FLOOD PLAIN INFORMATION

NORTH FORK REPUBLICAN RIVER

WRAY
COLORADO

PREPARED FOR
THE COLORADO WATER CONSERVATION BOARD
BY
CORPS OF ENGINEERS, U. S. ARMY
KANSAS CITY, MISSOURI, DISTRICT
JUNE 1969

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Cover photo: May 1958 Flood at City Park.

INTRODUCTION

This report evaluates the flood hazards along the North Fork Republican River in the vicinity of Wray, Colorado. The report is prepared for the Colorado Water Conservation Board at the request of the city of Wray as an aid in the solution of local flood problems and to promote the best utilization of the lands subject to overflow. The report is based upon historical information, available streamflow records, and other technical data defining the size and occurrence of potential flooding in the Wray area.

Contained in the report are maps, water surface profiles, and flood plain cross sections indicating the extent of flooding which could be expected in the future under existing conditions. From the information presented herein, flood risks may be appraised and construction of facilities may be planned to avoid flood damage.

Although the city of Wray has escaped severe flooding in the past, the possibility of a flood of this magnitude definitely exists as evidenced by past occurrences in adjacent basins. It is important that the probability of such large floods be anticipated in the prudent planning of flood plain development.

It should be recognized that the flood hazards in the Wray area are evaluated as of the date of this report. Plans or recommendations for the solution of flood problems are not included; however, a basis is provided for study and planning by interested parties toward minimizing vulnerability to flood damages. Zoning and subdivision regulations, construction of flood protection works, flood proofing, or a combination of these approaches may be used by planners in the guidance of those who would propose utilization of

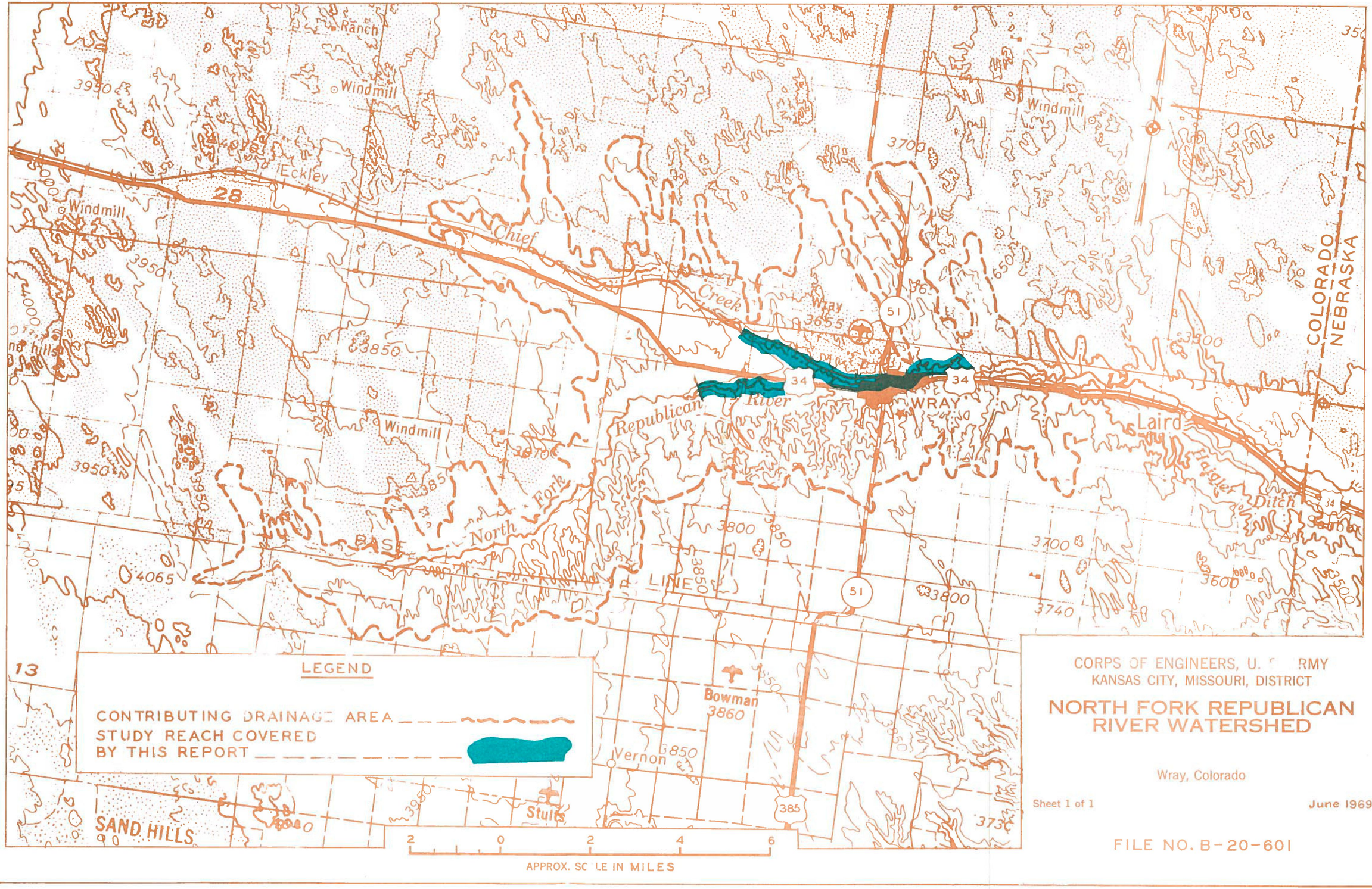
the flood plain. A glossary is included at the end of the text to aid in the understanding of unfamiliar terms used in the report. The Kansas City District of the Corps of Engineers will, upon request, provide technical assistance to Federal, State, and local agencies in the interpretation and use of the information contained herein.

SUMMARY OF FLOOD SITUATION

The city of Wray, Colorado, is located along both sides of the North Fork Republican River about 25 miles above its confluence with the Arikaree River. The information included in this report covers that portion of the river from river mile 22.0 to just above river mile 33.0 in the vicinity of Wray. Plate 1 shows the contributing watershed and study reach as discussed in this report.

Much of Wray is on high ground and free of flooding from the North Fork Republican River. However, the topography surrounding Wray has influenced development of the flood plain to a great extent. In early times, the bluffs rising steeply from the valley floor on both the northern and southern edges of Wray provided protection from the elements. Today, these same bluffs form a barrier to development in the city, encouraging the exploration of the North Fork flood plain for future development. Flooding from the North Fork Republican River watershed has not been severe in the past and development of the flood plain is increasing despite the potential dangers.

While no official flood records are available for the North Fork Republican River at Wray, stream gaging records have been maintained continuously since March 1931 at the Colorado-Nebraska State line located about 16 miles downstream from Wray. As an indication of past flooding in the basin, only one minor flood event had been recorded in the station's entire history. Intermittent records are also available for a station located about four miles upstream of Wray, but operation is presently discontinued.



CORPS OF ENGINEERS, U. S. ARMY
KANSAS CITY, MISSOURI, DISTRICT

NORTH FORK REPUBLICAN RIVER WATERSHED

Wray, Colorado

Sheet 1 of 1

June 1969

FILE NO. B-20-601

PLATE NO. 1

GENERAL CONDITIONS AND PAST FLOODS

General

The history and a discussion of floods on the North Fork Republican River at Wray, Colorado, are contained in this section of the report. The flood history has been developed from interviews with local residents, newspaper files, and historical records. Additional information was also gathered from field investigations, office computations, and available gage records.

The Stream and Its Valley

The North Fork Republican River watershed, which originates in central Yuma County, Colorado, is an area comprised largely of sandhills having an ill defined drainage pattern and little, if any, surface runoff. Although the total drainage area at U.S. Highway 385 on the west edge of Wray is 1,216 square miles, only 59 square miles actually contribute to surface runoff. The watershed has a semiarid climate with hot summers and long cold winters. Summer precipitation, in the form of intense short duration thunderstorms, accounts for the majority of the total annual precipitation. These intense local storms, called cloudburst storms, occur frequently in the plains region.

The basin is somewhat irregular in shape with the major axis orientated in a southwest-northeast direction. A tributary stream, Chief Creek, joins the North Fork about one mile above Wray. A small lake, Stalker Lake, is located about two miles above Wray on Chief Creek and is maintained as a fish preserve by the Colorado Fish and Game Commission. The lake has little influence in the control of floodflows.

The watershed is predominately agricultural with most of the area devoted to grazing or raising of crops through irrigation. Few artificial ponds have been built in this area since most of the water is obtained by pumping from wells.

The flood plain of the North Fork Republican River has a moderate width averaging about one-quarter of a mile in the Wray area. The valley is fairly flat with steep bluffs rising 100 to 150 feet high on both sides. The riverbed slopes about 10 feet per mile with a channel varying from 10 to 20 feet wide and banks 5 to 10 feet high.

Settlement

The town of Wray was laid out in July 1886 by William Campbell and Amos Steck, President and Secretary of the See Bar See (C-C) Land and Cattle Company. A plat of the town was filed on July 31, 1886; the town was incorporated in 1906. It was named for Joun Wray, a cattle foreman for the Print (IP) Olive Spread, a ranch operating here and in the surrounding states. In 1889, following a long controversy between cattle kings and homesteaders over smaller counties, Yuma County was formed from a portion of Washington County. Wray was made the county seat in 1902. In 1903 Yuma County's size doubled with the addition of a part of Arapahoe County. Today, the community of Wray (population 2,082) is a marketing and distributing center for the surrounding farming and livestock raising area. The city is served by U.S. Highways 34 and 351, and the Chicago, Burlington, and Quincy Railroad. Favorable growth is evidenced by the recently constructed and unique city facilities, a new shopping center, and rejuvenation of existing business places.

Development in the flood plain

Topographical barriers existing on the northern and southern edges of Wray have forced expansion into the North Fork Republican River flood plain. In 1934, the city obtained aid through the WPA and attempted to improve some of the bottom area so it could be developed for business purposes. The river channel was straightened and a levee built at the west edge of Adams Street. A diversion dam was also placed in the North Fork at the west end of town, and a millrace was constructed parallel to and on the south side of the river channel. Lack of knowledge of the flooding potential coupled with the availability of flat unused land has spurred development up to the edges of the channel. Presently, business establishments are located on both sides of the channel at Main and Adams Streets. A shopping center housing ten businesses was recently constructed in the flood plain between Adams Street and Highway 385. The tracks of the Chicago, Burlington, and Quincy Railroad are also in the flood plain and have been subjected to inundation in past years as have portions of U.S. Highways 34 and 385.

Bridges across the stream

Ten bridges cross the North Fork Republican River in the study reach. Table 1 lists pertinent elevations for these structures. Various flood crests are shown for purposes of comparison.

Table 1. Bridges across the North Fork Republican River

Mile above mouth	Identification	Elevations in feet above mean sea level				
					Immediately upstream of bridge	
		Streambed	Low steel	Bridge floor	Standard Project Flood crest	Intermediate Regional Flood crest
22.2	Sewage lagoon entrance	3480.80	3488.20	3489.70	3493.75	3492.15
24.9	C.B. & Q. Railroad	3504.20	3513.40	3516.80	3517.99	3516.86
25.3	Main Street	3511.50	3517.50	3519.10	3524.65	3521.80
25.37	Adams Street	3512.90	3518.50	3519.50	3525.33	3522.40
25.44	Blake Street extended	3519.00	3525.10	3526.10	3529.83	3527.25
25.6	U.S. Highway 385	3519.60	3526.00	3528.00	3530.39	3527.66
25.8	U.S. Highway 34	3521.20	3529.00	3531.00	3533.00	3531.00
27.0	U.S. Highway 34	3530.40	3538.10	3539.60	3541.92	3540.20
28.6	Farm Road	3545.50	3552.50	3553.50	3555.38	3554.32
29.2	U.S. Highway 34	3552.30	3561.80	3563.50	3564.00	3561.00
33.0	Colorado Highway 29	3584.00	3590.00	3591.00	3592.00	3590.00

Obstructions to floodflow

There are no natural obstructions to floodflow in the North Fork Republican River flood plain through Wray. Obstructions have been created by man's continued encroachment on the flood plain. Examples of this condition are the bridges across the river and millrace at Main and Adams Streets. These structures are actually box culverts, which are sufficient for low water flows but become inadequate during high flow periods. This situation is further aggravated by buildings located at the channel edges forcing floodwaters to flow in a northeasterly direction down Second Street. The millrace dam is a minor obstacle but is easily overtopped during periods of high flow.

Flood damage prevention measures

Planned effective flood damage prevention measures have not been taken in Wray with regard to high flows occurring on the North Fork Republican River. Businesses and residences in the flood plain have raised floors as a result of past flood experiences and are effectively protected from low to moderate flooding, but no general protective measures for extreme events have been accomplished. Flooding from sidehill runoff in the town, which was a problem because of inadequate channels and watercourses to carry the excess flow, has been relieved since 1961 by the completion of a watershed treatment project which included six retarding dams. The dams have a total capacity of 340 acre-feet and were designed to control the runoff from a 100-year storm rainfall over the 3.0 square mile drainage area above the structures. The uncontrolled outlets through the structures were designed to limit the outflow to the downstream channel capacities. The project was developed by the Soil Conservation Service of the Department

of Agriculture under sponsorship of the Hale Soil Conservation District and the city of Wray.

Flood warning and forecasting services

The following statement was furnished by the U.S. Weather Bureau on flood warning services available for the North Fork Republican River at Wray, Colorado:

> At the present time there is no specific flood forecasting service for the North Fork Republican River at Wray, Colorado. The area, however, is within the effective range of the Weather Surveillance Radar (WSR-3) facility at Goodland, Kansas, Weather Bureau Office. This installation provides information on location of storms and areas of intense precipitation, and through mass news media provides for broadcasts of locations of possible flash flooding. Improvement in this procedure is expected with the installation of the more powerful radar at Limon, Colorado. This radar, which is scheduled for operation in about two years, will provide continuous information on precipitation intensity and storm location and movement, and a better coverage of the area for flash flood warning.

Flood situation

Gaging stations. Records are available for two gaging stations maintained by the U.S. Geological Survey on the North Fork Republican River near Wray. The Colorado-Nebraska State line station located approximately 16 miles east of Wray was established in March 1931 and has been operating continuously since that time. The station is situated on the right bank, 100 feet east of the Colorado-Nebraska State line and approximately one-half mile north of U.S. Highway 34. Intermittent records are also available for the

Wray gaging station located approximately 5 miles west of Wray. This station was established in March 1937 and operated to October 1946. In October 1951, the station was reestablished at a location 3/4 mile downstream of the original location and operated until October 1957. Reestablishment of the station was again made for a two year period from October 1962 to October 1964. The station is presently discontinued.

Flood records. It is unfortunate that flood records are not available for documentation in the vicinity of Wray. At the Colorado-Nebraska State line station only one flood event has been recorded in its 37 year history. This flood event had a crest stage of less than one foot above flood stage. At the Wray, Colorado, station, operation of the station had been discontinued during all periods of heavy rainfall.

Historical floods. The flood problems affecting the city of Wray in the past rely completely upon historical accounts. Extracts from newspaper articles, interviews with residents, and review of previous studies were used to compile the flood history of Wray. Unfortunately, some instances of flooding in Wray were overshadowed by extreme events occurring in neighboring basins. Table 2 summarizes the known historical storm rainfall data at Wray. Figures 1 through 4 show the extent of flooding from two past events at Wray.

Fig. 1. July 1932 flood. View of Main Street looking north toward 2nd Street.

Fig. 2. May 1958 flood. Floodwaters upstream of the U. S. Highway 385 bridge.

Fig. 3. May 1958 flood. View downstream of U.S. Highway 385 bridge. Shopping center is now located in area to left of picture.

Fig. 4. May 1958 flood above Wray. Note stranded livestock at right of picture.

Table 2. Summary of historical storm rainfalls - Wray, Colorado

Date	Rainfall (inches)	Remarks
July 21, 1932	3.50	
May 30, 1935	1.15	Rainfalls up to 9 inches in 2 hours recorded in basin to the south.
July 11, 1941	1.60	Yuma station recorded 1.58 inches.
Sep. 22, 1941	2.68	Four to 5 inch centers in adjacent basins.
Sep. 1 & 2, 1942	4.33	3.34 inches recorded at Yuma.
Apr. 27, 1947	6.60	Damage to crops and buildings downstream of Wray reported.
May 14, 1951	3.56	
Sep. 7, 1951	1.25	6 inch centers reported to the west and south.
Aug. 11, 1956	1.55	
May 1, 1958	3.10	
June 30 - July 1, 1962	4.88	
June 17 & 18, 1965	1.47	Extreme rainfall amounts of up to 14 inches recorded in basins to the west.
July 28 & 29, 1966	3.61	

The maximum rainfall of record for Wray, the storm of April 27, 1947, is documented in the following excerpt from the "Monthly Weather Review" published by the Weather Bureau:

> "One of worst storms in many years. 6.60 inches of rain recorded. Many persons forced to leave home and flee from high water which poured off surrounding hills and ran through town. 6-8 inches of hail, as measured on the level, was carried by floodwaters and built into banks 5-6 feet deep against obstructions. Holes pounded in roofs; cellars flooded a few inches up to 8 or more feet. Some homes flooded with several feet of water, hail, and debris. Almost no home in Wray escaped entirely from damage. Automobiles parked at curbs were floated up a block, carried over curbs, and slammed against trees. Light service was not affected."

Hydrologic studies of this event indicate that the storm did not occur in the North Fork basin above Wray, but was concentrated in a small area directly over the town. This event, however, is a good example of the cloudburst type activity which is prevalent in this region.

A recurrence of an event of this magnitude centered on the North Fork basin above Wray could have disastrous consequences in the flood plain area. Excerpts from the Wray Gazette are included below as an indication of other flood experiences:

> May 14, 1951. Deluge of rain at Wray, starting Monday night about 7 p.m. with a cloudburst and continuing intermittently throughout the night. The Government rain gage registered 3.56 inches of rain, most of which fell within the first 30 minutes. The bridge fill on the lower part of Adams Street was washed out. Water went over lower Main Street and flooded the ball diamond. No water entered any buildings and damage was confined mostly to the street at the north side of the Gardner Locker Building.

> September 7, 1951. High waters covered the lower part of town from heavy rains. Water reached flood proportions west and south of Wray. The rain began at 4 a.m. at Wray and came in a downpour. 1.25 inches was registered at Wray. West and south the rain was much heavier with as much as six inches reported. Water reached the doorway at Bills Motor, The Wray Implement Company, Stedwells, and Gardners, but did not enter any buildings.

> July 1, 1962. More than three inches of rain fell at Wray with up to 5 inches being recorded west of Wray. The lower part of the city park was under water. The machinery lot north of the highway, where the Wray Implement Company has a fleet of combines, was covered, but the machinery was settling (sic) out of the water.

Duration and rate of rise. Actual numerical values of rise and durations for past floods in the North Fork Republican River are not available because of insufficient data for analysis. Generally, rates of rise for past events have been very fast with short durations. The majority of past storms have not lingered over the watershed, but have moved with great speed, releasing large amounts of water over relatively small areas, which is indicative of the cloudburst type of storm.

Velocities. Velocities of past floodwaters in the Wray area have not been measured in the field.

FUTURE FLOODS

This section of the report discusses the Intermediate Regional Flood and the Standard Project Flood for the North Fork Republican River at Wray and the hazards of great floods. Floods the size of the Standard Project Flood represent reasonable upper limits of expected flooding. Those of the size of the Intermediate Regional Flood represent floods that may reasonably be expected to occur more frequently although they will not be as high as the Standard Project Flood.

Unfortunately, when data for the Intermediate Regional Flood or the Standard Project Flood are presented, many people tend to ignore them in the mistaken belief that they could not occur during their lifetime. Actually, the chance of a flood the size of, or greater than the Intermediate Regional Flood occurring in the next 25 years is better than 1 to 4.

Intermediate Regional Flood. The Intermediate Regional Flood is defined as a flood having an average frequency of occurrence in the order of once in 100 years at a designated location although the flood can occur in any year. Probability estimates of this kind are normally based on statistical analyses of streamflow records available for the watershed understudy. The estimate for the North Fork Republican River was determined in this way. Since there are no available official records of severe flooding in the basin above Wray, adjustments were made to the basic analysis to reflect the potential for severe flooding from cloudburst storms occurring in the area.

Results of these studies indicate that the Intermediate Regional Flood would have a peak discharge of 4,200 cubic feet per second at Wray. A flood of this magnitude could be disastrous but

would be much less severe than the Standard Project Flood. Comparison of Intermediate Regional Flood depths at various locations in Wray can be made by referring to the stream profile on plate 6.

Standard Project Flood. Severe as the maximum known flood may have been on any given stream, only in rare instances will it have reached what hydrologists regard as the maximum flood potential of the basin. The threat of flooding in excess of any past event must be recognized. The Corps of Engineers, in cooperation with the Weather Bureau, has made broad and comprehensive studies based on the voluminous records of past storms and floods and has evolved generalized procedures for estimating the flood potential of streams. These procedures have been used in determining the Standard Project Flood for Wray. This flood is defined as the largest flood that can be expected from the most severe combination of meteorological and hydrological conditions that are considered reasonably characteristic of the geographical region involved.

Standard Project storm rainfall used for the North Fork Republican River amounts to 5.4 inches in 3 hours, 10.0 inches in 24 hours, and a total of 12.1 inches in 96 hours. The 24-hour rainfall amount for the Standard Project Flood is over 3 inches more than the greatest rainfall recorded at Wray. The peak discharge calculated from these rainfall amounts would be 11,700 cubic feet per second at Wray. The flood profile for the Standard Project Flood is also shown on plate 6.

It is not practical to assign a frequency to the Standard Project Flood because the occurrence of such a flood would be a rare event although it could occur in any year.

Possible larger floods. Floods larger than the Standard Project Flood are possible; however, the combination of factors that would be necessary to produce such floods would seldom occur. Consideration of floods of this magnitude may become important if possible damages indicate the need of extremely high assurance that flood risk be eliminated.

Areas flooded and depths of flooding. The flood plain areas along the North Fork Republican River in the vicinity of Wray that would be inundated by an Intermediate Regional Flood or Standard Project Flood are shown on plates 3 through 5. An index map showing the general relationship of these areas is found on plate 2. Depths of flow can be estimated from the flood profiles shown on plate 6 and cross sections on plates 7 and 8.

Limits of the flooded areas shown on the plates were determined from topographic maps with a ten-foot contour interval and a horizontal scale of 1 inch to 1,000 feet and were supplemented by field investigations. The actual limits may vary from those shown due to map limitations and the contour interval used. Figures 5 through 14 indicate depths of flooding at selected locations.

Velocities, rates of rise, and duration. Water velocities during floods vary widely from place to place along the stream. The size and shape of the available flow-way area, the condition of the stream, and the bed slope are all factors influencing velocities. In Wray, marked differences in water velocities occur throughout the study reach. The velocity in developed areas increases as floodwaters are forced to flow around buildings and other obstacles not designed for water passage. Velocities generated by a flood of Intermediate Regional Flood proportions would generally be lower than the much larger Standard Project Flood, but

Fig. 5. City power facilities located just upstream of the Chicago, Burlington & Quincy Railroad bridge.

Fig. 6. Furniture store on east side of Main Street between 2nd and 3rd Streets. Note location of channel at left of picture.

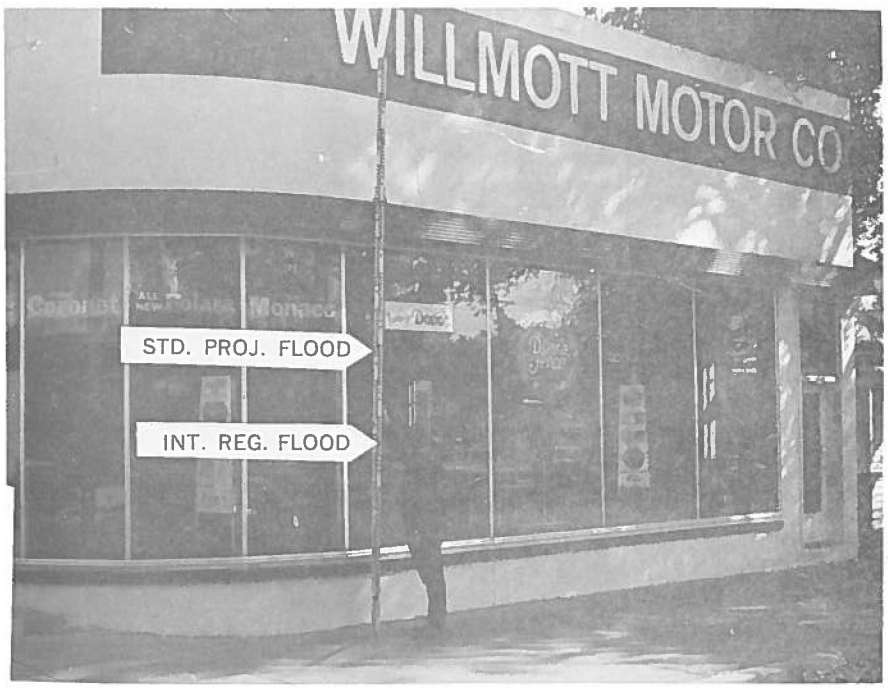


Fig. 7. Automobile dealer on Main Street north of 2nd Street.

Fig. 8. Bowling lanes at southeast corner of 2nd and Main Streets. Location of channel and millrace shown in background.

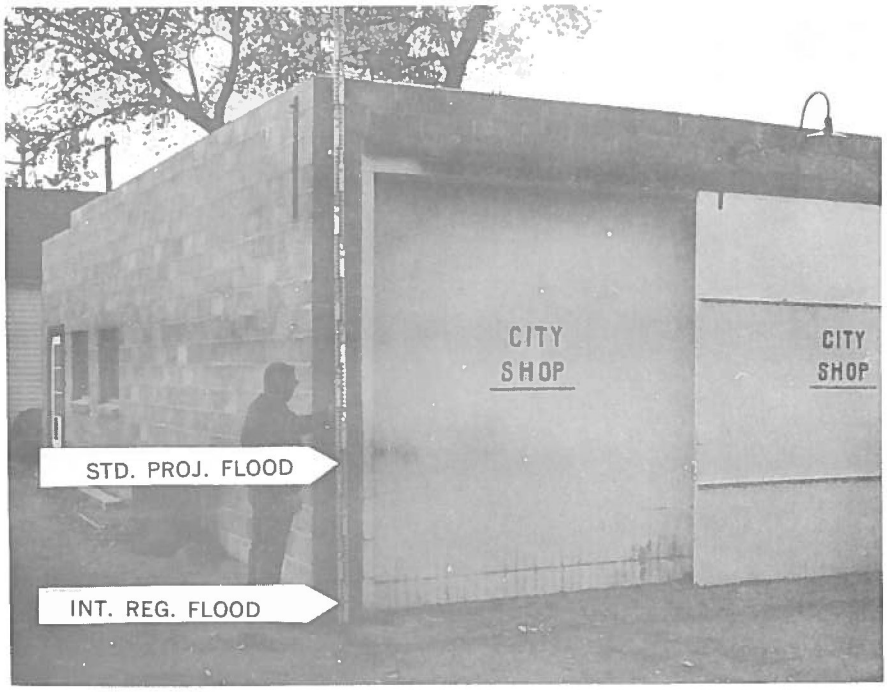


Fig. 9. City vehicle shops situated between river and millrace on Adams Street.

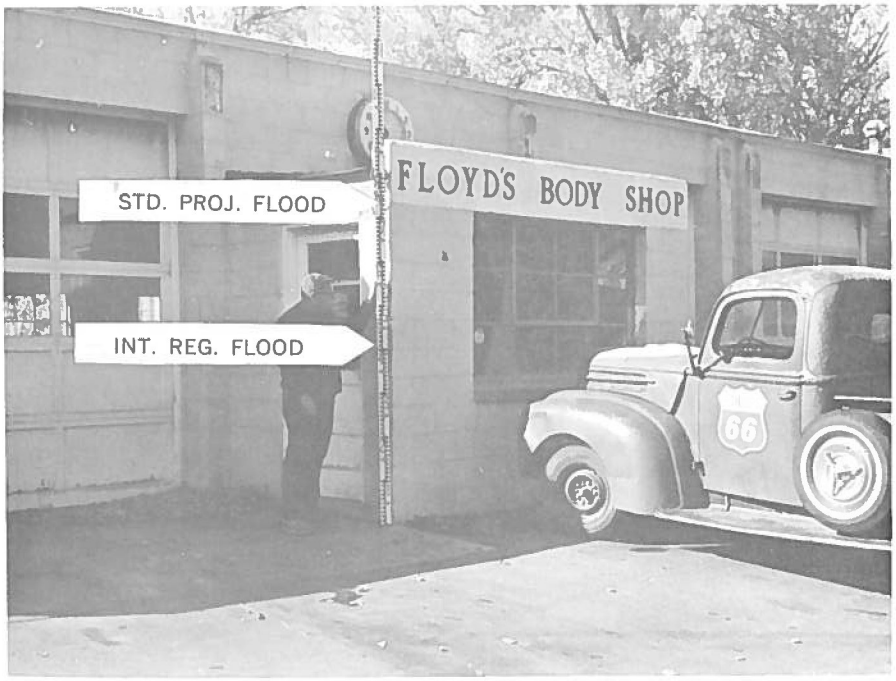


Fig. 10. Repair shop on west side of Adams Street at 2nd Street.

Fig. 11. Supermarket in new shopping center situated in flood plain between Blake Street and U.S. Highway 385.

Fig. 12. Southwest corner of shopping center shown above.

Fig. 13. Upstream side of U.S. Highway 385 bridge at Wray.

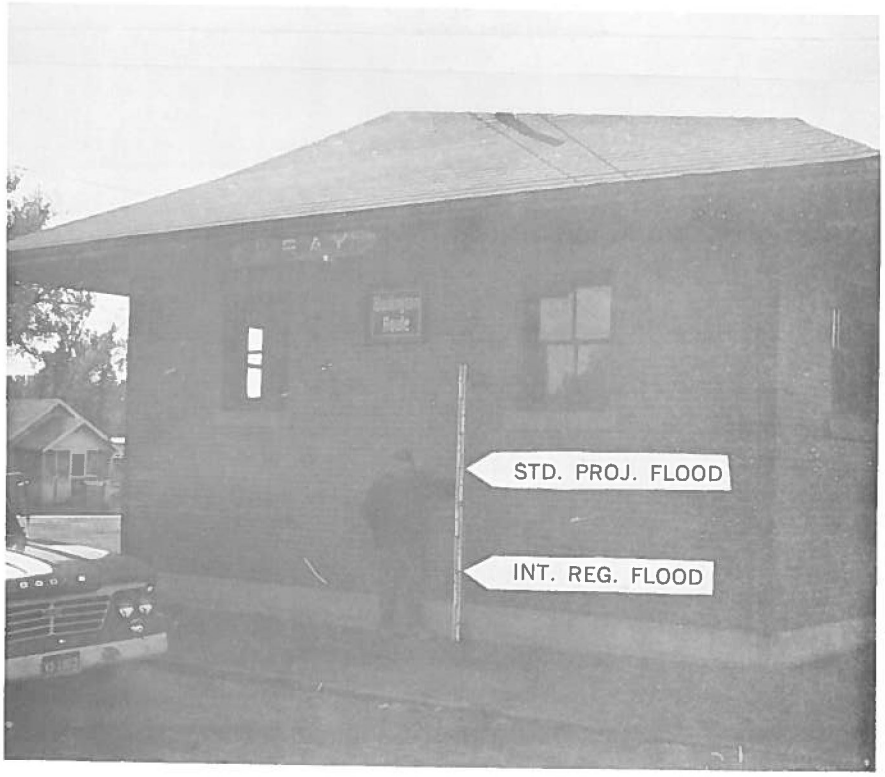


Fig. 14. Chicago, Burlington and Quincy Railroad Depot at Wray.

would still be so dangerous to warrant extreme caution. As an indication of the velocities which could be generated by these floods, tables 3 and 4 show average values computed at selected locations in Wray.

Table 3. Intermediate Regional Flood - Velocities at selected locations

Mile	Identification	Maximum average velocities (feet per second) Channel	Left overbank	Right overbank
22.0	Sewage lagoon	5.46	1.15	1.86
24.9	Downstream of C.B. & Q. RR. bridge	4.69	1.27	1.38
25.3	Upstream of Main Street	3.87	1.52	0.86
25.35	Upstream of Adams Street	3.73	2.00	0.93
25.5	Shopping Center	2.59	1.26	0.23
25.6	Upstream of U.S. Hwy 385 bridge	2.31	0.93	1.10
25.7	U.S. Hwy 34 bridge	6.89	1.71	2.33

Table 4. Standard Project Flood - Velocities at selected locations

Mile	Identification	Maximum average velocities (feet per second) Channel	Left overbank	Right overbank
22.0	Sewage lagoon	6.07	1.73	2.18
24.9	Downstream of C.B. & Q. RR. bridge	6.44	1.99	2.10
25.3	Upstream of Main Street	5.01	2.32	1.84
25.35	Upstream of Adams Street	5.01	2.73	2.07
25.5	Shopping Center	3.90	1.95	0.67
25.6	Upstream of u.S. Hwy 385 bridge	3.63	1.51	1.65
25.7	U.S. Hwy 34 bridge	7.95	2.63	1.84

Point velocities in congested areas may be much higher than the average shown in the tables. Rates of rise and duration of flooding can assume varying degrees of importance depending on the basin characteristics and the flood plain involved. In steep basins, such as the North Fork above Wray storm runoff concentrates quickly and results in high rates of rise with a relatively short duration of flooding. A flood of Standard Project Flood proportions would rise to its peak in about 10 hours at a rate of about one foot per hour. The flood would remain above banks for about one and one-half days. These rapid rise times and high stream velocities would create a hazardous situation in developed areas such as in Wray and should be treated accordingly.

Hazards of great floods. Underestimating the destructive force of flood flows, especially when depths of flooding are not extremely deep, is an obvious danger. Velocities greater than three feet per second in combination with flood depths of three feet or more are considered extremely hazardous. A velocity of two feet per second combined with depths of two feet or more produce undesirable conditions in developed areas such as would occur at Wray.

Potential health hazards attributable to floods normally include the loss or pollution of drinking water and food supplies; damaged, destroyed, or inoperative sewage facilities; and prolonged flooding conditions that may spread insect-borne diseases are all problems which may be encountered during or after flood events.

GLOSSARY OF TERMS

Flood. An overflow of lands not normally covered by water and that are used or usable by 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 or stream or an ocean, lake, or other body of standing water.

Normally, a "flood" is considered as any temporary rise in stream flow or stage, but not the ponding of surface water, that results in significant adverse effects in the vicinity. Adverse effects may include damages from overflow of land areas, temporary backwater effects in sewers and local drainage channels, creation of unsanitary conditions or other unfavorable situations by deposition of materials in stream channels during flood recessions, rise of ground water coincident with increased streamflow, and other problems.

Flood Crest. The maximum stage or elevation reached by the waters of a flood at a given location.

Flood Peak. The maximum instantaneous discharge of a flood at a given location. It usually occurs at or near the time of the flood crest.

Flood Plain. The relatively flat area or low lands adjoining the channel of a river, stream or watercourse or ocean, lake, or other body of standing water, which has 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. It is generally drawn to show surface elevation for the crest of a specific flood, but may be prepared for conditions at a given time or stage.

Flood 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.

Head Loss. The effect of obstructions, such as narrow bridge openings or buildings that limit the area through which water must flow, raising the surface of the water upstream from the obstructions.

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."

Left Bank. The bank on the left side of a river, stream, or watercourse, looking downstream.

Low Steel (or Underclearance). See "underclearance."

Right Bank. The bank on the right side of a river, stream, or watercourse, looking downstream.

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% to 60% of the Probable Maximum Floods for the same basins. Such floods, as used by the Corps of Engineers, 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.

Underclearance. 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. This is referred to as "low steel" in some regions.

AUTHORITY, ACKNOWLEDGEMENTS, AND INTERPRETATION OF DATA

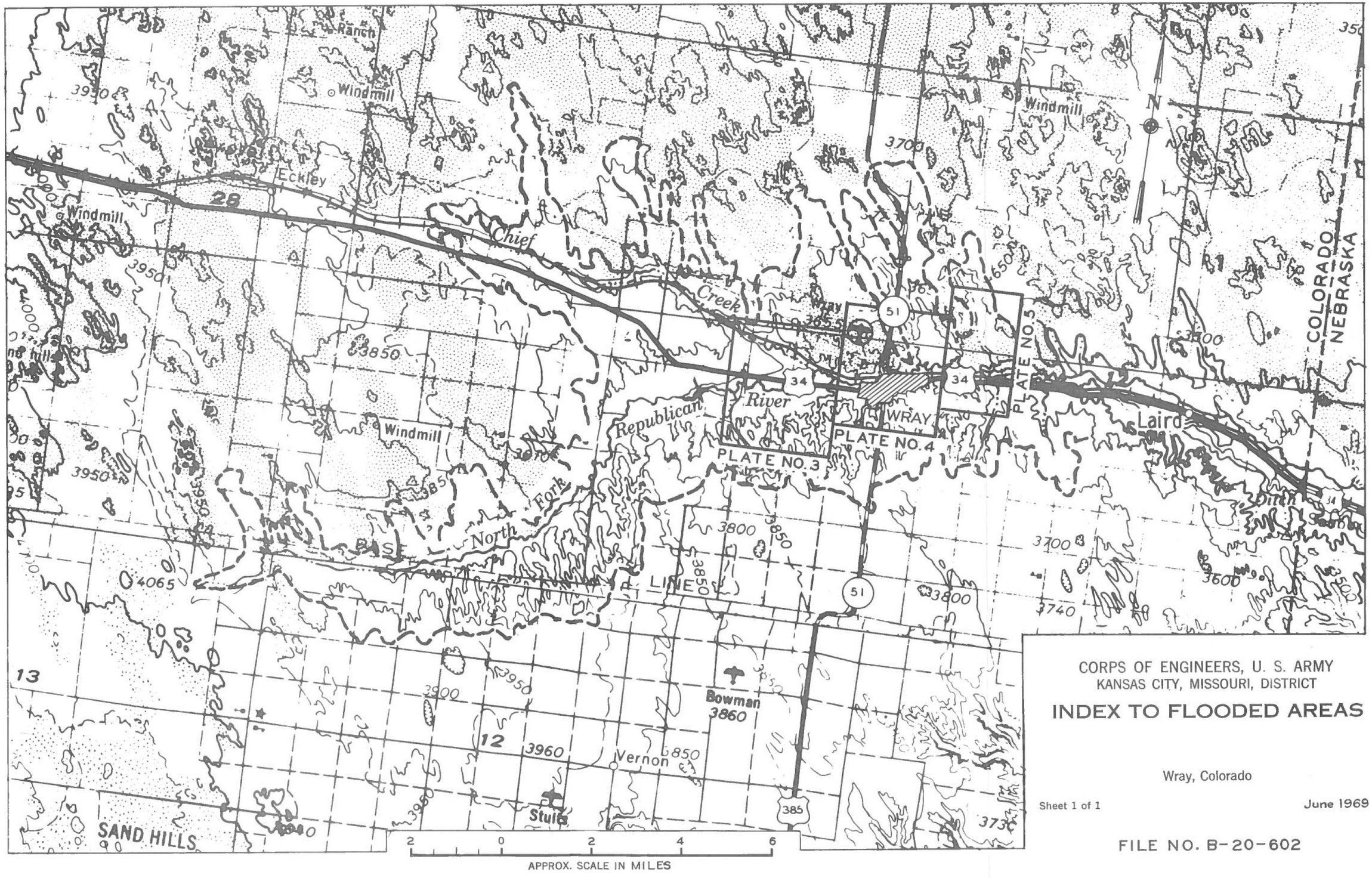
This report has been prepared in accordance with the authority granted by Section 206 of the Flood Control Act of 1960 (P.L. 86-645), as amended.

* * *

Assistance and cooperation of the U.S. Weather Bureau, the U.S. Geological Survey, the State of Colorado, the city of Wray, The Wray Gazette, and private citizens in supplying useful data are appreciated.

* * *

This report presents the local flood situation for Wray, Colorado. The Kansas City District of the Corps of Engineers will provide interpretation and technical assistance in application of data presented herein.



CORPS OF ENGINEERS, U. S. ARMY
KANSAS CITY, MISSOURI, DISTRICT

INDEX TO FLOODED AREAS

Wray, Colorado

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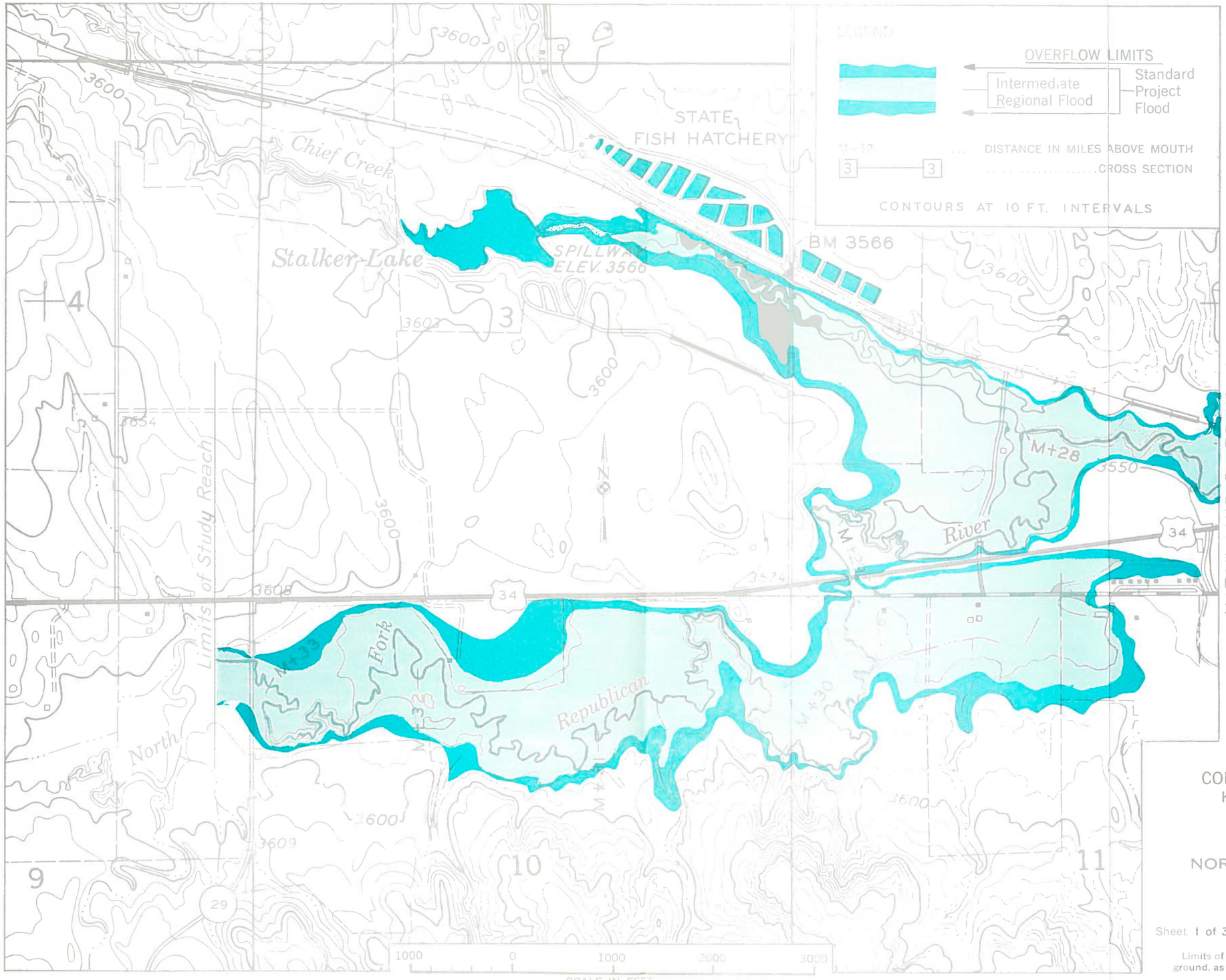
June 1969

FILE NO. B-20-602

PLATE NO. 2



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KANSAS CITY, MISSOURI, DISTRICT

FLOODED AREAS

NORTH FORK REPUBLICAN RIVER

Wray, Colorado

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Limits of overflows indicated may vary some from actual locations on ground, as explained in the report.

FILE NO. B-20-603

PLATE NO. 3

LEGEND:

OVERFLOW LIMITS

Intermediate Regional Flood

Standard Project Flood

M+12.....DISTANCE IN MILES ABOVE MOUTH

3 — 3 .....CROSS SECTION

CONTOURS AT 10 FT. INTERVALS

MATCH LINE PLATE NO. 3

MATCH LINE PLATE NO. 5

M+24

M+25

M+26

M+27

BM 3516

BM 3564

Substation

Wray

Gravel Pits

Park

North Fork Republican River

C.B.&Q.R.R.

SHOPPING CENTER

BASEBALL

SCALE IN FEET

1000 0 1000 2000 3000

CORPS OF ENGINEERS, U. S. ARMY
KANSAS CITY, MISSOURI, DISTRICT

FLOODED AREAS

NORTH FORK REPUBLICAN RIVER

Wray, Colorado

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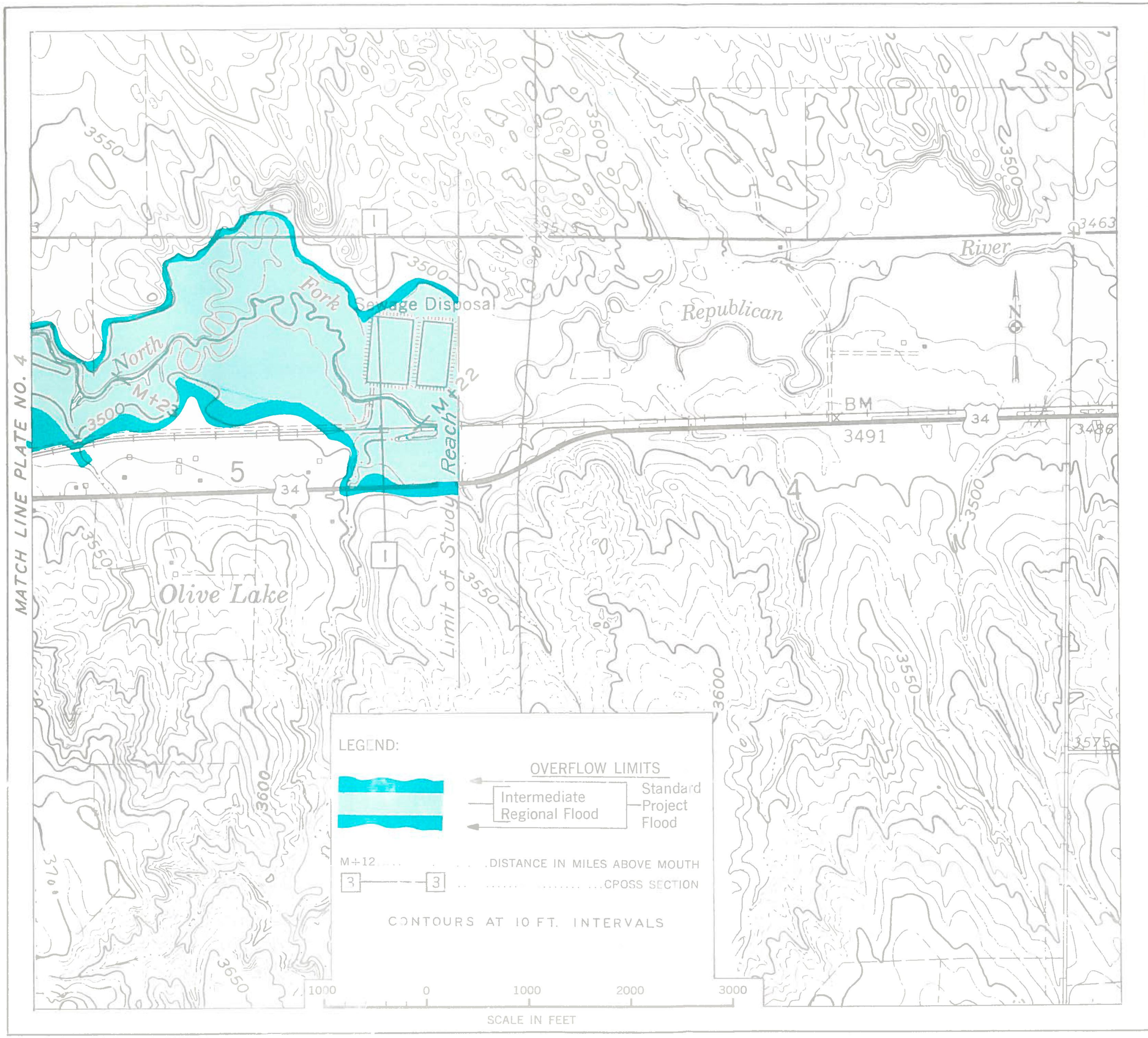
FILE NO. B-20-604

PLATE NO. 4



CORPS OF ENGINEERS, U. S. ARMY
KANSAS CITY, MISSOURI, DISTRICT

FLOODED AREAS

NORTH FORK REPUBLICAN RIVER

Wray, Colorado

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FILE NO. B-20-605

PLATE NO. 5

CORPS OF ENGINEERS, U. S. ARMY
KANSAS CITY, MISSOURI, DISTRICT

FLOOD ELEVATION PROFILES

NORTH FORK REPUBLICAN RIVER

Wray, Colorado

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FILE NO. B-20-606

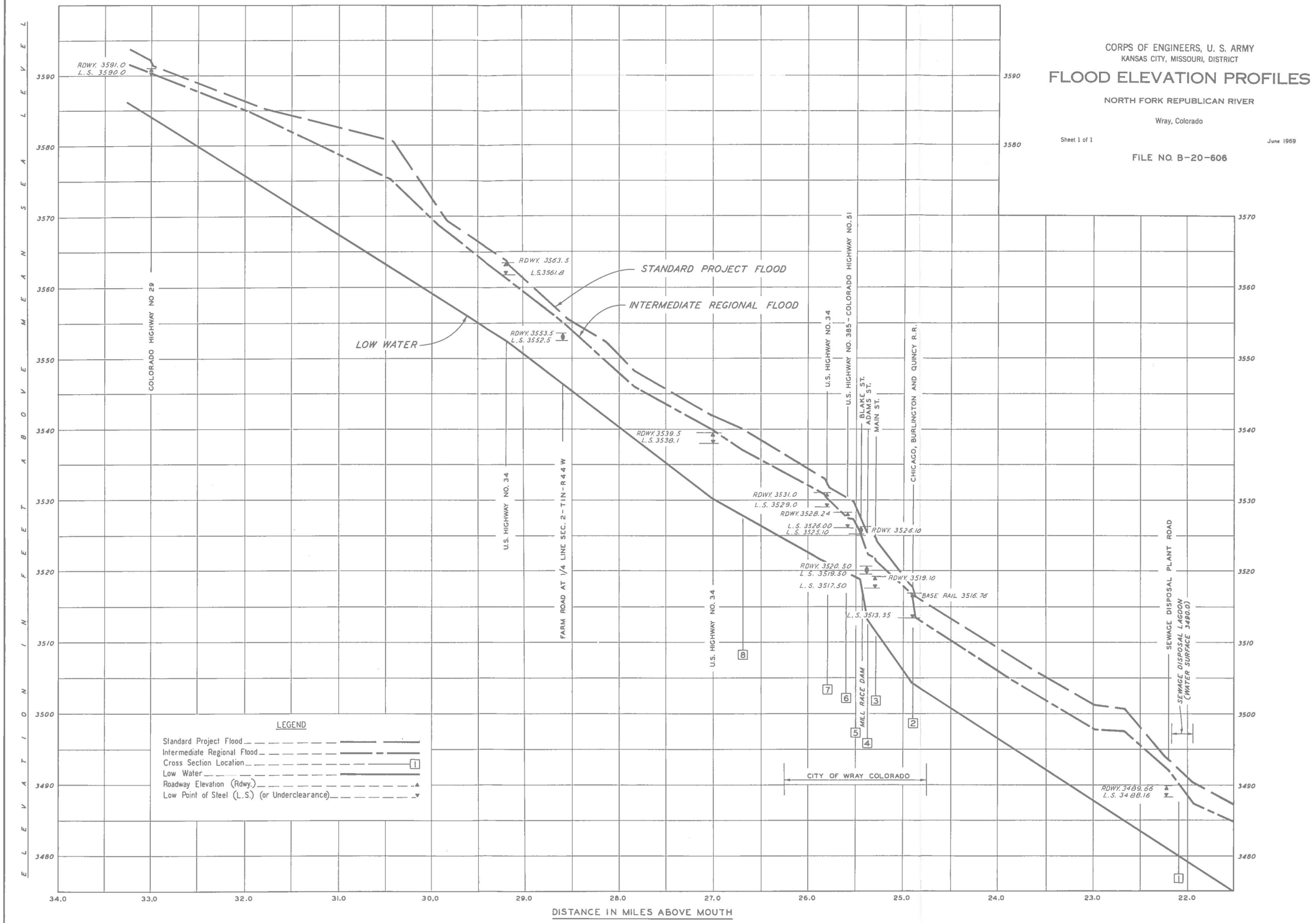
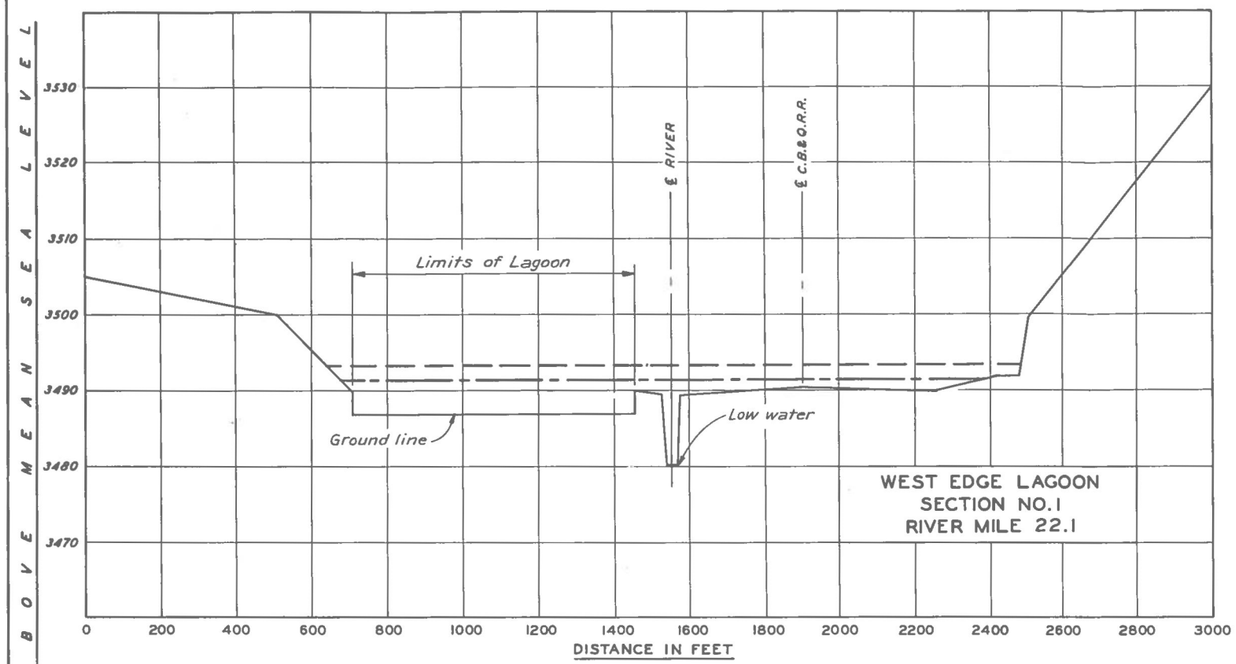
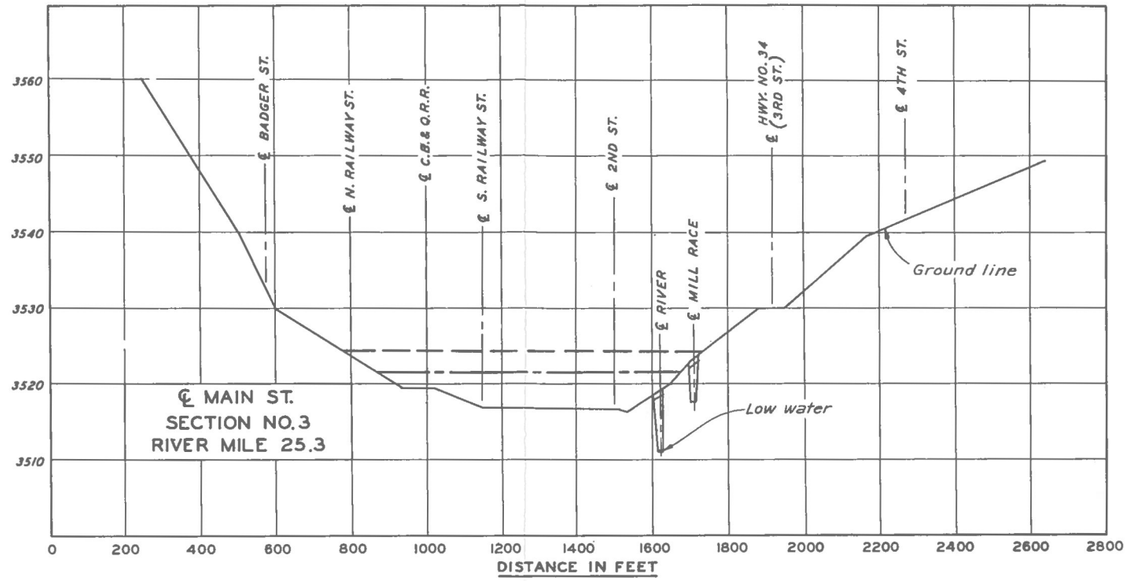
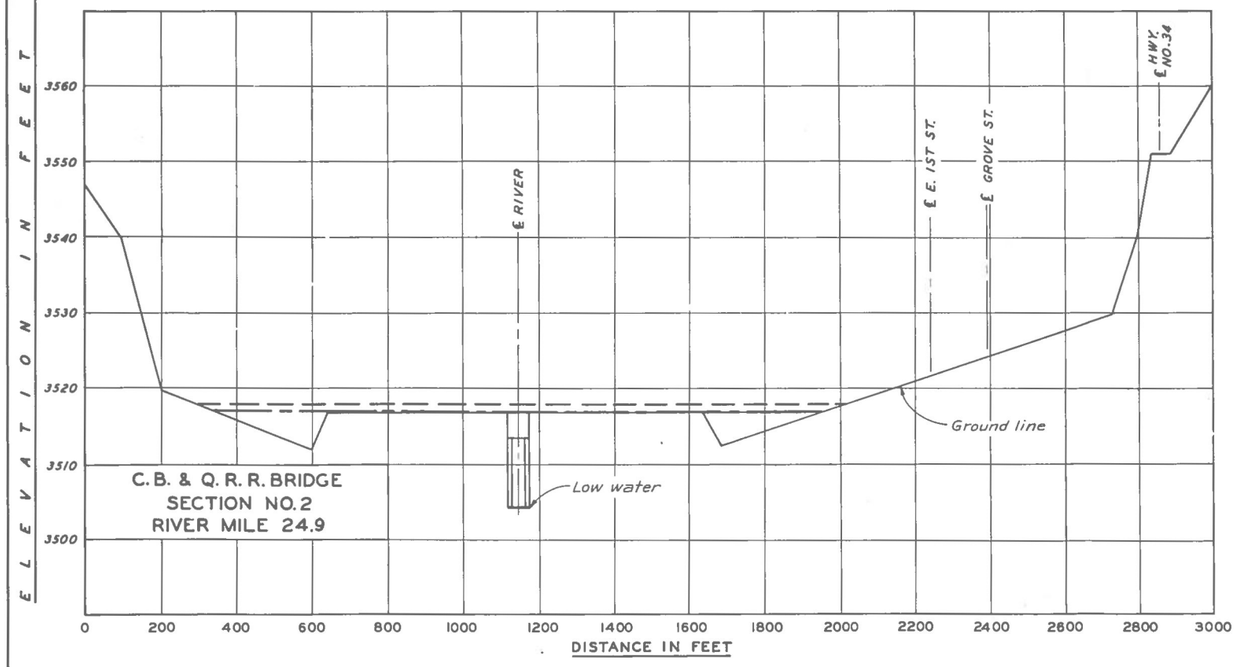
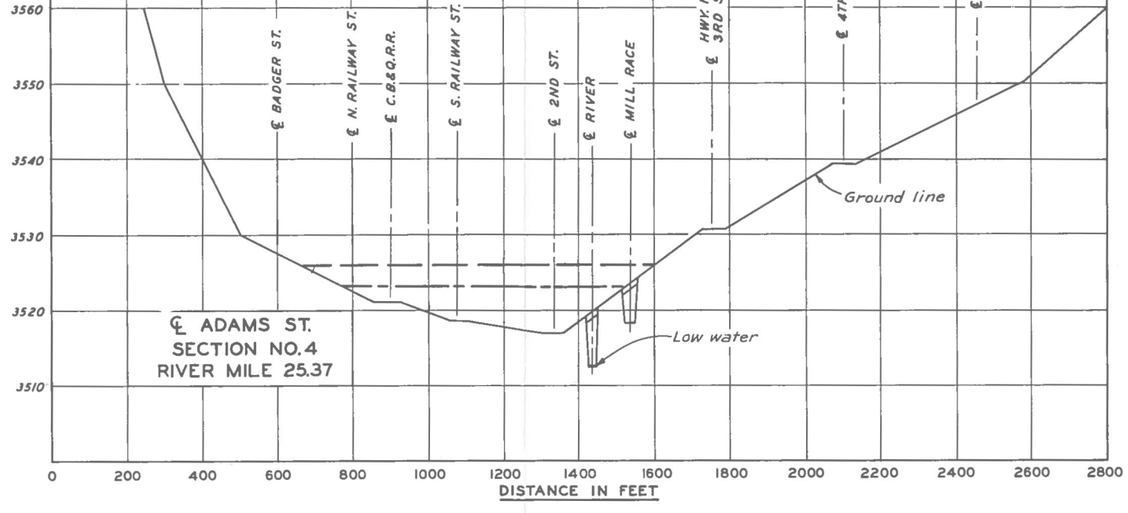


PLATE NO. 6









LEGEND

Standard Project Flood _ _ _ _ _ _ _ _

Intermediate Project Flood _ _ _ _ _ _ _ _

NOTE:
SECTIONS TAKEN LOOKING DOWNSTREAM.
42 CROSS SECTIONS NOT SHOWN ARE ON FILE WITH THE CORPS OF ENGINEERS.

CORPS OF ENGINEERS, U. S. ARMY
KANSAS CITY, MISSOURI, DISTRICT

CROSS SECTIONS

NORTH FORK REPUBLICAN RIVER

Wray, Colorado

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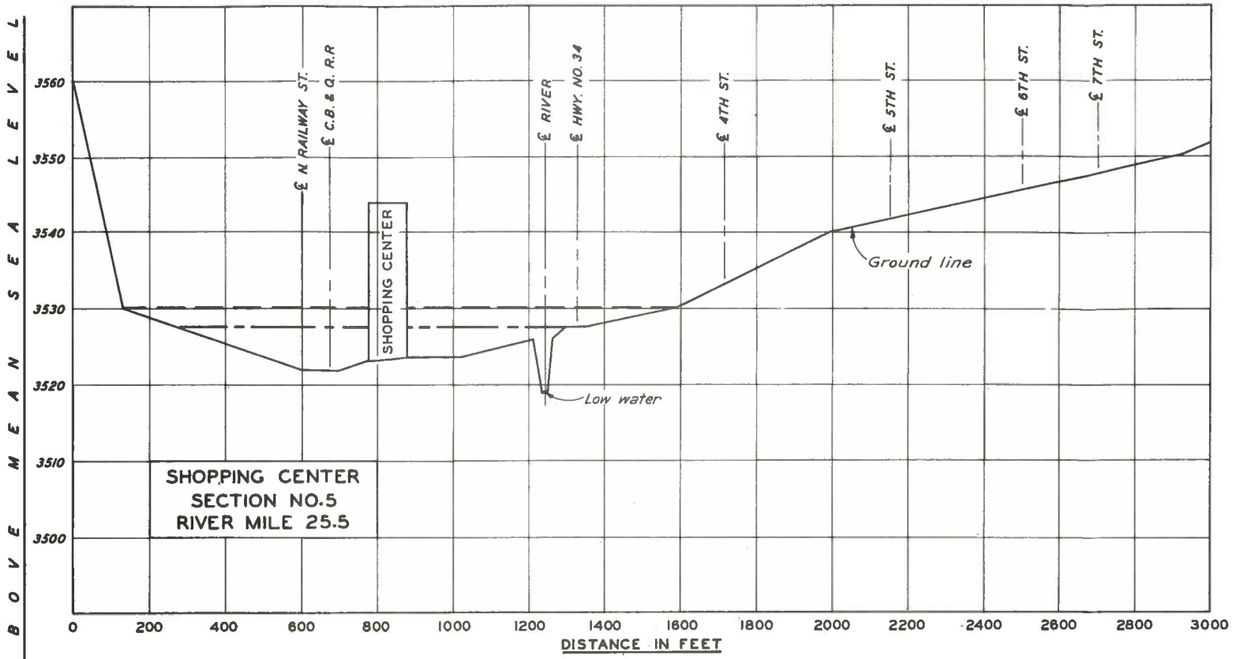
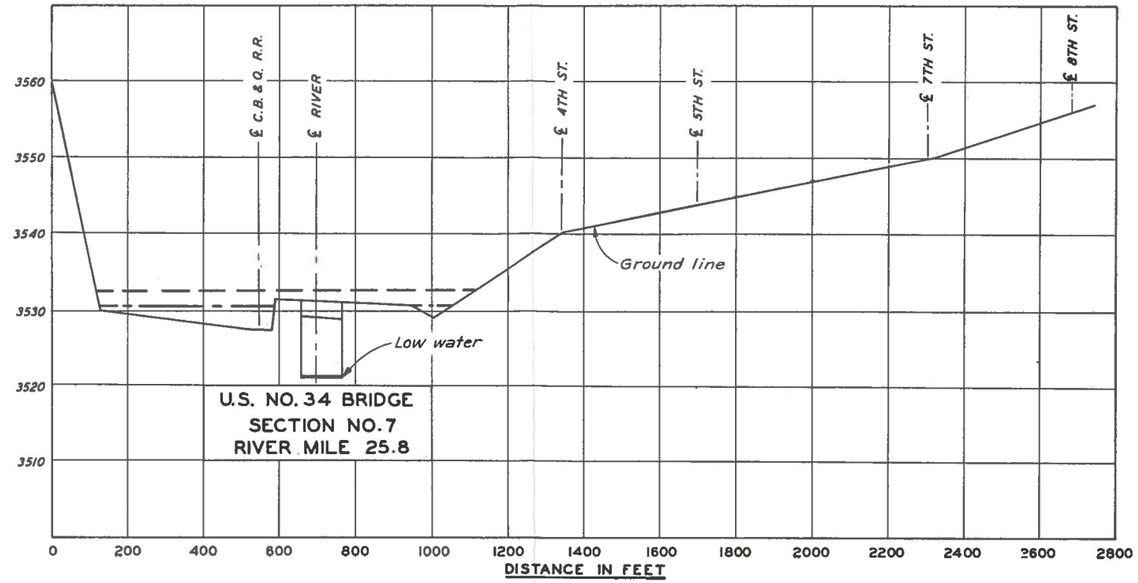
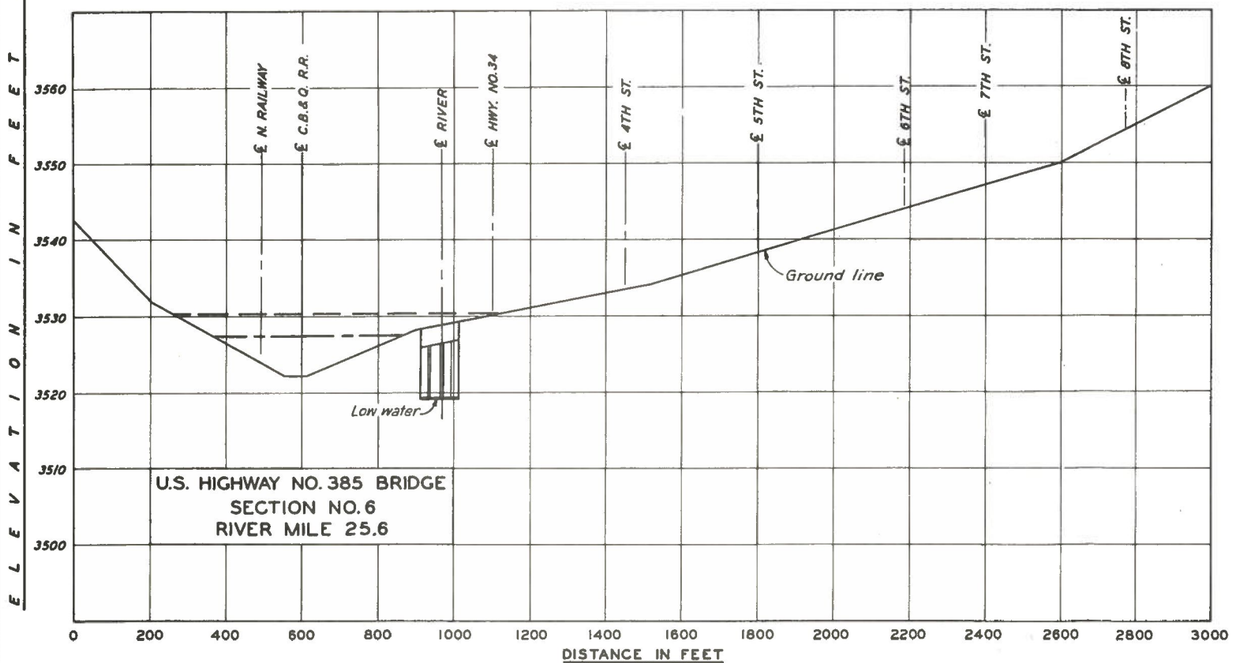
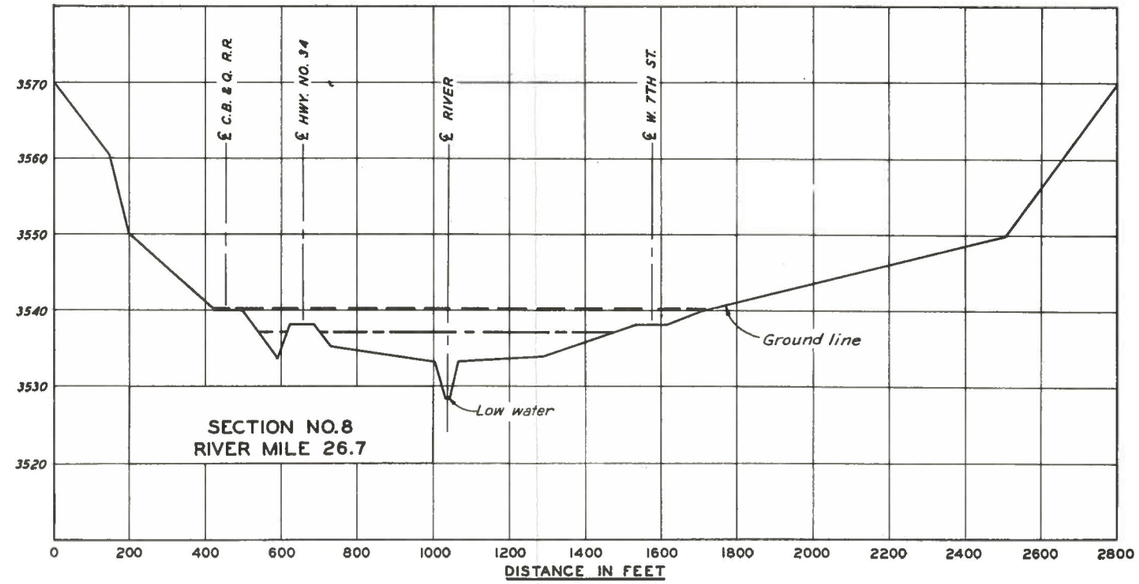
FILE NO. B-20-607

PLATE NO. 7









LEGEND

Standard Project Flood — — — — — — — —

Intermediate Project Flood — — — — — — — —

NOTE:
SECTIONS TAKEN LOOKING DOWNSTREAM.
42 CROSS SECTIONS NOT SHOWN ARE ON FILE WITH THE CORPS OF ENGINEERS.

CORPS OF ENGINEERS, U. S. ARMY
KANSAS CITY, MISSOURI, DISTRICT

CROSS SECTIONS

NORTH FORK REPUBLICAN RIVER

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FILE NO. B-20-608

PLATE NO. 8