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OOD PLAIN INFORMATION

Supplemental Report On

SOUTH FORK ZUMBRO RIVER

AND

TRIBUTARIES

Vicinity Of

ROCHESTER, MINNESOTA

PART I: TEXT AND WATER SURFACE PROFILES

PART II: FLOODWAY PLAN (Separate Document)

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October 1975

DEPARTMENT OF NATURAL RESOURCES
Division of Waters

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I. INTRODUCTION

This is a supplement to a report published by the St. Paul District, Corps of Engineers entitled "Flood Plain Information, South Fork Zumbro River and Tributaries, Rochester, Minnesota August 1968". The purpose of the original Corps' study was to document largest known floods of the past and to analyze the likelihood and magnitude of future floods. The study report contained maps, profiles, and cross-sections which indicated the extent of flooding that had been experienced and that might occur in the future in the vicinity of Rochester.

The purpose of this supplemental study and report is to:

1. Update the original Corps' study and to evaluate and reflect the effects of post-1968 flood plain development.
2. Reflect recent estimates of flow rates for floods of various frequencies.
3. Develop a comprehensive flood plain management plan in cooperation with City and County officials that is consistent with minimum statewide standards.

The information presented in this report is intended to be used by the City and County officials in their continued administration of flood plain regulations and to create a better awareness on the part of public officials and others of the objectives and procedures for floodplain management.

II. STUDY UPDATING

In its "Review Survey Report for Flood Control, Zumbro River Basin, Minnesota," dated April 17, 1972 the U.S. Army Corps of Engineers stated that six major shopping centers, ten large subdivisions, and numerous businesses, hotels, motels and public buildings have been constructed in the flood plain of the South Fork Zumbro River and its tributaries during the last twenty years. Since

publication of the Survey Report there have been other developments within the floodplain of these streams.

Development within a floodplain, while subject itself to flood damage, can also impede the flow of flood waters, resulting in increased flood stages and flood damages upstream of the development. In order to determine the areal extent and height of future flood events of a specified frequency in the Rochester vicinity, it was necessary to calculate the effects of development that has taken place since the 1968 Corps Flood Plain Information report. Accordingly, the data the Corps used in preparing this report were updated to reflect post - 1968 floodplain development.

Recently a re-study of stream flow data for the South Fork Zumbro River and its tributaries and other streams in the general region was made to obtain the best current estimate of the peak discharge of the regional (100-year frequency) flood at selected locations in the study reach. This study was carried out cooperatively by the U.S. Army Corps of Engineers, U.S. Geological Survey and the Soil Conservation Service. The revised peak discharges are shown in Table I.1.

Data reflecting post - 1968 floodplain development and revised peak discharge estimates were used, along with valid data from the 1968 Corps study to calculate water surface profiles for the South Fork Zumbro River and its tributaries. These profiles are shown on Plates 1 through 9. A comparison may be made of the changes in the water surface profiles by comparing these data with Plates 25 through 29 of the 1968 Corps report.

III. FLOOD PLAIN MANAGEMENT

With flood hazard information available, Olmsted County and the City of Rochester have the essential technical data to plan the needed land use and

TABLE I.1

INTERMEDIATE REGIONAL FLOODS (100 YEAR)

PEAK DISCHARGES

Location	Cross Section	River Miles	Drainage Area Sq. Mi.	Discharge cubic feet per second
South Fork Zumbro River				
USGS Gage	2.0	0.00	304.1	27,500
Above confluence with Cascade Creek	14.0	2.49	260.3	24,400
Above confluence with Silver Creek	19.0	3.28	240.3	23,700
Above confluence with Bear Creek	25.0	4.01	157.3	16,800
Cascade Creek				
Mouth	53.0	0.00	38.8	7,350
Above confluence with N.F. Cascade Cr.	72.5	2.36	20.4	3,770
North Fork Cascade Creek				
Mouth	81.0	0.00	11.7	4,280
Silver Creek				
Mouth	94.5	0.00	19.0	5,940
Tributary above confluence with Silver Creek in Sec. 32, Haverhill Twp.	111.0	2.98	3.8	1,810
Bear Creek				
Mouth	173.0	0.00	82.3	13,100
Above confluence with Willow Creek	186.1	2.65	48.0	8,900
Above confluence with Badger Run	155.0	3.00	31.4	7,420
Above confluence with tributary in Sec. 9, Marion Twp.	164.0	5.96	22.6	6,450
Badger Run				
Mouth	187.0	0.00	16.4	5,830
Above confluence with tributary in Sec. 21, Marion Twp.	200.0	3.38	9.8	4,740
Willow Creek				
Mouth	114.0	0.00	29.8	5,820
Above confluence with E.F. Willow Cr.	118.0	1.21	21.6	5,250
Above confluence with tributary in Sec. 26, Rochester Twp.	137.0	4.59	11.5	3,630
East Fork Willow Creek				
Mouth	144.5	0.00	7.2	3,030

development regulations for their flood-prone areas. The overall plans of the Rochester vicinity for industrial, commerical, and residential areas, for streets and utilities, and for parks and schools, can be coordinated with the need to convey floodwaters.

Such local planning procedures are an integral part of a comprehensive flood plain management program. Flood plain management involves the full range of public policy and action for insuring wise use of the flood plain. It includes everything from collection and dissemination of flood hazard information to actual acquisition of flood plain lands, construction of upstream and instream control measures, installation of warning systems, and enactment and administration of codes, ordinances, and statutes regulating flood plain land use and development.

A total flood plain management program might be comprised of numerous elements (Figure 1). Included might be: structural flood control works to protect existing development; regulations to guide new development; flood insurance for owners of existing and new properties; and individual adjustment measures such as flood-proofing and relocation.

Flood Control Measures

The U.S. Army Corps of Engineers has developed a local flood control plan for Rochester which would provide for reduction of flood stages along the South Fork Zumbro River, Cascade Creek and Bear Creek. The plan, which has been authorized by Congress, includes channel modifications; levee construction; floodproofing measures; alterations to bridges, sewers, and utilities in the floodplain; and a river walkway corridor system.

The Corps is now undertaking post-authorization studies to establish the most suitable overall plan for accomplishment of the authorized improvement and to establish the basic design of the project features.

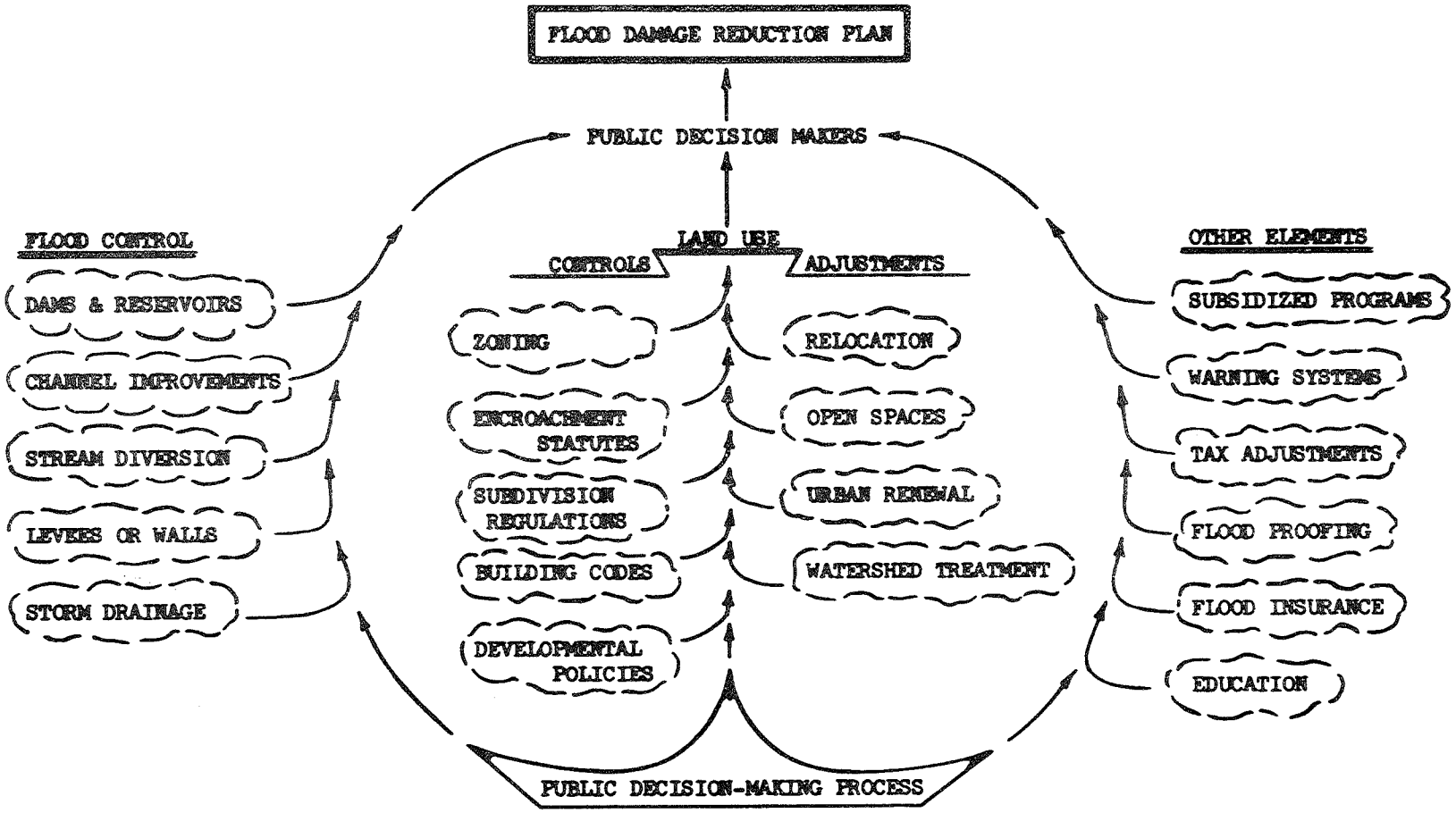


FIGURE 1. Elements for a flood damage reduction plan.

WALL - 1969

Under a favorable schedule of events actual construction of any authorized Corps project is not expected to start until the end of this decade or later.

A system of small headwater reservoirs is concurrently being studied by the U.S. Soil Conservation Service (SCS), consisting of seven flood control dams located throughout upstream areas of the watershed. Land treatment measures in the areas upstream of each structure would be a key element in the reservoir plan. Under present schedules, the start of construction of any SCS projects would be approximately 1980.

Future flood control studies in the Rochester vicinity will be conducted jointly by the Corps of Engineers and the Soil Conservation Service.

The location of the Corps and SCS project areas are shown in Figure 2.

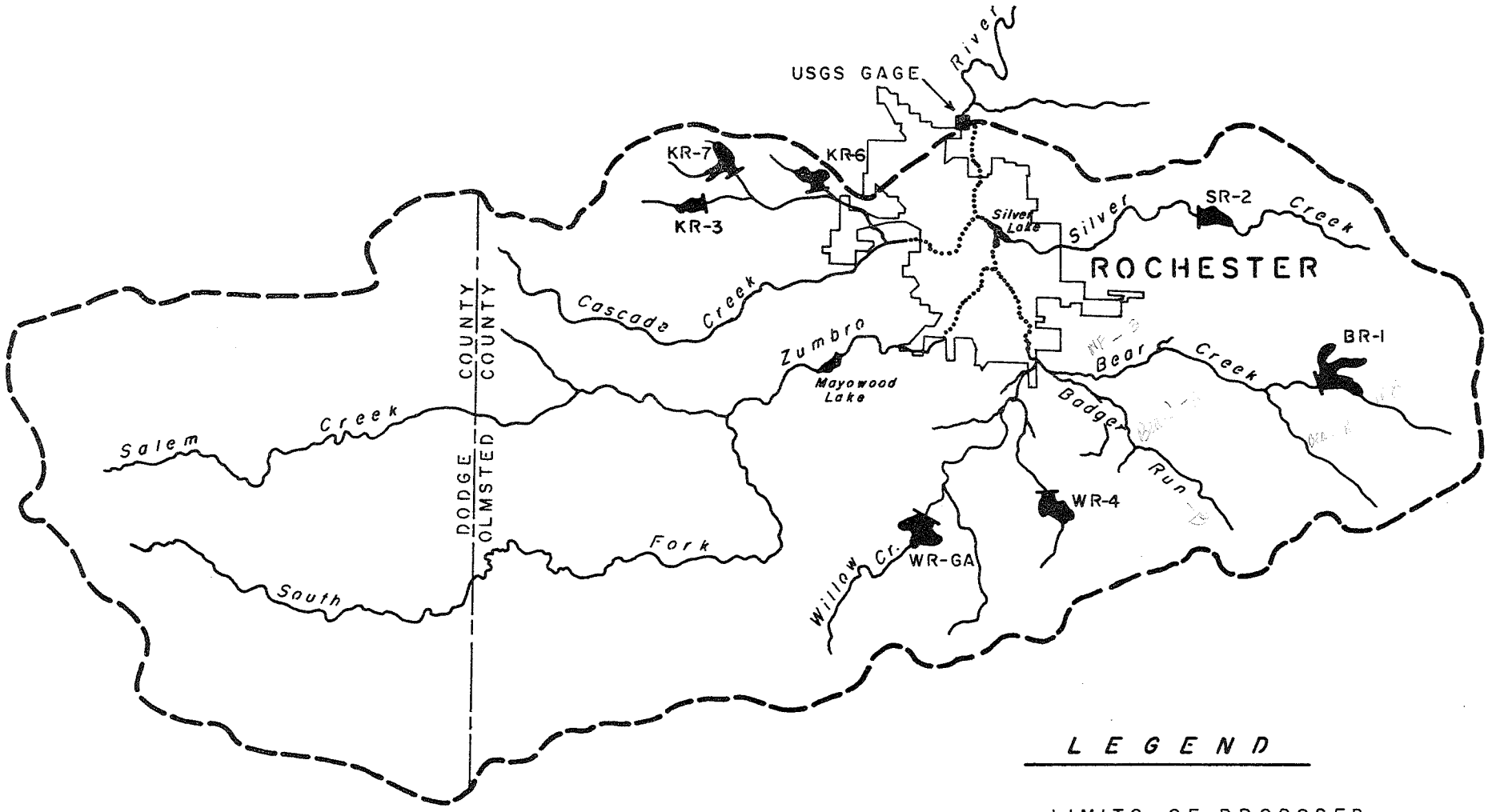
Flood Plain Regulations

In any program for flood damage reduction, a practical solution would not be possible without realistic consideration being given to adoption of flood plain regulations. Such regulations are designed to achieve two general objectives:

(1) restrict or prohibit uses which are dangerous to health, safety or property in times of flood or which cause increases in flood heights or velocities;

(2) require that uses vulnerable to floods, including public facilities which service such uses, be protected against flood damage at the time of initial construction.

The Minnesota Legislature, in enacting the Flood Plain Management Act of 1969 (Minnesota Statutes, Chapter 104, as amended in 1973), recognized that flood plain management practices are necessary tools to protect human life and health and minimize property damages and economic losses. Under the Act as



SOUTH FORK ZUMBRO RIVER WATERSHED
PROPOSED FLOOD CONTROL PLANS

U.S. ARMY CORPS OF ENGINEERS
AND SOIL CONSERVATION SERVICE
OCTOBER, 1975

FIGURE 2

amended, local units of government are required to prepare or amend flood plain regulations within six months after sufficient data are available to define flood plain and floodway areas along watercourses within their respective jurisdictions.

The Statewide Standards and Criteria for Management of Flood Plain Areas in Minnesota, developed by the Department of Natural Resources, will serve as the basis for determination of compliance with the Flood Plain Management Act and the effectiveness of continued administration and enforcement of local flood plain regulations. State flood plain management standards provide that the delineation of the flood plain and floodway and enactment of flood plain regulations are to be based on the regional (100-year frequency) flood.

The various regulatory controls used to achieve the above objectives and as required by the statewide standards and criteria are summarized below.

Zoning Ordinances. Zoning is concerned primarily with the separation of incompatible uses of land. Zoning ordinances containing flood plain regulations often divide flood plain areas into floodway and flood fringe areas and apply reasonable regulations to both areas.

The portion of the flood plain adjacent to a river or stream is normally subject to deep, frequent and high velocity flood flows. This area serves the primary function of conveying floodwaters from upstream to downstream areas and is termed the floodway (Figures 3 and 4). Outer flood plain areas are flooded less frequently and at lower depths and velocities. These flood fringe areas are not as essential to the passage of flood flows. However, unprotected dwellings and other uses placed in these areas are subject to flood damage.

To meet flood management goals as well as nature's needs to convey floodwaters, flood plain regulations tightly control development in floodway areas.

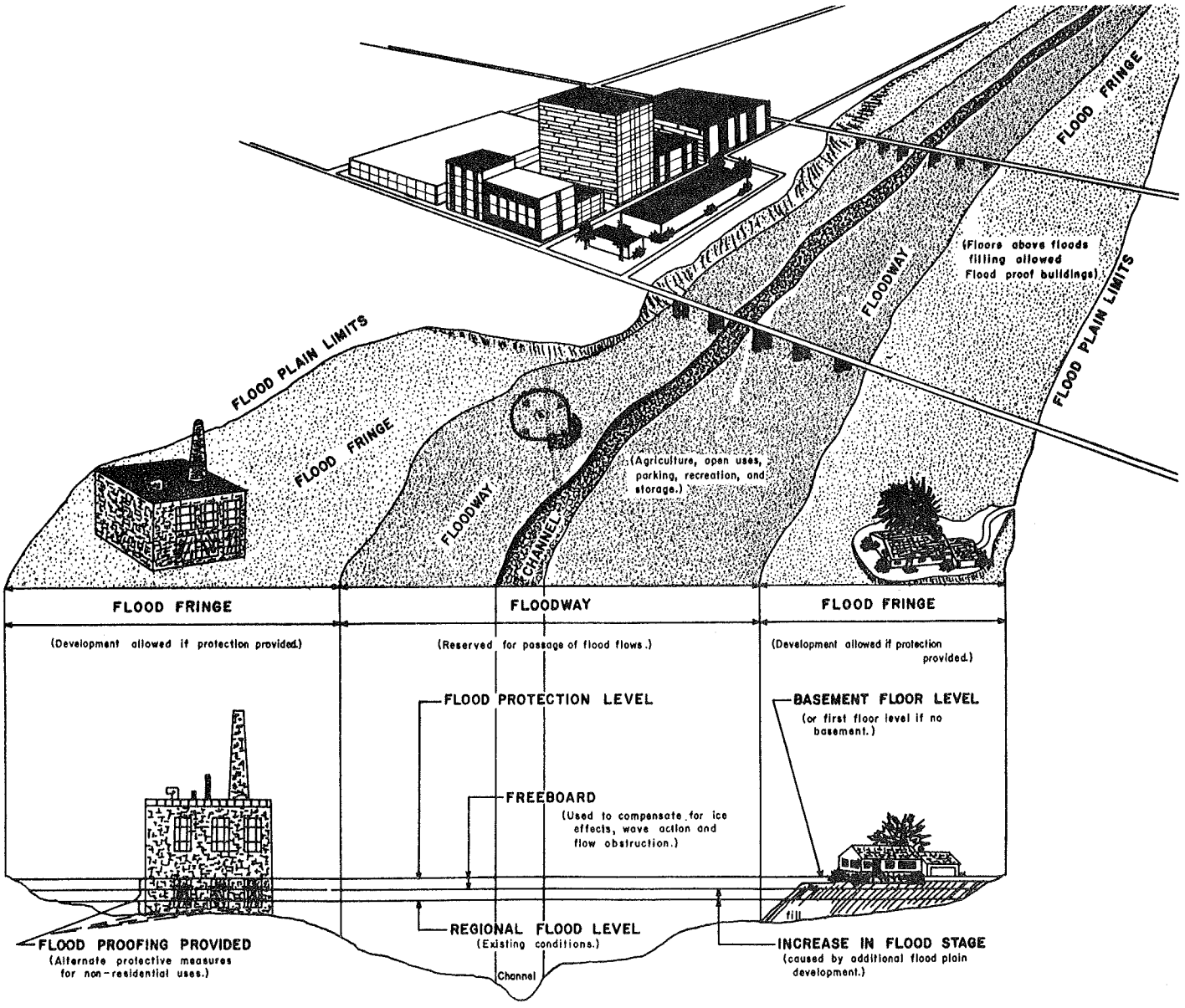
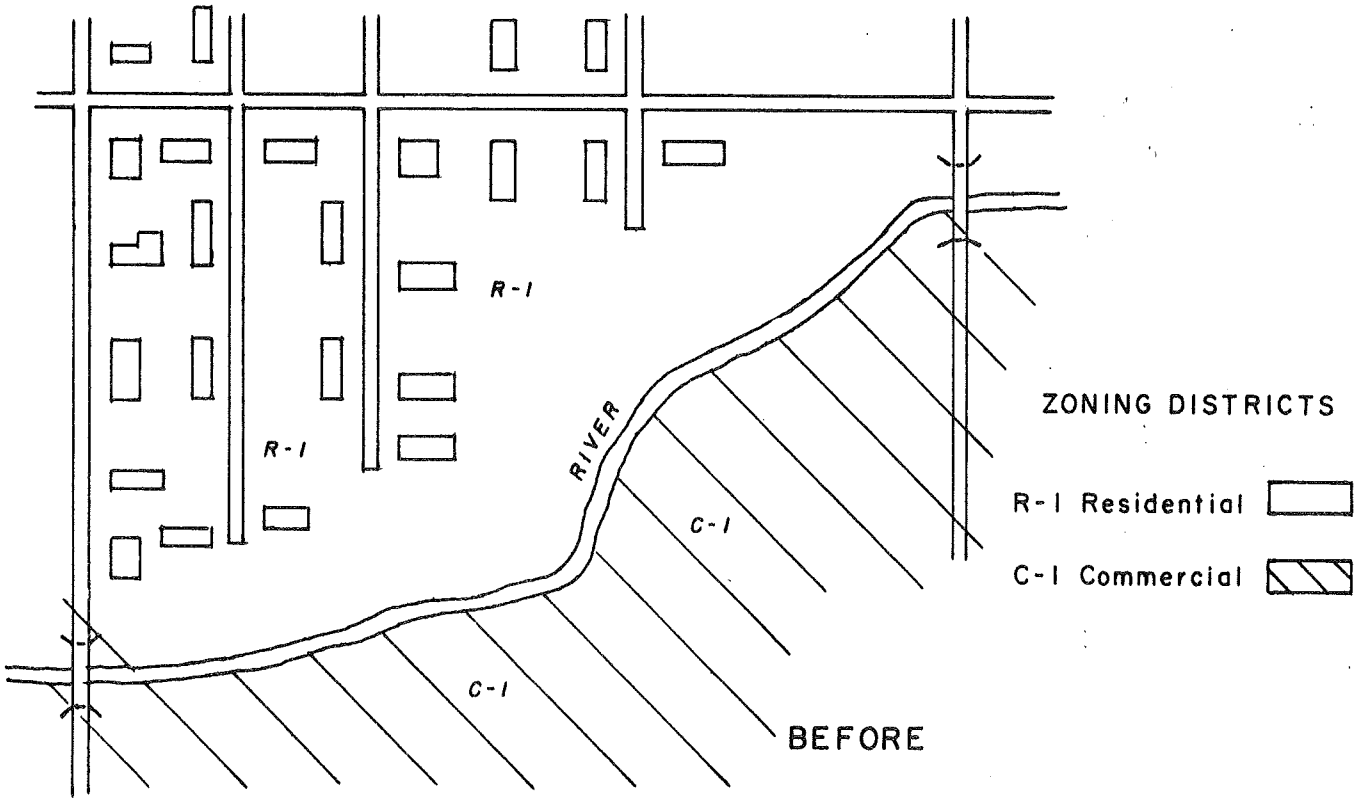


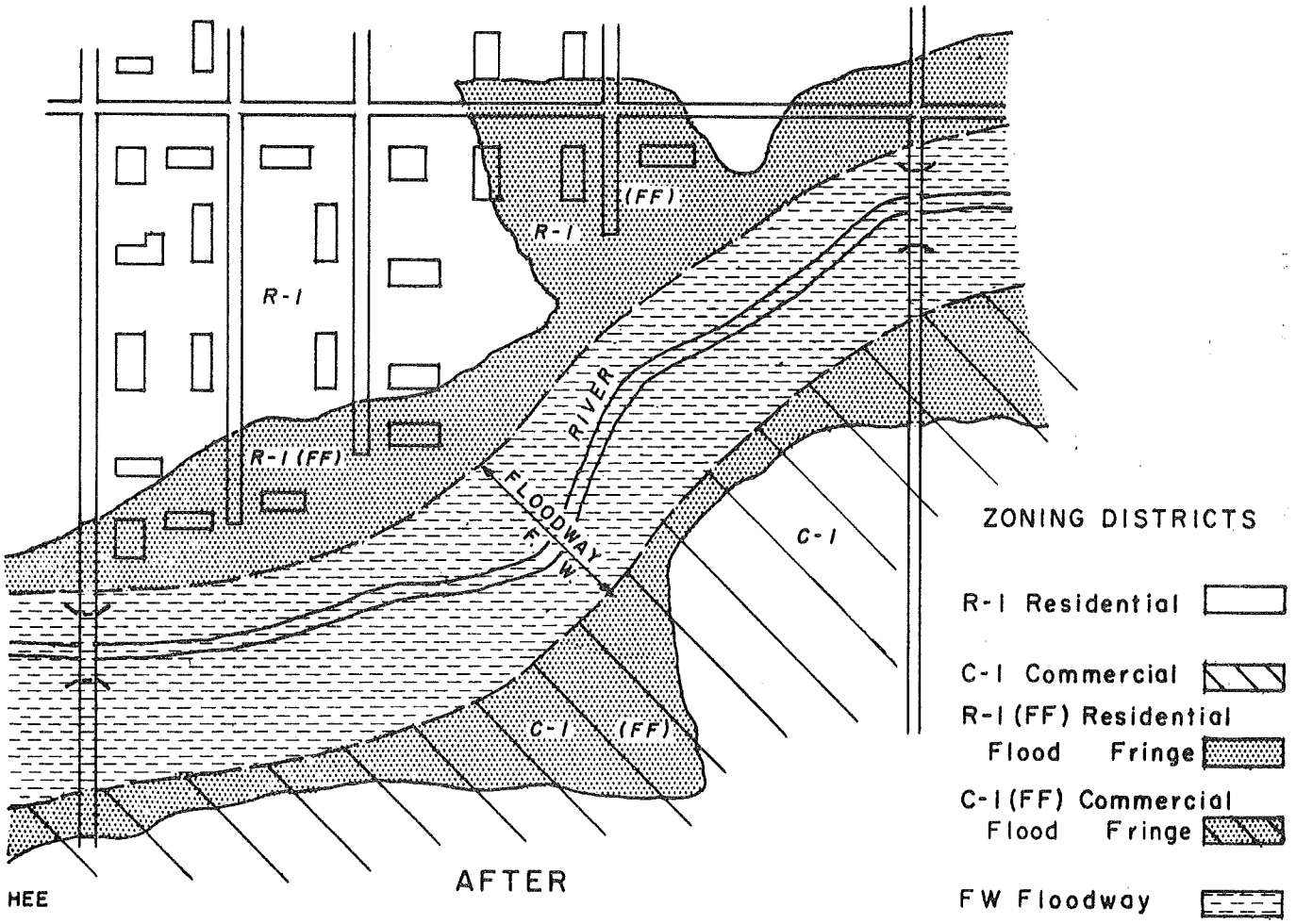
FIGURE 3. A three-dimensional view of the structure of a regulatory flood plain.

FIGURE 4. TYPICAL ZONING MAP

BEFORE AND AFTER ADDITION OF FLOOD REGULATIONS

USING A TWO DISTRICT APPROACH





Debris, fill, buildings, roads, bridges and other uses which would individually or collectively increase flood heights or would be seriously damaged by floods, are prohibited. To meet the needs of man, regulations control, but permit, most development in outer fringe areas. Dwellings and essential services must be placed on fill or otherwise protected to the regulatory flood protection level (Figure 3). This prevents the urban blight, unsanitary conditions, loss of life, economic losses and social disruptions that accompany uncontrolled flood fringe uses.

Regulatory flood protection elevations, at each of the representative flood plain cross-sections used in the study, are shown on sheets 2-4 in Part II of this study.

The division of flood plain areas into floodway and flood fringe districts within zoning ordinances must be based on technical studies, such as has been accomplished for the South Fork of the Zumbro River and its tributaries within the Rochester vicinity. The County and City have selected floodways along their watercourses within the study reaches. These have been determined to be consistent with state flood plain management standards and are shown on Plates 1 through 19 in Part II of this report. The floodway will be included within the local flood plain zoning ordinances.

The limits of the floodway are designated so that permissible encroachments on the flood plain will not generally cause an increase in the stage of the 100-year frequency flood of more than 0.5 feet in any one reach or for the cumulative effects of several reaches of watercourse.

Subdivision Regulations. Subdivision regulations are used to guide the process and manner of land division to assure that lots meet buyer needs without putting a disproportionate burden upon a community.

Subdivision regulations can reduce flood losses by:

(1) prohibiting the subdivision of lands subject to serious flooding unless hazards are overcome;

(2) requiring the designation of flood hazard areas on subdivision plats and the insertion of restrictions on purchase deeds to control lands unsuitable for dwellings or other uses;

(3) prohibiting encroachment in floodway areas by fill or structures;

(4) requiring that a portion of each lot be filled or otherwise protected to provide a safe building site with adequate areas for waste disposal (if onsite facilities are used) at an elevation above flood heights; and

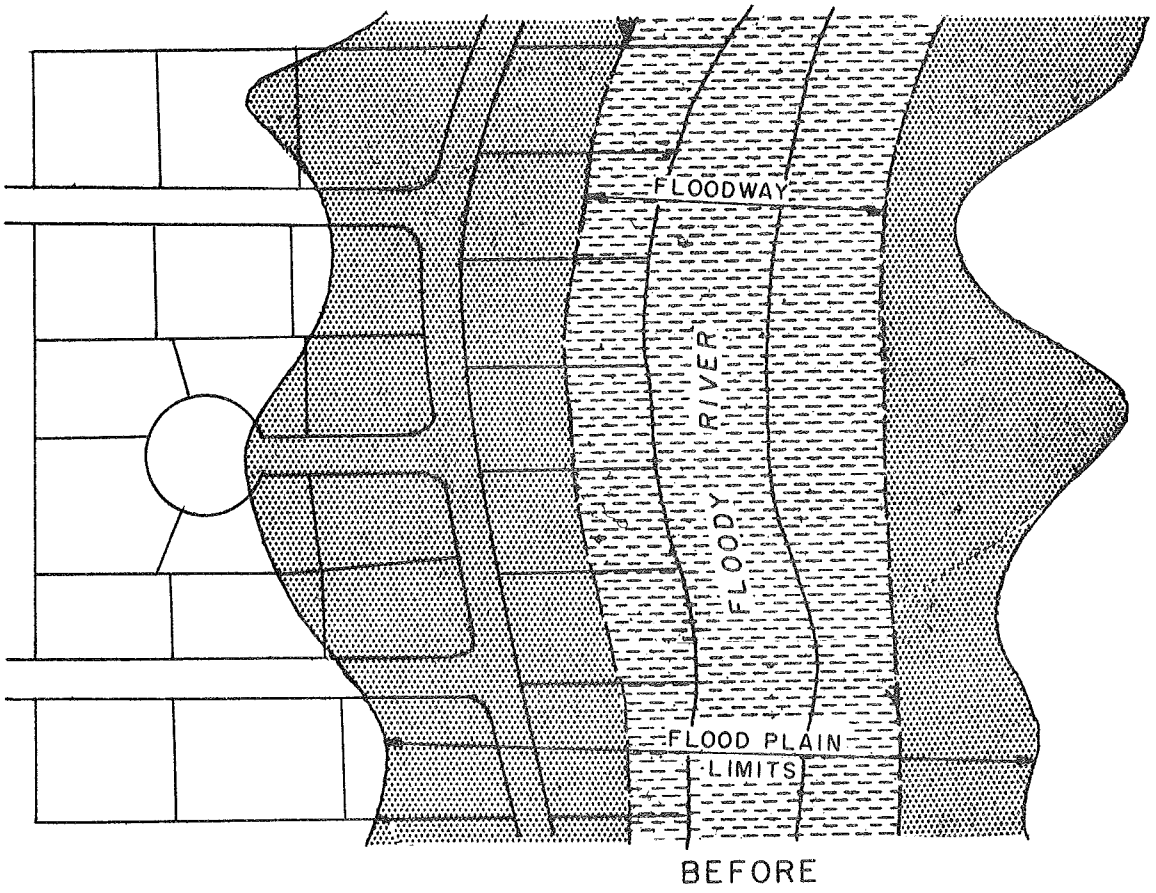
(5) requiring the installation of streets, sewer, water and other facilities which are flood-proofed, elevated or otherwise protected against floods (Figure 5).

Minnesota flood plain management regulations require that, where practical, subdivision regulations also be included in a local flood plain management program when sufficient data are available for their effectuation.

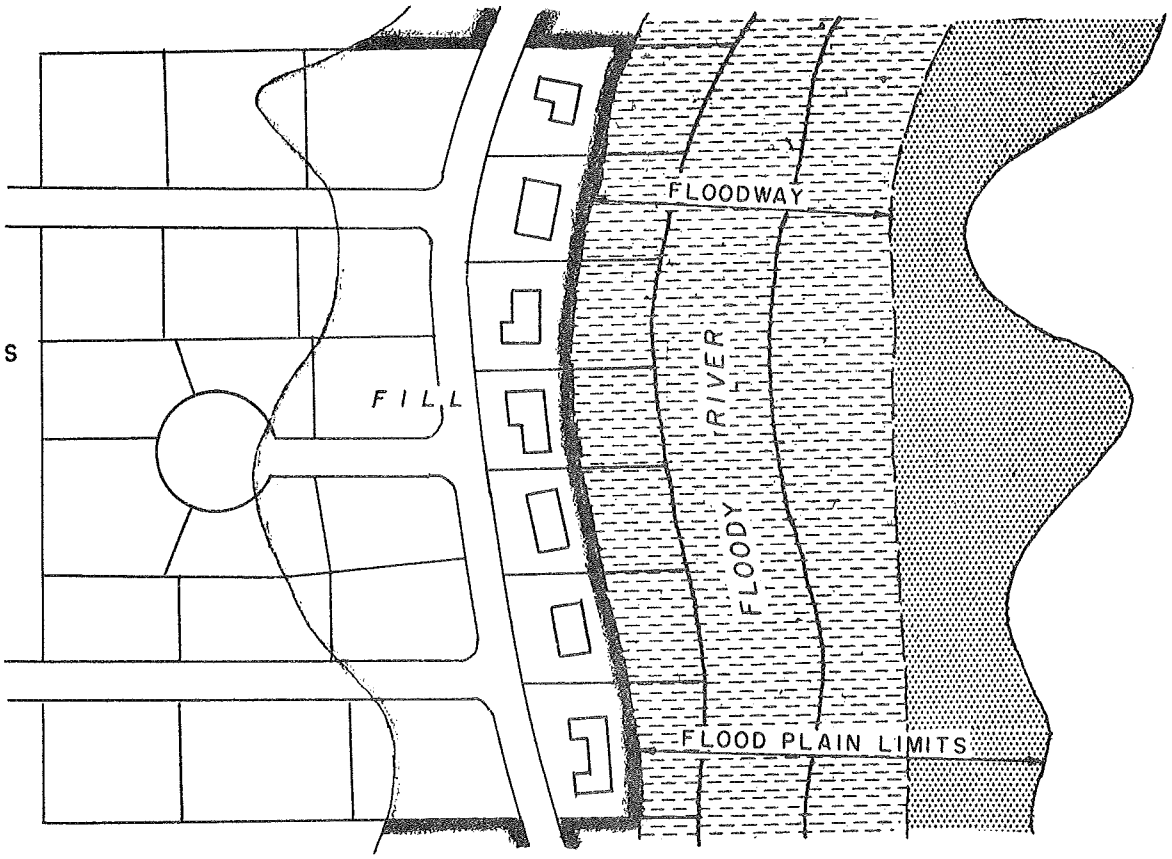
As most development within rural areas is through land subdivision, such regulations are often effective flood plain management tools within such areas.

Building Codes. A building code is a set of regulations adopted by a local governing body setting forth standards for the construction of buildings and other structures for the purpose of protecting the health, safety and general welfare of the public. In a flood plain management context such regulations establish the special design and construction provisions that should be required for buildings, structures and support facilities that are or may be subject to flooding, relying upon zoning regulations to establish the areas of application. These provisions may include: anchorage of structures to prevent flotation, installation of water-tight barriers over openings, reinforcement of walls to resist water pressures, use of materials to reduce

FIGURE 5. TYPICAL FLOOD PLAIN SUBDIVISION
BEFORE AND AFTER SITE PREPARATION



BEFORE



BUILDING SITES AND STREETS HAVE BEEN ELEVATED BY FILL.

AFTER

HEE

wall seepage, construction or modification of water supply and waste disposal systems to prevent entry of floodwaters, placement of essential utilities above the flood protection elevation and installation of pumping facilities for internal and subsurface drainage.

Where existing streets or utilities are at locations which make the elevation of buildings or structures impractical, building code provisions can effectively reduce flood damages to new buildings or structures and to additions or reconstruction of existing buildings located below the required flood protection elevation.

In 1971 the Minnesota Legislature adopted an act providing for a state building code. After July 1, 1972, any county or city which had previously enacted a building code or subsequently enacts a code must adopt the state code. The state code does not apply to frame buildings and farm dwellings.

In January 1974 flood-proofing regulations were incorporated into the state building code and are applicable to flood plain areas previously designated by local zoning ordinances. The Code adopted in substance a publication of the U.S. Army Corps of Engineers, entitled "Flood-Proofing Regulations"* with amendments to bring it in line with state flood plain management regulations.

The Code distinguished between two types of flood hazard areas. (Figure 6). There are those areas where the primary flood threat would come from the overland flow of floodwaters. However, there are also additional areas beyond the runout line of the regulatory flood that could be affected by floods. These areas, termed secondary flood hazard areas, could be affected by higher floods, by underground water travel, or backflooding of sewerage or drainage systems which could pollute domestic water supplies and cause other related problems to public and private utilities.

Within the primary flood hazard area, plans and specifications for any

*"Flood-Proofing Regulations", Office of the Chief of Engineers, U.S. Army, Washington, D.C. June 1972.

AREA OF APPLICATION
FOR
FLOOD-PROOFING REGULATIONS
MINNESOTA STATE BUILDING CODE

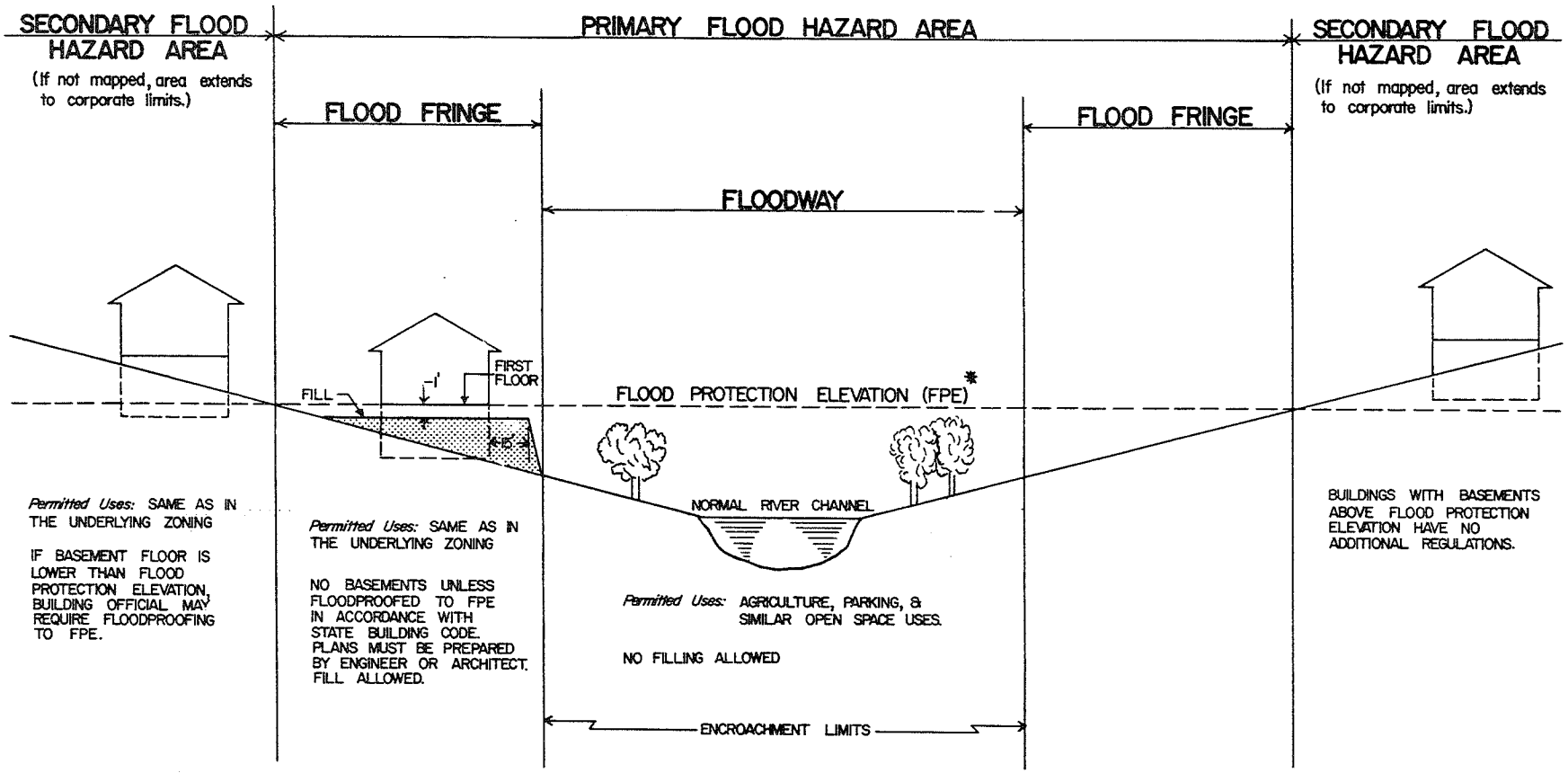


FIGURE 6.

* FLOOD PROTECTION ELEVATION IS DEFINED IN DNR ADMINISTRATIVE REGULATIONS AS A POINT NOT LESS THAN 1 FOOT ABOVE THE REGIONAL (100-YEAR) FLOOD PLUS EFFECTS OF FURTHER FLOOD PLAIN ENCROACHMENT.

and all proposed improvements must be prepared by a licensed engineer or architect. In the secondary hazard area the need for the extent of flood-proofing is at the discretion of the local building official. It is felt that he will have better knowledge of the flood-related problems associated with this area.

Sanitary Regulations. Sanitary codes establish minimum standards for waste disposal and water supply for the purpose of protecting the health and general welfare of the public. Sanitary codes commonly prohibit use of onsite waste disposal facilities such as septic tank systems in areas of high groundwater and flood hazards. Elevation or structural "floodproofing" requirements are sometimes established for public sewer systems. Well codes often establish special flood-proofing requirements for water supply facilities located in flood hazard areas.

These provisions are generally encompassed in the state's flood plain management standards, with more specific provisions contained in the state's shoreland management standards which apply to lands within 300 feet of any river or stream or to the landward side of a flood plain, whichever distance is greater. The shoreland management standards are currently applicable in all unincorporated areas of the state. Compatible standards are being developed for municipalities having shoreland areas.

To assist counties and municipalities in the implementation of flood plain regulations, the Division of Waters of the Department of Natural Resources, has developed sample zoning ordinances and subdivision regulations, which are available to local officials upon request.

National Flood Insurance Program

Under the National Flood Insurance Act of 1968 (Public Law 90-448), as amended, the Secretary of Housing and Urban Development (HUD) is authorized to carry out a National Flood Insurance Program. The program was established to

make flood insurance available for losses due to inundation by floodwaters from the overflow of streams, rivers, or other inland waters or from unusual and rapid accumulation of runoff of surface waters from any source. Areas subject to inundation from mudslides which are caused by the accumulation of water on or under the ground are also eligible. At present, coverage is available for buildings and mobile homes used for residential, business, religious and agricultural purposes, properties occupied by non-profit organizations, and properties owned by state or local governments or their agencies. Coverage is available for both structures and their contents.

Insurance is sold to property owners or renters only after the locality has applied to HUD and expressed an interest in being declared eligible for flood insurance and has adopted land use and control measures for flood hazard areas consistent with criteria set forth in the HUD regulations.

Both Olmsted County and the City of Rochester are currently participating in the National Flood Insurance Program.

Other Measures

Land use controls such as zoning, subdivision regulations and building codes can play an important role in flood plain management. However, in order for these measures to be effective, it is important that the County and City take action to implement other programs and measures to supplement these controls. A few possible measures are: (1) open space land acquisition programs; (2) urban renewal programs; (3) preferential tax assessment; (4) flood-proofing of existing structures; and (5) public policy governing the construction of public facilities such as bridges, streets, and utilities compatible with the flood hazard and to locate such facilities in a manner to discourage private development in flood-prone areas.

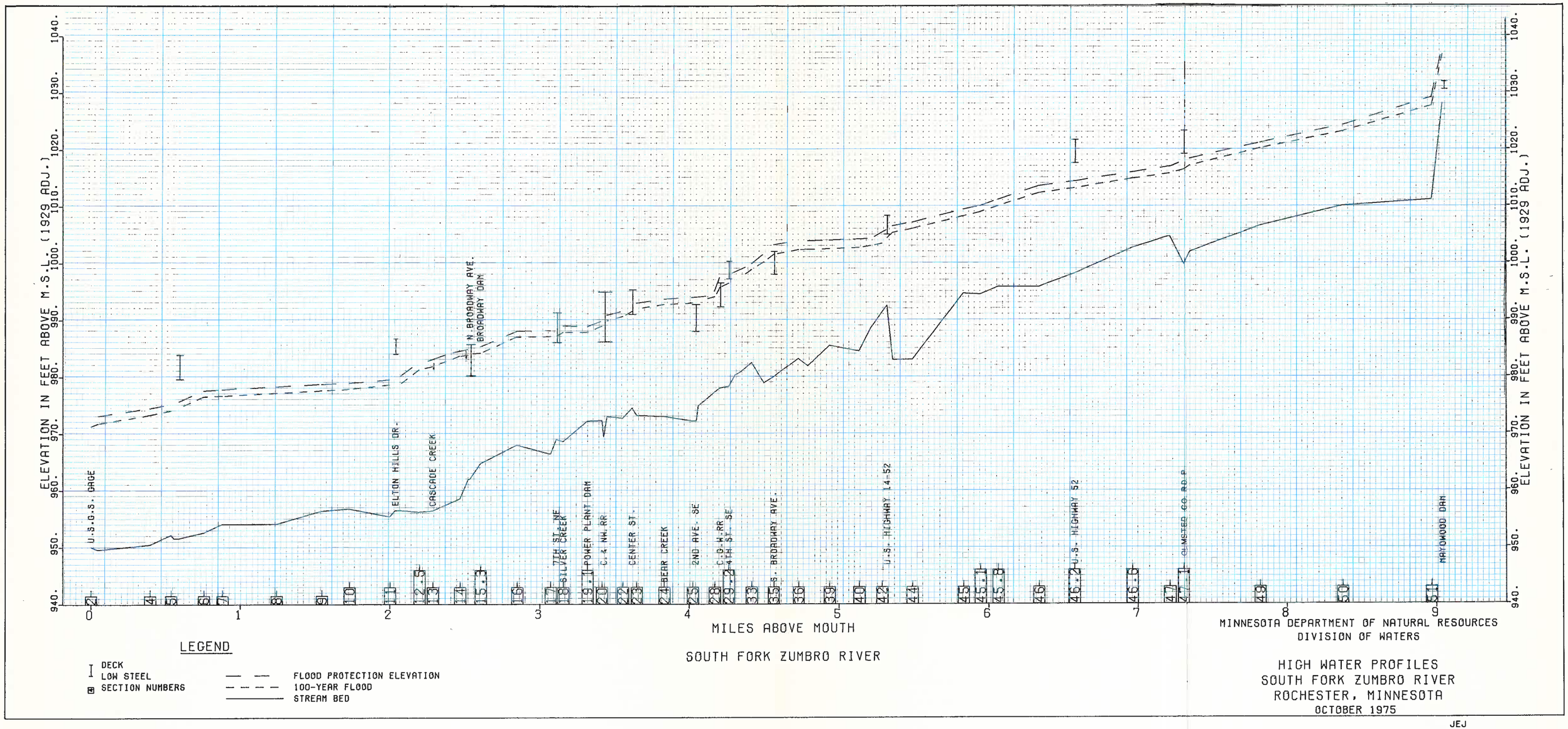
The Department of Natural Resources, upon request, will provide assistance, within its available appropriations and personnel, to the County and City in

flood-proofing techniques, flood insurance concepts, and the establishment of a local flood data collection program.

IV. SUMMARY

The data presented in this supplement represents up-to-date flood plain development patterns as well as the best hydrologic estimate of the flood risk along the streams studied. As such, it supercedes comparable data contained in the Corps of Engineers report entitled "Flood Plain Information, South Fork Zumbro River and Tributaries, Rochester, Minnesota, August 1968." It should be used as the technical basis for continued enforcement of local flood plain regulations. This supplement is also designed to create an awareness on the part of both local officials and the general public of the need to manage the flood plains of the South Fork Zumbro and its tributaries.

The Department of Natural Resources will provide assistance, upon request, in the interpretation and use of the data contained in this report supplement.



LEGEND

I DECK
I LOW STEEL
⊞ SECTION NUMBERS

— — FLOOD PROTECTION ELEVATION
– – – – 100-YEAR FLOOD
——— STREAM BED

SOUTH FORK ZUMBRO RIVER

MINNESOTA DEPARTMENT OF NATURAL RESOURCES
DIVISION OF WATERS

HIGH WATER PROFILES
SOUTH FORK ZUMBRO RIVER
ROCHESTER, MINNESOTA
OCTOBER 1975

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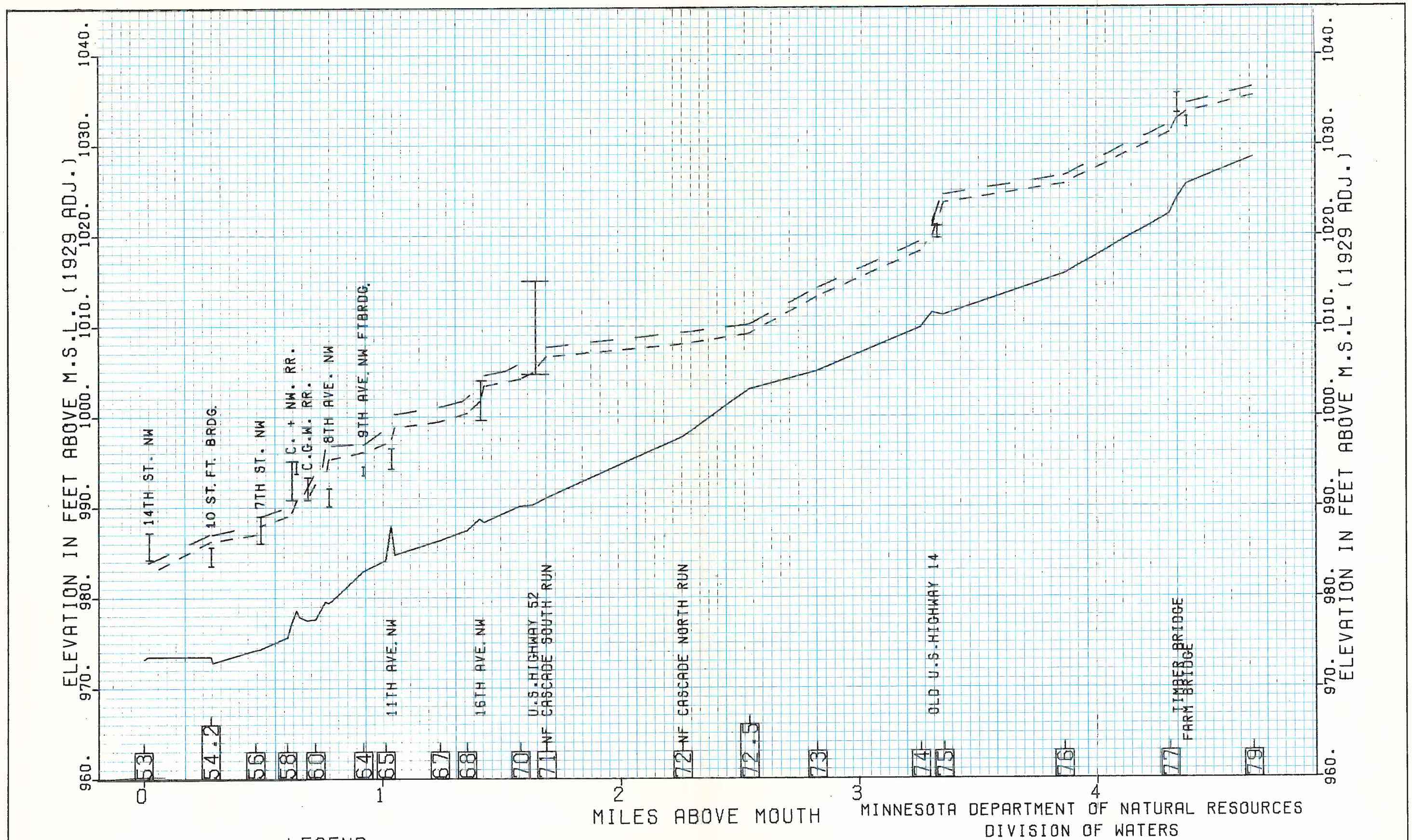
PLATE 1



LEGEND

DECK
LOW STEEL
54 SECTION NUMBERS

FLOOD PROTECTION ELEVATION
100-YEAR FLOOD
STREAM BED

CASCADE CREEK

MINNESOTA DEPARTMENT OF NATURAL RESOURCES
DIVISION OF WATERS

HIGH WATER PROFILES
CASCADE CREEK
ROCHESTER, MINNESOTA
OCTOBER 1975

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PLATE 2

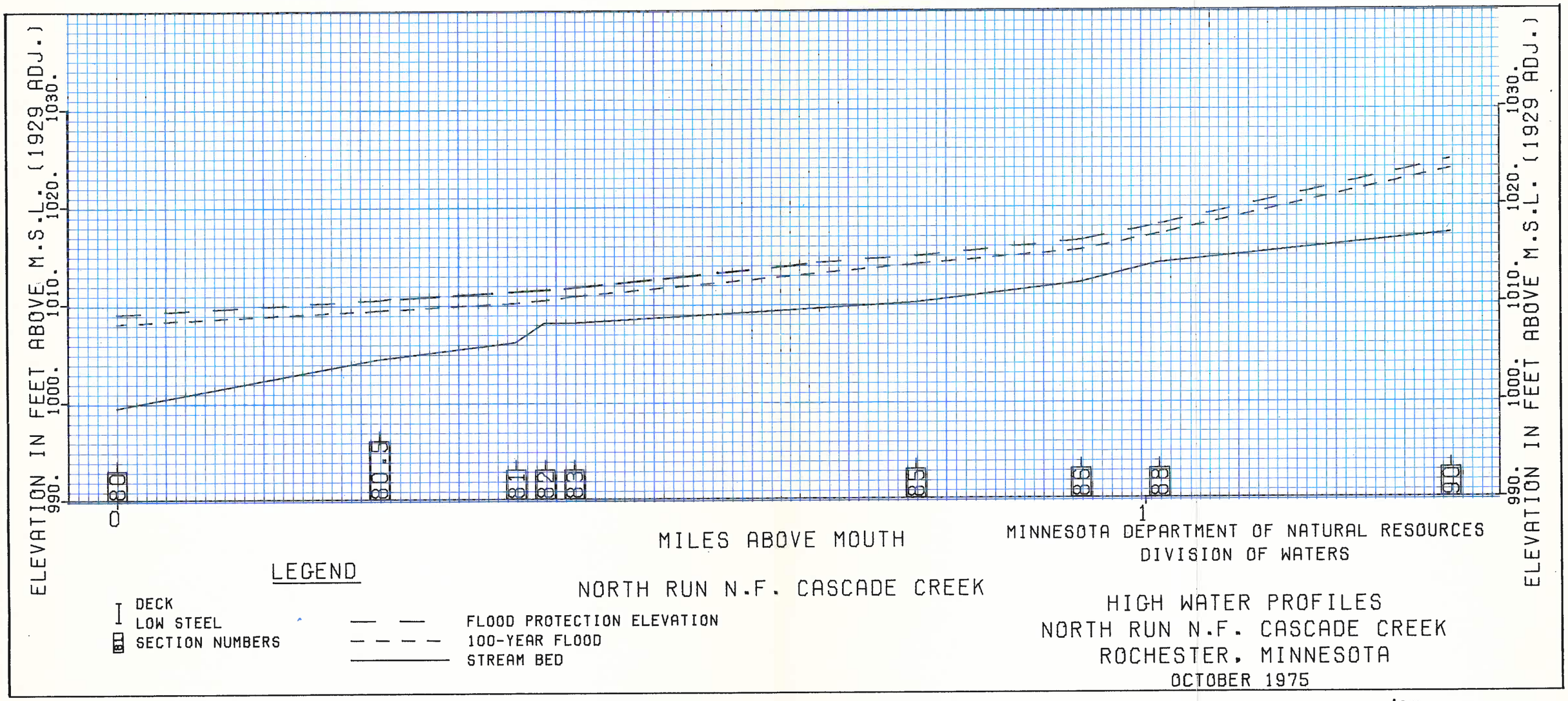
ELEVATION IN FEET ABOVE M.S.L. (1929 ADJ.)
1030.
1020.
1010.
1000.
990.
0
1
MILES ABOVE MOUTH
80
80.5
81
82
83
85
86
88
90
LEGEND
DECK
LOW STEEL
SECTION NUMBERS
FLOOD PROTECTION ELEVATION
100-YEAR FLOOD
STREAM BED
NORTH RUN N.F. CASCADE CREEK
MINNESOTA DEPARTMENT OF NATURAL RESOURCES
DIVISION OF WATERS
HIGH WATER PROFILES
NORTH RUN N.F. CASCADE CREEK
ROCHESTER, MINNESOTA
OCTOBER 1975
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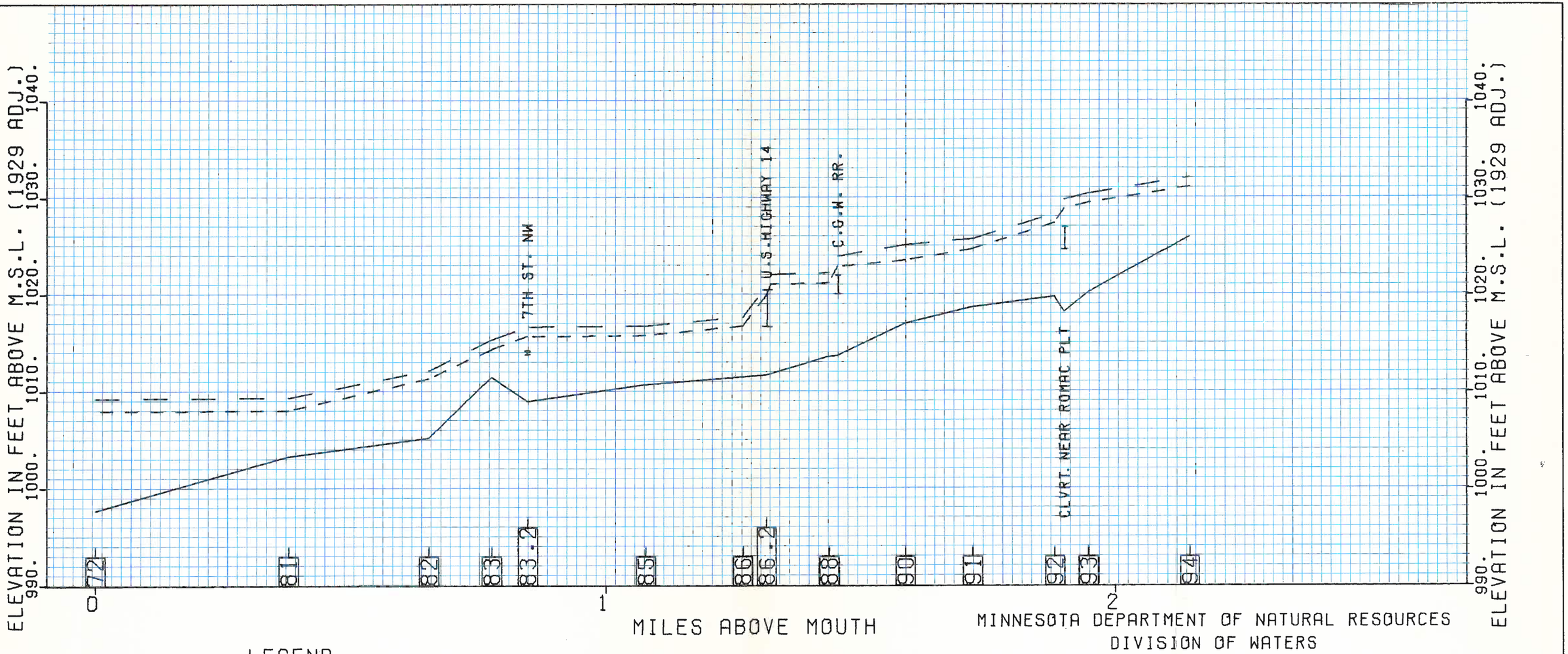
PLATE 3



LEGEND

I DECK
I LOW STEEL
82 SECTION NUMBERS

— — FLOOD PROTECTION ELEVATION
– – – – 100-YEAR FLOOD
——— STREAM BED

SOUTH RUN N.F. CASCADE CREEK

MINNESOTA DEPARTMENT OF NATURAL RESOURCES
DIVISION OF WATERS

HIGH WATER PROFILES
SOUTH RUN N.F. CASCADE CREEK
ROCHESTER, MINNESOTA

OCTOBER 1975

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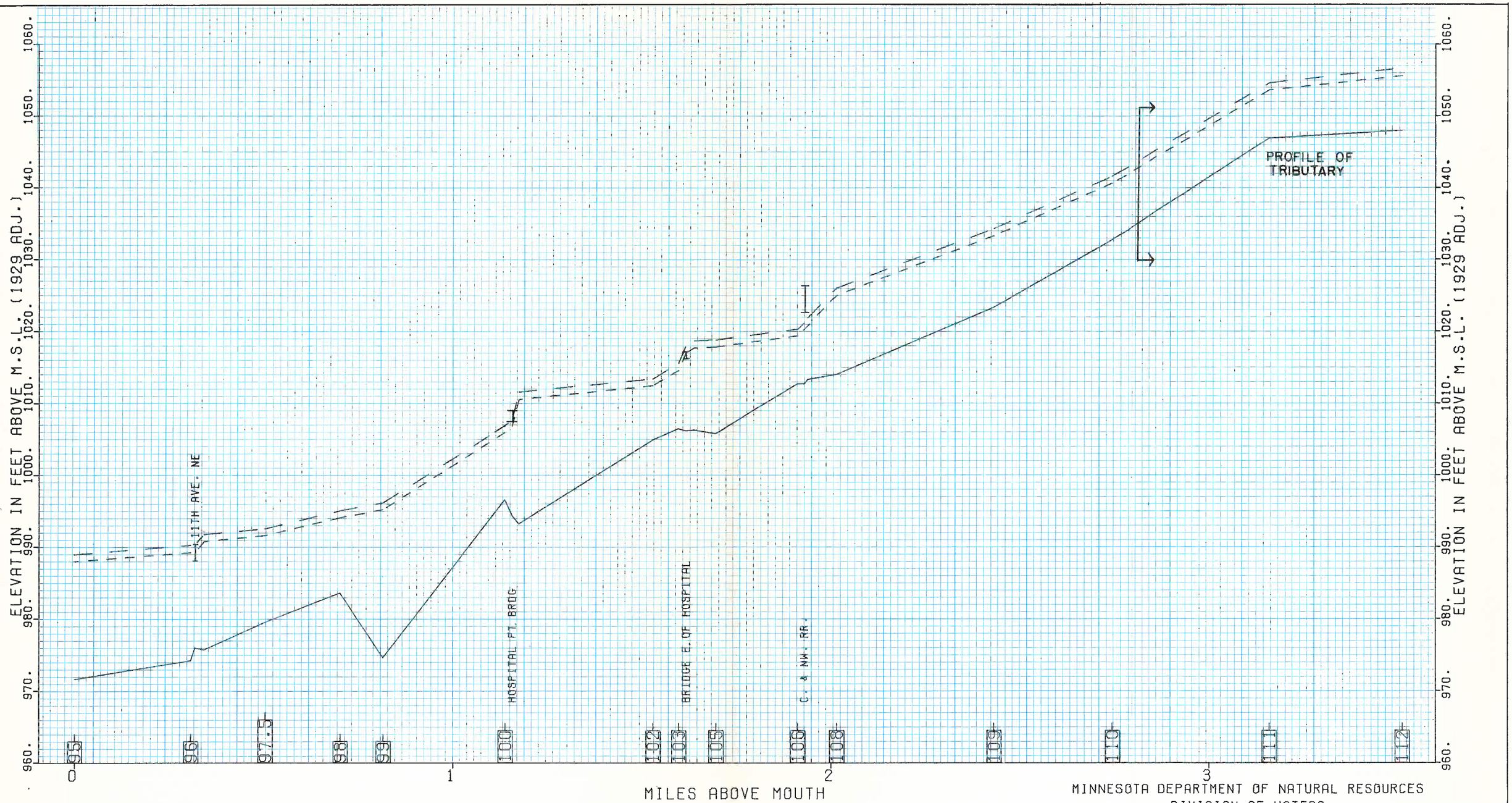
PLATE 4



LEGEND

- DECK
- LOW STEEL
- 95 SECTION NUMBERS
- FLOOD PROTECTION ELEVATION
- 100-YEAR FLOOD
- STREAM BED

SILVER CREEK

MINNESOTA DEPARTMENT OF NATURAL RESOURCES
DIVISION OF WATERS

HIGH WATER PROFILES
SILVER CREEK
ROCHESTER, MINNESOTA

OCTOBER 1975

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PLATE 5

ELEVATION IN FEET ABOVE M.S.L. (1929 ADJ.)

1000. 1010. 1020. 1030. 1040. 1050. 1060. 1070. 1080.

U.S. HIGHWAY 52

SEC 17 MARION TWP.

COUNTY ROAD L

155 156 157 158.1 159 160 161 162 163 164 165 167 168 169 170 171

0 1 2 3 4

MILES ABOVE MOUTH

MINNESOTA DEPARTMENT OF NATURAL RESOURCES
DIVISION OF WATERS

LEGEND

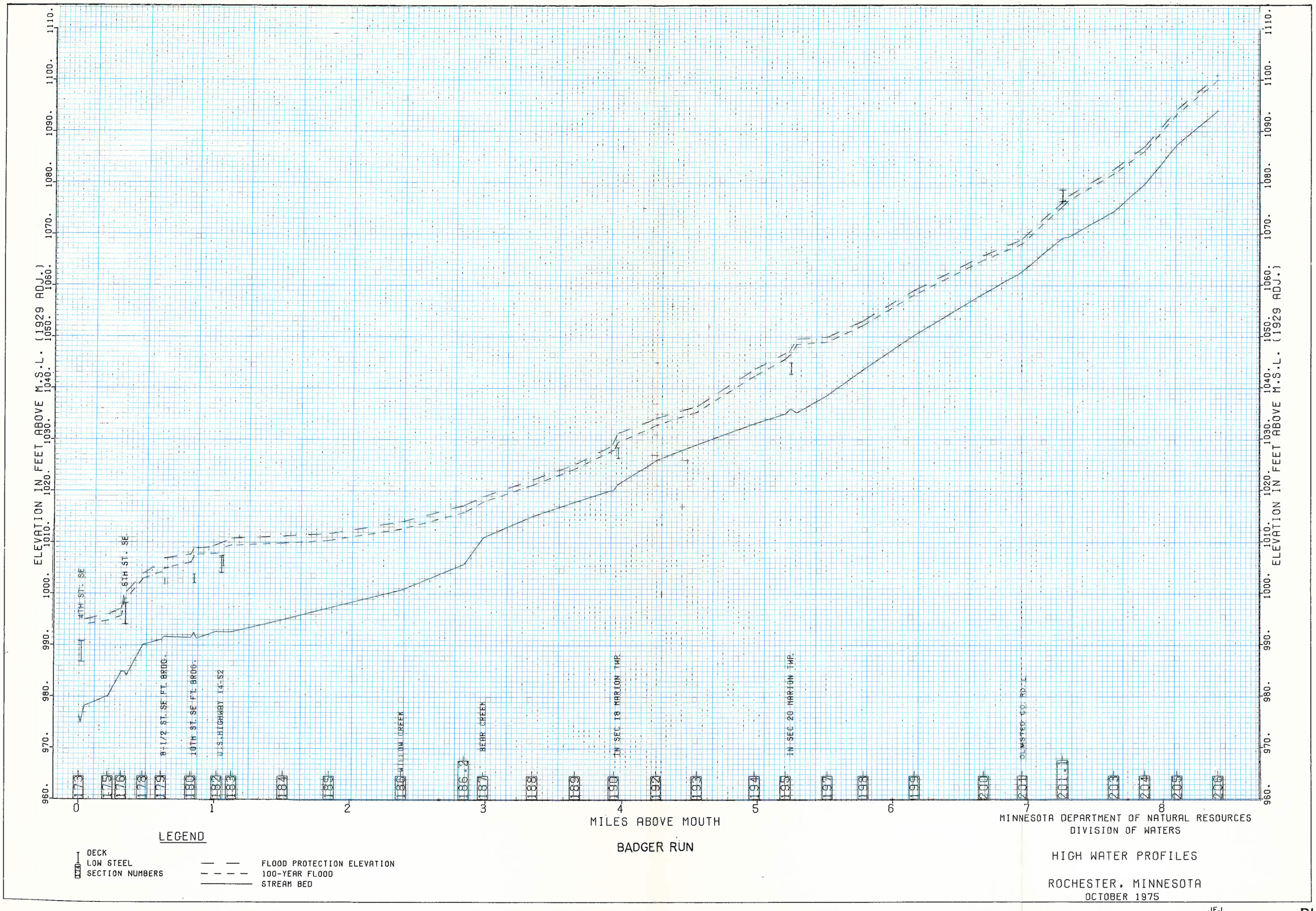
DECK
LOW STEEL
SECTION NUMBERS

FLOOD PROTECTION ELEVATION
100-YEAR FLOOD
STREAM BED

BEAR CREEK

HIGH WATER PROFILES
BEAR CREEK
ROCHESTER, MINNESOTA
OCTOBER 1975

PLATE 6



LEGEND

- DECK
- LOW STEEL
- SECTION NUMBERS
- FLOOD PROTECTION ELEVATION
- 100-YEAR FLOOD
- STREAM BED

BADGER RUN

MINNESOTA DEPARTMENT OF NATURAL RESOURCES
DIVISION OF WATERS

HIGH WATER PROFILES

ROCHESTER, MINNESOTA
OCTOBER 1975

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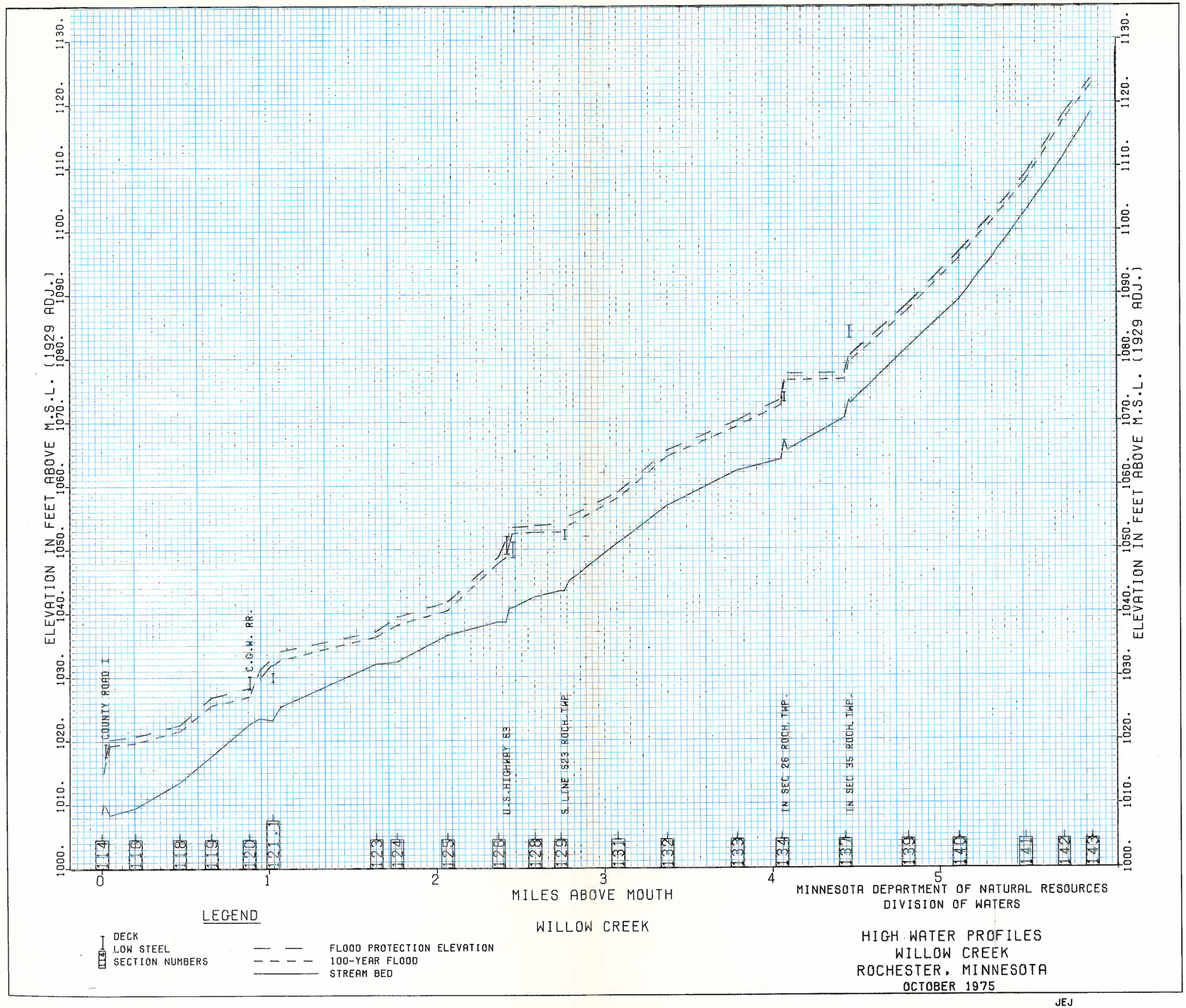
PLATE 7



MINNESOTA DEPARTMENT OF NATURAL RESOURCES
DIVISION OF WATERS

WILLOW CREEK

HIGH WATER PROFILES
WILLOW CREEK
ROCHESTER, MINNESOTA

OCTOBER 1975

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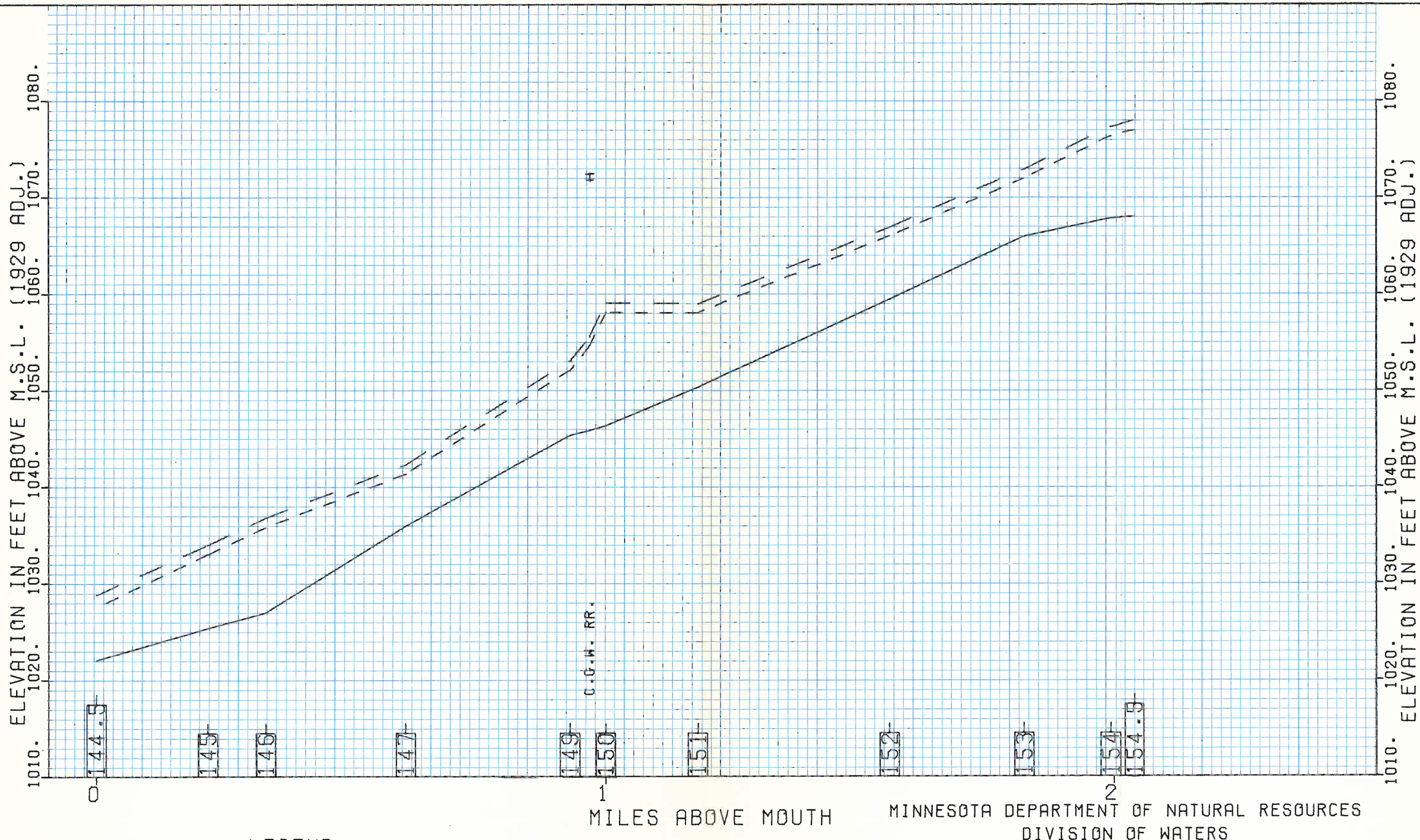
PLATE 8



LEGEND

DECK
LOW STEEL
[146] SECTION NUMBERS

FLOOD PROTECTION ELEVATION
100-YEAR FLOOD
STREAM BED

MINNESOTA DEPARTMENT OF NATURAL RESOURCES
DIVISION OF WATERS

EAST FORK WILLOW CREEK

HIGH WATER PROFILES
EAST FORK WILLOW CREEK
ROCHESTER, MINNESOTA
OCTOBER 1975

JEJ

PLATE 9