

WATER YEAR 1986 IN IOWA: PRECIPITATION AND WATER RESOURCES

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FACTORS FOR CONVERTING INCH-POUND UNITS TO  
INTERNATIONAL SYSTEM OF UNITS (SI)

For convenience of readers who may wish to use the International System of Units (SI), the data may be converted by using the following factors:

Multiply inch-pound unit	By	To obtain metric unit
inch	25.40	millimeters
feet	0.3048	meters
cubic feet per second	0.02832	cubic meters per second
acre-feet per year	1,233	cubic meters per year
acre-feet per year	$1.233 \times 10$	cubic hectometers per year

## ABSTRACT

Water year 1986 was the second wettest on record in Iowa since records began being kept in the late 1800's. This report examines the spatial distribution of precipitation, the deviations from normal precipitation, and the effect of the excess precipitation on the water resources of Iowa. New high ground-water levels were established in water wells and new peak stages and new peak discharges were established at stream gaging stations.

## INTRODUCTION

This report provides information regarding precipitation and precipitation patterns during water year 1986 (October 1985 - September 1986) and the influence of the above-average precipitation on ground water and surface water in the State.

## PRECIPITATION

Water year 1986 was the second wettest in Iowa since records were kept, beginning in 1873. The precipitation for water year 1986 is shown in figure 1. Precipitation at reporting sites ranged from 27.37 inches at Forest City in Winnebago County in north-central Iowa to 57.91 inches at Keosauqua in Van Buren County in southeast Iowa. Average precipitation normally ranges from about 27.50 inches in the northwest to about 35.00 inches in the southeast part of the State.





Precipitation from the reporting sites is averaged within each of nine climatological districts (fig. 2). In addition to serving as regional descriptors for various parts of the State, the climatological districts, which coincide with crop districts, allow for application of climatic information to agricultural activities.

Average monthly and total precipitation for water year 1986 is listed in table 1 by climatological districts. The statewide average values were derived from the district values, which were areally weighted and used as multipliers for the statewide values. The normal or 30-year precipitation is the average for calendar years 1951 through 1980 and is shown in table 1. Average monthly precipitation in Iowa for water year 1986 is compared to the normal precipitation from 1951 through 1980 (fig. 3).

The statewide average precipitation in water year 1986 totaled 41.32 inches and exceeded the normal precipitation of 32.09 inches by 29 percent (table 1). The water year ranks as the second wettest during the entire period of record. The water year was noted for record snowfall, record floods, excess runoff, excess soil moisture, and excess soil erosion. Normal precipitation was exceeded by more than 50 percent (fig. 4) in climatological districts in northwest, west-central, and eastern Iowa. Precipitation in the east-central and southeast climatological districts averaged about 42 percent above normal.

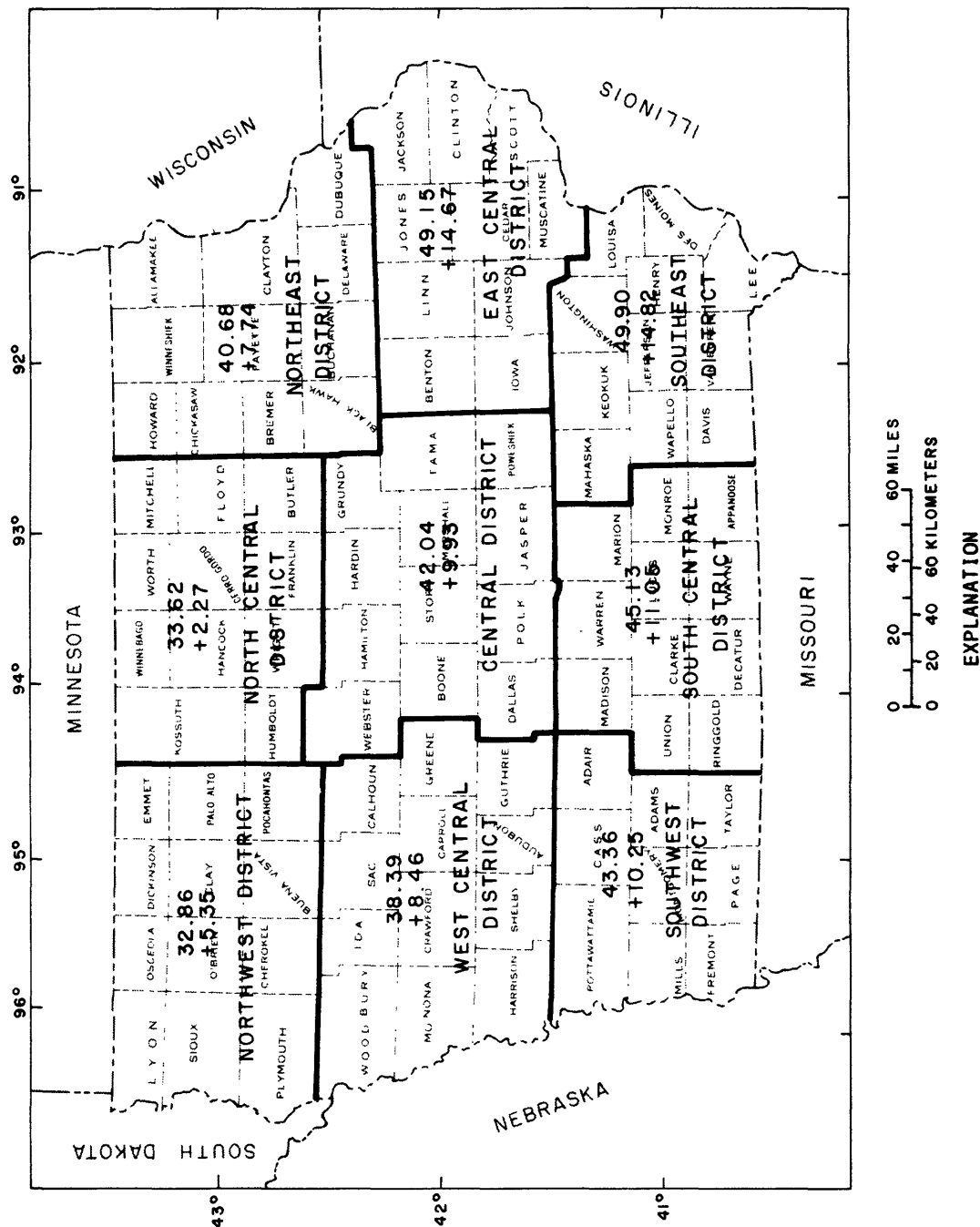


Figure 2.--Average precipitation for water year 1986 by climatological district.

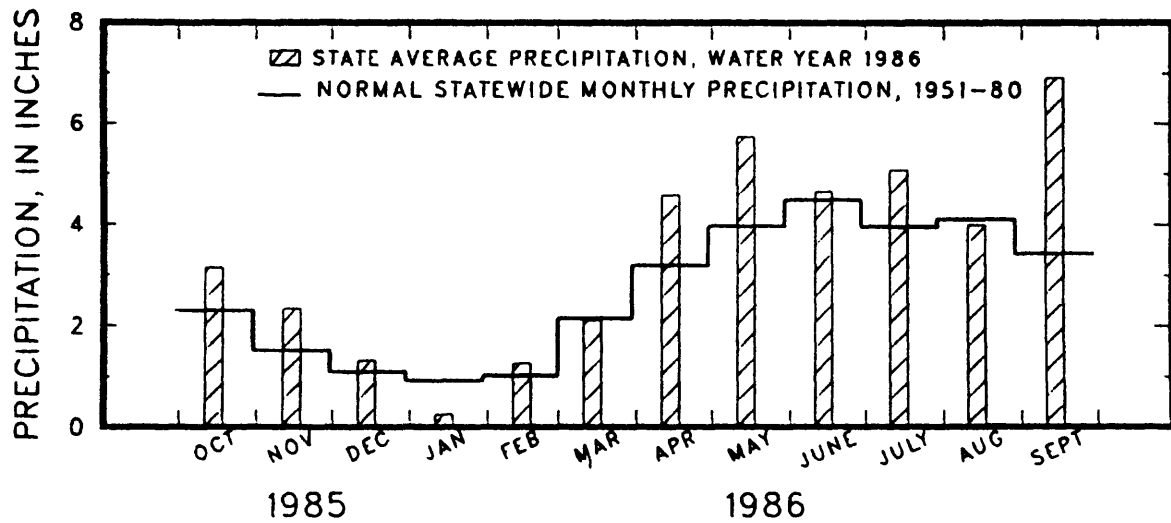


Figure 3. -- State average precipitation during water year 1986 compared to normal statewide monthly precipitation, 1951-80 (from Melcher and others, 1987).

TABLE 1.-- Average monthly and annual precipitation for water year 1986 and normal precipitation from 1951 through 1980, in inches.

Water Year 1986													
Climatological district	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Year
Northwest	1.28	1.48	.78	.24	.21	1.97	5.82	4.31	4.03	3.97	3.94	4.83	32.86
North Central	1.56	1.75	.96	.33	.78	1.97	4.26	4.96	2.85	5.64	3.37	5.19	33.62
Northeast	2.87	3.16	1.81	.69	1.74	1.83	2.98	5.29	4.76	4.01	3.95	7.59	40.68
West Central	1.85	.86	.78	.04	1.12	3.12	6.73	4.66	5.68	4.34	4.09	5.12	38.39
Central	3.00	1.45	1.48	.28	1.40	1.99	4.59	5.67	6.78	4.52	4.05	6.83	42.04
East Central	5.42	4.41	2.12	.47	1.74	1.97	2.89	7.75	6.12	4.41	4.30	7.55	49.15
Southwest	3.25	.70	.70	.00	1.51	2.45	6.83	4.87	3.70	7.59	3.47	8.29	43.36
South Central	4.15	2.37	1.44	.02	1.20	1.98	4.40	6.58	3.24	6.17	4.54	9.04	45.13
Southeast	5.89	5.35	1.78	.10	1.70	1.53	2.48	8.05	3.60	6.34	4.06	9.02	49.90
State total	3.14	2.33	1.31	.25	1.25	2.11	4.59	5.72	4.64	5.09	3.98	6.91	41.32

Normal Precipitation 1951 to 1980													
Climatological district	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Year
Northwest	1.82	1.09	.77	.56	.93	1.72	2.45	3.56	4.25	3.54	3.90	2.92	27.51
North Central	2.09	1.39	.98	.82	.93	2.04	2.93	3.96	4.63	4.21	4.15	3.22	31.35
Northeast	2.35	1.69	1.22	.93	.98	2.13	3.40	4.05	4.43	4.36	4.00	3.40	32.94
West Central	2.10	1.23	.82	.74	1.01	2.00	2.87	4.02	4.52	3.49	3.95	3.18	29.93
Central	2.25	1.46	.99	.88	1.04	2.15	3.24	4.08	4.74	3.89	4.16	3.23	32.11
East Central	2.51	1.92	1.57	1.24	1.11	2.44	3.65	3.99	4.33	4.15	4.02	3.55	34.48
Southwest	2.44	1.50	.93	.84	1.02	2.12	3.15	4.14	4.66	3.99	4.53	3.79	33.11
South Central	2.61	1.73	1.11	1.03	1.07	2.36	3.57	4.00	4.55	3.88	4.21	3.96	34.08
Southeast	2.78	1.79	1.56	1.33	1.10	2.59	3.71	3.91	4.18	4.19	4.09	3.85	35.08
State total	2.30	1.51	1.09	.92	1.02	2.15	3.19	3.96	4.48	3.95	4.10	3.42	32.09

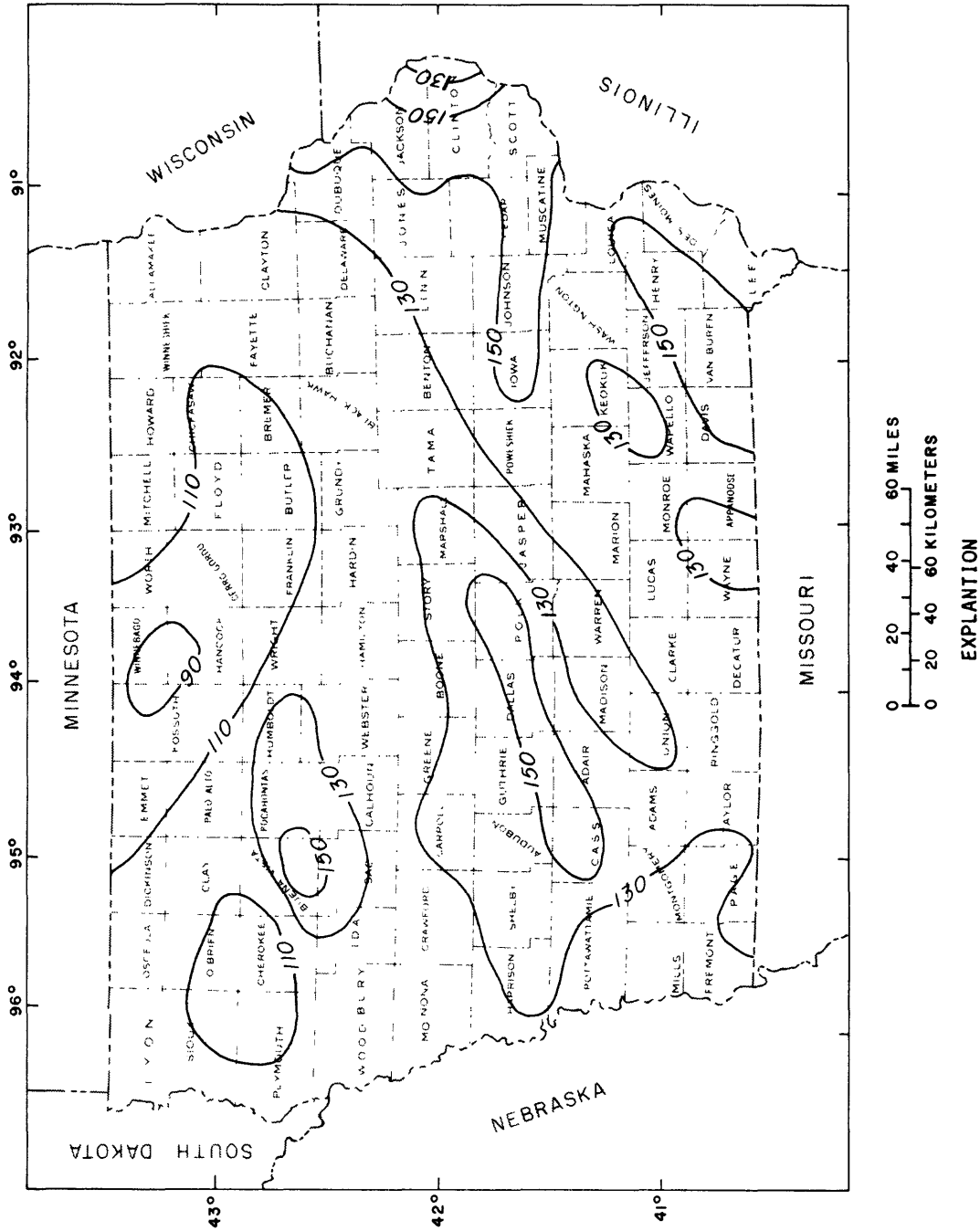


Figure 4.--Percent of normal precipitation for water year 1986.

Precipitation at the beginning of water year 1986 exceeded normal precipitation. The period of November and December 1985 was the second coldest during the period of record, the coldest being in 1880. A near record snowfall accumulation of 20.60 inches was measured through December, which was slightly less than the 1909 record of 20.90 inches.

January 1986 was unusually warm and was the fifth driest January on record. The warm spring accelerated the growth of vegetation by one or two weeks and stored soil moisture was used earlier than normal. Above average rainfall in April and May resulted in greater than normal soil moisture. Summer rainfall averaged about one inch above normal. Temperatures in August, the third coolest during the period of record, were about four degrees less than normal and as a result evapotranspiration was reduced. Rainfall in September averaged 6.91 inches, more than twice the normal. During the past 55 years only September 1941 and September 1965 have been wetter. For the period April through September 1986 a statewide average of 30.93 inches of rainfall occurred. This period ranked second only to 1902 as the wettest during the period of record. Excessive rains during the summer and fall of 1986 in Iowa and elsewhere in the Mississippi River basin contributed to record autumn floods on the Mississippi River.

Water year 1986 was the fifth consecutive water year that was wetter than normal. Water years 1982 to 1986 averaged 37.07 inches of precipitation, or about 16 percent above the normal precipitation of 32.09 inches. Likewise, the past decade, calendar years 1975 to 1984, averaged 35.07 inches of precipitation and was the wettest decade of record. It exceeded the second wettest decade from 1965 to 1974 by 1.53 inches and exceeded the normal precipitation by about 3 inches. The above normal precipitation becomes even more significant when added to the average annual runoff of 6.40 inches.

## WATER RESOURCES

Precipitation during water year 1986 had a number of significant effects on the water resources of Iowa. Water levels in wells and runoff from gaging stations throughout the State reflected the excess precipitation during the water year.

### Ground Water

Water levels in two shallow wells that penetrate the water table and that are completed in glacial drift of Pleistocene age in Linn and Webster Counties were above the average monthly water levels for the entire water year. Water levels in two similar wells in Johnson and Marion Counties were above the average monthly water levels for the entire water year except during April 1986 (figs. 5 to 7). Six wells developed in the glacial drift aquifer had period of record monthly high water levels established in water year 1986 (table 2). Eighteen wells developed in confined aquifers

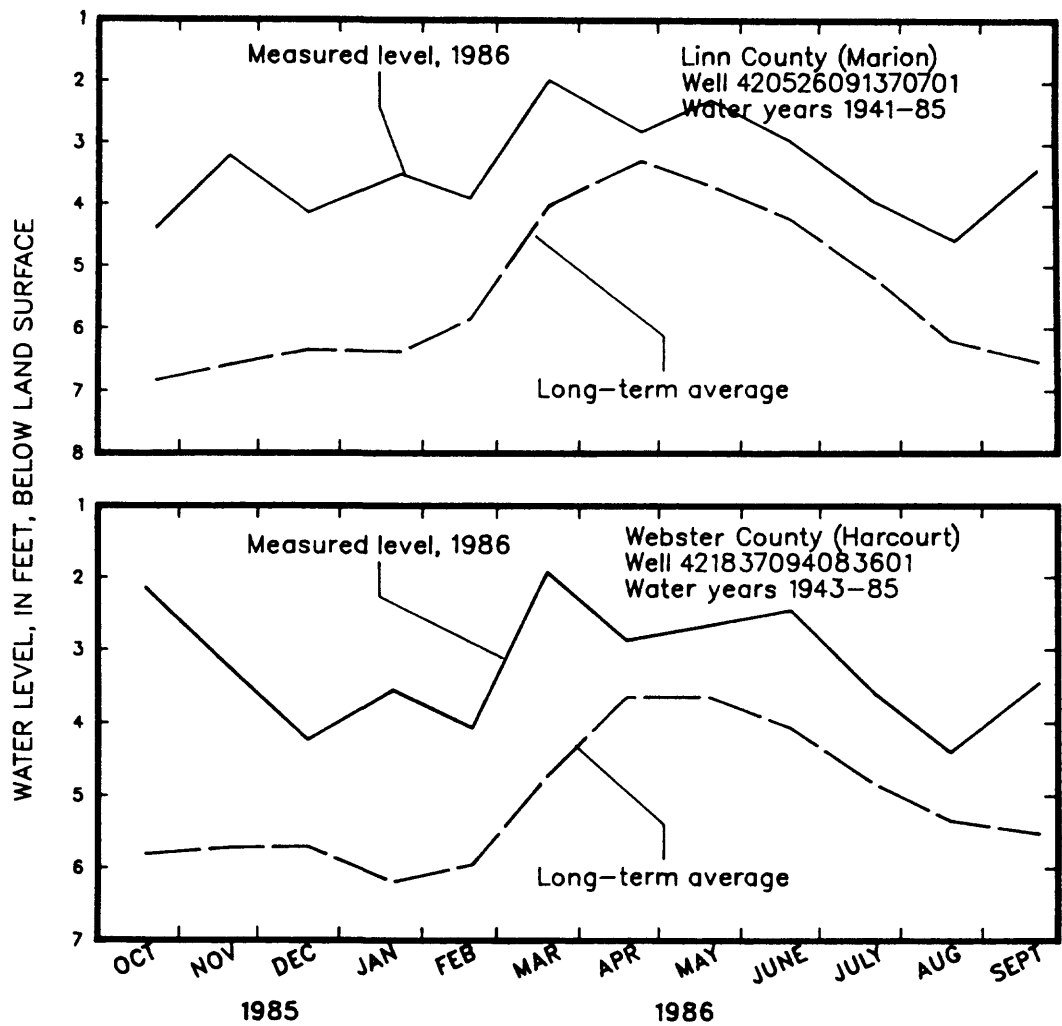


Figure 5.--Monthly water levels during water year 1986 compared to the average monthly level for the period of record (from Melcher and others, 1987).

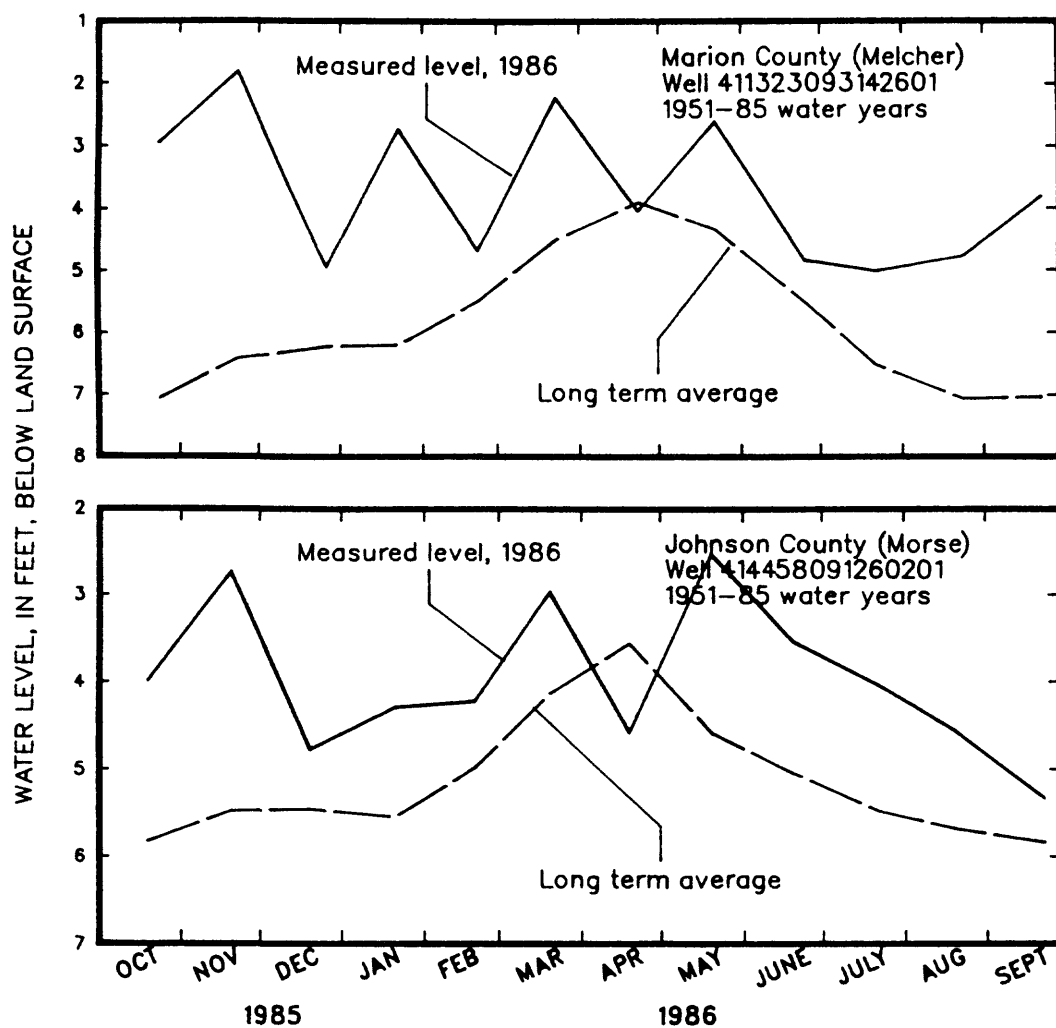
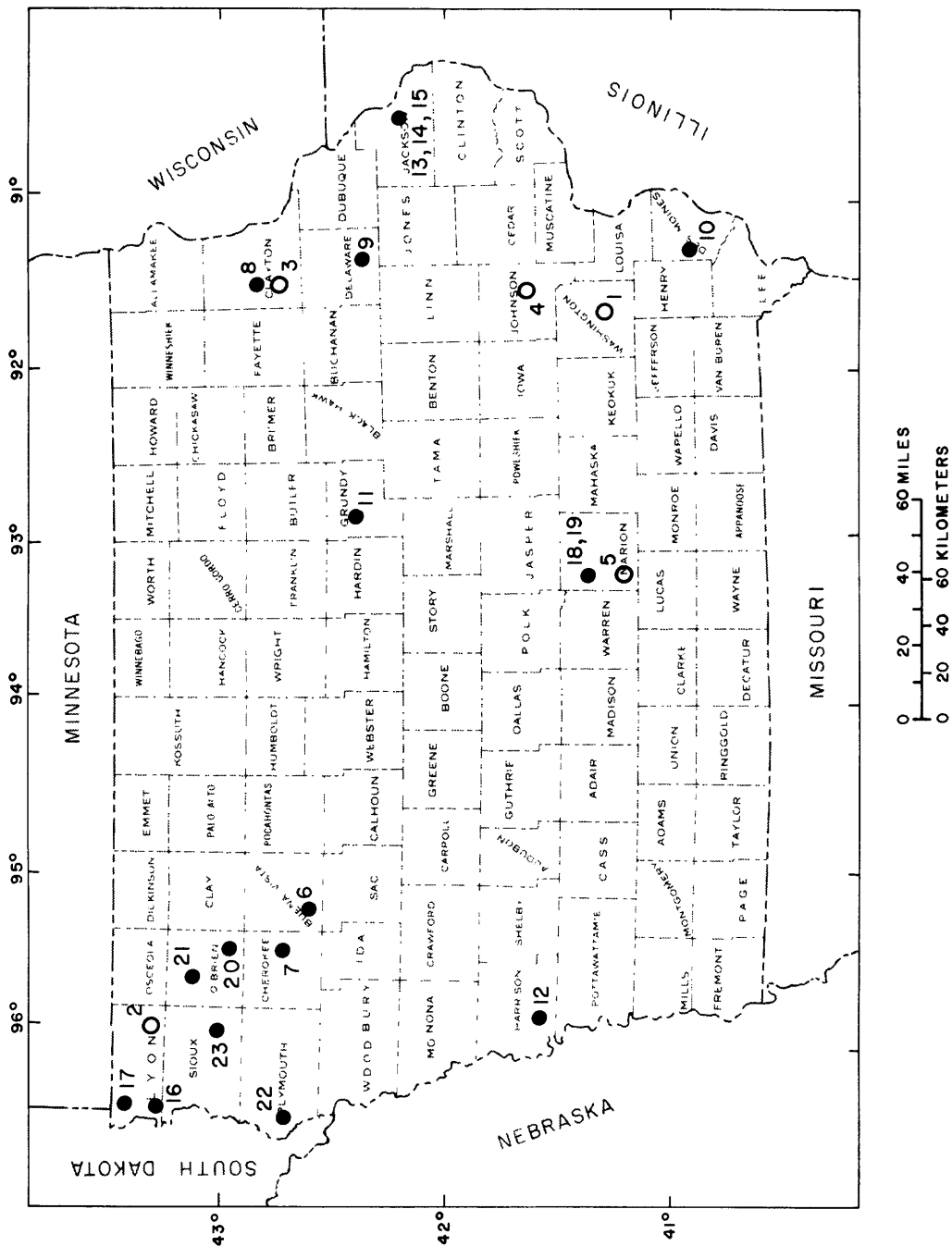


Figure 6.--Monthly water levels during water year 1986 compared to the average monthly level for the period of record (from Melcher and others, 1987).





#### EXPLANATION

- WELL WITH A NEW MONTHLY HIGH WATER LEVEL--Number refers to table 2
- WELL WITH A NEW HIGH WATER LEVEL FOR PERIOD OF RECORD--Number refers to table 3

Figure 7.--Wells measured during water year 1986 with new high water levels.

TABLE 2.-- Period of record monthly high water levels established during water year 1986 in wells completed in the glacial drift aquifers. (All water levels in feet below land-surface datum; cy, current year)

SITE NO. (fig. 7)	SITE I.D.	COUNTY	PERIOD OF RECORD	PREVIOUS HIGH DATE	WATER LEVEL	WATER YEAR DATE	1986 HIGH WATER LEVEL
1	421829091304701	Washington	1983-cy	11/15/84 6/19/84 8/21/84 9/20/84	3.49 3.71 5.81 8.17	11/7/85 6/6/86 8/7/86 9/5/86	2.09 1.99 4.54 5.56
2	432140095595301	Lyon	1947-cy	10/4/77 7/12/83 & 7/18/84	1.37 1.33	10/8/85 7/8/86	.48 1.16
3	424023091291201	Clayton	1957-cy	3/19/69	18.13	3/26/86	14.06
4	414458091260201	Johnson	1950-cy	11/18/73	3.24	11/20/85	2.74
5	411323093142601	Marion	1950-cy	11/28/61	2.00	11/19/85	1.80

had period of record high water levels established in water year 1986 (table 3).

#### Surface Water

The Nishnabotna River above Hamburg was in the excess-flow range (75 percent quartile of the 1951 to 1980 mean daily discharge, for a specific month) for the months of April, May, July, August, and September. The Des Moines River at Fort Dodge was in the excess-flow range for all months during water year 1986 except June (fig. 8). The Cedar River at Cedar Rapids was in the excess-flow range for all months except February, April, and August. None of the flow from the three stations was in the deficient-flow range (25 percent quartile of the 1951 to 1980 mean daily discharge, for a specific month) during water year 1986.

TABLE 3.--New high water levels for period of record established during water year 1986 in wells completed in confined aquifers. (All water levels in feet below land-surface datum; cy, current year; + indicates a flowing well)

SITE NO. (fig. 7)	SITE I.D.	COUNTY	PERIOD OF RECORD	AQUIFER	PREVIOUS HIGH WATER DATE	PREVIOUS HIGH WATER LEVEL	WATER YEAR 1986 HIGH WATER DATE	WATER YEAR 1986 HIGH WATER LEVEL
6	423618095194511	Buena Vista	1980-cy	Dakota	3/12/85	187.54	6/9/86	187.33
7	424348095231602	Cherokee	1979-cy	Dakota	5/13/85	189.15	6/9/86	188.84
8	424023091291201	Clayton	1957-cy	Pleistocene glacial drift	4/5/83	15.10	3/26/86	14.06
9	422029091144302	Delaware	1984-cy	Silurian	1/18/85	21.10	7/19/86 & 7/26/86	18.20
10	404844091142701	Des Moines	1950-cy	St. Peter	3/9/85	108.35	6/13/86	106.79
11	422605092560001	Grundy	1960-71 1973-cy	Devonian	2/22/83	34.45	8/7/86	33.99
12	413838095462001	Harrison	1981-cy	Mississippian	3/20/85	4.70	6/13/86	4.18
13	420842090165701	Jackson	1983-cy	Mt. Simon	4/12/84	+9.41	5/15/86	+9.75
14	420842090165703	Jackson	1982-cy	St. Peter & Prairie du Chien	4/16/85	6.25	1/8/86	5.19
15	420842090165704	Jackson	1982-cy	Galena	4/22/83	12.22	5/15/86	11.40
16	431812096302701	Lyon	1978-80 1982-cy	Dakota	3/28/80 & 5/6/80	93.40	7/8/86	91.89
17	432601096335511	Lyon	1978-80 1982-cy	Dakota	6/5/84	152.57	7/8/86	152.20
18	411329093142902	Marion	1945-55 1976-cy	Pleistocene glacial drift	3/18/86	14.41	5/21/86	13.43
19	411328093143503	Marion	1956-cy	Pleistocene glacial drift	11/8/85	10.69	5/21/86	10.55
20	425610095250611	O'Brien	1980-cy	Dakota	3/1/84 & 12/18/84	35.38	6/8/86	35.25
21	430930095350401	O'Brien	1980-cy	Dakota	10/18/84	359.14	7/8/86	358.39
22	424833096324701	Plymouth	1979-80 1982-cy	Dakota	7/18/85	139.12	4/23/86	137.80
23	430140095573101	Sioux	1980 1982-cy	Dakota	6/5/84	215.13	4/8/86	214.77

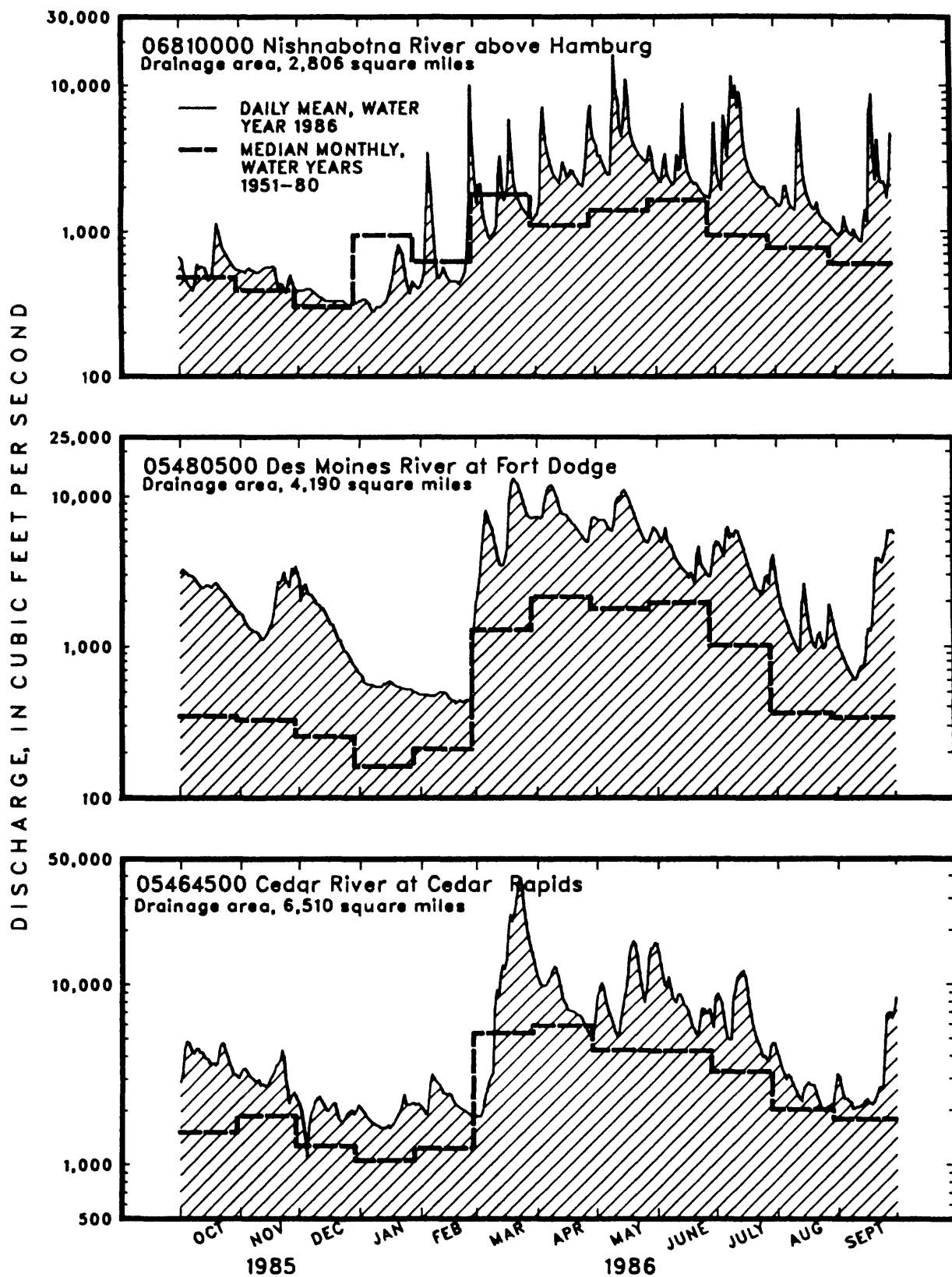
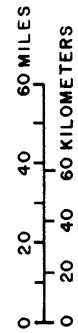
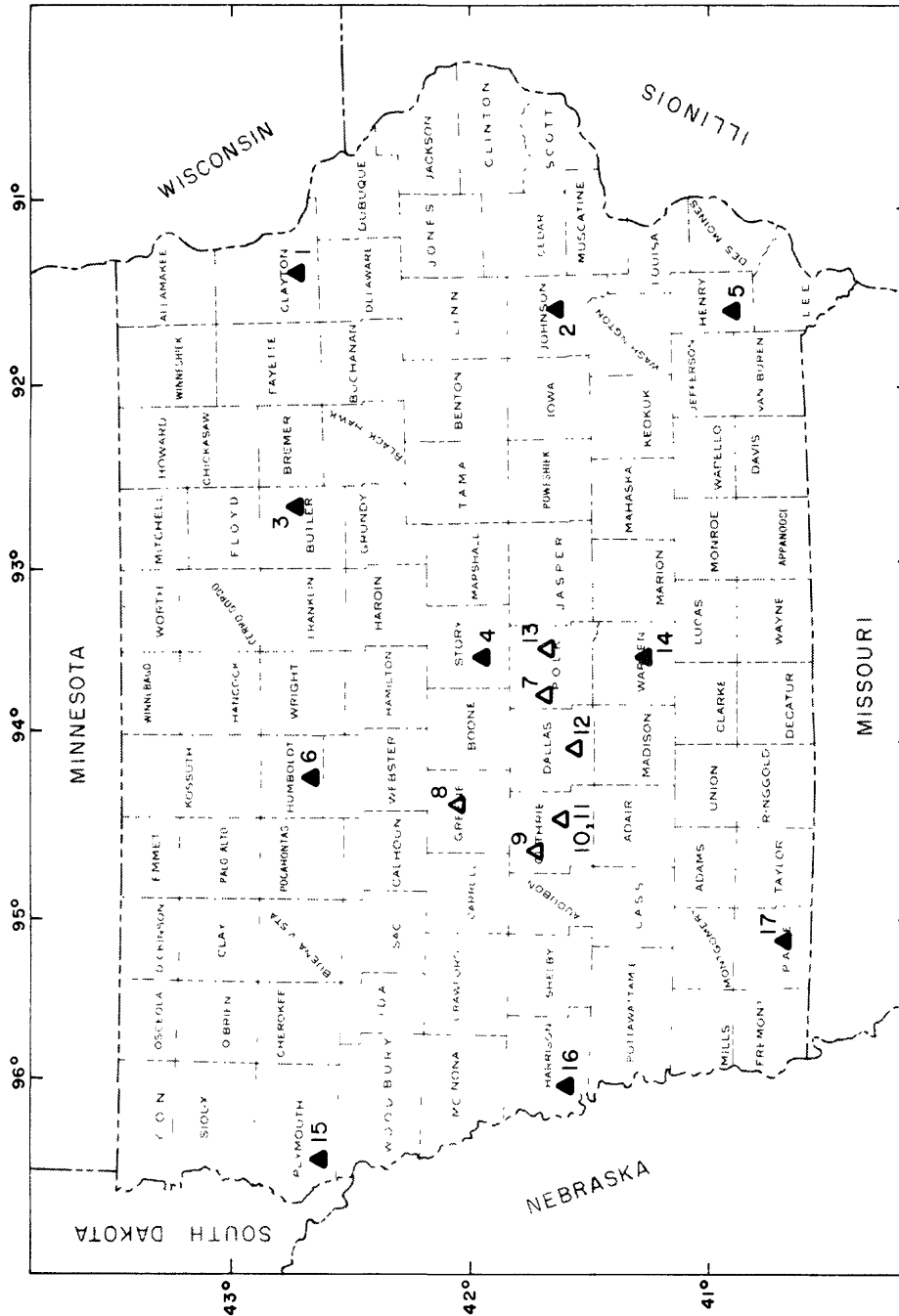


Figure 8.--Daily mean discharge for water year 1986 compared with median monthly discharges for water years 1951-80 for three index stations (from Melcher and others, 1987).

Stream flow characteristics for 10 representative stream flow stations (fig. 9) in the climatological districts are shown in table 4. Two are located in the North Central District due to the diverse morphology within the district. For each station, mean discharge in cubic feet per second, mean runoff in inches per year, and mean volume in acre-feet per year were greater during water year 1986 than the averages for the period of record.

TABLE 4.-- Stream flow characteristics for representative stream flow stations. (sq. mi., square mile; cfs, cubic feet per second; in/yr, inches per year; acre-ft/yr, acre-feet per year; cy, current year)

SITE NO. (fig. 9)	STATION NUMBER	STATION	PERIOD OF RECORD	DRAINAGE AREA (SQ. MI.)	AVERAGE FOR PERIOD OF RECORD			AVERAGE FOR WATER YEAR 1986		
					MEAN DISCH. (CFS)	MEAN RUNOFF (IN/YR)	MEAN VOLUME (ACRE-FT /YR)	MEAN DISCHARGE (CFS)	MEAN RUNOFF (IN/YR)	MEAN VOLUME (ACRE- FT/YR)
1	05412500	Turkey River at Garber	1913-16 1919-27 1929-30 1932-cy	1,545	958	8.42	694,100	1,272	11.18	920,600
2	05454300	Clear Creek near Coralville	1952-cy	98	68	9.43	9,340	126	17.47	91,380
3	05462000	Shell Rock River at Shell Rock	1953-cy	1,746	1007	7.83	729,600	1,390	10.81	1,006,000
4	05470500	Squaw Creek at Ames	1919-27 1965-cy	204	131	8.72	94,910	201	13.40	145,800
5	05473400	Cedar Creek near Oakland Mills	1977-cy	530	414	10.60	299,900	561	14.36	405,900
6	05479000	East Fork Des Moines River at Dakota City	1940-cy	1,308	560	5.81	405,700	1,032	10.72	747,300
14	05487470	South River near Ackworth	1940-cy	460	248	7.32	179,700	328	9.67	237,200
15	06600500	Floyd River at James	1934-cy	886	222	3.40	160,800	482	7.39	349,000
16	06609500	Boyer River at Logan	1918-25 1937-cy	871	328	5.11	237,600	510	7.95	369,400
17	06817000	Nodaway River at Clarinda	1918-25 1936-cy	762	347	6.18	251,400	656	11.69	474,800



# EXPLANATION

- 8 PEAK STAGE AND DISCHARGE LOCATION--  
Number refers to table 5
- 2 REPRESENTATIVE STREAM FLOW STATION--  
Number refers to table 4

Figure 9.--Surface water stations--peak stage and discharge locations and representative stream flow locations.

During water year 1986, seven new peak stages (gage height in feet) and five new peak discharges in cubic feet per second were established at gaging stations in Iowa. These stations are represented by open triangles in figure 9 and the 1986 peaks are compared to the previous peaks in table 5.

TABLE 5.-- New peak stages and discharges for period of record in water year 1986. (sq. mi., square mile; cfs, cubic feet per second; cy, current year)

SITE NO. (fig. 9)	STATION NUMBER	STATION	PERIOD OF CONTINUOUS RECORD	DRAINAGE AREA (SQ.MI.)	DATE	PREVIOUS PEAKS		DATE	WATER YEAR 1986 PEAKS	
						GAGE HEIGHT (FEET)	DISCHARGE (CFS)		GAGE HEIGHT (FEET)	DISCHARGE (CFS)
7	05481950	Beaver Creek near Grimes	1960-cy	358	5/19/74	14.69	7,340	6/30/86	14.73	7,980
8	05483000	East Fork Hardin Creek near Churdan	1952-cy	24	5/5/60	8.92	413	6/30/86	10.78	870
9	05483450	Middle Raccoon River near Bayard	1979-cy	375	7/3/73	21.63	4,600	6/30/86	24.70	12,300
10	05483470	Lake Panorama (stage only) at Panora	1979-cy	433	12/29/84	7.18	--	6/30/86	50.10	--
11	05483600	Middle Raccoon River at Panora	1958-cy	440	5/19/74	14.80	14,000	6/30/86	15.50	15,300
12	05484500	Raccoon River at Van Meter	1915-cy	3,441	6/13/47	21.37	41,200	7/1/86	22.69	40,200
13	05484800	Walnut Creek at Des Moines	1971-cy	78	7/1/73	17.72	9,000	5/10/86	18.32	12,500

#### SUMMARY

The 1986 water year was the second wettest on record. A state average of 41.32 inches of precipitation exceeded the normal average precipitation of 32.09 inches by 29 percent. Because of the excess precipitation: (1) ground-water levels were above the average monthly levels in four wells, (2) new high monthly ground-water levels were established in six wells, (3) new high ground-water levels for the period of record were established in 18 wells, (4) three stream gaging stations were in the excess-flow range during

most of the water year, (5) mean discharge, mean runoff, and mean volume were greater than the averages for the period of record for 10 representative drainage basins, and (6) seven new peak stages and five new peak discharges were established at stream gaging stations.

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