

UFL/COEL-77/001

DETERMINATION OF DIRECTION OF LITTORAL TRANSPORT
ALONG THE NORTH SHORE OF SANTA ROSA ISLAND,
FLORIDA

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Sponsor:
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Mobile District, Corps of Engineers
Mobile, Alabama

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I. INTRODUCTION

The study described in this report was authorized by a contract dated October 19, 1976 between Department of the Army, Mobile District, Corps of Engineers, Mobile, Alabama and the Engineering and Industrial Experiment Station, University of Florida. The purpose of this study was to determine the actual direction of littoral transport along the north shore of Santa Rosa Island in the vicinity of Pensacola Beach, Florida. To accomplish this objective the sand tracer method was used for the study. Visual observations and instrument recordings of the environment factors were also made during the tracing operations. The investigation covered a time span from September 14, 1976 to March 12, 1977.

II. GENERAL DESCRIPTION OF THE PROJECT AREA

Santa Rosa Island is a barrier island facing the Gulf of Mexico that lies between Pensacola Beach and Fort Walton Beach. Santa Rosa Sound, situated on the north of the island, is an integral part of the intracoastal waterway between Panama City and Mobile Bay. Frequent barge traffic as well as recreational boating was observed during the sand tracing operations. The area of immediate interest to this investigation was the north shore of Santa Rosa Island near Pensacola Beach. It stretches from Avenida 10 to Santa Rosa Villa, a highly developed recreational community.

III. FIELD MEASUREMENTS AND PROCEDURES

1. Test site and operation period:

The sand tracing operation and environmental factor observations were carried out in November 1976 and again in February 1977. The location of the test sites are shown in figure 1. The categories and operating duration are shown in the following table.

	sand tracing	environmental factor observations
Site A	13-14 Nov. 1976 15-20 Feb. 1977	13-14 Nov. 1976 15-20 Feb. 1977
Site B	13-14 Nov. 1976	13-14 Nov. 1976 19-20 Feb. 1977
Site C	-----	19-20 Feb. 1977

2. Sampling grid and tracer sands preparation:

A. The November 1976 operation: The grid system established at site A is shown in figure 2. The initial spacing was 25 feet apart, but was expanded to 50 feet and finally 100 feet between sampling stations. A similar grid was established at site B as shown in figure 3.

B. The February 1977 operation: The initial spacing of 25 feet was too close. Therefore, 50 feet spacing between the sampling stations are adopted for site A. The grid system is shown in figure 4.

C. Tracer sands: Sands were collected from site A and B shortly before the tracing operation. These sands were coated with fluorescent dye in the Coastal and Oceanographic Engineering Laboratory (COEL), University of Florida. These colored sands were then injected in the predetermined coordinate system as shown in figures 2 to 4.

3. Injection of tracer and recovery of samples

A. November 1976 operation: Approximately 100 pounds of tracer sand was dumped instantaneously into the water at site A and B. The location of the injections are shown in figures 2 and 3. A dredge-type sand sampler was used for collecting the samples and the sampling stations were according to the predetermined coordinate system. The sampling frequency was based on the tidal cycles (approximately 24 hours). In this way, the field crew could work alternatively between sites A and B. Each sample was put into a sampling

cloth bag (2" x 4") with station number marked on the label, and then, sorted into sample sets for shipping to Gainesville for tracer count in COEL.

B. February 1977 operation: Sands were collected at two locations of site A for making tracers. The sands collected at the high-water mark were dyed blue and green. The sands collected 100 feet bayward from the high water mark were dyed yellow and red. These tracer sands were put back in four locations. Their relative positions are shown in figure 4. The purpose of this arrangement was to see if grain size and injection position influenced the sand tracing technique. However, only blue tracers were counted for the time being. The blue tracer alone was considered adequate for the purpose of determining the littoral drifting direction.

The sampling frequency was chosen to correspond to the high and low water level. The sampling procedure was similar to that for November 1976 operation.

4. Measurement of physical parameters:

A. Visual observations: Wave parameters such as height, length, direction, and period, were observed during sampling operations. Littoral drift currents were obtained by following a dye pack. These data are presented in the results and conclusion section of this report.

B. Recording instruments: Two tide recorders were installed. One was located at the Pensacola Beach Causeway Bridge. The second tide gage and a wind anemometer were located at the private pier of Dr. C. Gifford. The data are presented in the results and conclusion section of this report.

IV. RESULTS AND CONCLUSIONS

1. Results

The results are organized according to date and sampling sites in the following tables:

A. November 1976 operation:

Date	Equal Concentration Contours		Environmental Factors	
	Figures	Site	Figures	Site
November 13, 1976	5a, 7a	A, B	6a, 8a	A, B
November 14, 1976	5b, 7b	A, B	6b, 8b	A, B

Wind records for the tracing operating period are given in figures 9a and 9b. Tide records are presented in figures 10a through 10f.

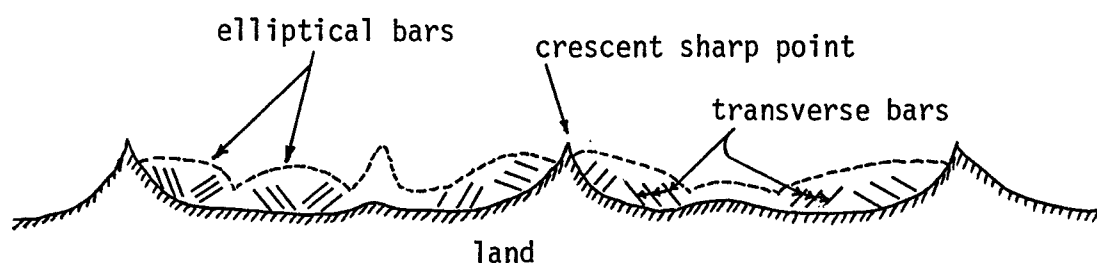
B. February 1977 operation:

Date	Equal Concentration Contours		Environmental Factors	
	Figures	Site	Figures	Site
February 15, 1977	11a	A	12a	A
February 16, 1977	11b	A	12b	A
February 17, 1977	11c	A	12c	A
February 18, 1977	11d	A	12d	A
February 19, 1977	11e	A	12e, 13a, 14a	A, B, C
February 20, 1977	11f	A	12f, 13b, 14b	A, B, C

Wind records for the period from February 15 to 20, 1977 are given in figures 15a through 15e. Tide records are presented in figures 16a-16d; and 17a-17e.

2. Discussion and conclusion:

- A. The observed wave parameters in Santa Rosa Sound are directly related to the wind conditions.
- B. There is an observable correspondence between the littoral transport and littoral drifting currents.
- C. Figures 5a and 5b have shown that the longshore movement was stronger than the on/offshore components.
- D. Figures 7a and 7b have shown that the tracer sands moved around the sharp land feature first and then towards the beach.
- E. Many distinctive land features have been observed in the project area, such as crescent sharp points (e.g. site B), and the semi-elliptical submerged sand bar which is superimposed with transverse bars in the NE and NW directions. It seems that all these have a strong indication of edge wave effects.



- F. Considerable bottom changes have taken place between November 1976 and February 1977. The shoals in figure 6b have grown both in size and in height, as shown in figure 4b. A transverse bar situated between 200 to 300 feet East (figure 4a) in the NE direction has grown out of the water surface. Sandpipers standing on the dry ridge of this transverse bar can be seen in figure 4c.

- G. Different patterns of tracer contour maps between November 1976 and February 1977 are clearly observable. Contour map figures 5 and 7 are characterized by one peak region while figures 11a to 11f have many peaks and valleys.
- H. Peaks of the contour map, figures 11a to 11f, correspond to the shoals in figure 4b and transverse bar in figure 4c very well. It may be explained that the tracers left the point of injection and moved along various route until they stopped at the shoals and transverse bar.
- I. There were relatively high concentration contours along the line which was parallel to the shore and 300 feet north. A sudden change in water depth, consequently, a sudden reduction of current velocity bayward along the line was realized. This may explain why the deposition of tracers along this line.
- J. A study of the sequence of figures 11a to 11f may shed light for bar formation in that area.

V. RECOMMENDATIONS

1. It would be desirable to extend the sand tracing study to cover the summer months.
2. Correlation analyses between (1) distinctive land features, (2) sand movements and environmental factors, would be most beneficial prior to any shoreline activities such as a beach nourishment project.
3. The present study provided for the collection of considerable data and the determination of the direction of littoral transport. It is recommended that the study be extended to obtain additional information about sand transport from the data already collected.

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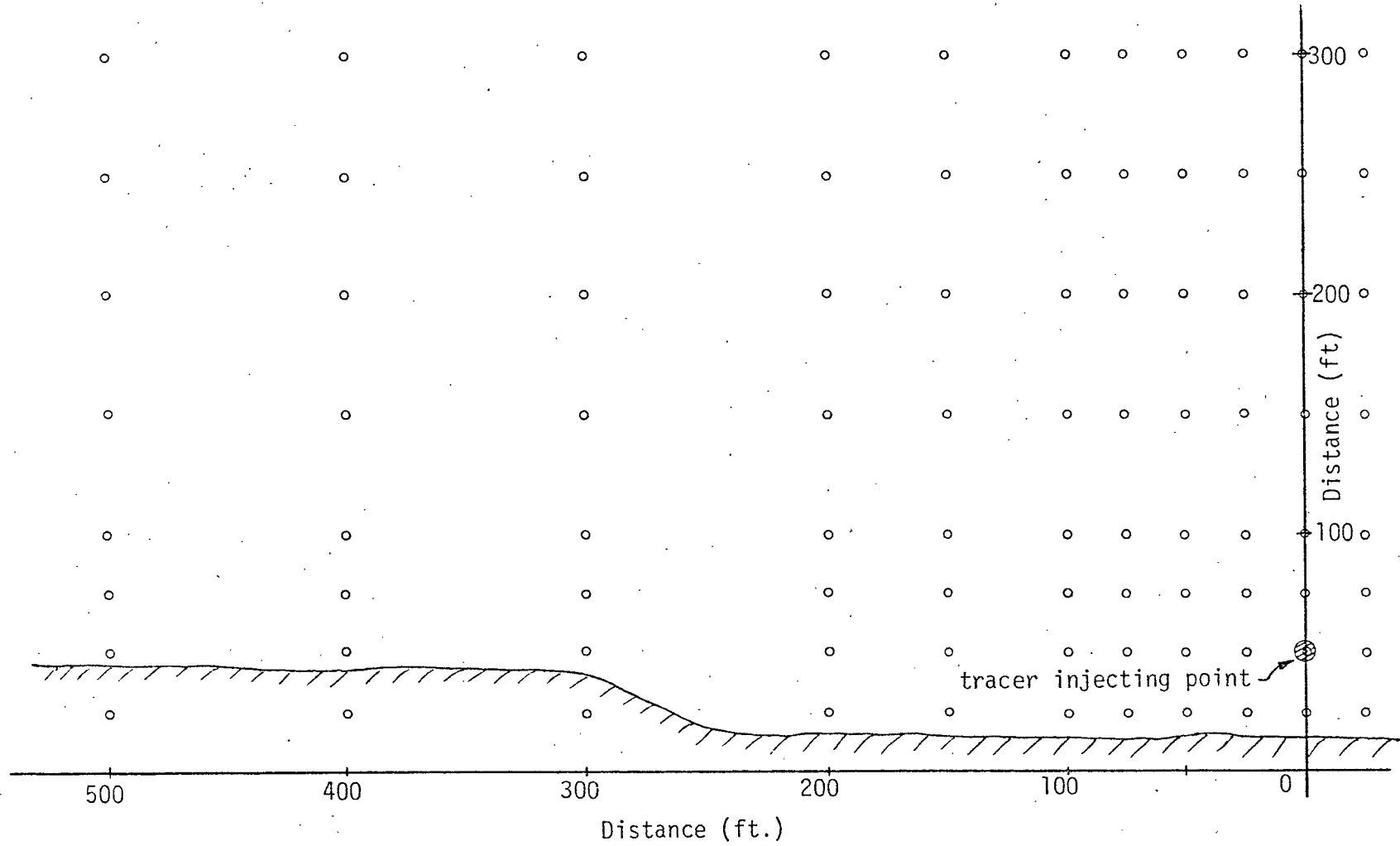


Figure 2. Sampling grid at site A, November operation, 1976

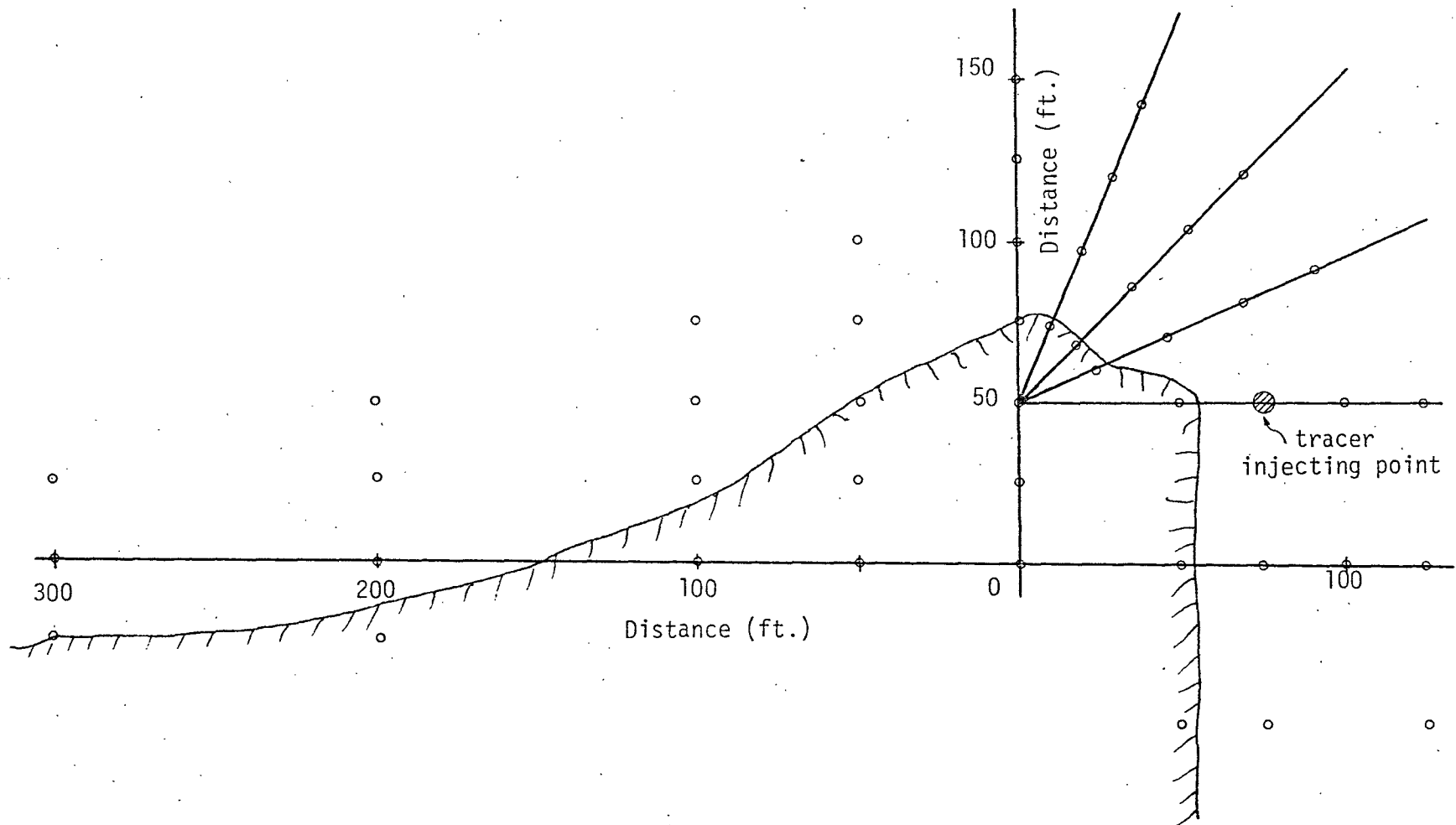


Figure 3. Sampling grid at site B, November operation, 1976

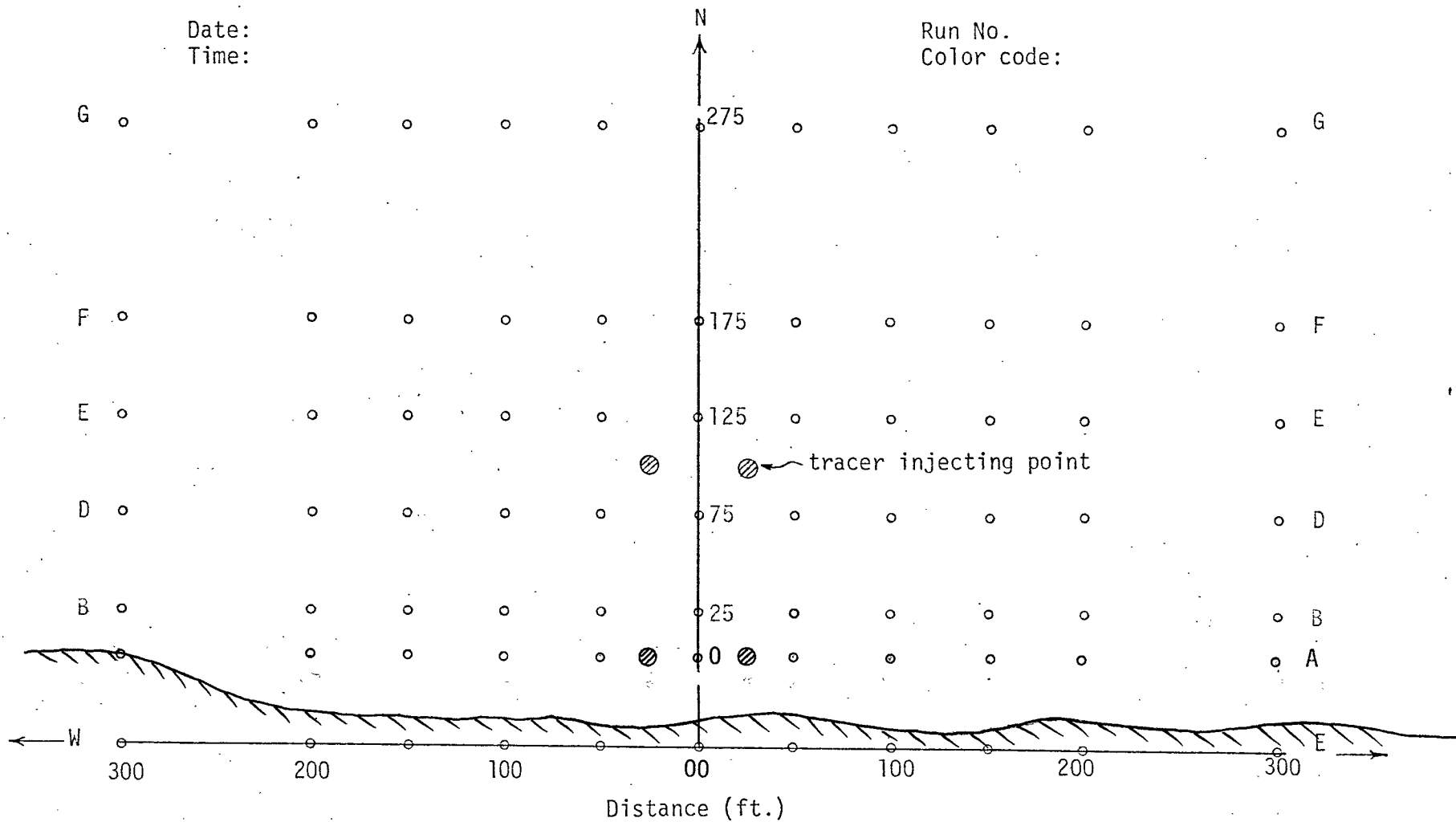


Figure 4a. Sampling grid at site A, February operation, 1977

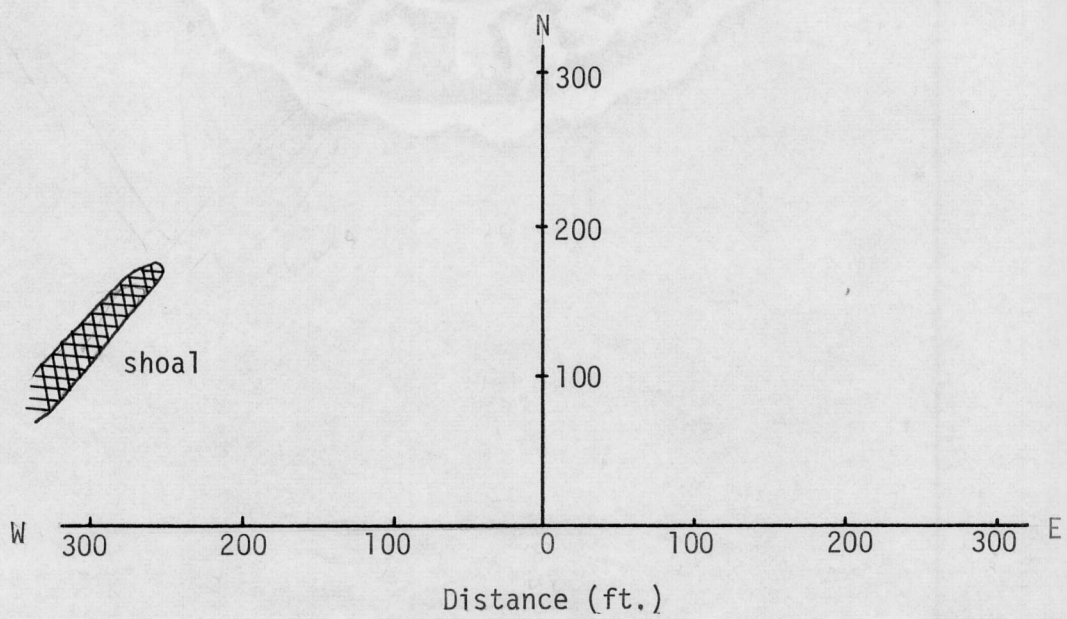


Figure 4b. Shoal location

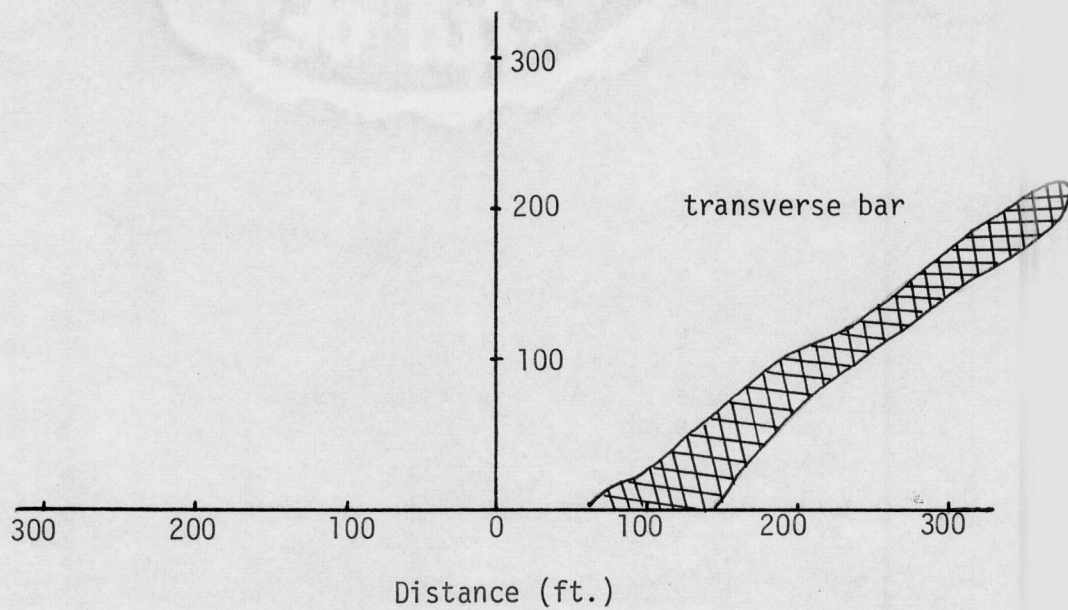


Figure 4c. Transverse bar location

Numbers = tracer sand count per 40 gm sample

⊙ = tracer sand injection point

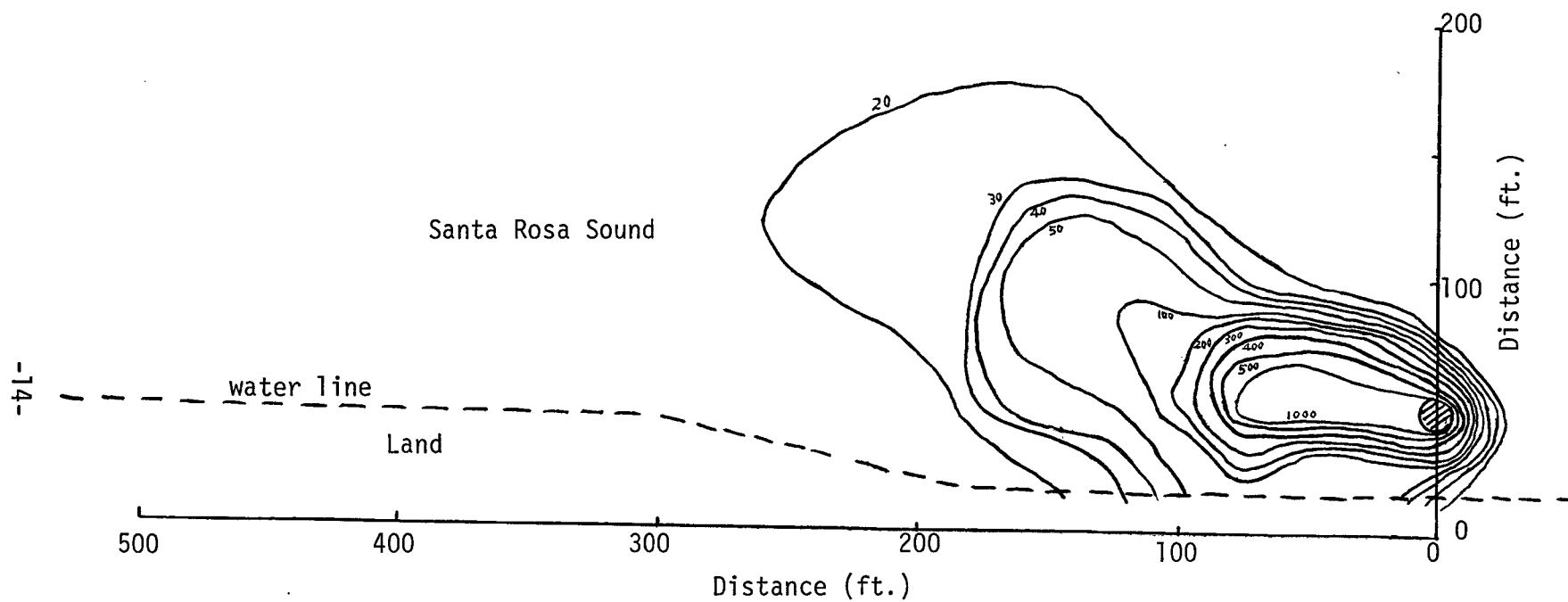


Figure 5a. Equal concentration contours for site A
Date: 11/13/76

Numbers = tracer sand count per 40 gm sample

⊙ = tracer sand injection point

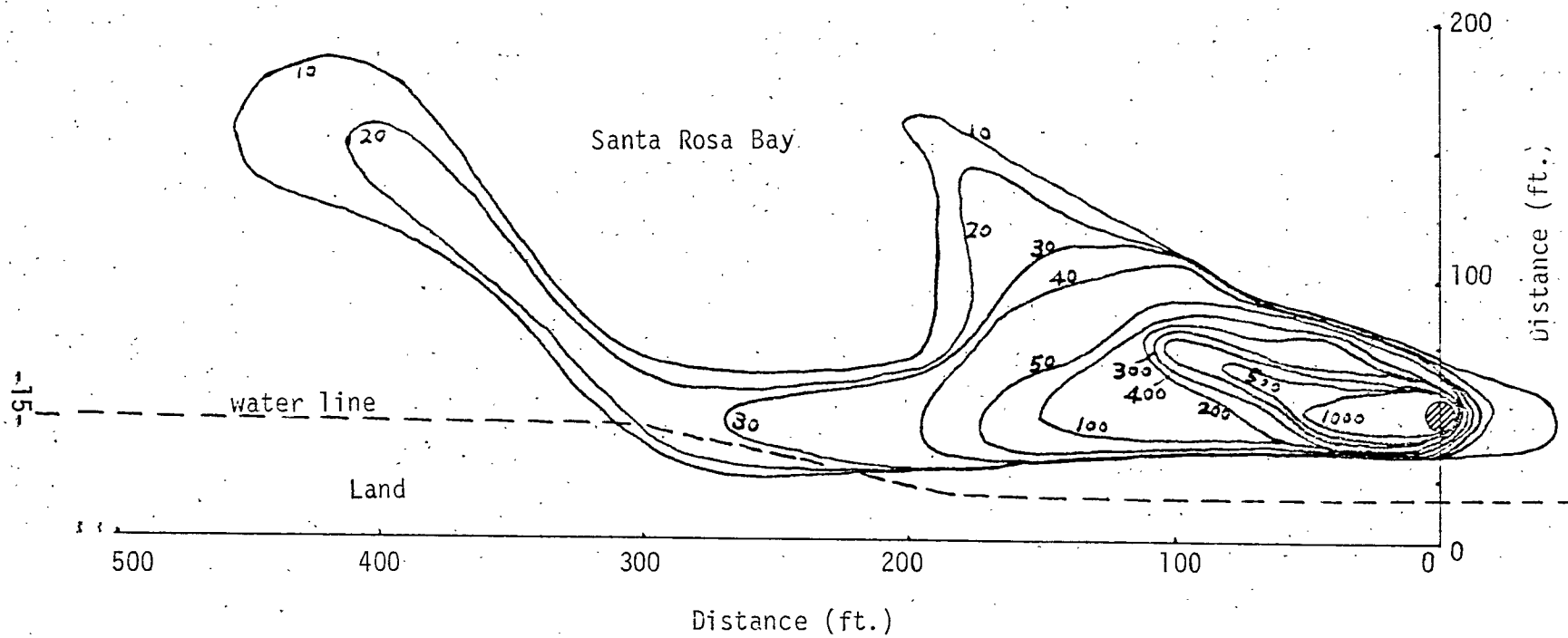


Figure 5b. Equal concentration contours for site A
Date: 11/14/76

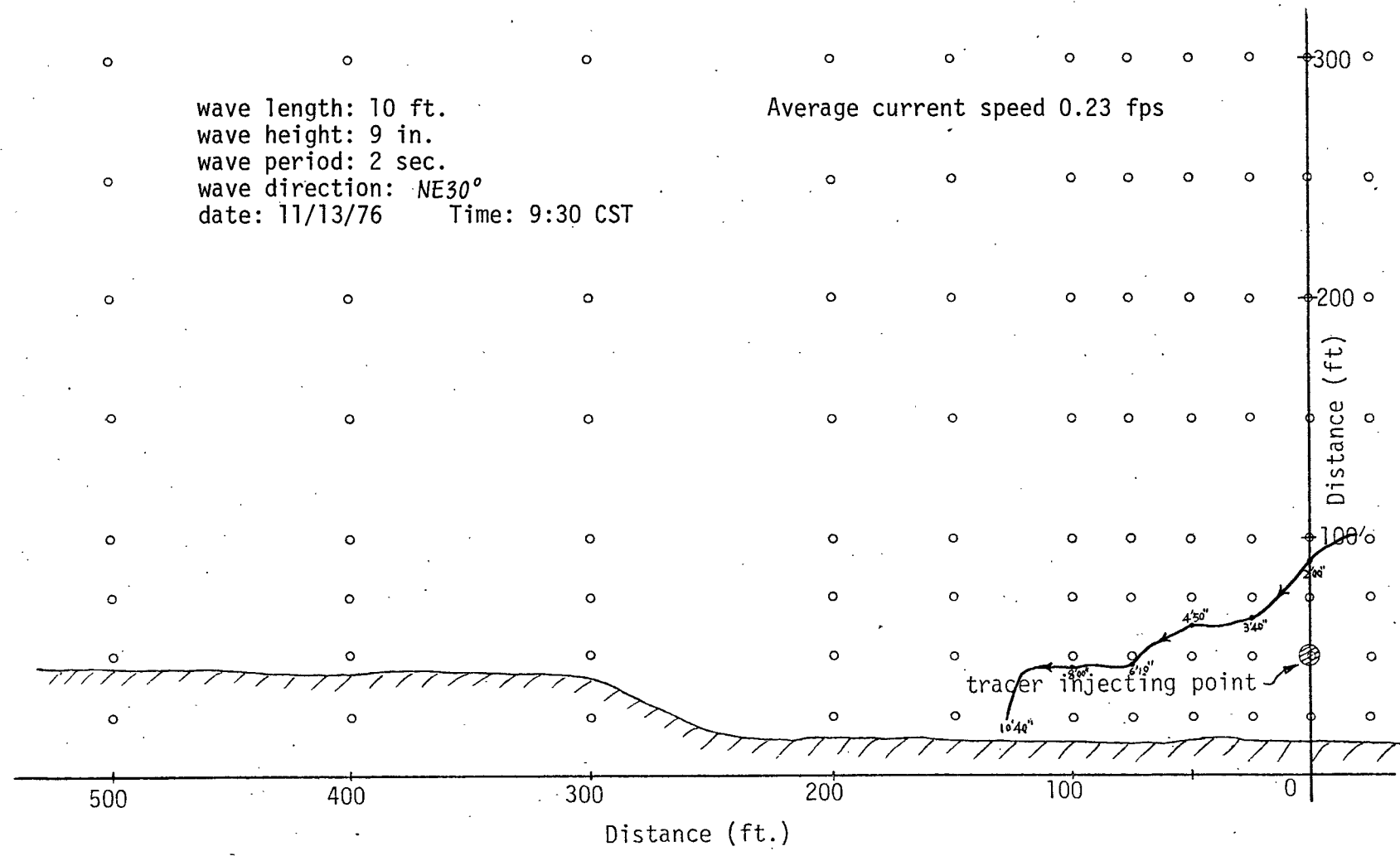


Figure 6a. Observed littoral current and wave parameters at site A

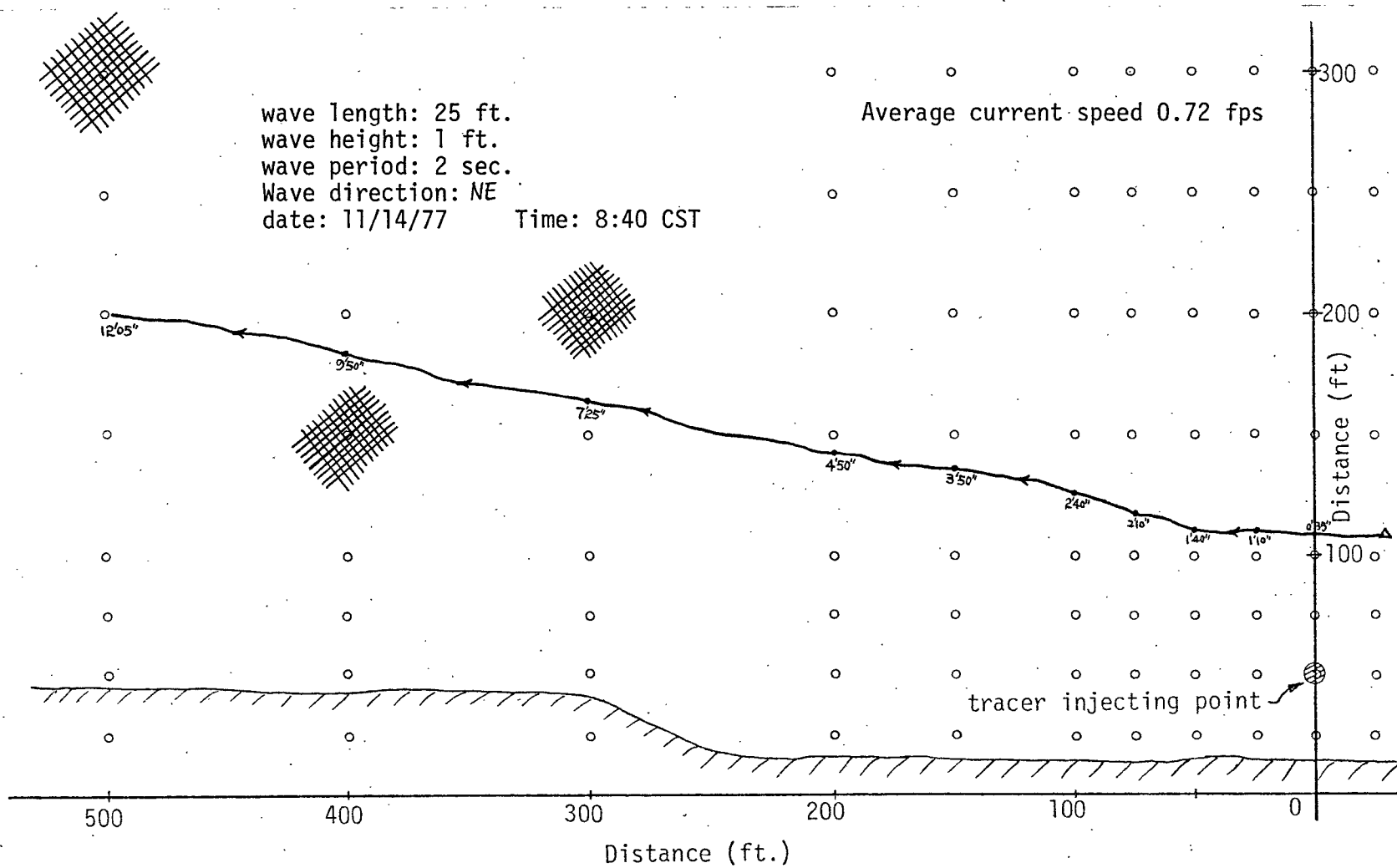


Figure 6b. Observed littoral current and wave parameters at site A

Numbers = tracer sand count per 40 gm sample

● = tracer sand injection point

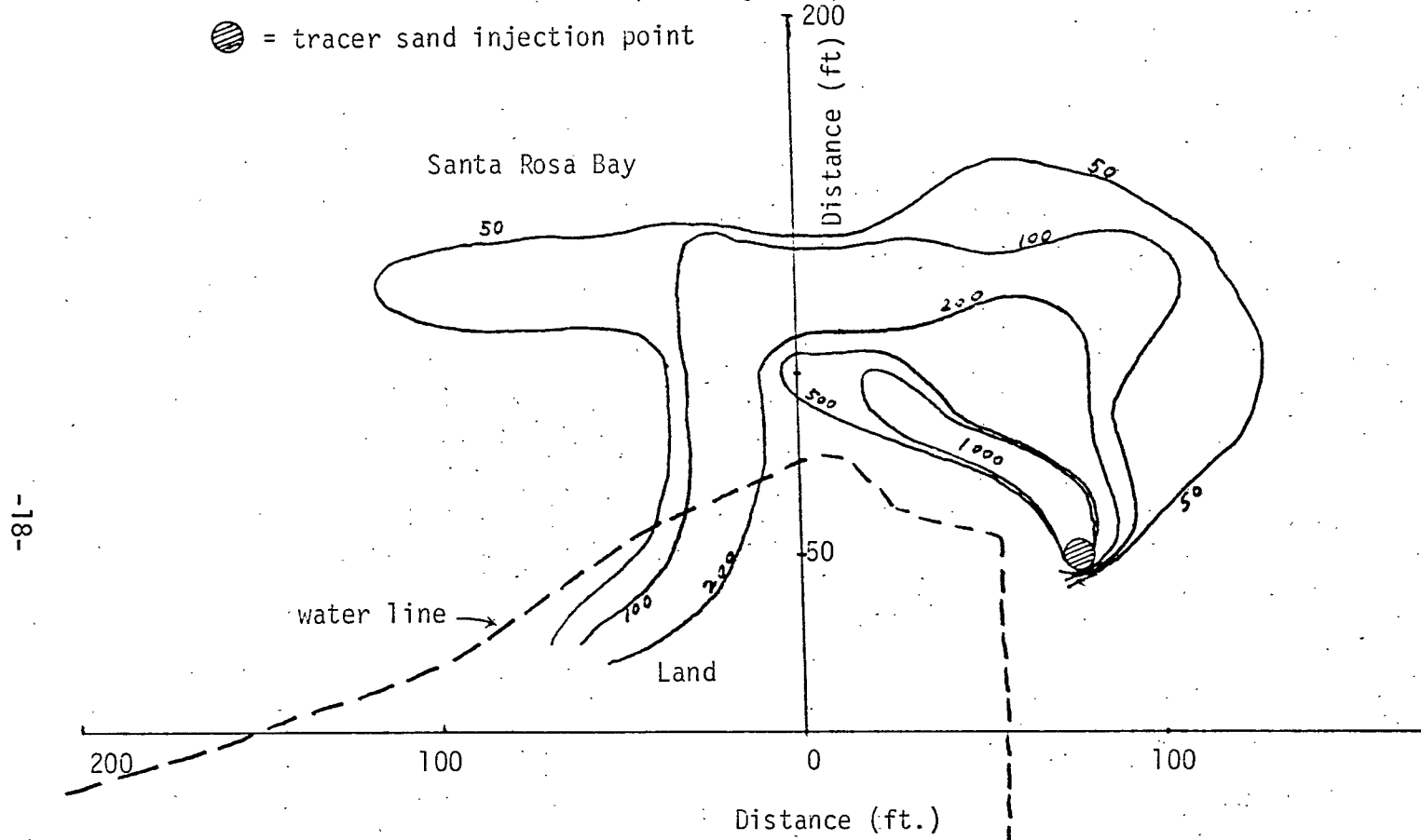


Figure 7a. Equal concentration contours for site B
Date: 11/13/76

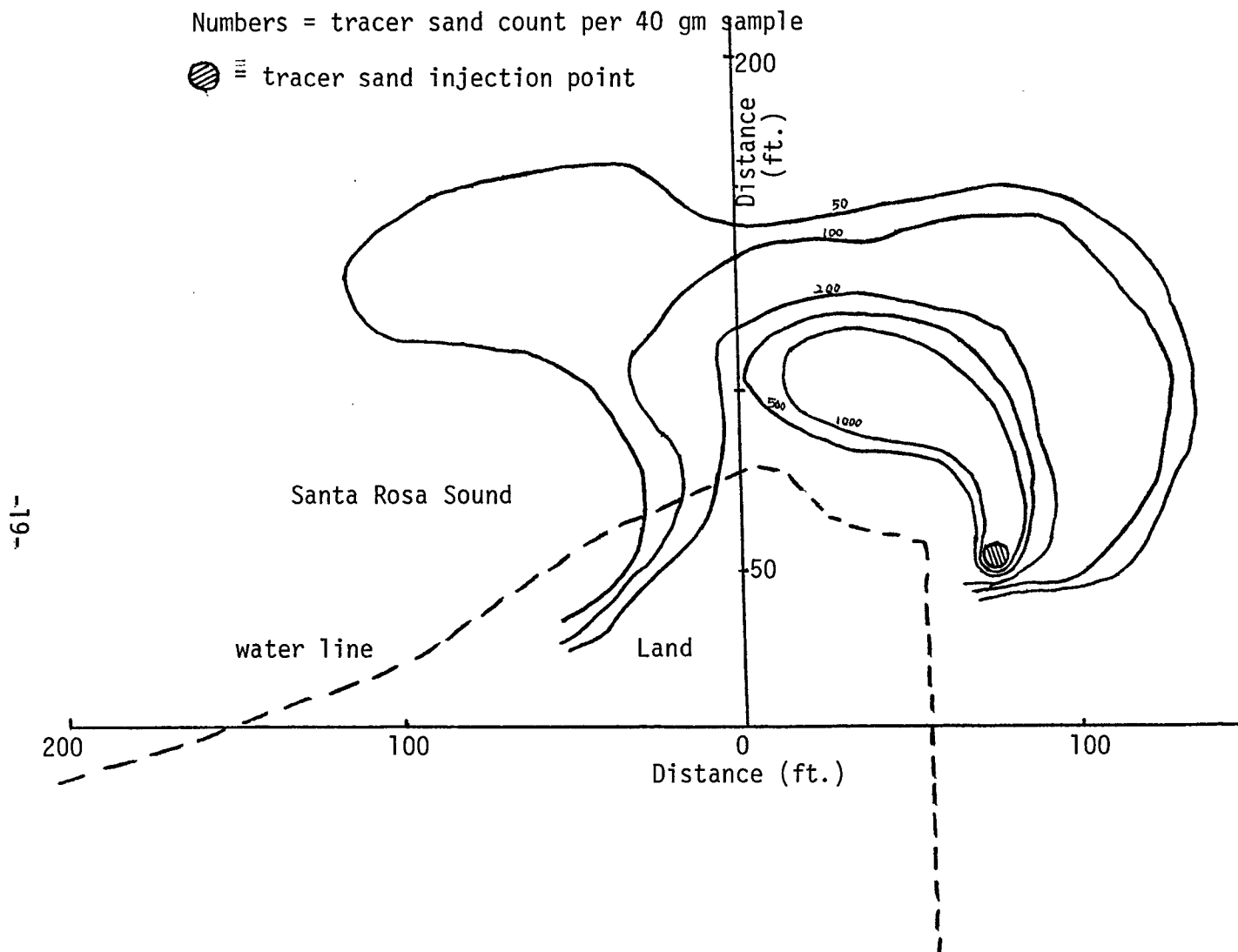


Figure 7b. Equal concentration contour for site B
Date: 11/14/76

wave length: 15 ft.
 wave height: 7 in.
 wave period: 1.6 sec.
 wave direction: NE
 Average current speed $V = 0.25$ ft/sec
 Date: 11/13/76 Time: 15:37 - 17:00

○ represents sampling stations

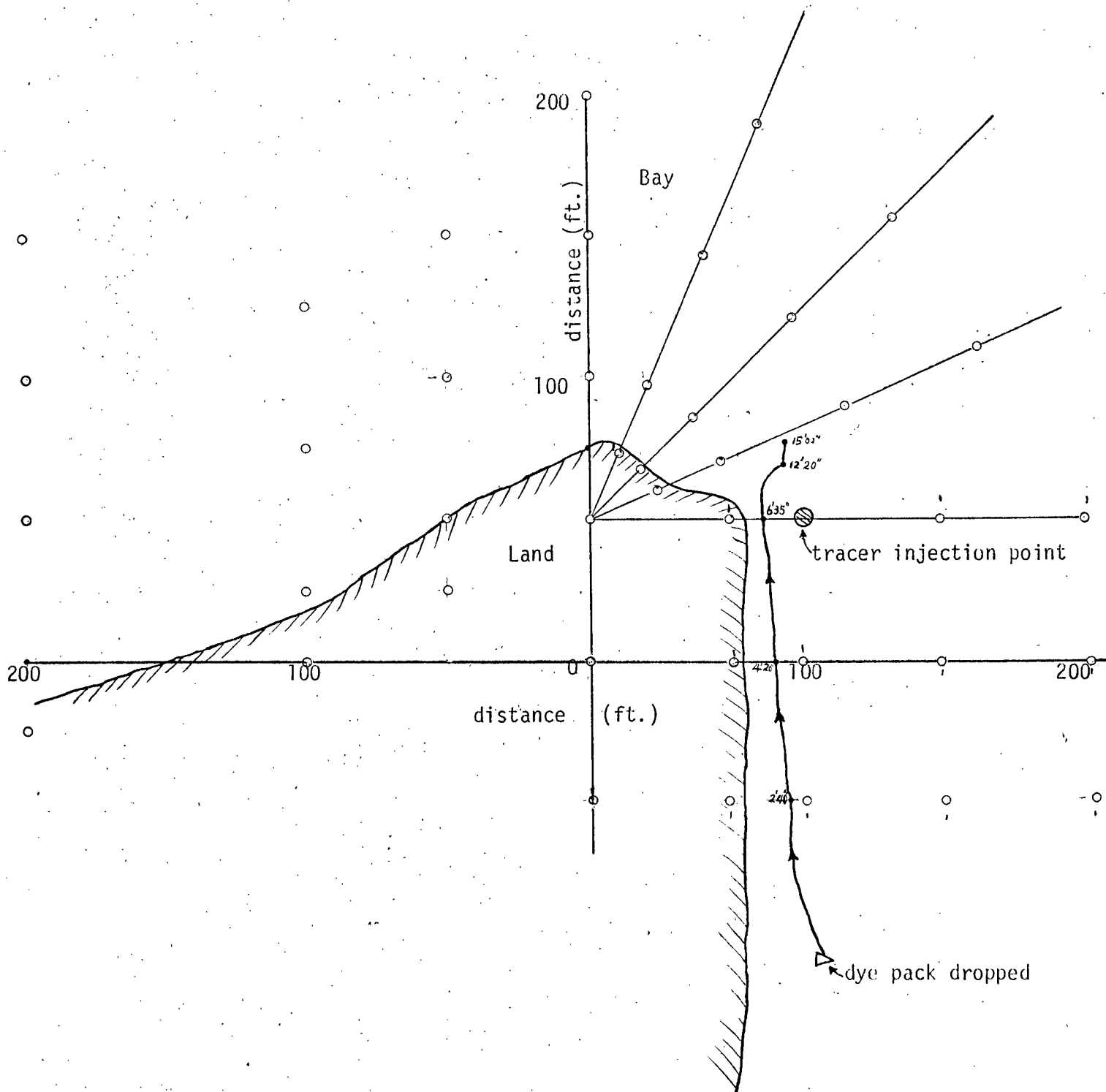


Figure 8a. Observed littoral current and wave parameters at site B

wave length: 25 ft.
wave height: 1 ft.
wave period: 1.6 sec.
wave direction: NE
date: 11/14/76

Average current speed 0.77 fps

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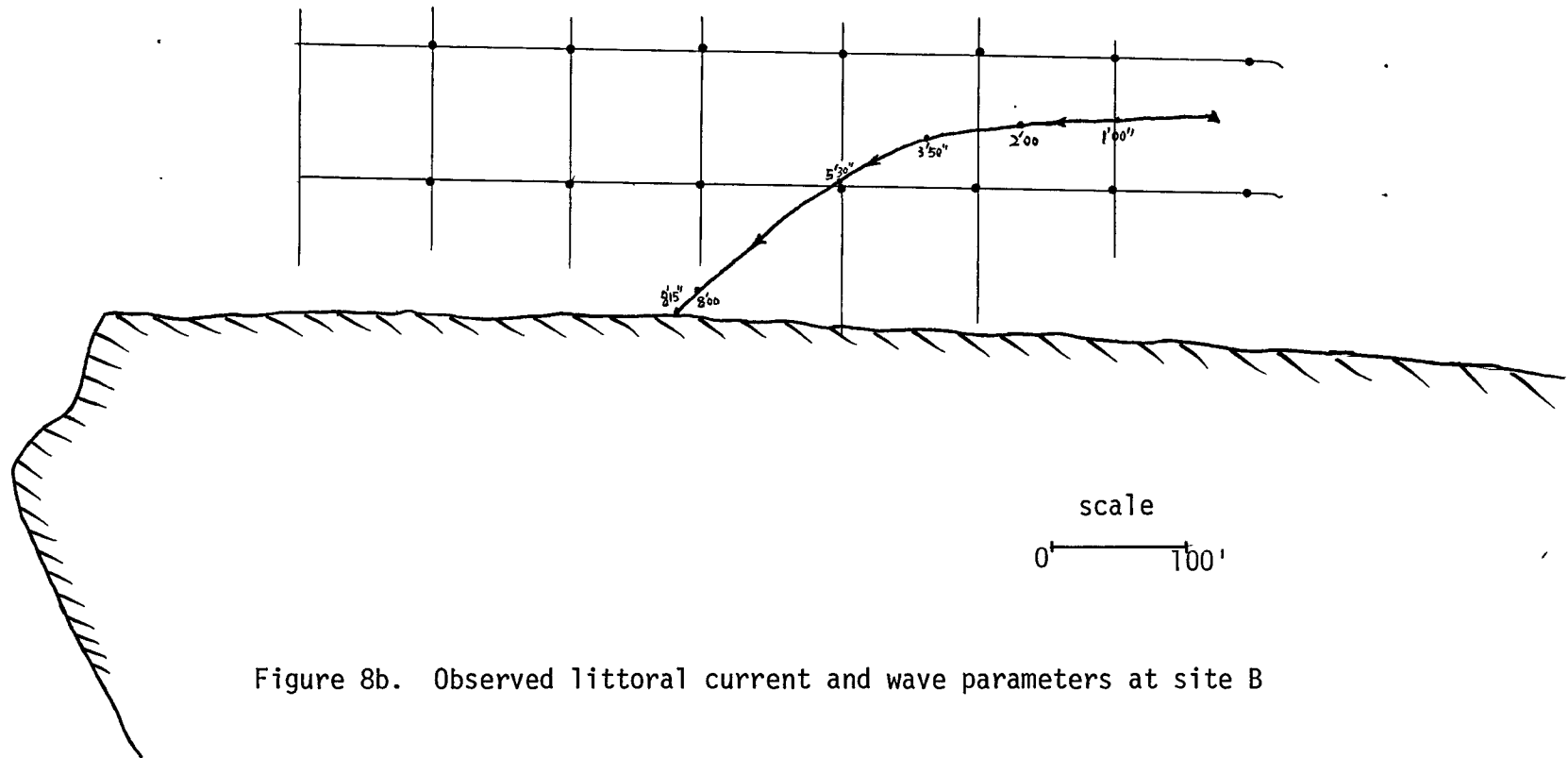
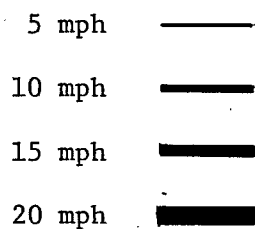
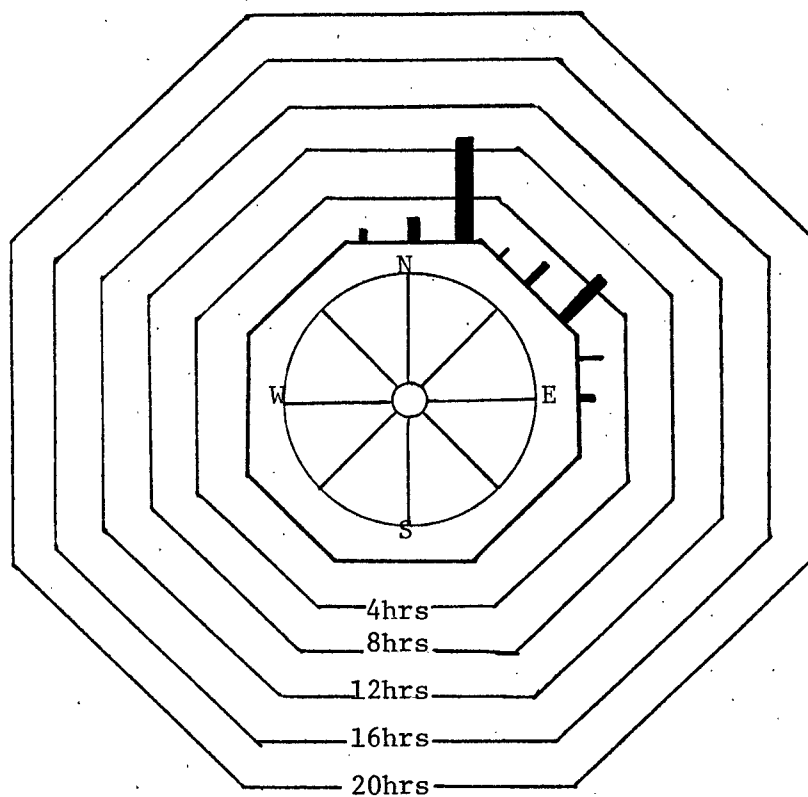


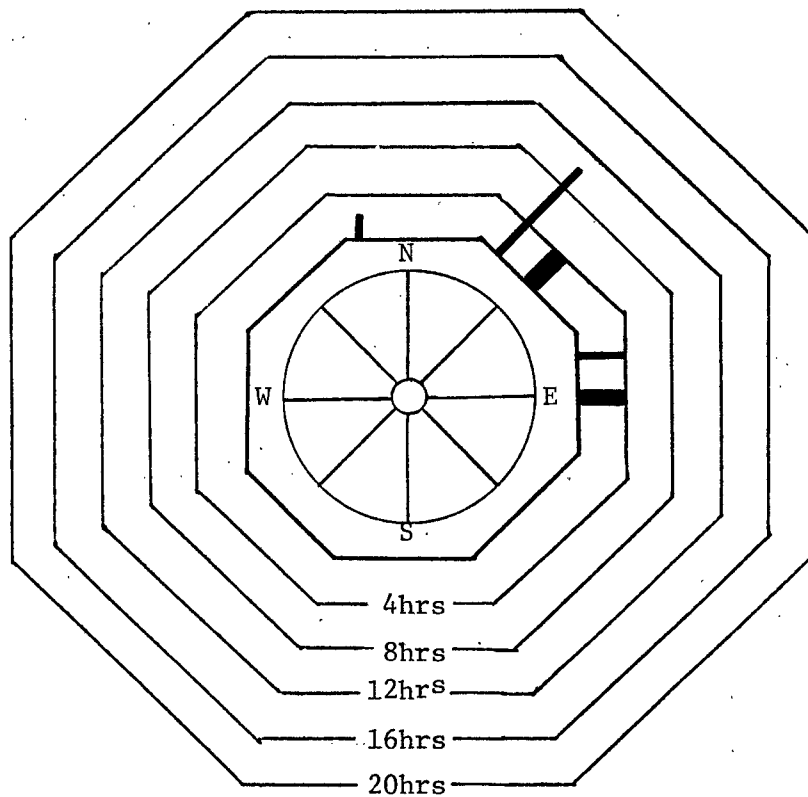
Figure 8b. Observed littoral current and wave parameters at site B





Location: Private pier, Avenida 22, Santa Rosa Island

Date: 11/13/76

Figure 9a. Wind records



15 mph 
 20 mph 

Location: Private pier, Avenida 22, Santa Rosa Island

Date: 11/14/76

Figure 9b. Wind records

Location: Private pier, Avenida 22, Santa Rosa Island

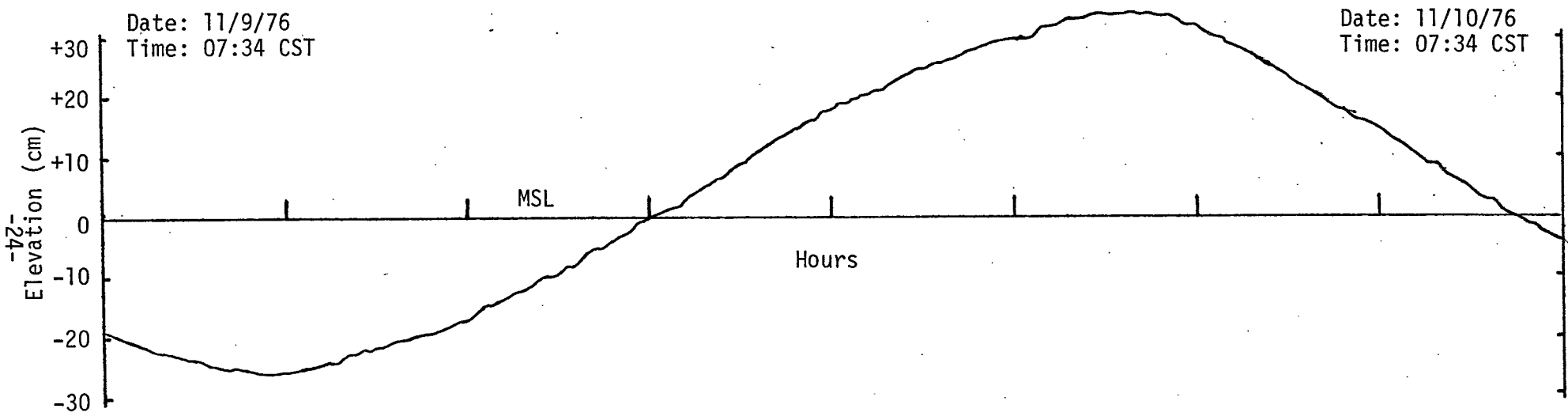


Figure 10a. Tide records

Location: Private pier, Avenida 22, Santa Rosa Island

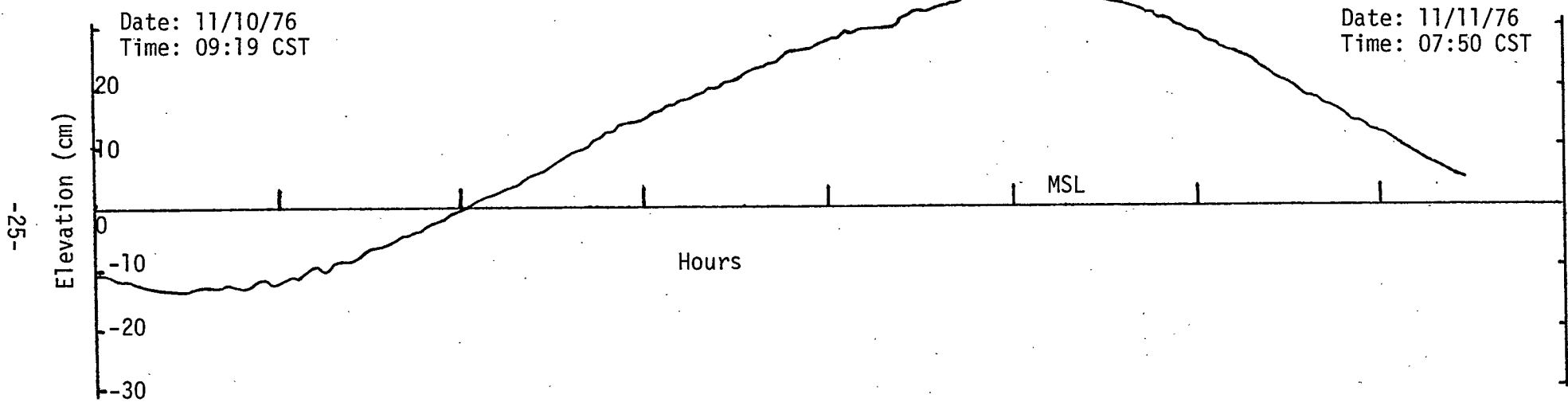


Figure 10b. Tide records

Location: Private pier, Avenida 22, Santa Rosa Island

Date: 11/12/76
Time: 07:53 CST

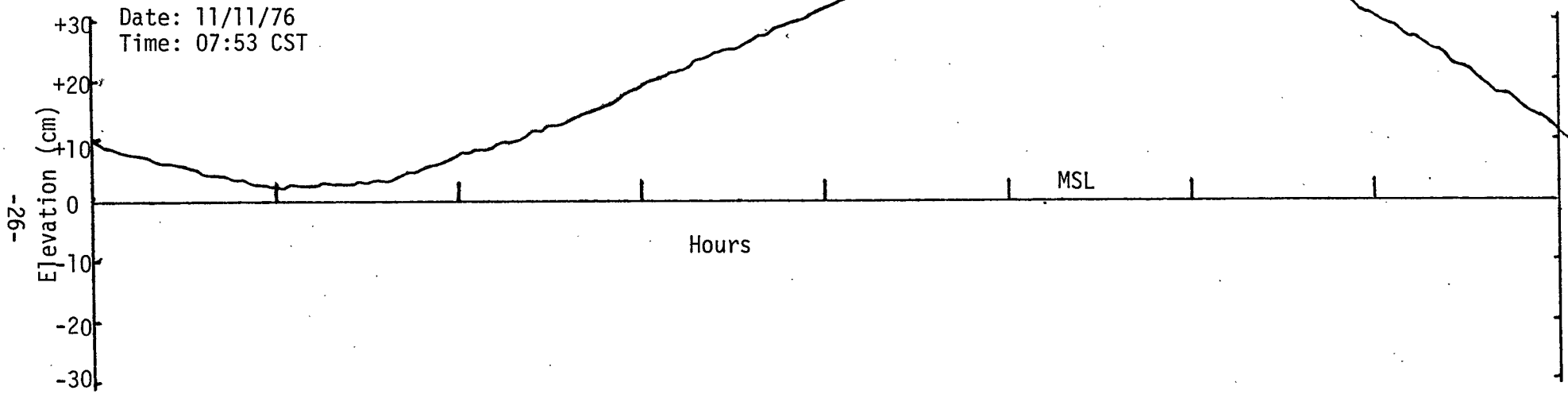


Figure 10c. Tide records

Location: Private pier, Avenida 22, Santa Rosa Island

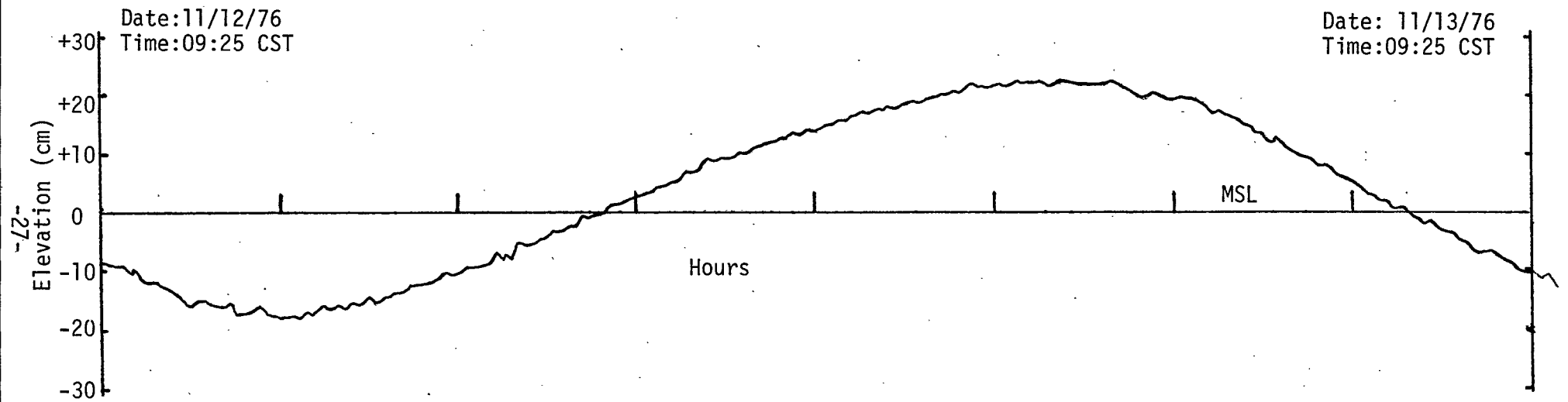


Figure 10d. Tide records

Location: Causeway bridge pier, Pensacola Beach

Date: 11/10/76
Time: 08:22 CST

Date: 11/11/76
Time: 08:22 CST

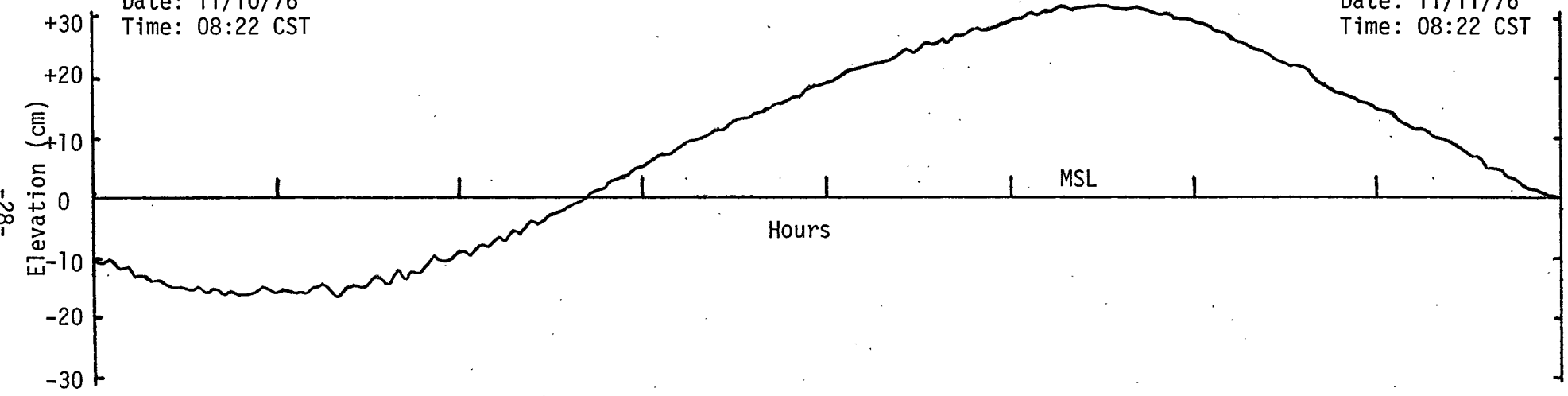


Figure 10e. Tide records

Location: Causeway bridge pier, Pensacola Beach

Date: 11/11/76
Time: 08:23 CST

Date: 11/12/76
Time: 08:23 CST

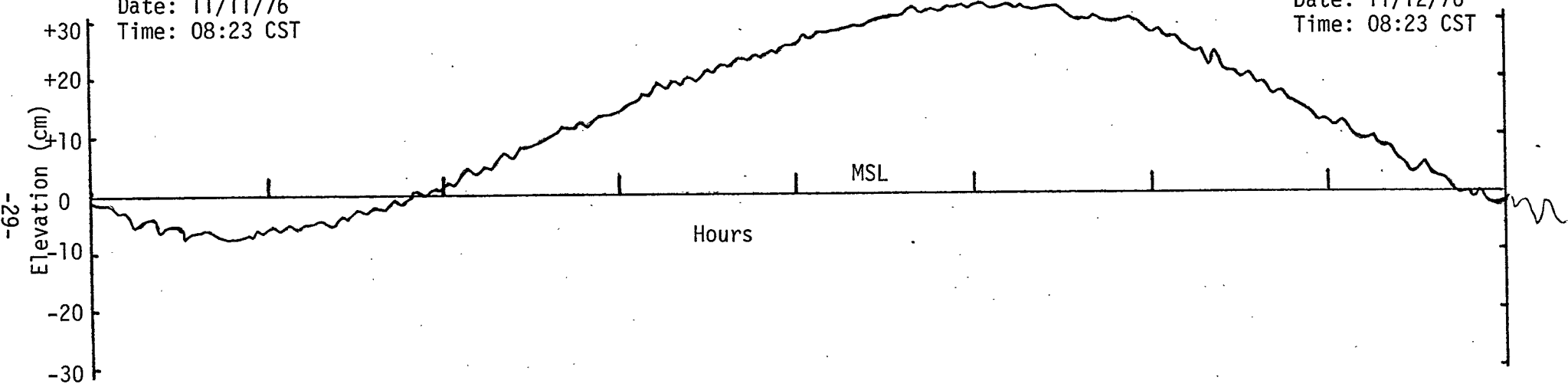


Figure 10f. Tide records

⊗ tracer injecting point

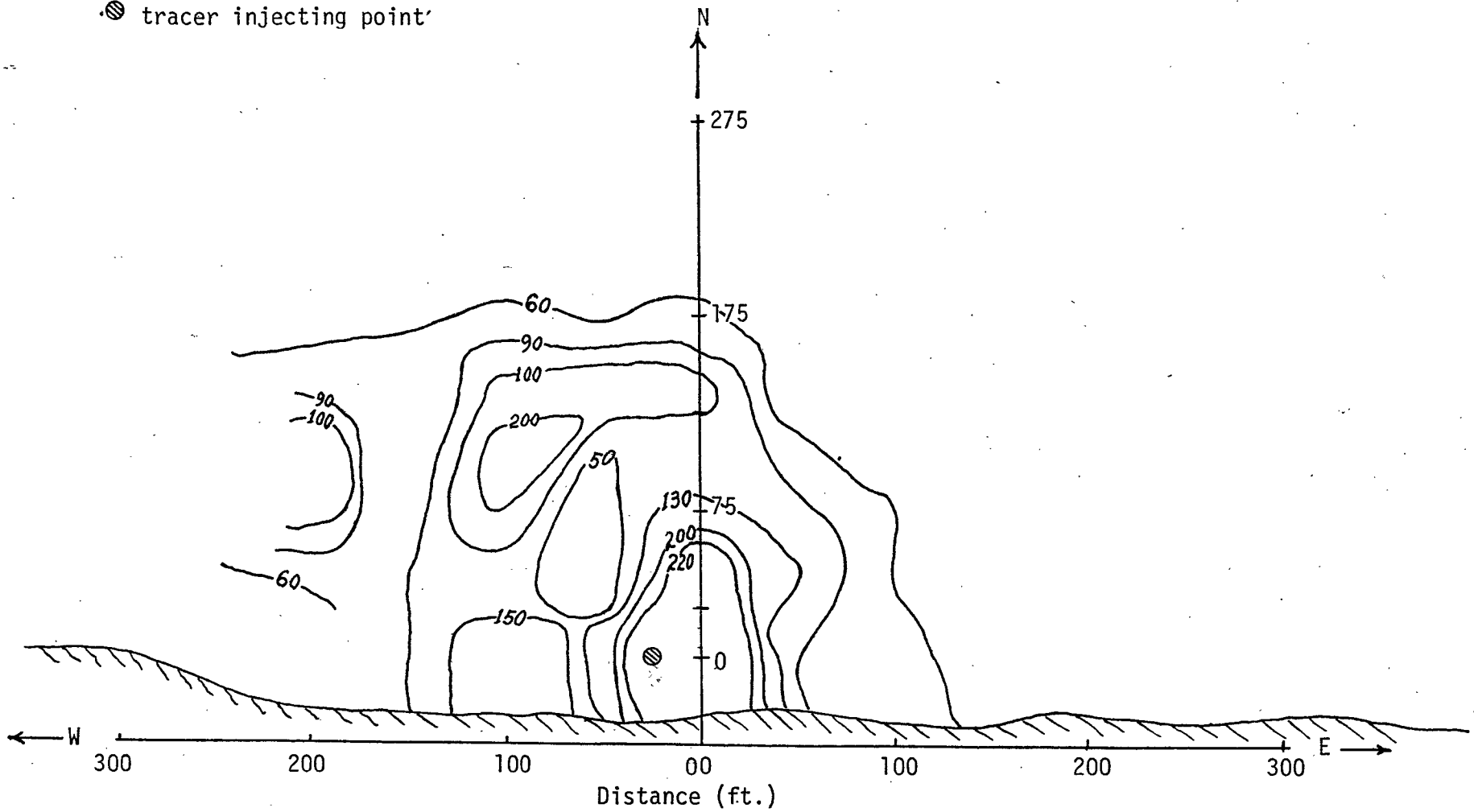


Figure 11a-1. Equal concentration contours for site A
Date: 2/15/77 Time: 13:00 - 14:00 CST

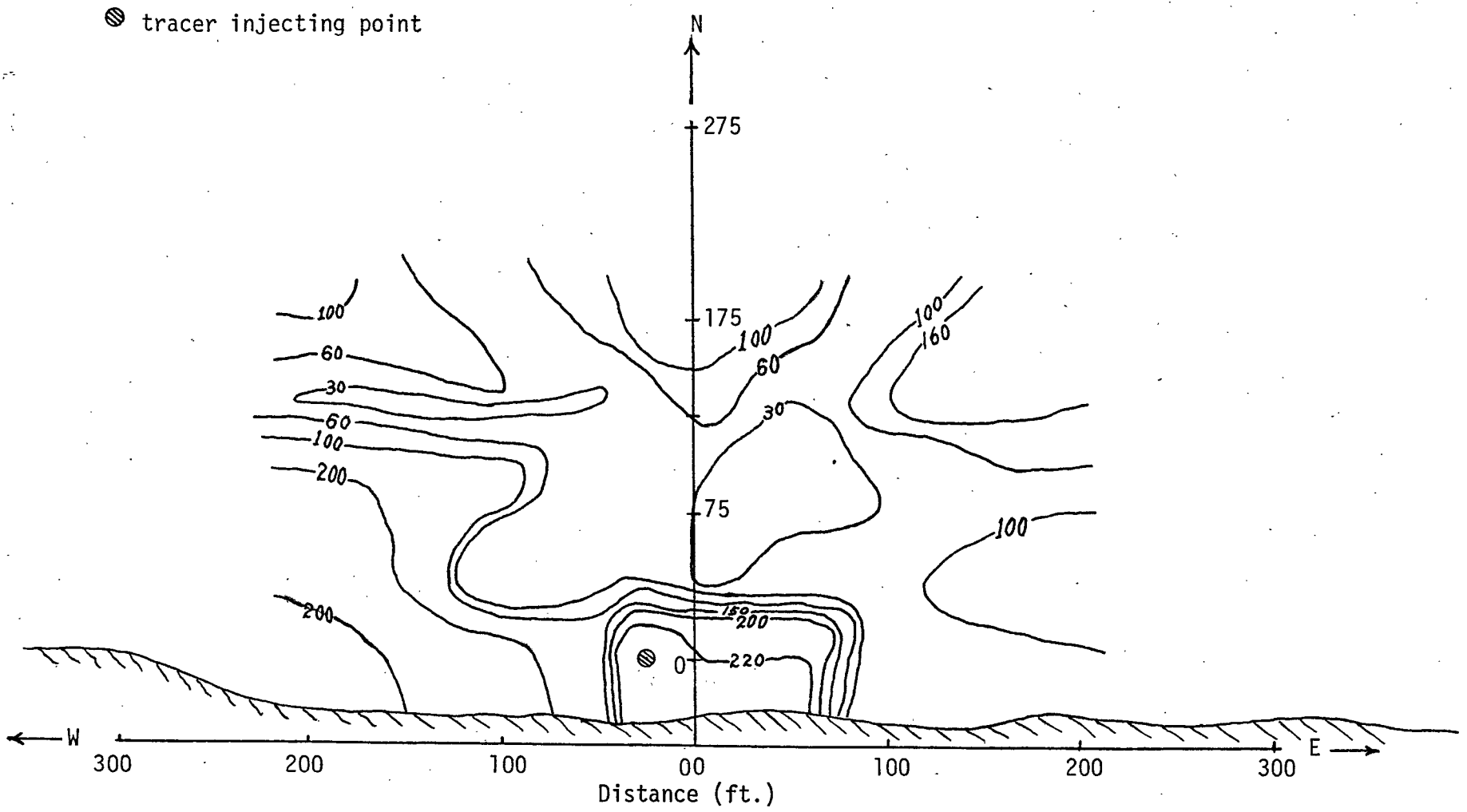


Figure 11a-2. Equal concentration contours for site A
Date: 2/15/77 Time: 20:00 CST

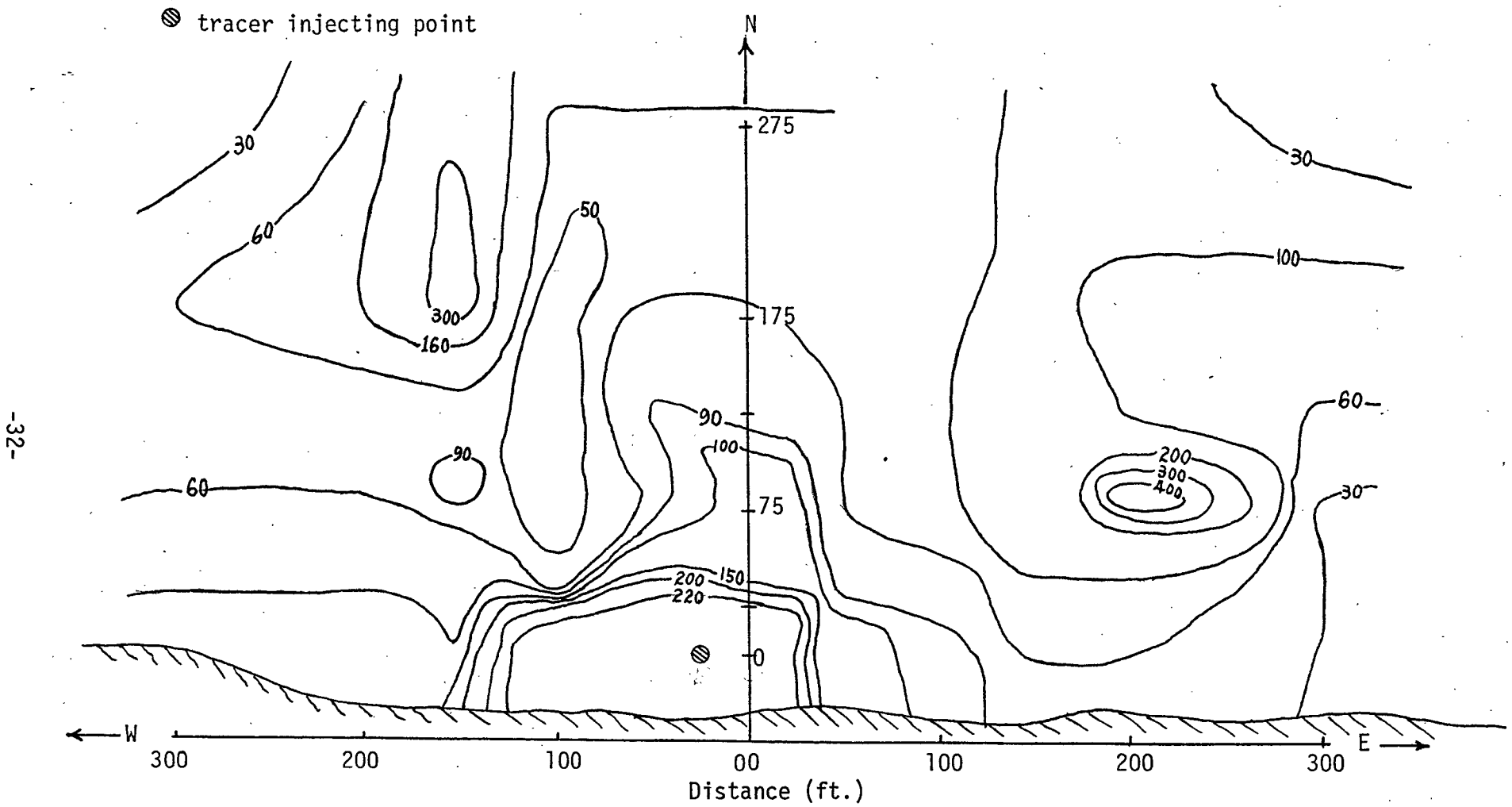


Figure 11b-1. Equal concentration contours for site A
 Date: 2/16/77 Time: 9:00 - 10:15 CST

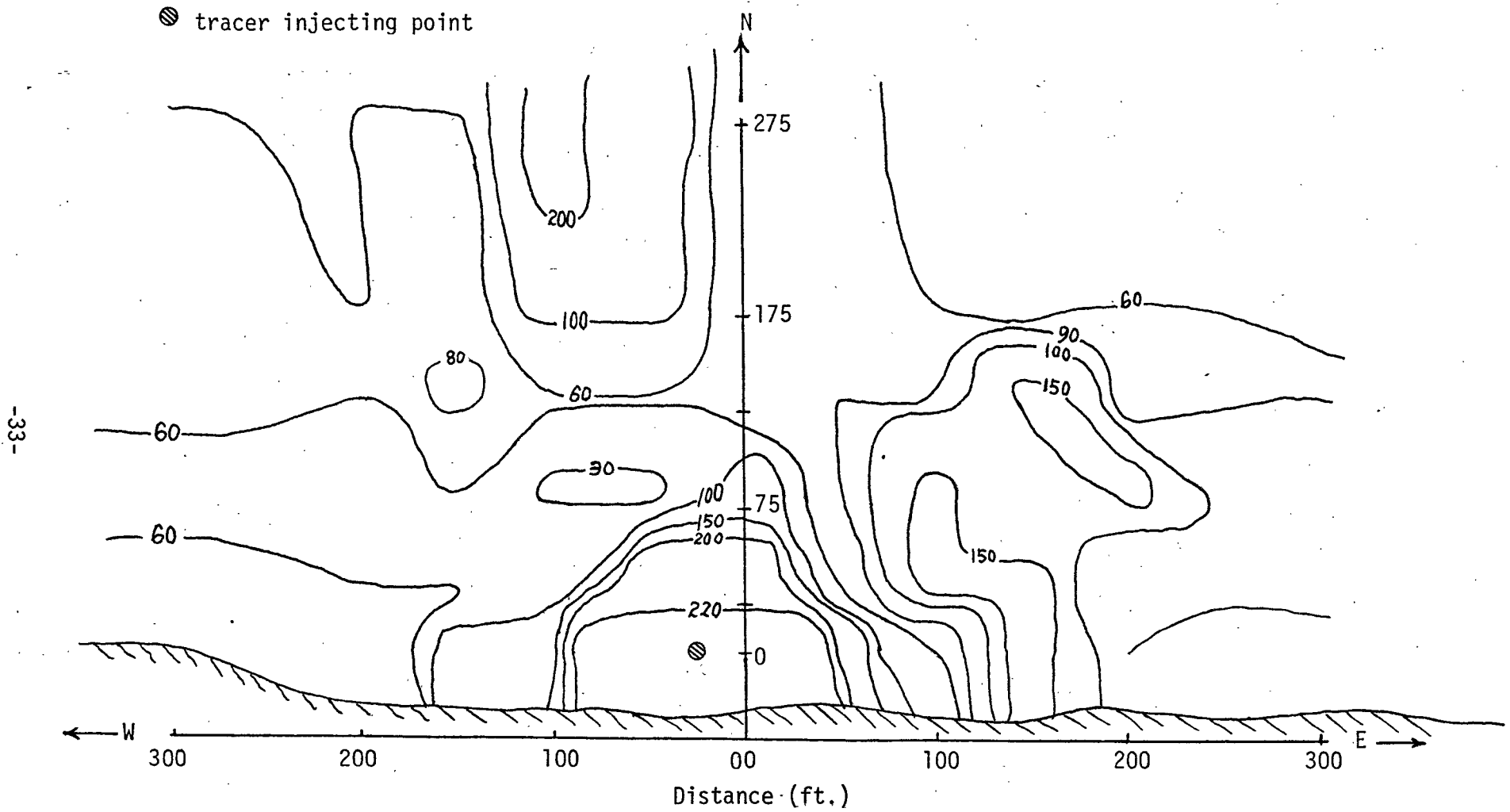


Figure 11b-2. Equal concentration contours for site A
 Date: 2/16/77 Time: 14:00 - 15:30 CST

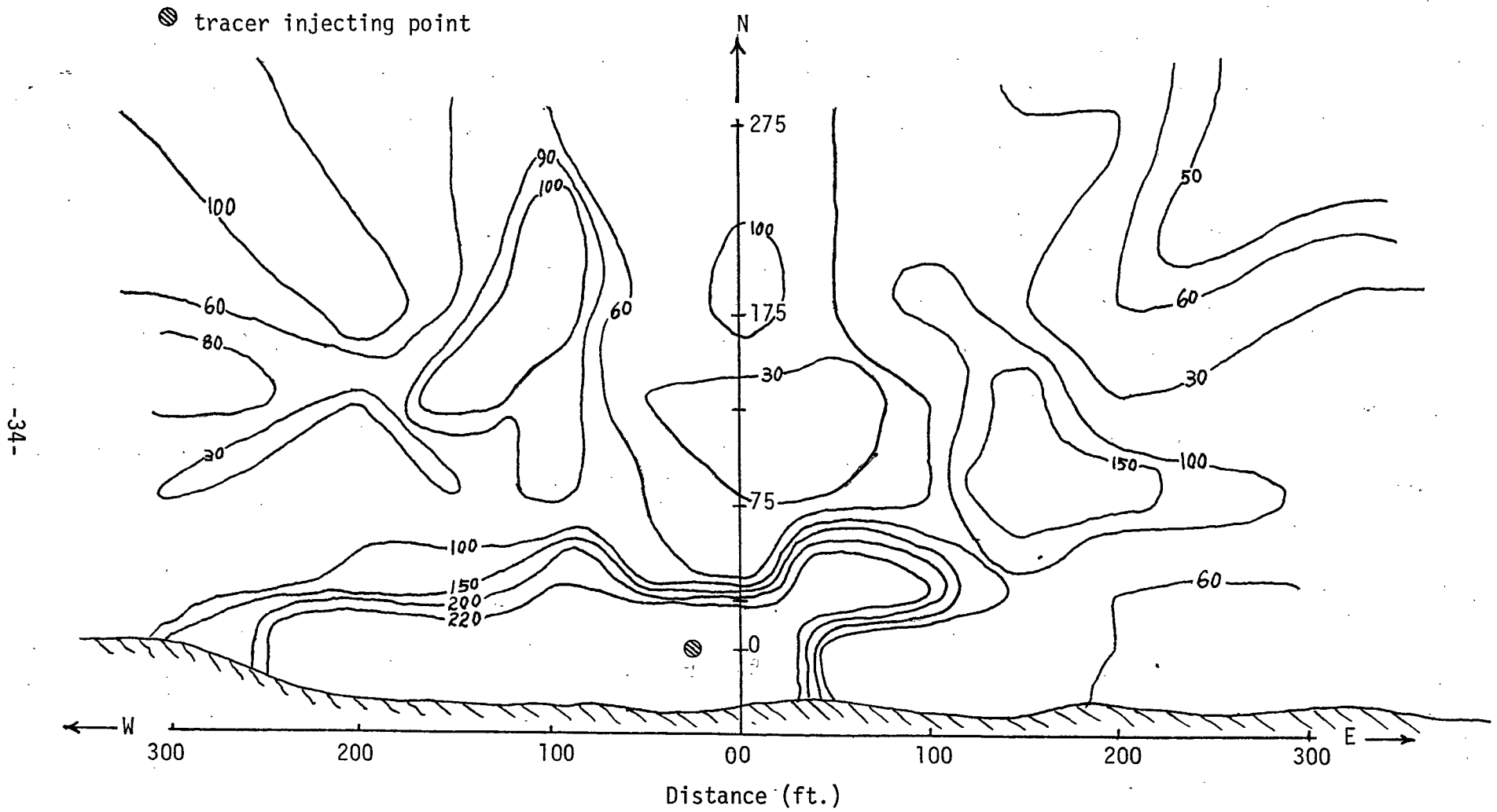


Figure 11c-1. Equal concentration contours for site A
 Date: 2/17/77 Time: 9:00 CST

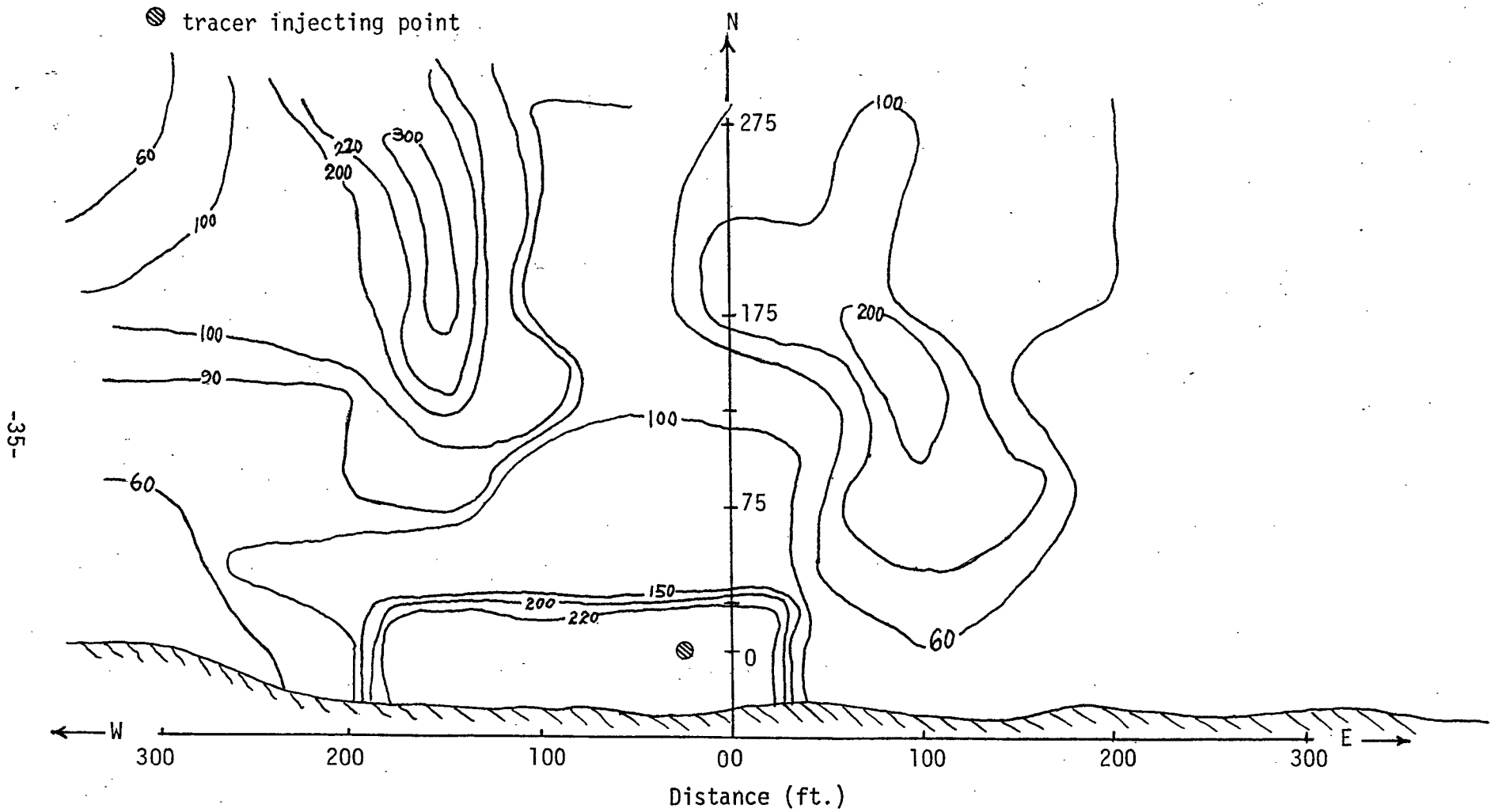


Figure 11c-2. Equal concentration contours for site A
Date: 2/17/77 Time: 15:00 CST

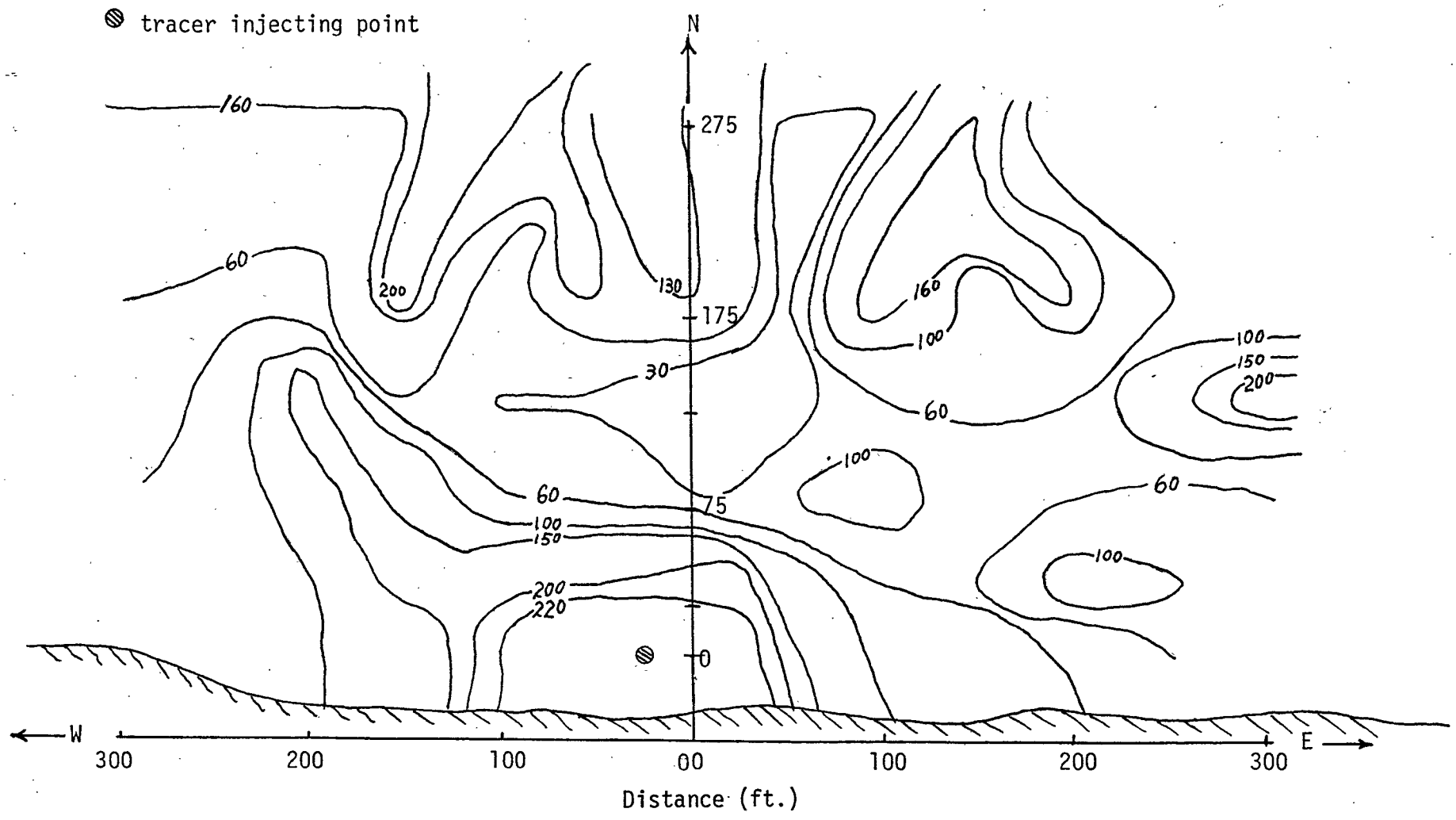


Figure 11d-1. Equal concentration contours for site A
Date: 2/18/77 Time: 9:00 CST

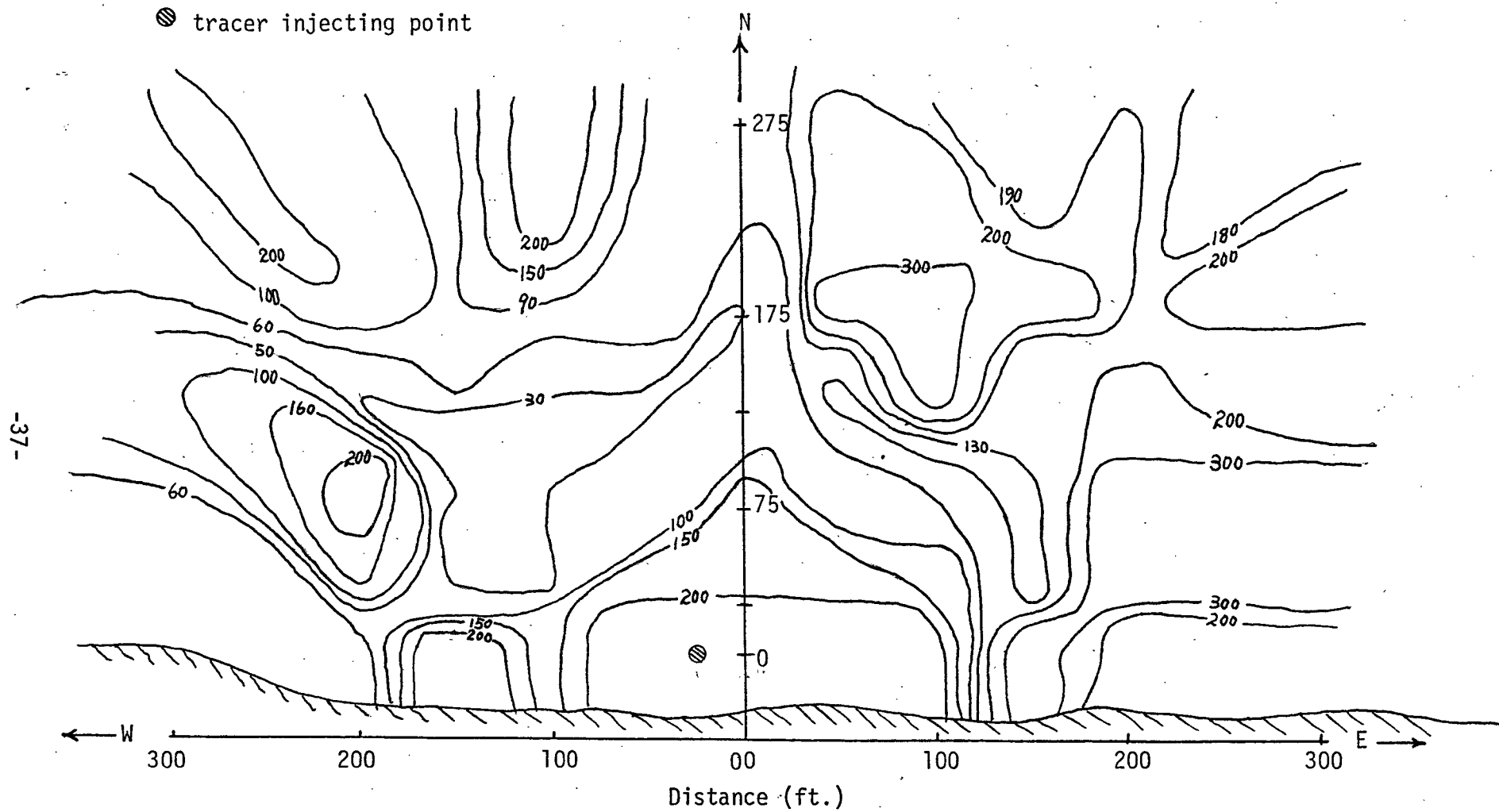


Figure 11d-2. Equal concentration contours for site A
 Date: 2/18/77 Time: 15:30 CST

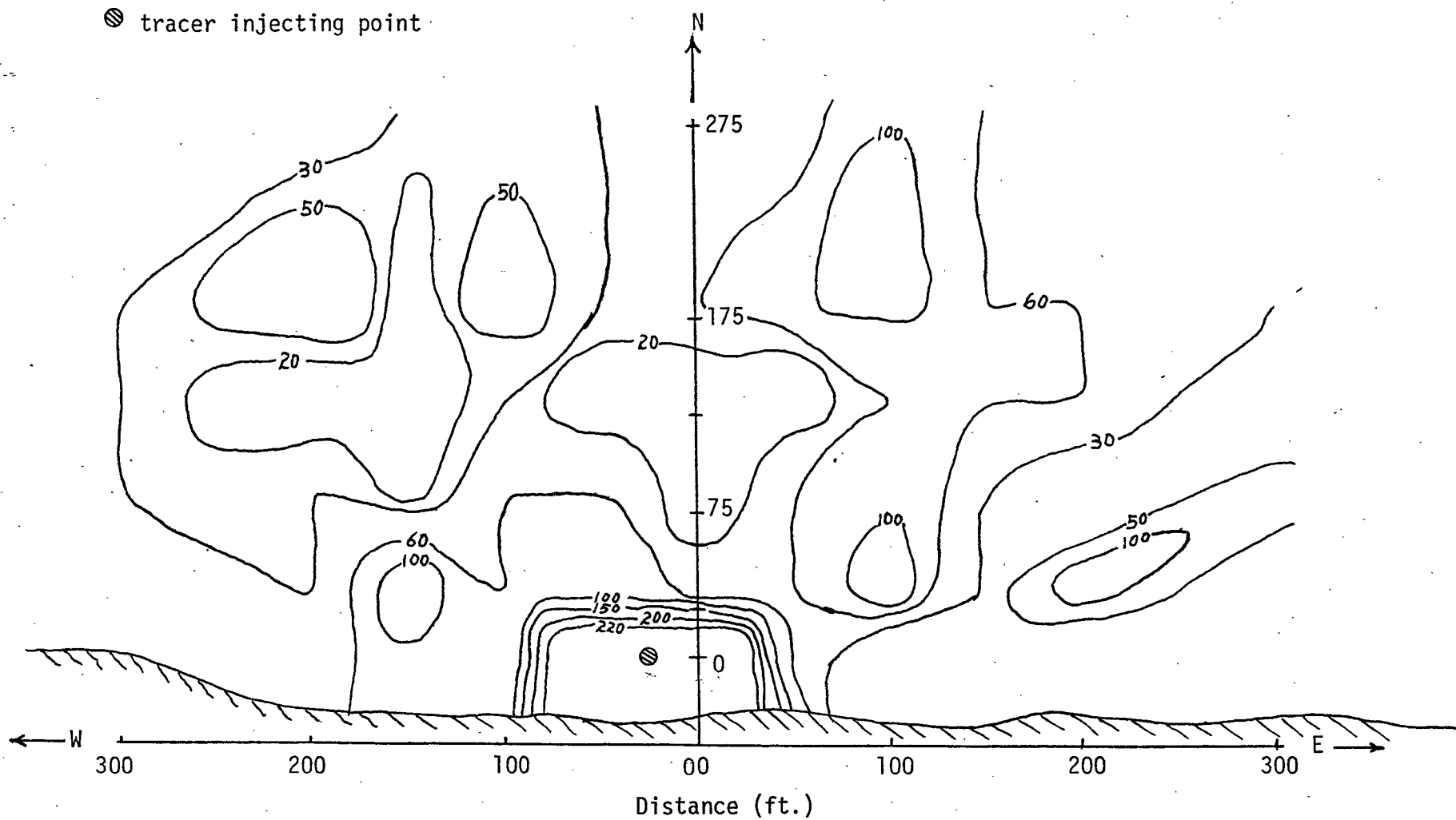


Figure 11e. Equal concentration contours for site A
Date: 2/19/77 Time: 11:00 CST

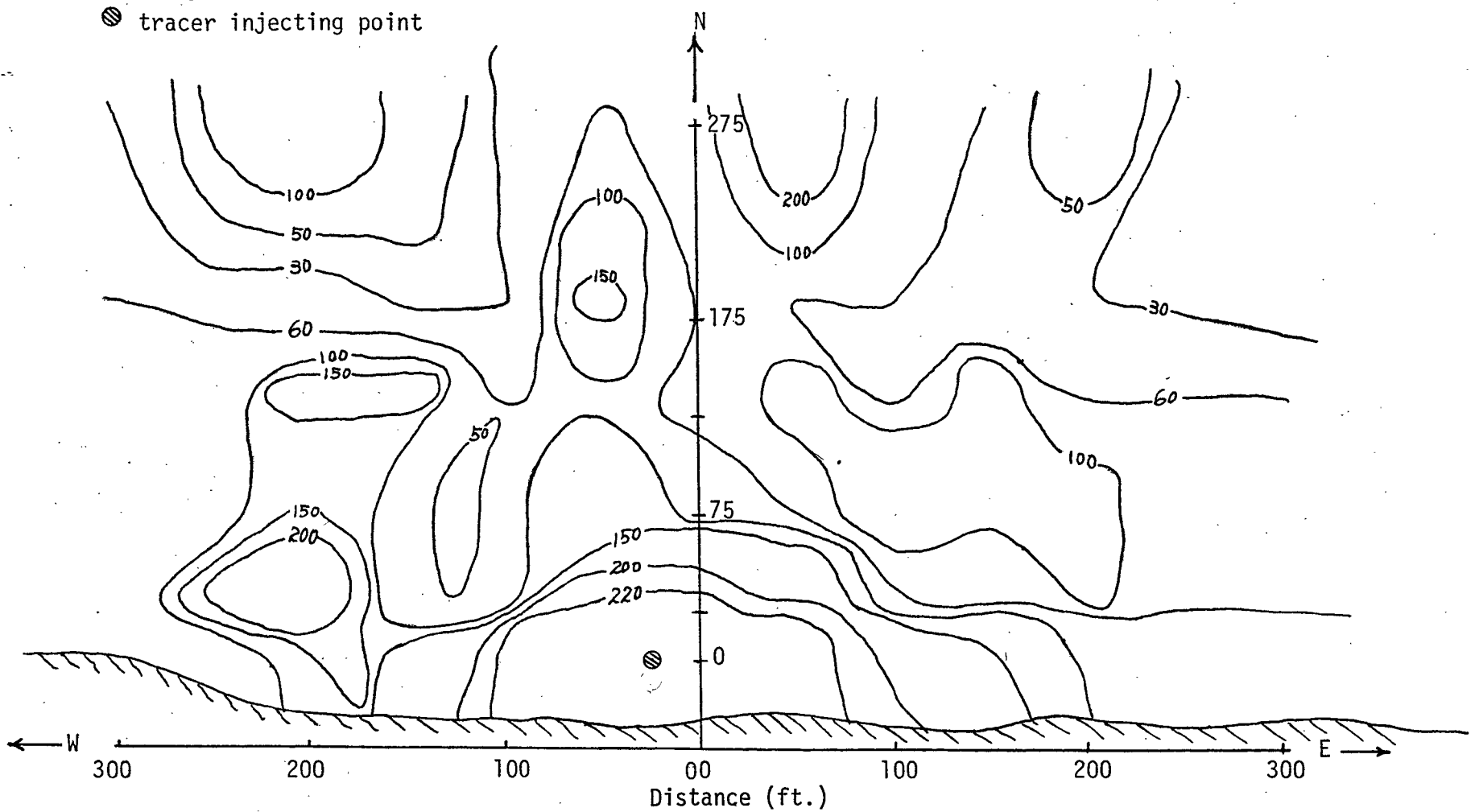


Figure 11f. Equal concentration contours for site A
Date: 2/20/77 Time: 11:00 CST

Date: 2/15/77

Wave height: 6 in.
wave period: 2.5 sec.
wave direction: NW
Average current speed: 0.51 ft/sec

Date: 2/16/77

wave height: 4 in.
wave period: 3 sec.
wave direction: NW
Average current speed: 0.23 ft/sec

Date: 2/17/77

wave height: 3 in.
wave period: 2 sec.
wave direction: NE
Average current speed: 0.21 ft/sec

Date: 2/18/77

wave height: 6 in.
wave period: 1.7 sec.
wave direction: NW
Average current speed: 0.33 ft/sec.

Figures 12a, 12b, 12c, 12d
Observed littoral current and wave parameters at site A

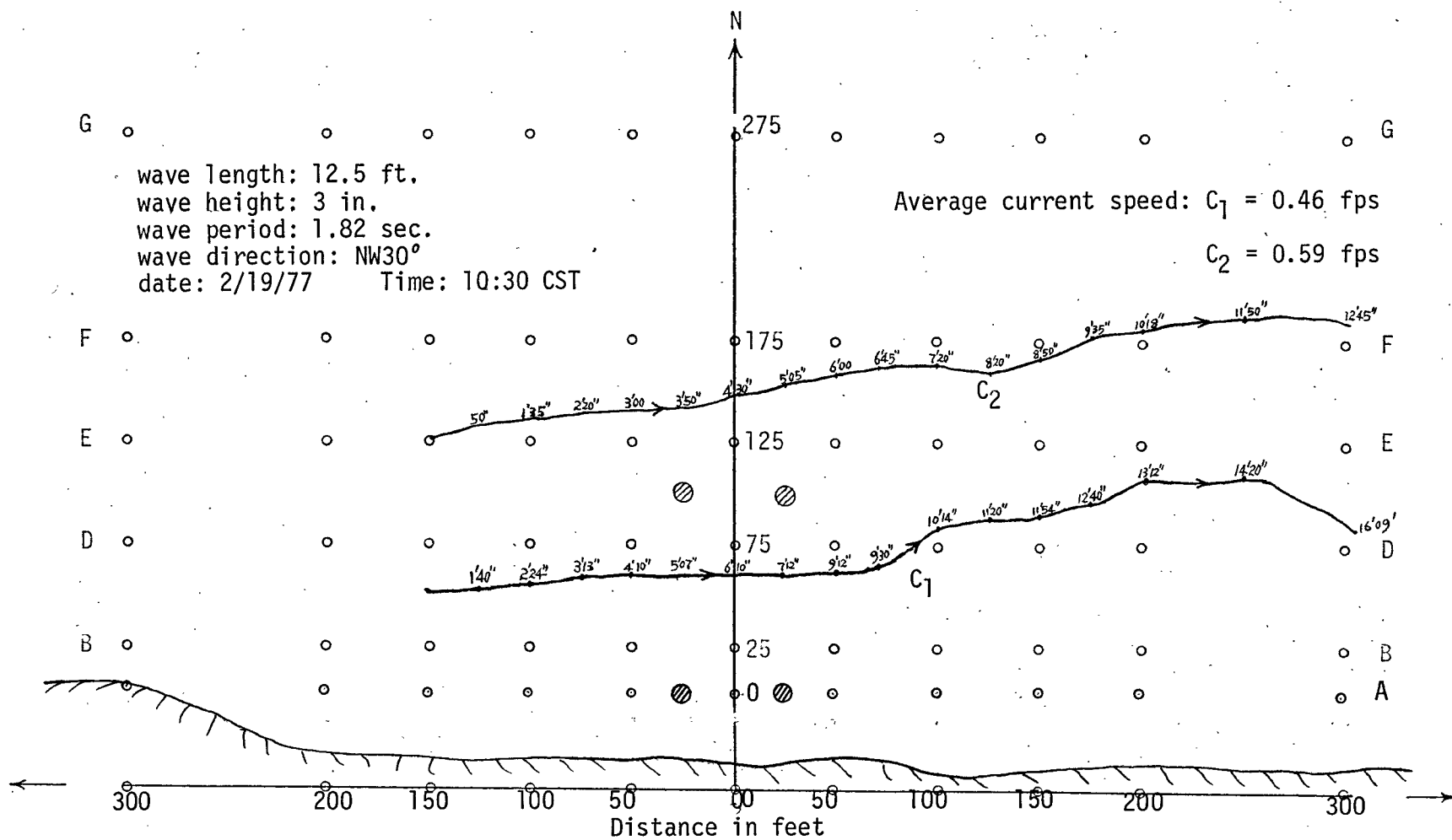


Figure 12e. Observed littoral current and wave parameters at site A

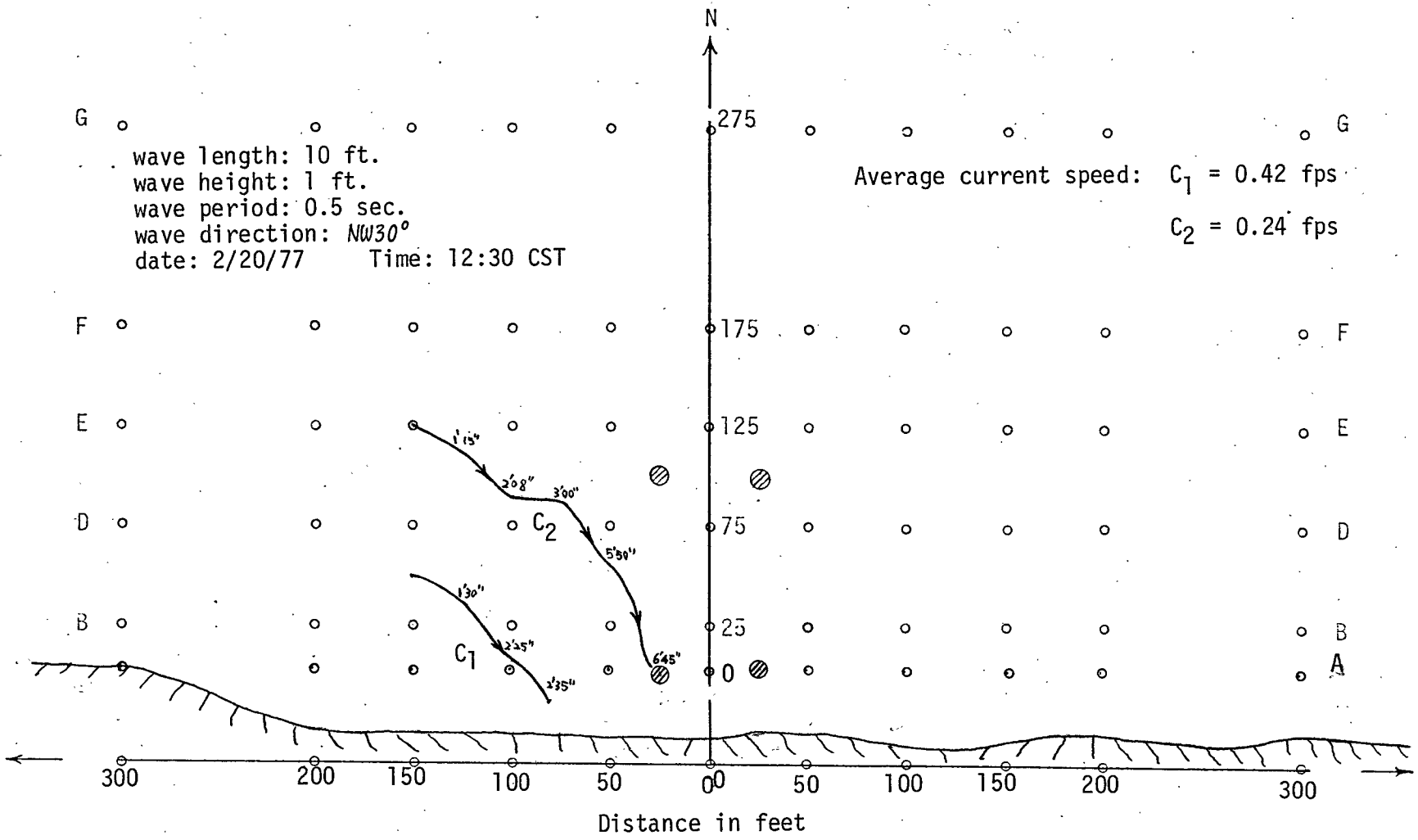


Figure 12f. Observed littoral current and wave parameters at site A

Date: 2/19/77
Time: 17:30 CST

Average current speed:
 $C_1 = 0.32$ fps
 $C_2 = 0.45$ fps

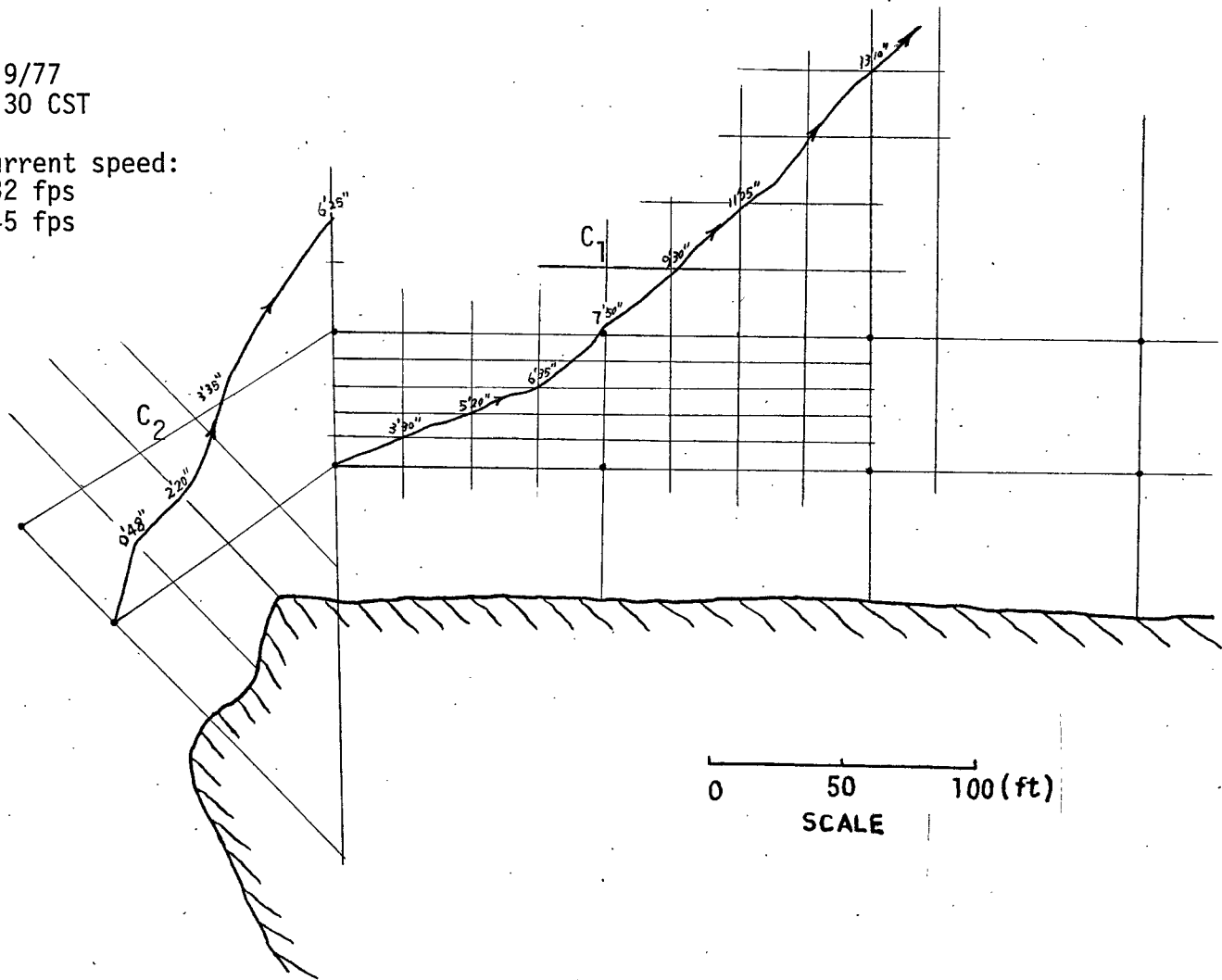


Figure 13a-1. Observed littoral current and wave parameters at site B

Date: 2/19/77
Time: 17:30 CST

Average current speed 0.35 fps

-44-

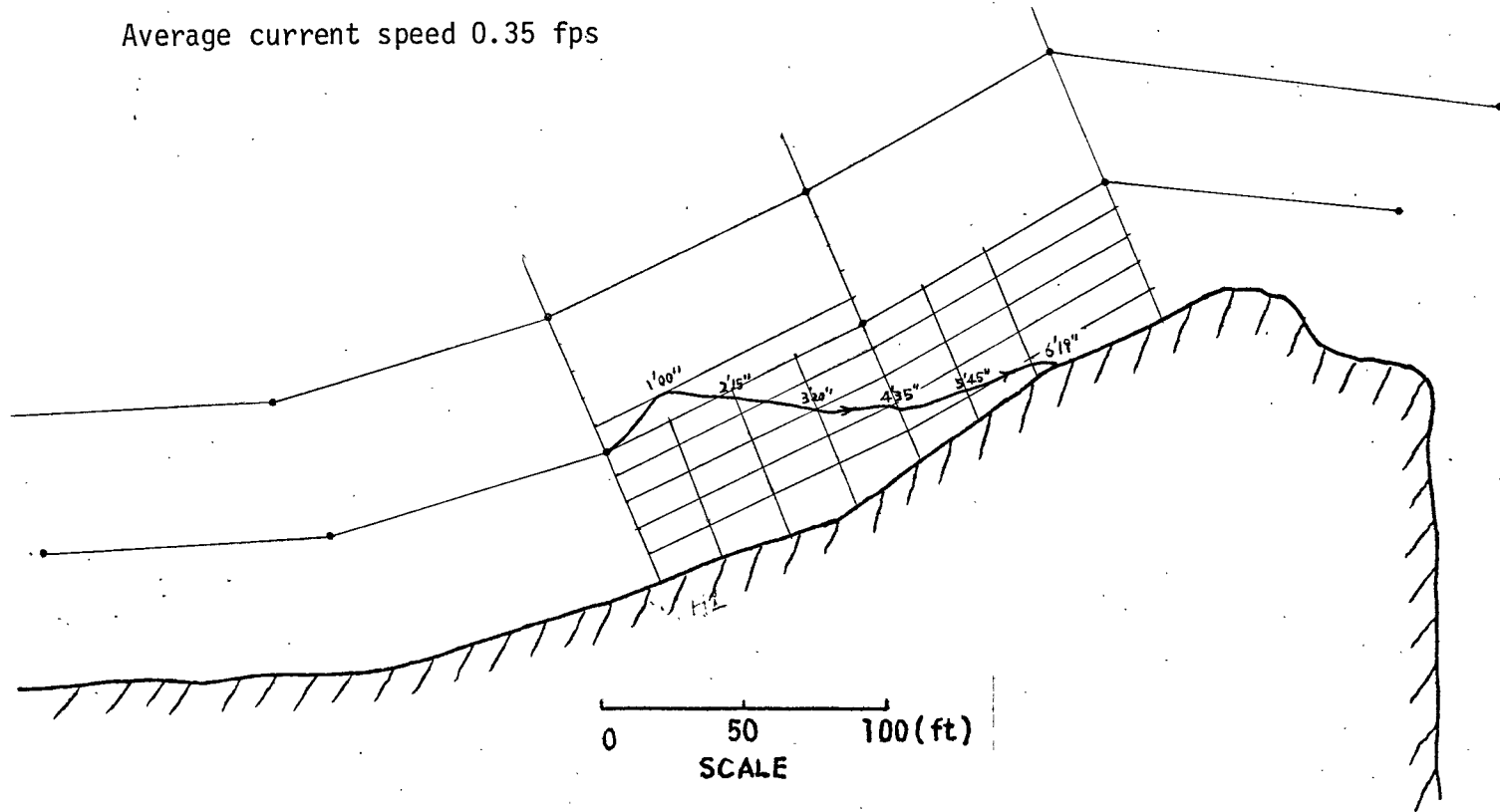


Figure 13a-2. Observed littoral current and wave parameters at site B

Wave length: 12.5 ft.
wave height: 10 in.
wave period: 0.5 sec.
wave direction: NW60°
Date: 2/20/77 Time: 9:38 CST

Average current speed: 0.51 fps

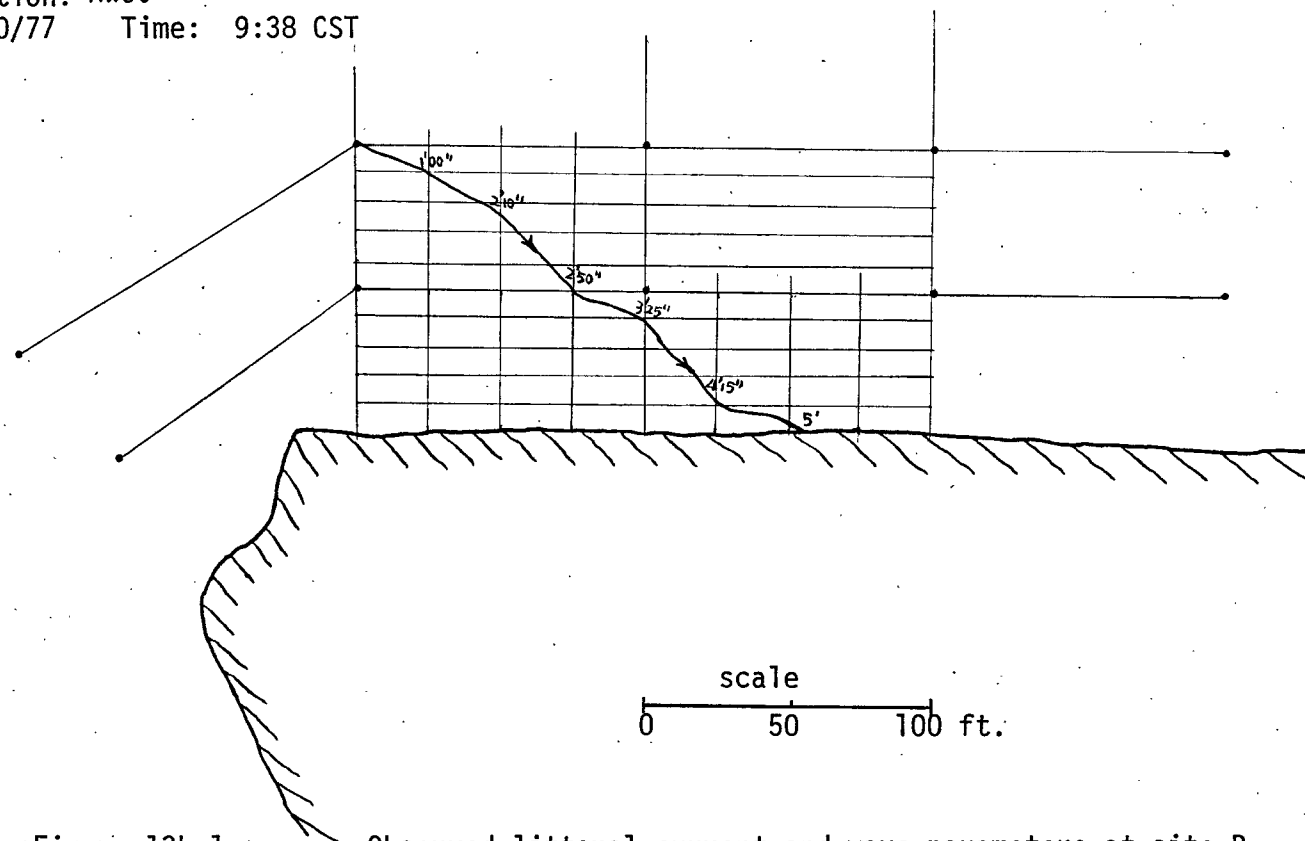


Figure 13b-1. Observed littoral current and wave parameters at site B

wave length: 12.5 ft.
wave height: 10 in.
wave period: 0.5 sec.
wave direction: NW60°
Date: 2/20/77 Time: 9:38 CST

Average current speed: $C_1 = 0.44$ fps
 $C_2 = 0.36$ fps
 $C_3 = 0.58$ fps

-46-

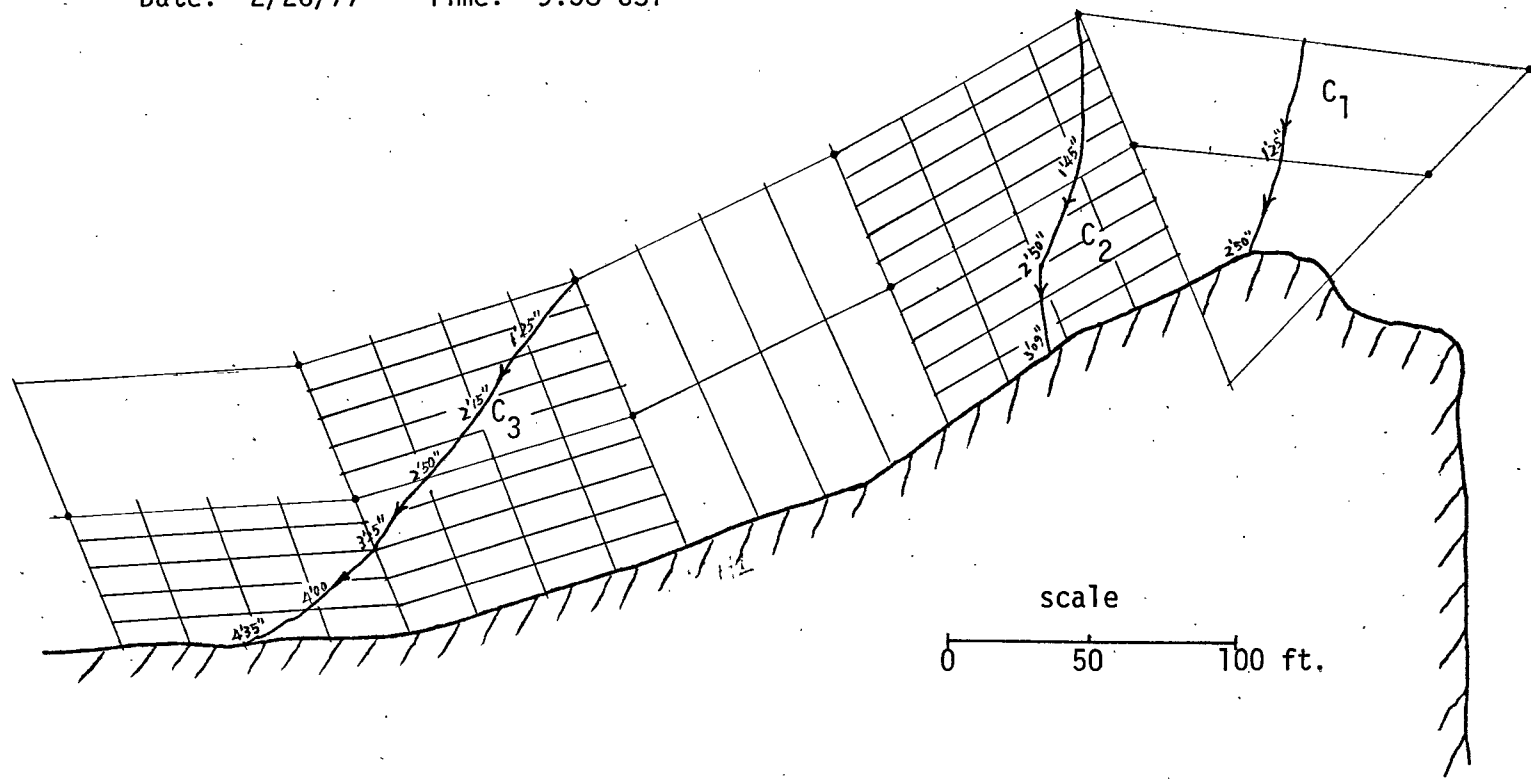


Figure 13b-2. Observed littoral current and wave parameters at site B

wave length: 8 ft.
wave height: 0.7 ft.
wave period: 0.5 sec.
wave direction: NW30°
Date: 2/20/77 Time: 14:00 CST

Average current speed 0.43 fps

-47-

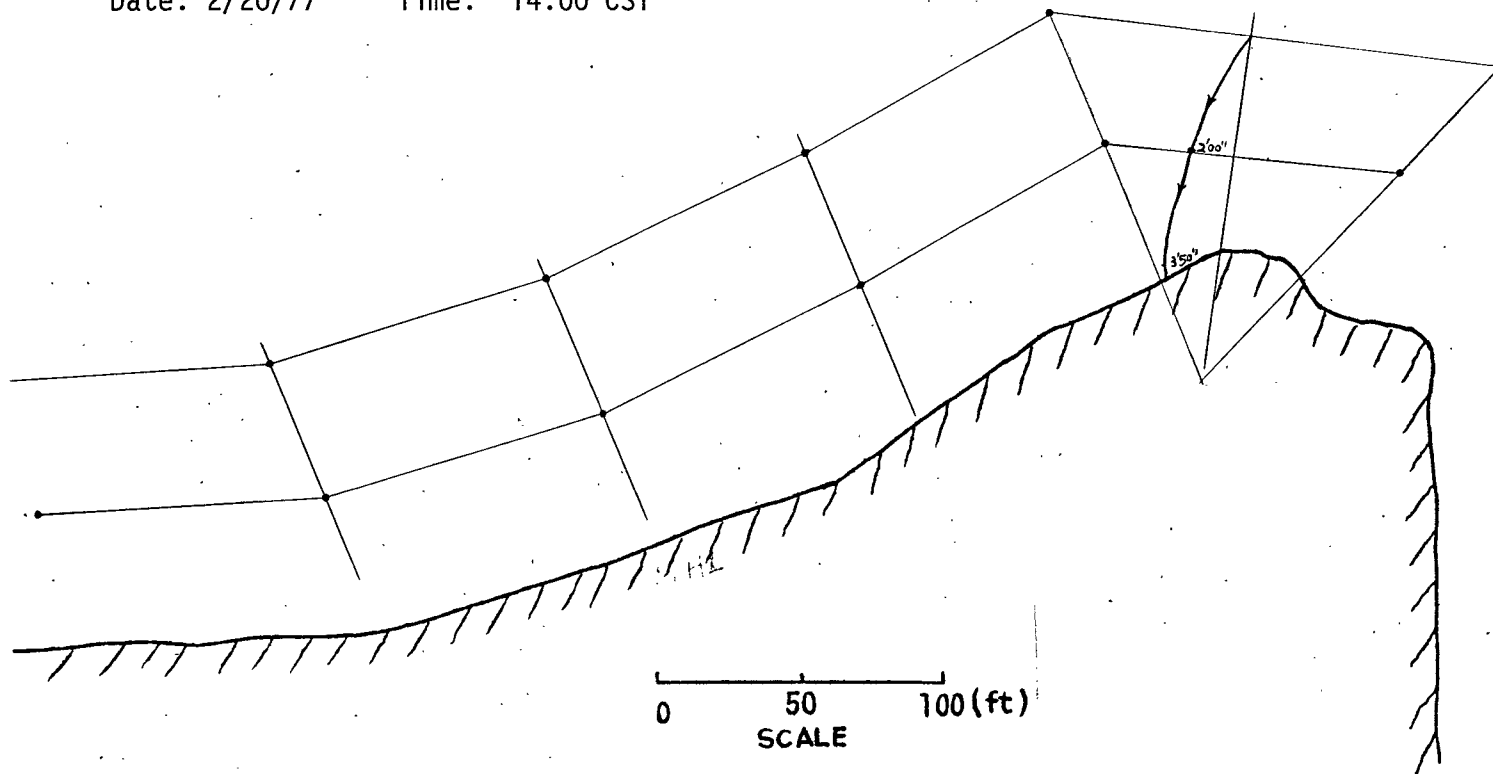


Figure 13b-3. Observed littoral current and wave parameters at site B

wave length: 8 ft.
wave height: 0.7 ft.
wave period: 1.61 sec.
wave direction: NW30°
Date: 2/20/77 Time: 14:00 CST

Average current speed: $C_1 = 0.31$ fps
 $C_2 = 0.40$ fps

-48-

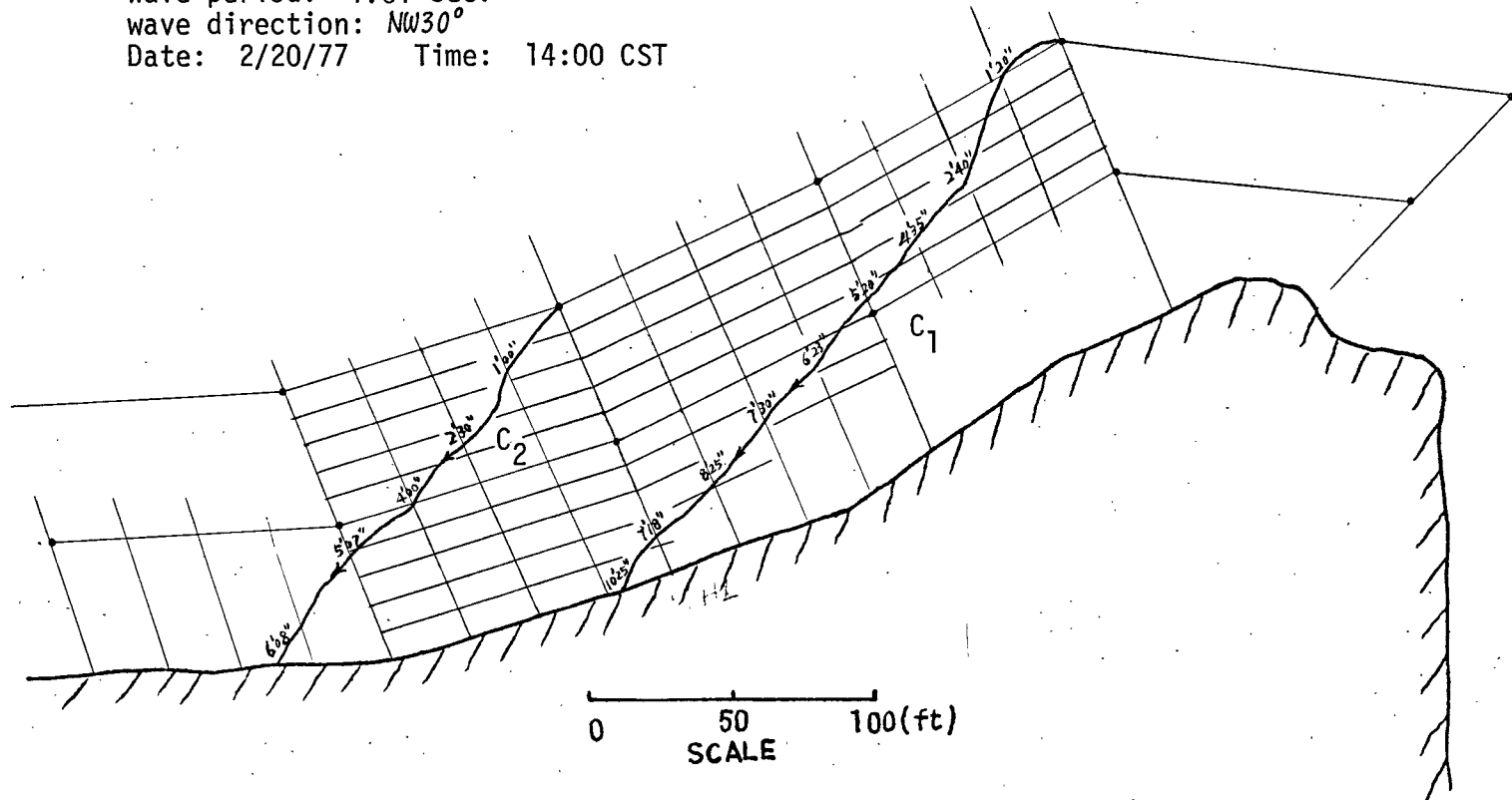


Figure 13b-4. Observed littoral current and wave parameters at site B

wave length: 8 ft.
 wave height: 0.7 ft.
 wave period: 1.61 sec.
 wave direction: $NW30^\circ$
 Date: 2/20/77 Time: 14:00 CST

Average current speed 0.41 fps

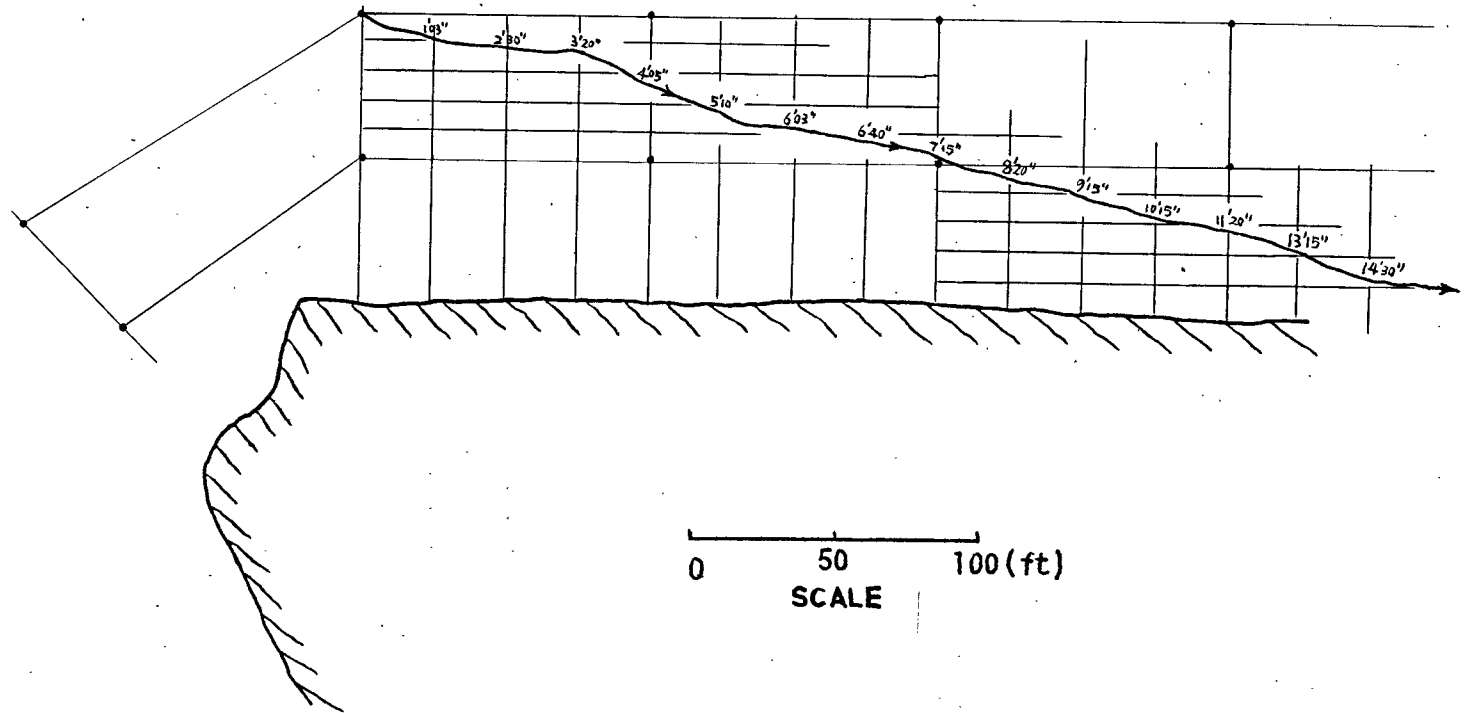
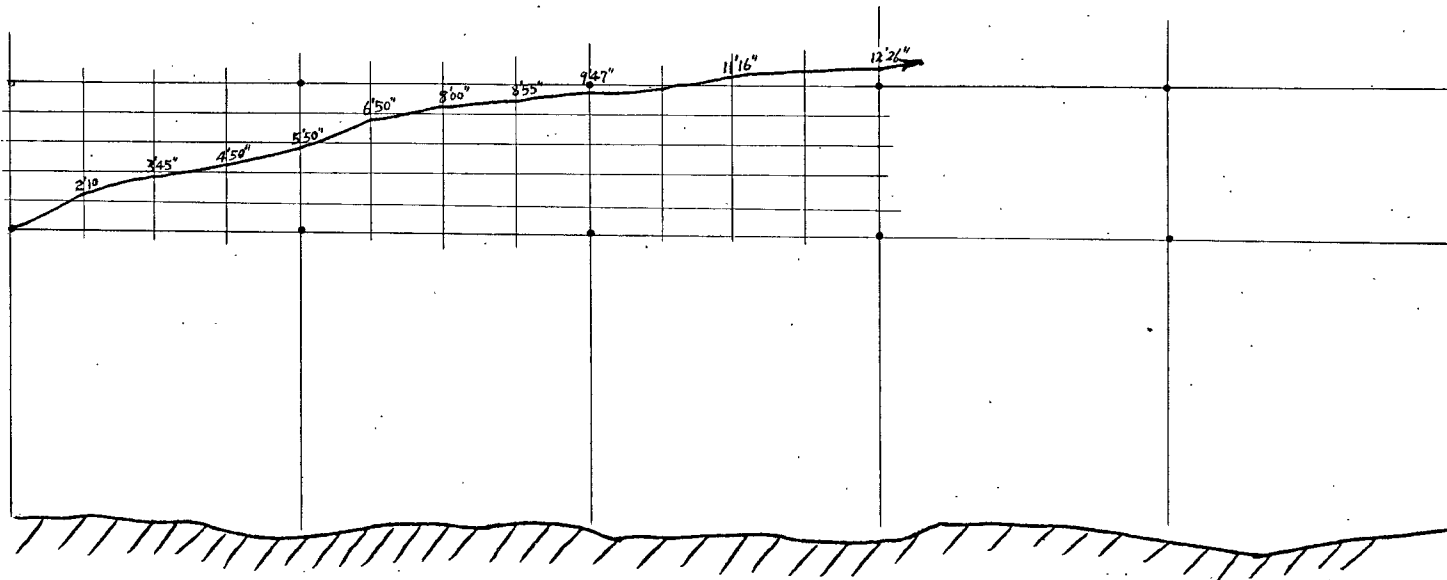


Figure 13b-5. Observed littoral current and wave parameters at site B

Date: 2/19/77 Time: 16:03 CST

Average current speed 0.40 fps

-50-



0 50 100 (ft)
SCALE

Figure 14a. Observed littoral current and wave parameters at site C

wave length: 10 ft.
 wave height: 0.7 ft.
 wave period: 1.75 sec.
 wave direction: NW30°
 Date: 2/20/77 Time: 13:00 CST

Average current speed: $C_1 = 0.67$ fps
 $C_2 = 0.57$ fps

-51-

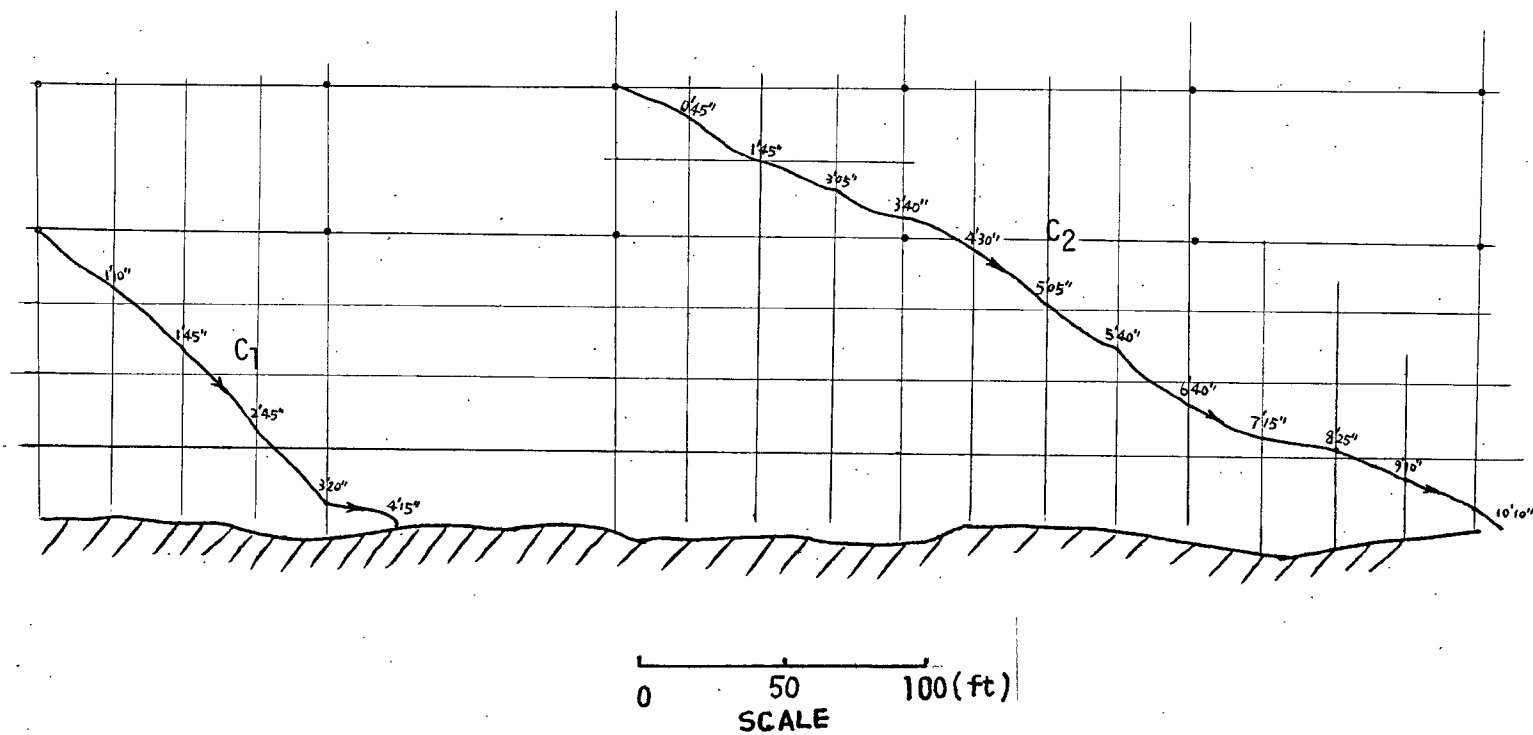
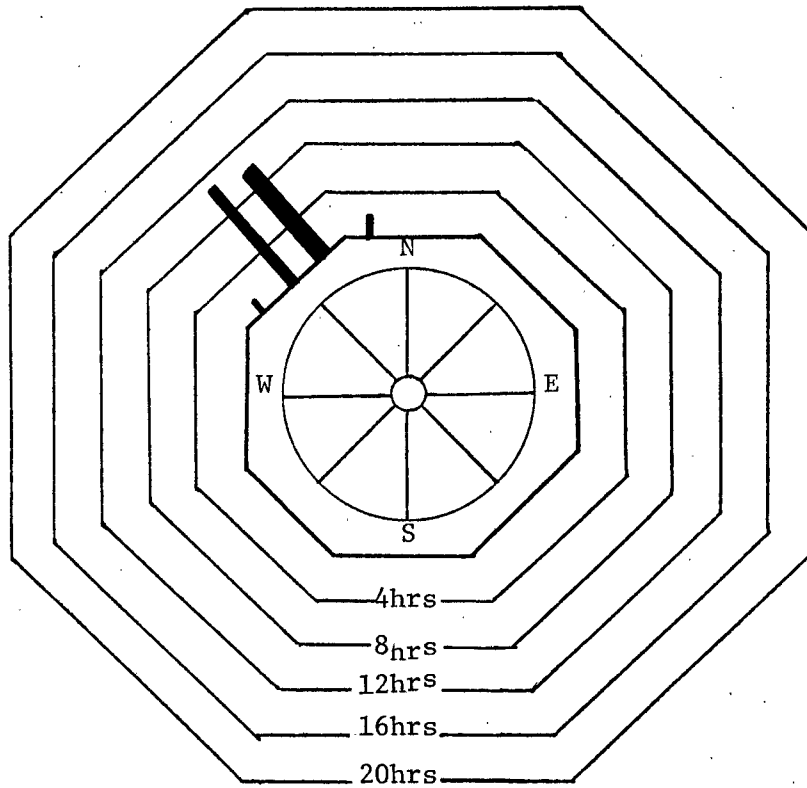





Figure 14b. Observed littoral current and wave parameters at site C



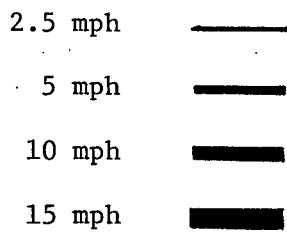
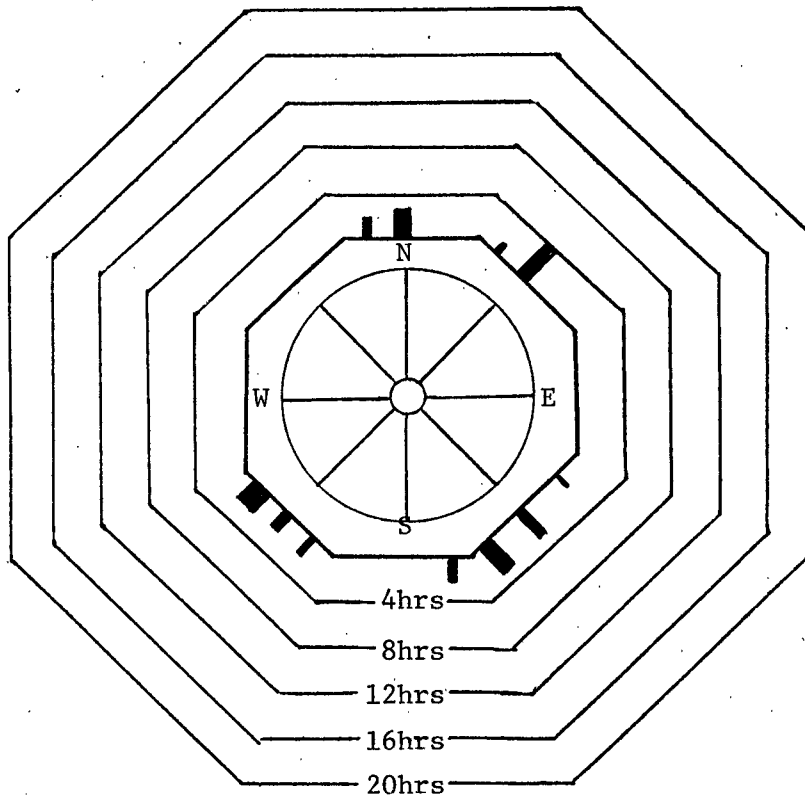
10 mph 
 15 mph 
 20 mph 

Location: Private pier, Avenida 22, Santa Rosa Island
 Date: 2/16/77

Location: Private pier, Avenida 22, Santa Rosa Island

Date: 2/16/77

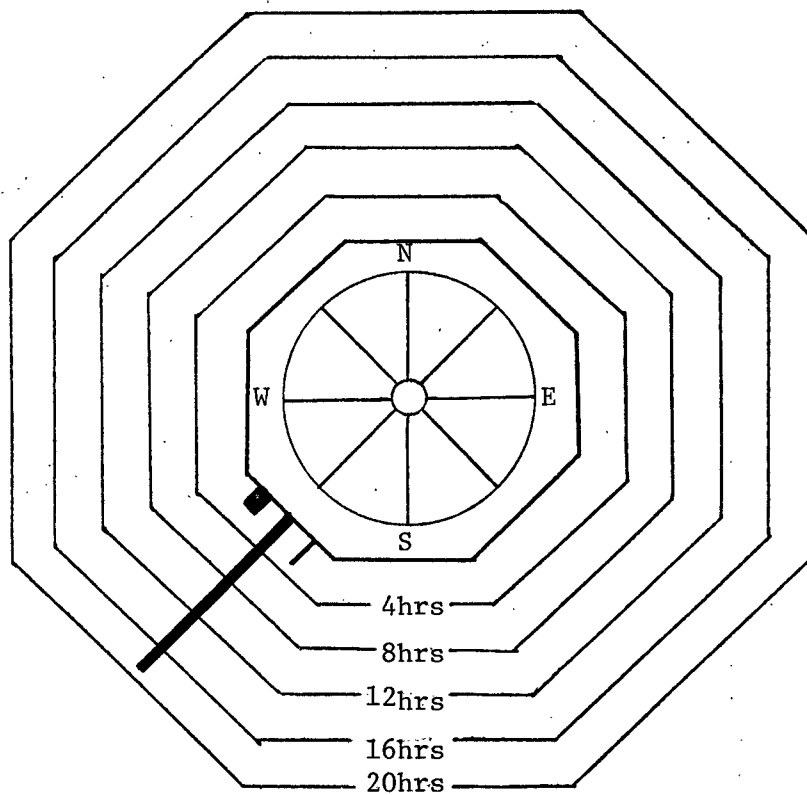
Figure 15a.. Wind records



Location: Private pier, Avenida 22, Santa Rosa Island

Date: 2/17/77

Figure 15b. Wind records

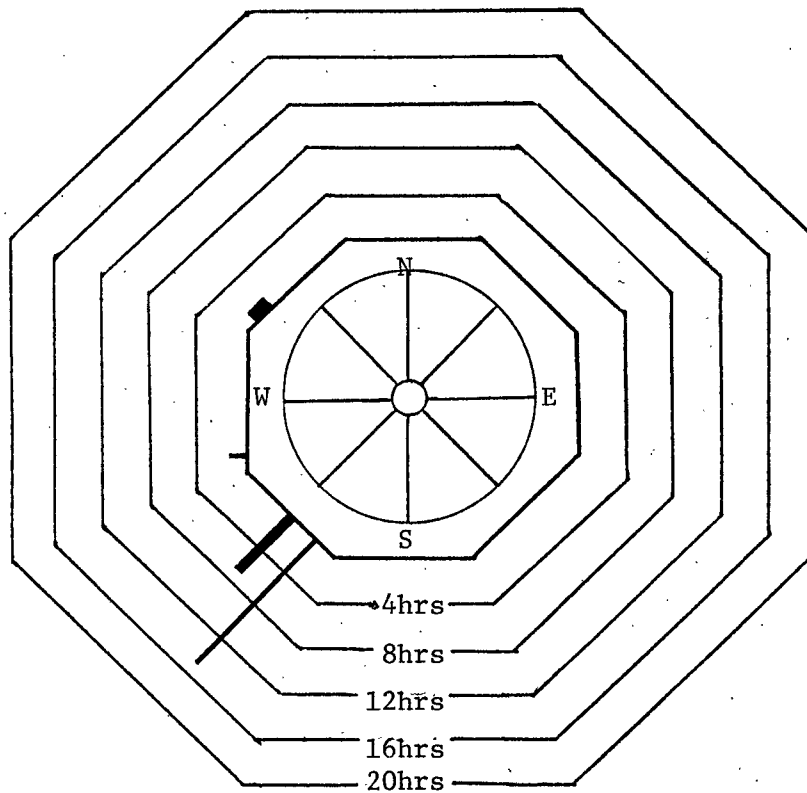


10 mph ———
 15 mph ———
 20 mph ———

Location: Private pier, Avenida 22, Santa Rosa Island

Date: 2/18/77

Figure 15c. Wind records



10 mph ———

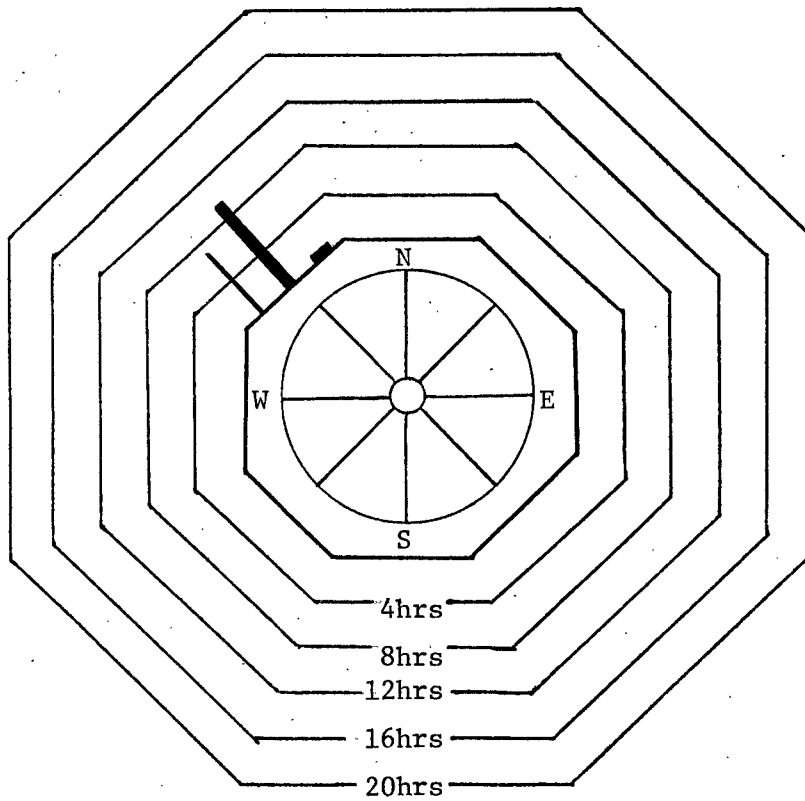
15 mph ———

20 mph ———

Location: Private pier, Avenida 22, Santa Rosa Island

Date: 2/19/77

Figure 15d. Wind records



15 mph ———

20 mph ———

30 mph ———

Location: Private pier, Avenida 22, Santa Rosa Island

Date: 2/20/77

Figure 15e. Wind records

Location: Private pier, Avenida 22, Santa Rosa Island

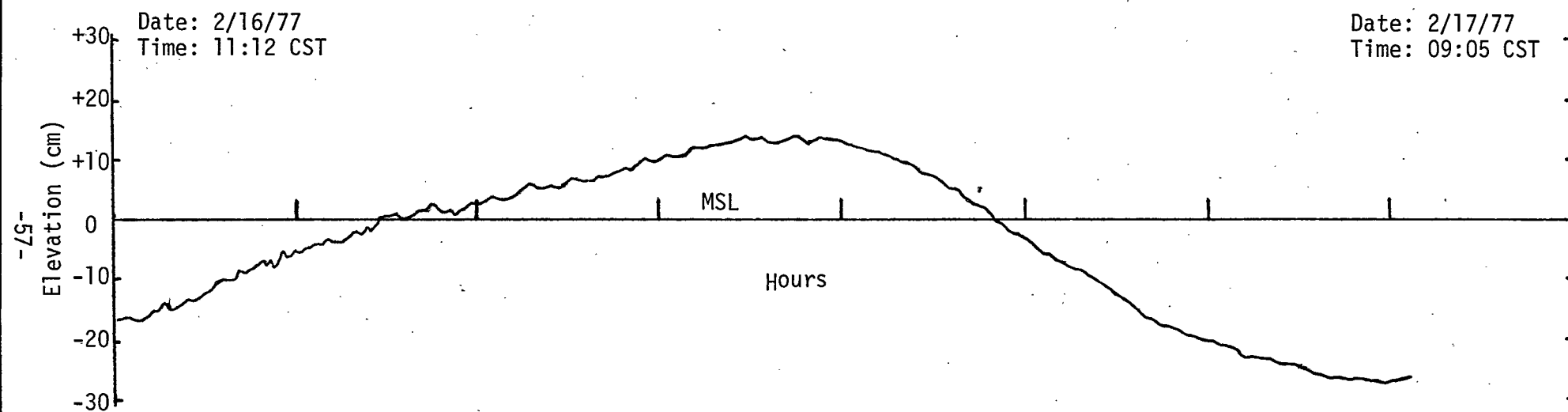


Figure 16a. Tide records

Location: Private pier, Avenida 22, Santa Rosa Island

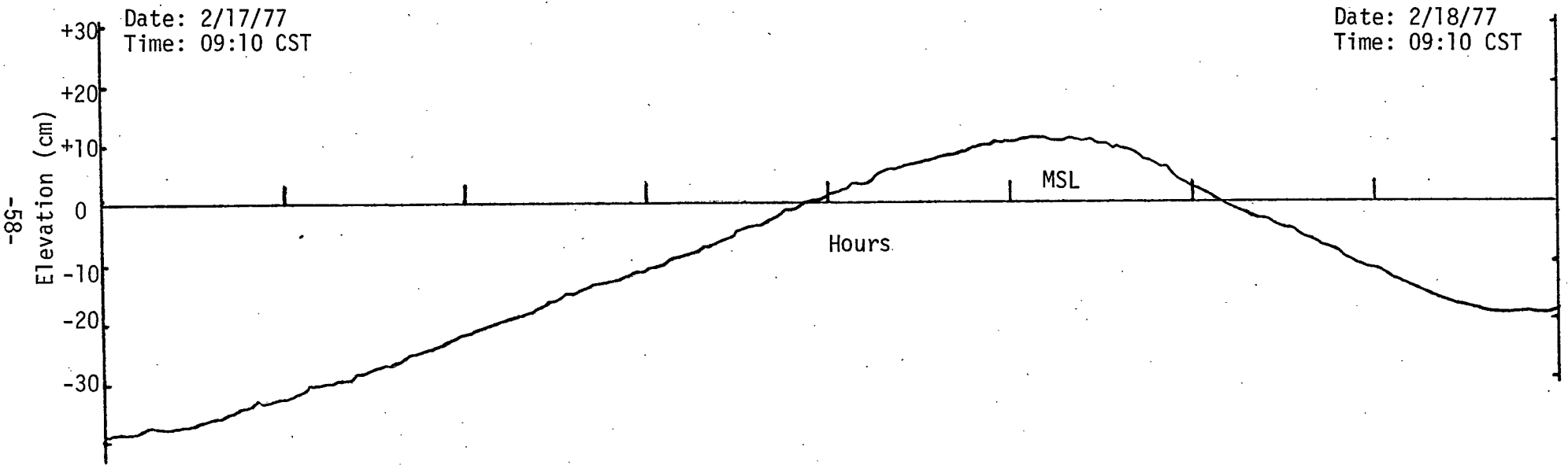
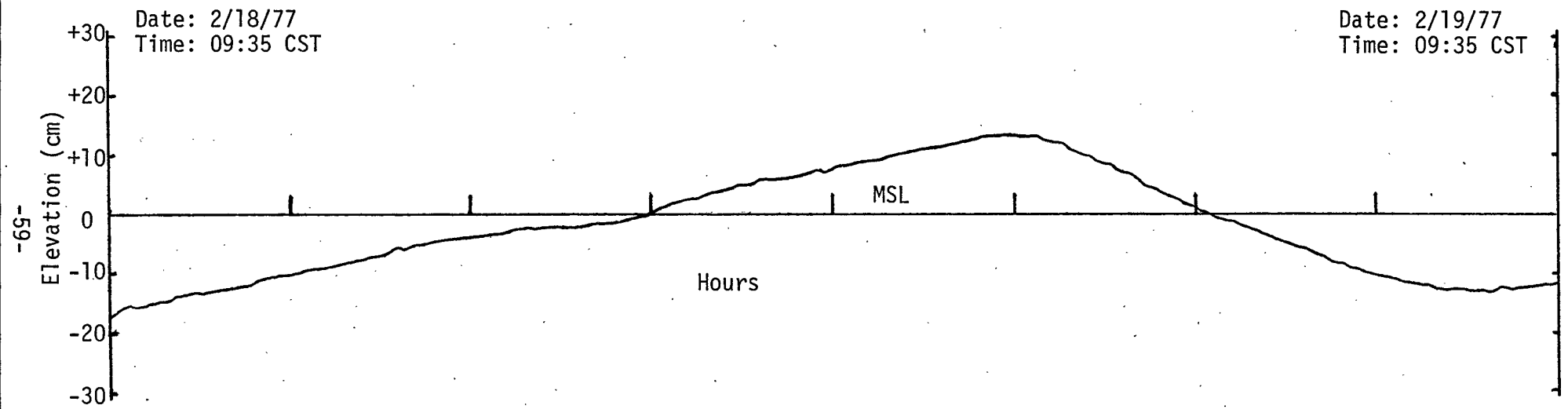


Figure 16b. Tide records

Location: Private pier, Avenida 22, Santa Rosa Island



Location: Private pier, Avenida 22, Santa Rosa Island

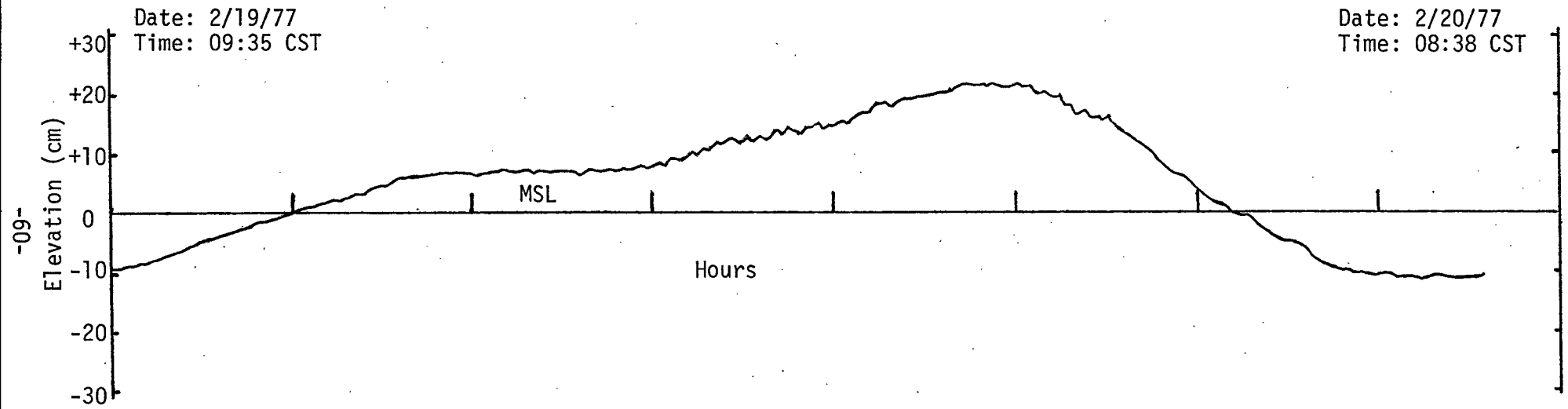


Figure 16d. Tide records

Location: Causeway bridge pier, Pensacola Beach

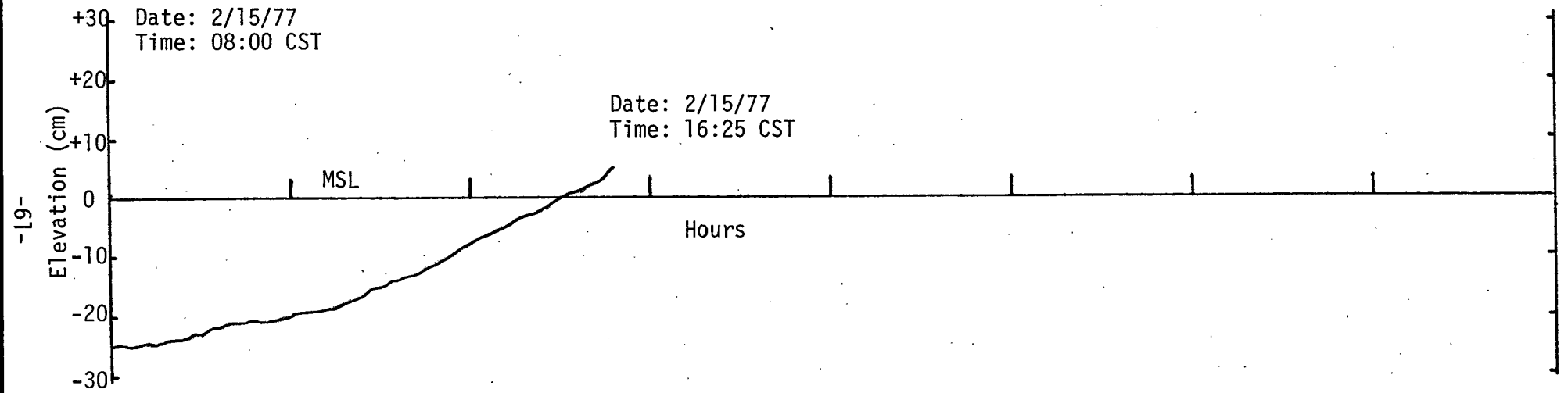


Figure 17a. Tide records

Location: Causeway bridge pier, Pensacola Beach

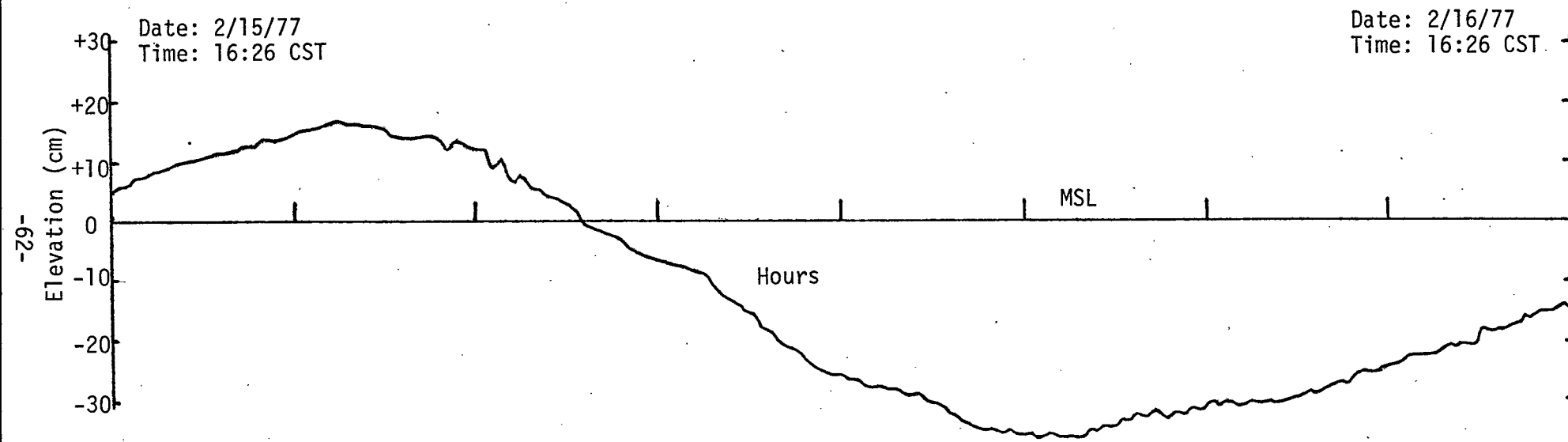


Figure 17b. Tide records

Location: Causeway bridge pier, Pensacola Beach

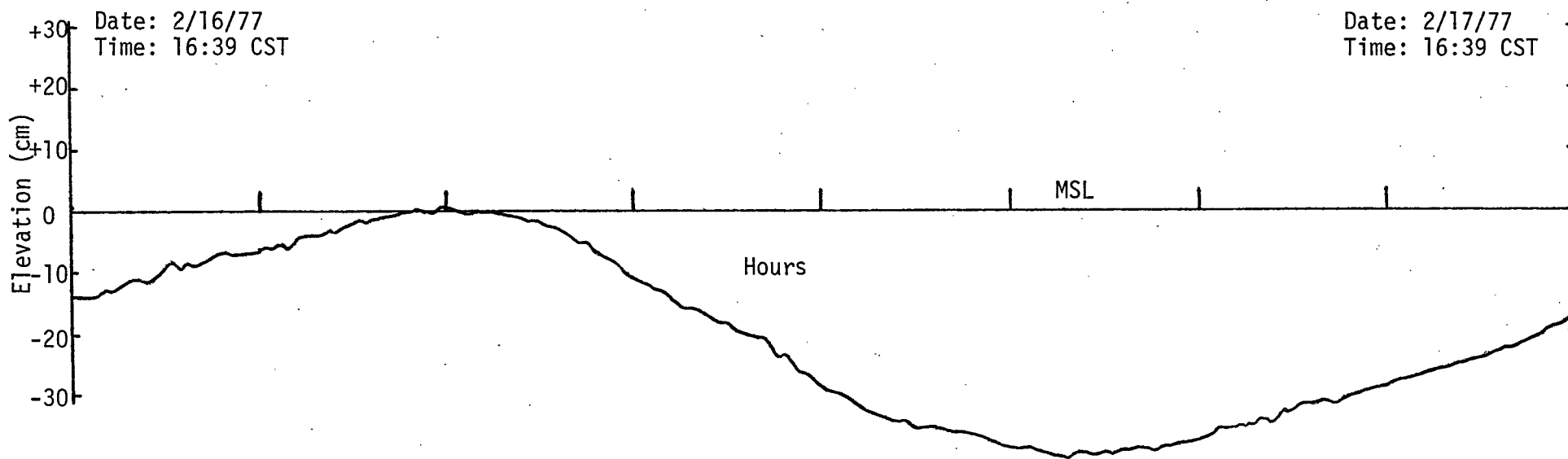


Figure 17c. Tide records

Location: Causeway bridge pier, Pensacola Beach

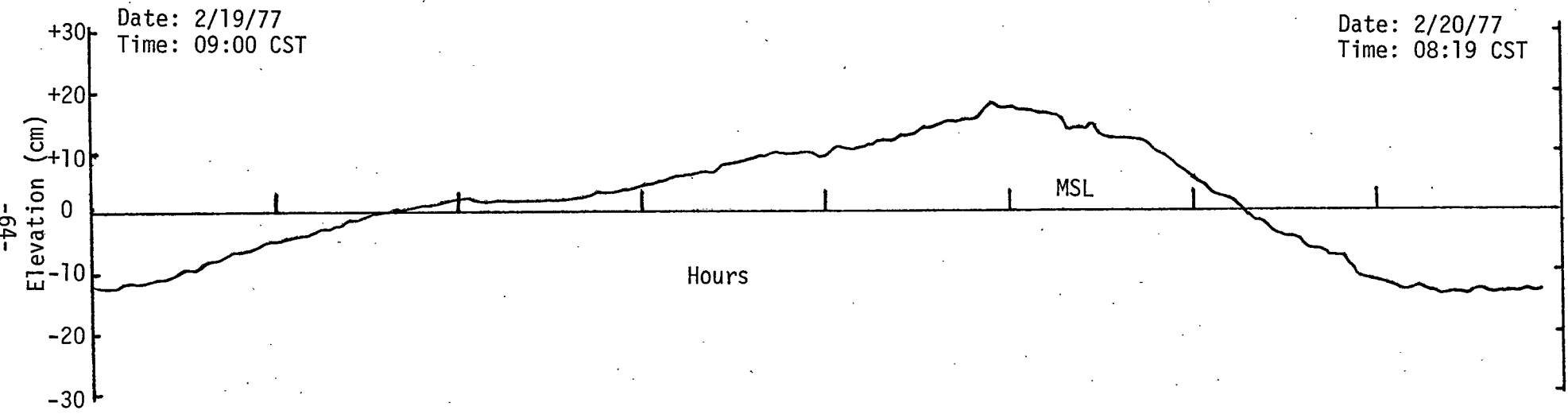


Figure 17d. Tide records

Location: Causeway bridge pier, Pensacola Beach

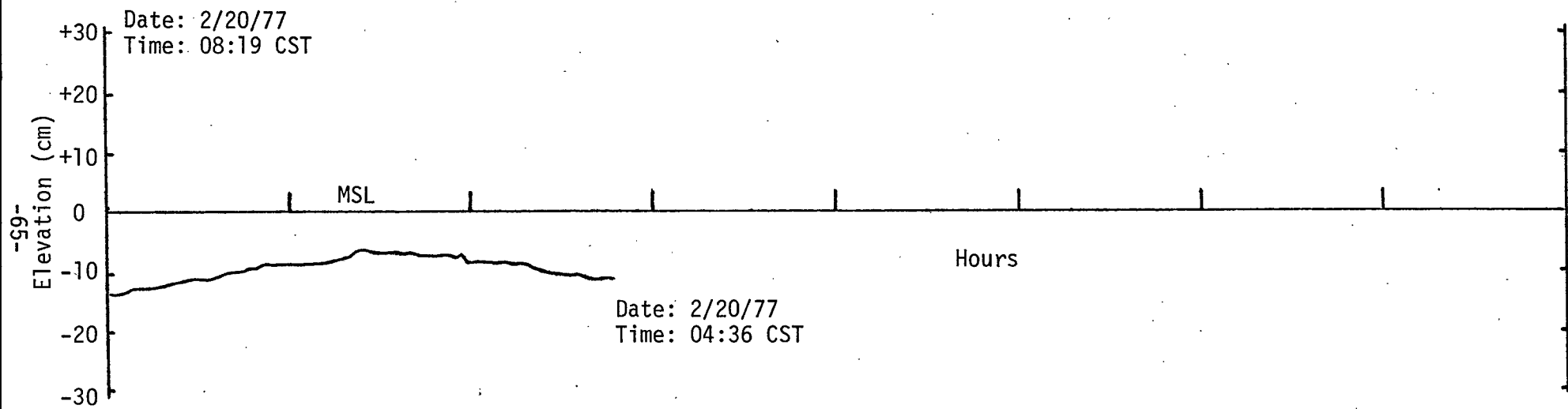


Figure 17e. Tide records