SKUNK RIVER

FLOOD PLAIN INFORMATION

ABOVE AMES, IOWA

J. Hammond

VICINITY MAP

25 0 25 50 75
SCALE IN MILES

PREPARED FOR THE STATE OF IOWA
IOWA NATURAL RESOURCES COUNCIL
BY CORPS OF ENGINEERS, U.S. ARMY
ROCK ISLAND DISTRICT, ILLINOIS
JUNE 1975

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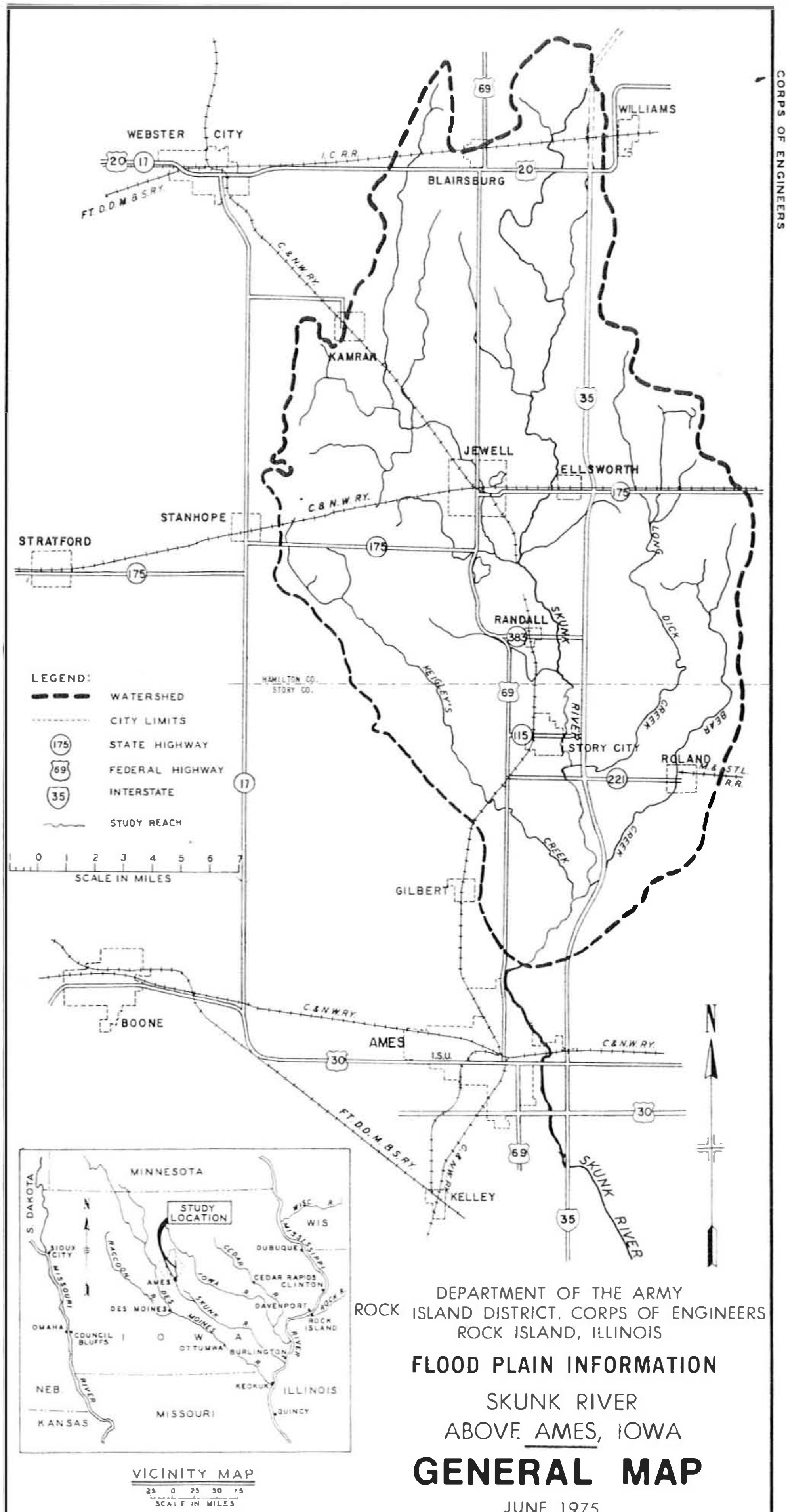
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BEAR CREEK
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HAMILTON CO.
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KELLEY
LEGEND:
WATERSHED
CITY LIMITS
STATE HIGHWAY
FEDERAL HIGHWAY
INTERSTATE
STUDY REACH
0 1 2 3 4 5 6 7
SCALE IN MILES
MINNESOTA
S. DAKOTA
STUDY LOCATION
SIOUX CITY
MISSOURI
RACCOON
AMES
DES MOINES
IOWA
SKUNK
CEDAR
DUBUQUE
CEDAR RAPIDS
CLINTON
DAVENPORT
ROCK ISLAND
MISSISSIPPI RIVER
WIS.
OMAHA
COUNCIL BLUFFS
I O W A
OTTUMWA
BURLINGTON
KEOKUK
NEB.
ILLINOIS
KANSAS
MISSOURI
QUINCY
VICINITY MAP
25 0 25 50 75
SCALE IN MILES
DEPARTMENT OF THE ARMY
ROCK ISLAND DISTRICT, CORPS OF ENGINEERS
ROCK ISLAND, ILLINOIS
FLOOD PLAIN INFORMATION
SKUNK RIVER
ABOVE AMES, IOWA
GENERAL MAP
JUNE 1975

PLATE 1

PREFACE

This report delineates areas subject to flooding from the Skunk River from just north of Ames, Iowa, northward to the northern Story County line. This reach includes a portion of the Cities of Ames and Story City, however, the area is primarily used for agricultural purposes. Properties along the river have been damaged by floods in 1918, 1944, 1947, 1954, 1958, 1960, 1965 and 1974. Open spaces near the communities are under pressure for development. Although large floods have occurred in the past, studies indicate that even larger floods are possible.

This report has been prepared because a knowledge of flood potential and flood hazards is important in land use planning and for management decisions concerning flood plain utilization. It includes a history of flooding in the study area and identifies those areas that are subject to possible future floods. Special emphasis is given to these floods through maps, photographs, profiles and cross sections. The report does not provide solutions to flood problems, however, it does furnish a suitable basis for the adoption of land use controls to guide flood plain development and thereby prevent intensification of the loss problems. It will also aid in the identification of other flood damage reduction techniques such as works to modify flooding and adjustments, including flood proofing, which might be embodied in an overall Flood Plain Management (FPM) program. Other FPM program studies--those of environmental attributes and the current and future land use role of the flood plain as part of its surroundings--would also profit from this information.

This report was prepared at the request of the Story County Board of Supervisors and the Story County Conservation Board with the endorsement of the Iowa Natural Resources Council by Brice, Petrides & Associates, Inc., Waterloo, Iowa, for the Corps of Engineers, Rock Island District, under continuing authority provided in Section 206 of the 1960 Flood Control Act, as amended.

Assistance and cooperation of the Story County Conservation Board, Story County Board of Supervisors, City of Ames, City of Story City, the Story City Herald, the Iowa Natural Resources Council, the National Weather Service, the United States Geological Survey and private citizens in supplying useful data and photographs for the preparation of this report are appreciated.

Additional copies of this report can be obtained from the Iowa Natural Resources Council. The Rock Island District of the Corps of Engineers, upon request, will provide technical assistance to planning agencies in the interpretation and use of the data presented as well as planning guidance and further assistance, including the development of additional technical information.

BACKGROUND INFORMATION

Settlement

Iowa was opened to settlers June 1, 1833, became a territory in 1838 and a state in 1846. With the establishment of statehood, increasing numbers of settlers were attracted to Iowa's rich agricultural land. Story County was platted before 1850. Nevada was founded in October, 1853, and became the county seat of Story County a short time later. The population of Story County in 1850 was 50.

John H. Keigley, his wife and at least one child settled six miles south of Story City in 1851. There were no roads nor bridges, only vast stretches of land covered by prairie grass, swamps, some creeks, the Skunk River and some wooded areas along the river. George William Sowers, his wife, three children, and a number of others arrived in 1853 at or near the present site of Story City. Mr. Sowers, Daniel M. Brown and George S. Prime promoted the second town in Story County called Fairview, in what is now a part of Story City. The name was changed to Story City in 1857. Story City was incorporated in 1881.

In 1864 the City of Ames was platted, and the first railroad train from the east reached Ames the 15th day of April, 1865. Ames was incorporated in 1870. Iowa State College (now Iowa State University) was founded in 1858.

The Stream and Its Valley

The Skunk River rises in Hamilton County in the central portion of Iowa and flows generally southeast to its confluence with the Mississippi nine miles below Burlington, Iowa. The reach covered by this study is approximately 18 miles long and flows generally in a southerly direction, as shown on the general map. Major tributaries in the study reach include Keigley Branch, Bear Creek and Long Dick Creek. Table 1 lists the drainage area at several points along the study reach.

TABLE 1

DRAINAGE AREAS
SKUNK RIVER

Location	Drainage Area sq. mi.
North Story County Line	173
Below the Mouth of Long Dick Creek	218
Below the Mouth of Bear Creek	258
Below the Mouth of Keigley Branch	306
At USGS Stream Gage North of Ames, Iowa	315

Developments in the Flood Plain

The predominant land use of the flood plain of the Skunk River is agricultural. However, some residential development exists at the lower end of the study reach near Ames and near the upper end of the study reach in the Story City area. The City of Story City has also located its sewage treatment facility and a municipal golf course in the flood plain.

Interstate No. 35 parallels the river throughout the study area and in places the highway embankment forms the eastern edge of the flood plain.

FLOOD SITUATION

Sources of Data

The United States Geological Survey (USGS) established a recording stream gage north of Ames, Iowa, on August 25, 1921. The gage is located 2.5 miles north of Ames and 3.5 miles downstream from Keigley Branch. Gage readings are available to date. Table 2 lists the major floods in the order of flow magnitude recorded at this gaging station.

Another USGS gaging station is located on the Skunk River just below the mouth of Squaw Creek. This is approximately 5 miles downstream of the above-referenced gage. Continuous stream flow data is available for this location from 1953 to the present date. There is also a USGS continuous recording stream gage on Squaw Creek at the Lincoln Way bridge in the City of Ames. Continuous stream flow data is available at this location from 1965 to the present date and additional stage and discharge data is also available on some floods prior to 1965.

TABLE 2
FLOOD CREST ELEVATIONS
SKUNK RIVER

Order No.	Date of Crest	Gage Heights Stage feet	Gage Heights Elevation feet (msl.)	Estimated Peak Discharge c.f.s.
1	June 10, 1954	13.66	907.27	8,630
2	May 20, 1944	13.90	907.51	8,060
3	June 13, 1947	11.95	905.56	6,550
4	March 30, 1960	10.33	903.94	6,210
5	June 23, 1974	9.61	903.22	5,780
6	March 29, 1951	10.90	904.51	5,320
7	April 6, 1965	9.43	903.04	5,260
8	November 24, 1930	11.20	904.81	5,230

In addition to the gage records, the USGS has made an indirect flow measurement at the bridge over the Skunk River near Randall on June 10, 1954. The flow rate was computed to be 13,600 c.f.s.

Newspaper files, historical documents and records were searched for information concerning past floods. Likewise, residents in the area were interviewed for past flood information. Using these data, a knowledge of floods which have occurred on the Skunk River, covered by this report, have been developed.

Flood Season and Flood Characteristics

Floods in the study area are caused primarily by intense rainfall with or without snowmelt. Floods caused by rainfall are characterized by shorter duration and high peak flows with relatively small volumes, whereas, snowmelt floods are characterized by longer duration and moderate peak flows with relatively large total volumes.

Snowmelt floods usually occur in spring and floods caused by intense rainfall occur anytime.

Factors Affecting Flooding and Its Impact

Obstructions to flood flows - Obstructions to flood flows are both natural and man-made. Natural obstructions include trees, brush, and other vegetation growing along the streambanks in floodway areas. Man-made obstructions include bridges, roadway fills and other obstructions or constrictions in the floodway. The bridges in the study area are shown in Figures 1 through 6 and listed in Table 3.

During floods, trees, brush, and other vegetation growing in the floodways impede flood flows, thus creating backwater and increased flood heights. Trees and other debris may be washed away and carried downstream to collect on bridges and other obstructions to flow. As flood flows increase, masses of debris break loose and a wall of water and debris surges downstream until another obstruction is encountered. Debris may collect against a bridge until the load exceeds its structural capacity. The limited flow capacity of obstructive bridges retard flood flows and result in flooding upstream, erosion of bridge piers and bridge approaches.

In general, obstructions restrict flood flows and result in overbank flows and unpredictable areas of flooding, destruction or damage to bridges, and an increased velocity of flow immediately downstream.

Flood damage reduction measures - There are no proposed or authorized flood control projects for this area.

A reservoir with the dam near the lower end of this study reach has been investigated. The project, Ames Dam and Reservoir, Skunk River, Iowa, was authorized in Public Law 89-298, approved 27 October 1965.

The dam would consist of an earth embankment about 85 feet high and about 1,450 feet long. Outlet works would consist of a 12-foot diameter tunnel, 500 feet in length, with gate tower on the upstream end, terminating in a stilling basin. The project would be operated for flood control, water quality control, recreation, and fish and wildlife enhancement.

Preconstruction planning for the project has been performed. However, in 1974, the State of Iowa expressed its opposition to proceeding with the project at this time. The project was reclassified "Inactive" in June 1974.

The present county zoning ordinance does not identify the flood prone areas nor take flood hazard into consideration even for areas that have been previously flooded. This study has been requested so that it may be used to identify the flood plain for the development of effective and more comprehensive flood plain management regulatory measures.

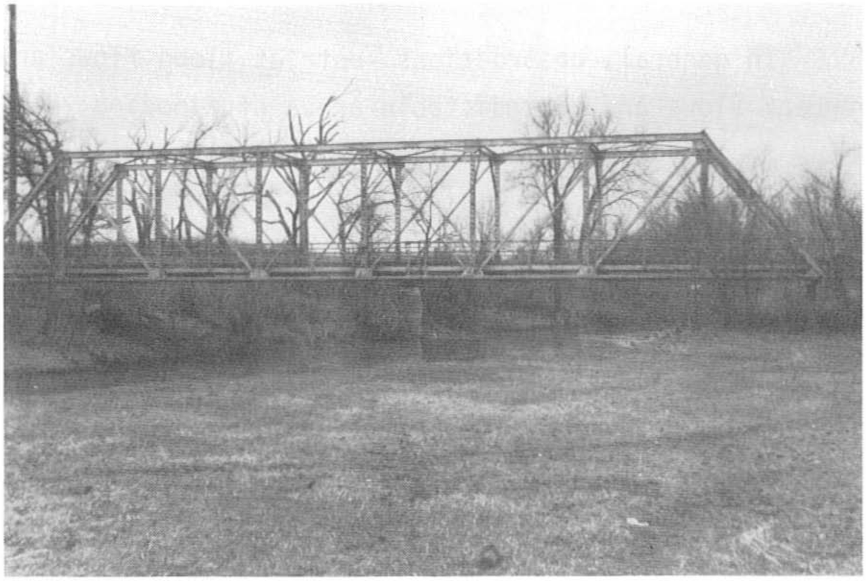


Figure 1. Skunk River - county road bridge at northeast corner of Section 13, T84N-R24W, looking downstream, Mile 8.02.

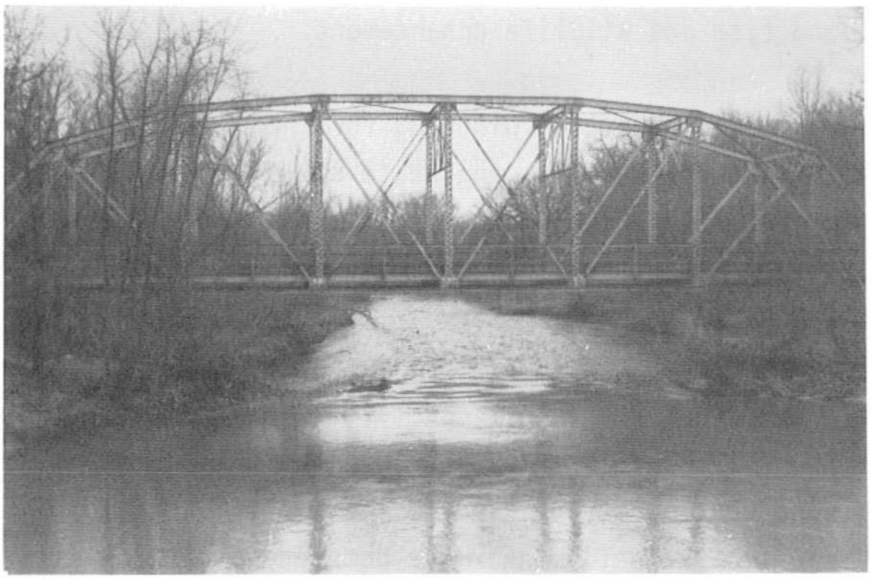


Figure 2. Skunk River - new Soper Mills bridge, looking downstream, Mile 9.62.

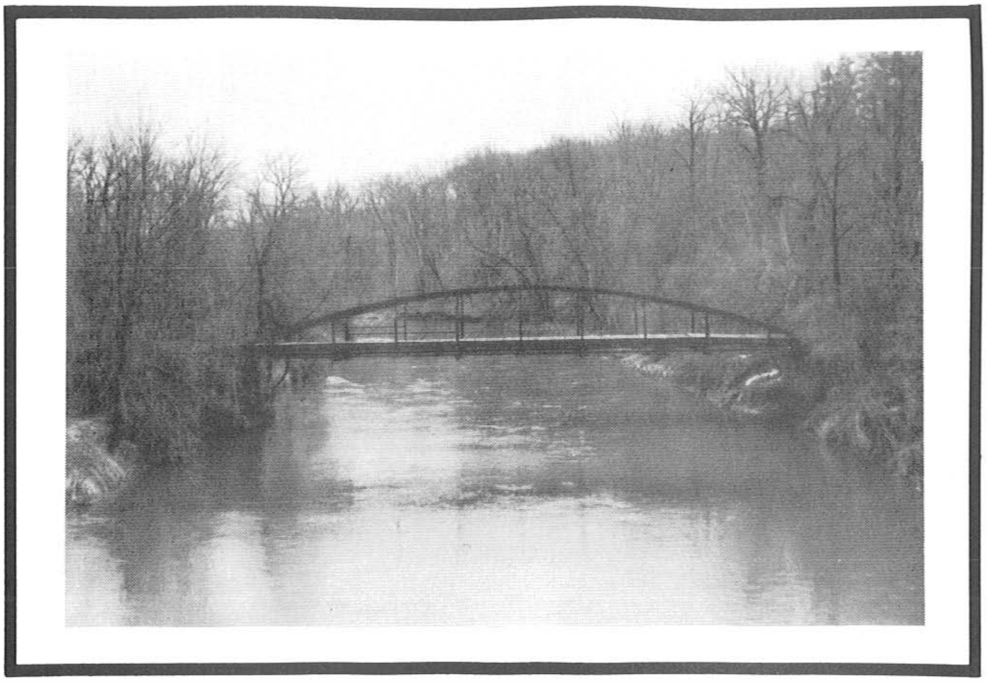


Figure 3. Skunk River - old Soper Mills bridge, looking downstream, Mile 9.65.

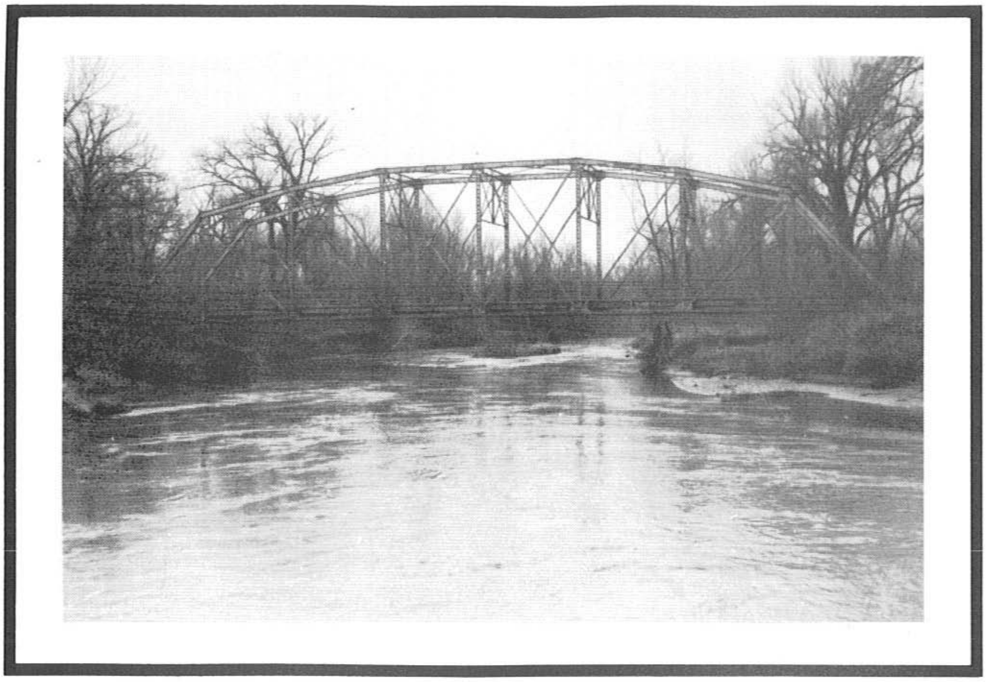


Figure 4. Skunk River - county road bridge at north quarter corner of Section 31, T85N-R23W, looking downstream, Mile 13.03.

Figure 5. Skunk River - Iowa Highway No. 221, looking upstream, Mile 16.75.

Figure 6. Skunk River - Broad Street, looking downstream, Mile 20.67.

TABLE 3

BRIDGES AND FLOOD ELEVATIONS

SKUNK RIVER

Study River Mile	Identification	Type	Number of Spans and Length in Feet	Approx. Low Steel Elevation	Flood Crest Elevations: Intermediate Regional Flood	Flood Crest Elevations: Standard Project Flood
8.02	County Road	Steel Truss	1 @ 140	922.4	921.9	930.6
9.62	County Road (Soper Mills Bridge)	Steel Truss	1 @ 152	932.3	929.0	935.7
9.65	Abandoned Soper Mills Bridge	Bow-string Truss	1 @ 80	929.3	929.3	935.7
13.03	County Road	Steel Truss	1 @ 155	941.7	942.0	949.1
16.75	Iowa Highway No. 221	Steel Truss	1 @ 156	961.4	956.8	965.9
20.67	Broad Street (Story City)	Concrete Slab	3 @ 50.5	974.5	973.1	980.1

Other factors and their impacts

Flood warning and forecasting - The National Oceanic and Atmospheric Administration (NOAA) National Weather Service provides flood forecasting service for major river basins. This system involves predictions of anticipated stages at a particular gage or gages in the basin. These forecasts are based on observed precipitation and stages at upstream points and anticipated weather conditions. The flood forecast is transmitted to City officials, newspapers, and radio and television stations in the basin. These media disseminate the information to residents of the flood plain in the form of a flood warning. This timely forewarning permits protective measures to be undertaken by industrial plants, public utilities, municipal officials, and individuals with property in the lowlands. Services available are of the following types:

1. Flash Flood: The Weather Service Forecast Office located at Des Moines supplies weather forecasts twice daily for the State. In addition to the routine forecasts, special forecasts of severe storms and general flash flood watches for small streams are issued as required. Ames is well within radar range of the WSR-57 radar at Des Moines which is capable of immediate detection and evaluation of rainfall intensity, location, and movement of storms and areas of heavy rainfall. Information is promptly relayed by teletype circuits and rainfall to radio and TV for broadcast and also to the River Forecast Center at Kansas City for action. The Weather Service Forecast Office at Des Moines issues Flash Flood Warnings as required for small streams in its area of responsibility.

2. Major Floods: River stage forecasts for Ames are based on radar coverage, reports from one river station, and 8 rainfall reporting stations in or near the basin. The River Forecast Center at Kansas City is staffed with professional hydrologists responsible for the preparation of river forecasts based on water equivalent of snow cover, rainfall-runoff relations, streamflow routing, and a working knowledge of anticipated weather conditions. The lead time between distribution of the forecasts and the flood crest may be short; however, lead time normally ranges from 12 hours for rainfall and up to a week or more for snowmelt. Specific crest forecasts are issued for Ames, Iowa, as required. The River District Office at Des Moines is responsible for the interpretation and distribution of flood forecasts and the operation of the hydrologic reporting substation network in its River District.

3. Hydroclimatic Data: Most of the data from the network is published. These records provide the basis for forecasts as well as for the planning and design of protective works and their operation during floods.

Flood fighting and emergency evacuation plans - Although there are no formal flood fighting or emergency evacuation plans for the area, provisions for alerting area residents and coordinating flood fighting operations of city and public service agencies in time of emergency are accomplished through the County and State Civil Defense and the County Engineer's Office.

Material storage on the flood plain - Fallen trees, logs, cars, construction materials, and other floatable objects may be found in the flood plains of the study area.

During floods, these floatable materials may be carried away by flood flows which can cause serious damage to structures and can clog bridge openings to create more hazardous flooding problems.

PAST FLOODS

Summary of Historical Floods

Damaging floods have been reported to have occurred on the Skunk River near Ames as early as 1881. Floods causing significant damage are described to have occurred in 1918, 1944, 1947, 1954, 1958, 1960, 1965 and 1974.

Flood Records

Flood heights were obtained at the USGS stream gaging station north of Ames. High water marks of past floods were obtained and newspaper files and historical documents were searched for information concerning past floods. Flood records were also examined for the stream gage on the Skunk River below the mouth of Squaw Creek and the stream gage on Squaw Creek.

Flood Descriptions

The following are descriptions and newspaper accounts of some of the past large floods that have occurred on the Skunk River north of Ames.

Flood of June 1918 - This is one of the earliest recorded floods. Runoff from sustained heavy rains resulted in one of the largest recorded floods on the Skunk River. The flood was produced by the combination of a series of heavy rainfalls totaling 14 inches within 20 consecutive days.

The Story City Herald, in its edition of Thursday, June 6, 1918, relates:

"On Tuesday morning the extent of the flood became evident. The Skunk River was highest in the memory of living men. The water surged all through the park, tearing the bandstand loose and carrying bridges around like feathers. The river reached up and licked the edge of our new pavement at the southwest corner of the park. The cement bridge was hid by the torrent. North and south of town, the bridges over the classic Skunk were rendered useless.

"It is estimated that the loss to Story County in bridges alone will run over two hundred thousand dollars.

"Hundreds of rods of woven wire were washed away by the flood waters during the past week. Perhaps the best idea of the height attained by the water in the river and the various creeks is to note the driftwood on the side of the hills and high land. It is almost impossible to believe that the water actually carried this debris to the heights shown. But it must be true.

"We note that Parley Sheldon of Ames believes that on July 7, 1881, the river was as high or higher than it was this week. He recalls that a man built a raft and carried brick enough to veneer a house from Ames to Cambridge.

"The highways are in such condition the mail carriers have been unable to make their routes and Skunk River is the highest it has ever been known with the exception of the flood of 1881."

Flood of May 1944 - The storm consisted of heavy winds and 8.21 inches of rain fell during a 48 hour period in the Ames area. Several county roads were blocked because of washed out and weakened bridges. Total damage in Ames surpassed all previous storm damages.

The Story City Herald, in its edition of Thursday, May 25, 1944, relates:

"Story City awoke Friday morning to see Skunk River far over its bank, with both parks covered with water. It was the highest the river has been since 1918. The rain during the night was approximately four inches, and seems to have covered a wide area, judging from reported floods in neighboring counties.

"Story City had no trains on Friday, Saturday and Sunday - the first time in many a day we've gone so long without our mail in the good old summertime."

Flood of June 1974 - The Story City Herald, in its edition of Wednesday, June 26, 1974, relates:

"High winds and torrential rain hit central Iowa Friday night, ripping homes and trees and causing flash floods on land that hadn't yet dried from last Tuesday's storm. Surrounding farms lost crops, buildings, and animals in what is estimated the worst storm in Story City since 1881.

"Hail and an estimated four inches of rain fell through the night. The Skunk River flooded both parks and covered the golf course."

Photographs of past floods at selected locations are shown in Figures 7 through 11.

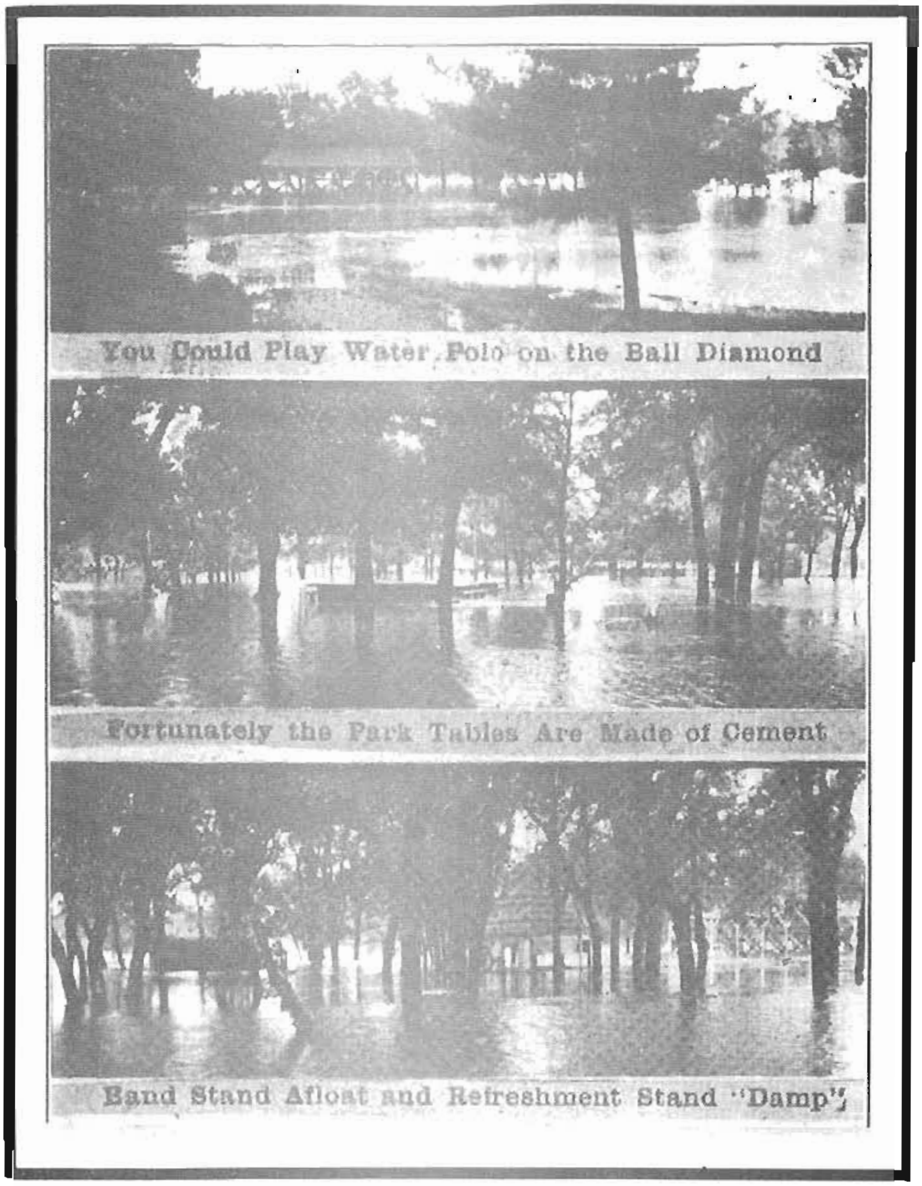


Figure 7. Skunk River - Story City park during flood of 1918.

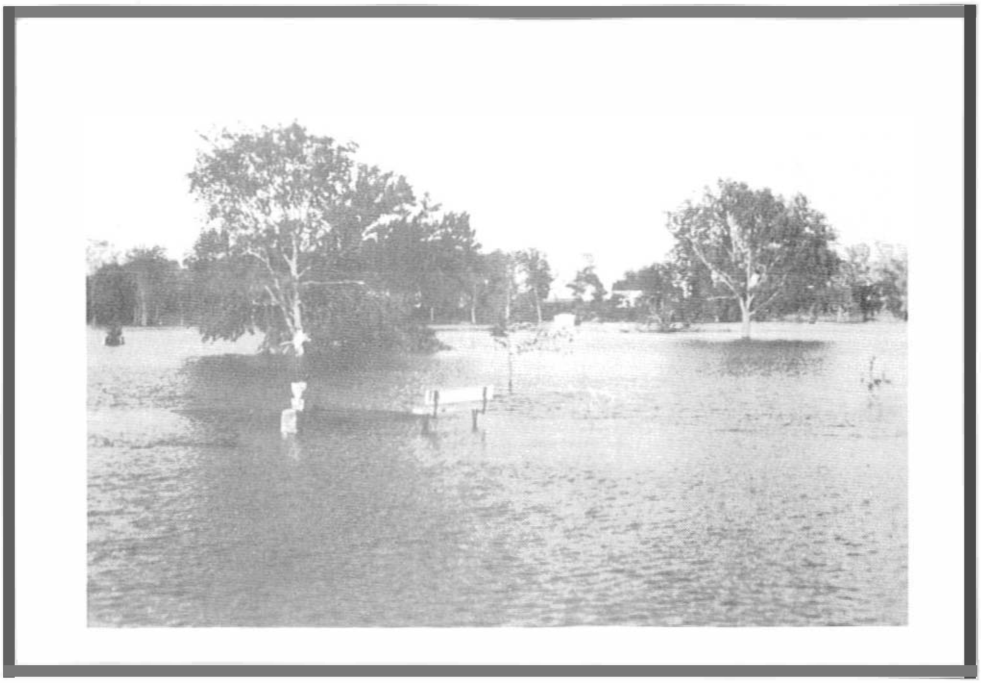


Figure 8. Riverbend Golf Course, flood of 1974.

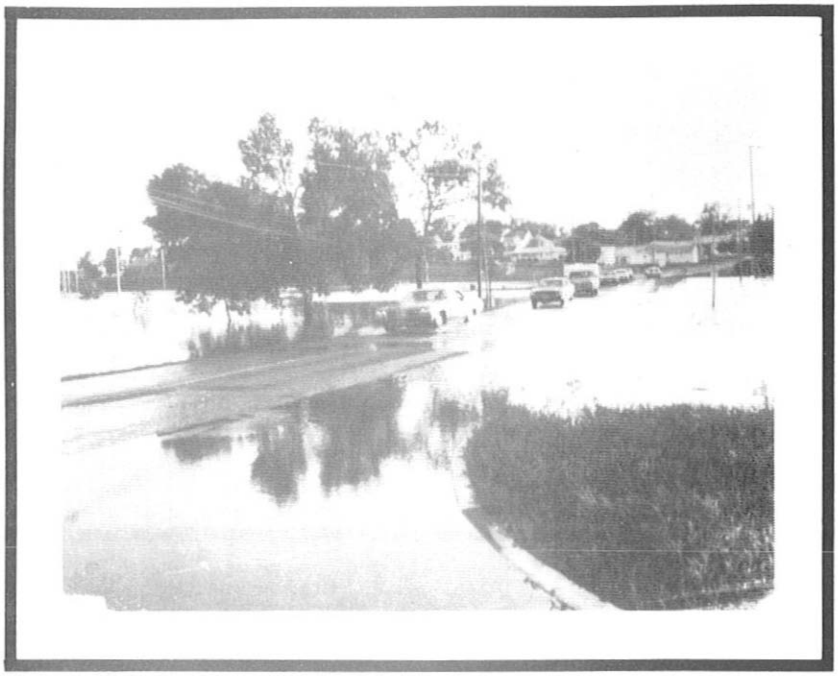


Figure 9. East of Story City on E. Broad Street, flood of 1974.

Figure 10. No. 6 green on Riverbend Golf Course, flood of 1974.

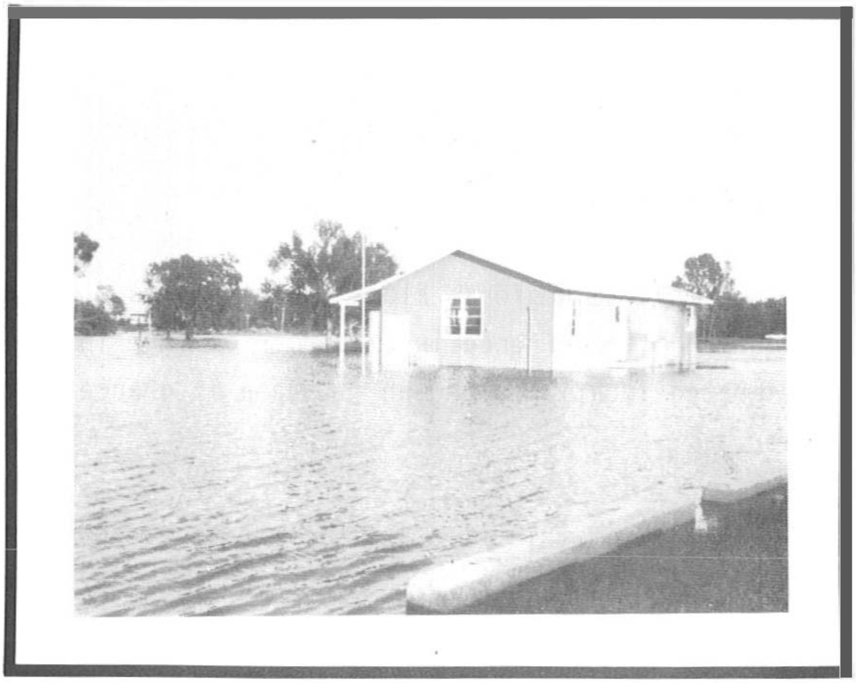


Figure 11. Clubhouse at Riverbend Golf Course, flood of 1974.

FUTURE FLOODS

Floods of the same magnitude as past floods can recur and floods larger than those known to have occurred in the study area can occur in the future. Discussion of these future floods are limited to those that have been designated as the Intermediate Regional Flood and the Standard Project Flood. The Standard Project Flood represents a reasonable upper limit of expected flooding with the existing conditions of development and encroachment in the flood plain area under study. The Intermediate Regional Flood represents a flood that may reasonably be expected to occur more frequently than the Standard Project Flood, although less severe.

Intermediate Regional Flood

The Intermediate Regional Flood is defined as a flood having an average frequency of occurrence in the order of once in one hundred years at a designated location although it has a 1% chance of occurring in any year.

The peak flow of this flood was developed using a unit hydrograph technique. The unit hydrograph was derived from a recorded flood hydrograph at the USGS stream gage north of Ames for the flood of 14 July 1962. The derived unit hydrograph accurately reconstituted the flood hydrograph for the June, 1947, flood. It was thus used to develop the flood hydrograph for the Intermediate Regional Flood at the gage site.

Table 4 shows peak flows of the Intermediate Regional Flood at selected locations in the study area.

Standard Project Flood

The Standard Project Flood is defined as a major flood that can be expected to occur from a severe combination of meteorological and hydrological conditions that is considered reasonably characteristic of the geographical area under consideration excluding extremely rare combinations. The Corps of Engineers, in cooperation with the National Weather Service, has made comprehensive studies and investigations based on the past records of experienced storms and floods and has developed generalized procedures for estimating the flood potential of streams. Peak discharges for the Standard Project Flood at selected locations are shown in Table 4. Plate 15 shows the Standard Project Flood discharge hydrograph.

TABLE 4
PEAK DISCHARGES
SKUNK RIVER

Location	Drainage Area sq. mi.	Intermediate Regional Flood c.f.s.	Standard Project Flood c.f.s.
USGS Gage North of Ames	315	12,200	44,000
Below Confluence with Keigley Branch	306	12,000	43,600
Below Confluence with Bear Creek	258	11,100	40,000
Below Confluence with Long Dick Creek	218	10,100	36,500
At Northern Story County Line	173	9,000	32,600

Frequency

Stream flow frequency data used in the study were derived by synthetic procedures based on stream gage records. Since the frequency analysis is based on chance and therefore approximate, it should be used with caution in connection with any planning of flood plain use. Floods larger than the Standard Project Flood are possible but the combinations of factors necessary to produce such large flows would be extremely rare. However, around twenty percent of the major storms which have occurred in the United States exceed the Standard Project Flood rainfall.

Hazards of Large Floods

The extent of damage caused by any flood depends on the topography of the area flooded, depth and duration of flooding, velocity of flow, rate of rise, and developments in the flood plain. An Intermediate Regional or Standard Project Flood on the Skunk River in the study area would result in inundation of residential, agricultural, commercial, and industrial areas. Deep floodwater flowing at high velocity and carrying floating debris or ice would create conditions hazardous to persons and vehicles attempting to cross flooded areas. In general, floodwater three or more feet deep and flowing at a velocity of three or more feet per second could easily sweep an adult person off his feet. Rapidly rising and swiftly flowing floodwater may trap persons in homes that are ultimately destroyed, or in vehicles that are ultimately submerged or floated. Waterlines can be ruptured by deposits of debris and the force of floodwaters, thus creating the possibility of contaminated domestic water supplies. Damaged sanitary sewerlines and sewage treatment plants could result in the pollution of floodwaters. Isolation of areas by floodwater could create hazards in terms of medical, fire, or law enforcement emergencies.

Flooded areas and flood damages - The areas that would be flooded by the Standard Project Flood and the Intermediate Regional Flood are delineated on Plates 3 through 11. Plate 2 is an index map showing the location of the flooded area maps on Plates 3 through 11. The actual limits of these overflow areas on the ground may vary from those shown on the maps because the scale of the maps does not permit precise plotting of the flooded area boundaries. With consideration of contour interval, map scale, and changes in topography since mapping has been completed, the delineations of the flooded areas in color should be accepted as general guides to areas inundated by the Standard Project Flood and the Intermediate Regional Flood. For specific locations, the water surface elevations of the aforementioned floods should be taken from Plates 12 through 14. These plates show the water surface profiles for the Standard Project and Intermediate Regional Floods. Additional information regarding flooding by the Standard Project and the Intermediate Regional Floods may also be obtained from Plate 16 showing typical flooded cross sections. Cross section locations are shown on the flooded area maps, Plates 3 through 11, and the water surface profiles on Plates 12 through 14. Table 5 lists the water surface elevations for the Intermediate Regional Flood and the Standard Project Flood along the streams covered by this report.

Obstructions - The water surface profiles of the Standard Project and the Intermediate Regional Floods depend in part upon the degree of obstruction and destruction of various bridges during flood. Debris carried downstream by floodwaters may collect on bridges which could decrease their carrying capacity and cause greater water depths upstream of these structures. Because it is impossible to forecast these events, it was assumed that all bridge structures would stand and that no clogging by debris or ice would occur. In some cases bridges may be high enough so as not to be inundated by flood flows; however, the approaches to these bridges may be at lower elevations subject to flooding and rendered impassable. Table 3 lists water surface elevations for the Standard Project and Intermediate Regional Floods at all bridges in the study reach that may be restrictive during flood flows. Table 5 lists water surface elevations at the location of all cross sections along the study reach.

TABLE 5

FLOOD ELEVATIONS

SKUNK RIVER

Study River Mile miles above mouth of Squaw Creek	Identification	Intermediate Regional Flood feet (msl.)	Standard Project Flood feet (msl.)
4.91	At USGS Gage	907.6	931.8
5.96		912.3	919.2
6.61		915.5	923.1
8.01	DS County Road	921.9	930.4
8.03	US County Road	921.9	930.6
8.56		924.1	932.5
9.46		927.7	934.9
9.60	DS Soper Mills Bridge	928.6	935.5
9.63	US Soper Mills Bridge	929.0	935.7
9.66	US Old Soper Mills Bridge	929.3	935.7
9.77		930.3	942.2
9.97		932.0	945.8
10.26		932.9	947.2
10.91		934.8	947.6
11.91		938.3	949.2
12.51		939.7	949.6
13.02	DS County Road	942.0	950.7
13.04	US County Road	942.8	951.0
14.46		946.2	952.7
15.94		953.3	957.0
16.74	DS Iowa Highway No. 221	956.7	963.6
16.76	US Iowa Highway No. 221	956.8	965.9
17.26		959.6	966.6
18.46		961.7	968.6
19.11		965.7	971.7
20.04		970.4	975.4
20.22	DS Story City STP	970.5	975.4
20.26	US Story City STP	971.8	979.5
20.66	DS Broad Street (Story City)	972.5	979.9
20.68	US Broad Street (Story City)	973.1	980.1
20.83		973.1	980.1
21.21		973.9	980.6
21.76		976.2	981.9
22.31		979.6	983.8
23.10		981.7	986.9

Velocities of flow - Water velocities during floods depend largely on the size and shape of the cross sections, conditions of the stream, and the streambed slope, all of which vary on different streams and at different locations on the same stream. Table 6 lists the maximum velocities of the Standard Project and Intermediate Regional Floods at various locations in the study area. These velocities are based on open river conditions and may be considerably greater at flow constrictions. Due to these high channel and overbank velocities severe erosion to streambanks, fill and scour around bridge piers and abutments, and transporting of large objects downstream are possible.

Rates of rise and duration of flooding - Intense rainfall with or without snowmelt usually produces the floods in the study area. Table 7 lists the maximum rate of rise, height and time of rise from bank-full stage to maximum flood flow level, and duration above bank-full stage for the Standard Project and the Intermediate Regional Floods in the streams investigated.

Photographs, future flood heights - Figures 12 through 19 show the approximate levels of the Standard Project Flood and the Intermediate Regional Flood at various locations in the study area.

TABLE 6

MAXIMUM VELOCITIES

SKUNK RIVER

Location River Mile	Flood	Maximum Velocities Channel f.p.s.	Maximum Velocities Overbank f.p.s.
6.61	Intermediate Regional	6.7	1.8
6.61	Standard Project	11.1	3.8
9.46	Intermediate Regional	7.6	2.4
9.46	Standard Project	7.9	2.8
9.66	Intermediate Regional	9.3	1.9
9.66	Standard Project	23.0	5.3
10.91	Intermediate Regional	7.6	1.3
10.91	Standard Project	14.5	4.2
12.51	Intermediate Regional	7.1	2.0
12.51	Standard Project	9.3	4.0
17.26	Intermediate Regional	3.4	0.9
17.26	Standard Project	4.8	1.7
20.22	Intermediate Regional	10.1	3.7
20.22	Standard Project	20.5	8.1
20.83	Intermediate Regional	4.3	1.9
20.83	Standard Project	5.1	2.8
23.10	Intermediate Regional	8.5	1.8
23.10	Standard Project	14.6	4.2

TABLE 7

RATES OF RISE AND DURATION

SKUNK RIVER

Location	Flood	Maximum Rate of Rise ft/hr	Height of Rise feet	Time of Rise hours	Duration Above Bank-full Stage hours
USGS Gage North of Ames	Standard Project	2.0	20.0	42	120
	Intermediate Regional*	1.0	14.0	36	45

*Estimated values

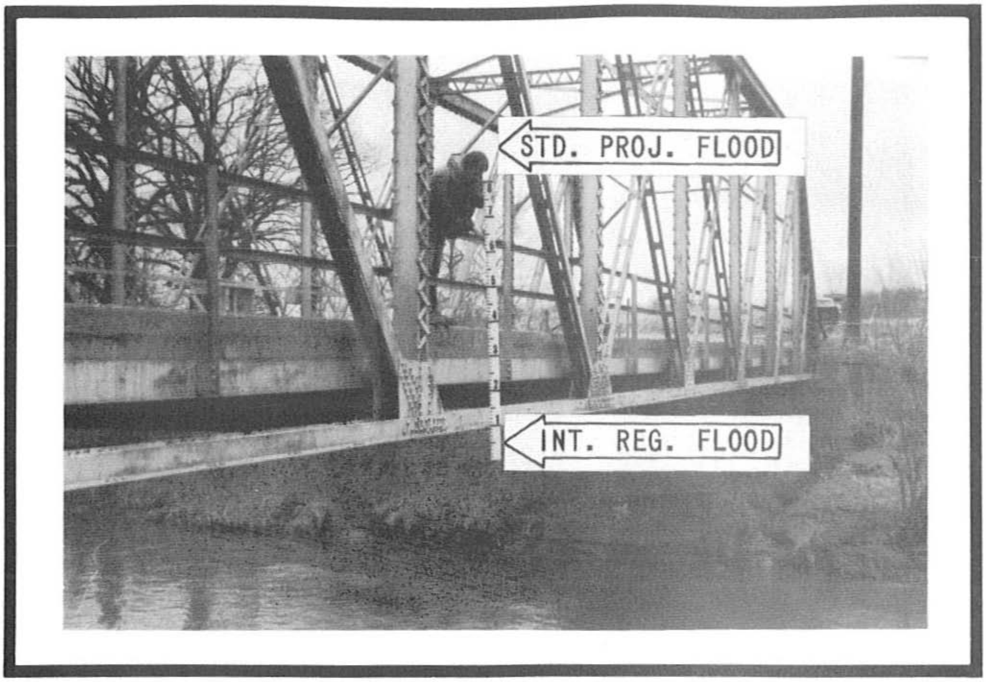


Figure 12. Skunk River - county road, northeast corner of Section 13, T84N-R24W, Mile 8.02, downstream side.

Figure 13. Skunk River - new Soper Mills bridge, Mile 9.62, upstream side.

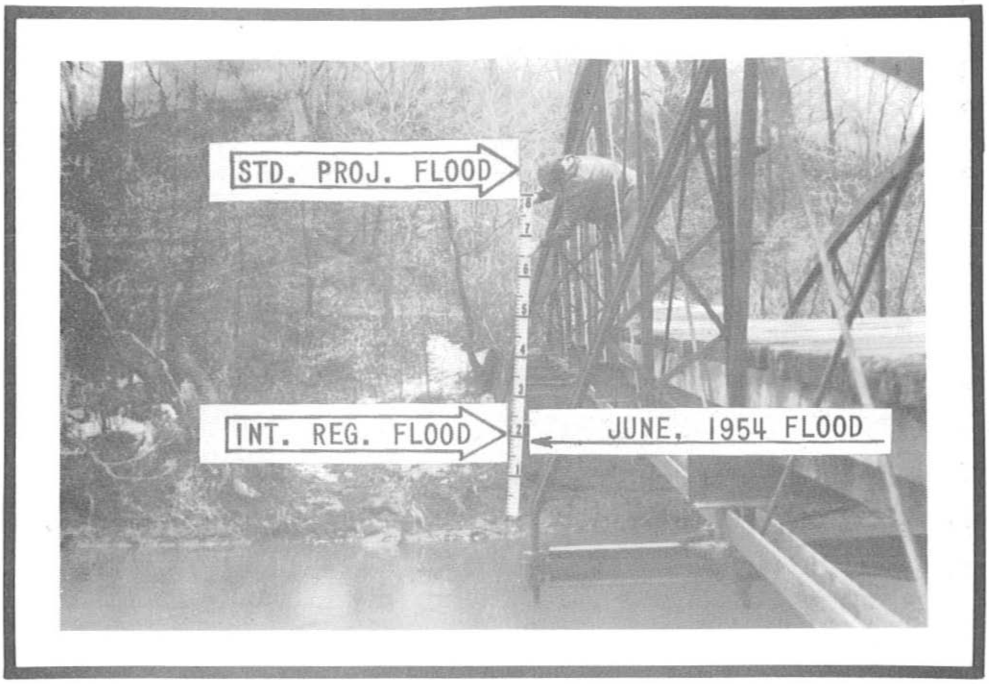


Figure 14. Skunk River - old Soper Mills bridge, Mile 9.65, upstream side.

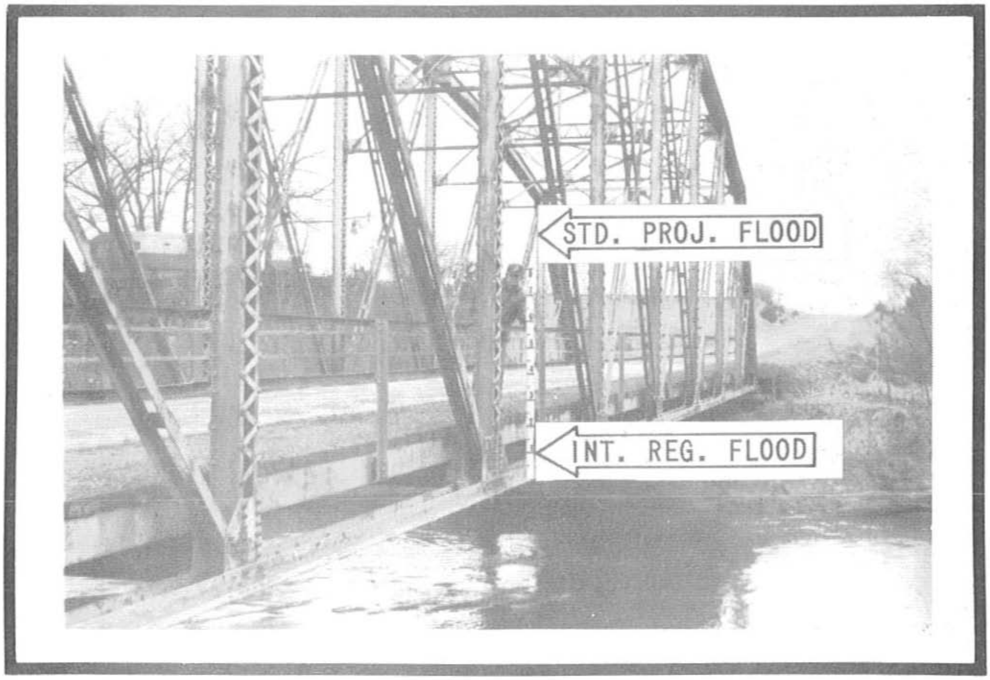


Figure 15. Skunk River - county road at north quarter corner of Section 31, T85N-R23W, Mile 13.03, upstream side.

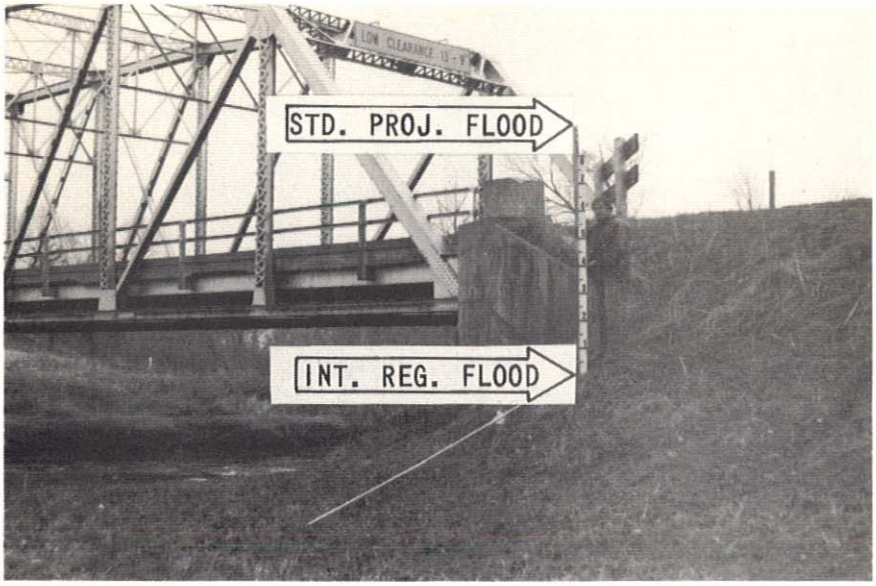


Figure 16. Skunk River - Iowa Highway No. 221, Mile 16.75, upstream side.

Figure 17. Story City Water Pollution Control Facility, northwest fence corner, Mile 20.22.

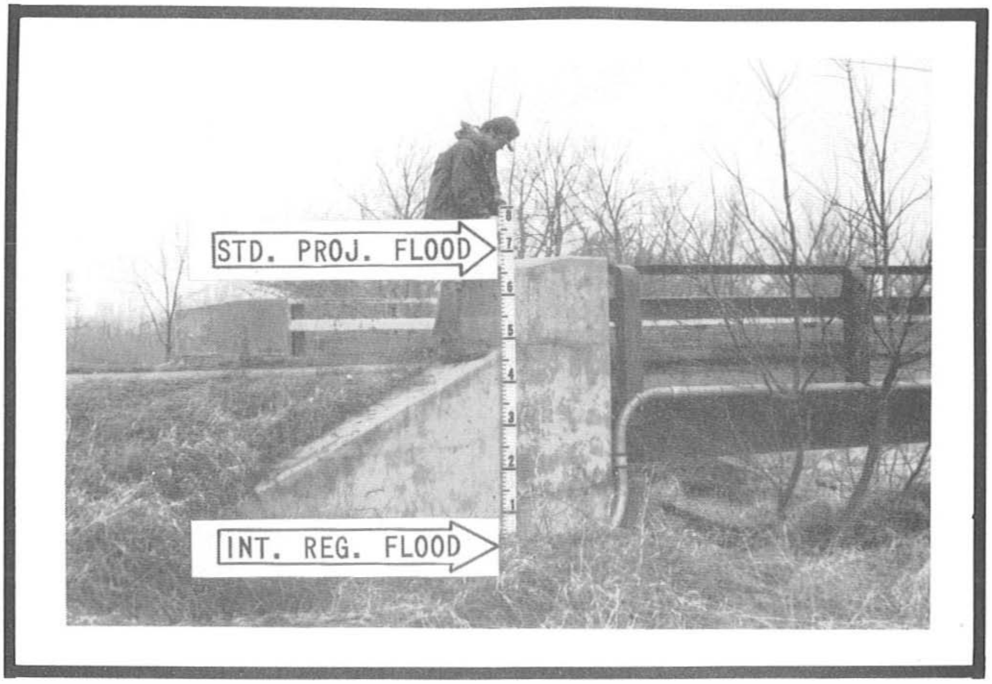


Figure 18. Skunk River - Broad Street, Mile 20.67, upstream side.

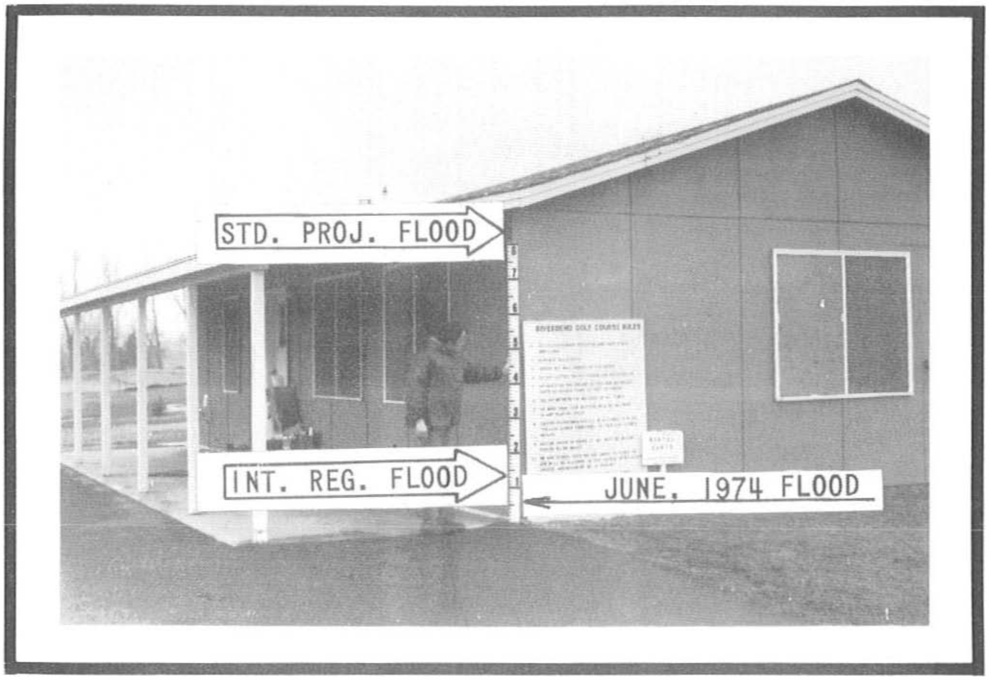


Figure 19. Riverbend Golf Course, Story City, Iowa, northeast corner of clubhouse, Mile 20.65.

GLOSSARY

Backwater. The resulting high water surface in a given stream due to downstream obstruction or high stages in an intersecting stream.

Bank-full Stage. The stage or elevation at which overflow of the natural banks of a stream or body of water begins in the reach or area in which the elevation is measured.

Climatological Station. The place where temperature, precipitation, evaporation, soil temperature, and other atmospheric phenomena are observed and recorded.

Discharge. The rate of flow or volume of water flowing in a given stream at a given place and within a given period of time.

Discharge Hydrograph. A graph showing discharge with respect to time.

Flood. An overflow of lands not normally covered by water and that are used or usable my man. Floods have two essential characteristics: The inundation of land is temporary and the land is adjacent to and inundated by overflow from a river, stream, ocean, lake, or other body of standing water.

Floodway. The channel of a watercourse and those portions of the adjoining flood plain which are required to carry and discharge the floodwaters.

Flood Crest. The maximum stage or elevation reached by floodwaters at a given location.

Flood Hazard. The state or degree of risk for those exposed or susceptible to flooding.

Flood Plain. The areas adjoining a river, stream, watercourse, ocean, lake, or other body of standing water that have been or may be covered by floodwater.

Flood Profile. A graph showing the relationship of water surface elevation to location, the latter generally expressed as distance above mouth for a stream of water flowing in an open channel.

Flood Proofing. A body of techniques for preventing or reducing flood damage to isolated structures and contents of buildings in a flood hazard area. It seeks to reduce damage once floodwater reaches a building.

Frequency Curve. This is actually a cumulative frequency curve which relates the magnitude of an event to the frequency with which that magnitude is exceeded as events occur at random. For example, if 25 floods at a location exceed 10,000 cubic feet per second in 100 years, on the average, then the value of 10,000 c.f.s. on the frequency curve will correspond to an exceedence probability of 0.25 in any one year or an exceedence frequency of 25 times per 100 years, 250 times per 1,000 years or simply 25 percent.

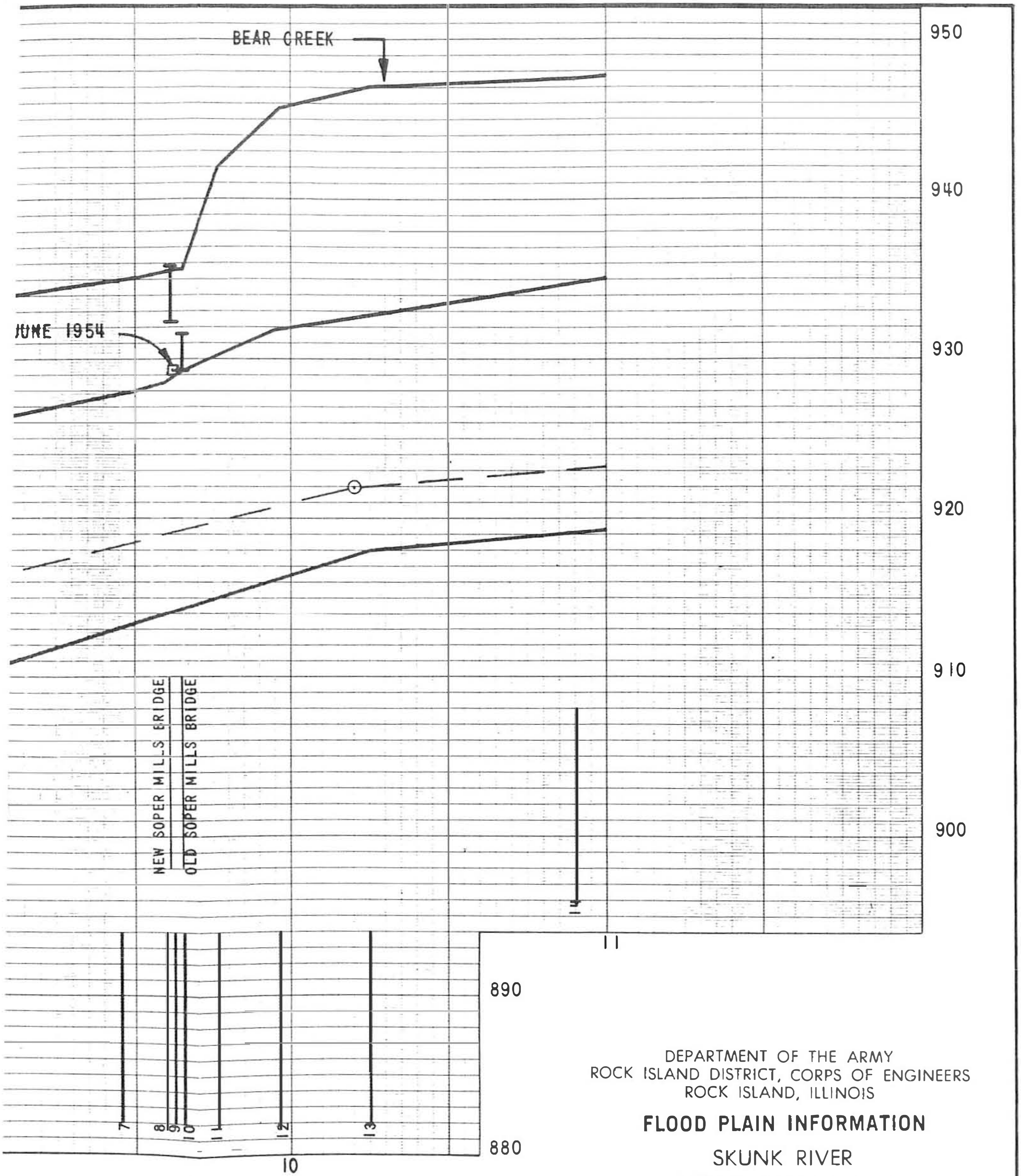
Intermediate Regional Flood. A flood having an average frequency of occurrence in the order of once in 100 years although the flood may occur in any year. It is based on statistical analyses of streamflow records available for the watershed and analyses of rainfall and runoff characteristics in the general region of the watershed.

Low Steel. The lowest point of a bridge or other structure over or across a river, stream or watercourse that limits the opening through which water flows. For culverts or arch bridges, it is the elevation at the top of the opening.

Stage Hydrograph. A graph showing the position or elevation of the water surface with respect to time.

Standard Project Flood. The flood that may be expected from the most severe combination of meteorological and hydrological conditions that is considered reasonably characteristic of the geographical area in which the drainage basin is located, excluding extremely rare combinations. Peak discharges for these floods are generally about 40-60 percent of the Probably Maximum Floods for the same basins. As used by the Corps of Engineers, Standard Project Floods are intended as practicable expressions of the degree of protection that should be sought in the design of flood control works, the failure of which might be disastrous.

Streambed. The bottom part of a stream below the usual water surface. It is the area which is kept practically bare of vegetation by the wash of the waters of the stream from year to year.



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ROCK ISLAND, ILLINOIS

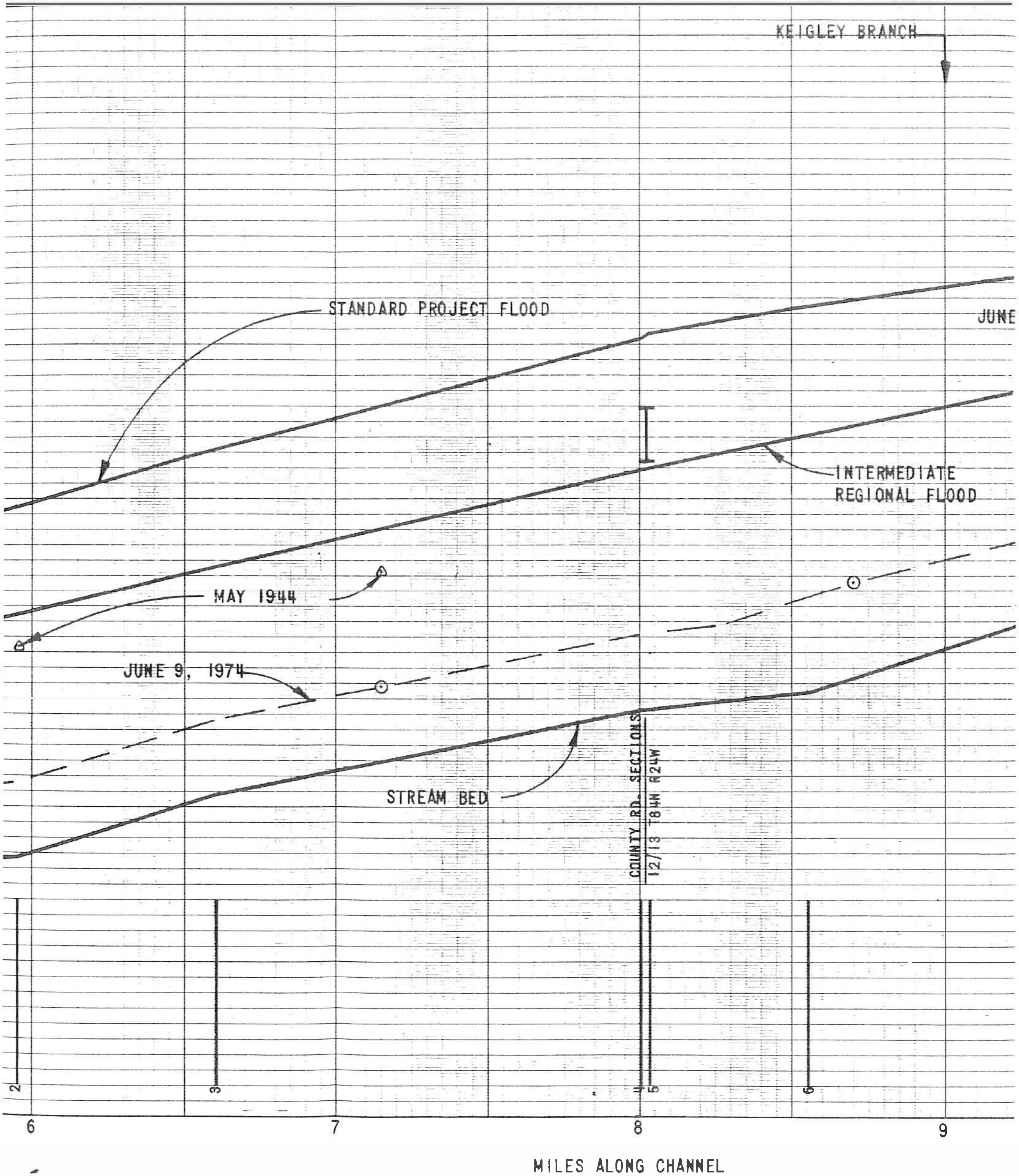
FLOOD PLAIN INFORMATION

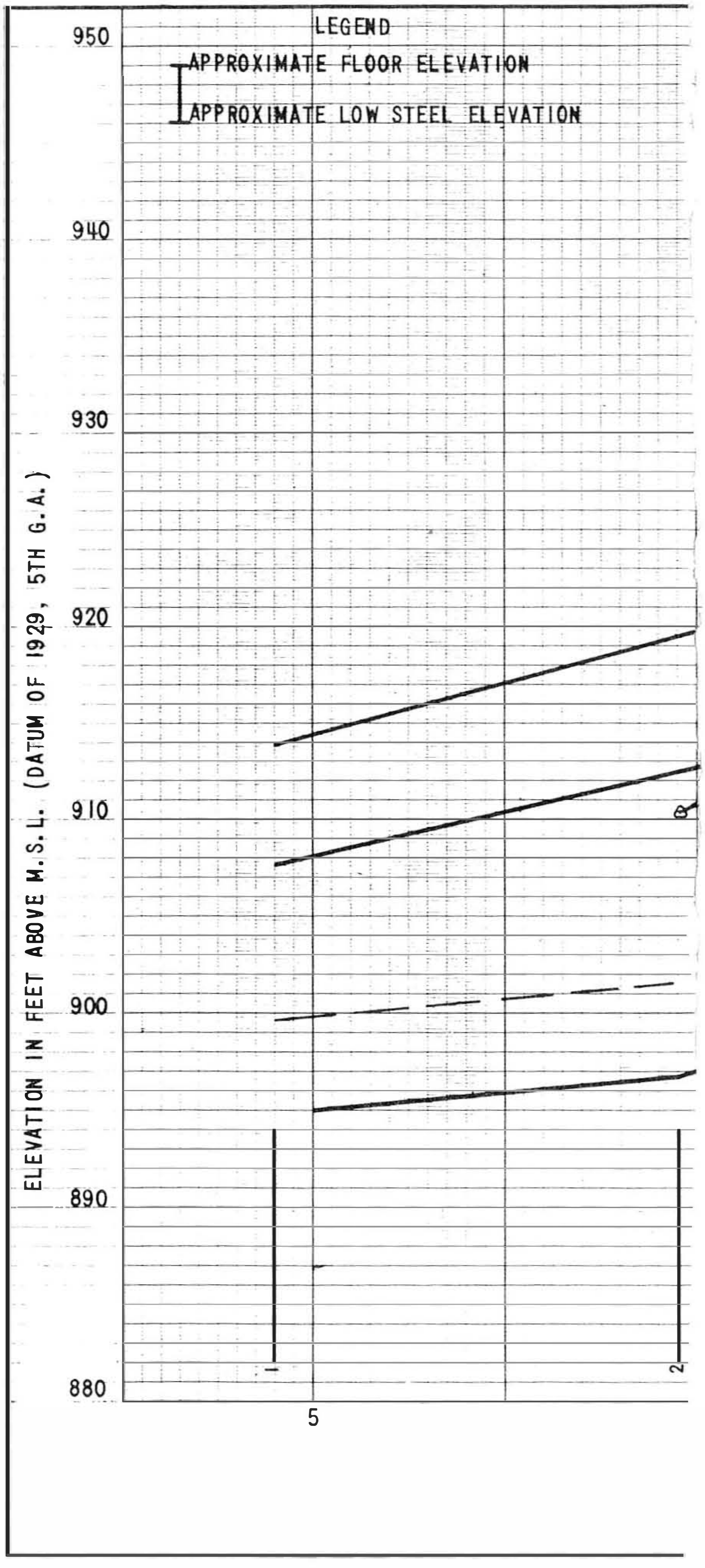
SKUNK RIVER
ABOVE AMES, IOWA

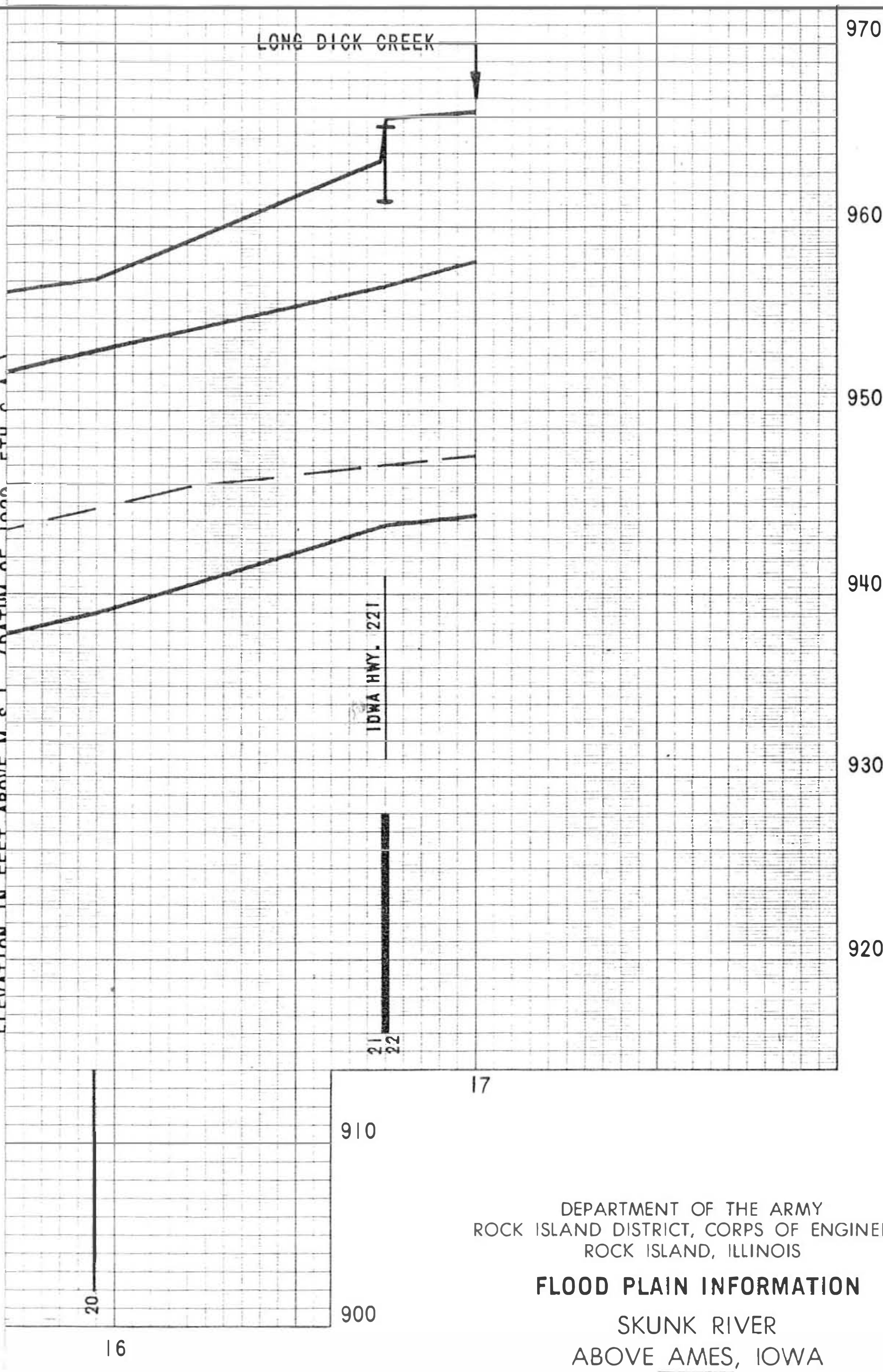
HIGH WATER PROFILES

JUNE 1975

PLATE 12


KEIGLEY BRANCH
STANDARD PROJECT FLOOD
JUNE
INTERMEDIATE
REGIONAL FLOOD
MAY 1944
JUNE 9, 1974
STREAM BED
COUNTY RD. SECTIONS
12/13 T84N R24W
2
3
4
5
6
6
7
8
9
MILES ALONG CHANNEL


LEGEND
APPROXIMATE FLOOR ELEVATION
APPROXIMATE LOW STEEL ELEVATION
ELEVATION IN FEET ABOVE M.S.L. (DATUM OF 1929, 5TH G.A.)
950
940
930
920
910
900
890
880
5
1
2



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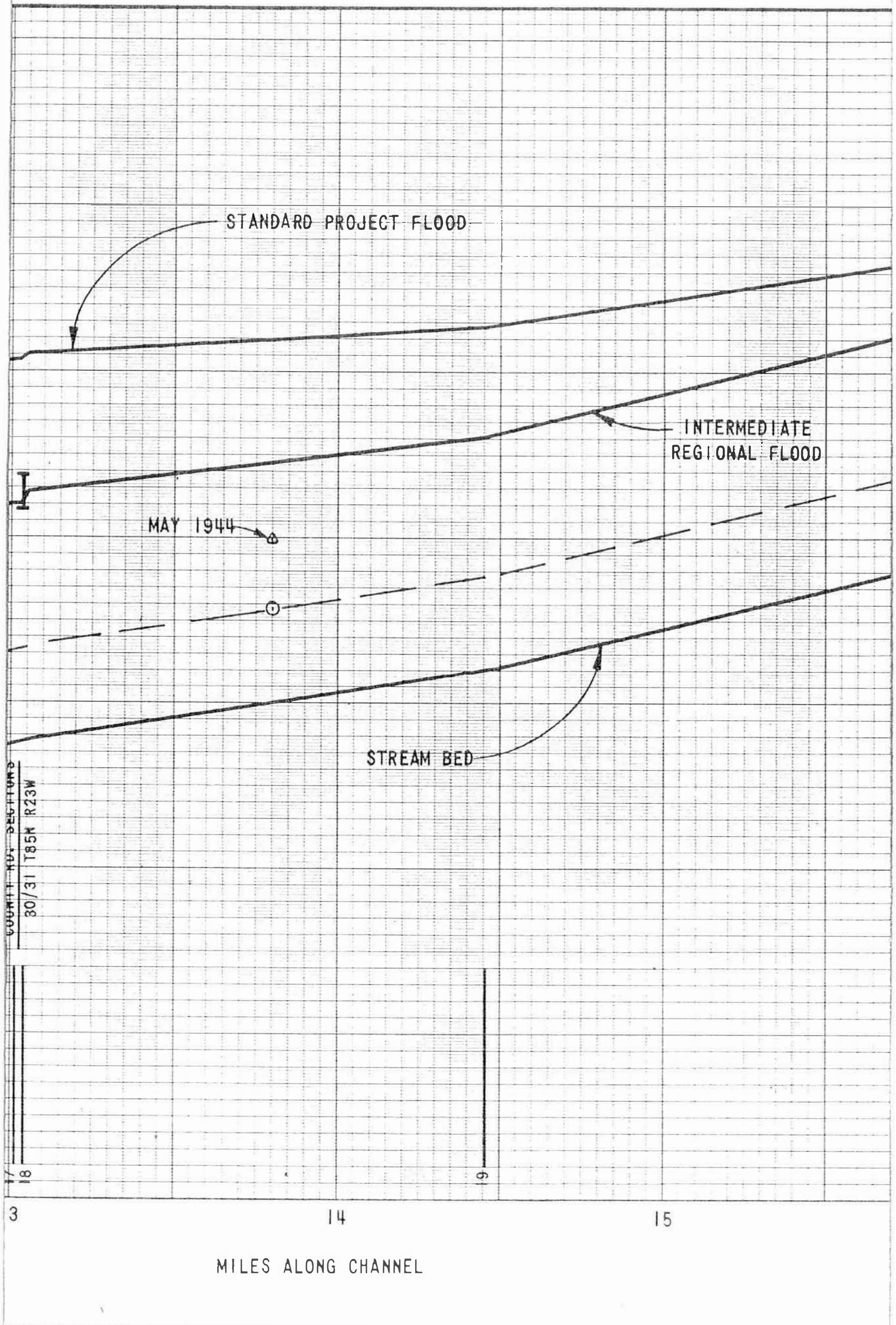
FLOOD PLAIN INFORMATION

SKUNK RIVER
ABOVE AMES, IOWA

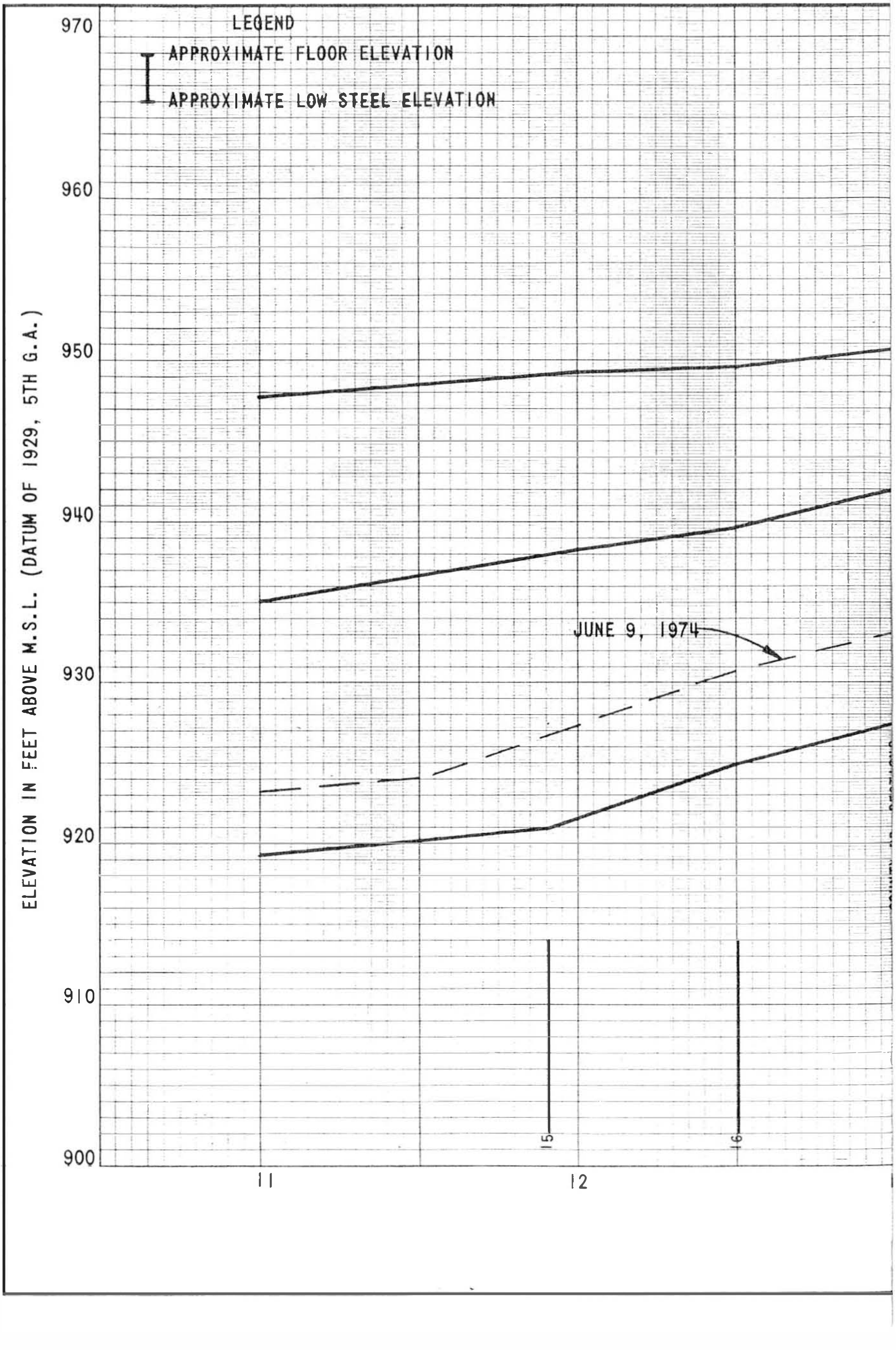
HIGH WATER PROFILES

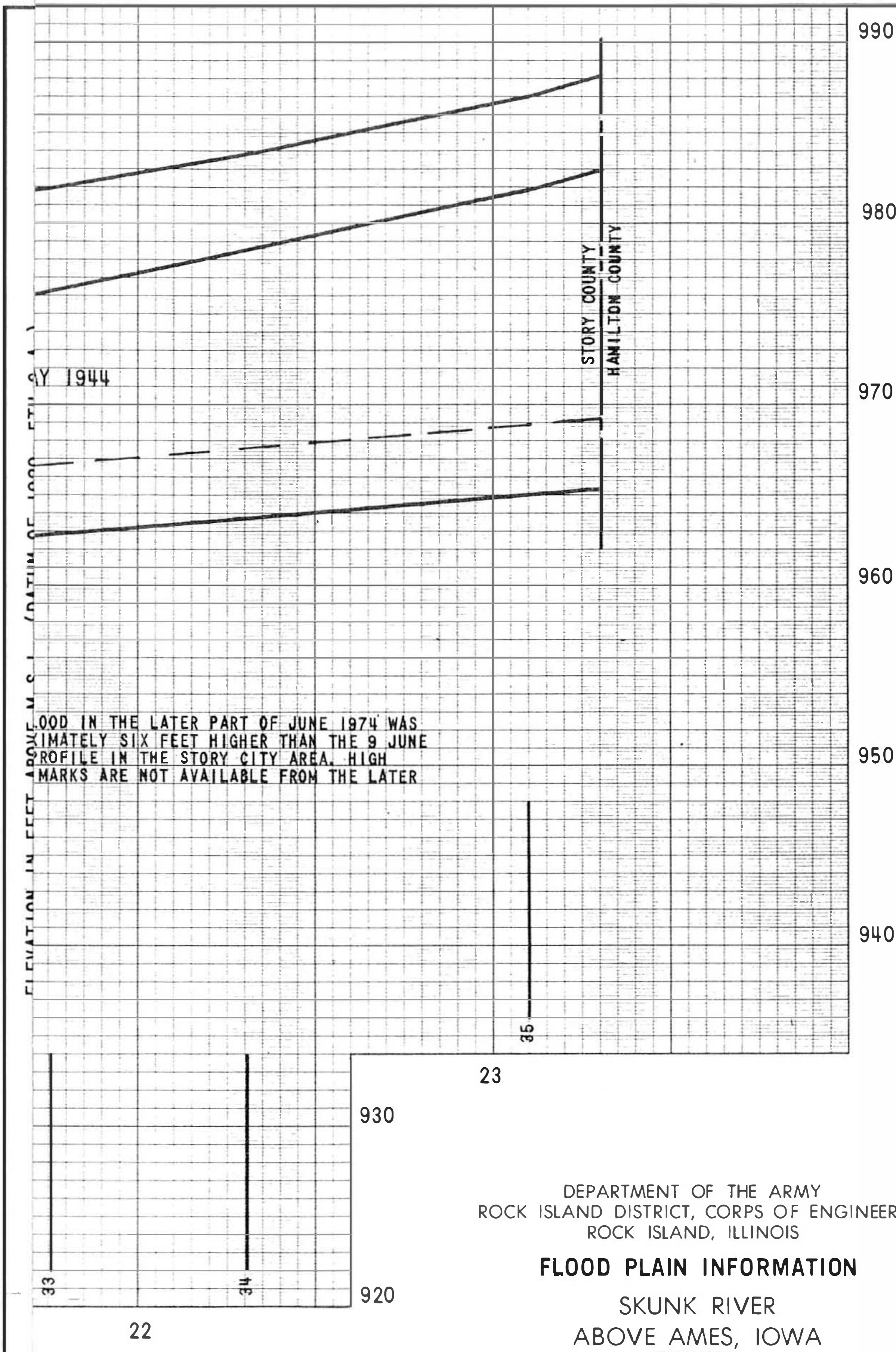
JUNE 1975

PLATE 13



STANDARD PROJECT FLOOD
INTERMEDIATE REGIONAL FLOOD
MAY 1944
STREAM BED
30/31 T85W R23W
18
19
3
14
15
MILES ALONG CHANNEL


LEGEND
APPROXIMATE FLOOR ELEVATION
APPROXIMATE LOW STEEL ELEVATION
ELEVATION IN FEET ABOVE M.S.L. (DATUM OF 1929, 5TH G.A.)
970
960
950
940
930
920
910
900
JUNE 9, 1974
15
16
11
12



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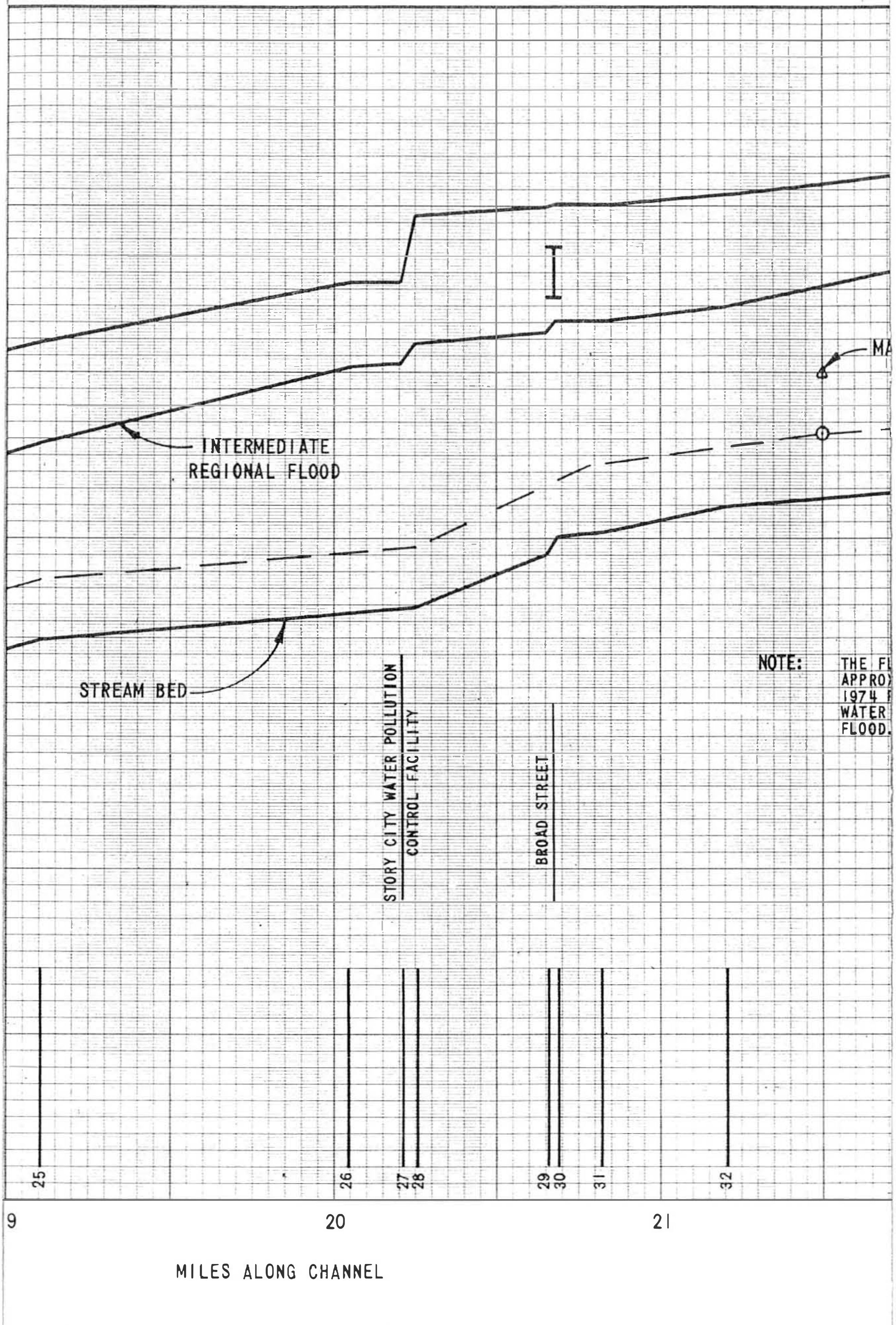
FLOOD PLAIN INFORMATION

SKUNK RIVER
ABOVE AMES, IOWA

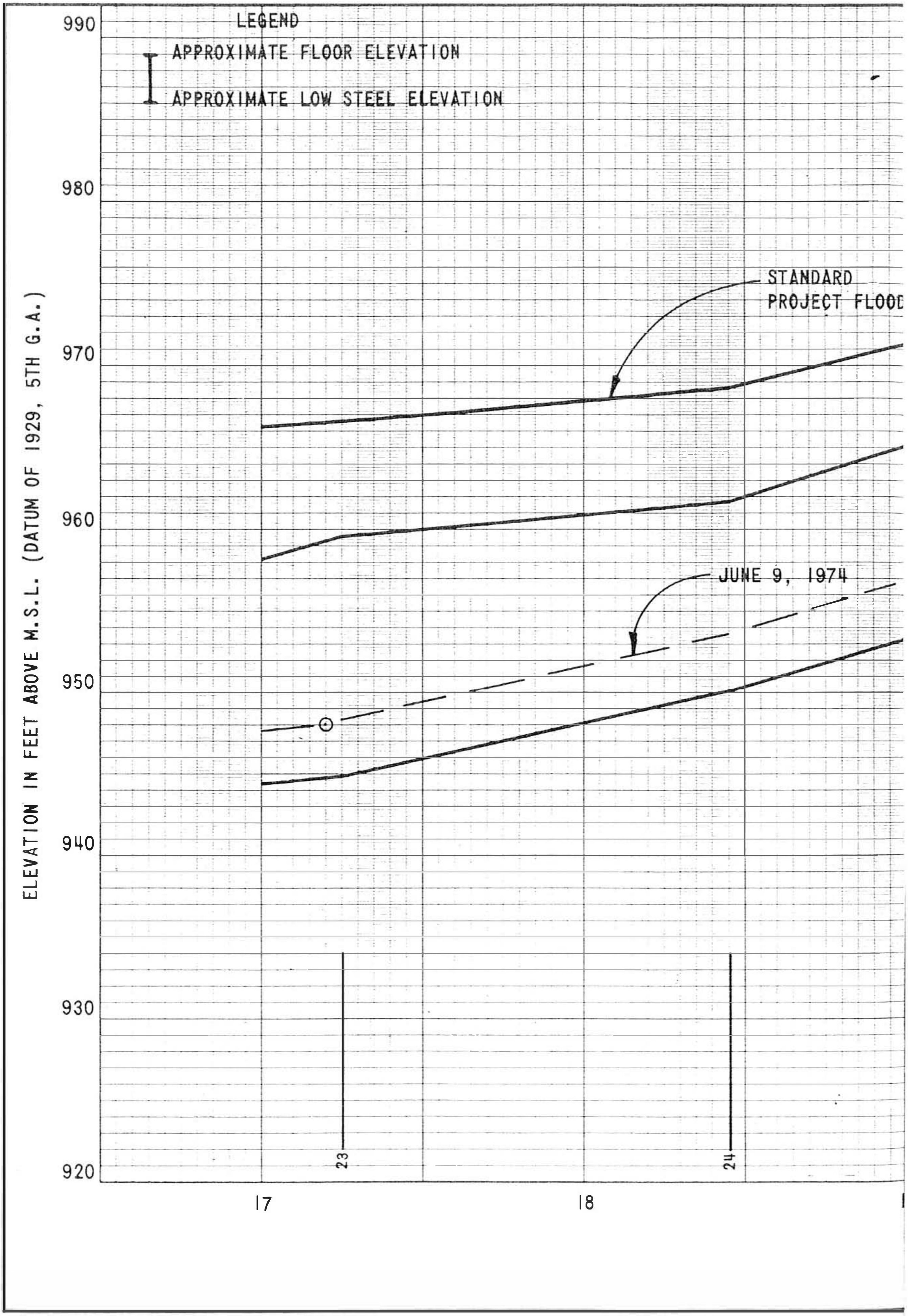
HIGH WATER PROFILES

JUNE 1975

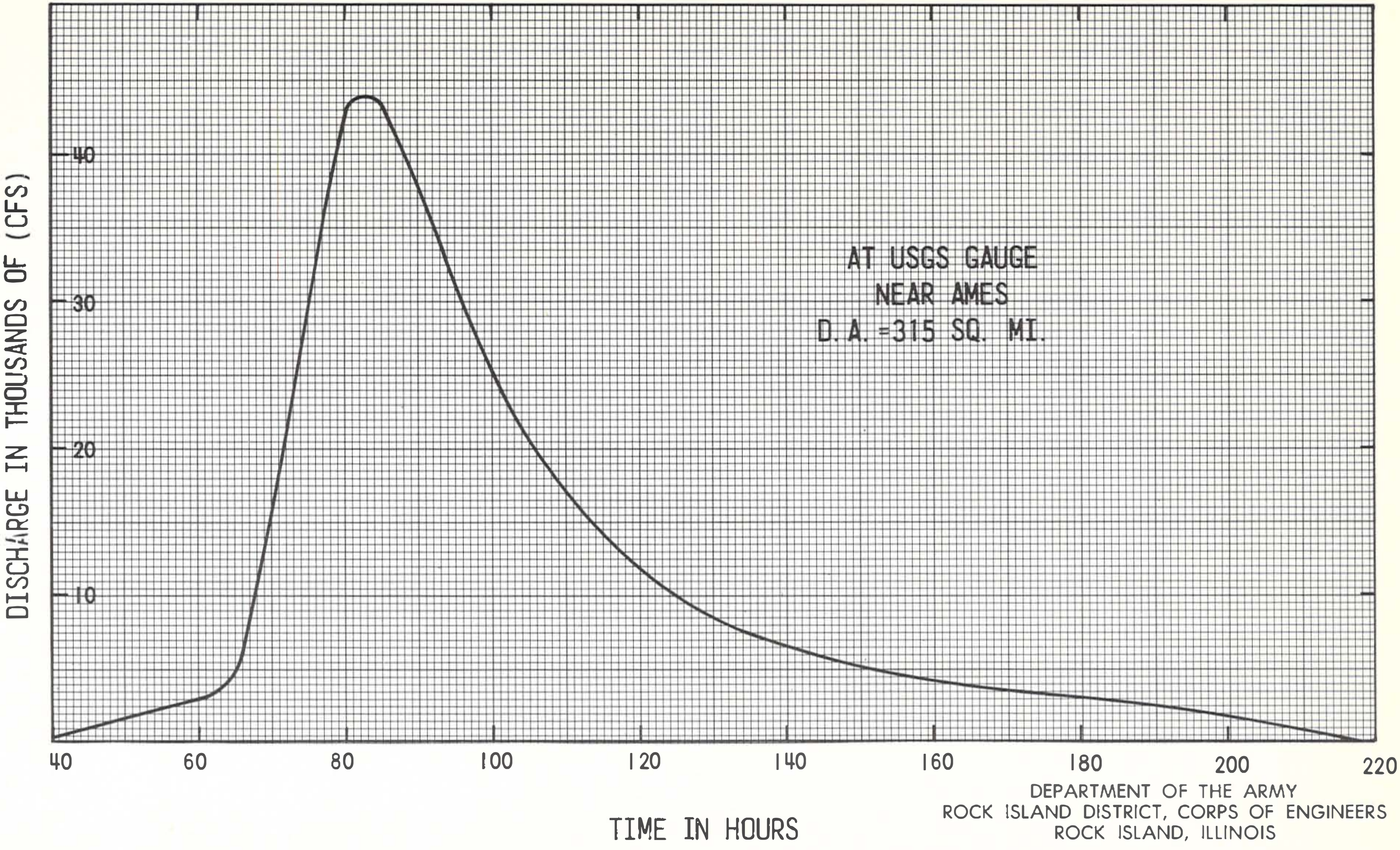
PLATE 14



INTERMEDIATE REGIONAL FLOOD
STREAM BED
MA
NOTE:
THE FL
APPRO
1974
WATER
FLOOD.
STORY CITY WATER POLLUTION CONTROL FACILITY
BROAD STREET
25
26
27
28
29
30
31
32
9
20
21
MILES ALONG CHANNEL



LEGEND
APPROXIMATE FLOOR ELEVATION
APPROXIMATE LOW STEEL ELEVATION
STANDARD
PROJECT FLOOD
JUNE 9, 1974
ELEVATION IN FEET ABOVE M.S.L. (DATUM OF 1929, 5TH G.A.)
990
980
970
960
950
940
930
920
23
24
17
18



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FLOOD PLAIN INFORMATION

SKUNK RIVER

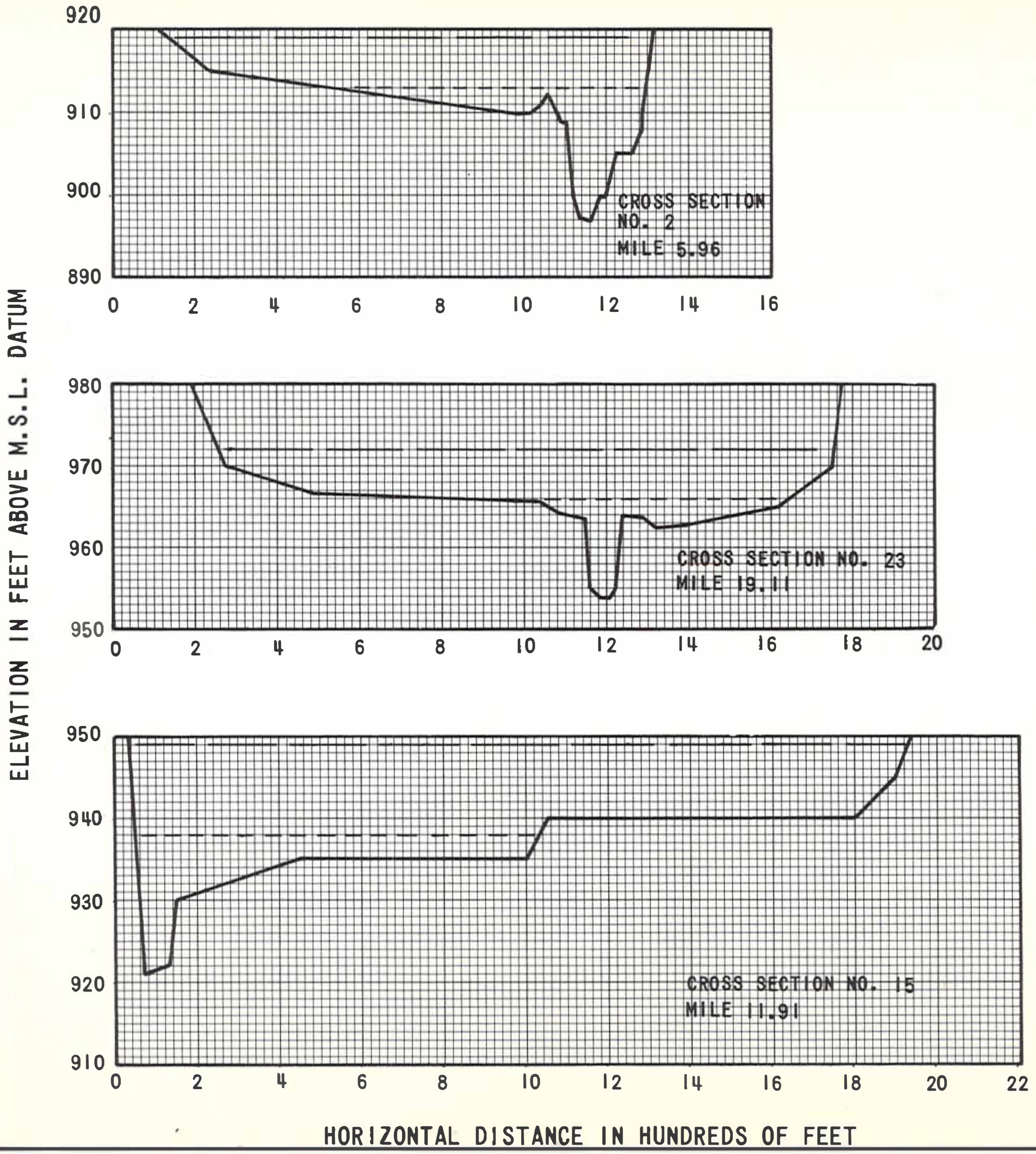
ABOVE AMES, IOWA

STANDARD PROJECT FLOOD

HYDROGRAPH

JUNE 1975

PLATE 15



LEGEND

— — STANDARD PROJECT FLOOD

- - - - - INTERMEDIATE REGIONAL FLOOD

NOTES:

1. SECTIONS PLOTTED LOOKING UPSTREAM.
2. THIRTY-TWO ADDITIONAL CROSS SECTIONS WERE USED IN HYDRAULIC COMPUTATIONS.

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FLOOD PLAIN INFORMATION

SKUNK RIVER
ABOVE AMES, IOWA

SELECTED CROSS SECTIONS

JUNE 1975