# Determination of Flood Plain and Floodway Limits and Minimum Protection Levels Along Ralston Creek, Iowa City, Iowa

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by

Iowa Natural Resources Council
Grimes State Office Building
Des Moines, Iowa 50319

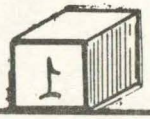
April, 1972

A portion of a state-wide program for the control, utilization and protection of the water resources of Iowa.

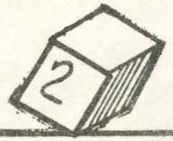
8-18-72 Natural Resources Council, gift

# IOWA NATURAL RESOURCES COUNCIL (INRC)

# FLOOD PLAIN MANAGEMENT PROGRAM



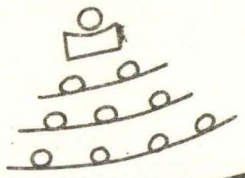

FORESIGHTED LOCAL IOWA OFFICALS RECOGNIZE POTENTIAL FLOOD HAZARD FROM URBANIZATION AND UNWISE FLOOD PLAIN



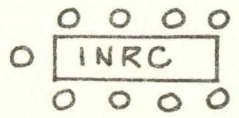

TECHNICAL ASSISTANCE TO PROGRESSIVE COMMUNITIES IS COORDINATED THROUGH THE INRC


INRC, CORPS OF ENGINEERS AND U.S.G.S. CAN PROVIDE BASIC FLOOD INFORMATION


FLOOD PLAIN PLAN AND REGULATIONS APPROVED BY CITY AND INRC



CITY ORDINANCE APPROVED




ADOPTED IN STATE PLAN FOR FLOOD CONTROL


WHY ?

1. PROTECT HUMAN LIFE & HEALTH
2. MINIMIZE FUTURE FLOOD DAMAGES

HOW?

1. STUDY POTENTIAL FLOODS
2. PLAN FOR FLOOD PLAIN NEEDS OF MAN AND FOR NATURE'S DISCHARGE OF FLOOD WATERS
3. LOCAL FLOOD PLAIN REGULATIONS

Lee

Figure 1

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Text



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Plates 2-12 - Flood Plain and Floodway Maps

Plates 13-18 - Flood Profiles

## Introduction

Major floods have been reported to occur in the Ralston Creek Basin in 1932, 1941, 1950, 1956, 1962, 1965, and 1967. In 1952, the Engineer's Club of Iowa City prepared a comprehensive report of flooding in the Ralston Creek Basin. In 1960 the Iowa Highway Research Board published Bulletin No. 16, An Analysis of the Ralston Creek Hydrologic Record, by J. W. Howe and Richard Warnock.

In 1962 the Iowa Natural Resources Council received a letter from the Iowa City Public Works Director requesting assistance in applying for Federal funds to study the Ralston Creek flood problem. As a result the Rock Island District of the Corps of Engineers undertook a flood control study in accordance with the provisions of Section 205 of the 1948 Flood Control Act but a structural project was not found to be economically feasible. By letter dated May 10, 1966, the City Manager of Iowa City requested the Iowa Natural Resources Council to undertake a flood plain study along Ralston Creek which would provide information sufficient to base flood plain zoning regulations. As time permitted the Iowa Natural Resources Council staff developed and compiled hydrologic and hydraulic information along Ralston Creek which the City of Iowa City could use to develop sound flood plain zoning regulations and which the Resources Council could use to carry out its flood plain regulatory responsibilities under the provisions of Chapter 455A of the Iowa law.

In 1968 information was furnished the City of Iowa City which identified the flood plain or flood hazard area along Ralston Creek. As a result the City Council of Iowa City passed a resolution which directed the city building officials

to have written indication of Resources Council approval prior to issuance of building permits for structures proposed in the identified flood hazard area. As compilation of hydrologic and hydraulic information along Ralston Creek was finalized, a flood plain zoning ordinance was developed in conjunction with the Iowa City Department of Public Works and the Iowa City Department of Community Development, which included appropriate zoning restrictions along Ralston Creek as well as modification of existing zoning restrictions along the Iowa River.

Purpose

The purpose of this report is to document hydrologic and hydraulic studies conducted by the Iowa Natural Resources Council at the request of the City of Iowa City of Ralston Creek and its north and south branches. The purpose of the studies was to develop technical information which could provide guidance in reducing and minimizing flood damages in the Ralston Creek basin and protect life and property from floods on Ralston Creek. The technical information consists of:

1. delineation of a flood plain area
2. delineation of a floodway or area needed to convey flood flows by identification of encroachment limits
3. determination of minimum flood protection levels to be required of high damage potential industrial, commercial or residential types of development.

It is intended that this report be a part of a state-wide program for the control, utilization and protection of the water resources of the State.

Flood Plain

Chapter 455A of Iowa law defines flood plain as "...the area adjoining the river or stream which has been or may hereafter be covered by flood water."

In keeping with this definition the flood plain of Ralston Creek was delineated by identifying the inundation limits of a large flood representative of large floods excluding extremely rare events which have been observed on streams and rivers in Iowa of similar size and characteristics. Such a large flood is called a Regional Flood and is derived from the Iowa Natural Resources Council chart, "Experienced Iowa Floods," This chart is shown as Figure 2 in this report.

As indicated by the appropriate curve plotted on Figure 2, the Regional Flood at the mouth of Ralston Creek (drainage area equals 8.75 square miles) is 6,800 cfs. Following the appropriate curve, the Regional Flood is identified from Figure 2 at various locations along Ralston Creek in which the upstream drainage area is in excess of 2.0 square miles. Table 1 lists the magnitude of the Regional Flood at certain locations along Ralston Creek.

The Iowa Natural Resources Council at its December 2, 1969 meeting adopted the above identifed Regional Flood (concurrent with a flow of 25,000 cfs. in the Iowa River) to be used to delineate the Ralston Creek flood plain.

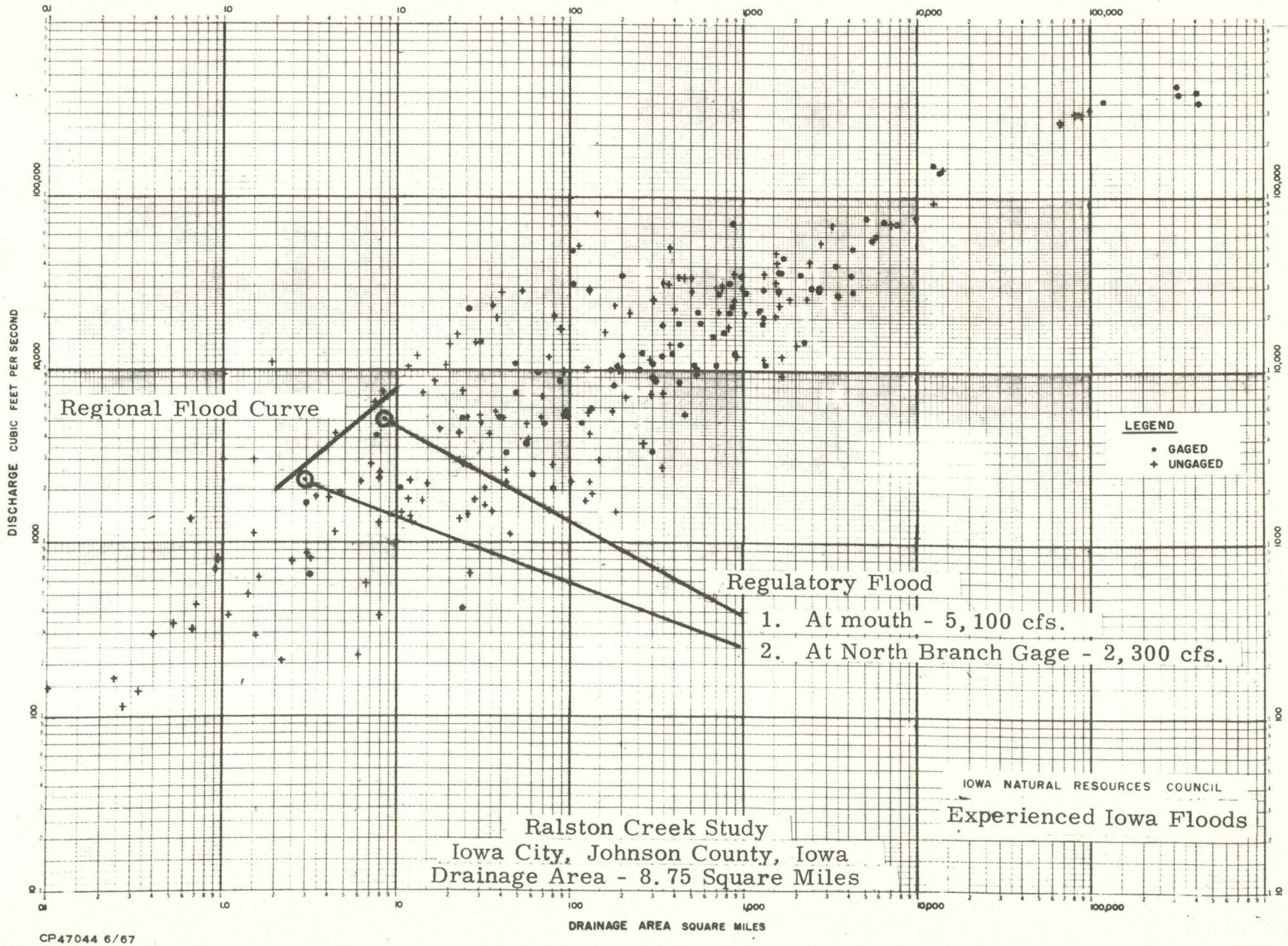
Regional Flood Curve
LEGEND
• GAGED
+ UNGAGED
Regulatory Flood
1. At mouth - 5,100 cfs.
2. At North Branch Gage - 2,300 cfs.
IOWA NATURAL RESOURCES COUNCIL
Experienced Iowa Floods
Ralston Creek Study
Iowa City, Johnson County, Iowa
Drainage Area - 8.75 Square Miles
DISCHARGE CUBIC FEET PER SECOND
DRAINAGE AREA SQUARE MILES
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Figure 2

TABLE I

Regional and Regulatory Flood Discharges along Ralston Creek, Iowa City, Iowa, Listed by Station in Relation to Bridge Crossings.

MAIN STEM

| Station (Hundreds of Feet) | Crossing | Drainage Area (Square Miles) | Regulatory Flood (cubic feet per second) | Regional Flood (cubic feet per second) |
|---|---|---|---|---|
| 2 + 00 (Mouth) | | 8.75 | 5,100 | 6,800 |
| 5 + 05 | Highway No. 6 | | | |
| 11 + 00 | Spur Line R.R. | | | |
| 17 + 85 | | 8.6 | 5,000 | 6,700 |
| 18 + 35 | Kirkwood Ave. | | | |
| 23 + 00 | | 8.5 | 5,000 | 6,600 |
| 25 + 40 | Benton Street | | | |
| 29 + 60 | Lafayette Street | | | |
| 33 + 43 | C.R.I. & P.R.R. | | | |
| 35 + 90 | | 8.3 | 5,000 | 6,500 |
| 37 + 51 | Prentiss Street | | | |
| 41 + 90 | Maiden Lane | | | |
| 43 + 61 | Gilbert Street | | | |
| 48 + 35 | | 8.1 | 5,000 | 6,400 |

TABLE I (Continued)

MAIN STEM

| Station (Hundreds of Feet) | Crossing | Drainage Area (Square Miles) | Regulatory Flood (cubic feet per second) | Regional Flood (cubic feet per second |
|---|---|---|---|---|
| 49 + 20 | Van Buren Street | | | |
| 53 + 10 | | 8.1 | 4,900 | 6,400 |
| 53 + 60 | Burlington Street | | | |
| 57 + 62 | College Street | | | |
| 59 + 62 | | 8.0 | 4,900 | 6,300 |
| 61 + 58 | Washington Street | | | |
| 66 + 42 | Johnson Street | | | |
| 69 + 92 | | 7.8 | 4,800 | 6,200 |
| 70 + 42 | Dodge Street | | | |
| 74 + 63 | Lucas Street | | | |
| 76 + 50 | Iowa Avenue | | | |
| 80 + 18 | Governor Street | | | |
| 84 + 95 | | 7.5 | 4,800 | 6,100 |
| 86 + 02 | Evans Street | | | |
| 89 + 57 | | 7.5 | 4,700 | 6,100 |

TABLE I (Continued)

MAIN STEM

| Station (Hundreds of Feet) | Crossing | Drainage Area (Square Miles) | Regulatory Flood (cubic feet per second) | Regional Flood (cubic feet per second) |
|---|---|---|---|---|
| 95 + 86 | | 7.4 | 4,700 | 6,000 |
| 98 + 00 (Junction of North & South Branches) | | 7.4 | 4,700 | 6,000 |
| | SOUTH BRANCH | | | |
| 98 + 00 (Mouth) | | 4.3 | 3,100 | 3,700 |
| 103 + 52 | | 4.2 | 3,000 | 3,500 |
| 106 + 57 | College Street | | | |
| 114 + 78 | Muscatine Avenue | | | |
| 121 + 60 | | 3.8 | 2,800 | 3,500 |
| 124 + 88 | Center Street | | | |
| 131 + 18 | Sheridan Avenue | | | |
| 138 + 00 | | 3.5 | 2,600 | 3,100 |
| 154 + 45 | | 3.2 | 2,400 | 3,100 |
| 157 + 00 | Sixth Avenue | | | |
| 159 + 97 | F Street | | | |

TABLE I (Continued)

SOUTH BRANCH

| Station (Hundreds of Feet) | Crossing | Drainage Area (Square Miles) | Regulatory Flood (cubic feet per second) | Regional Flood (cubic feet per second |
|---|---|---|---|---|
| 164 + 82 | Muscatine Avenue | | | |
| 167 + 77 | Fourth Avenue | | | |
| 170 + 25 | | 3.0 | 2,300 | 2,800 |
| 171 + 72 | Third Avenue | | | |
| 179 + 80 | First Avenue | | | |
| 183 + 40 | | 2.8 | 2,200 | 2,800 |
| 198 + 00 | | 2.6 | 2,100 | 2,400 |
| 200 + 97 | Meadow Street | | | |
| 208 + 00 | | 2.3 | 1,900 | 2,400 |
| 220 + 00 | | 2.1 | 1,700 | 2,000 |
| 223 + 28 (End of Reach) | | 2.0 | 1,700 | 2,000 |
| | NORTH BRANCH | | | |
| 0 + 00 (Mouth) | | 3.1 | 2,400 | 2,800 |
| 7 + 10 | | 3.0 | 2,300 | 2,800 |

TABLE I (Continued)

NORTH BRANCH

| Station (Hundreds of Feet) | Crossing | Drainage Area (Square Miles) | Regulatory Flood (cubic feet per second) | Regional Flood (cubic feet per second |
|---|---|---|---|---|
| 10 + 17 | Jefferson Street | | | |
| 18 + 93 | Rochester Avenue | 3.0 | 2,300 | 2,800 |
| 24 + 00 (End of Reach) | | 2.9 | 2,300 | 2,800 |

Floodway and Encroachment Limits

Chapter 455A of Iowa law defines floodway as "...the channel of a river or stream and those portions of the flood plains adjoining the channel, which are reasonably required to carry and discharge the flood water or flood flow of any river or stream."

Encroachment limits may be thought of as lines which generally parallel a river or stream channel and delineate the area reasonably required to carry and discharge the flood water or flood flows. In other words, encroachment limits are used to distinguish the floodway within the flood plain.

The following considerations are usually given in locating encroachment limits:

1. In heavily developed flood plain areas having high damage potential or in areas where additional flood plain encroachment may reduce the level of protection of existing or proposed works for flood control, encroachment limits are located in a manner such that the increase in flood stage resulting by confining the regulatory flood discharge [1] to between said encroachment limits is minimized as much as possible, but in any event shall be less than 1.0 foot.
2. In other areas, the increase in flood stage resulting from confining the regulatory flood discharge to between the encroachment limits shall generally not exceed 1.0 foot.
3. That existing buildings located in the flood plain shall be excluded from between the encroachment limits insofar as possible.

4. That wherever possible, opposite encroachment limits shall be located at equivalent offsets from the river or stream channel.

5. Where any of the above four considerations are in conflict that consideration listed first shall usually apply.

1.) Note: The term, Regulatory Discharge, will be discussed in the next section.

Figure 3 illustrates the concept of flood plain encroachment. In this illustration note that the flood plain encroachment shown causes an increase in the stage of the Regulatory Discharge (identified as design flood) 1.5 feet or 0.5 foot in excess of the general criteria stated above. Thus the encroachment limits and the indicated limits of permissible flood plain encroachment would have to be moved landward in order to be consistent with the stated criteria.

Since most of the Ralston Creek and tributary flood plains included in this study have been severely encroached upon, it is desirable to limit the increase in stage of the regulatory discharge to a minimum when said discharge is confined to the floodway or between the encroachment limits. In locating the encroachment limits as many existing structures as possible were excluded from the floodway or from between the encroachment limits. However, in order to avoid possible future substantial increases in flood stage, a number of buildings had to be included in the floodway or between the encroachment limits. Except at certain bridge crossings of Ralston Creek where road grade overflow was needed to limit increases in flood stage, floodway widths or distances between encroachment limits were selected to be either 100 feet, 80 feet, or 70 feet depending upon location of the stream

reach within the basin. See Table 2. Such floodway widths or distances between encroachment limits in most instances exceeded the width of areas of effective flow assumed when computing the water surface profiles for the Regional Flood and the Regulatory Discharge. Also, the indicated floodway widths or distances between the encroachment limits will permit the construction of future bridge crossings and permit possible future channel improvements which could substantially reduce the stage of the Regulatory and Regional Floods, thereby reducing the hazard of flooding to a number of existing buildings located in the flood plain or flood hazard area.

On the main stem of Ralston Creek downstream from the junction of the north and south branches, at the existing bridge crossings where road grade overflow is needed to prevent substantial increases in flood stages, the floodway width or distance between the encroachment limits was expanded to 200 feet following an equal and opposite encroachment concept. Where the number of buildings located in the floodway or between the encroachment limits could be reduced by shifting the required 200 ft. road grade overflow area to most or all of one side or the other of the creek, such a shift was made. The Kirkwood Avenue crossing of Ralston Creek is an example of such a shift.

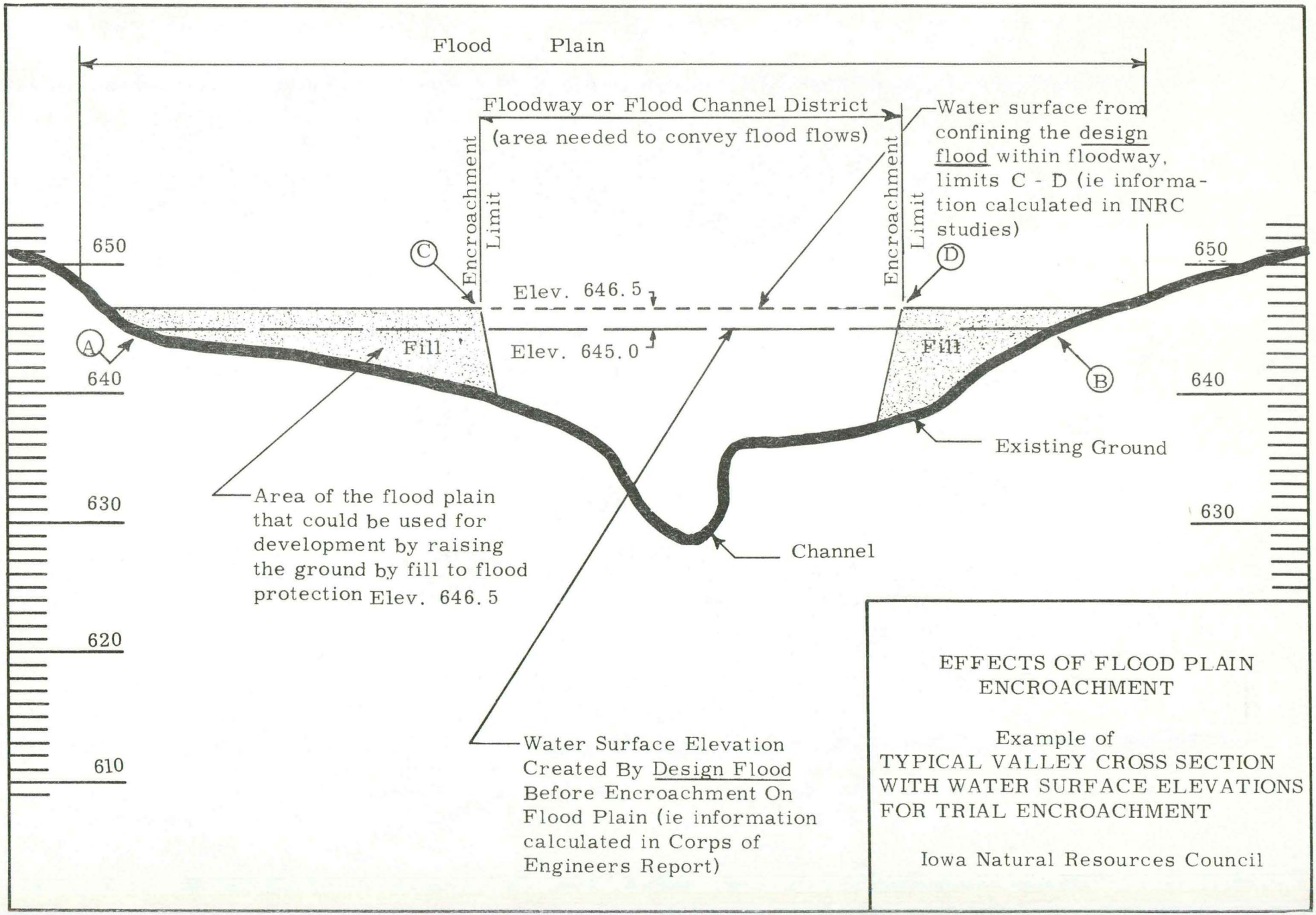


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Figure III

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TABLE 2

Floodway Widths Along Ralston Creek and Tributaries

| Station (Hundreds of Feet) | Reach | Width of Floodway (Feet) |
|---|---|---|
| 2 + 00 to 98 + 00 | Mouth of main stem to junction of north and south branches | 100 |
| 0 + 00 to 18 + 93 | Mouth of north branch to north branch gage | 80 |
| 18 + 93 to 24 + 00 | Upstream from north branch gage | 70 |
| 98 + 00 to 124 + 88 | Mouth of south branch to Center Street | 80 |
| 124 + 88 to 223 + 28 | Upstream south branch from Center Street | 70 |

Regulatory Flood

The regulatory flood is a flood discharge used to:

1. determine the hydraulic effect of the floodway as identified and delineated by flood plain encroachment limits; and,
2. to identify minimum levels of flood protection to be required of all high damage potential industrial, commercial, or residential types of development.

Recognizing that a large flood representative of large floods excluding extremely rare events which have been observed on Iowa's rivers and streams may be suitable for flood plain delineation consistent with Iowa law, such a flood magnitude may not be a reasonable basis for flood plain regulation. Therefore, by Iowa Natural Resources Council policy, a 100 year flood (a flood having a one percent chance of occurrence in any one year and usually lessor in magnitude than the Regional Flood) is used for determining effects of encroachments and minimum flood protection levels.

The 100 year flood discharge of 5, 100 cfs. at the mouth of Ralston Creek and 2, 300 cfs. at the north branch gage was determined using 45 years of continuous stream flow record at the north branch gage (Station 18 + 93 at Rochester Avenue; drainage area equal to 3. 0 square miles) and following the log Pearson Type III method of computing flood frequencies. It was assumed that the 100 year flood discharge data computed for the north branch was applicable to the south branch.

To take into account the change in drainage area, the 100 year flood discharge was extrapolated upstream from the north branch gage and down-

stream from the north branch gage to the junction of the north and south branches in accordance with the ratio to the eight-tenths power of the drainage area at the gage site to the drainage area at the upstream or downstream point along the branch. Downstream from the junction of the north and south branches along the main stem of Ralston Creek to its mouth, the 100 year flood was increased in accordance with the ratio of the square root of the drainage areas. The 100 year flood flow on Ralston Creek is assumed to occur coincident with a flow of 15,000 cfs. in the Iowa River. The magnitude of 100 year flood discharge; the technique to extrapolate the magnitude of the 100 year flood to points along the creek involving drainage areas greater or less than that at the north branch gage site; and the coincident flow in Iowa River was adopted by the Iowa Natural Resources Council at its December 2, 1969, meeting.

Minimum Flood Protection Levels

The minimum flood protection level is the minimum elevation to which high damage potential types of flood plain development must be provided flood protection. In accordance with Iowa Natural Resources Council policy and as indicated in the section entitled Regulatory Flood, the elevation of the minimum flood protection level corresponds to the elevation of the regulatory flood (100 year flood) as confined to the floodway between the encroachment limits. In Figure 3, the increased stage of the regulatory flood (identified as design flood in the figure) as confined to between the indicated encroachment limits identifies what would be the minimum flood protection level at that particular location along the illustrated stream.

The desired level of flood protection is achieved by placing the lowest water entry elevation of high damage potential types of flood plain development at or above the minimum flood protection level.

For high damage potential structures having basements or levels below the minimum flood protection level, the Iowa Natural Resources Council ordinarily requires:

1) Walls and floors located below the minimum flood protection level be designed and constructed to withstand the hydrostatic pressure of an elevated water table.

2) Sanitary sewer systems below minimum flood protection levels be provided with backup valves.

One acceptable method of protecting walls and floors from the hydrostatic pressures of an elevated watertable is to place compacted fill at the minimum flood protection level extending for a distance of 15 feet out from and completely around the perimeter of the structure to be protected. Walls and floors below the minimum flood protection level should be of poured concrete construction. If protection is to be provided by a levee, the levee is to provide freeboard protection above the regulatory discharge of an additional three feet or up to the level of the regional flood.

High damage potential type industrial, commercial or residential type development is considered to consist of but not necessarily be limited to:

1) Homes, apartment buildings, hotels, motels, house trailers and other types of residential buildings; (For house trailers the lowest water entry level shall be considered to be the trailer pad.)
2) Educational institutions, including dormitories;
3) Health institutions including clinics, DDS and MD offices, and veterinary establishments;
4) Airfields or airports of public value;
5) Communication buildings, including telephone exchanges, telegraph offices, radio and TV stations;
6) Camp grounds for family groups, youth groups, or other groups whose occupants may not have adequate warning or

means of escape during flood or whose occupants may be incapable of leaving during flooding and who may be endangered by failure of building utilities or services;

7) Public service buildings such as civic centers, police stations, and fire stations;

8) Commercial and industrial buildings;

9) Warehouse, stockpiles, tanks and other material storage facilities posing a possible hazard to the public due to damage from flooding (i.e. ammonia tanks; fuel and oil tanks; acidic or basic materials; chemicals; floatables which could cause a jam, explosion, or other hazardous chemical reaction; etc.)

means of escape during flood or whose occupants may be incapable of leaving during flooding and who may be endangered by failure of building utilities or services;

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9) Warehouse, stockpiles, tanks and other material storage facilities posing a possible hazard to the public due to damage from flooding (i.e. ammonia tanks; fuel and oil tanks; acidic or basic materials; chemicals; floatables which could cause a jam, explosion, or other hazardous chemical reaction; etc.)

Explanation of Maps and Profiles

From the hydrologic and hydraulic data developed, maps and water surface profiles were prepared to assist the user in relating the flood plain construction policies of the Iowa Natural Resources Council to specific flood plain construction projects.

The floodway as identified by encroachment limits and the flood plain are delineated on topographic maps of a 1 inch equals 100 feet scale with a contour interval of 2 feet. The photography upon which the topographic mapping is based was taken or flown in November 1964. The maps were compiled and drafted in February 1965. In the first fifteen copies of this report the general Iowa City map showing the Iowa River and Ralston Creek is identified as Sheet 1 of 20. In subsequent reports this plate is identified as Plate 1. Likewise in the first 15 copies of this report the eleven large scale plates showing the floodway and flood plain along Ralston Creek and its north and south branches are identified as Sheet 10 of 20 through 20 of 20. In subsequent reports these plates are identified as Plate 2 through Plate 12.

In addition to the maps delineating the limits of the floodway and flood plain, profiles of the Regional and Regulatory Flood are shown on Plate 21 through Plate 26 in the first 15 copies of this report. In subsequent reports these plates are identified as Plate 13 through Plate 18.

As related in previous sections of the report the inundation limits of the Regional Flood are used to define the limits of the flood plain while the elevation of the Regulatory Flood is used to identify minimum flood protection levels. These water surface profiles were generated by using a standard step procedure of calculating backwater curves. Insofar as

possible the cross section information used to develop the Ralston Creek model represent current conditions. Changes have been made to the model to reflect bridges, streets, and other flood plain encroachments which have been undertaken or constructed since 1965. The latest computations were made March 30, 1972. In determining channel and flood plain roughness, observed flood profiles along Ralston Creek were matched by selecting appropriate roughness parameters for use in the standard step backwater calculations. The roughness parameters used to match the observed profiles were then used to calculate the Regional and Regulatory Flood Profiles.

Since the topographic maps reflect conditions at the time of the aerial photography, the flood plain limits as shown on the maps may vary in precision because of changed conditions. In the event a question arises as to the location of a parcel of property with respect to the flood plain, current elevations of the property should be checked against the elevation of the Regional Flood Profile adjacent to the property. That portion of the property below the elevation of the Regional Flood would be considered to be in the flood plain.

Both the Regional and Regulatory Flood profiles are plotted to 1 inch equals 200 feet horizontal scale and 1 inch equals 2 feet vertical scale. Bridges are located along the profile to make it easier to relate between the topographic maps and the flood profiles.

Example: Relating to Sheet 13 of 20 of the first 15 copies of the report (Plate 5 in subsequent copies of the report), determine the minimum flood protection level and the Regional Flood elevation for the lot located northwest of the intersection of Dodge and Iowa

Streets. From the center of the building located on the above described lot project a line toward the creek which would intersect the estimated centerline of the floodway at right angles. In doing this note that the intersection of the projected line and the floodway centerline is approximately 75 feet downstream from Dodge Street. Referring to Sheet 22, of the first 15 copies of the report (Plate 14 in subsequent copies of the report) the elevation of the Regulatory Flood profile is shown to be at elevation 664.2 representing the minimum flood protection level. The Regional Flood is shown to be at elevation 665.5 and represents the vertical limit of the flood plain.

Regulatory Flood profile elevations representing minimum flood protection levels are located on the topographic maps at intervals along Ralston Creek. The decimal point of each elevation identifies a point on the map for which the elevation is applicable as a Minimum Flood Protection level.

The general location map and the detailed topographic maps of Ralston Creek were prepared by the Iowa City Public Works Department from the hydrologic and hydraulic information furnished by the Iowa Natural Resources Council. The Regional and Regulatory Flood Profiles were prepared by the Iowa Natural Resources Council.

Table 3 lists the elevations of the Regional Flood and Regulatory Flood by station or distance along Ralston Creek (one station equals 100 feet). The stationing of the bridge crossings along Ralston Creek are also shown in Table 3.

TABLE 3

Elevations referenced to mean sea level along Regional and Regulatory Flood Profiles Ralston Creek, Iowa City, Iowa, Listed by Station in Relation to Bridge Crossings.

| Station (Hundreds of Feet) | Crossing | Regulatory Flood Elevation | Regional Flood Elevation |
|---|---|---|---|
| | MAIN STEM | | |
| 2 + 00 | | 641.60 | 644.80 |
| 4 + 00 | | 642.01 | 644.91 |
| 4 + 55 | | 642.14 | 645.00 |
| 5 + 05 | Highway No. 6 | | |
| 5 + 55 | | 644.81 | 648.22 |
| 7 + 00 | | 645.06 | 648.42 |
| 11 + 00 | Spur Line R. R. | | |
| 13 + 00 | | 646.81 | 649.46 |
| 15 + 25 | | 647.34 | 649.87 |
| 17 + 00 | | 647.48 | 649.92 |
| 17 + 85 | | 647.50 | 649.94 |
| 18 + 35 | Kirkwood Ave. | | |
| 19 + 20 | | 647.84 | 650.24 |
| 23 + 00 | | 649.93 | 651.75 |
| 24 + 90 | | 650.35 | 652.06 |
| 25 + 40 | Benton Street | | |
| 26 + 00 | | 650.57 | 652.28 |
| 27 + 77 | | 650.78 | 652.45 |
| 29 + 10 | | 650.92 | 652.53 |

TABLE 3 (Continued)

| Station (Hundreds of Feet) | Crossing | Regulatory Flood Elevation | Regional Flood Elevation |
|---|---|---|---|
| 29 + 60 | Lafayette Street | | |
| 30 + 30 | | 651.09 | 652.85 |
| 31 + 67 | | 653.49 | 654.55 |
| 32 + 93 | | 653.68 | 654.81 |
| 33 + 43 | C.R. I. & P.R.R. | | |
| 34 + 35 | | 655.69 | 657.78 |
| 35 + 90 | | 655.79 | 657.88 |
| 37 + 01 | | 655.86 | 657.94 |
| 37 + 51 | Prentiss Street | | |
| 39 + 00 | | 656.29 | 658.24 |
| 41 + 25 | | 656.38 | 658.34 |
| 41 + 90 | Maiden Lane | | |
| 42 + 70 | | 657.30 | 658.81 |
| 42 + 80 | | 657.36 | 658.86 |
| 43 + 61 | Gilbert Street | | |
| 44 + 80 | | 660.47 | 661.54 |
| 46 + 60 | | 660.97 | 662.12 |
| 48 + 35 | | 661.15 | 662.35 |
| 49 + 20 | Van Buren Street | | |
| 50 + 52 | | 661.27 | 662.50 |
| 52 + 50 | | 661.30 | 662.51 |
| 53 + 10 | | 661.41 | 662.67 |

TABLE 3 (Continued)

| Station (Hundreds of Feet) | Crossing | Regulatory Flood Elevation | Regional Flood Elevation |
|---|---|---|---|
| 53 + 60 | Burlington Street | | |
| 54 + 18 | | 661.55 | 662.84 |
| 56 + 30 | | 661.73 | 663.03 |
| 57 + 12 | | 661.96 | 663.27 |
| 57 + 62 | College Street | | |
| 58 + 12 | | 661.96 | 663.30 |
| 59 + 62 | | 662.05 | 663.36 |
| 60 + 30 | | 662.07 | 663.39 |
| 61 + 08 | | 662.27 | 663.70 |
| 61 + 58 | Washington Street | | |
| 62 + 08 | | 662.51 | 663.98 |
| 63 + 30 | | 662.81 | 664.25 |
| 65 + 30 | | 663.18 | 664.61 |
| 65 + 92 | | 663.60 | 664.93 |
| 66 + 42 | Johnson Street | | |
| 66 + 92 | | 663.82 | 665.17 |
| 69 + 36 | | 664.10 | 665.45 |
| 69 + 92 | | 664.20 | 665.55 |
| 70 + 42 | Dodge Street | | |
| 70 + 92 | | 664.88 | 666.92 |
| 74 + 13 | | 666.20 | 668.03 |
| 74 + 63 | Lucas Street | | |

TABLE 3 (Continued)

| Station (Hundreds of Feet) | Crossing | Regulatory Flood Elevation | Regional Flood Elevation |
|---|---|---|---|
| 75 + 13 | | 666.41 | 668.27 |
| 76 + 50 | Iowa Avenue | | |
| 79 + 20 | | 667.25 | 669.00 |
| 79 + 68 | | 667.58 | 669.23 |
| 80 + 18 | Governor Street | | |
| 80 + 68 | | 667.80 | 669.50 |
| 84 + 95 | | 668.81 | 670.41 |
| 85 + 52 | | 668.89 | 670.48 |
| 86 + 02 | Evans Street | | |
| 86 + 52 | | 669.14 | 670.73 |
| 87 +22 | | 669.19 | 670.78 |
| 89 + 57 | | 669.37 | 670.93 |
| 92 + 50 | | 669.69 | 671.25 |
| 94 + 20 | | 669.89 | 671.43 |
| 95 + 86 | | 670.13 | 671.67 |
| 98 + 00 (Junction of North and South Branches) | | 670.40 | 671.94 |
| | SOUTH BRANCH | | |
| 98 + 00 (Mouth) | | 670.40 | 671.94 |
| 101 + 18 | | 670.50 | 672.04 |
| 103 + 52 | | 670.63 | 672.17 |
| 106 + 07 | | 670.81 | 672.33 |

TABLE 3 (Continued)

| Station (Hundreds of Feet) | Crossing | Regulatory Flood Elevation | Regional Flood Elevation |
|---|---|---|---|
| 106 + 57 | College Street | | |
| 107 + 07 | | 672.77 | 673.68 |
| 108 + 25 | | 672.89 | 673.82 |
| 110 + 28 | | 672.97 | 673.91 |
| 113 + 00 | | 673.11 | 674.07 |
| 114 + 28 | | 673.27 | 674.29 |
| 114 + 78 | Muscatine Avenue | | |
| 116 + 00 | | 673.44 | 674.50 |
| 118 + 20 | | 673.74 | 674.81 |
| 120 + 05 | | 673.89 | 674.96 |
| 121 + 60 | | 674.25 | 675.29 |
| 124 + 38 | | 674.73 | 675.76 |
| 124 + 88 | Center Street | | |
| 125 + 38 | | 675.48 | 676.95 |
| 127 + 72 | | 677.95 | 679.09 |
| 130 + 68 | | 678.32 | 679.46 |
| 131 + 18 | Sheridan Avenue | | |
| 131 + 68 | | 678.53 | 679.70 |
| 134 + 75 | | 680.66 | 682.00 |
| 136 + 50 | | 680.71 | 682.07 |
| 138 + 00 | | 680.83 | 682.19 |
| 139 + 00 | | 680.89 | 682.24 |
| 139 + 60 | | 680.94 | 682.28 |

TABLE 3 (Continued)

| Station (Hundreds of Feet) | Crossing | Regulatory Flood Elevation | Regional Flood Elevation |
|---|---|---|---|
| 142 + 00 | | 681.23 | 682.53 |
| 144 + 40 | | 681.68 | 682.85 |
| 145 + 40 | | 681.93 | 683.05 |
| 148 + 00 | | 682.72 | 683.70 |
| 149 + 70 | | 683.63 | 684.43 |
| 150 + 75 | | 683.81 | 684.61 |
| 153 + 00 | | 684.35 | 685.11 |
| 154 + 45 | | 684.81 | 685.55 |
| 156 + 50 | | 685.76 | 686.50 |
| 157 + 00 | Sixth Avenue | | |
| 157 + 50 | | 686.67 | 687.21 |
| 158 + 97 | | 687.62 | 688.30 |
| 159 + 47 | E Street | | |
| 159 + 97 | | 689.37 | 690.07 |
| 162 + 00 | | 689.40 | 690.10 |
| 164 + 32 | | 689.64 | 690.37 |
| 164 + 82 | Muscatine Avenue | | |
| 165 + 32 | | 693.09 | 693.89 |
| 166 + 18 | | 693.24 | 694.08 |
| 167 + 27 | | 693.27 | 694.12 |
| 167 + 77 | Fourth Avenue | | |
| 168 + 27 | | 693.42 | 694.29 |

TABLE 3 (Continued)

| Station (Hundreds of Feet) | Crossing | Regulatory Flood Elevation | Regional Flood Elevation |
|---|---|---|---|
| 170 + 25 | | 693.45 | 694.34 |
| 171 + 22 | | 693.50 | 694.37 |
| 171 + 72 | Third Avenue | | |
| 172 + 22 | | 693.62 | 694.50 |
| 173 + 70 | | 693.69 | 694.58 |
| 176 + 20 | | 693.83 | 694.73 |
| 177 + 70 | | 693.93 | 694.82 |
| 179 + 30 | | 694.03 | 694.92 |
| 179 + 80 | First Avenue | | |
| 180 + 30 | | 694.42 | 695.25 |
| 183 + 40 | | 695.03 | 695.83 |
| 185 + 40 | | 695.34 | 696.15 |
| 188 + 00 | | 696.27 | 697.08 |
| 190 + 00 | | 696.76 | 697.58 |
| 192 + 00 | | 697.32 | 698.15 |
| 194 + 00 | | 697.82 | 698.67 |
| 196 + 00 | | 698.27 | 699.11 |
| 198 + 00 | | 698.72 | 699.56 |
| 200 + 47 | | 699.29 | 700.02 |
| 200 + 97 | Meadow Street | | |
| 201 + 47 | | 700.59 | 701.55 |
| 203 + 60 | | 701.49 | 702.17 |

TABLE 3 (Continued)

| Station (Hundreds of Feet) | Crossing | Regulatory Flood Elevation | Regional Flood Elevation |
|---|---|---|---|
| 206 + 00 | | 702.05 | 702.67 |
| 208 + 00 | | 702.27 | 702.88 |
| 210 + 00 | | 702.86 | 703.47 |
| 212 + 00 | | 703.51 | 704.09 |
| 214 + 00 | | 704.80 | 705.39 |
| 216 + 00 | | 705.39 | 706.00 |
| 218 + 00 | | 705.79 | 706.41 |
| 220 + 00 | | 706.35 | 707.00 |
| 221 + 73 | | 706.66 | 707.24 |
| 223 + 28 (End of Reach) | | 706.97 | 707.48 |
| | NORTH BRANCH | | |
| 0 + 00 (Mouth) | | 670.40 | 671.94 |
| 0 + 70 | | 670.42 | 671.95 |
| 2 + 25 | | 670.47 | 672.00 |
| 4 + 00 | | 670.57 | 672.07 |
| 6 + 00 | | 670.68 | 672.14 |
| 7 + 10 | | 670.76 | 672.21 |
| 9 + 77 | | 671.11 | 672.49 |
| 10 + 17 | Jefferson Street | | |
| 10 + 67 | | 671.82 | 672.90 |
| 11 + 50 | | 672.05 | 673.10 |

TABLE 3 (Continued)

| Station (Hundreds of Feet) | Crossing | Regulatory Flood Elevation | Regional Flood Elevation |
|---|---|---|---|
| 13 + 50 | | 672.51 | 673.51 |
| 15 + 70 | | 673.03 | 673.97 |
| 18 + 53 | | 675.17 | 675.77 |
| 18 + 93 | Rochester Avenue | | |
| 19 + 43 | | 676.48 | 677.36 |
| 22 + 00 | | 677.28 | 678.23 |
| 24 + 00 (End of Reach) | | 677.46 | 678.40 |

## Use of Report

Iowa Natural Resources Council. The Iowa Natural Resources Council will use the information contained in the report to carry out its responsibilities under the provisions of Chapter 455A of the Iowa Code, 1971, as amended.

The inundation limits of the Regional Flood which identifies the flood plain or flood hazard area will be used to determine when Resources Council consideration is required. The encroachment limits will be used to help determine if a particular project will adversely affect or unduly restrict the capacity of the floodway. The Regulatory Flood will be used in determining minimum flood protection levels to be required of high damage potential types of development. The report will help indicate if a particular project by itself or relative to others will adversely affect the control, development, protection, allocation, or utilization of water resources of the State, or adversely affect or interfere with the state comprehensive plan for water resources, or an approved local water resources plan.

City of Iowa City. The information contained in this report is intended to serve as the hydrologic and hydraulic basis for local flood plain zoning regulations which meet the previously indicated specific requirements of the Iowa Natural Resources Council for flood plain construction. In addition, the information can readily be used in meeting general requirements of the Iowa Natural Resources Council for local flood plain zoning regulations which consist of the following:

1. Describe the limits of the flood plain or flood hazard area.
2. Limit the extent of flood plain encroachment by delineation of a floodway through establishment of encroachment limits.

3. Set minimum levels of flood protection to be required of all development located in the flood plain having a flood damage potential.

4. Provide for disposition of non-conforming uses and structures.

Besides zoning regulations, the information contained in the report can serve as the basis for flood plain provisions in a subdivision ordinance and/or flood proofing provisions in a building code.

Further uses can include guidance toward implementation of:

1. Land use development policies such as green belt or open space programs.

2. Tax adjustments for floodway and flood plain lands.

3. Warning signs

4. Flood insurance in accordance with the provisions of the National Flood Insurance Program.

## Conclusions

To conclude, the development of the hydrologic and hydraulic information contained in this report is based upon sound engineering principles. The use of principles of engineering in developing flood plain construction requirements enhances the validity of the requirements since the hydraulic effects of such construction or the actual inundation limits of a certain size flood can usually be shown. It is further concluded that state and local flood plain regulation based upon the hydrologic and hydraulic information and the indicated criteria can be upheld in a court of law.

The criteria applied to the various types of flood plain construction projects have evolved from approximately ten years of flood plain regulation in the State by the Iowa Natural Resources Council. These criteria are also consistent with similar criteria in adjoining states as well as several federal agencies. Finally it is emphasized that the criteria of the Iowa Natural Resources Council reflect minimum requirements since floods exceeding the magnitude of the Regulatory Flood have occurred in Iowa and can be expected to occur again. Cities, towns and counties implementing flood plain regulations should be aware of this limitation.

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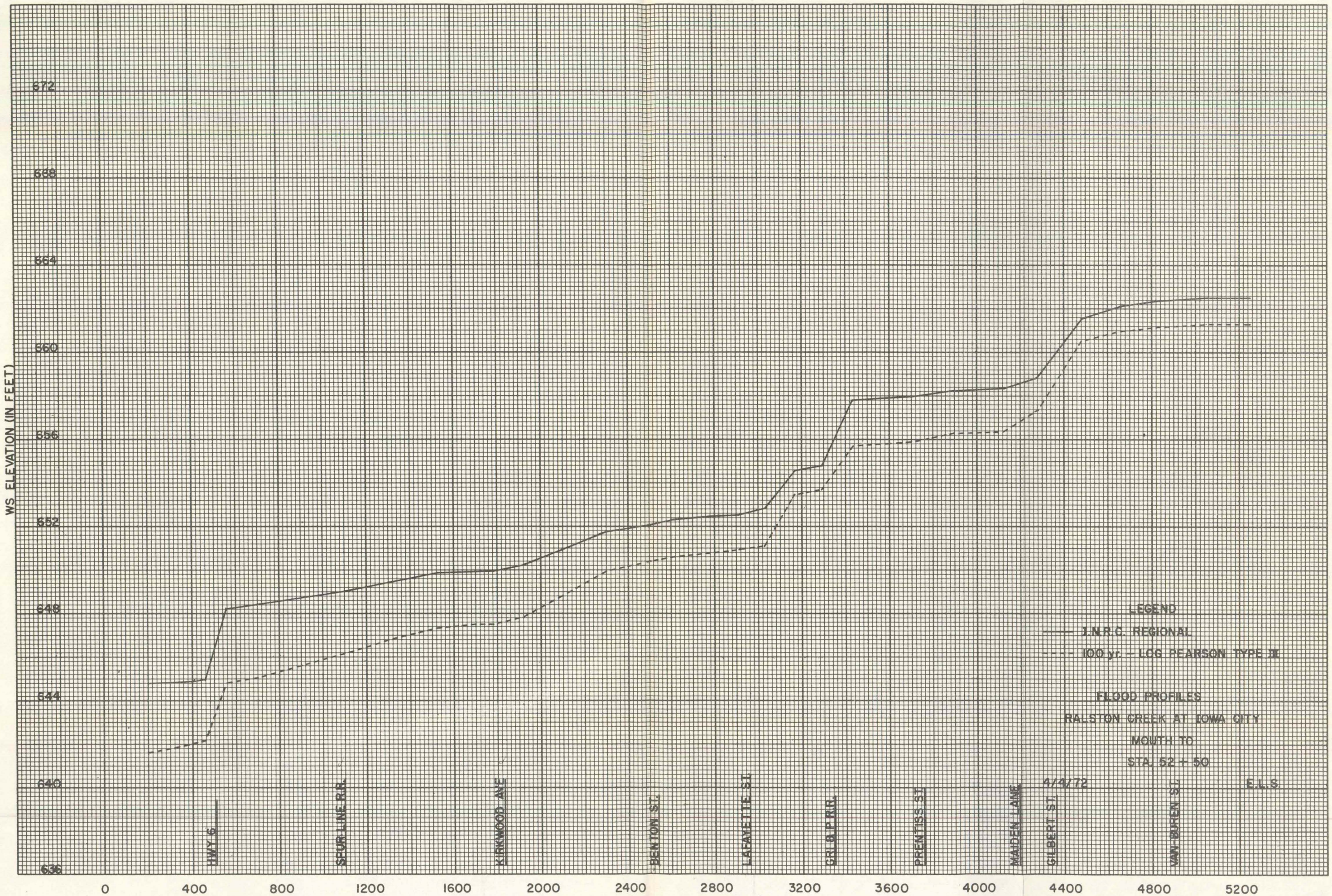


PLATE 13

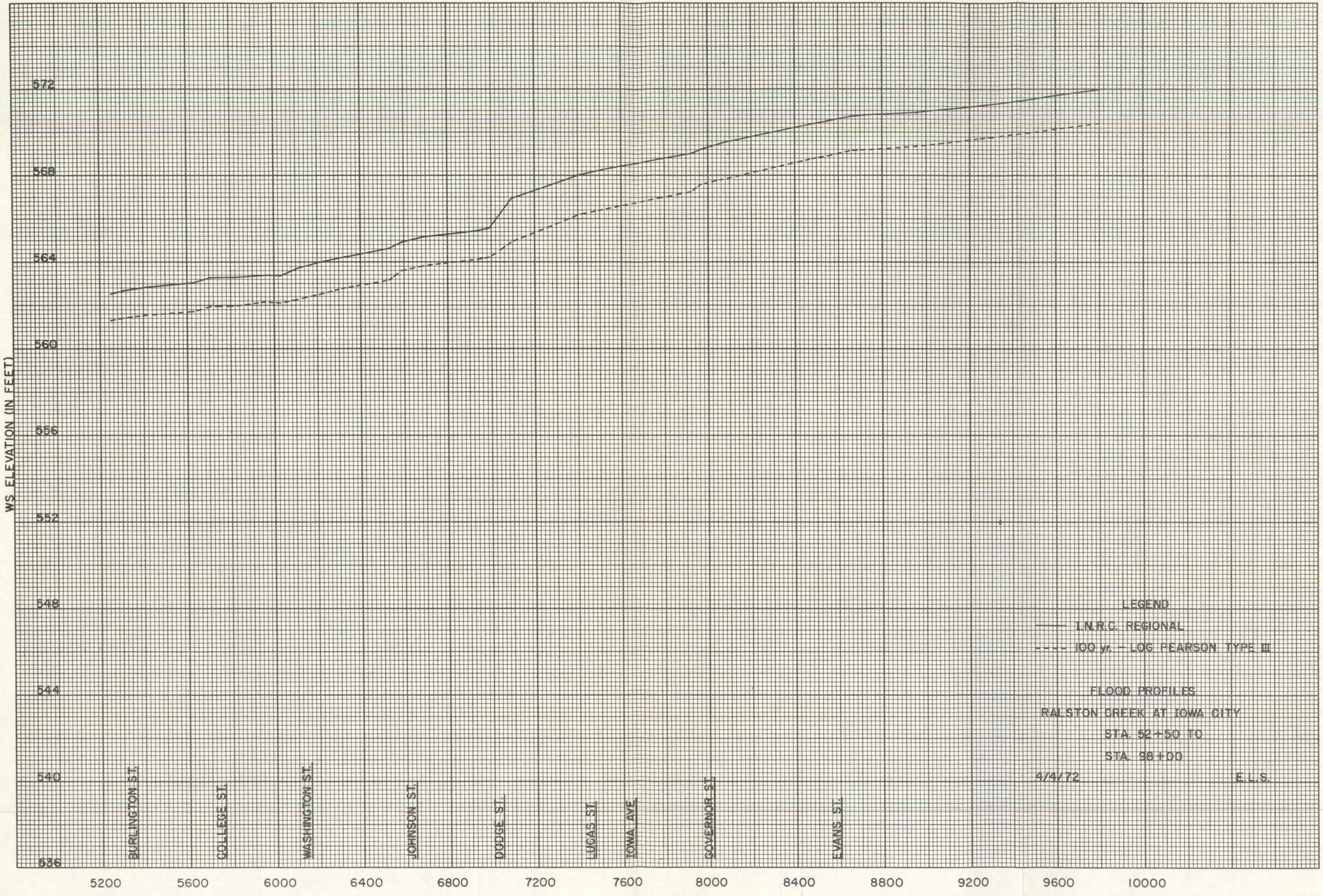


PLATE 14

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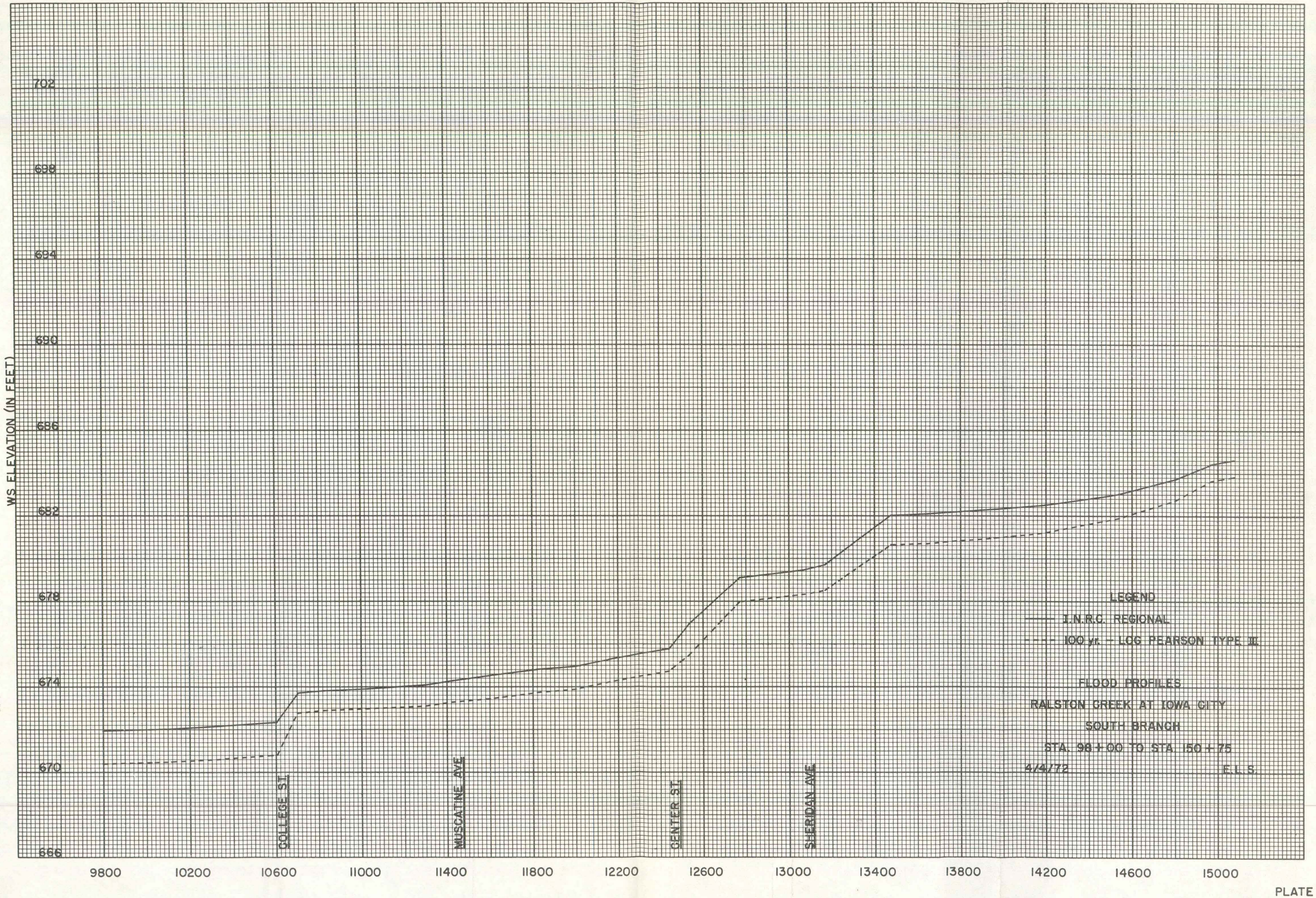


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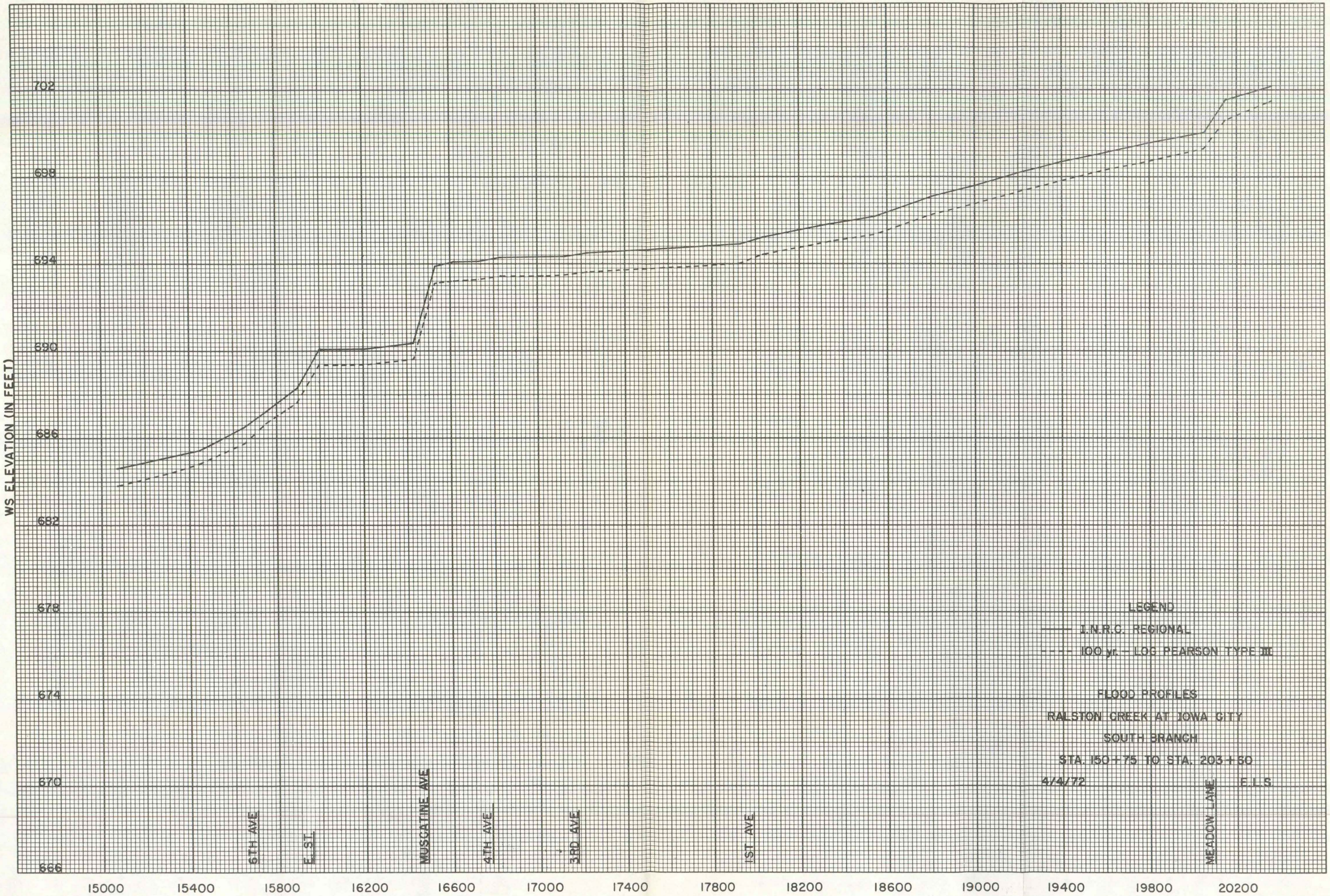


PLATE 16

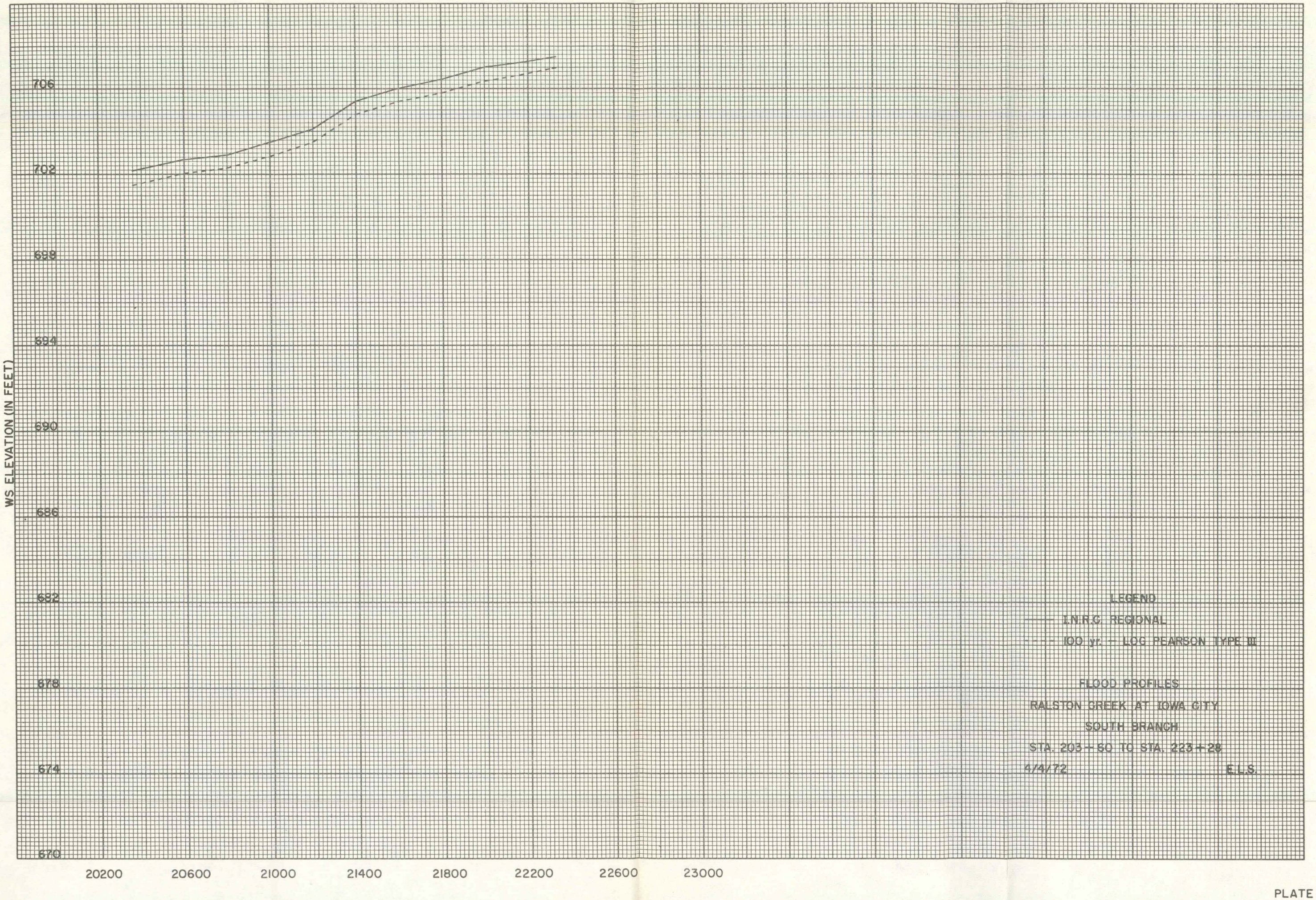


PLATE 17

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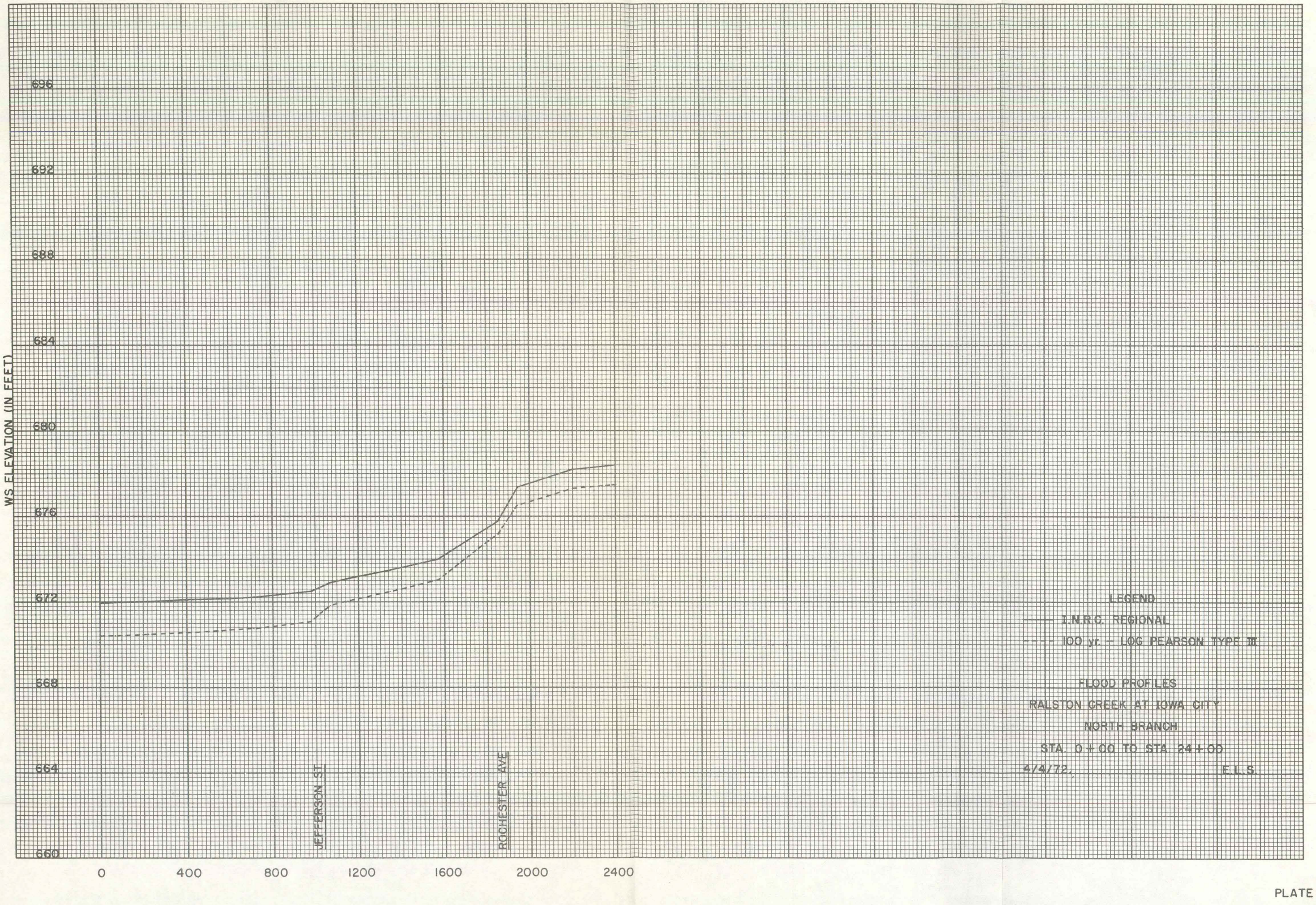


PLATE 18