	0400	15.79	1,810		1000	25.32	13,400
	0600	16.90	2,280		1100	25.24	13,000
	0800	18.86	3,290		1200	25.26	13,100
	1000	19.69	3,780		1300	25.35	13,600
	1200	20.08	4,050		1330	25.57	14,700
	1400	20.17	4,120		1400	25.48	14,200
	1600	20.15	4,110		1430	25.56	14,600
	1800	20.09	4,060		1500	25.53	14,500
	2000	20.07	4,040		1600	25.51	14,400
	2200	20.07	4,040		1700	25.46	14,100
	2400	20.10	4,070		1800	25.26	13,100
					1900	25.23	13,000
June 26	0200	20.32	4,250		2000	25.11	12,400
	0400	20.30	4,240		2100	24.93	11,700
	0600	20.90	4,750		2200	24.72	11,000
	0800	21.20	5,030		2300	24.73	11,000
	1000	21.71	5,540		2400	24.56	10,500
	1200	21.60	5,430				
	1400	21.41	5,240	June 28	0200	24.50	10,300
	1600	21.33	5,160		0400	24.29	9,810
	1800	21.23	5,060		0600	24.16	9,550
	2000	20.98	4,810		0800	23.94	9,120
	2200	21.02	4,850		1000	23.94	9,120
	2400	21.99	5,820		1200	23.68	8,650
					1400	23.49	8,310
June 27	0200	22.62	6,820		1600	23.33	8,020
	0400	23.38	8,110		1800	23.03	7,480
	0600	23.94	9,120		2000	22.74	7,010
	0700	24.20	9,630		2200	22.38	6,440
	0800	24.26	9,750		2400	22.01	5,850

Table 10.--Station data--Continued

05471000 South Skunk River below Squaw Creek near Ames, Iowa--Continued

Maximum annual peak stages and discharges

Water year	Date	Gage height (feet)	Discharge (ft^3/s)
1944	May 19, 1944	13.	10,000
1953	May 1, 1953	5.47	1,620
1954	Aug. 28, 1954	12.36	8,700
1955	Oct. 14, 1954	6.81	2,680
1956	May 13, 1956	3.05	638
1957	June 16, 1957	11.58	6,360
1958	July 4, 1958	12.82	8,550
1959	May 31, 1959	10.57	5,520
1960	Mar. 30, 1960	13.20	9,260
1961	Sept. 30, 1961	8.27	3,520
1962	July 15, 1962	11.87	6,330
1963	May 12, 1963	10.20	4,780
1964	June 23, 1964	9.80	4,440
1965	Apr. 6, 1965	12.59	7,340
1966	June 12, 1966	11.45	6,380
1967	June 8, 1967	9.90	4,960
1968	June 25, 1968	12.07	7,310
1969	Mar. 20, 1969	12.15	6,620
1970	May 13, 1970	10.35	4,950
1971	Feb. 20, 1971	12.67	8,610
1972	Aug. 2, 1972	8.05	3,340
1973	Apr. 16, 1973	11.94	6,860
1974	June 23, 1974	23.19	7,800
1975	June 27, 1975	25.57	14,700

Table 11.--Bench Marks

8323-30 SE - About 4.25 miles (6.84 km) southeast of Ames, on I-35 bridge over South Skunk River, on top of left downstream wingwall; a chiselled square. Elev. 879.35 ft (268.03 m)

8323-30 NW - About 4 miles (6.44 km) southeast of Ames, on county road bridge over South Skunk River, on top of upstream side of left pier; a chiselled square. Elev. 871.87 ft (265.75 m)

8324-24 SW - About 3.75 miles (6.03 km) southeast of Ames, near southwest corner of sec.24, just north of entrance to farmhouse east, on east headwall of concrete culvert; a chiselled square. Elev. 907.07 ft (276.47 m)

8324-23 SE - About 3.5 miles (5.23 km) southeast of Ames, 1 mile (1.6 km) south of Highway 30, 0.5 mile (0.8 km) east of Highway 69, at southwest corner of intersection at T-road south, on top of south headwall of concrete culvert; a chiselled square. Elev. 884.70 ft (269.66 m)

8324-14 NE - About 2.5 miles (4.02 km) southeast of Ames, at the southeast corner of the intersection of Highway 69 and Airport Road, on top of the concrete foundation for traffic light controls; a chiselled square. Elev. 903.72 ft (275.45 m)

8324-13 SE - About 2 miles (3.22 km) southeast of Ames, on Highway 30 bridge over South Skunk River, on right downstream curb; an Iowa Department of Transportation plug. Elev. 891.40 ft (271.70 m)

8324-13 NW - About 2 miles (3.22 km) southeast of Ames at 16th Street bridge over South Skunk River, downstream of mouth of Squaw Creek, at right upstream end of bridge, on top of 1 x 1 foot (0.3 m x 0.3 m) timber over pile cap, top of vertical bolt; a chiselled cross (RM 6). Elev. 882.78 ft (269.07 m)

8324-12 NW - At Lincoln Way bridge over South Skunk River, on top of wingpost at left downstream end of bridge; an Iowa Department of Transportation plug. Elev. 897.11 ft (273.44 m)

8324-1 SE - At the Chicago and North Western Railroad bridge over South Skunk River, on the south end of the top stone of the east abutment, 9 feet (2.7 m) south of the south rail of the south track; a standard Monel metal rivet. Elev. 908.13 ft (276.80 m)

8424-36 SW - At 13th Street bridge over South Skunk River, on top of wingpost at left upstream end of bridge; a chiselled square. Elev. 903.94 ft (275.52 m)

Table 11.--Bench marks--Continued

8424-23 SW - About 3 miles (4.83 km) northeast of Ames, at Riverside Road bridge over South Skunk River, at left downstream bridge seat, top of anchor bolt; a chiselled cross. Elev. 908.02 ft (276.76 m)

8324-11 SW - At South Duff Avenue bridge over Squaw Creek, at left upstream end of bridge, on top of wingpost; a chiselled square. Elev. 897.09 ft (273.43 m)

8324-10 NE - At C. & N. W. Railroad crossing on 4th Street, on base of signal at southwest corner of intersection, on top of bolt on southeast corner of base; a chiselled cross. Elev. 900.76 ft (274.55 m)

8324-10 NE - At C. & N.W. Railroad bridge over Squaw Creek, on upstream end of left pier, on top of bolt on anchor plate; a chiselled cross. Elev. 887.10 ft (270.39 m)

8324-10 NE - At 4th Street bridge over Squaw Creek, at left upstream end of bridge, on top of curb; a chiselled square. Elev. 900.68 ft (274.53 m)

8324-10 NW - At Lincoln Way bridge over Squaw Creek, on top of left downstream wingwall; a chiselled square. Elev. 903.52 ft (275.39 m)

8324-3 NE - At 6th Street bridge over Squaw Creek, on top of right downstream wingwall; a chiselled square. Elev. 908.41 ft (276.88 m)

8324-3 NE - On C. & N.W. Railroad overpass over 6th Street, on north end of west stone abutment; a Monel metal rivet, a standard U.S.C.&G.S. disk RV 564. Elev. 915.20 ft (278.95 m)

8324-3 NW - At 13th Street bridge over Squaw Creek, on top of wingpost at right downstream end bridge; an Iowa Department of Transportation plug. Elev. 912.44 ft (278.11 m)

8424-33 SE - At Stange Road bridge over Squaw Creek, on top of wingwall at left upstream end of bridge; a chiselled cross. Elev. 912.56 ft (278.15 m)

8324-4 NE - About 1.2 (1.93 km) miles west along the C. & N.W. Railroad from the station at Ames, Iowa. At the overhead bridge of the railroad over Stange Road. In the top of the north end of the east concrete abutment; a standard U.S.C. & G.S. disk stamped "W-32 1934". Elev. 937.72 ft (285.82 m)

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