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INTRODUCTION

This report concerns the flood dangers along the Dickinson Drainage Ditch which runs through the easterly section of Dickinson, North Dakota. It was prepared at the request of the City of Dickinson through the North Dakota State Water Commission. Flood hazards are identified to assist local officials and others in making prudent use of stream valleys and to indicate the dangers to existing developments in the valley. Information is based upon an analysis of flood statistics, urban growth patterns and other technical data affecting floods on the Drainage Ditch.

General characteristics of the valley, detailed descriptions of the study reach on the ditch, a record of flood history of the ditch, and the probable effect of floods greater than any of record are presented, in that order, in this report. A definition of the technical terms used throughout is included at the end. Two potential floods, Intermediate Regional and Standard Project, were used to represent reasonable limits of expected flooding. The Intermediate Regional Flood is representative of one with an average frequency of about once in a hundred years, or approximately a 1 percent chance of occurrence in any specific year. It was developed from an analysis of available basin stream and rainfall records. The Standard Project Flood represents a rare event and exceeds, by a wide margin, any known flood on this stream. In developing controls and planning for flood plain construction, appropriate consideration should be given to historical, Intermediate Regional and Standard Project Floods.

The report contains maps, profiles, and cross sections which indicate the extent of flooding that might occur in the future in the valley of the Drainage Ditch. This should prove helpful in planning the best use of the flood plains. From the maps, profiles and cross sections, the depth of probable flooding by occurrence of

SUMMARY OF FLOOD SITUATION

The Dickinson Drainage Ditch rises approximately 4.5 miles northwest of the City of Dickinson. The Ditch runs in a southeasterly direction crossing through the easterly section of town and ends at the Heart River near the sewage lagoons. This report covers approximately a 4 mile stretch beginning at the mouth of the Drainage Ditch and extending approximately 4 miles upstream to the north-south county road that is State Avenue within the city limits.

In recent years the City of Dickinson has experienced a steady expansion into the Dickinson Drainage Ditch Basin and to some extent into the flood prone areas next to the stream. The developments are largely residential, such as the Parkview area which was first started in 1952 and the Pleasant Valley Addition started in 1955. Some commercial developments are located in the vicinity of Highway 22, Interstate I-94 and U. S. Highway 10. It is anticipated that this expansion will continue.

Although none of the areas have experienced any serious flooding since the late 1930's, the problem of future floods does exist. Floods with a magnitude of the Intermediate Regional Flood and the Standard Project Flood have occurred elsewhere and could occur in the City of Dickinson in any year.

* * *

THE CAUSES OF FLOODS along the Dickinson Drainage Ditch are primarily intense thunderstorm rainfall during the summer months and to a lesser extent, rapid snowmelt runoff in the spring. Snowmelt runoff can contribute to damaging floods when combined with heavy rainfall. The basin terrain is hilly and somewhat impervious. This, coupled with a drop in elevation of approximately 27 feet per mile produces rapid concentration of runoff. The result is the potential for flash-type flooding.

The last major damaging flood occurred in the late

FLOODED AREAS by the Standard Project Flood and the Intermediate Regional Flood would extend over the entire valley floor. The width of the flooded area would vary from 300 feet to 1,500 feet for a Standard Project Flood and from 100 feet to 1,000 feet for an Intermediate Regional Flood. Downstream from the Northern Pacific Railway, the flooded area would decrease in width because the valley narrows and the velocity of flow increases with the increased channel slope. The Standard Project Flood covers more area than the Intermediate Regional Flood due to the increased depth. The area is much greater where the flow is obstructed by the Northern Pacific Railway embankment.

* * *

DURATION OF FLOODS is quite short with high peak flows.

* * *

HAZARDOUS CONDITIONS would occur during large floods as a result of the rapidly rising stream, high velocities and deep flows. Velocities greater than 3 feet per second combined with depths of 2 feet or greater are generally considered extremely hazardous, but lesser velocities and depths are dangerous. Both the Intermediate Regional Flood and the Standard Project Flood would have hazardous velocities and depths. Channel velocities of 3 to 6 feet per second are common in the section studied for both the Intermediate Regional Flood and the Standard Project Flood. Maximum velocities within the Dickinson city limits reach 9 feet per second during the Intermediate Regional Flood and 10-1/2 feet per second during the Standard Project Flood.

* * *

FLOOD CONTROL AND DEFENSE in the Dickinson Basin has been developed to meet particular situations. The Stark County Water Management District has the responsibility for flood control projects such as channel improvements. The channel has been improved in the developed areas. There is no flood warning system, but the low crossings in the Drainage Ditch are barricaded and flares are set out when the low crossings are overtopped.

Developments Within the Flood Plain

The City of Dickinson has zoned most of the area within the valley as residential. The only commercial zoning near the Drainage Ditch is near the intersection of Highway 22 and Interstate 94, and in the vicinity of U. S. Highway 10 on the east side of town. Since 1952, a total of 18 additions have been added to the Northeast Section of the city. Three of these have been added since 1967. Seven of these additions border the Drainage Ditch. The lower areas along the Drainage Ditch are prone to flooding and as these additions are further developed, higher runoff from the upland areas will increase the danger of flooding in the valley developments. The major damageable items are located within the city limits of Dickinson. These include the trailer court on the east side of U. S. Highway 22, houses built in the flood plain, and some commercial developments north of U. S. Highway 10. These items are shown on plates 2 and 3.

The development trend is indicated by table 1, which shows the City of Dickinson's population figures for 1950 and 1960 along with the projected figures for the future.

TABLE 1
POPULATION PROJECTIONS

	Year	Population	Increase
	1950	7,469	
	1960	9,971	2,502
Est.	1965	11,800	1,829
Est.	1970	12,800	1,000
Est.	1980	15,400	2,600
Est.	1990	18,000	2,600

The projected population figures were developed by the Bureau of Reclamation for their Water Supply Report on the Enlargement of the Dickinson Dam and Reservoir dated August, 1954.

TABLE 2

MAJOR STRUCTURES ACROSS DICKINSON DRAINAGE DITCH

Identification	Type of Crossing	Stream Bed Elev. feet	Road-way Elev. feet	Intermediate Regional Flood Crest feet	Standard Project Flood Crest feet	Underclearance 1/ Elev. feet	Relation to Inter. Reg. Flood Above feet	Relation to Inter. Reg. Flood Below feet
Northern Pacific Railway	1. 12 Ft. Conc. Arch	2392.8	2412.7 2/	2402.0	2413.7	2404.8	2.8	
	2. Twin 8'x7' RCB 3/	2393.0	2412.7 2/	2402.0	2413.7	2400.0		2.0
	3. 6' Dia. Culvert	2391.7	2412.7 2/	2402.0	2413.7	2397.7		4.3
U. S. Highway 10	Triple 9'x7' RCB	2393.5	2402.4	2402.4	2413.7	2400.5		1.9
2nd Ave. East	30'-0" Bridge	2415.2	2420.8	2422.0	2423.0	2420.8		1.2
Sims Street	23'-6" Bridge	2417.1	2423.7	2424.4	2426.3	2422.8		1.6
3rd Ave. East (Highway 22)	Tiple 8'x8' RCB	2430.2	2441.4	2440.7	2442.7	2438.2		2.5
Interstate I-94	Two 9' Dia. Struct. Plate Culverts	2436.2	2447.9	2448.3	2448.8	2445.2		3.1
County Road	6' Dia. Culvert	2451.8	2459.9	2461.9	2462.8	2457.8		4.1

1/ See Glossary of Terms

2/ Denotes Base of rail elevation

3/ RCB means reinforced concrete box

All elevations are based on U. S. G. S. mean sea level datum.

2nd Avenue East Bridge

30 ft. Clear Span

Sims Street Bridge

23 ft. 6 in. Clear Span

Culverts under Interstate I-94.
Two Structural Plate Culverts - 9 ft. Diameter

POTENTIAL FLOODS

This section mainly discusses the Intermediate Regional Flood and Standard Project Flood on the Dickinson Drainage Ditch, and some of the hazards inherent in floods of these magnitudes. The Intermediate Regional Flood represents those floods with an average frequency of occurrence of about once in a hundred years, and is increasingly being accepted by the public as the limit for application of local regulations and the minimum standard for flood protection. The Standard Project Flood is of greater magnitude and represents a reasonable upper limit of expected flooding. However, it is not the largest possible flood that might ever occur. Both floods are further defined in the Glossary of Terms. It is emphasized that lesser floods than the Intermediate Regional Flood are much more likely to occur and could also cause damage, hardship and inconvenience. Such lesser floods would inundate smaller areas than indicated on the maps for the Intermediate Regional Flood.

Flooding in the magnitude of the Intermediate Regional and Standard Project Floods has occurred on other streams in the plains states, and they could occur in this basin at any time. It is therefore desirable, in connection with these studies, to consider their effects so protective measures can be considered.

Intermediate Regional Flood

Frequency studies of available gaging data for streams in the region show that the Intermediate Regional Flood discharge on the Dickinson Drainage Ditch would be 1,800 cubic feet per second in the upstream end of the reach, and 2,000 cubic feet per second below the Interstate Highway Bridge. The depth of flow would average about 9 feet upstream of Highway 10 and about 12 feet upstream of Interstate 94, with depths of as little as 3 feet between and beyond these points. U. S. Highway 10 and Interstate 94 would have less than a foot of water flowing over the roadways. Highway 22 would be above

Hazards of Great Floods

The amount and extent of damage caused by a flood depends in general upon the area flooded, depth of the water, flood velocity, rate of rise and duration of flooding.

Where the flow is obstructed by the Northern Pacific Railway, the Standard Project Flood covers more area than the Intermediate Regional Flood. Because the valley floor rises only a few feet between the stream and the bordering hills, the area covered by the Standard Project Flood and the Intermediate Regional Flood are approximately the same where flow is not obstructed by the railway. The large increase in damage resulting from greater floods would be caused primarily by increased water depths and increased velocities. Tabulated in table 3 are discharges and stages for the Intermediate Regional Flood and the Standard Project Flood.

TABLE 3

FLOOD STAGES

Flood	Intermediate Regional		Standard Project	
Location	Interstate 94	U.S. Hwy. 10	Interstate 94	U.S. Hwy. 10
Discharge	2,000	2,000	5,000	5,000
Average Flood Depth at Channel in Feet	12.1	8.9	12.6	19.5

The profiles were developed by backwater computations using the "standard step method" employing cross sections, topographic maps, and roughness coefficients established by field investigation. Consideration was also given to the effect of clogging of various bridge openings during floods and the forcing of flows over roads, streets and railways. For the Standard Project Flood the flow generally exceeded the capacity of the bridge openings, and blockage had only minor effect on water surface elevations. The effect of

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, stream, 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 stream flow, 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 water course or ocean, lake or other body of standing water, which has been or may be covered by flood water.

Intermediate Regional Flood

A flood having a one percent probability or 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 analysis 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 water course, looking downstream.

Low Steel (or Underclearance)

See "Underclearance."

Right Bank

The bank on the right side of a river, stream or water course, looking downstream.

Standard Project Flood

The flood that may be expected from the most severe combination of meteoroligical 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 percent to 60 percent 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 water course that limits the opening

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 (Public Law 86-645) as amended.

* * *

Assistance and cooperation of the U. S. Weather Bureau; U. S. Geological Survey; and Dickinson City Engineer in supplying useful data are appreciated.

* * *

This report presents the local flood situation along the Dickinson Drainage Ditch. The Omaha District of the Corps of Engineers will provide interpretation and technical assistance in application of data presented herein.

NOTES:

1. Flood outlines are based on surveys at the locations of valley and ditch cross sections. Outlines between cross sections are interpreted from U.S.G.S. quadrangle maps 7.5 minute Series, dated 1959. Users should determine actual ground elevations where precision is required. Profiles are based on U.S.G.S. mean sea level datum.
2. Photo copies are produced from aerial photography made in August, 1965.

LEGEND

STANDARD PROJECT FLOOD
INTERMEDIATE REGIONAL FLOOD

o 34 LOCATION OF ENDS OF SURVEYED VALLEY AND STREAM CROSS SECTIONS.

SCALE IN FEET

1000 500 0 1000 2000 3000

DICKINSON, NORTH DAKOTA
DRAINAGE DITCH
FLOODED AREAS

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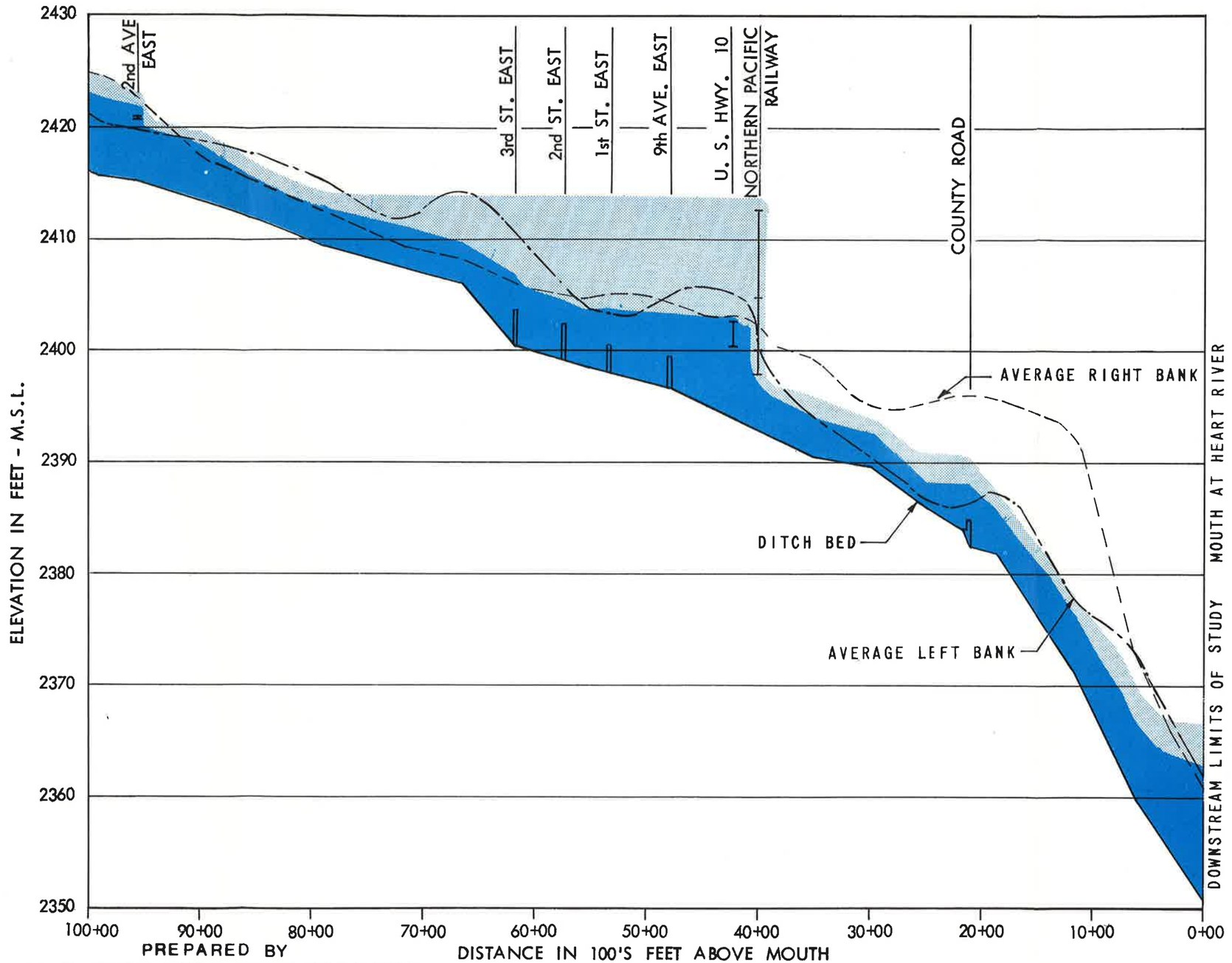
DACW45-68-C-0082

U. S. ARMY ENGINEER DISTRICT, OMAHA
CORPS OF ENGINEERS OMAHA, NEBRASKA
JUNE 1968



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CULVERT SYMBOL
Roadway Elevation
Culvert Invert

BRIDGE SYMBOL
Roadway Elevation
Underclearance

LEGEND
STANDARD PROJECT FLOOD
INTERMEDIATE REGIONAL FLOOD

DICKINSON, NORTH DAKOTA
DRAINAGE DITCH

PROFILES

U. S. ARMY ENGINEER DISTRICT, OMAHA
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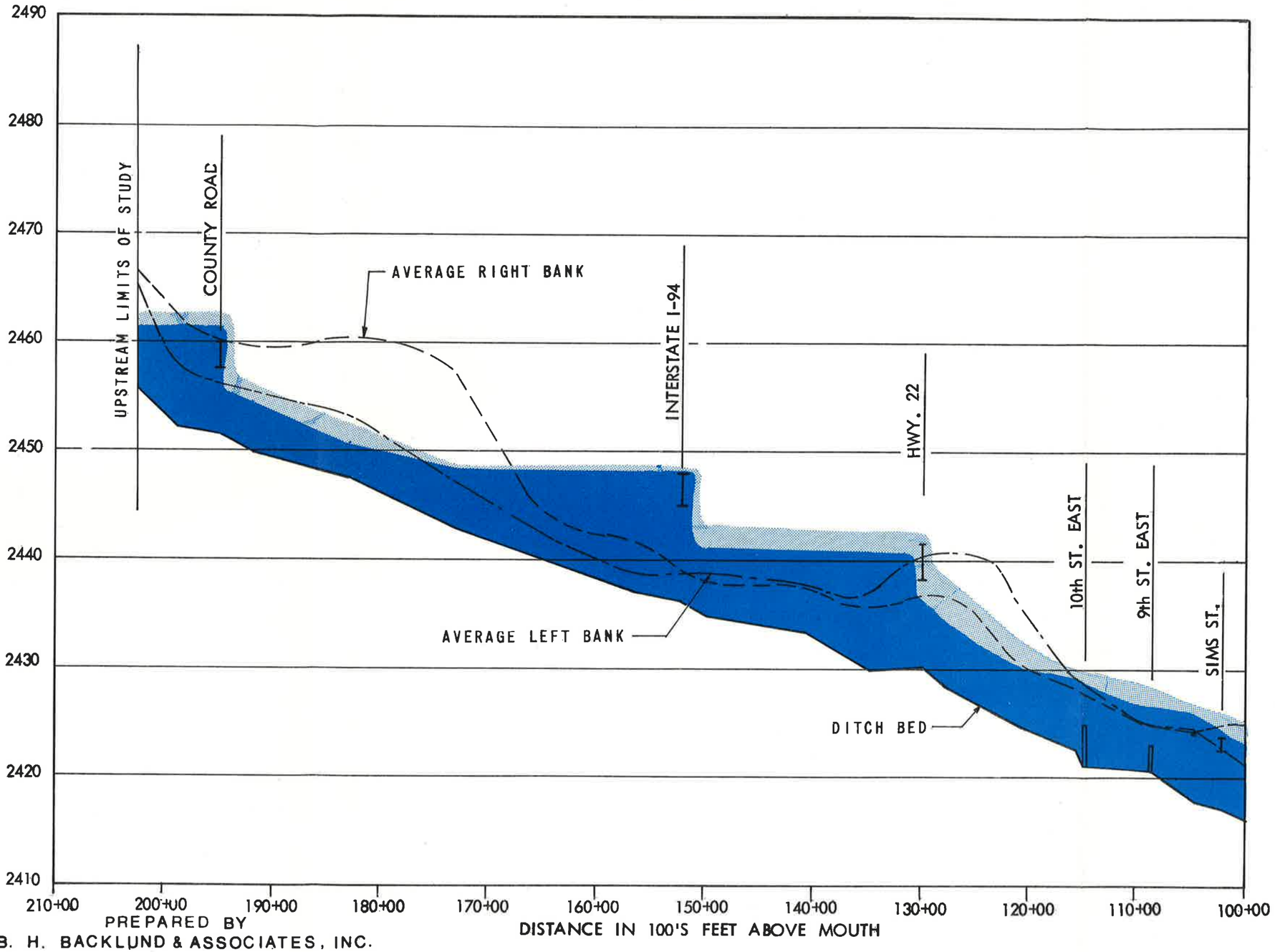

CULVERT SYMBOL
- Roadway Elevation
- Culvert Invert

BRIDGE SYMBOL
- Roadway Elevation
- Underclearance

LEGEND
- STANDARD PROJECT FLOOD
- INTERMEDIATE REGIONAL FLOOD

DICKINSON, NORTH DAKOTA
DRAINAGE DITCH

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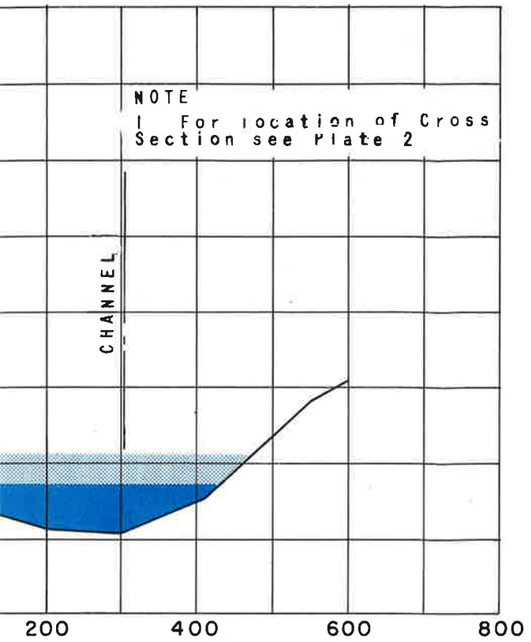
PLATE 5



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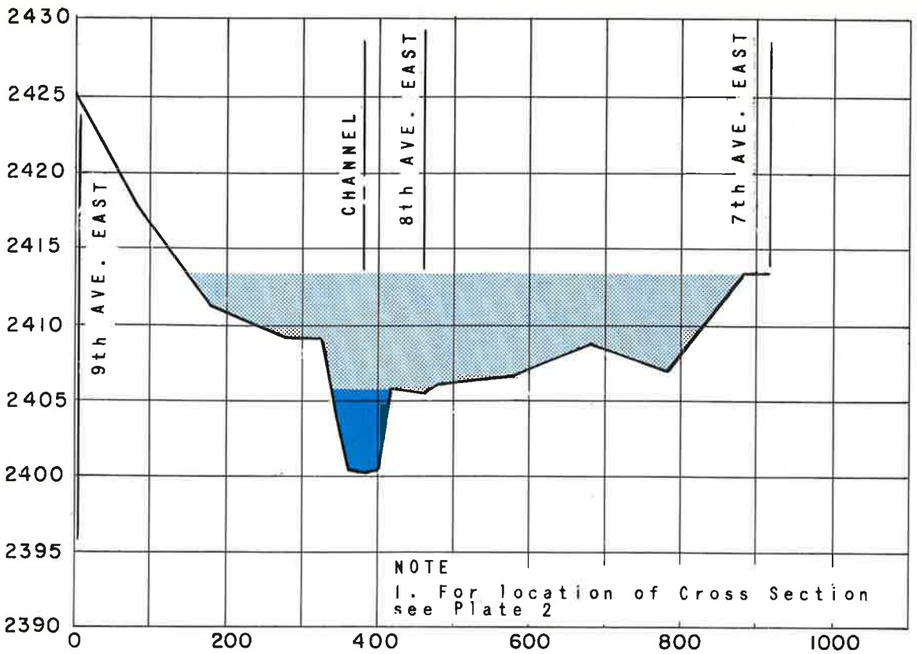

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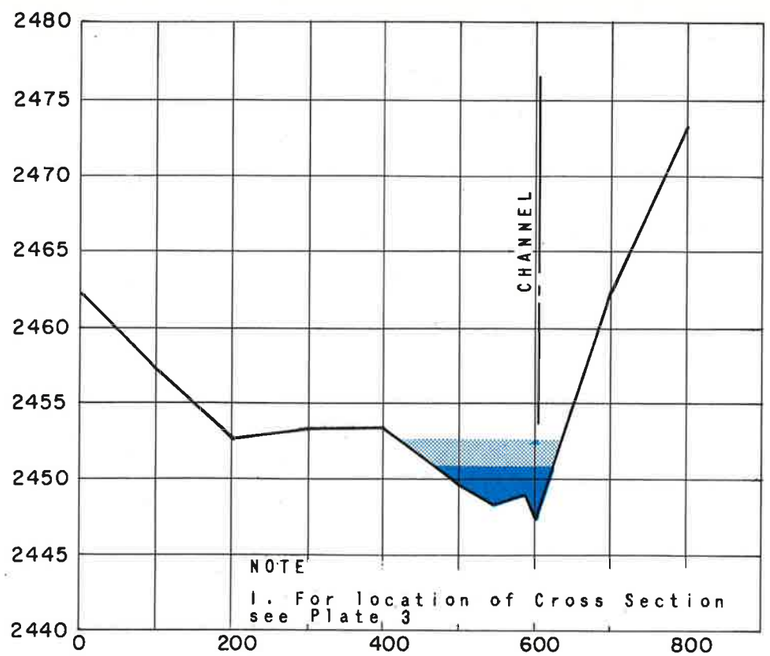

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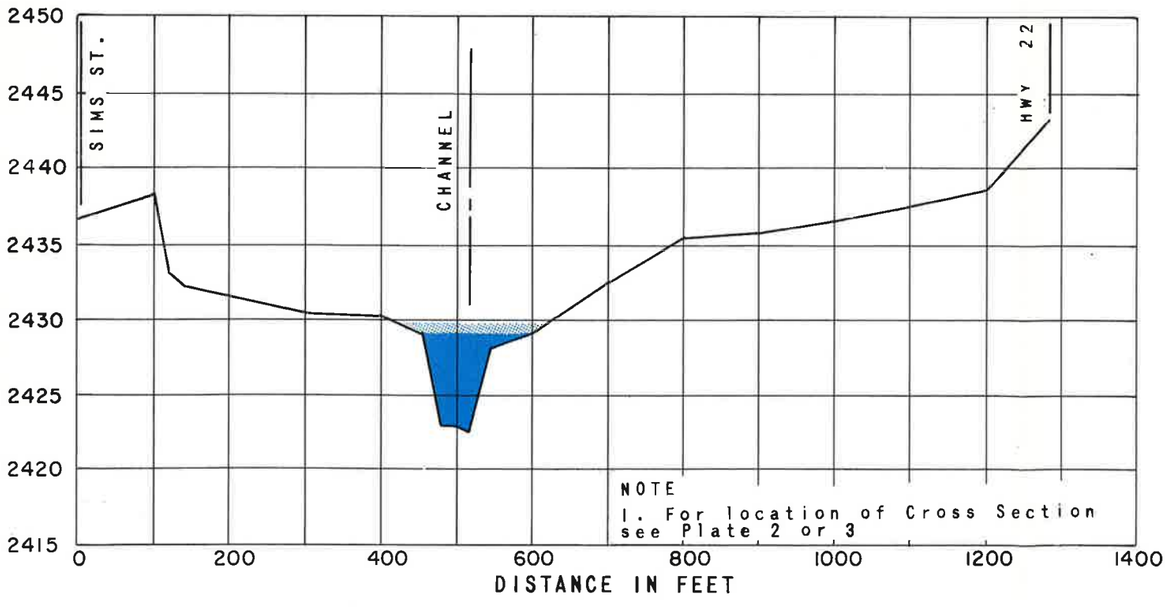

SECTION 35

LEGEND

STANDARD PROJECT FLOOD

INTERMEDIATE REGIONAL FLOOD

DICKINSON, NORTH DAKOTA
DRAINAGE DITCH

CROSS SECTIONS

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