SCOUR AROUND BRIDGE PIERS OF OVERFLOW STRUCTURES AT I-35 BRIDGE ON THE CIMARRON RIVER

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by

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16 ABSTRACT

The October 1986 flood of the Cimarron River resulted in severe scour around piers of eight overflow structures of the I-35 bridge. A major portion of the flood passed through these structures resulting in a high velocity of flow. Furthermore, the bridge is located on a meander, and that leads to a skewed flow in the flood plain. This fact caused additiona scour around the piers. The scour was measured using the Electronic Distance Meter. After the flood receded, the maximum depth of scour ranged from 10 feet to 30 feet.

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ABSTRACT

The October 1986 flood of the Cimarron River resulted in severe scour around piers of eight overflow structures of the I-35 bridge. A major portion of the flood passed through these structures, resulting in a high velocity of flow. Furthermore, the bridge is located on a meander, and that leads to a skewed flow in the flood plain. This fact caused additional scour around the piers. The scour was measured using the Electronic Distance Meter. After the flood receded, the maximum depth of scour ranged from 10 feet to 30 feet.

CONTENTS

LIST OF FIGURES

LIST OF TABLES

INTRODUCTION

This report presents data on scourholes of the eight overflow structures directly north of the I-35 bridge on the Cimarron River. These scourholes in the floodplain of the river resulted from the 1986 October flood in the river. An aerial photograph is presented in Figure 1. Eight overflow structures are labeled as Structures C, D, L, K, M, N, O and P. Structures A and B are part of the main bridge on I-35. Described below are the procedures used to obtain the scourhole data.

PROCEDURES

An Electronic Distance Meter (EDM) was used to obtain the extent and profile of each scourhole. It was placed at a point near the scourhole from which all points on the scourhole were visible. This location was referenced to a point on the bridge, such as a bridge pier. The height setting on the instrument was determined from the bridge seat elevation, the angle setting on the instrument was zero and referenced to the bridge. The perimeter was determined by taking shots at regular intervals around the scourhole and recording the angle of the shot and the horizontal and vertical distances from the instrument. The recordings were reduced to give the location and the elevation of these points on the perimeter.

All scourholes were full of water at the time of the survey, therefore, a small boat was needed for the interior shots. The water surface elevation was determined by the same method as the perimeter shots. Depth readings were taken throughout the scourholes and the location of the readings was recorded. The elevation of these points was determined by subtracting the depth from the water surface elevation.

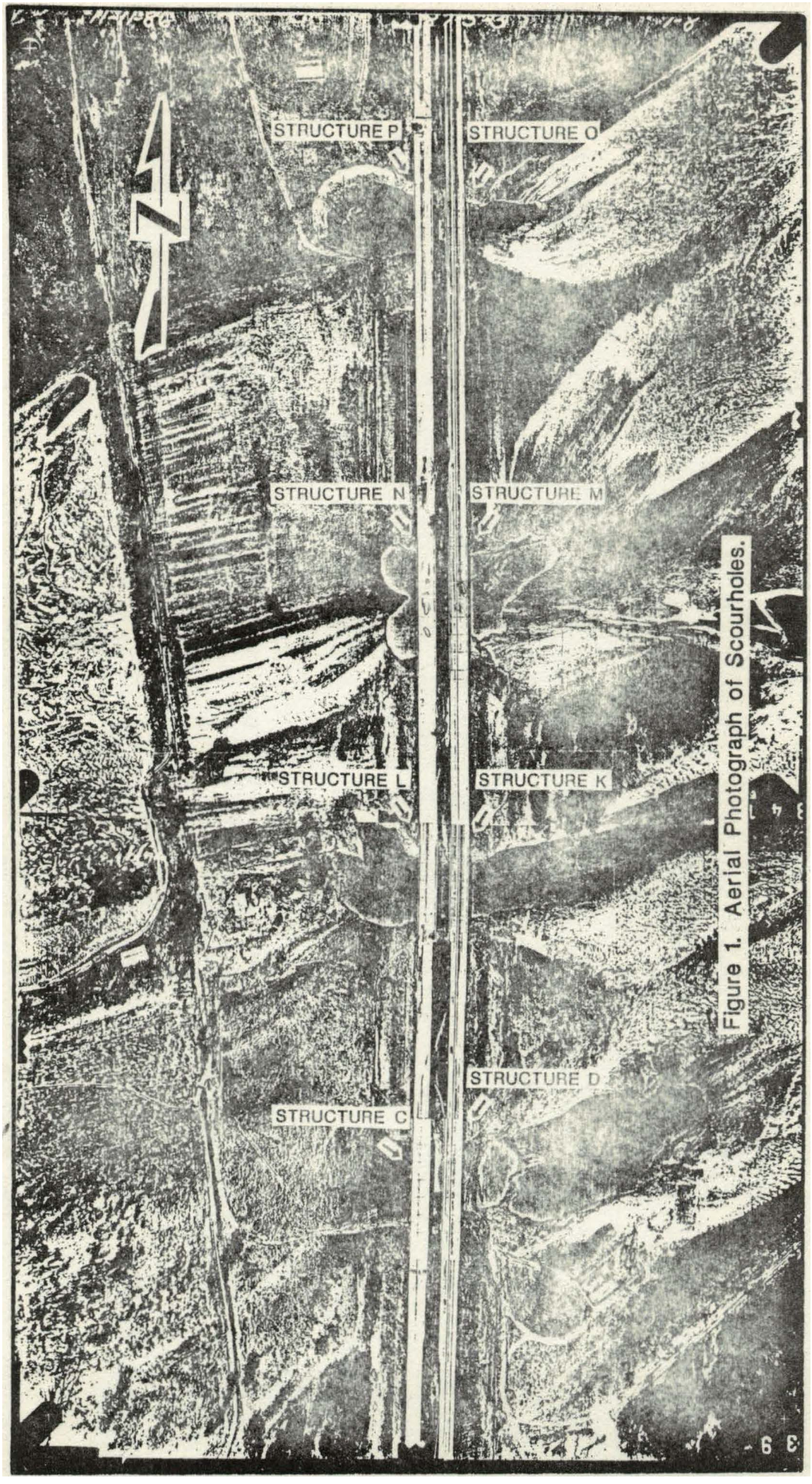

Figure 1. Aerial Photograph of Scourholes.

RESULTS

The results are shown in Table 1 and Figures 2 through 17. Included is a plan view and a profile for each scourhole. Each scourhole is referenced by the station numbers of the overflow structures it is between and its direction relative to the highway. The plan view indicates the approximate line of the scour profile. Scales and flow directions are indicated in each figure.

Figure 1 presents aerial view of scourholes near Overflow Structures C-D, L-K, N-M and P-O similar to those in Figures 2 through 17 based on actual field surveys. Even though the four sets of scourholes appear continuous in the aerial photograph, they sometimes contain two locations of maximum scour depths.

Table I gives the span of each structure. Note that Structures A and B are part of the main bridge. Also shown is the upstream or downstream location of the scourhole relative to the structure, and the maximum scour depth found after the flood receded. Most of the deep scourholes are generally located on the upstream side of the structures.

TABLE I

Maximum Scour Depths Near Structures C Through J at I-35 Bridge on the Cimarron River

Span Structure	Scourhole (feet)	Maximum Scour Depth Location	(feet)
P	281.33	Upstream	30.0
O	281.33	Downstream	10.7
N	201.33	Upstream	15.4
M	201.33	Downstream	11.4
L	281.33	Upstream	22.7
K	281.33	Downstream	12.2
C	161.33	Upstream	10.2
D	161.33	Downstream	27.0

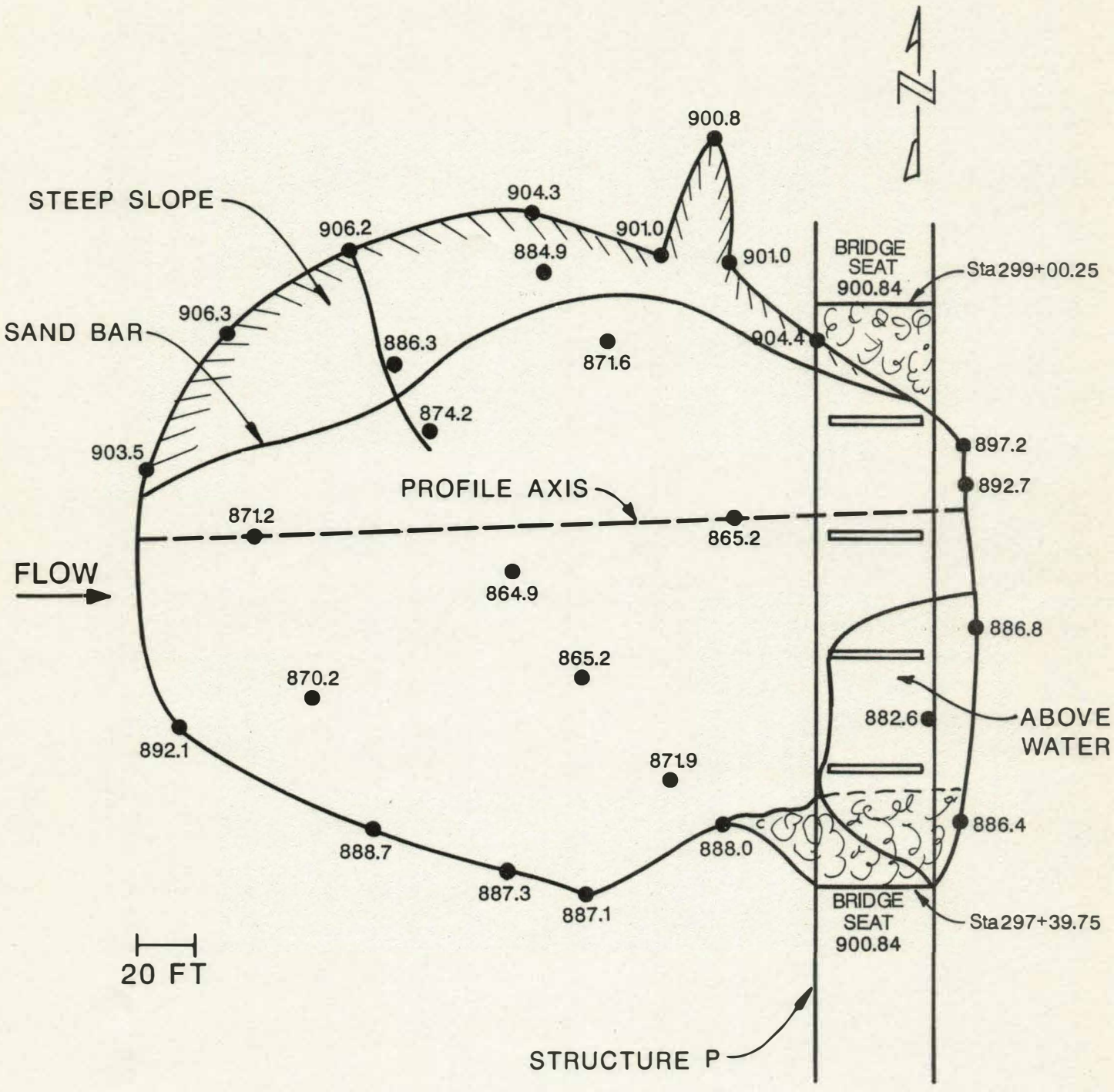

Figure 2. Location of Scour Hole Upstream of Structure P.

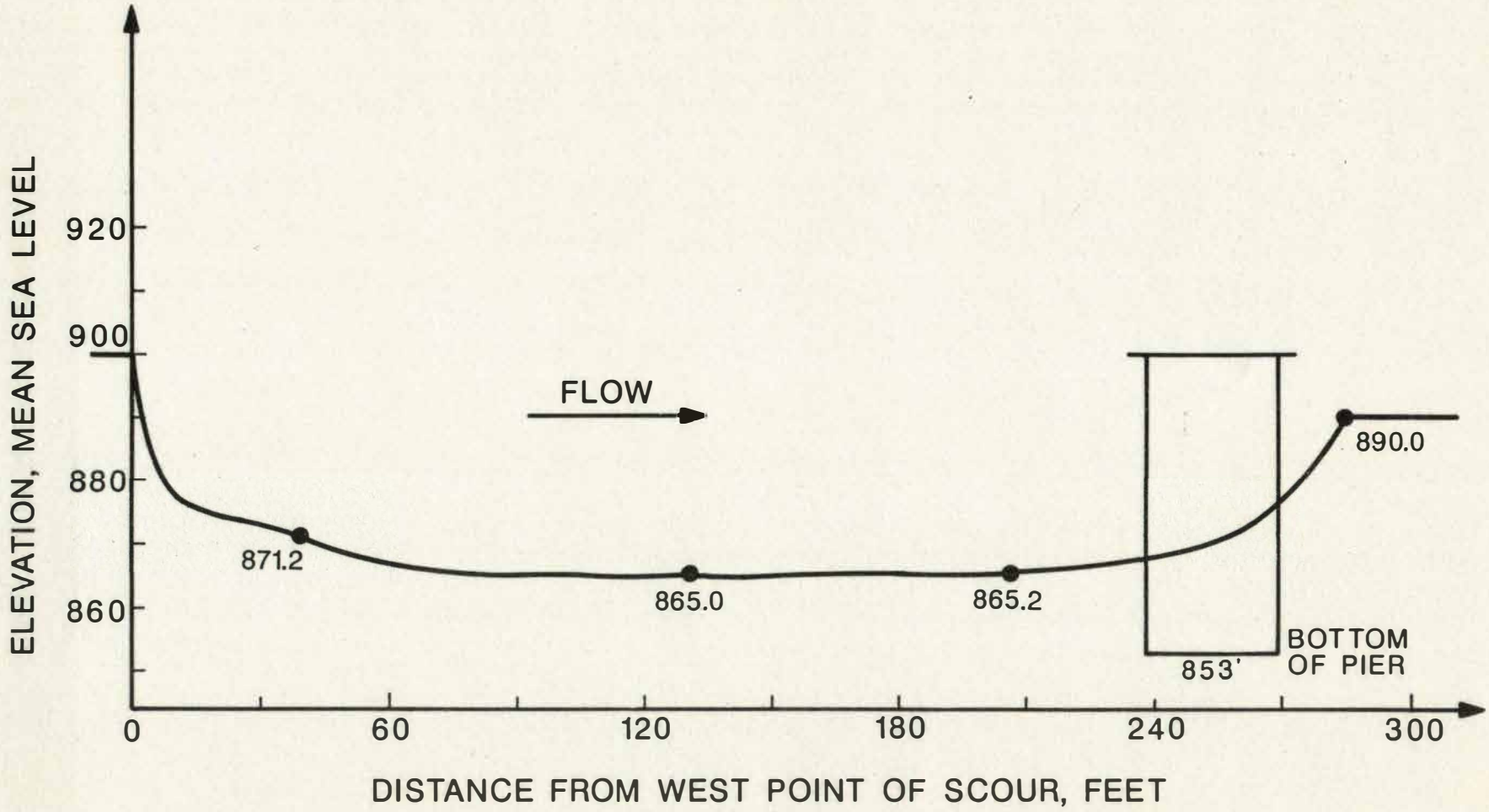

Figure 3. Profile of Scour Hole Upstream of Structure P.

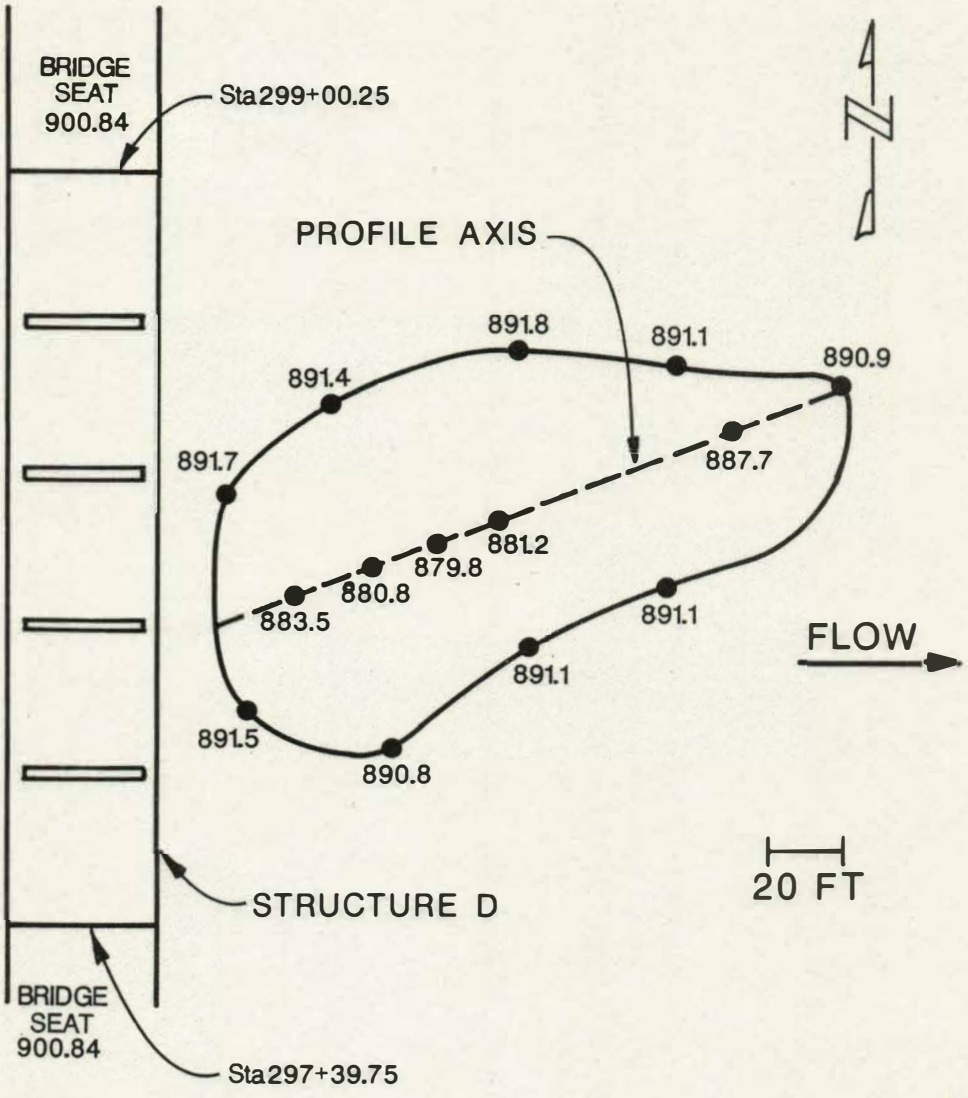

Figure 4. Location of Scour Hole Downstream of Structure O.

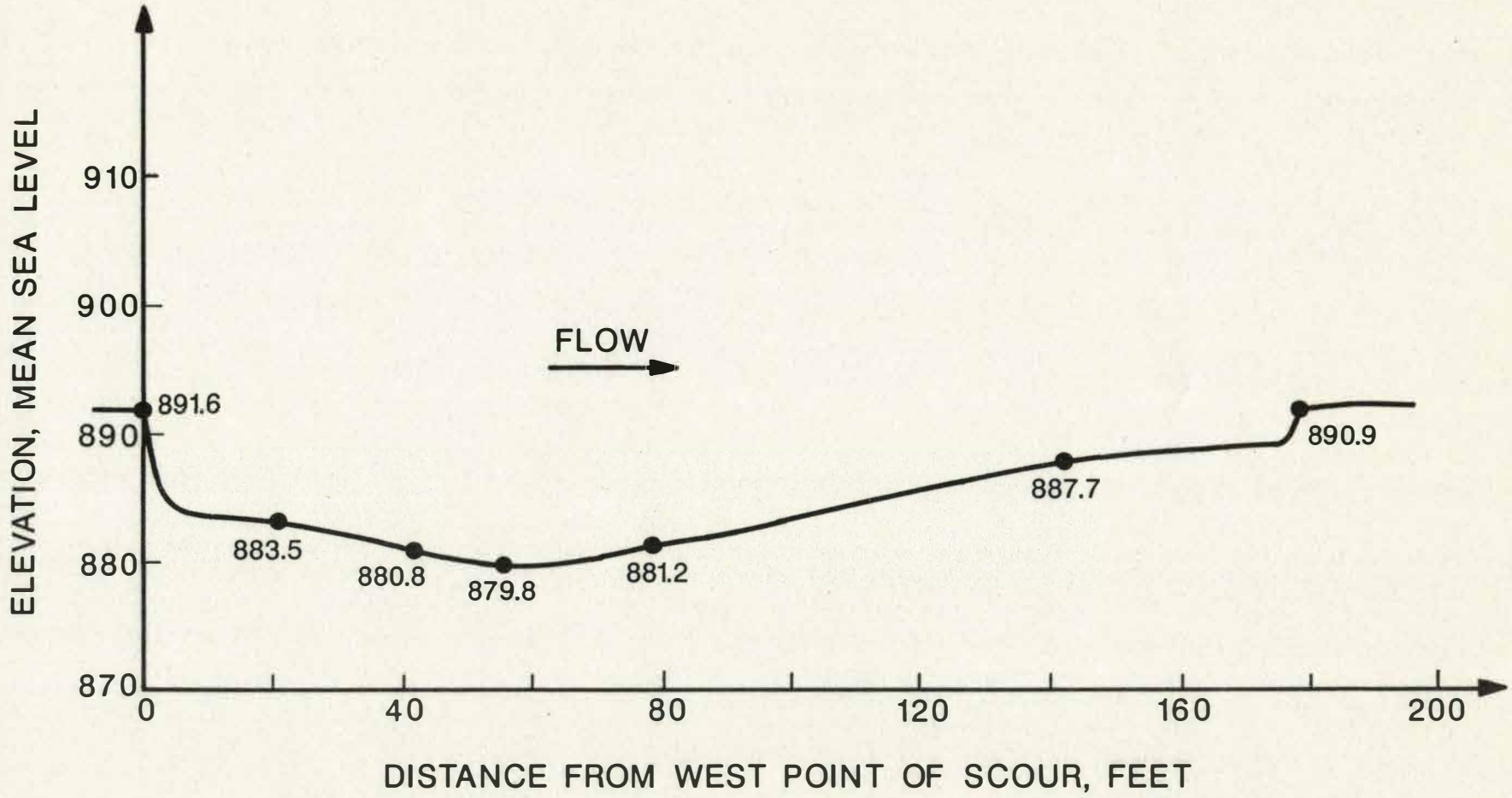

Figure 5. Profile of Scour Hole Downstream of Structure O.

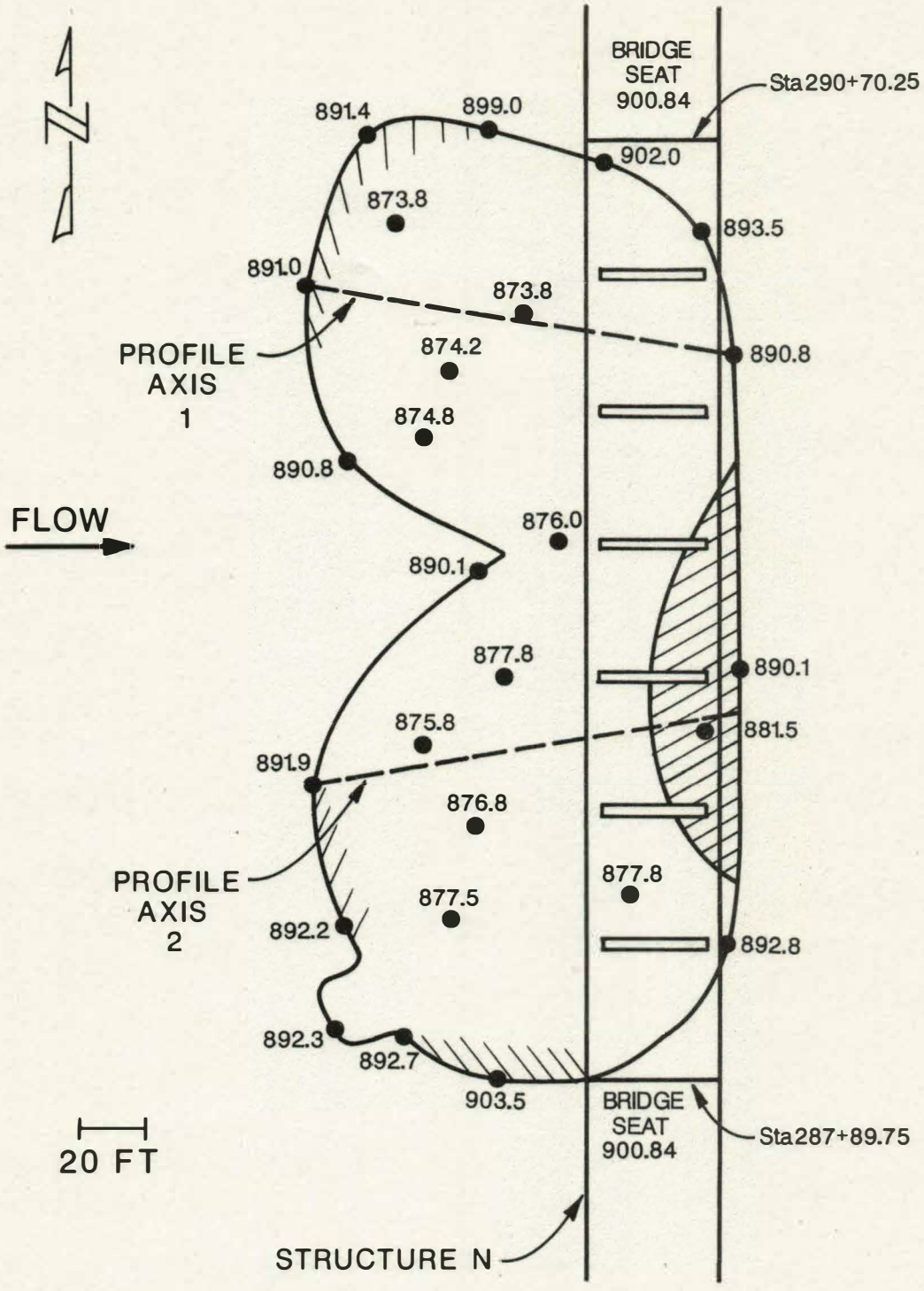

Figure 6. Location of Scour Hole Upstream of Structure N.

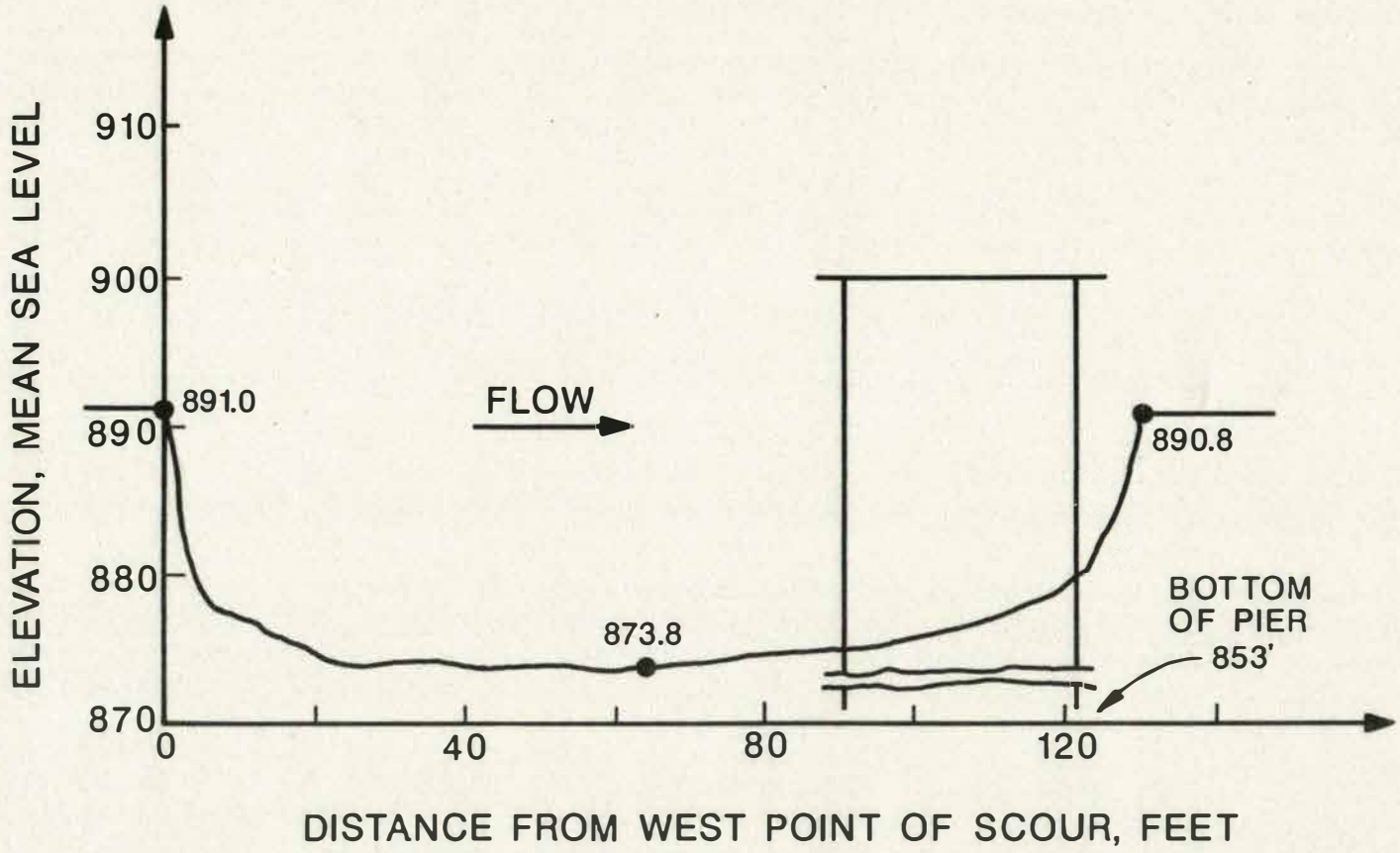

Figure 7a. Profile of North Scour Hole Upstream of Structure N.

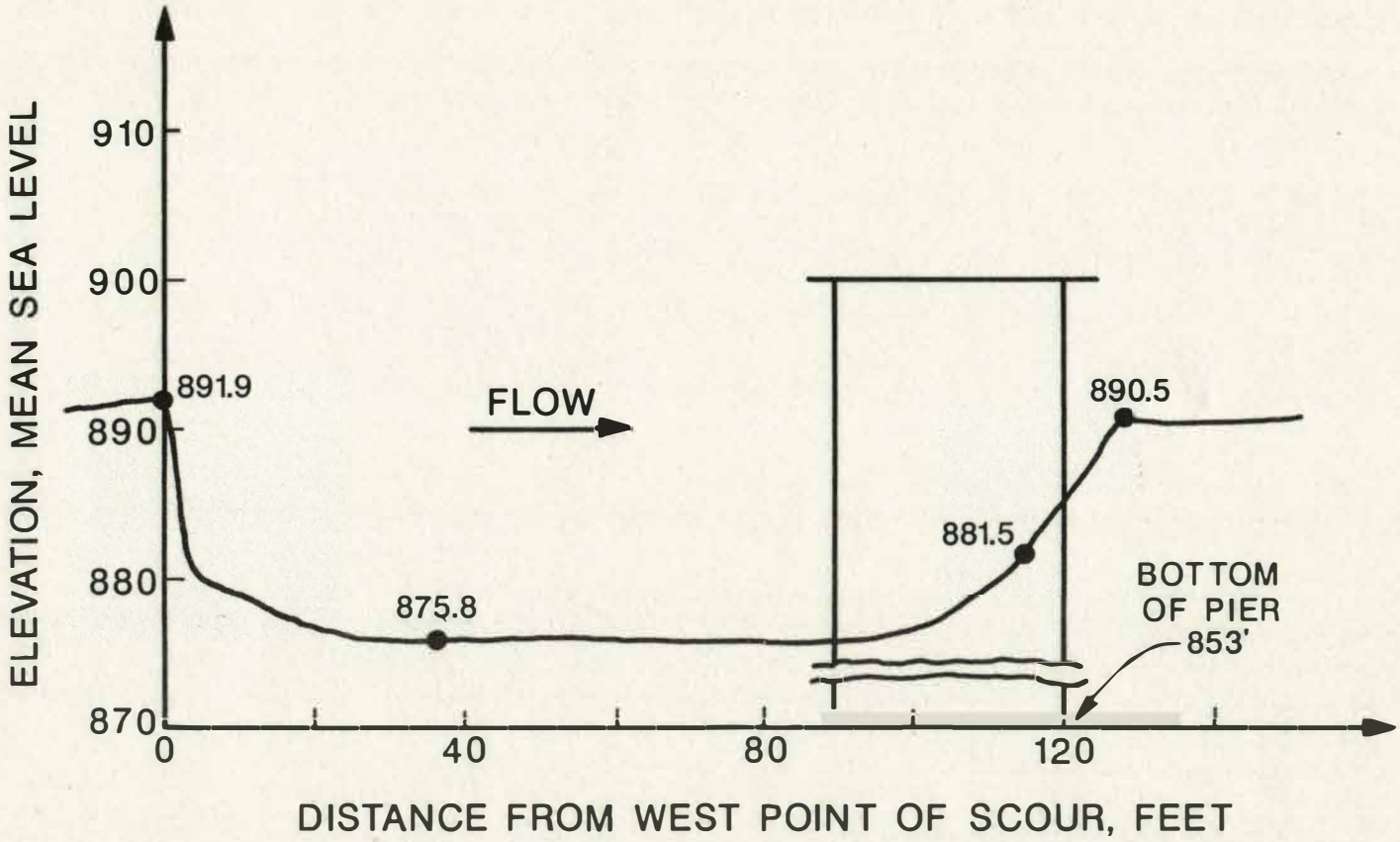

Figure 7b. Profile of South Scour Hole Upstream of Structure N.

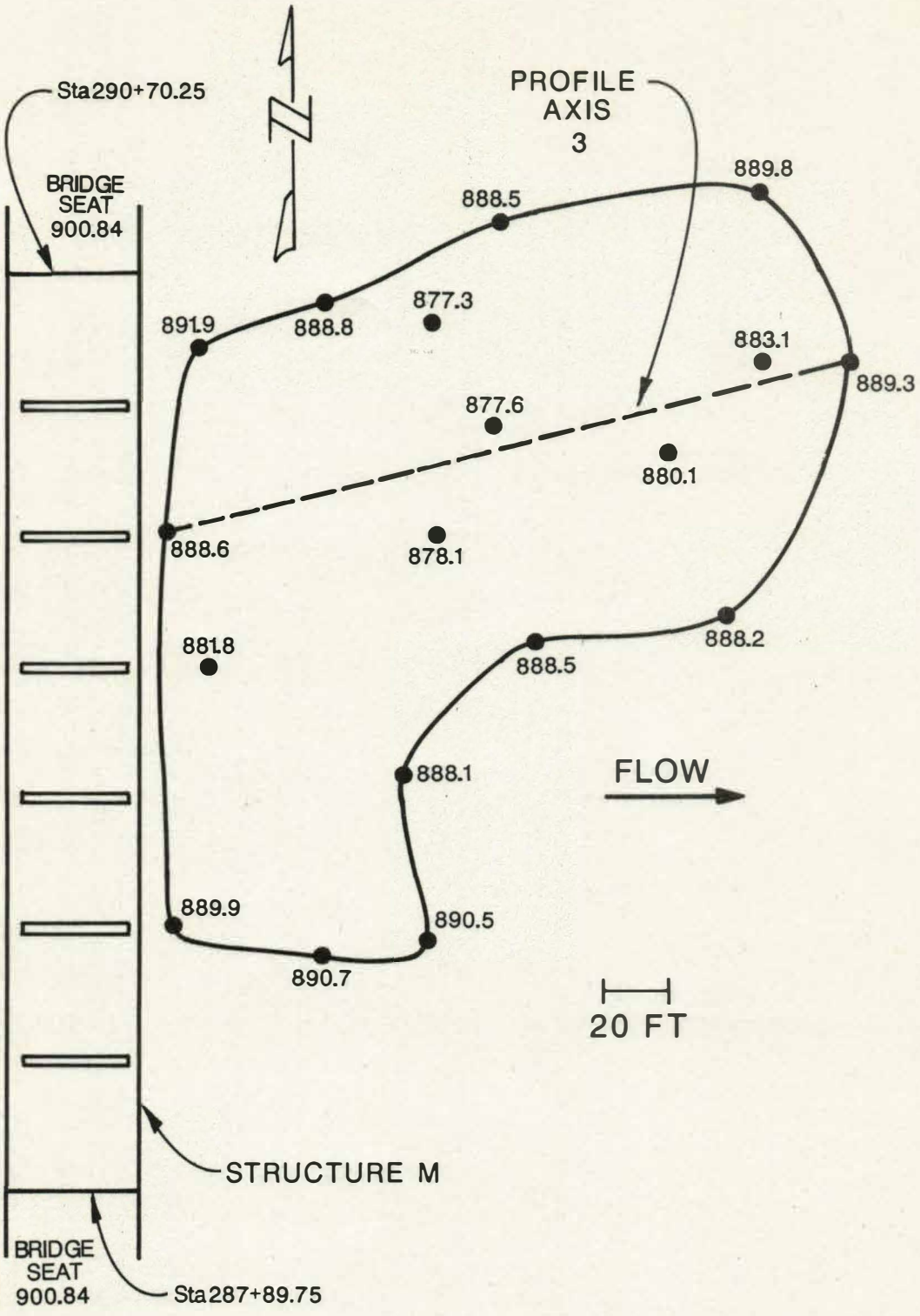

Figure 8. Location of Scour Hole Downstream of Structure M.

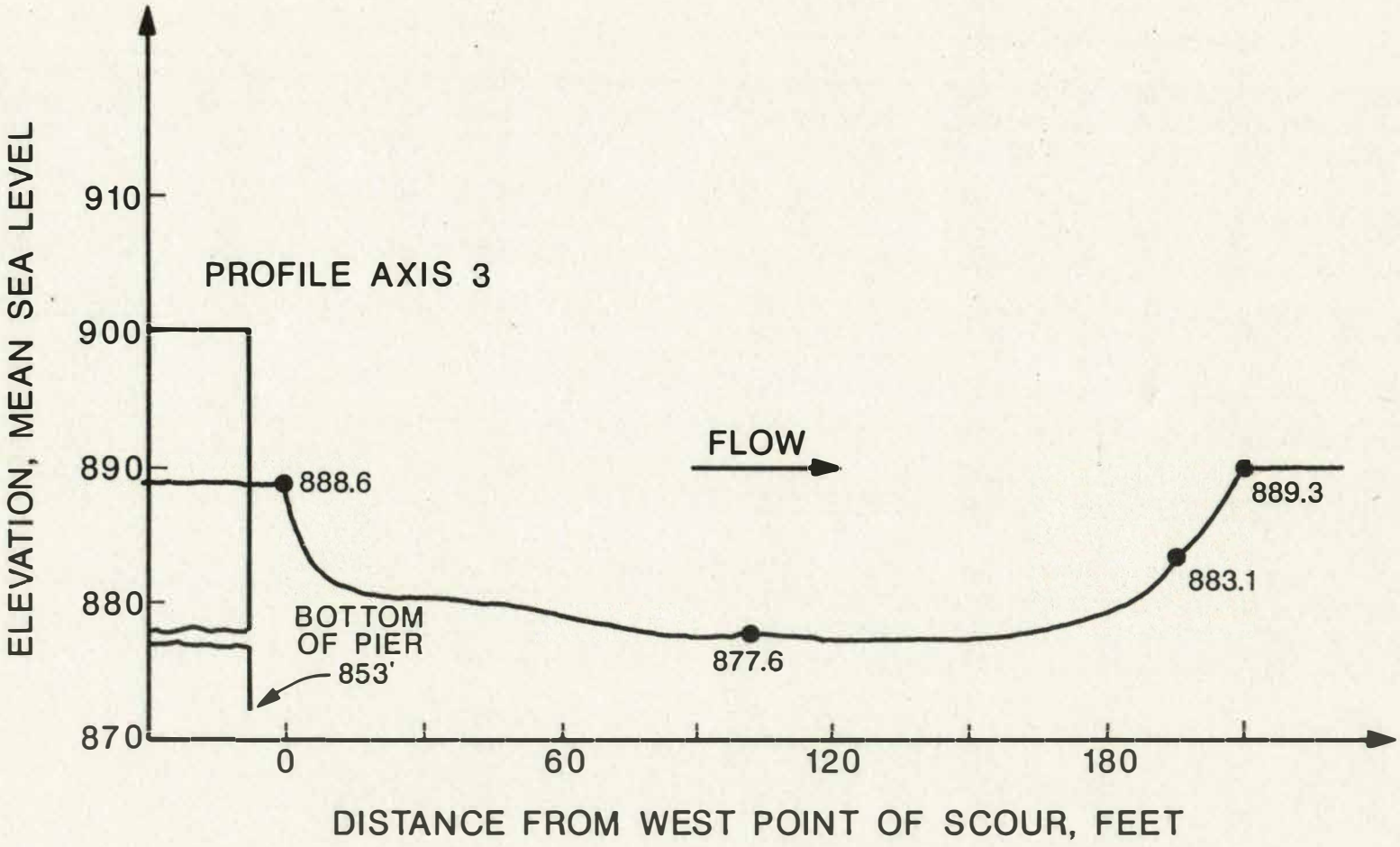

Figure 9. Profile of Scour Hole Downstream of Structure M.

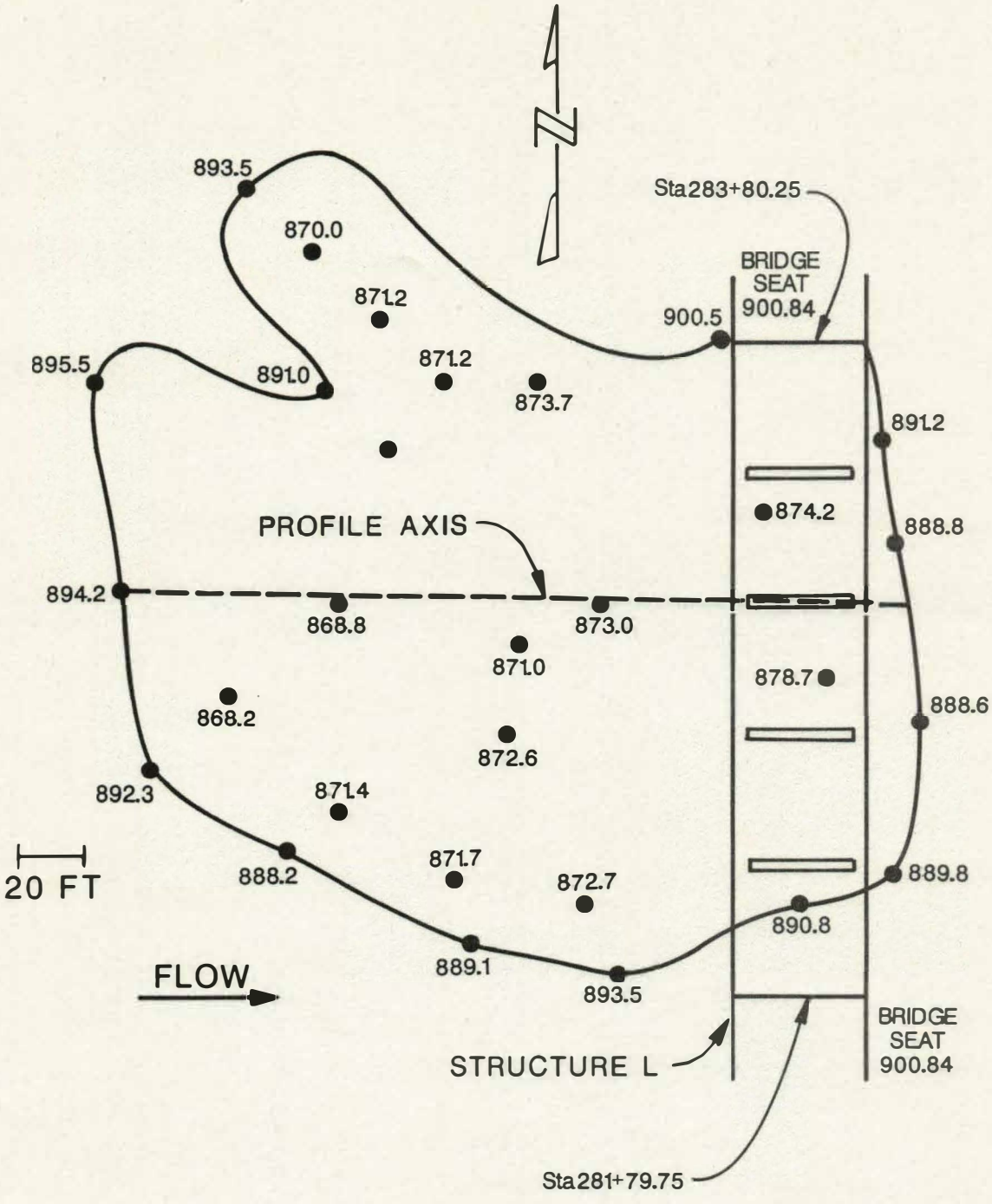

Figure 10. Location of Scour Hole Upstream of Structure L.

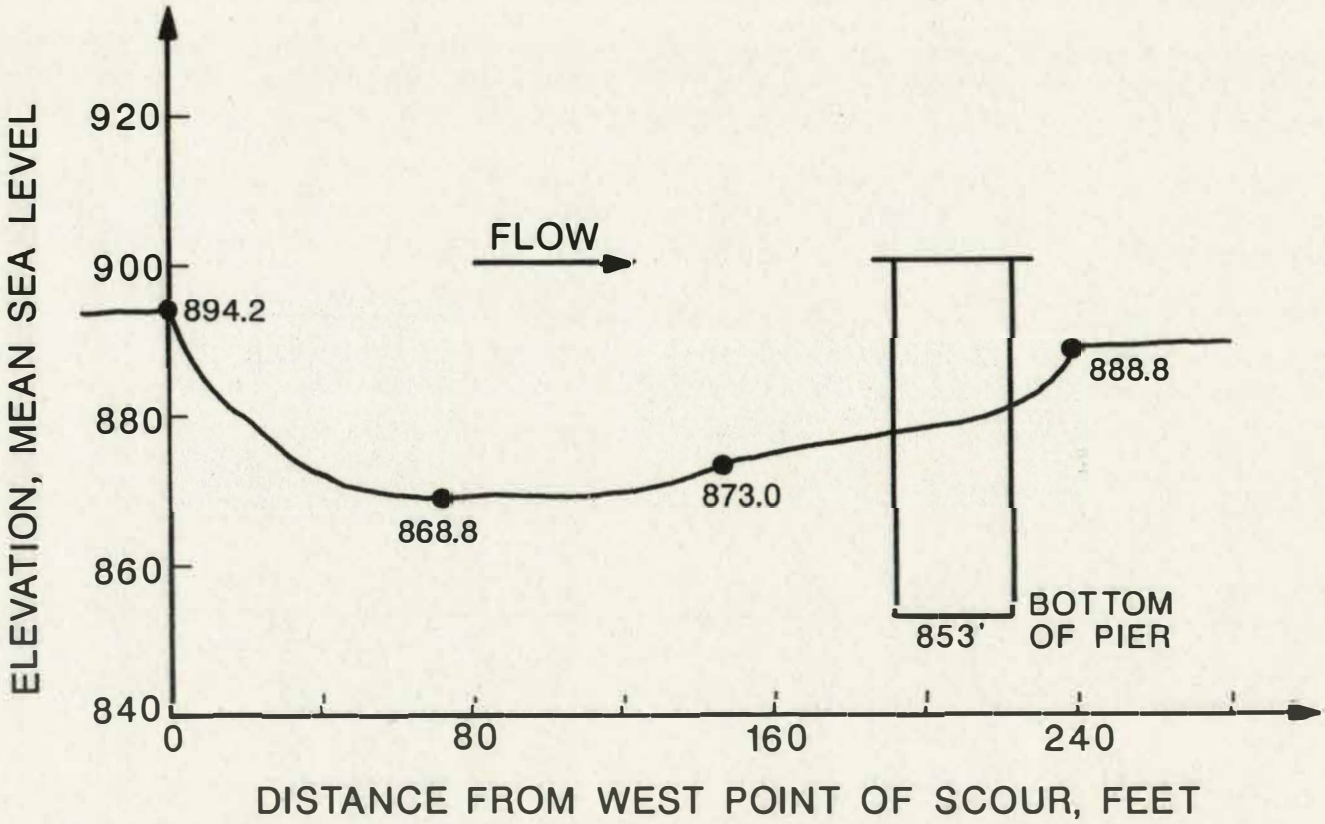

Figure 11. Profile of Scour Hole Upstream of Structure L.

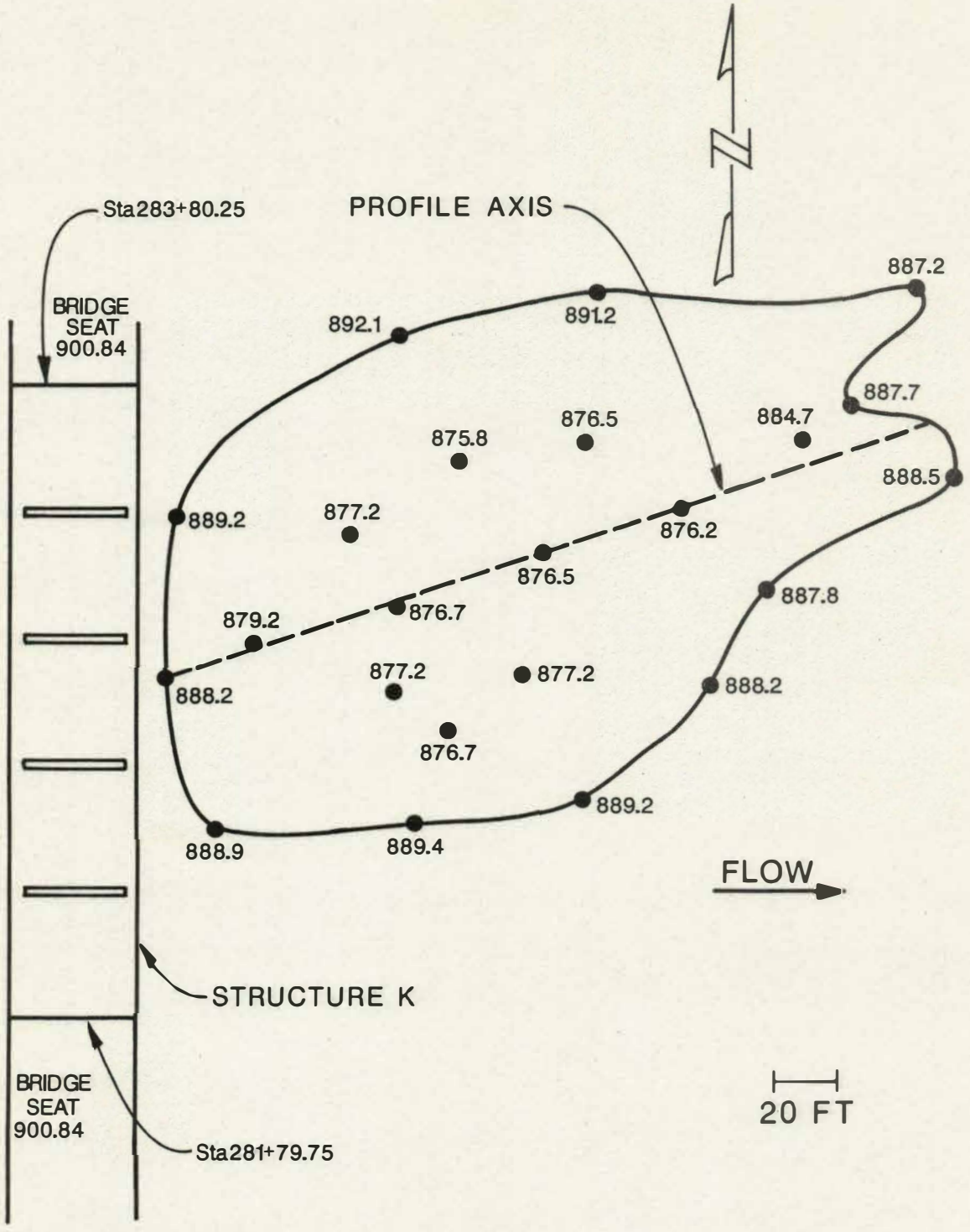

Figure 12. Location of Scour Hole Downstream of Structure K.

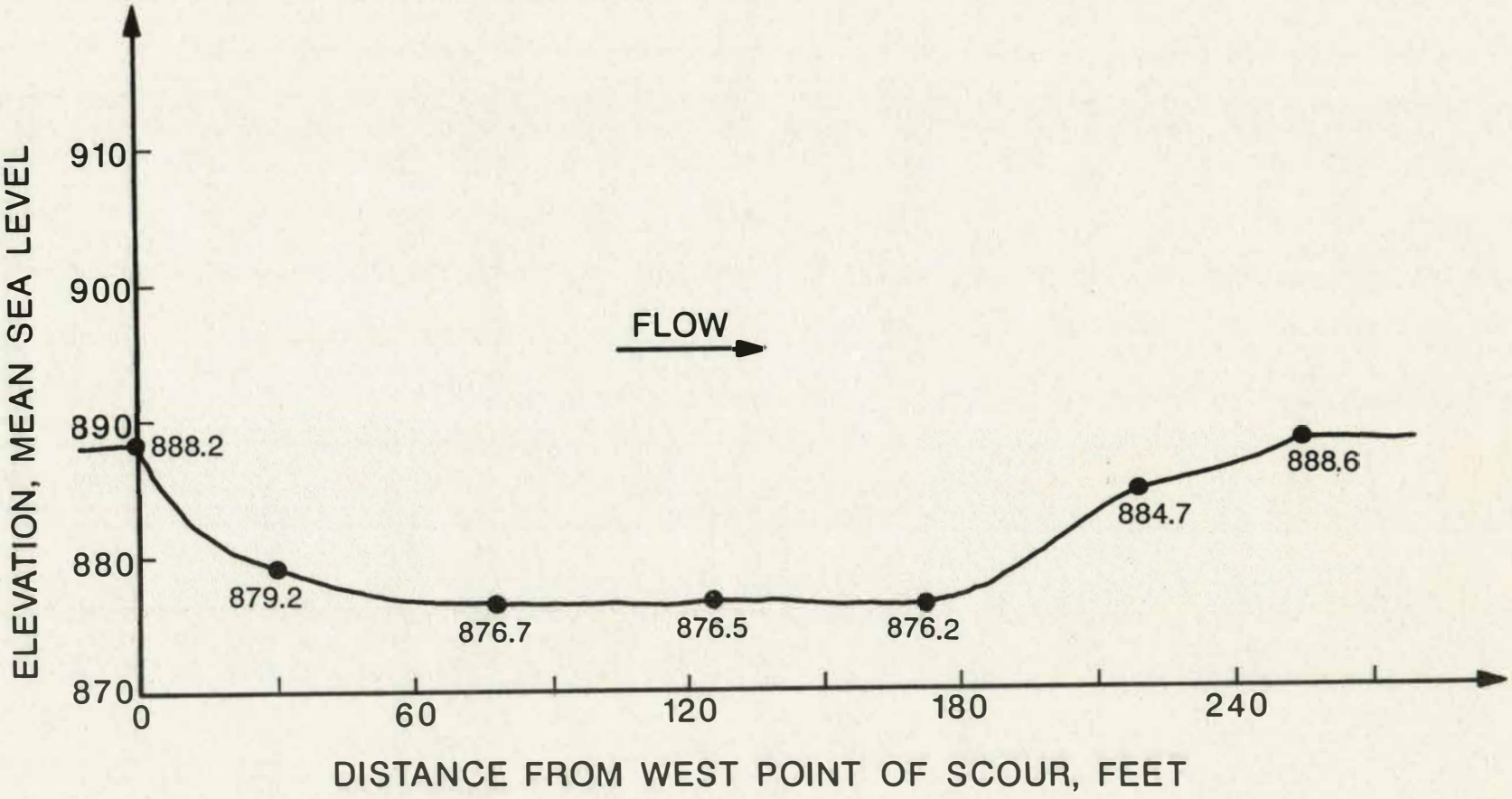

Figure 13. Profile of Scour Hole Downstream of Structure K.

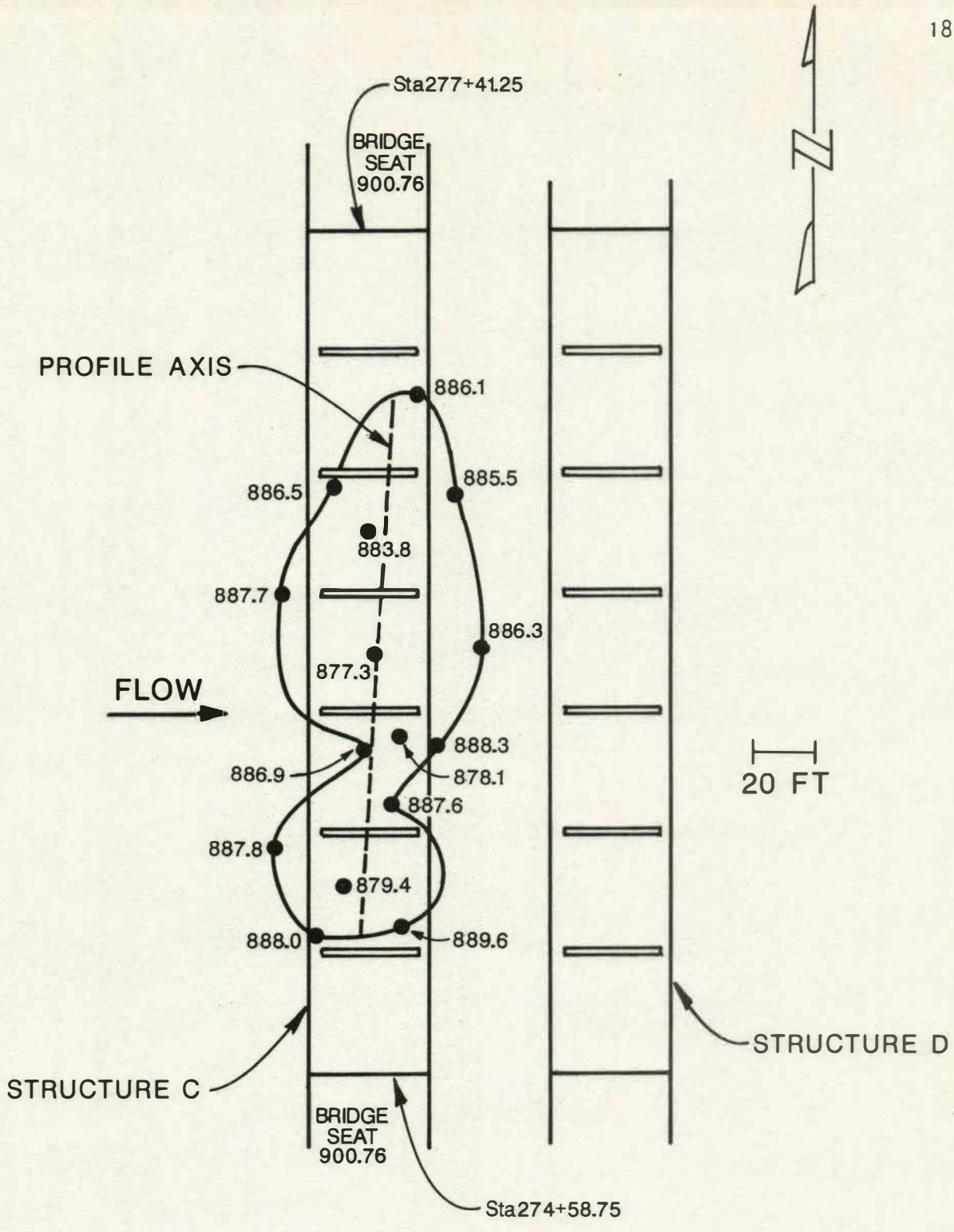

Figure 14. Location of Scour Hole Upstream of Structure C.

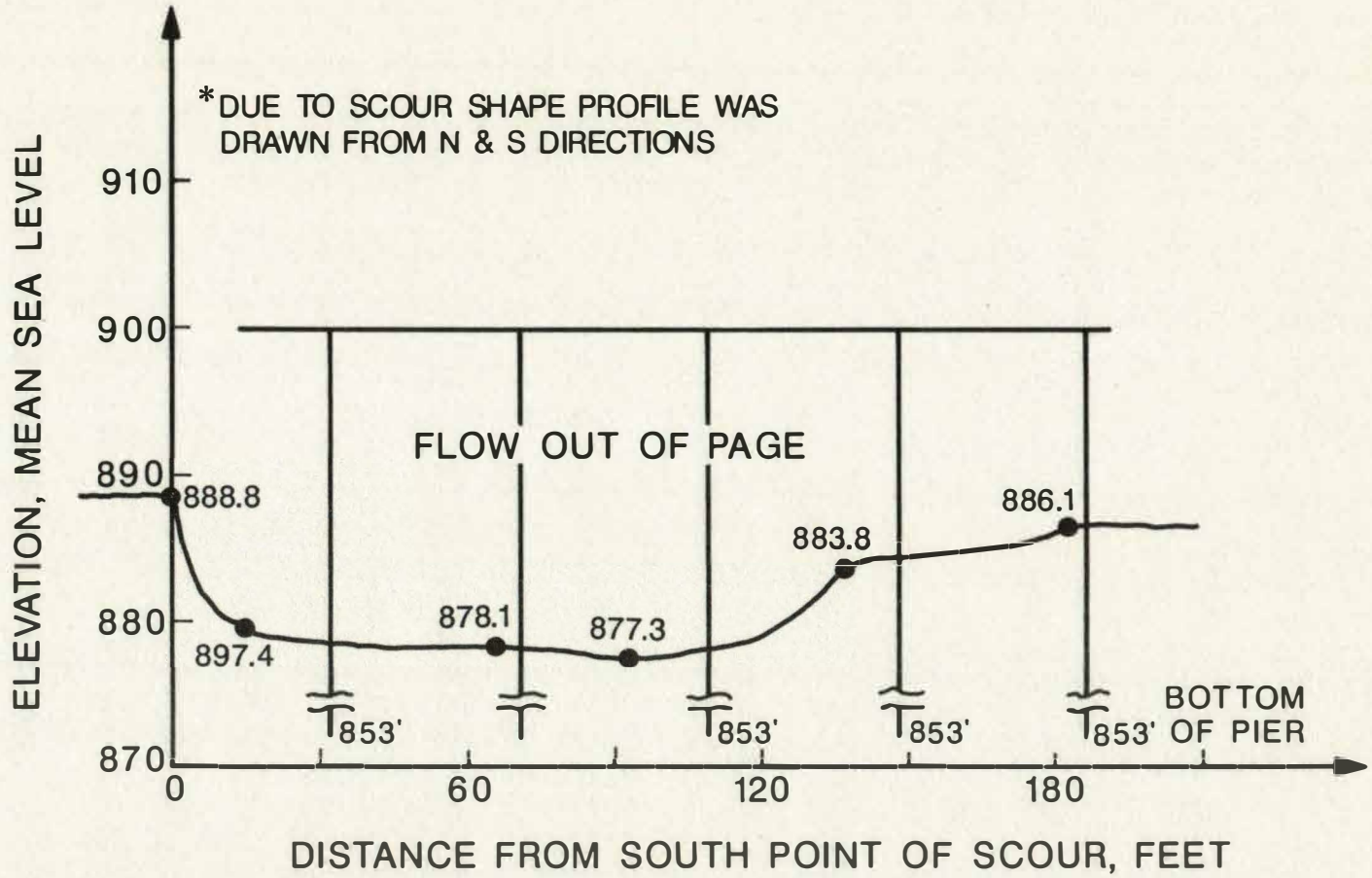

Figure 15. Profile of Scour Hole at Structure C.

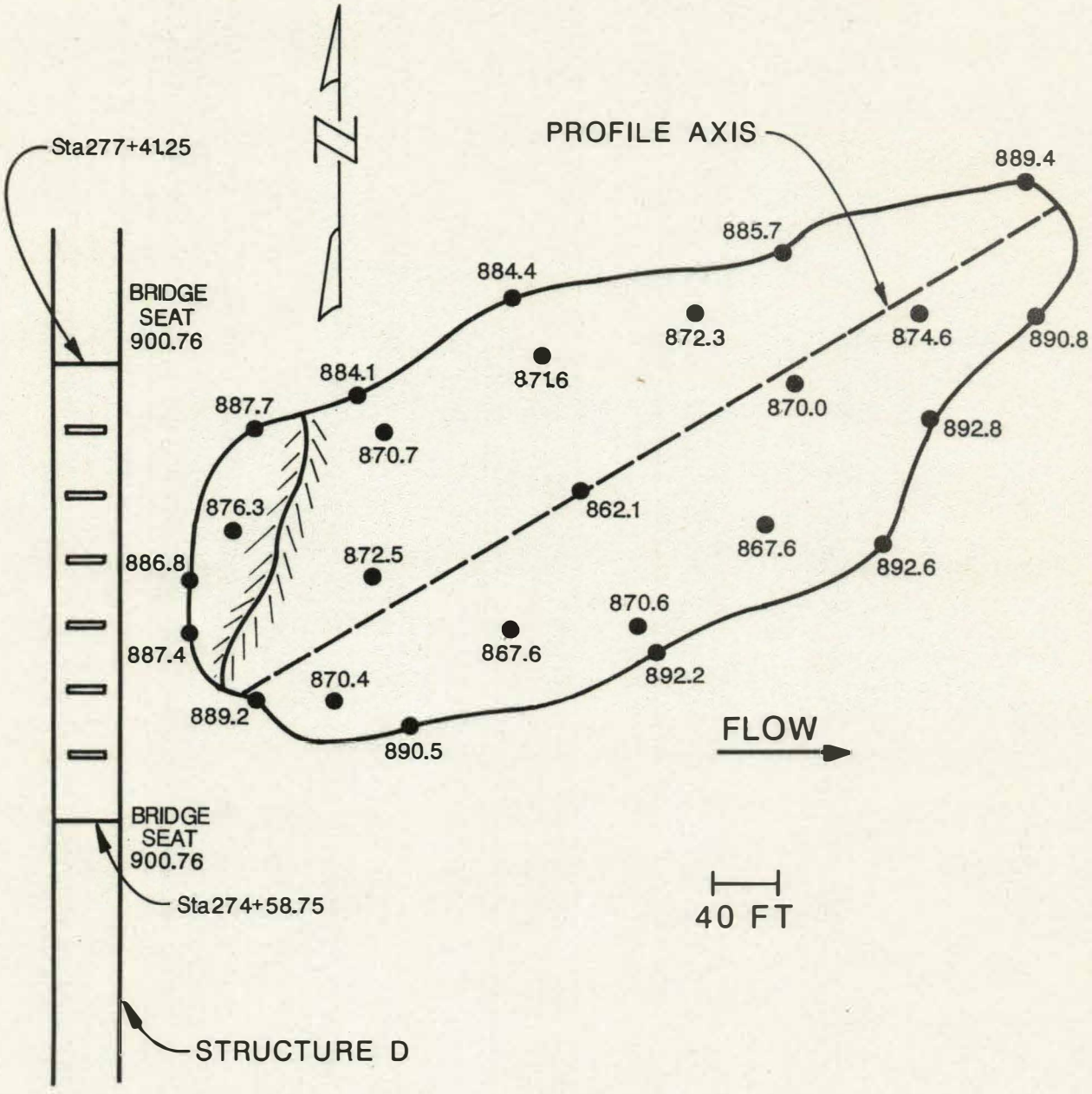

Figure 16. Location of Scour Hole Downstream of Structure D.

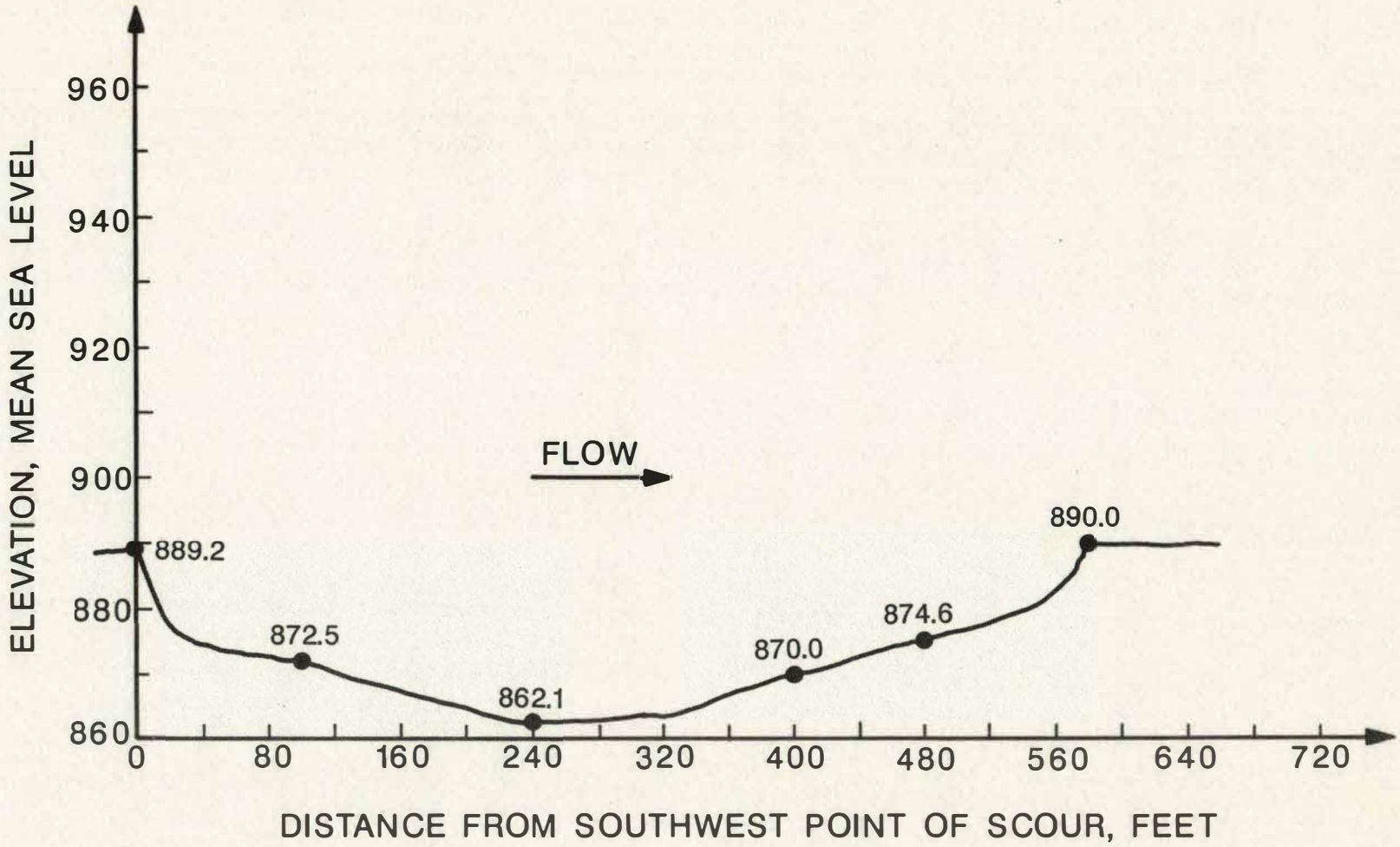

Figure 17. Profile of Scour Hole Downstream of Structure D.