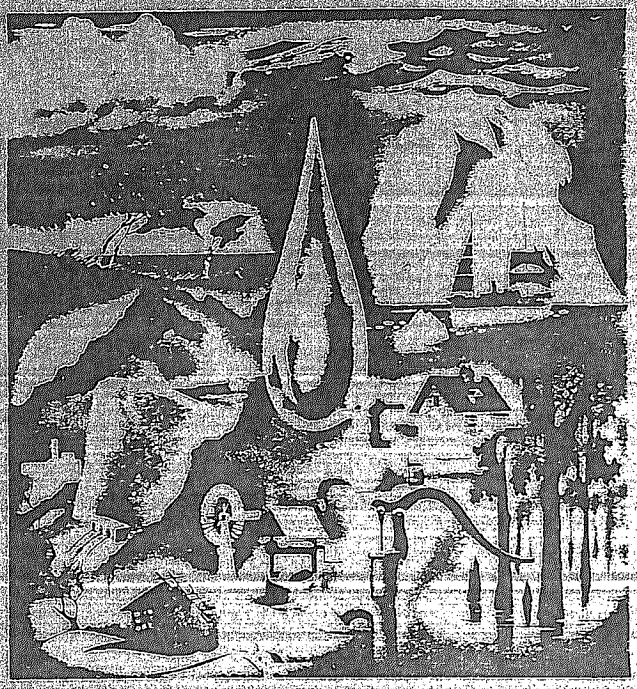

Technical Report No. 1

June 1967

Louisiana
Water Resources
Research Institute

THE RECENT ALLUVIUM OF THOMAS AND DUNCAN POINTS

A Geologic Evaluation of the Mississippi River Alluvium as a Potential Source of Ground Water for the Baton Rouge Area, Louisiana

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THE RECENT ALLUVIUM OF THOMAS AND DUNCAN POINTS

KEY WORDS: geologic formations; aquifers; freshwater; water supply; alluvium; natural recharge

ABSTRACT: Available borings and reports concerning the Mississippi River alluvium near Baton Rouge, Louisiana, are examined and interpreted. Two particular areas, Thomas Point-Devil's Swamp and Duncan Point, contain sands which are potential sources of naturally-filtered river water. Due to the scarcity of reliable borings in the Thomas Point-Devil's Swamp area, subsurface data from nearby similar areas are extrapolated. Two of the 12 figures and 3 plates analyze the frequency of depths to top of the sand obtained from borings. At Duncan Point, the potential aquifer sand is estimated to extend from -20 to below -200 feet mean sea level. Thomas Point, more difficult to interpret, probably has sand from -95 (possibly -65) down to -150 feet msl or lower. Additional borings are needed.

REFERENCE: Martinez, Joseph D., "The Recent Alluvium of Thomas and Duncan Points," Louisiana Water Resources Research Institute, Technical Report No. 1, Louisiana State University, Baton Rouge, Louisiana, June 1967.

EDITORIAL NOTE

This publication is the first of a series to report the technical details of water resources research now, or soon to be, under way in Louisiana. In the nature of progress reports, such papers--serving as basic documents for future discussions or publications--will focus on a limited portion of a technical project. More comprehensive papers, of interest to a wider audience, will incorporate some of the basic information published in this TR series.

Dr. Martinez' investigation was made under contract with the Louisiana Water Resources Research Institute and his paper is one of several preliminary reports on the geological aspects of preventing or ameliorating salt water intrusion into the fresh water aquifers now supplying the Baton Rouge area. The work was supported by funds under Grant No. A-004-LA (Public Laws 88-379 and 89-404, Title I, Sect. 100) from the Office of Water Resources Research, U. S. Department of the Interior.

TECHNICAL REPORT NO. 1 JUNE 1967

THE RECENT ALLUVIUM OF THOMAS AND DUNCAN POINTS

A Geologic Evaluation of the Mississippi River Alluvium as a Potential Source of Ground Water Supply for the Baton Rouge Area, Louisiana

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CONTENTS

LIST OF FIGURES

THE RECENT ALLUVIUM OF THOMAS AND DUNCAN POINTS

A Geologic Evaluation of the Mississippi River Alluvium as a Potential Source of Ground Water Supply for the Baton Rouge Area, Louisiana

INTRODUCTION

The Mississippi River alluvium in the vicinity of Baton Rouge is a potential major source of ground water. It can be used as a natural filtration plant by drilling and operating well fields to induce infiltration from the Mississippi River. Thomas Point, north-west of Baton Rouge, and Duncan Point, south, are two major areas of alluvium on the east bank of the river.

This report examines subsurface data from these areas and similar locations on the west side. It then compares and evaluates the two major sites as potential sources of ground water.

Thomas Point and Devil's Swamp:

Meyer and Turcan [1955a] suggested that the Devil's Swamp area of Thomas Point might offer a potential source of ground water, but they did not give a detailed evaluation of the possibilities in their paper.

Three factors, combined with the general character of the Recent alluvium, make this area attractive. The first is that it is a narrow neck of land hydraulically connected to the Mississippi River on both sides. The second is that Thompson's Creek, which enters the Mississippi River about eleven miles upstream, transports such a large amount of sand to the river that point bar deposits on Free Nigger Point are anomalously high in sand content. Consequently, the sandy substratum on Thomas Point may be somewhat coarser than otherwise might be expected. Finally, the orientation of bars and swales on Thomas Point is such that, if depositional conditions produced a permeability anisotropy, the orientation should favor rather than hinder infiltration.

On the dark side, meandering of the Mississippi over a long period of time could cause changes in shape, reduction in size, or even isolation of Thomas Point from the east bank. The significance of this process is indicated by a comparison of the banklines shown on the 1935 and 1965 USGS topographic maps (Figure 1).

However, the Corps of Engineers, having built revetments on the east side of the river at Springfield Bend, appears committed to maintaining the Mississippi in its present channel.

Duncan Point:

The area just south of Baton Rouge is potentially favorable for development of a ground water supply subject to continuous recharge by the Mississippi. Point bar deposits underlie much of this area; typical bar and swale topography is clearly evident near Louisiana State University and south along the river, nearly to the point itself. The pervious character of the near-surface material on Duncan Point is shown by the history of underseepage during the high water periods in 1937, 1945, and 1950. Figure 2, which is modified from Technical Memorandum No. 3-424 of the Waterways Experiment Station, [1956], shows the locations of sand boils which developed between L.S.U. and the river at these times. The very factor that was then unfavorable greatly enhances the feasibility of the proposed type of water supply. The hydraulic connection between the river and the Recent deposits in this area has been pointed out by Meyer and Turcan [1955b].

STRATIGRAPHIC FRAMEWORK OF THE RECENT ALLUVIUM

Extrapolations from the preceding data and from other information have been made on the basis of Fisk's concepts of the nature of the Recent alluvium. In his first report, Fisk [1944], after dividing the Mississippi River alluvium into a lower graveliferous unit and an upper non-graveliferous unit, further subdivided the upper unit into a substratum of clean, fine sands and a cohesive top stratum. He differentiated the cohesive top stratum into natural levees, the uppermost part of sand bar ridges, clay plugs, sand bar sloughs, and back swamp deposits. Later, Fisk [1947] slightly modified his concept by dividing the Recent alluvium into a pervious substratum of sands and gravels and a fine-grained relatively impermeable top stratum. The fine-grained top stratum includes natural levees, point bars, back swamps, channel fillings, and back swamps and point bars overlain by thin natural levees.

In Plate 5 of his 1947 report, Fisk considered the entire thickness of sand and gravel in the pervious substratum, and some fine-grained material as well, to have been deposited by braided streams after incisement during the last period of glaciation. After describing in detail the possible modes of origin of all of the fine-grained deposits, he further pointed out that, within the alluvial ridges, the deposits have been reworked to highly irregular distribution and thickness. He

stated in the text and showed diagramatically (Figure 3) that "in general, the substratum sands lie closer to the surface than in the undisturbed valley deposits in the marginal basins."

Although he explained in detail how the fine-grained seidments are deposited during point bar growth, he did not discuss the reworking that brought the substratum sands closer to the surface. Certainly, if the river channel is generally deeper than and has migrated across the back swamp deposits, these deposits must have been either reworked or replaced. The questions then arise in the analysis of Fisk's diagram (Figure 3): what is the source of the additional sand and gravel deposited in the new prism of sediment in the meander belt, and what has happened to the back swamp material? According to Kolb [1956], the material forming the flood plain of the Mississippi River reflects the grain sizes of the original substratum materials in the upper part of the valley which were slowly moved south by meandering processes. Perhaps this can explain the source of sand and gravel in the new prisms of sediment in the meander belt.

Durham [1961], postulating a different origin for the substratal material, suggested that scour and fill associated with lateral planation could have formed the valley and its alluvium simultaneously.

EVALUATION OF THE THOMAS POINT - DEVIL'S SWAMP AREA

Subsurface Data from Thomas Point and Devil's Swamp:

The subsurface data for Thomas Point and Devil's Swamp is fragmentary. One interpretive section across the point, prepared by Fisk [1947] from an examination of 6 Corps of Engineers borings (Figure 4), shows the highest elevation of the top of the sand sequence, where it was encountered, to be -33, and the lowest, -48 ft. msl. Some borings that were in predominately argillaceous material did not bottom in sand. Fisk considered this material to be swale fillings, the lowest elevation of which appears to be at least -88 ft msl.

Five borings were made on Springfield Bend for caving bank studies by the U. S. Army Engineers. Their locations are shown on Plate I. The highest elevation of the top of the sand is -35.4 ft msl and the lowest is -84 ft msl.

The deepest of 31 borings for the Devil's Swamp Barge Canal penetrates only to -37 ft msl. Nearly all of the sediments logged ranged from clay to sandy silt. There were very few samples of clean sand. Only one boring, DS-16C, reached the top of the sand, which was at an elevation of -15 ft msl. The depth of these borings and the character of the material indicate, with the exception of DS-16C, that they did not go beneath the top stratum of the Mississippi River alluvium.

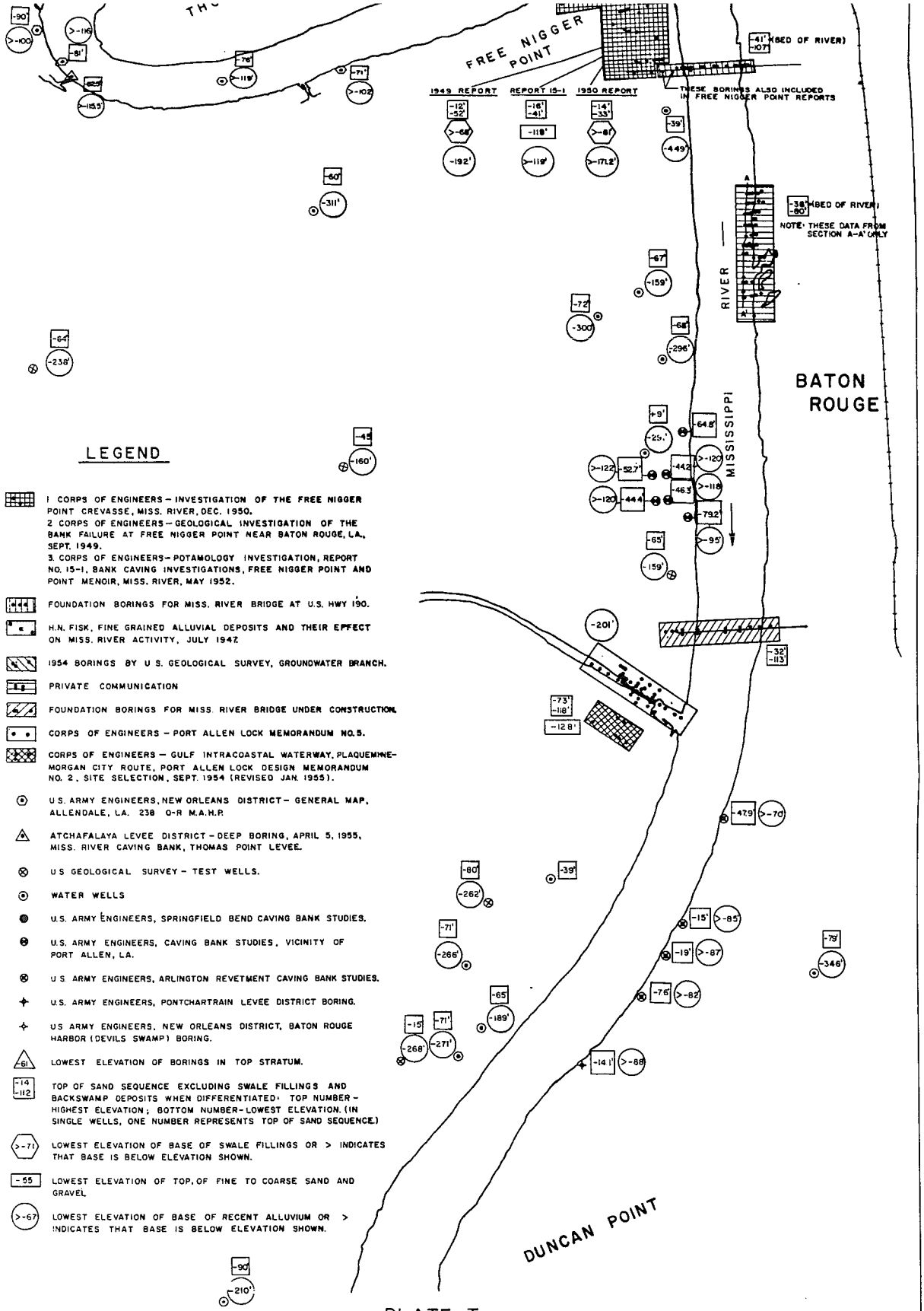
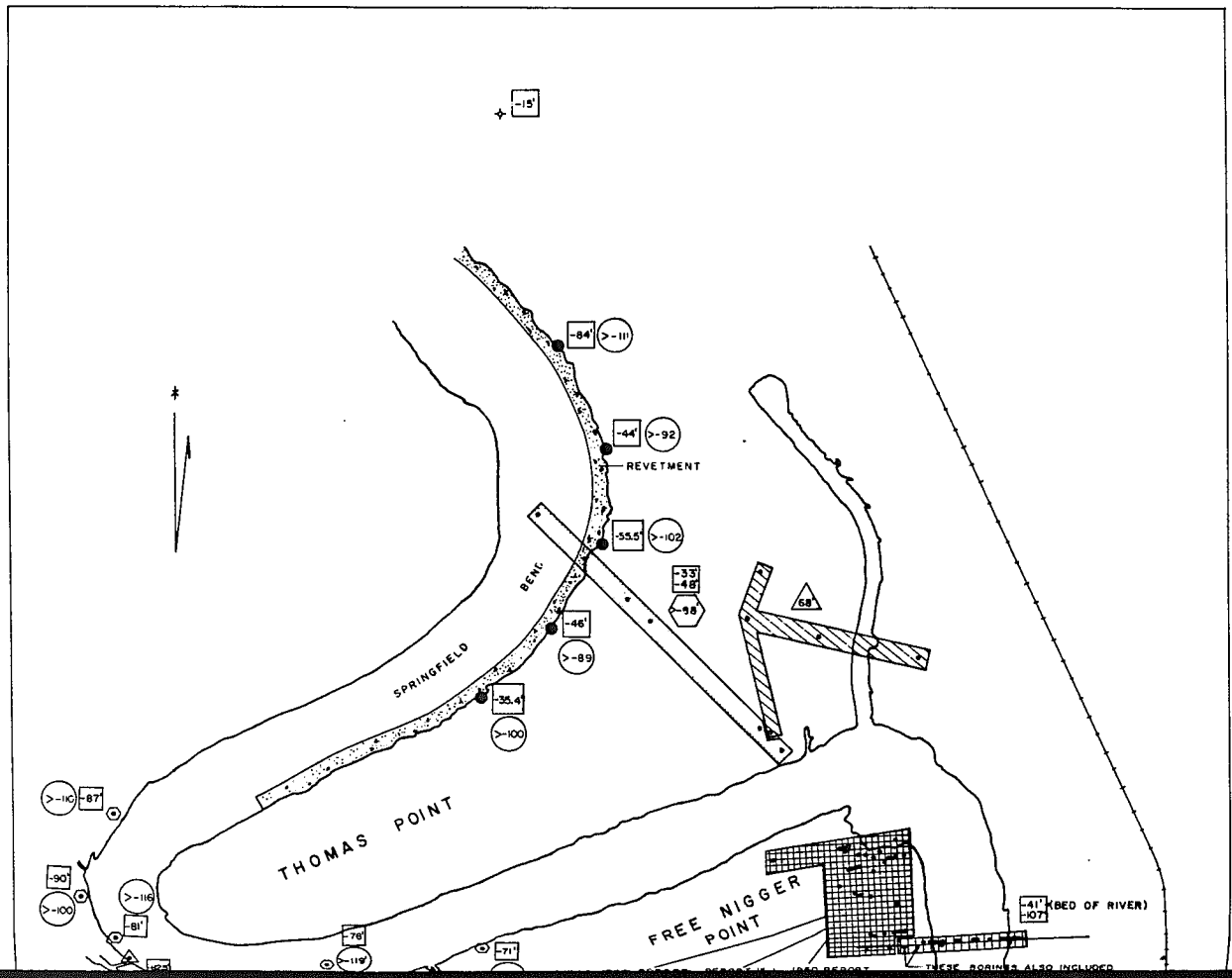
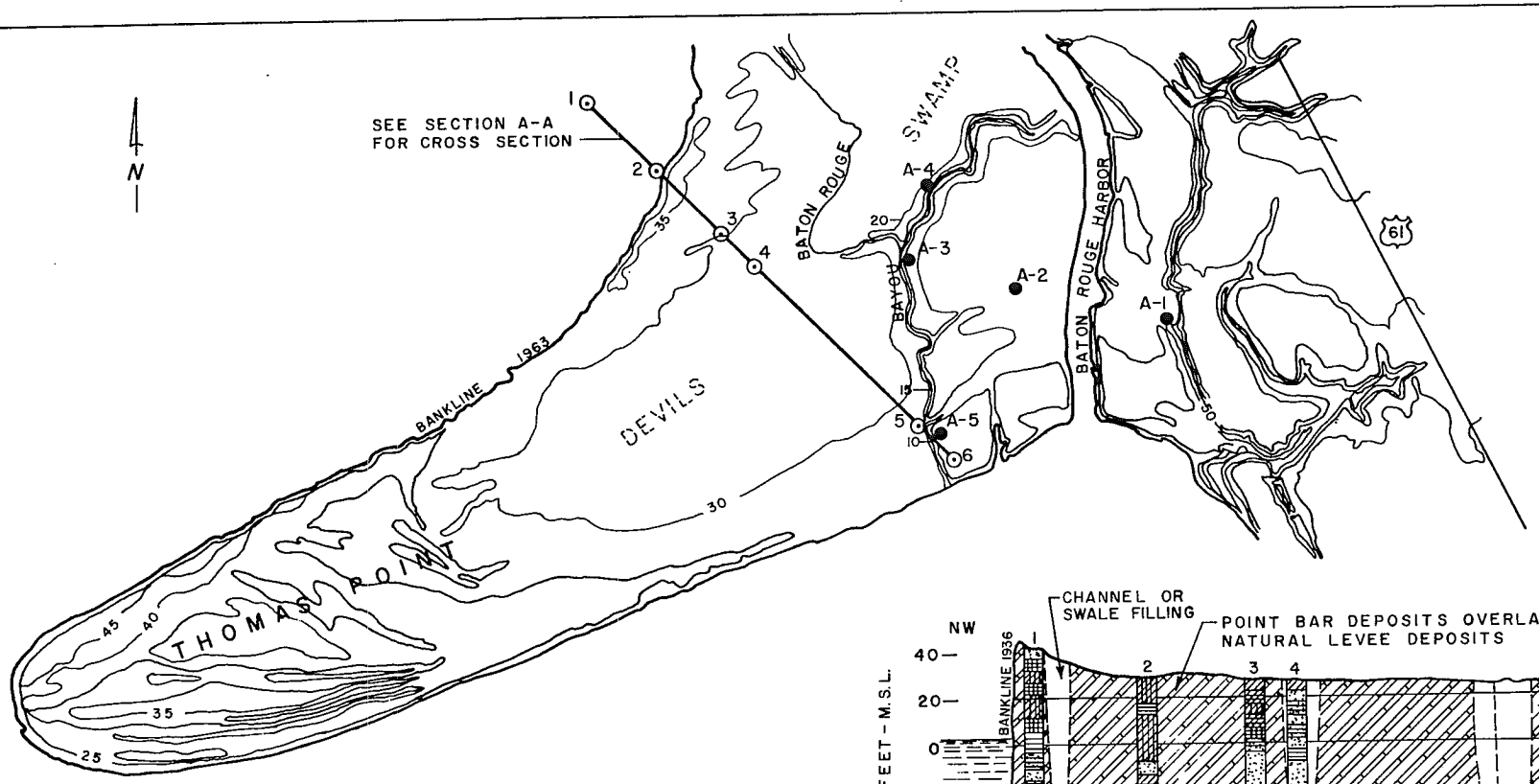


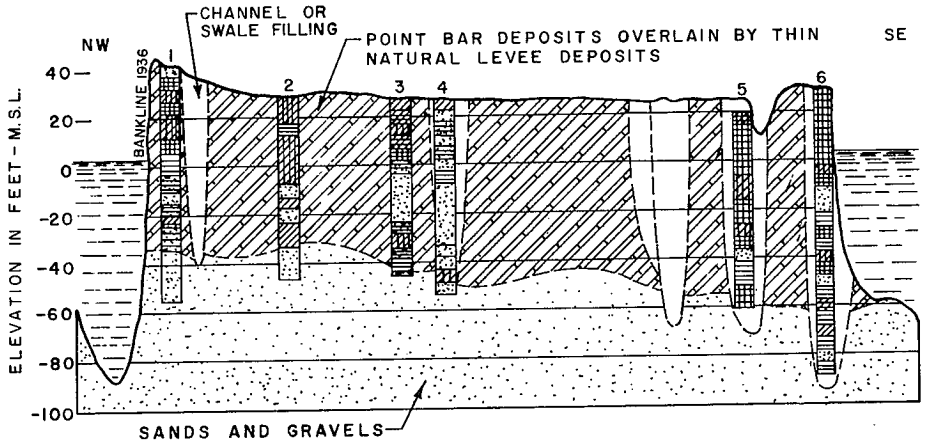
PLATE I

BORING LOCATIONS AND SUMMARY OF DATA

1967


-15'
-84'
>-111
-44'
>-92
REVETMENT
-55.5'
>-102
-33'
-48'
>-98
68'
-46'
>-89
-35.4'
>-100
BENC
SPRINGFIELD
THOMAS POINT
>-110
-87'
-90'
>-100
>-116
-81'
-76'
>-119
-71'
FREE NIGGER POINT
-41'
-107'
(BED OF RIVER)
THESE BORINGS ALSO INCLUDED





BORING LOCATIONS AND GEOLOGIC SECTION

THOMAS POINT - DEVILS SWAMP AREA

SCALE

1 ½ 0 1 MILE

SECTION A-A

(FROM FISK, 1947)

LEGEND FOR LOGS

- SILT
- CLAYEY SILT
- SANDY SILT
- CLAY
- SILTY CLAY
- SANDY CLAY
- LOAM
- SILTY LOAM
- CLAYEY LOAM
- SANDY LOAM
- SILTY CLAY LOAM
- SILTY SAND
- CLAYEY SAND
- GUMBO
- SAND

DRAWN BY: *DHH*

DATE: 7/25/66

FIG. 4

The earlier Corps of Engineers [1949] report on Free Nigger Point says that the surface of contact between the graveliferous and non-graveliferous units is at -75, and the top of the Pleistocene, at -150 ft. msl. A study of the logs and cross sections in this report suggests that the top of the sand sequence, underlying point bar material, generally ranges from an elevation of -12 to -52 ft. msl. In places, fine-grained alluvium extends much deeper, the lowest at -68 ft. msl. The report takes this fine-grained material to be swale fillings.

Two other borings in the vicinity are detailed in Report No. 15-1 [1952] of the Corps of Engineers. The top of the sandy substratum in these borings ranges from -16 to -41 ft. msl. The base of sand and/or gravel extends at least to -118 ft. msl. Figure 5 (cross section C-C' from the 1949 report) is a typical example of the subsurface interpretation of bar and swale stratigraphy in this report.

The Corps of Engineers report on the Port Allen Lock [1956] presents a somewhat different picture. Figure 6 is a section normal to the river, based on 15 borings. According to Kolb (verbal communication), the section represents a clay plug filling in an abandoned channel. Three of the borings are considered to have penetrated the Pleistocene-Recent contact at -192, -195, and -201 ft. mlg. The top of the substratum sands ranges from -49 to -129 ft. mlg, with depths from other logs in this vicinity falling within these limits. The thalweg of the river is below -54 ft. mlg in the line of this section. This report also gives test data for the dewatering of the site for the lock construction. These may be extrapolated to the Devil's Swamp area to study infiltration.

Several years later the Corps of Engineers [1955] had additional information from 24 borings. The elevation of the top of sand in these ranges from -73 to -118 ft. mlg.

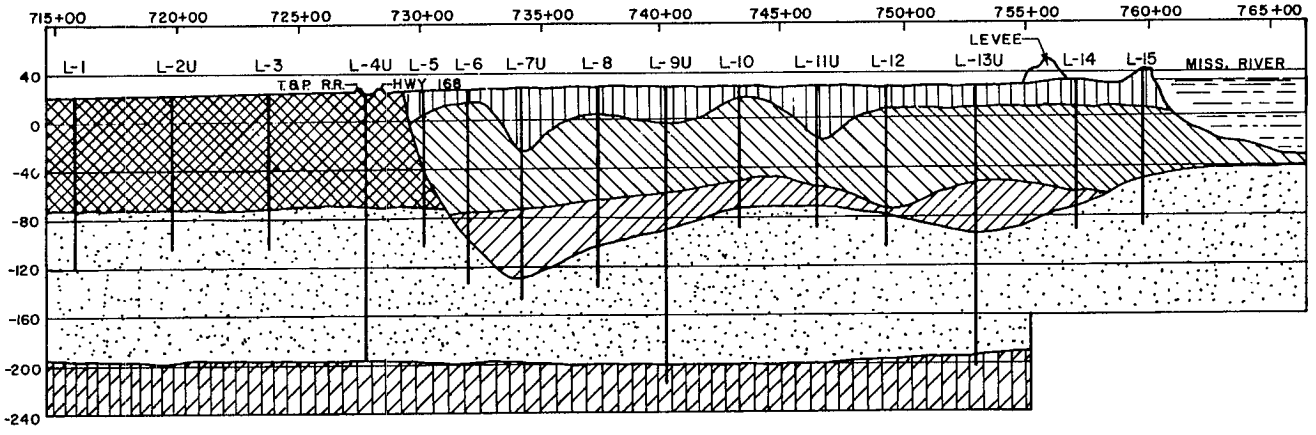
Depth Estimates in the Thomas Point - Devil's Swamp Area:

Three basic predictions, needed for evaluating the potential of the Thomas Point - Devil's Swamp area as a natural filter plant, are the:

1. Depth to the base of the sand and gravel.
2. Depth to the top of the sand and gravel.
3. Expected variation of these depths.

Because insufficient information exists from borings of adequate depth in the Thomas Point - Devil's Swamp area itself to provide a basis for such predictions, extrapolations from subsurface data in adjacent areas have been necessary.

The first prediction stems from the logs of 63 wells which apparently penetrated the base of the sand and gravel sequence of the Recent alluvium or which give some indication of a minimum depth to the base. It is extremely difficult to



LEGEND

- BACKSWAMP CLAYS
- CLAYS
- SILTS AND SANDY SILTS WITH CLAY STRATA
- CLAYS WITH SILT AND SAND STRATA
- SUBSTRATUM SANDS
- PLEISTOCENE DEPOSITS (CLAYS AND SILTS)

GEOLOGIC SECTION AT PORT ALLEN LOCK

(FROM CORPS OF ENGINEERS, DESIGN MEMORANDUM 5)

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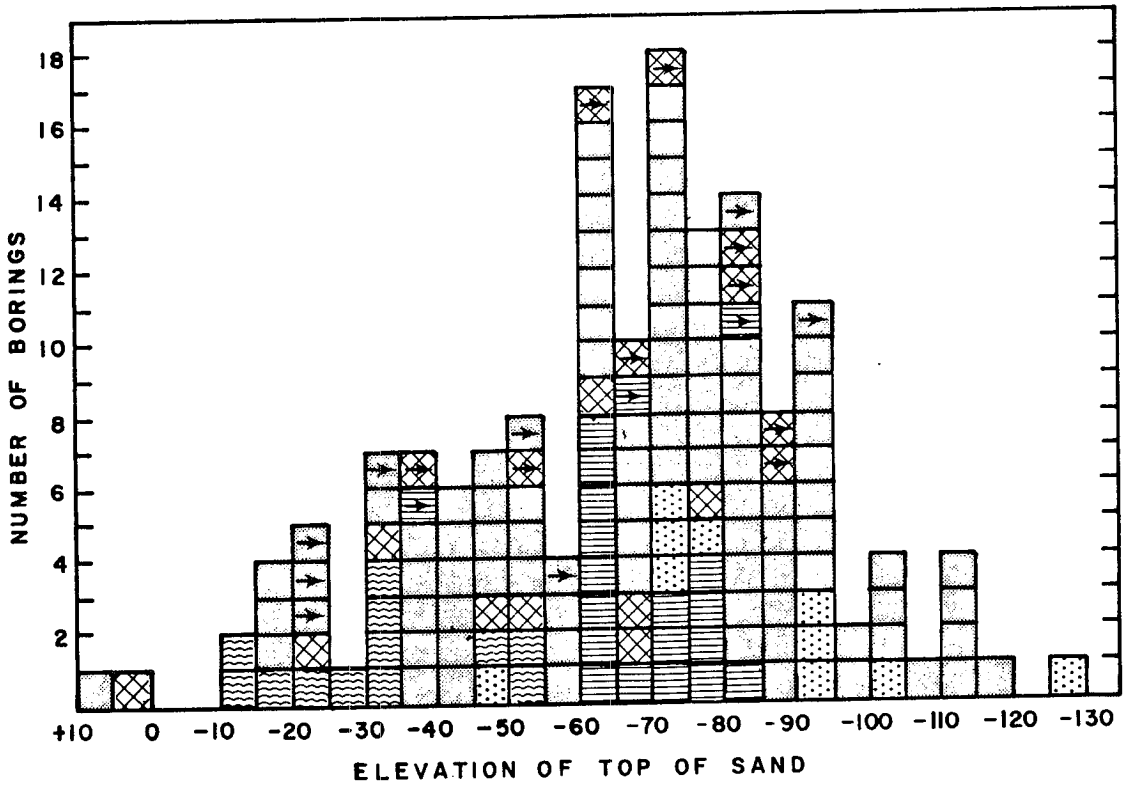
DATE: 7/25/66

FIG. 6



LEGEND

- BACKSWAMP DEPOSITS
- CLAY PLUG FILLING, VERBAL COMMUNICATION (KOLB)
- POINT BAR DEPOSITS
- SWALE DEPOSITS
- UNDIFFERENTIATED
- THIS ELEVATION OR LOWER

FREQUENCY DISTRIBUTION OF ELEVATION OF TOP OF SAND

(FOR ALL BORINGS IN AREA SHOWN ON PLATE I OF MISSISSIPPI RIVER ALLUVIUM EXCEPT THOSE ON DUNCAN POINT AND ALL BUT ONE OF THE DEVILS SWAMP CANAL BORINGS.)

FIG. 7

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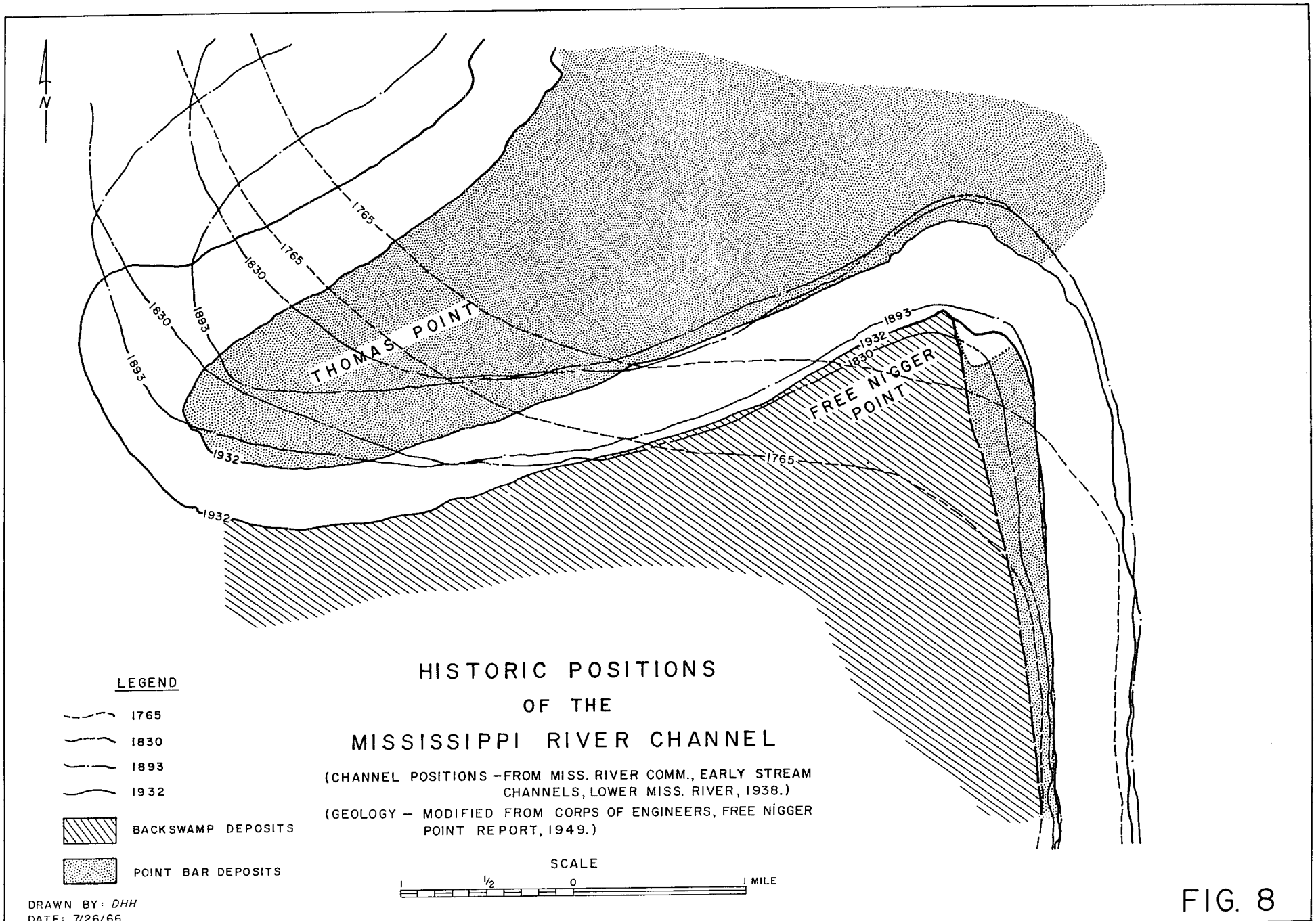

HISTORIC POSITIONS OF THE MISSISSIPPI RIVER CHANNEL

(CHANNEL POSITIONS – FROM MISS. RIVER COMM., EARLY STREAM CHANNELS, LOWER MISS. RIVER, 1938.)

(GEOLOGY – MODIFIED FROM CORPS OF ENGINEERS, FREE NIGGER POINT REPORT, 1949.)

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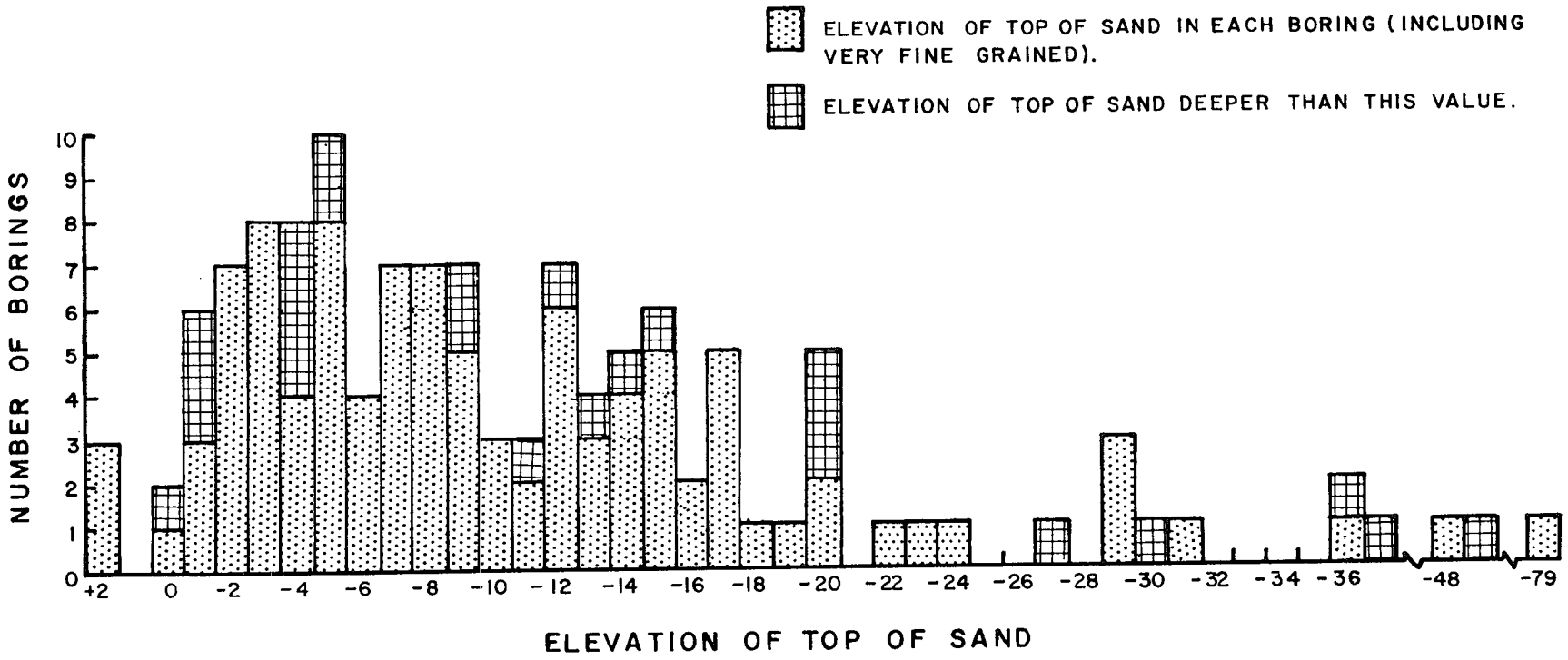
DATE: 7/26/66

FIG. 8



FREQUENCY DISTRIBUTION OF ELEVATION OF TOP OF SAND

IN BORINGS PUBLISHED IN U.S. ENGINEERS UNDERSEEPAGE REPORT T.M. 3-424 FOR DUNCAN POINT SOUTH OF BATON ROUGE, LOUISIANA AND IN FIVE LEVEE BORINGS AND ONE WATER WELL

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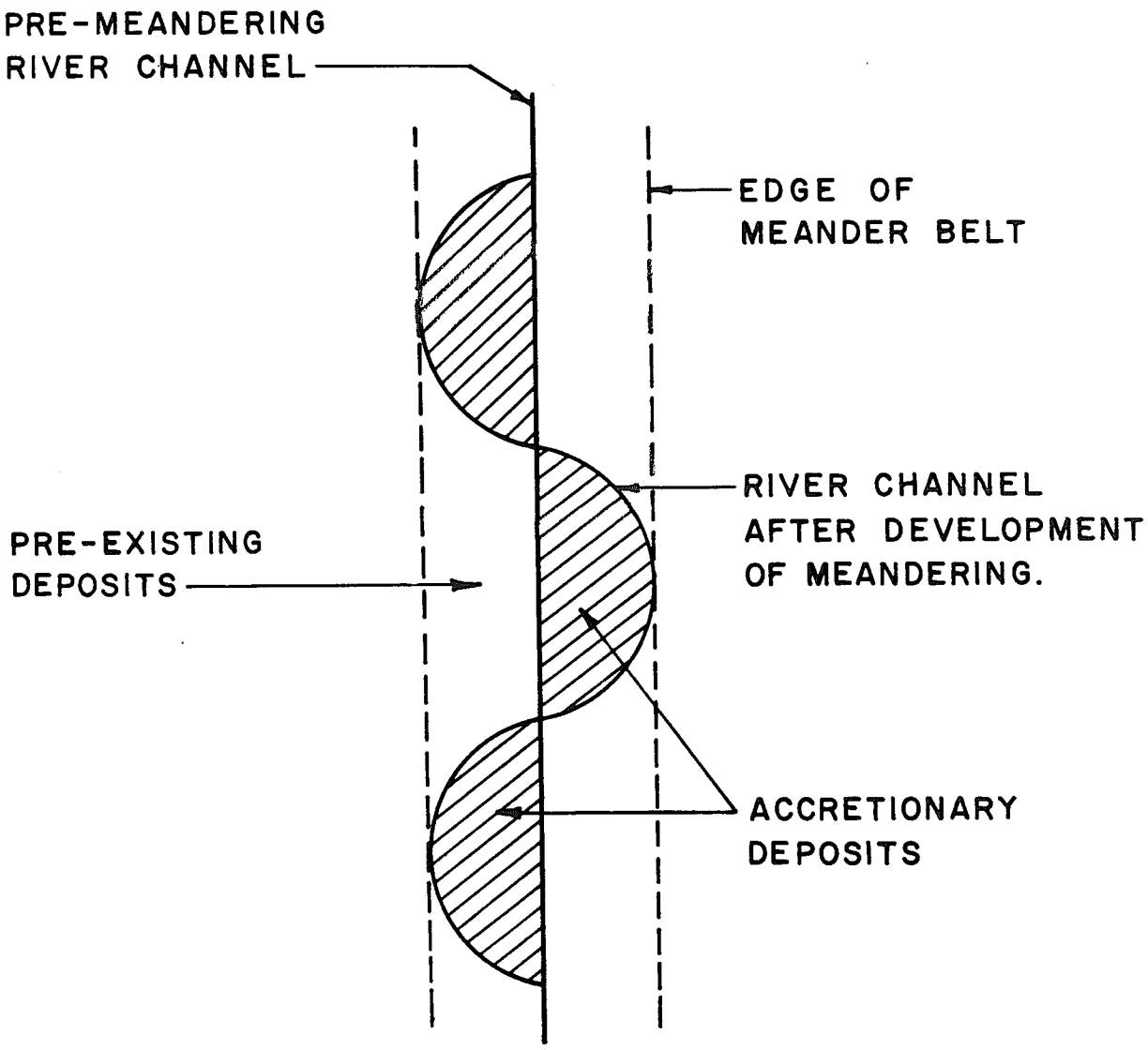
DATE: 3/67

FIG. 9



EARLY STAGE OF MEANDER DEVELOPMENT

AND

RESULTING ACCRETIONARY DEPOSITS

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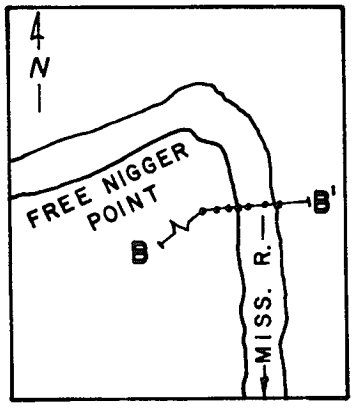
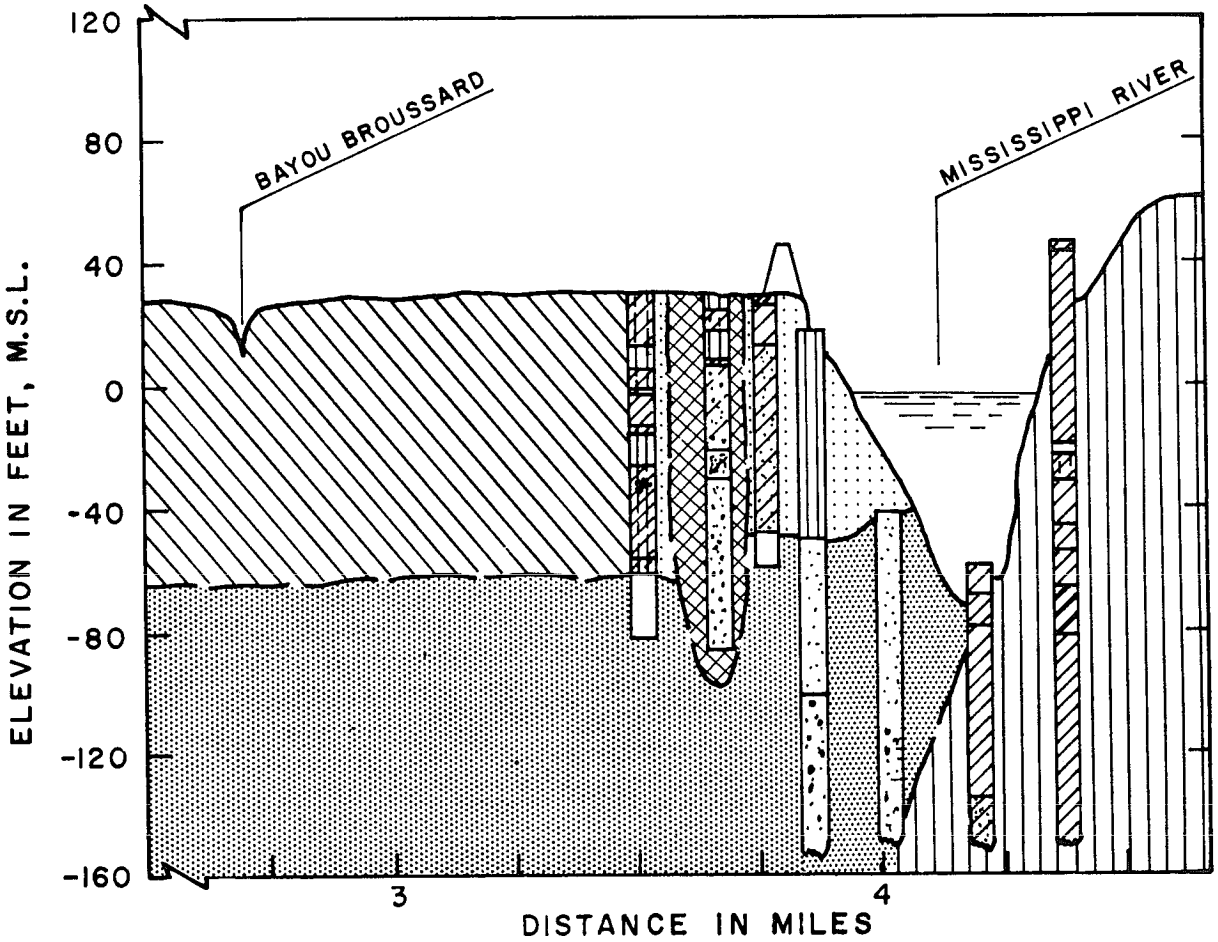
FIG. 10



LOCATION MAP

LEGEND

- CLAY
- SILT
- SAND
- GUMBO
- FINE-GRAINED TOPSTRATUM
- BACKSWAMP DEPOSITS
- CHANNEL FILLING (SWALE)
- PLEISTOCENE DEPOSITS
- SAND



SECTION B-B'

CROSS SECTION AT MISSISSIPPI RIVER BRIDGE

(MODIFIED FROM CORPS OF ENGINEERS, FREE NIGGER POINT REPORT, 1949)

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DATE: 7/66

FIG. 12

ACKNOWLEDGEMENTS

The writer wishes to thank Mr. George Cardwell of the U. S. G. S. for furnishing boring data. Particular thanks are due Dr. Charles Kolb of the U. S. Engineers Waterways Experiment Station at Vicksburg for calling attention to pertinent sources of data and furnishing valuable advice. Mr. R. T. Saucier also made helpful and important comments.

Dr. C. O. Durham, Director of the School of Geology at L. S. U., also gave valuable advice and read the manuscript critically. Finally, thanks are extended to Professor Raphael G. Kazmann for certain basic data and his critical review of the manuscript, as well as for encouragement to carry this work to conclusion.

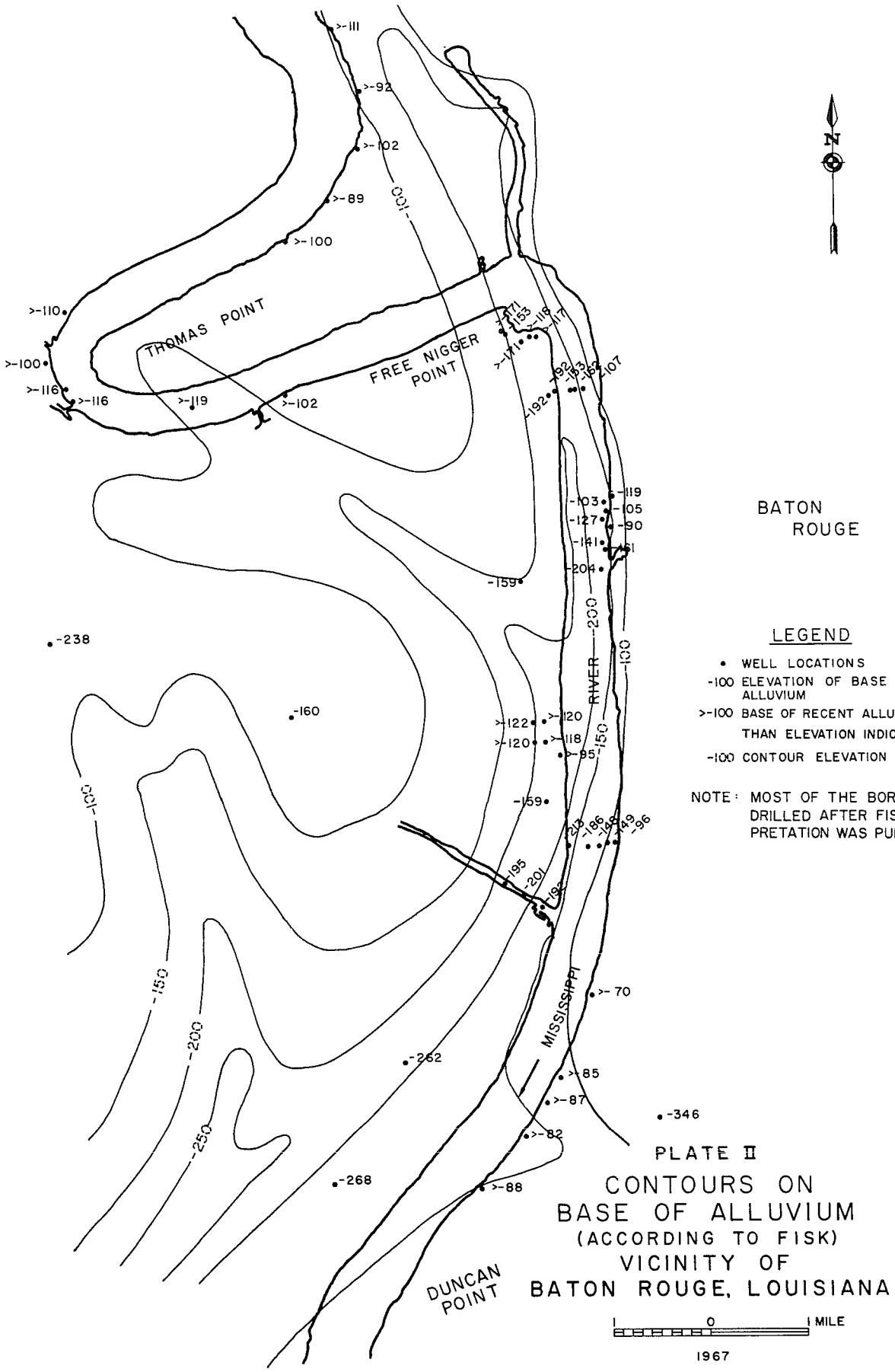

PLATE II

CONTOURS ON BASE OF ALLUVIUM (ACCORDING TO FISK) VICINITY OF BATON ROUGE, LOUISIANA

1967

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(AFTER FISK, ENTRENCHED VALLEY SYSTEM, MISSISSIPPI RIVER ALLUVIAL VALLEY, 1944.)