INDIAN POINT No. 2
ROUTINE MONTHLY THERMAL MONITORING
FOR NOVEMBER 1974

REPORT No. 5

JUNE 1976

Prepared By:

DAMES & MOORE

And

CONSOLIDATED EDISON COMPANY OF NEW YORK, INC.

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CON[...]K, INC.

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NUCLEAR AND EMISSIONS CONTROL ENGINEERING DEPARTMENT

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I. INTRODUCTION

This report presents the results of the fifth (I-1through I-5)* of a series of routine monthly thermal monitoring surveys concerning the thermal effluent from the Consolidated Edison Company of New York, Inc. (Con Edison) Indian Point Nuclear Generating Station, located at Buchanan, New York. The purpose of these surveys is to fulfill regulatory requirements imposed upon Con Edison by both the United States Atomic Energy Commission (AEC), now the United States Nuclear Regulatory Commission (NRC), through the Environmental Technical Specification Requirements for Indian Point Unit Nos. 1 and 2 (I-6), and the New York State Department of Environmental Conservation (NYSDEC), through the Section 401 Water Quality Certification for Indian Point Unit No. 2 (I-7). Indian Point Unit No. 2, with a licensed power level corresponding to an electrical output of 906 MWe (gross) was the only unit in operation at the time of the survey.

Hudson River water is drawn through separate intakes in front of each unit, passes through the once-through condenser cooling water system, and is released downstream of the plant through a common discharge structure (see Figure 1). Unit No. 2 operated at an average output of 700 MWe (gross) during the field operation reported herein, while Unit No. 1 was out of service in accordance with NRC regulations.

The thermal plume, down to at least 2°F excess temperature, was measured over five consecutive tidal phases (HWS, Ebb, LWS, Flood and HWS again) on November 20, 1974 from two mobile monitoring platforms. The ambient reference temperature and conductivity were obtained at a river cross section upstream from the plant (at the Bear Mountain Bridge) during both Ebb and LWS and at a river cross section downstream from the plant (at Croton Point) during both Flood and HWS. The intake and discharge temperatures were measured periodically in the intake forebay and in the discharge canal, respectively, during the field operation. The field procedure, equipment, and boats used in the survey are described in Section II. The results are presented and discussed in Section III.

The extent of the thermal plume was compared to the surface width and cross-sectional area constraints of the New York State Thermal Criteria. The width of the plume was

*Numbers in parenthesis refer to similarly numbered references and footnotes at the end of each section.

evaluated utilizing the three foot depth measurements as a reference datum. The employment of the three foot depth measurement as an upper layer datum for comparing the lateral width of the plume was concurred with by the New York State Department of Environmental Conservation (I-8). The methodology and rationale employed in the analysis of the Indian Point thermal effluent is discussed in detail in a previous report in this series (I-5).

The location of both the maximum cross-sectional area and maximum width of the river contained within the 4°F excess temperature isotherm occurred, for all tidal phases, in the immediate vicinity of the discharge.

The maximum extent of the thermal plume with respect to the lateral width and cross-sectional area constraints of the State Thermal Criteria was observed during low water slack, where the 4°F excess temperature isotherm occupied approximately 49% of the river's width and approximately 18% of the river's cross-sectional area. These values are well within the linear and cross-sectional numerical limits found in the New York State Thermal Criteria (I-9).

References and Footnotes

(I-1) "Indian Point No. 2 Routine Monthly Thermal Monitoring, Report No. 1, May 1974," prepared by Dames & Moore and Consolidated Edison Company of New York, Inc.

(I-2) "Indian Point No. 2 Routine Monthly Thermal Monitoring, Report No. 2, June 1974," prepared by Dames & Moore and Consolidated Edison.

(I-3) "Indian Point No. 2 Routine Monthly Thermal Monitoring, Report No. 3, July 1974," prepared by Dames & Moore and Consolidated Edison Company of New York, Inc.

(I-4) "Indian Point No. 2 Routine Monthly Thermal Monitoring, Report No. 3, Supplement, July 1974," Consolidated Edison Company of New York, Inc.

(I-5) "Indian Point No. 2 Routine Monthly Thermal Monitoring, for September 1974, Report No. 4," Dames & Moore and Consolidated Edison Company of New York, Inc.

(I-6) Appendix B to Facility Operating License DPR-26, Environmental Technical Specification Requirements, for Consolidated Edison Company of New York, Inc. Indian Point Nuclear Generating Units Numbers 1 and 2. Docket No. 50-3 and 50-287, USAEC, August 9, 1973.

(I-7) Letter of September 24, 1973 from Mr. James L. Biggane, NYSDEC, to Mr. Carl L. Newman, Con Edison.

(I-8) Letter of November 14, 1975 from Mr. Thomas Quinn, NYSDEC, to Mr. John Szeligowski, Con Edison.

(I-9) The New York State Thermal Criteria are found in the NYSCRR Part 704, Title 6.

II. FIELD EQUIPMENT AND PROCEDURE

On Thursday, November 20, 1974, mobile scans of the Indian Point thermal plume were conducted over five consecutive tidal phases (1-1/4 tidal cycles) by the Dames & Moore field team. Each scan consisted of a near field study and a far field study preceded by several vertical profiling and scanning transects across the river. On shore, intake and discharge temperatures were monitored periodically throughout the day.

A. EQUIPMENT

1. Near Field

The near field study was conducted from a power boat equipped with a Motorola Mini-Ranger for navigation and position determination, and an Endeco Model 156 data acquisition system for monitoring the temperature of the plume. Both instruments were interfaced with an analog digitizer allowing for position and time, and temperature at three depths to be automatically recorded on magnetic tape periodically at a predetermined rate.

The specific temperature monitoring equipment arrangement employed depended on the depth at which the plume data were obtained. For depths below 10 ft. the unit consisted of three thermistor probes connected to a towing chain. The probes were positioned on the chain and interfaced with the system so that water temperatures at three depths (minus 11, 17, and 23 foot) were obtained simultaneously. For the near-surface measurements, thermistors were fixed to a vertical pipe, resulting in readings at the surface, and 3 and 6 foot depths.

This boat was also employed to conduct temperature and conductivity profiling transects prior to each tidal phase in the vicinity of the Indian Point Generating Station. An Interocean Model 518 temperature monitoring unit in conjunction with a Hydrolab Model TC-2 conductivity meter was used to obtain temperature and conductivity as a function of depth, utilizing a graduated cable to obtain the depth.

2. Far Field First High Water Slack

The far field scanning data was acquired from a second boat, equipped similarly to the near field boat except that an Endeco Model 156 data acquisition system was employed in conjunction with a Motorola Mini-Ranger. Both instruments were interfaced with a magnetic tape cassette and a paper tape printer so that the data (position, time and temperature) were automatically recorded. The sensing unit consisted of three thermistor probes affixed to a towing chain, with a hydrodynamic fish suspended at the bottom of the chain. The probes were positioned such that water temperatures at the surface, 3 and 6 foot depths were measured. For all tidal phases the far field boat was also used to conduct static ambient profiles with a Hydrolab Model 6D Surveyor water analysis system. Data obtained were temperature and conductivity as a function of depth. In addition, the far field boat conducted ambient temperature scans using the thermistor chain.

3. Intake and Discharge

Intake and discharge temperatures were monitored with an Inter Ocean Model 518A temperature monitor that was calibrated against precision mercury thermometers.

B. PROCEDURE

1. Near Field

Each near field survey commenced with a temperature and conductivity profile at a transect running from the east shore to the west shore of the river (Transect bb' on Figure 4). This transect, located approximately 3000 ft. south of the discharge canal, consisted of taking temperature and conductivity measurements versus depth at five prepositioned stationary buoys placed across the width of the river.

Upon completion of this profiling transect, the near field scanning survey was initiated close to the center of the river. The vertical pipe was towed with probes at depths of 0, 3 and 6 feet; six to eight lines were run parallel to the discharge canal. Each successive parallel line was run closer to the discharge canal so that coverage was usually from the east shore out to about 1200 ft. from the shore. Each line began and ended where the surface temperature was less than 2°F above ambient or when, in the judgement of the supervisor, the scan intruded into the far field. Data were collected every two seconds; boat speed was about 7 mph.

After completion of the first level of scans, the same procedure was followed for the greater depths, save that the successive parallel lines were run in the opposite direction (i.e., from the east shore towards the river channel) and the thermistor chain was employed. The thermistor probes were fixed to the cable in such locations that, when towed at a 55° wire angle, the thermistors would be at 11, 17, and 23 foot depths. For the last three phases of the survey, the depths changed to 13.8, 16.2 and 18.7 feet due to damage to the probe towing system.

2. Far Field

Preceding each of the far field scans, both a profiling and a scanning transect were run to determine ambient river conditions. The profiling transect consisted of taking temperature and conductivity measurements versus depth at several predetermined stations across the width of the river. The profiling stations were distributed so as to be representative of the ambient conditions found over the width of the river. At ebb and LWS the transect was located north of the Indian Point site at the Bear Mountain Bridge, while on flood and HWS it was located south of the site at Croton Point (Transects xx' and yy' on Figure 4). The ambient or reference scanning transects consisted of shore to shore temperature scans using the thermistor chain deployed at three depths (0, 3 and 6 feet) at the same location as the ambient profiling transect. These scans were performed sequentially either before or after the ambient profiling transects. Ambient scanning transects were conducted during each tidal phase. Ambient profiling transects were also conducted during each tidal phase, save for the second HWS.

Upon completion of the determination of ambient reference conditions, the boat proceeded to the discharge area to start the far field thermal scan. The boat began tracing the position of the plume by zigzagging across the river. Boat speed was approximately 5 mph and thermistor depths were 0, 3 and 6 feet. Thermal data, navigational position and time were automatically recorded on magnetic tape cassettes, with the paper tape providing a visual record of the data. Each tidal phase mapping continued until plume temperatures less than 2°F above ambient were measured; viz, a shore scan wherein the plume temperature was less than 2°F above ambient.

3. Intake and Discharge

Intake temperatures were monitored at the northernmost and southernmost intake bays of Unit Nos. 1 and 2 Temperatures were monitored at bottom, 2/3 total depth, 1/3 total depth and surface. One set of measurements was taken at each intake bay.

Discharge temperatures were monitored at the same relative depths at one cross section of the canal. One set of measurements was taken on the east side of the canal, one on the west side and one in the middle.

Both the intake and discharge sequence were conducted during each tidal phase. A summary of intake and discharge data is presented in Table 5.

C. STATION OPERATING DATA

As previously mentioned, Indian Point Nuclear Generating Station Unit No. 2 operated at an average electrical output of approximately 700 MWe (gross) during the field operation while Unit No. 1 was off-line in accordance with NRC regulations during the entire survey period. The electrical generation for the Station during the day preceding the survey and the day of the survey is tabulated in Table 1 and illustrated in Figure 2.1. The circulating water flow rates for each unit are presented in Table 4. The total flow was 430,500 gpm.

The electrical generation and circulating water flow rates for both Lovett Unit Nos. 3, 4 and 5 and Bowline Unit Nos. 1 and 2 are presented in Tables 2 and 3 and illustrated in Figures 2.2 and 2.3, respectively. Lovett Unit Nos. 1 and 2 were not operating during this period. The average electrical generation during the survey for these downstream facilities was over 300 MWe for Lovett, and over 400 MWe for Bowline.

III. RESULTS

A. SUMMARY

Reference, or ambient, temperature and conductivity measurements were taken at either a northern transect at Bear Mountain Bridge (Transect xx', Figure 4) for the ebb and LWS thermal plume surveys or a southern transect at Croton Point (Transect yy', Figure 4) for the flood and HWS thermal plume surveys. These reference (ambient) baseline temperature measurements were obtained either outside the influence of artificial heat sources or in a region where such influence is minimal. These reference temperatures, as discussed in the previous reports in this series, are not necessarily equivalent to the ambient or natural temperature in the immediate vicinity of Indian Point (III-1 through III-5).

These reference measurements consisted of (a) temperature and conductivity profiles, obtained by taking temperature and conductivity measurements at various depths at several stations along each transect, and (b) temperature scans, obtained by towing the thermistor string from shore to shore at each transect and continuously recording the temperature at both the surface and several other depths. Examination of these ambient or reference temperature scans indicates the variation in ambient from shore to shore and also with depth. As discussed in previous reports, the scanning technique appears to be the preferable method for obtaining ambient because it covers a greater area than the profiling method. Its limitation, constricting the sampling to the upper portion of the river at these transects, is compensated for by the buoyant behavior of the thermal plume; i.e., the plume is primarily an upper layer phenomenon. It should be emphasized that these ambient reference measurements present the natural temperature distribution at the locale of these measurements only.

Computations for comparing the extent of the plume with the New York State Thermal Criteria were performed utilizing the computational procedure discussed in the September, 1974 routine monthly thermal survey report, namely, employing an upper layer datum as an index for evaluating the lateral extent of the plume. (See Table 9).

The area average ambient temperature for the Indian Point reach was obtained from a synthesis of the ambient reference temperature and salinity measurements conducted at the ambient reference transects (Croton Point and the Bear Mountain Bridge), and salinity measurements conducted at Indian Point. The longitudinal salinity distribution was employed to obtain the natural longitudinal area average temperature distribution. The surface temperature associated with the area average temperature at Indian Point was obtained by extrapolating the solar stratification at both Bear Mountain and Croton Point to Indian Point.

It was demonstrated in the September report (III-5) that employing the upper layer datum as the index results in both the maximum cross-sectional area and lateral width of the plume occurring at the same axial river locations. The maximum cross-sectional area of the river included within the 3.4°F excess temperature isotherm occurred during LWS, when approximately 20% of the river's cross-sectional area was contained within this isotherm. The maximum lateral extent of the river (at the upper layer datum) occupied by the 3.4°F excess temperature isotherm also occurred during LWS, with 52% of the river's width contained within this isotherm.

Tabulated values for the intensity and extent of the plume for the five successive phases of the tidal cycle that were examined are presented in Table 9. A discussion of the analyses and results is presented below.

B. DISCUSSION

1. Ambient

The ambient (natural) water temperature is the temperature that would exist without the influence of any artificial heat sources. The ambient water temperature varies spatially and temporally and is influenced by local meteorological and hydrological factors, the morphology of the river and the topography of the surroundings. This natural variation can be considerable in the Indian Point reach with temperature changes of about 2°F within a 3 hour period not an uncommon occurrence. (III-4).

The difference between the thermal plume temperature, due to artificial sources such as an electric generating station, and the ambient temperature defines the intensity and extent of the thermal plume. If the ambient natural temperature is spatially and temporally isothermal, one could go a sufficient distance either upstream or downstream outside the influence of the thermal discharge and determine the ambient temperature of the plume region. However, in the Indian Point reach (and for that matter most of the Hudson) the ambient temperature is a spatially and temporally varying quantity. The ambient temperature in the plume region is therefore obtained from ambient temperatures measured outside the region of the plume.

The ambient reference temperatures were obtained, as previously described, from a northern transect at Bear Mountain Bridge for the ebb and LWS (slack after ebb) measurements, and from a southern transect at Croton Point (some 50,000 feet south of the station) for the flood and HWS (slack after flood) measurements.

Two separate procedures were employed to evaluate ambient. The first, as described previously, involved the use of a fixed transect, located either at Bear Mountain or Croton Point. Several stations representative of the cross section of the river were selected, and temperatures at various depths were obtained. This static profiling pattern produces a grid-like representation of the temperature at the cross section. The second method employed involved the use of mobile monitoring instrumentation, whereby a temperature scan was made from shore to shore at the transect. This technique produced a continuous (data sampling and recording every three seconds) band of temperatures along the path of the vessel. Data for all tidal phases were obtained using the thermistor string at the surface, and at depths of approximately three and six feet.

Table 7 compares the average values (means) of the ambient transect data obtained by the two different techniques. The scan technique appears to be the preferred approach because it samples the entire river surface, whereas profiling provides discrete points which, depending upon the location of these points, may or may not be a truly representative sample. For example, the profile surface average at Bear Mountain was based on 2 to 3 points whereas the scan utilized sixty values. The scan technique, however, has a drawback in that it is impossible within the time frame of a tidal phase to conduct a scan at many depths and provide a quasi-synoptic picture of the entire ambient cross section.

The selection of a representative ambient temperature for the Indian Point reach must take into consideration the location of the reference ambient measurements, the river morphology, local meteorology, and the tidal phase under consideration. The procedures utilized to determine ambient have been discussed in detail in previous reports (III-4 and III-5). However, for continuity and completeness the salient aspects will be discussed here.

Figure 6.2 depicts the movement of a parcel of plume water from the beginning of flood tide (1200) through HWS (1728), when it experienced its maximum excursion upstream-a distance of approximately 15,000 ft from the intake. The Bear Mountain Bridge, which is located approximately 22,000 ft upstream of the intake, was unaffected by the plume and could provide a representative ambient if the water at Bear Mountain is thermally unaffected by natural sources during its travel downstream from Bear Mountain. However, this indeed was not the case (III-4). Water that passed Indian Point at ebb (0832) contained residual plume water. Water that reached Indian Point at LWS (1200) was in the vicinity of Bear Mountain Bridge sometime before maximum ebb. Examination of Figure 6.2 shows that a portion of the water passing Indian Point at flood (1439) on the 20th was presumably in the vicinity of the Bear Mountain Bridge on the previous day (III-5).

During its travel downstream to Indian Point, the upstream water would be influenced by the local meteorology and river morphology. Considering the latter first, it was previously shown (III-8) that because of the change in the configuration of the river, from a width of 1500 ft. at the Bear Mountain Bridge and Round Island to a width of over 6000 feet at Peekskill Bay, the surface layer would have a propensity to be influenced by the local meteorology. Table 10 presents meteorological data from the 400 foot Meteorological Tower located at the Indian Point site. The average air temperature on the day of the survey was 48°F, with ebb measurements being conducted during the coldest part of the day (42°F) with a warming trend for the rest of the day. There was light intermittent rain during most of the day, with limited visibility during mid-afternoon. Stratification due to solar heating (Figure 6.3), was smaller than in previous surveys due to prevalent weather conditions, with values for the difference between surface and 6 foot depth being approximately half in magnitude compared to the values calculated for the September, 1974 survey (III-5).

Similar rationale is utilized in the selection of ambient for flood and HWS. Neither Georges Island water nor Croton Point water reach Indian Point. If there was little or no difference between Bear Mountain measurements and Croton Point or Georges Island measurements, one could logically (but not always correctly) conclude that the longitudinal natural temperature profile is relatively flat between Bear Mountain and Haverstraw Bay. Croton Point was selected as a reference station because it was believed that, during the warmest months, surface heating would be less of an influence there than at Grassy Point (which is south of Verplanck), and thus result in a conservative reference temperature (see Figure 4).

The difficulty in the utilization of Croton Point arises when there is a considerable water temperature gradient between Bear Mountain and Croton Point. The

November 20, 1974 survey measurements, as seen in Table 7, showed scan differences of up to 1.1°F between these locations, with the Croton Point temperature higher than the Bear Mountain temperature. This contrast with the pattern of both the July ambient survey and the August intensive survey, wherein because of the influence of solar heating on the wide expanse in Croton and Haverstraw Bays, the temperatures recorded at at Croton Point were generally greater than the temperatures recorded at the Bear Mountain Bridge. The Bear Mountain temperatures were higher than the Croton Point temperatures during the September routine survey and during most of the October intensive survey. The decrease in absolute temperature from August to November follows the seasonal cooling trend of the river, which is influenced by decreasing air temperatures, cooler freshwater runoff, and cooler ocean temperatures.

The determination of an ambient temperature at Indian Point must be made from an evaluation of all the information available including the temporal changes in temperature at the transects taken at the baseline positions, a consideration of temperature well below the surface, an estimate of the natural changes in temperature as the river water flows downstream from the upstream baseline position at Bear Mountain, variations during the day from solar heating and atmospheric cooling, etc. It should be emphasized that water that is measured at Croton Point will never reach the Indian Point area. Water that is measured at the Bear Mountain Bridge during maximum ebb will, depending upon the prevailing tidal characteristics, pass Indian Point at LWS during the same tidal cycle or on the succeeding tidal cycle. Or stated differently, water that is at Indian Point during the maximum ebb and the LWS thermal plume surveys was at the Bear Mountain Bridge during the early ebb of this tidal cycle or some previous tidal cycle. Figure 6.2 depicts the convective transport distance, computed from tidal velocities, for the survey period. There is, therefore, a logistic problem in the following sense: to translate ambient temperature measurements conducted at Bear Mountain Bridge and Croton Point to an Indian Point ambient temperature. That is

$$Ta\,[p,\ t(1)\,] = Ta\,[r,\ t(2)\,] + \theta\ (x,t) \qquad (1)$$

where

$Ta\,[p,\ t(1)\,]$= ambient temperature in the plume region at time t(1)

$Ta\,[r,\ t(2)\,]$= ambient temperature in the reference region at time t(2)

θ (x,t) = ambient temperature spatial and temporal variations between plume regions and reference regions

As previously indicated, the factors that influence θ include local river hydrology and meteorology, and the morphological configuration of the river and its surroundings. The primary influence on θ would be the water temperature difference between the ocean water and the water over the dam at Troy. The water in the Indian Point reach is a mixture of ocean and fresh water, with the actual temperature distribution determined by the relative proportions of each, and by localized influences.

1.1 Temperature Salinity Relationship

Relationships are available in the literature that permit one to relate the temperature distribution in an estuary to the salinity gradient. Using the relationship presented by Edinger(III-9):

$$\frac{T(x) - Tr}{To - Tr} \propto \frac{S(x)}{So} \tag{2}$$

where T(x), Tr and To are the intermediate, upstream river, and ocean temperatures, respectively, and S(x) and So are the intermediate and ocean salinities, respectively. One can relate the Bear Mountain and Croton Point area average salinity and temperature accordingly:

$$\frac{T(CP) - T(BM)}{To - Tr} = \frac{K\,[\,S(CP) - S(BM)\,]}{So} \tag{3}$$

and the Indian Point and Bear Mountain area average temperatures and salinities as

$$\frac{T(IP) - T(BM)}{To - Tr} = \frac{K\,[\,S(IP) - S(BM)\,]}{So} \tag{4}$$

where K is a proportionality constant. Therefore,

$$T(IP) - T(BM) = [T(CP) - T(BM)]\,\frac{[S(IP) - S(BM)]}{S(CP) - S(BM)} \tag{5}$$

This enables one to compute the Indian Point area average temperature from the Indian Point salinity and the Bear Mountain and Croton Point area average temperatures and salinities. Setting

$$\Delta\theta(CP-BM) = T(CP) - T(BM) \quad (6)$$

$$\Delta S(IP-BM) = S(IP) - S(BM) \quad (7)$$

$$\Delta S(CP-BM) = S(CP) - S(BM) \quad (8)$$

the Indian Point area average temperature becomes

$$T(IP) = T(BM) + \Delta\theta(CP-BM) \frac{\Delta S(IP-BM)}{\Delta S(CP-BM)} \quad (9)$$

The above expression gives the area average ambient temperature at Indian Point. It now remains to compute the surface and near surface variation because there will be a departure from the area average temperature due to factors such as solar stratification. This departure can be expressed as

$$Ts = T + \delta \quad (10)$$

where Ts is the surface temperature, T is the area average temperature, and δ is the surface excess temperature.

Figure 6.3 depicts the daily variation in stratification at the ambient reference transects. The increase in surface warming during the daylight hours both at Bear Mountain and Croton Point is apparent. The surface stratification, i.e., the tendency for the surface to be warmer than the deeper layers is due primarily to short wave solar radiation. It is also influenced by factors such as wind induced mixing, vertical mixing, and local river morphology. Solar stratification is greater in shallow areas (i.e., Peekskill and Haverstraw Bays) and less in the deeper areas (i.e., Bear Mountain Bridge). The temperature rise due to solar stratification decreases with increasing depth. During daylight hours, one could theoretically extrapolate the solar stratification at Bear Mountain or Croton Point to Indian Point. The Bear Mountain value would be too conservative (i.e., underestimate the temperature rise), while the Croton Point (flood) value would tend to approximate the Indian Point rise during ebb and be less than the Indian Point rise during flood.

Therefore, utilizing Figure 6.3, one has

$$\delta(IP,FHWS) > \frac{\delta(CP,FHWS) + \delta(BM,Ebb)}{2} \qquad (11)$$

$$\delta(IP,Ebb) > \frac{\delta(BM,Ebb) + \delta(BM,LWS)}{2} \qquad (12)$$

$$\delta(IP,LWS) > \frac{\delta(BM,LWS) + \delta(CP,Flood)}{2} \qquad (13)$$

$$\delta(IP,Flood) > \delta(CP,Flood) \qquad (14)$$

$$\delta(IP,SHWS) > \frac{\delta(CP,Flood) + \delta(CP,SHWS)}{2} \qquad (15)$$

where $\delta(p,t)$ is the solar stratification at location p [i.e., Indian Point (IP) etc.] at tidal phase t [i.e., First High Water Slack (FHWS), etc.]. Equations (11), (12) and (13) are fairly straightforward. Because of the time proximity of the ebb, LWS and flood ambient reference temperatures, and the topographic and climatological factors previously discussed, equations (14) and (15) reflect the fact that the rate of decrease in solar stratification is less at Indian Point than at the ambient reference transects. A similar approach can be utilized to evaluate the stratification at the 3 foot depth.

The surface stratification term at Bear Mountain and Croton Point can be evaluated in either of two ways. It can be computed as the difference between the surface scan and the six foot depth scan temperature, or the difference in temperature between the surface scan temperature and the area average profile temperature. The former method contains the inherent assumption that at a depth of six feet the effect of solar stratification has diminished. Even with this assumption, this method is preferred, because the data base for the scan temperatures is more extensive than for the profile temperatures. For example, whereas the scan at Bear Mountain would include over 50 temperature measurements at a particular depth across the width of the river, profile data is obtained by lowering a probe and recording a single measurement at several depths at about 5 lateral locations along the ambient transects. The former method is also conservative when the effect of solar stratification extends to deeper depths, for this method would then underestimate the temperature rise due to solar heating.

An alternate and more tractable approach than computing the solar stratification would be to employ a datum that would minimize the effect of these spatial and temporal variations in temperature. The previous discussion demonstrated the value of utilizing the three foot measurement as a datum since natural fluctuations are reduced at this depth. An analysis of the November, 1974 survey plume data utilizing this approach will be employed below.

The effects of solar stratification have been reported upon in the literature. Measurements conducted in Lake Michigan disclose that surface solar heating effects of the order of over 3°F are not uncommon (III-11).

Examination of the reference ambient temperature patterns indicates that not only is there a natural variation with depth but there is also a natural variation laterally (i.e., shore to shore). This effect is more significant at Croton Point than at the Bear Mountain Bridge, because, as discussed previously, of the pronounced variation in river morphology in the Croton Point region.

Some conservatism was introduced by the selection of the excess temperature isotherm for the width and cross-sectional area computations. Generally, if the calculated value of the 4°F excess temperature isotherm was, for example 54.5°F, calculations were based on the next lowest mapped temperature, 54.0°F. This results in computed cross-sectional areas and widths that are greater than those obtained if one were to use exactly the 4°F excess temperature isotherm. It should be noted that the actual absolute temperature and not the excess temperature isotherms were plotted, thus avoiding an *a priori* decision on the value of ambient. Producing 0.1°F isotherm intervals on the maps would have rendered them impossible to read, thus 0.5°F and 1.0°F increments were selected for the mappings.

1.2 Sample Calculation (FHWS)

The Indian Point ambient surface datum is obtained by adding the computed surface solar stratification at Indian Point to the Indian Point area average temperature. The Indian Point solar stratification at the first HWS is obtained from Figure 6.3. As previously discussed, the solar stratification at Croton Point would normally be greater (at the same time and for the same meteorological conditions) than at Bear Mountain, and probably approximate the stratification at Indian Point.

Therefore, since the time of the FHWS plume measurements falls between the time of the FHWS and the ebb ambient reference measurements, and since the ebb measurements were conducted after the plume measurements, as well as later in the day, utilizing equation (11) would underestimate the stratification at Indian Point. That is, since

$$\delta(\text{CP,FHWS}) = 0.08°\text{F}$$

$$\delta(\text{BM, Ebb}) = -0.11°\text{F}$$

and

$$\delta(\text{IP,FHWS}) > \frac{\delta(\text{CP,FHWS}) + \delta(\text{BM,Ebb})}{2} \qquad (11)$$

$$\delta(\text{IP, FHWS}) > -0.01°\text{F}$$

a negligible surface solar stratification was used. Similarly, utilizing an upper layer datum equivalent to the area average temperature is a conservative estimate because it ignores the presence of solar stratification at the three foot depth.

2. Cross-Sectional Area and Width Computations

The percentage of the river's width and cross-sectional area contained within the 4°F excess temperature isotherm was computed utilizing both the surface and the three foot depth as a datum for each of the tidal phases examined.

2.1 First High Water Slack

Ambient for the Indian Point reach at first high water slack is obtained, as cited above, from a synthesis of the ambient reference measurements upstream (north) of the site at the Bear Mountain Bridge with those downstream (south) of the site at Croton Point, the origin of the tidal flood current. As previously discussed, although two ambients can be assigned to reflect the natural vertical variation in temperature for convenience identical upper layer and area average ambients were employed. The relevant data from Table 8 are:

First High Water Slack Data Survey

	Upper Layer Width Datum	Cross-Sectional Area
(1) Ambient Temperature (°F)	49.6	49.6
(2) 4°F Excess Temperature plus Ambient (°F)	53.6	53.6
(3) Temperature at utilized for plume analysis (°F)	53.0	53.0
(4) Difference, (3)-(1); Excess Temperature utilized for plume analysis (°F)	3.4	3.4
(5) Percentage of river's width contained within Excess Temperature isotherm (%)	34	--
(6) Percentage of river's cross-sectional area contained within Excess Temperature isotherm (%)	--	10

Note: The lateral width and cross-sectional area analyses listed in this and other tidal phase tables were both conducted at the same lateral locations.

The maximum upper layer index lateral extent of the 3.4°F excess temperature isotherm (53.0°F), as determined from Figure 7.8, occurs approximately 300 feet south of the discharge canal (site locale bb', Figure 4). The isotherm's width is approximately 1700 feet, which translates into a percentage river's width of about 34%.

The location and extent of the maximum cross-sectional area of the 3.4°F excess temperature isotherm can be determined from examining the isotherms obtained at the various depth intervals from the surface down to minus 23 feet. This cross section also occurs approximately 300 feet south of the discharge canal (site locale bb' in Figure 5),and occupies approximately 10 percent of the river's cross-sectional area. The cross-sectional temperature pattern at this locale is depicted in Figure 7.6.

2.2 Ebb

Ambient for the ebb plume measurements in the Indian Point reach is obtained, as with the other tidal phases, from the ambient reference temperature measurements conducted at the Bear Mountain Bridge and at Croton Point. The relevant data from Table 8 are:

Ebb

Data Summary

	Upper Layer Width Datum	Cross-Sectional Area
(1) Ambient Temperature(°F)	49.6	49.6
(2) 4°F Excess Temperature plus Ambient(°F)	53.6	53.6
(3) Temperature utilized for plume analysis(°F)	53.0	53.0
(4) Difference,(3)-(1); Excess Temperature utilized for plume analysis(°F)	3.4	3.4
(5) Percentage of river's width contained within Excess Temperature isotherm(%)	22	--
(6) Percentage of river's cross-sectional area contained within Excess Temperature isotherm(%)	--	5

The maximum lateral extent of the 3.4°F excess temperature isotherm (53.0°F) is obtained from Figure 8.9. It occurs approximately 300 feet south of the discharge structure, and has a linear extent of approximately 730 feet which translates into a percentage lateral extent of about 22%.

The location and extent of the maximum cross-sectional area contained within the 3.4°F excess temperature isotherm (53.0°F) can be realized from an examination of the isotherms obtained at the various depths. This cross section is also located approximately 300 feet south of the discharge canal. The cross-sectional temperature patterns at this location are presented in Figure 8.6. The cross-sectional area occupied by this excess temperature isotherm is approximately 8000 square feet or about 5% of the river's cross-sectional area.

As previously mentioned, the difficulty in differentiating the effect of the plume from the ambient surface temperature in the vicinity of Indian Point is well documented by the temperature patterns from this tidal phase. Figure 8.7 indicates that in the vicinity of the transmission line the 53.0°F isotherm is essentially confined to the surface. It is difficult, if not impossible, to discern what portion if any of this (isotherm) is due to the plume, and what portion is due to the natural tendency of the upper layer to be warmer than the subsurface layers. The solar stratification (i.e. surface temperature rise) of 0.1°F at Bear Mountain Bridge at 1100 should be noted: it is an indication of solar stratification (Figure 6.3).

It should be noted that as the plume travels down river (as illustrated in Figures 8.6, 8.7 and 8.9), the 53.0°F isotherm "disappears" at the 3 foot depth directly south of the transmission lines and occupies approximately 26% of the surface width but less than 1.0% of the cross-sectional area.

2.3 Low Water Slack

The relevant data for low water slack are:

Low Water Slack
Data Summary

	Upper Layer Width Datum	Cross-Sectional Area
(1) Ambient Temperature (°F)	49.6	49.6
(2) 4°F Excess Temperature plus Ambient (°F)	53.6	53.6
(3) Temperature utilized for plume analysis (°F)	53.0	53.0
(4) Difference, (3) - (1); Excess Temperature utilized for plume analysis (°F)	3.4	3.4
(5) Percentage of river's width contained within Excess Temperature isotherm (%)	52	--
(6) Percentage of river's cross-sectional area contained within Excess Temperature isotherm (%)	--	20

Note: The 4.0°F excess temperature isotherm occupied 49% of the river's width and 18% of the river's cross-sectional area at this tidal phase. This was the greatest extent of the 4.0°F excess temperature isotherms encountered during the survey.

The maximum lateral width of the 3.4°F excess temperature isotherm (53.0°F) at the upper layer depth can be estimated from Figure 9.8 as approximately 2600 feet, or about 52% of the river's width. This occurs at the discharge canal. The cross-sectional area contained within the 3.4°F excess temperature isotherm (53.0°F), obtained from the scans conducted at the various depths, is approximately 32,000 square feet, or about 20% of the river's cross-sectional area. This cross-sectional temperature pattern is illustrated in Figure 9.6.

As mentioned previously, the difficulty in determining the effect of solar stratification is shown in Figures 9.7 and 9.8, wherein the 3.4°F excess temperature isotherms (53.0°F) are approximately equal in magnitude at the surface and three foot depths. The volume occupied by the plume is at a maximum directly in front of the discharge and quickly diminishes in intensity on either side of the discharge.

2.4 Flood

Ambient for the Indian Point reach at flood is obtained, as discussed in detail above, from a synthesis of both the ambient reference measurements upstream of the site, at Bear Mountain Bridge, and the ambient reference measurements downstream of the site at Croton Point. Utilizing the data presented in Table 8 the following table can be constructed:

Flood
Data Summary

		Upper Layer Width Datum	Cross-Sectional Area
(1)	Ambient Temperature(°F)	49.6	49.6
(2)	4°F Excess Temperature plus Ambient(°F)	53.6	53.6
(3)	Temperature utilized for plume analysis(°F)	53.0	53.0
(4)	Difference,(3)-(1); Excess Temperature utilized for plume analysis(°F)	3.4	3.4
(5)	Percentage of river's width contained within Excess Temperature isotherm(%)	16	--
(6)	Percentage of river's cross-sectional area contained within Excess Temperature isotherm(%)	--	10

The maximum lateral width of the river occupied by the 3.4°F excess temperature isotherm (53.0°F), measured at the upper layer index depth, occurs in the vicinity of the discharge canal as can be seen from inspection of Figure 10.9. The lateral intrusion into the river at this location is approximately 820 feet, or about 16% of the width of the river.

The maximum cross-sectional area occupied by the 3.4°F excess temperature isotherm (53.0°F) occurs in the vicinity of the discharge canal. Utilizing Figure 10.7, which presents the cross-sectional temperature pattern at this location, approximately 10% of the river's cross-sectional area is found to be contained within this isotherm. For comparison, usage of Figure 11.1 shows that approximately 3% of the river's cross-sectional area is contained within the same excess temperature isotherm at Lents Cove. This is indicative of the limited volume of the river occupied by the plume.

2.5 Second High Water Slack

The relevant data for the day's second high water slack are:

Second High Water Slack Data Summary

	Upper Layer Width Datum	Cross-Sectional Area
(1) Ambient Temperature (°F)	49.6	49.6
(2) 4°F Excess Temperature plus Ambient (°F)	53.6	53.6
(3) Temperature utilized for plume analysis (°F)	53.0	53.0
(4) Difference, (3) - (1); Excess Temperature utilized for plume analysis (°F)	3.4	3.4
(5) Percentage of river's width contained within Excess Temperature isotherm (%)	22	--
(6) Percentage of river's cross-sectional area contained within Excess Temperature isotherm (%)	--	8

The maximum lateral width of the 3.4°F excess temperature isotherm (53.0°F) can be determined from Figure 11.5. This occurs in the vicinity of the outfall structure, and has a lateral intrusion of approximately 1100 ft, which translates into a percentage river's width of about 22%.

The cross-sectional area occupied by the 3.4°F excess temperature isotherm is determined from the plume scans conducted at the various depths. The maximum cross-sectional area contained within this isotherm also occurs in the vicinity of the discharge canal. Approximately 13,000 square feet, or 8% of the river's cross-sectional area, is contained within the 3.4°F excess temperature isotherm.

3. Conductivity

Conductivity profiles were obtained at a transect located south of the Indian Point discharge canal (Transect bb', Figure 4) during the first four phases of the tidal cycle. During flood and first high water slack profiles were also obtained at Croton Point, while the Bear Mountain Bridge transect was employed to obtain profiles for ebb and low water slack. The change in the vertical salinity gradient as the salt wedge moved past Indian Point can be traced from Figures 5.3, 5.4 and 5.5.

The average conductivity measurements obtained at the profiling transects are presented in Table 11. It can be seen that the area average conductivity obtained at Indian Point is more reflective of the conductivity obtained at the Bear Mountain Bridge rather than at Croton Point. Using the conductivity gradient (change in conductivity with longitudinal distance) as an index, the gradient between Croton and Indian Points is 1.8×10^{-2} umho/ft and 1.9×10^{-2} umho/ft at first HWS and flood, respectively, while the gradient between Bear Mountain Bridge and Indian Point is $-2. \times 10^{-4}$ and 1.0×10^{-3} umho/ft at ebb and LWS, respectively. One can therefore conclude, as discussed above, that Indian Point water would be more representative of Bear Mountain water than Croton Point water.

Reference and Footnotes

(III-1) "Indian Point No. 2 Routine Monthly Thermal Monitoring, Report No. 1, May 1974," prepared by Dames & Moore and Consolidated Edison Company of New York, Inc.

(III-2) "Indian Point No. 2 Routine Monthly Thermal Monitoring, Report No. 2, June 1974," prepared by Dames & Moore and Consolidated Edison Company of New York, Inc.

(III-3) "Indian Point No. 2 Routine Monthly Thermal Monitoring, Report No. 3, July 1974," prepared by Dames & Moore and Consolidated Edison Company of New York, Inc.

(III-4) "Indian Point No. 2 Routine Monthly Thermal Monitoring, Report No. 3 Supplement, July 1974," Consolidated Edison Company of New York, Inc.

(III-5) "Indian Point No. 2 Routine Monthly Thermal Monitoring, for September 1974, Report No. 4," Dames & Moore and Consolidated Edison Company of New York, Inc.

(III-6) Estuarine circulation is obviously a much more complicated process than what is presented herein, involving in addition to convection transport, diffusional mixing and transport, and density induced circulation.

(III-7) The width of the Hudson in the immediate vicinity of the discharge canal is approximately 5000 ft.

(III-8) This discussion of ambient is abstracted from the report "Indian Point Nuclear Generating Station Intensive Thermal Survey Program, August and October, 1974," prepared by Dames & Moore and Consolidated Edison Company of New York, Inc., March 1976. It is included for continuity in the text.

(III-9) "Estuarine Temperature Distribution" by John E. Edinger, Chapter IV in Estuarine Modelling, George H. Ward and William H. Espey, Jr. Editors, Tracor, Inc. Water Pollution Control Research Series No. 16070 02V 02171, Water Quality Office USEPA (1971).

(III-10) Garvine, R.W., "The Distribution of Salinity and Temperature in the Connecticut River Estuary," Journal of Geophysical Research, Vol. 80, No. 9, p. 1176-83(1975).

(III-11) Frigo, A.A., R.A. Paddock, and D.L. McCown, "Field Studies of the Thermal Plume from the D.C. Cook Submerged Discharge with Comparison to Hydraulic-Model Results," Water Resources Research Programs, Argonne National Laboratory, June 1975.

TABLE 1

INDIAN POINT ELECTRICAL GENERATION DURING SURVEY (1)

Date	Time	Unit 1	Unit 2
		-----------MWe(gross)-----------	
11/17/75	0200	OFF LINE	710
	0400		710
	0600		710
	0800		710
	1000		700
	1200		700
	1400		720
	1600		720
	1800		720
	2000		720
	2200		720
	2400		720
11/18/74	0200		710
	0400		710
	0600		710
	0800		710
	1000		720
	1200		710
	1400		710
	1600		710
	1800		710
	2000		710
	2200		720
	2400		720
11/19/74	0100		720
	0200		720
	0300		720
	0400		720
	0500		720
	0600		715
	0700		710
	0800		710
	0900		720
	1000		720
	1100		710
	1200		720

TABLE 1 (Cont'd)

INDIAN POINT ELECTRICAL GENERATION DURING SURVEY

Date	Time	------MWe(gross)---- Unit 1	Unit 2
11/19/74 (cont'd)	1300	OFF LINE	720
	1400		720
	1500		720
	1600		720
	1700		720
	1800		720
	1900		720
	2000		710
	2100		710
	2200		710
	2300		710
	2400		720
11/20/74	0100		720
	0200		720
	0300		720
	0400		715
	0500		715
	0600		710
	0700		710
	0800		720
	0900		720
	1000		720
	1100		720
	1200		720
	1300		720
	1400		720
	1500		720
	1600		700
	1700		535
	1800		390
	1900		520
	2000		715
	2100		720
	2200		720
	2300		720
	2400		720

(1) Source: High Tension Log Sheet, Indian Point Station, Unit No. 2.

TABLE 2

OPERATING CHARACTERISTICS OF LOVETT DURING SURVEY[1]

Date	Time	---Unit 3--- MWe (gross)	---Unit 4--- MWe (gross)	---Unit 5--- MWe (gross)
11/17/74	0400	OFF LINE	80	90
	0800		62	90
	1200		142	144
	1600		143	134
	2000		160	185
	2400		139	95
11/18/74	0400		67	90
	0800	28	155	165
	1200	50	152	199
	1600	49	165	200
	2000	50	177	200
	2400	39	105	138
11/19/74	0200	39	74	132
	0400	31	83	132
	0600	25	83	135
	0800	50	143	172
	1000	50	164	187
	1200	50	162	190
	1400	50	164	190
	1600	51	150	193
	1800	50	168	200
	2000	50	167	200
	2200	50	156	190
	2400	17	128	130

TABLE 2 (cont'd)

OPERATING CHARACTERISTICS OF LOVETT DURING SURVEY[1]

Date	Time	---Unit 3--- MWe(gross)	---Unit 4--- MWe(gross)	---Unit 5--- MWe(gross)
11/20/74	0100	16	130	118
	0200	16	128	105
	0300	16	128	92
	0400	16	76	92
	0500	16	70	92
	0600	16	75	92
	0700	28	136	121
	0800	50	143	173
	0900	50	162	190
	1000	50	170	200
	1100	50	169	200
	1200	50	165	200
	1300	51	165	200
	1400	50	165	200
	1500	50	165	200
	1600	50	170	100
	1700	50	172	100
	1800	50	175	175
	1900	45	145	170
	2000	15	145	194
	2100	OFF LINE	147	195
	2200		160	195
	2300		145	195
	2400		127	151

(1) Units 3, 4 and 5 have rated capacities of 75, 185 and 205 MW(e), respectively. Their condenser cooling water flow rates are 42,000 gpm, 104,300 gpm and 120,000 gpm for units 3, 4 and 5, respectively.

TABLE 3

OPERATING CHARACTERISTICS OF BOWLINE DURING SURVEY [1]

Date	Time	Unit 1	Unit 2
11/17/75	0400	OFF LINE	291
	0800		291
	1200		292
	1600		401
	2000		580
	2400		314
11/18/75	0400	OFF LINE	298
	0800		437
	1200		581
	1600		587
	2000		587
	2400		585
11/19/75	0200	OFF LINE	523
	0400		291
	0600		282
	0800		529
	1000		299
	1200		565
	1400		588
	1600		583
	1800		586
	2000		587
	2200		592
	2400		585

TABLE 3 (Cont'd)

OPERATING CHARACTERISTICS OF BOWLINE DURING SURVEY[1]

Date	Time	Unit 1 MW(e)	Unit 2 MW(e)
11/20/75	0100	OFF LINE	481
	0200		372
	0300		279
	0400		280
	0500		280
	0600		278
	0700		351
	0800		466
	0900		558
	1000		585
	1100		585
	1200		583
	1300		588
	1400		590
	1500		591
	1600	168	589
	1700	263	591
	1800	281	584
	1900	294	524
	2000	293	344
	2100	283	96
	2200	286	OFF LINE
	2300	282	
	2400	279	

(1) The rated capacity of Units 1 and 2 are each 624 MW(e) gross. Their circulating water flow rates were 256,000 gpm per unit during the survey period.

TABLE 4

CHARACTERISTICS OF THE INDIAN POINT CIRCULATING WATER SYSTEM

		UNIT 1	UNIT 2
A)	System Flow Capacity		
	1. Circulating Water System		
	Number of pumps	2	6
	Full Flow rate/pump(gpm)	140,000	140,000
	Reduced Flow rate/pump(gpm)	84,000	84,000
	2. Service Water System		
	Number of Conventional Pumps	2	3
	Flow rate/pump(gpm)	16,000	5,000
	Number of Nuclear Pumps	4	3
	Flow rate/pump(gpm)	1,500	5,000
B)	Survey Flow - November 20, 1974		
	1. Circulating Water System		
	Number of Operating Pumps	1	4
	Average Circulating Water Average Flow rate(gpm)	74,000	314,500
	2. Service Water System		
	Service Water Flow rate(gpm)	22,000	20,000
	3. Total Flow Rate(gpm)	96,000	334,500

TABLE 5

INDIAN POINT INTAKE AND DISCHARGE TEMPERATURES

Tidal Phase	UNIT ONE INTAKE			UNIT TWO INTAKE			DISCHARGE CANAL			
	Time	Temperature (°F) North Bay	Temperature (°F) South Bay	Time	Temperature (°F) North Bay	Temperature (°F) South Bay	Time	Temperature (°F) East Wall	Temperature (°F) Mid Canal	Temperature (°F) West Wall
First HWS	0600	51.3	51.3	0535	51.3	51.3	0637	70.9	70.9	71.1
Ebb	1007	50.7	50.7	0828	51.0	51.0	0920	70.8	70.8	71.0
LWS	1224	51.7	51.9	1201	50.4	50.7	1248	70.3	70.1	70.1
Flood	1450	52.1	52.3	1430	51.0	51.4	1505	71.3	71.3	71.4
Second HWS	1648	51.4	51.9	1710	51.6	51.8	1619	70.7	70.8	71.0

Note: Intake temperatures were obtained at the north and south bays of both units at four equidistant depths from surface to bottom. Discharge canal temperatures were obtained at one cross section at the same depth intervals, near the west wall, east wall and mid channel.

TABLE 6

RIVER GAUGE FLOW OVER TROY LOCK

(INCLUDING POWER HOUSE)

DATE	FLOW - (CFS)	DATE	FLOW - (CFS)
October 1	14.400	November 1	6,820
2	12,400	2	6,880
3	11,600	3	6,100
4	10,800	4	6,030
5	10,400	5	7,480
6	9,360	6	16,760
7	9,070	7	15,070
8	8,780	8	14,360
9	8,590	9	11,830
10	8,570	10	10,680
11	7,880	11	9,900
12	7,500	12	9,240
13	6,970	13	20,420
14	6,890	14	24,260
15	7,680	15	20,120
16	9,880	16	19,170
17	11,300	17	16,770
18	11,000	18	14,150
19	10,400	19	13,770
20	9,290	20	14,420
21	7,720	21	29,820
22	9,540		
23	8,480		
24	8,600		
25	8,450		
26	8,110		
27	7,530		
28	6,650		
29	7,320		
30	7,390		
31	8,580		

TABLE 7

AMBIENT REFERENCE TEMPERATURE

		Average Scan Transect Temperature (°F)			Profile Transect Temperature (°F)	
Tidal Phase (and times)	Location	Zero Foot Depth	Three Foot Depth	Six Foot Depth	Surface Average	Area Average
First High Water Slack (0340)	Croton Point	49.80	49.44	49.72	51.1	51.1
Ebb (0735)	Bear Mountain Bridge	49.85	50.06	49.96	50.0	50.0
Low Water Slack (1055)	Bear Mountain Bridge	49.42	49.13	49.29	49.4	49.4
Flood (1350)	Croton Point	50.25	50.21	50.07	51.2	50.9
Second High Water Slack (1525)	Croton Point	49.87	49.56	49.71	---	---

TABLE 8

AMBIENT TABULATION - INDIAN POINT REGION

Tidal Phase	Surface Average Temp. (°)	Upper layer (3 ft. depth) Average Temperature (°F)	Area Average Average Temp. (°F)
First High Water Slack	49.6	49.6	49.6
Ebb	49.6	49.6	49.6
Low Water Slack	49.8	49.6	49.6
Flood	49.8	49.6	49.6
Second High Water Slack	49.8	49.6	49.6

TABLE 9

PERCENTAGE WIDTHS AND CROSS-SECTIONAL AREAS -

COMPARISON WITH NEW YORK STATE THERMAL CRITERIA

	Width		Area	
Tidal Phase	Excess Temperature (°F)	Percentage Width (%)	Excess Temperature (°F)	Percentage Cross-sectional Area (%)
First High Water Slack	3.4	34	3.4	10
Ebb	3.4	22	3.4	5
Low Water Slack*	3.4	52	3.4	20
Flood	3.4	16	3.4	10
Second High Water Slack	3.4	22	3.4	8

* The 4.0°F excess temperature isotherm (53.6°F) occupied a maximum of 49% of the river's width and a maximum of 18% of the river's cross-sectional area at this tidal phase. This was the greatest extent of the 4.0°F excess temperature isotherm encountered during the survey.

TABLE 10

METEOROLOGICAL DATA AT INDIAN POINT

INDIAN POINT 400 FOOT TOWER

November 20, 1974

HOUR ENDING AT	AMBIENT TEMP. 33' (°F)	DEW POINT 33' (°F)	WIND SPEED 33' (°F)	WIND SPEED 400' MPH	NET RADIATION (cal/cm²/min) I.P.	C. Park*
0100	47	39	2	8	-0.07	0.0002
0200	46	37	1	6	-0.04	0.003
0300	47	37	1	6	-0.07	0.028
0400	47	36	1	6	-0.07	0
0500	45	37	1	6	-0.07	0
0600	44	36	1	4	-0.19	0
0700	43	37	1	6	-0.26	0
0800	42	39	0	4	-0.26	0.002
0900	44	43	0	5	-0.15	0.003
1000	45	44	1	10	-0.07	0.028
1100	47	46	3	12	-0.04	0.026
1200	46	47	3	14	0.00	0.008
1300	48	48	2	10	0.00	0.003
1400	49	48	2	12	0.00	0
1500	50	50	3	15	0.00	0
1600	50	50	4	13	-0.04	0
1700	51	50	3	12	-0.07	0
1800	51	51	3	14	-0.07	0
1900	51	50	4	12	-0.07	0
2000	50	49	3	10	-0.11	0
2100	50	48	2	6	-0.15	0
2200	50	47	4	7	-0.19	0
2300	51	45	8	13	-0.19	0
2400	51	44	9	19	-0.22	0

* National Weather Service, Central Park Station

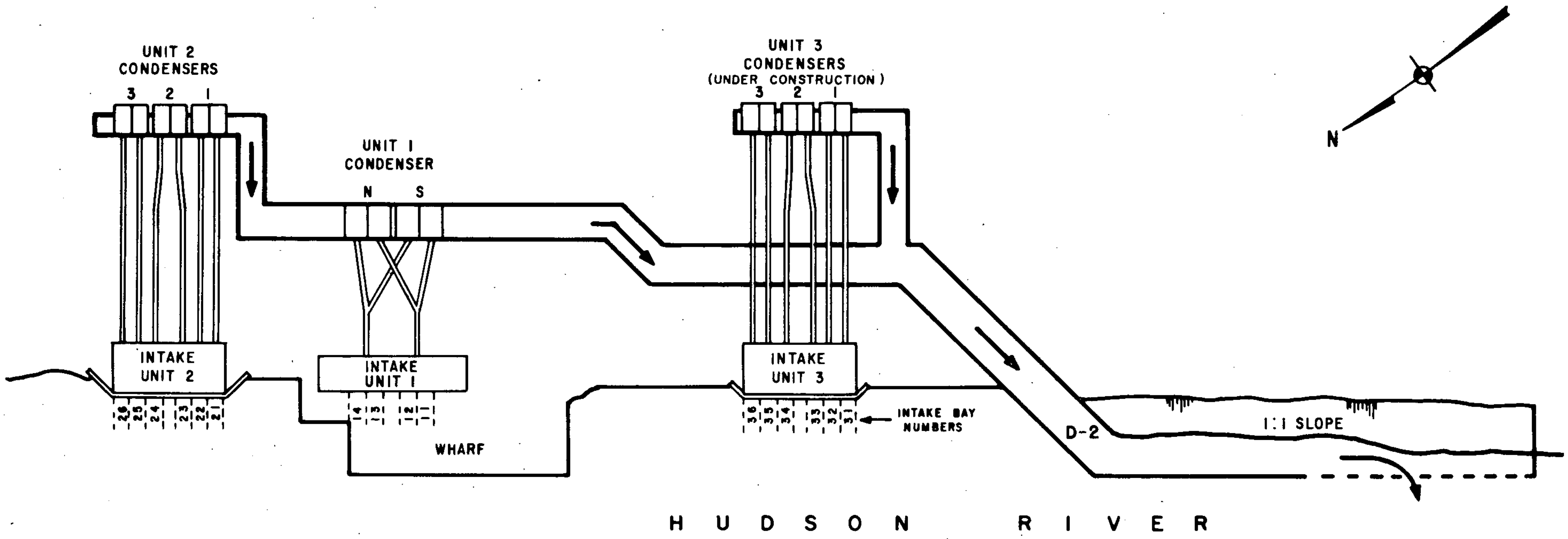
TABLE 11

CONDUCTIVITY MEASUREMENTS

	AREA AVERAGE CONDUCTIVITY (umho) X10^2			SURFACE AVERAGE CONDUCTIVITY (umho) X10^2			BOTTOM AVERAGE CONDUCTIVITY (umho) X10^2		
TIDAL PHASE	Croton Point	Indian Point	Bear Mountain	Croton Point	Indian Point	Bear Mountain	Croton Point	Indian Point	Bear Mountain
First HWS	12.6	3.7		11.6	3.4		12.9	3.6	
Ebb		2.6	2.7		2.6	2.7		2.7	2.7
LWS		2.8	2.3		2.8	2.3		2.8	2.3
Flood	12.9	3.3		10.5	3.0		13.1	3.2	

(1) Maximum Depth of Measurements was 70 feet

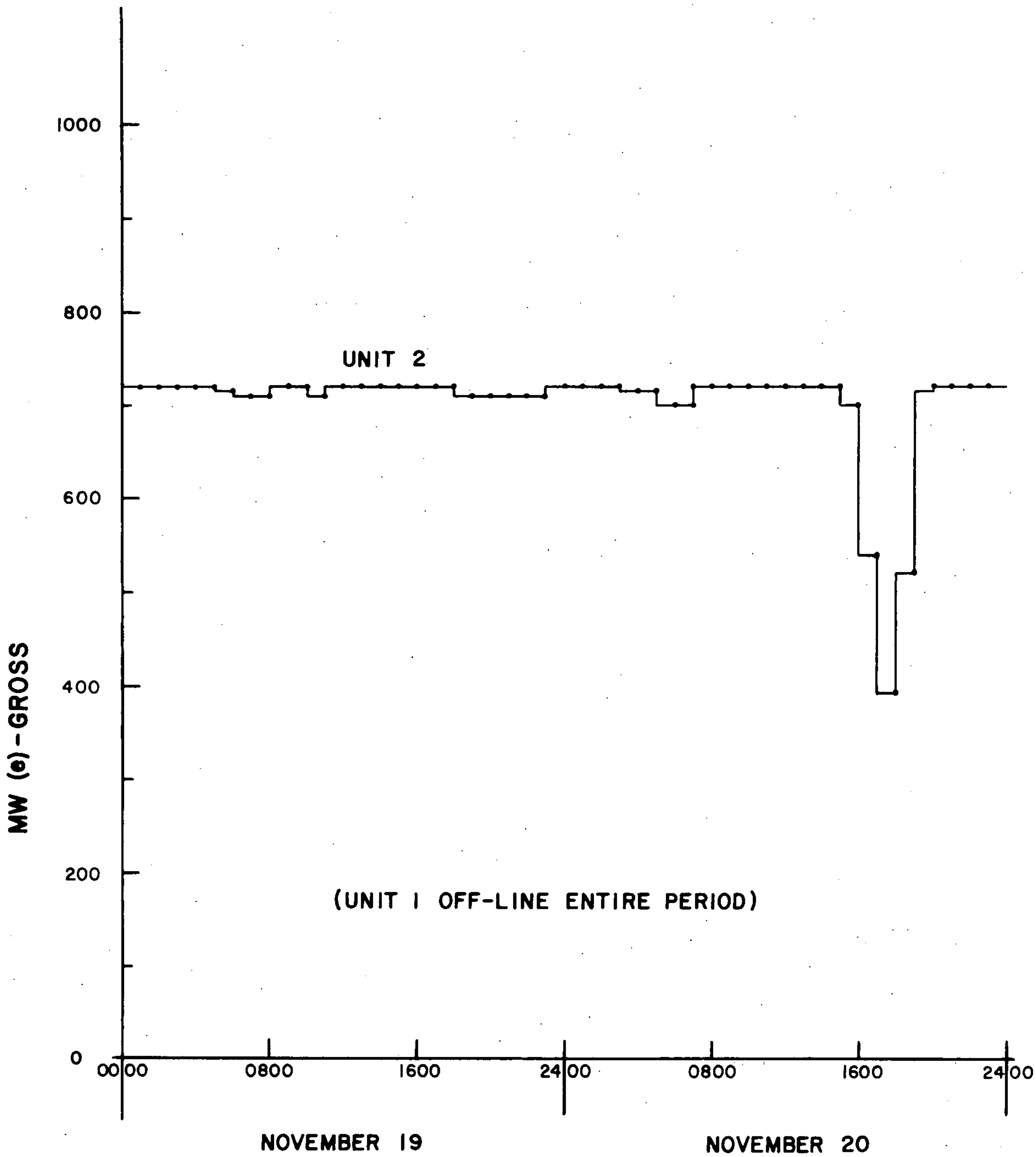
CIRCULATING WATER SYSTEM



INDIAN POINT STATION
CIRCULATING WATER SYSTEM

FIGURE 1

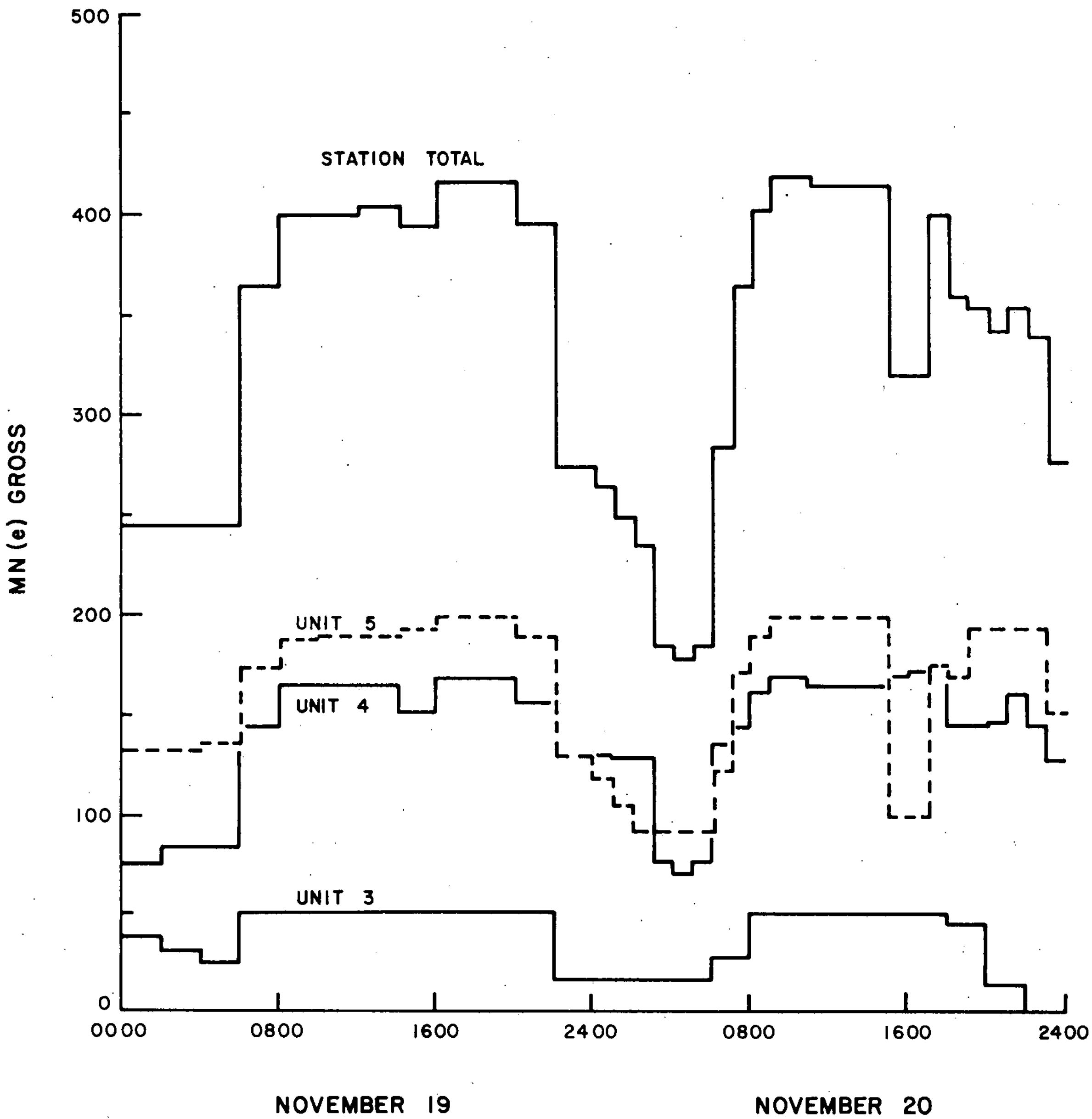
CE - EC
DWG. № 76-77



INDIAN POINT STATION
ELECTRICAL OUTPUT
NOVEMBER 19 AND 20, 1974

FIGURE 2.1

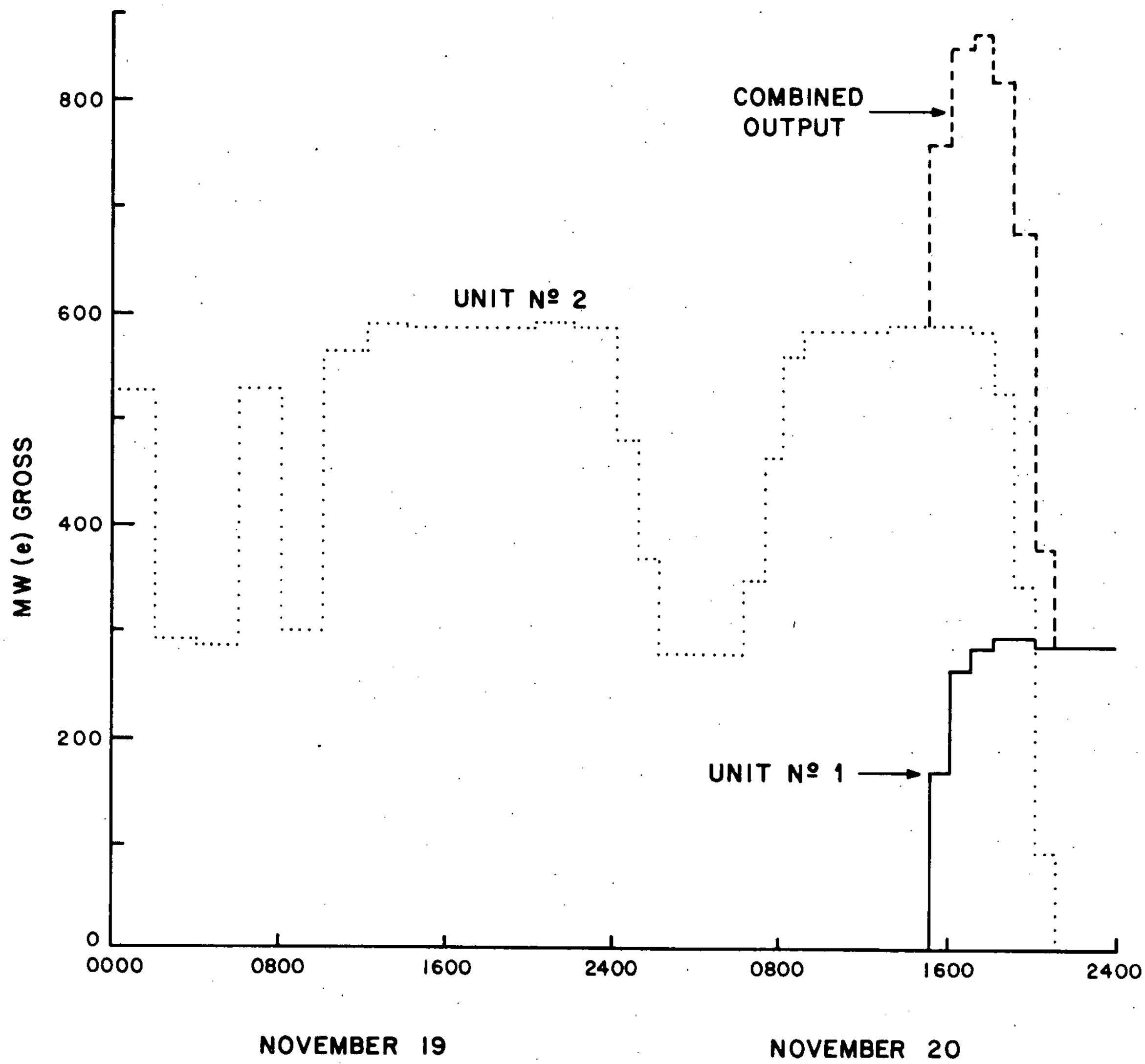
CE - EC
DWG. Nº 76-144



LOVETT STATION
ELECTRICAL OUTPUT
NOVEMBER 19 AND NOVEMBER 20, 1974

FIGURE 2.2

CE - EC
DWG. Nº 76-79



BOWLINE STATION
ELECTRICAL OUTPUT
NOVEMBER 19 AND 20, 1974

FIGURE 2.3

DAILY SURFACE WATER TEMPERATURES AT TROY DAM AND THE BATTERY, 1974

REFERENCE: BATTERY – NOS, NOAA
TROY – USGS

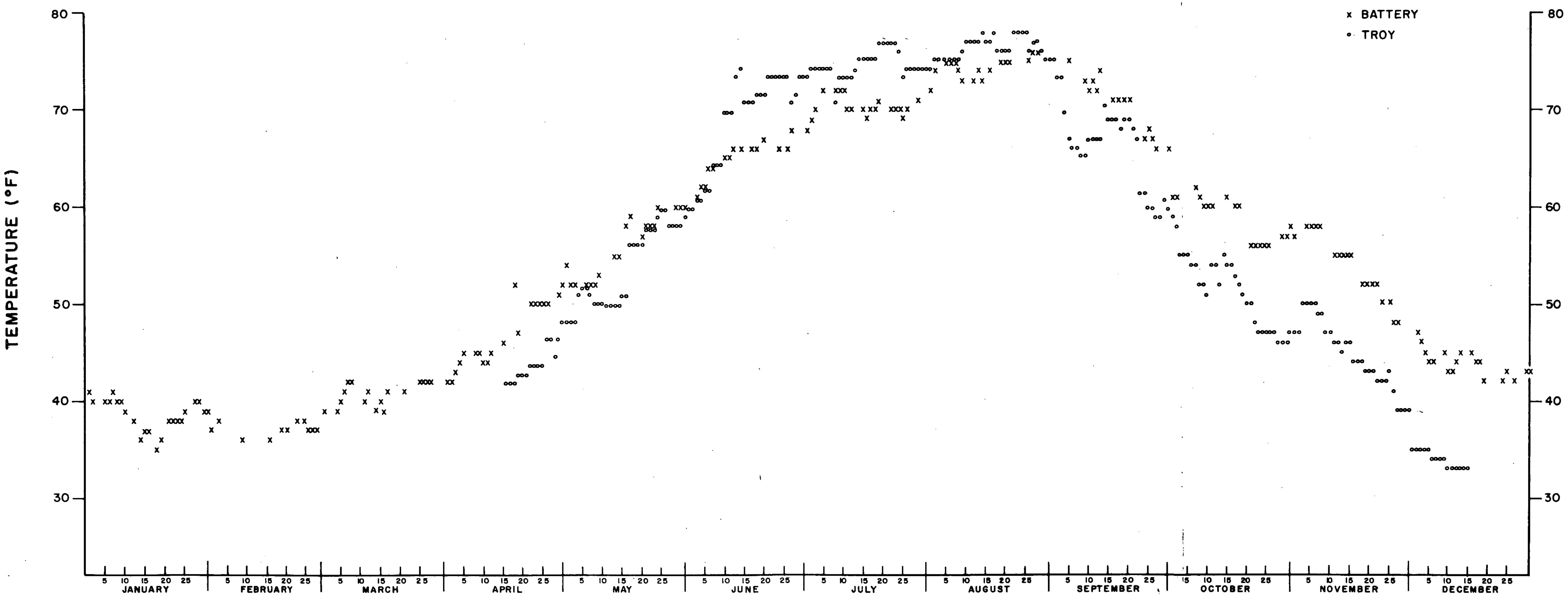
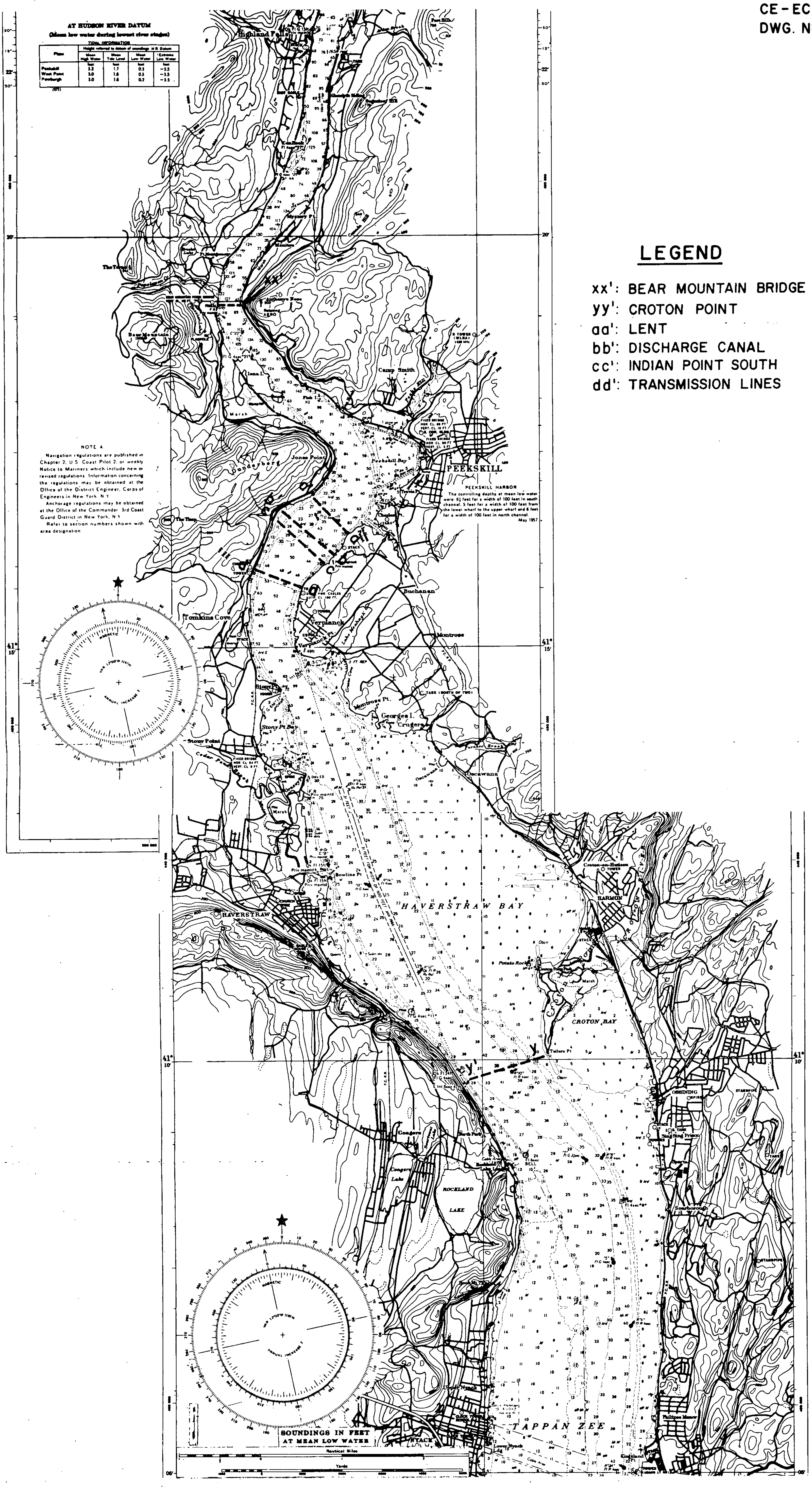


FIGURE 3

CE-EC
DWG. Nº 76-194



LEGEND

xx': BEAR MOUNTAIN BRIDGE
yy': CROTON POINT
aa': LENT
bb': DISCHARGE CANAL
cc': INDIAN POINT SOUTH
dd': TRANSMISSION LINES

LOCATION OF AMBIENT REFERENCE TRANSECTS
AND CROSS-SECTIONAL PATTERNS

FIGURE 4

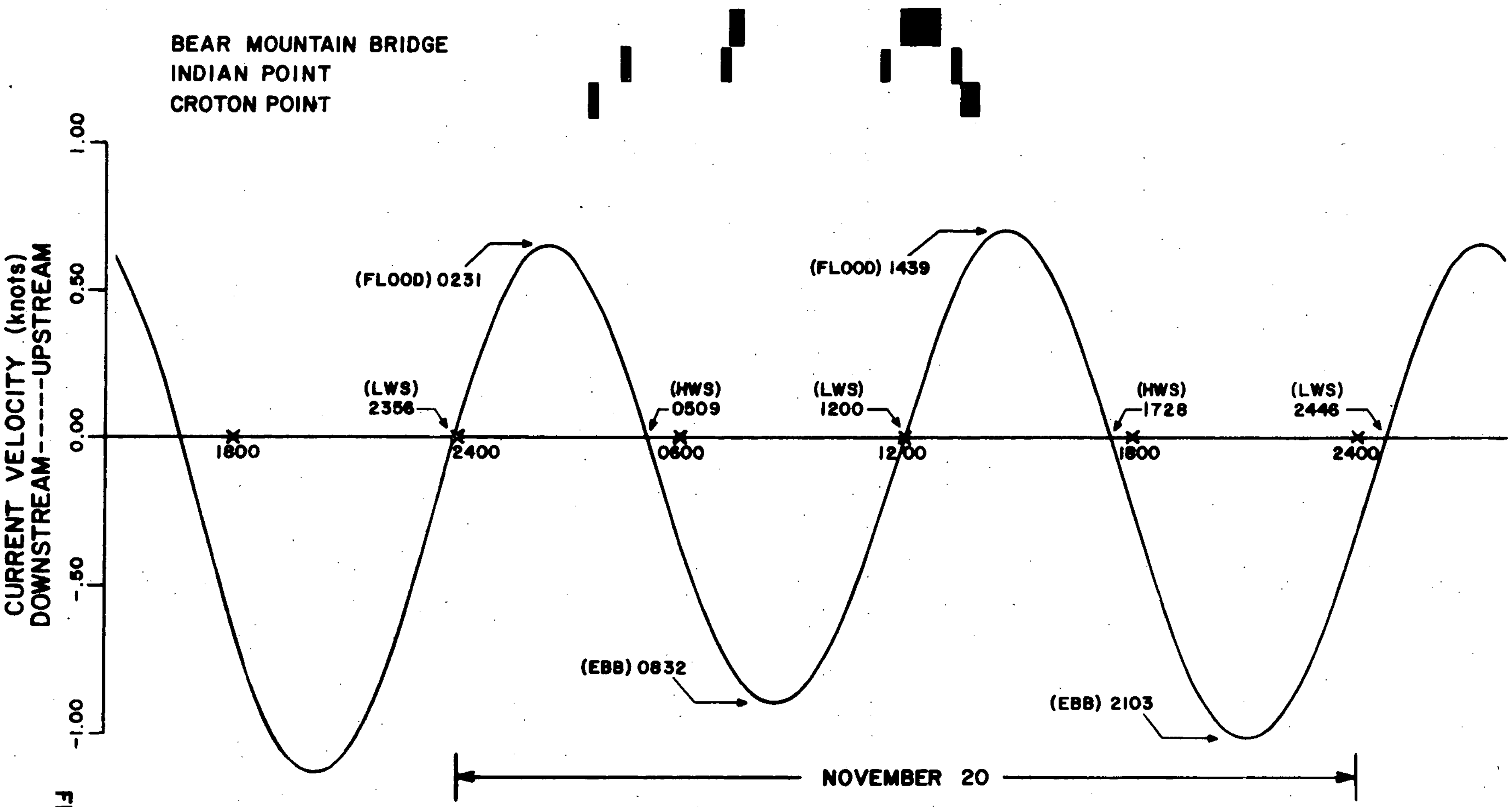
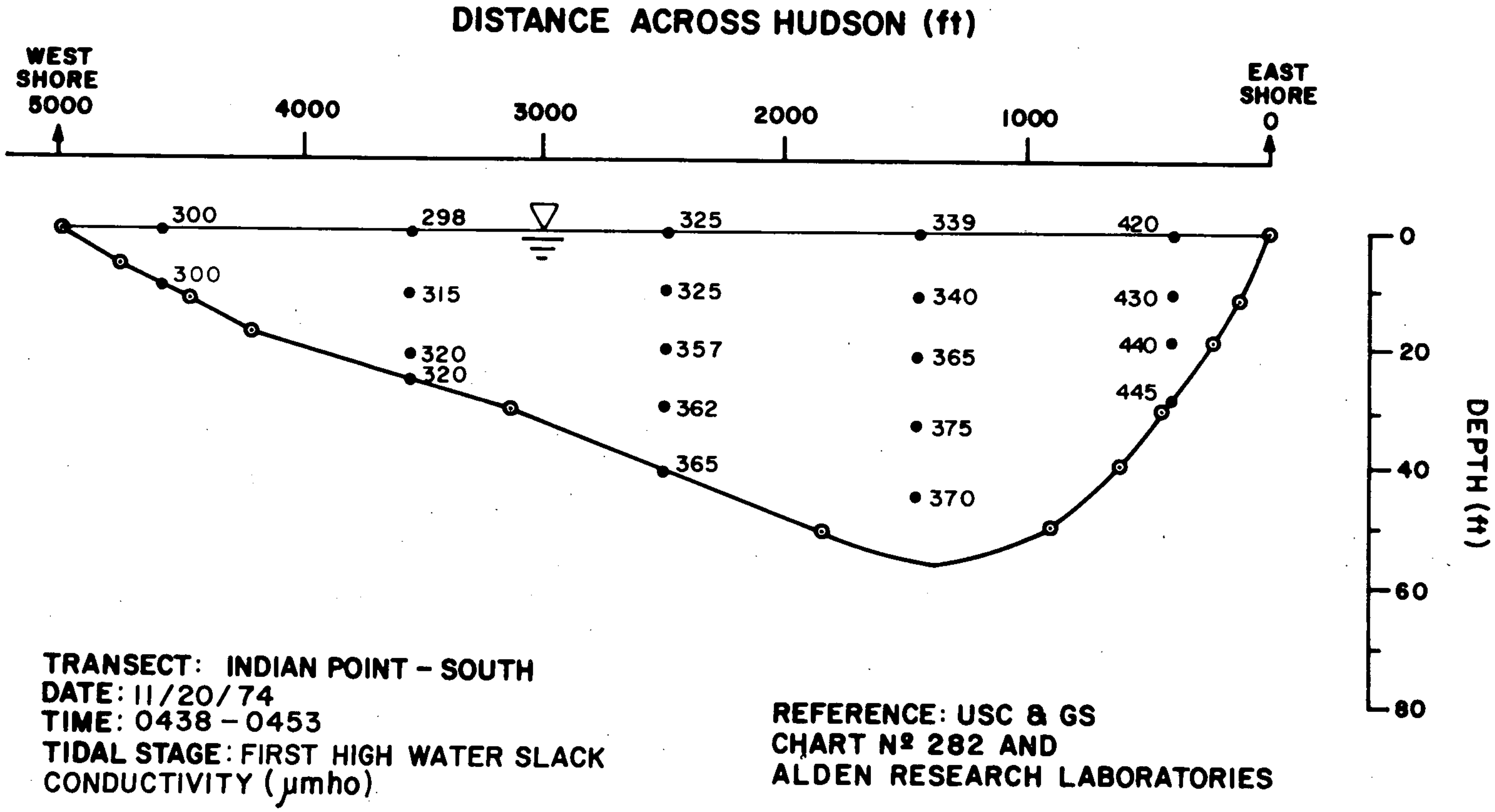


FIGURE 5.1

TIDAL CURRENTS AND
TIME SEQUENCE OF CONDUCTIVITY MEASUREMENTS
NOVEMBER 20, 1974
(REF: TIDAL CURRENT TABLES, 1974, ATLANTIC COAST
OF NORTH AMERICA [AT PEEKSKILL], NOAA)

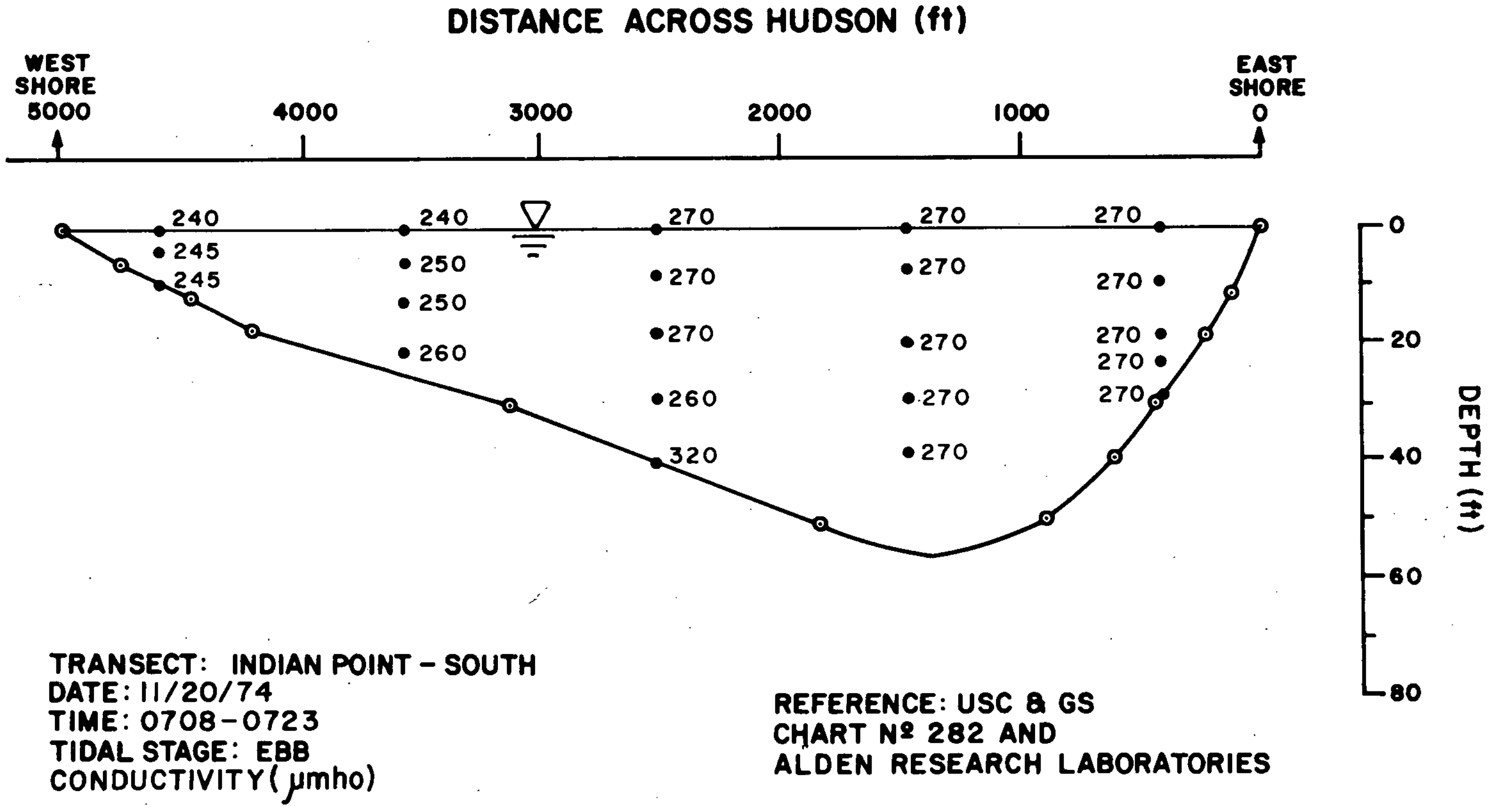
CE-EC
DWG. Nº 76-80



CONDUCTIVITY PROFILE MEASUREMENTS AT
INDIAN POINT - SOUTH: FIRST HIGH WATER SLACK

FIGURE 5.2

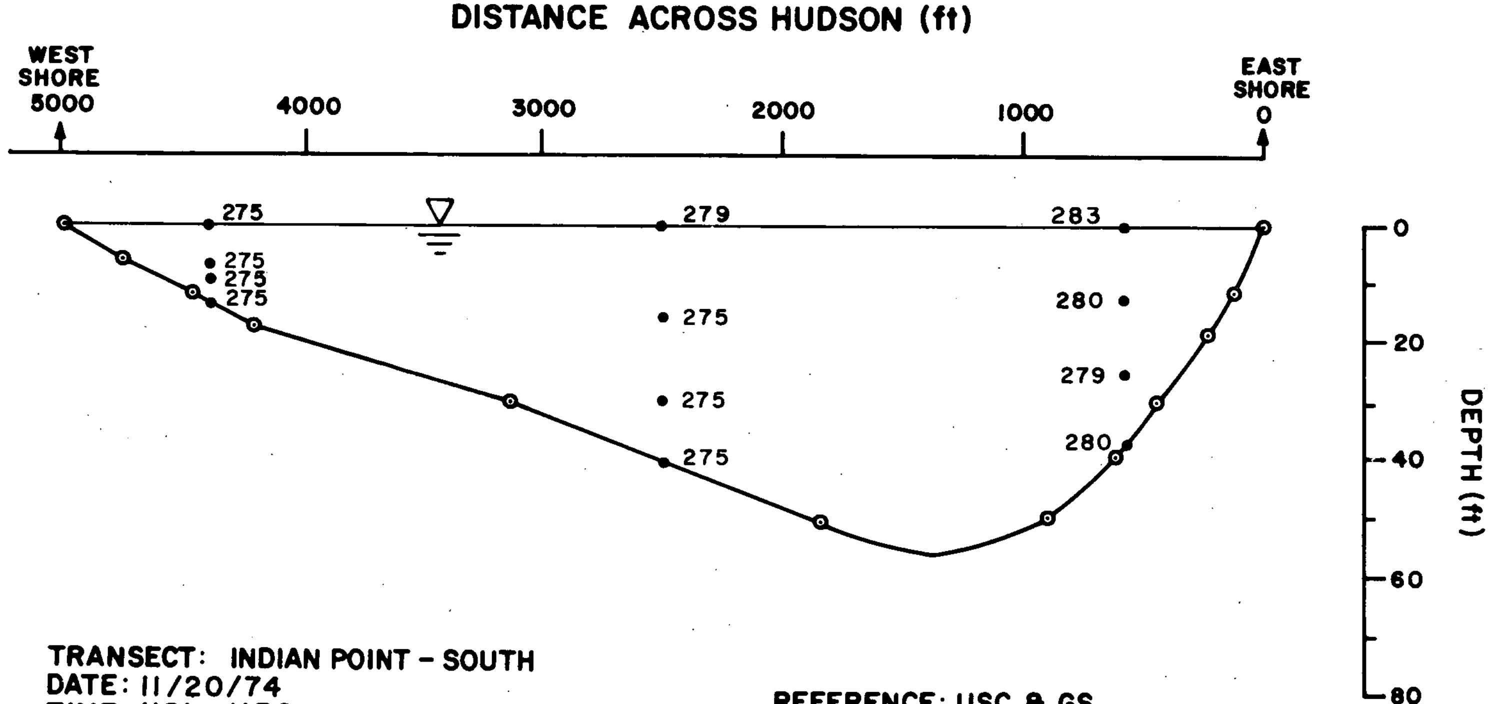
CE-EC
DWG. NO. 76-81



CONDUCTIVITY PROFILE MEASUREMENTS AT
INDIAN POINT-SOUTH: EBB

FIGURE 5.3

CE-EC
DWG.NO.76-82



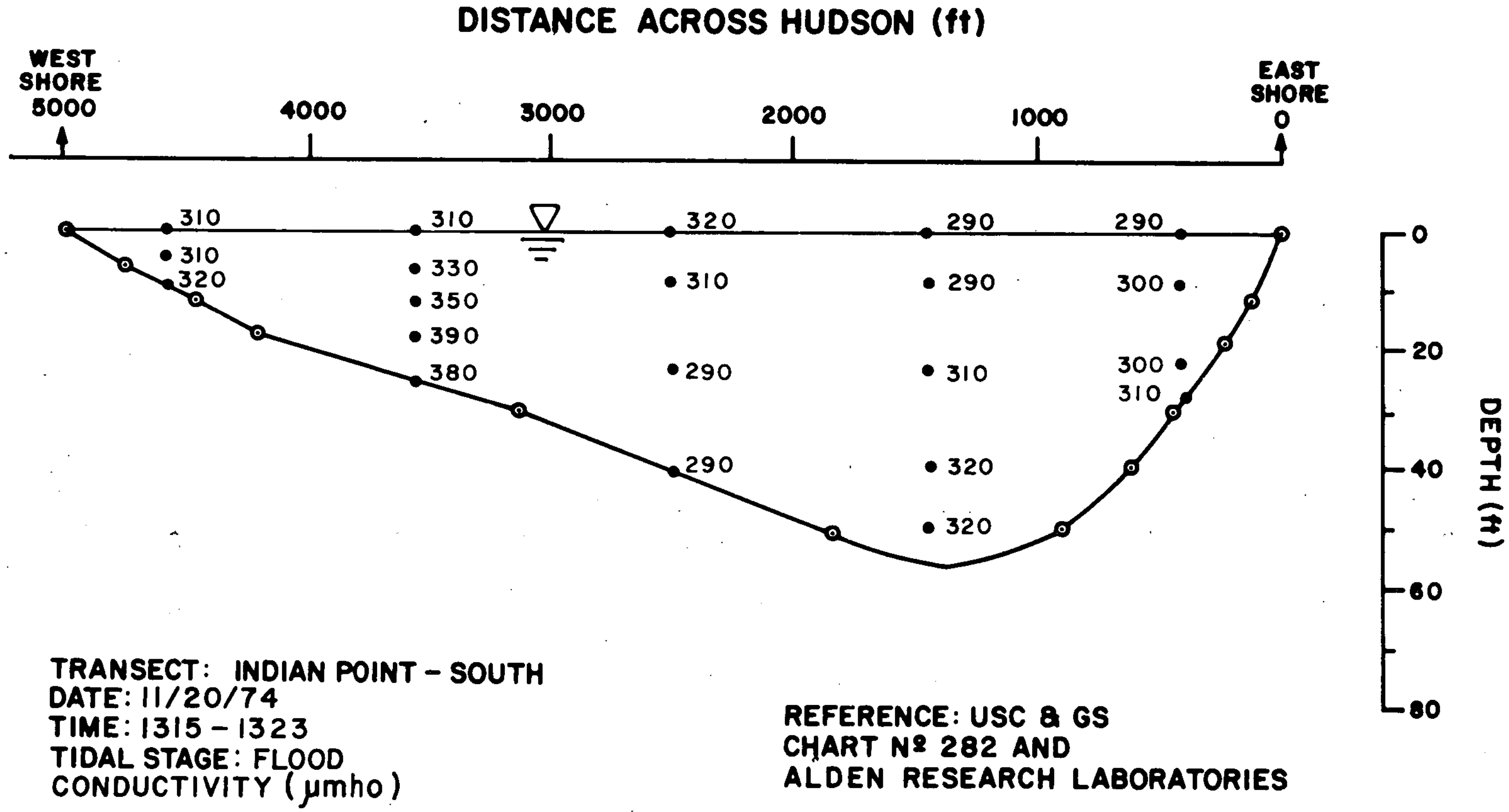
TRANSECT: INDIAN POINT - SOUTH
DATE: 11/20/74
TIME: 1121 - 1132
TIDAL STAGE: LOW WATER SLACK
CONDUCTIVITY (μmho)

REFERENCE: USC & GS
CHART Nº 282 AND
ALDEN RESEARCH LABORATORIES

CONDUCTIVITY PROFILE MEASUREMENTS AT
INDIAN POINT - SOUTH : LOW WATER SLACK

FIGURE 5.4

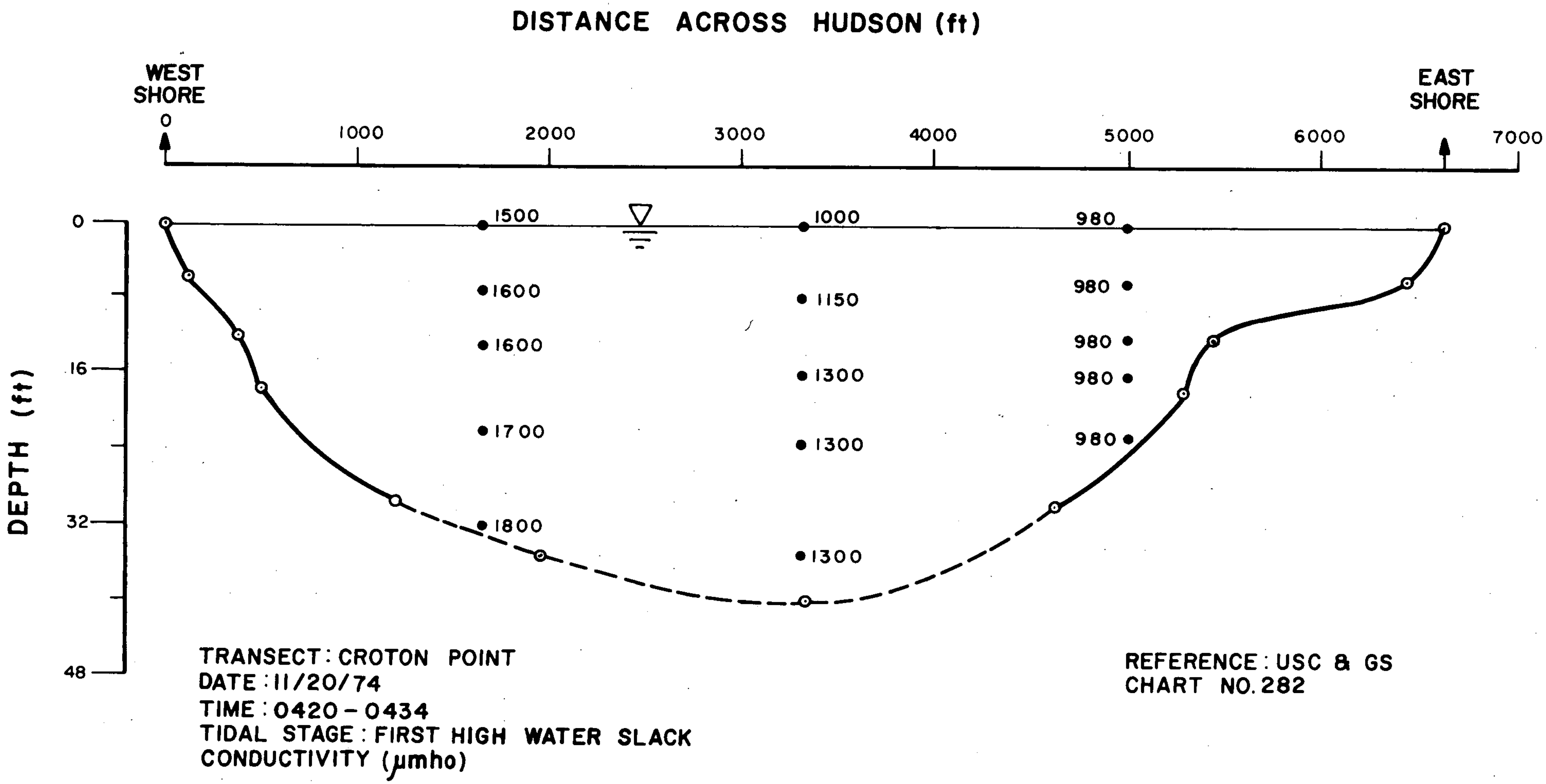
CE - EC
DWG.NO.76-83



CONDUCTIVITY PROFILE MEASUREMENTS AT
INDIAN POINT-SOUTH: FLOOD

FIGURE 5.5

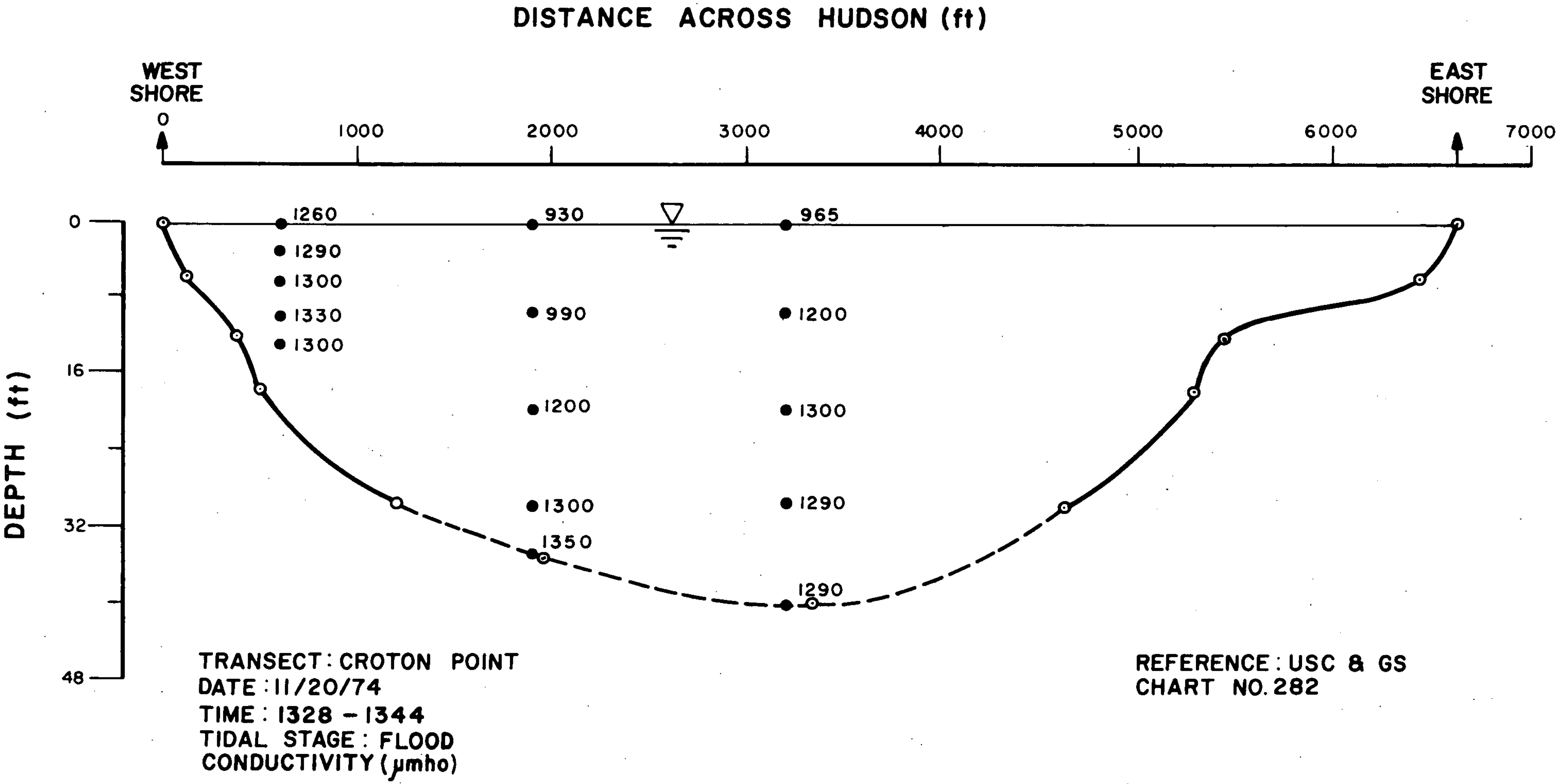
CE-EC
DWG.NO.76-84



CONDUCIVITY PROFILE MEASUREMENTS
CROTON POINT
FIRST HIGH WATER SLACK

FIGURE: 5.6

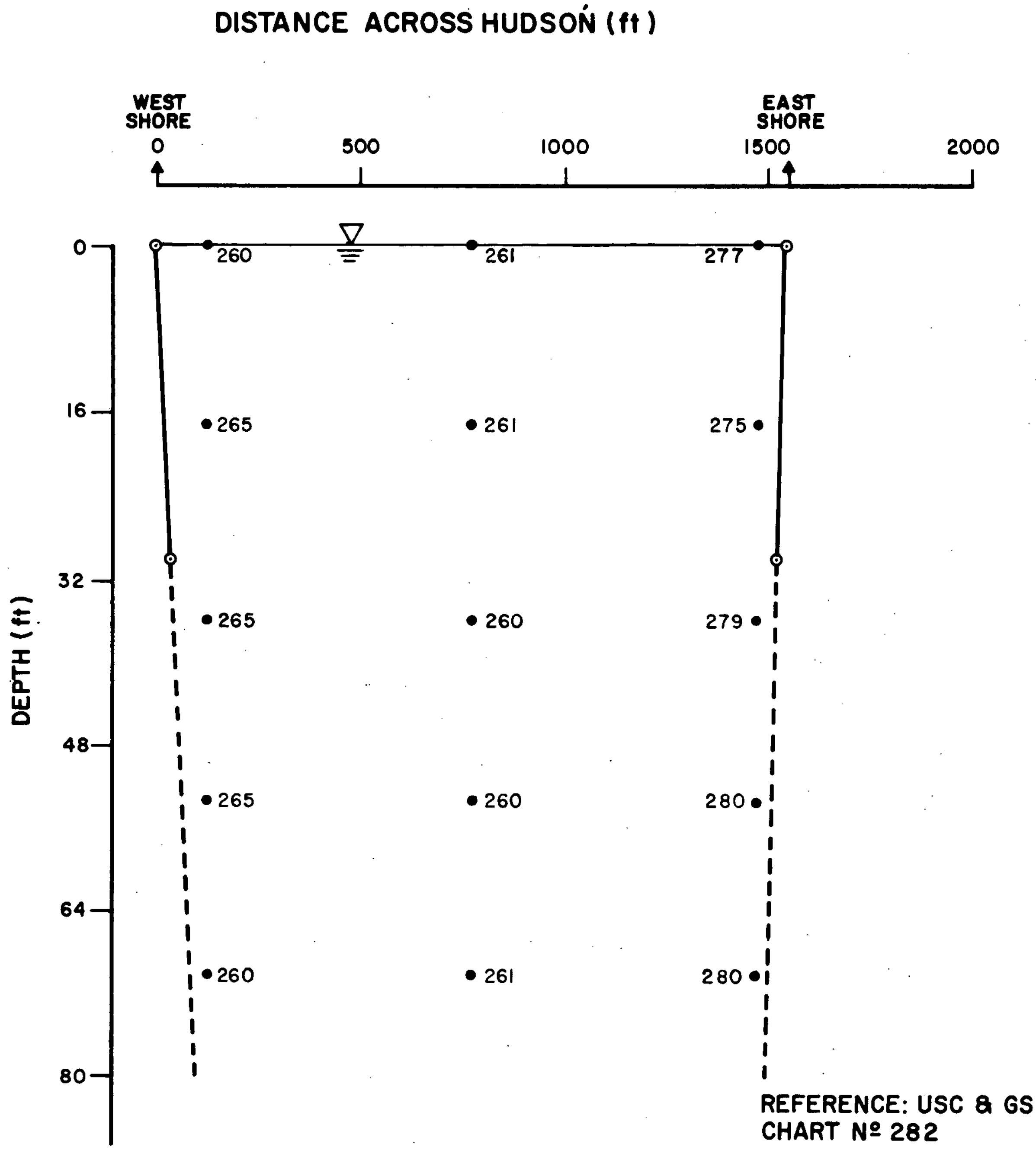
CE-EC
DWG. NO. 76-85



CONDUCTIVITY PROFILE MEASUREMENTS
CROTON POINT
FLOOD

FIGURE: 5.7

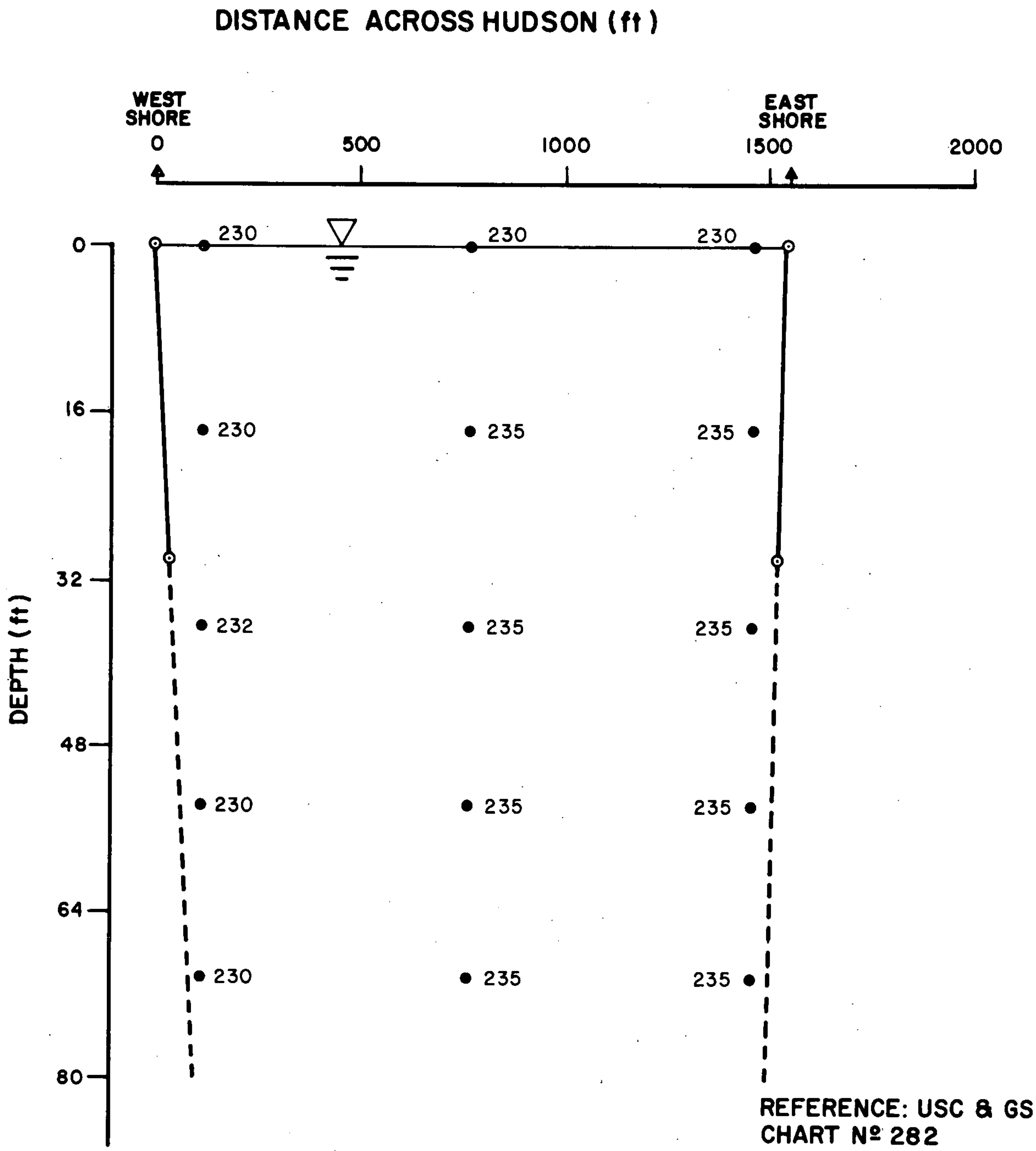
CE-EC
DWG. NO. 76-86



TRANSECT: BEAR MOUNTAIN BRIDGE
DATE: 11/20/74
TIME: 0720-0732
TIDAL STAGE: EBB
CONDUCTIVITY (μmho)

CONDUCTIVITY PROFILE MEASUREMENT AT BEAR MOUNTAIN BRIDGE: EBB

FIGURE 5.8



TRANSECT: BEAR MOUNTAIN BRIDGE
DATE: 11/20/74
TIME: 1153-1253
TIDAL STAGE: LOW WATER SLACK
CONDUCTIVITY: (μmho)

CONDUCTIVITY PROFILE MEASUREMENTS
BEAR MOUNTAIN BRIDGE-LOW WATER SLACK

FIGURE: 5.9

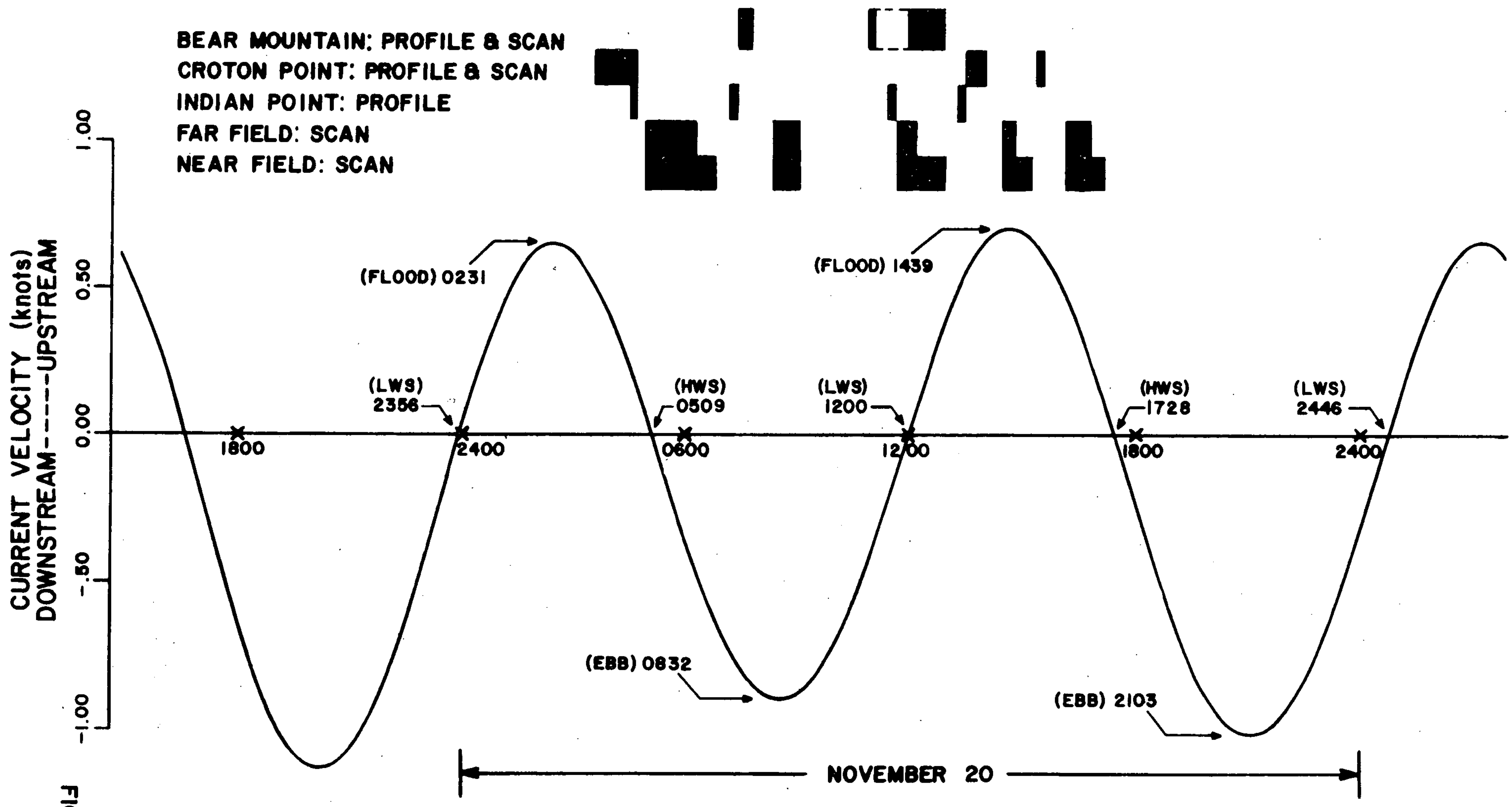


FIGURE 6.1

TIDAL CURRENTS AND
TIME SEQUENCE OF TEMPERATURE MEASUREMENTS
NOVEMBER 20, 1974
(REF: TIDAL CURRENT TABLES, 1974, ATLANTIC COAST
OF NORTH AMERICA [AT PEEKSKILL], NOAA)

CE-EC
DWG. Nº 76-89

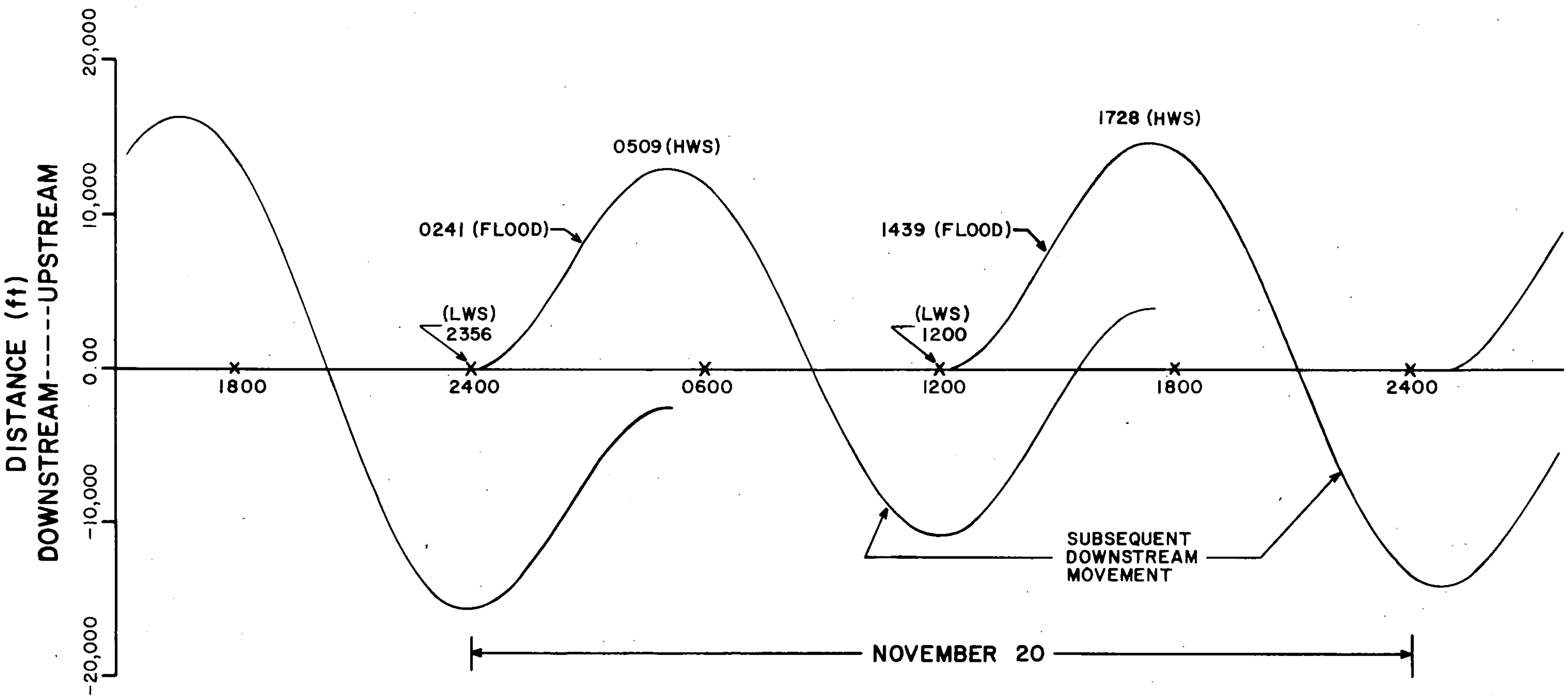
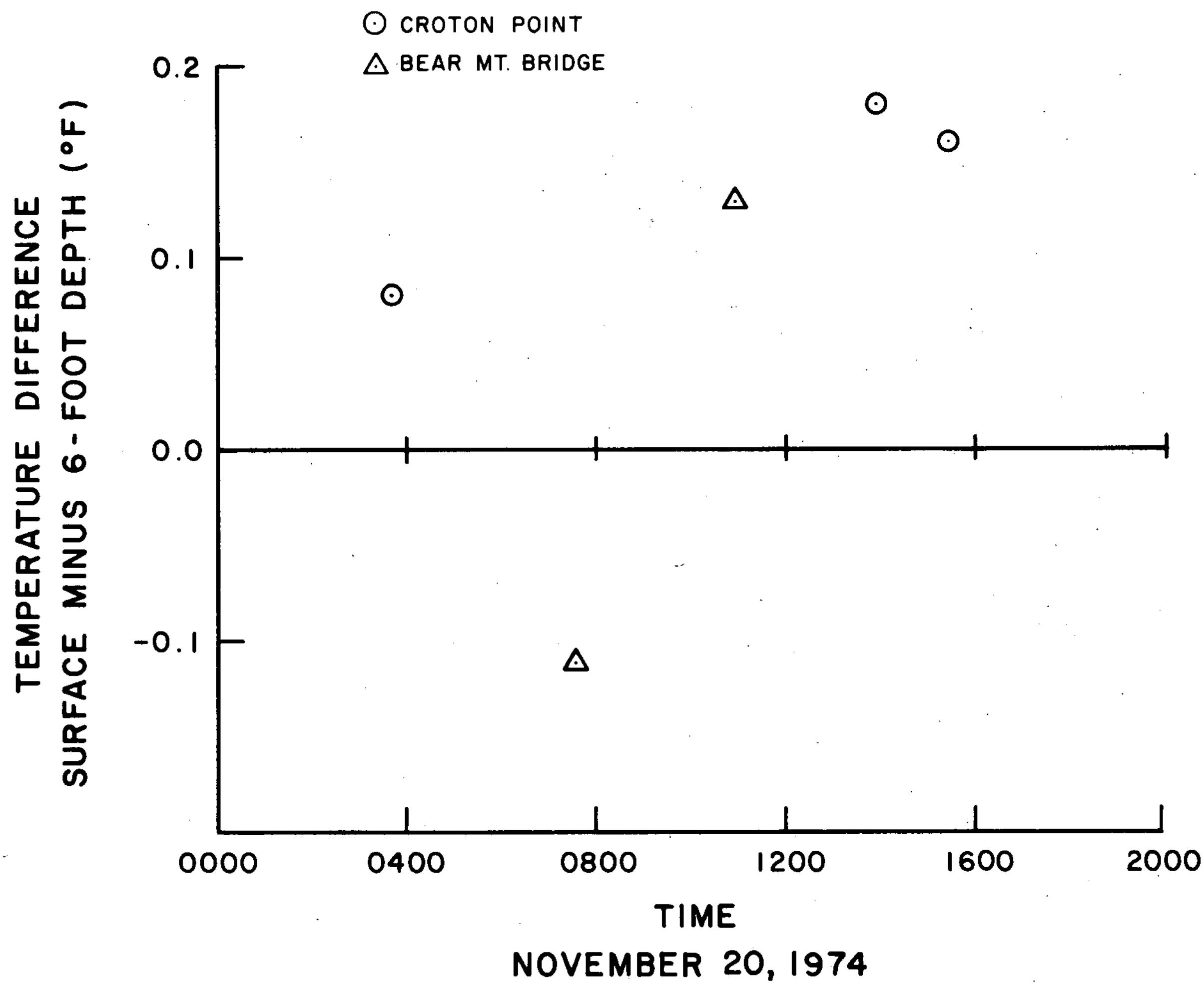


FIGURE 6.2

CONVECTIVE TRANSPORT DISTANCE
OF THERMAL PLUME

CE-EC
DWG. Nº 76-90



SOLAR STRATIFICATION
AT
AMBIENT REFERENCE TRANSECTS

FIGURE 6.3

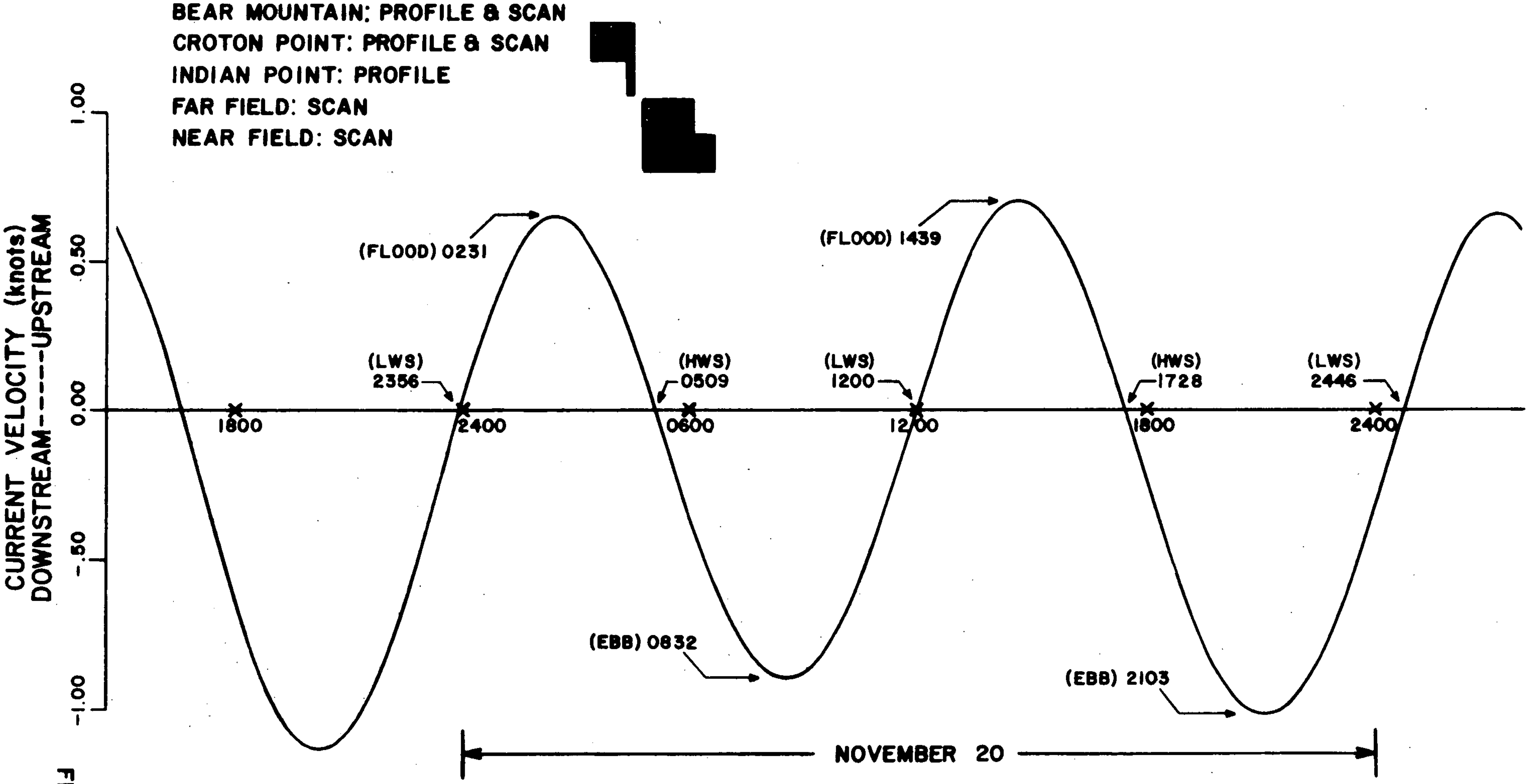
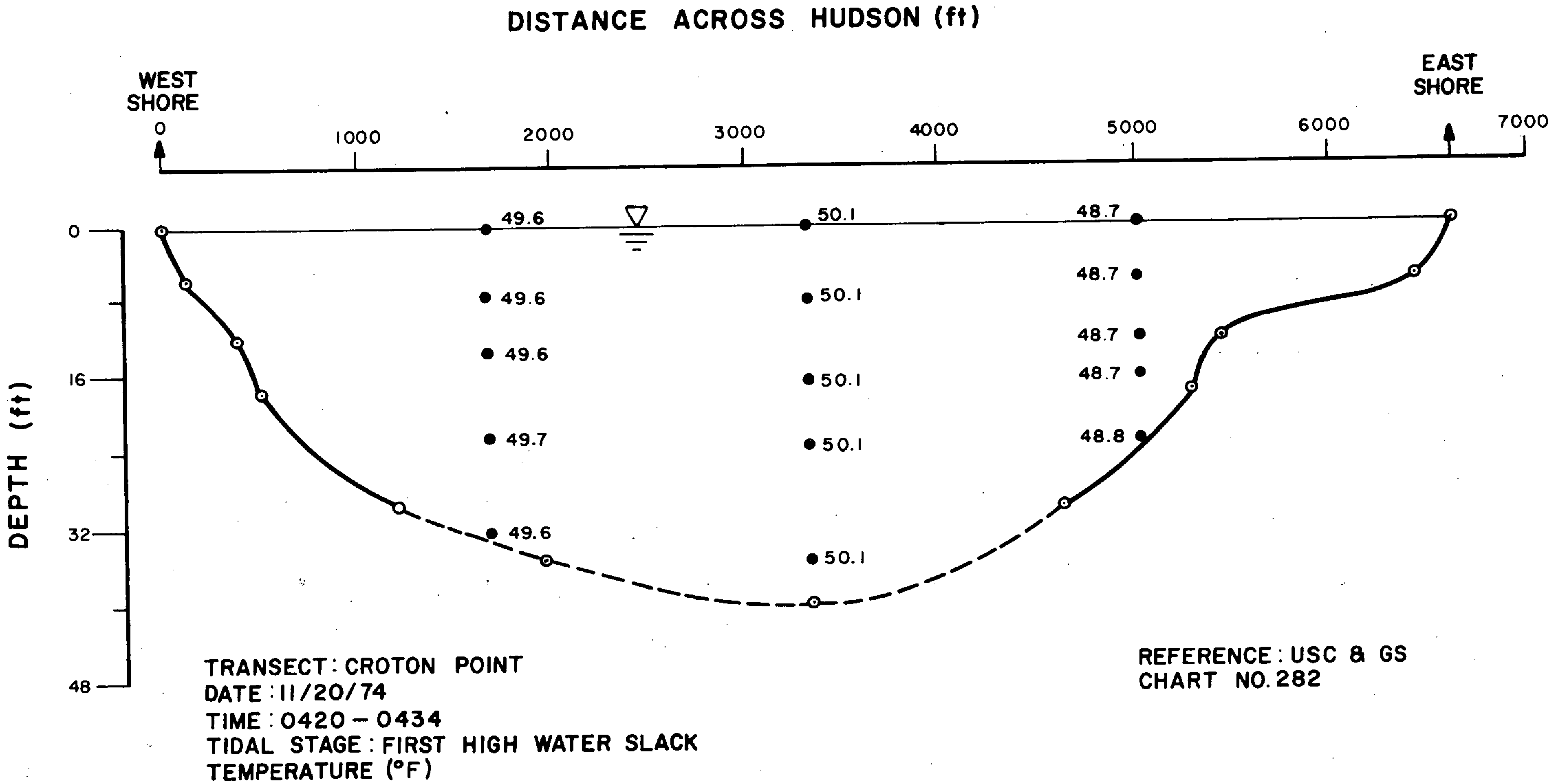


FIGURE 7.1

TIDAL CURRENTS AND
TIME SEQUENCE OF TEMPERATURE MEASUREMENTS
NOVEMBER 20, 1974
——(FIRST HIGH WATER SLACK)——
(REF: TIDAL CURRENT TABLES, 1974, ATLANTIC COAST
OF NORTH AMERICA [AT PEEKSKILL], NOAA)

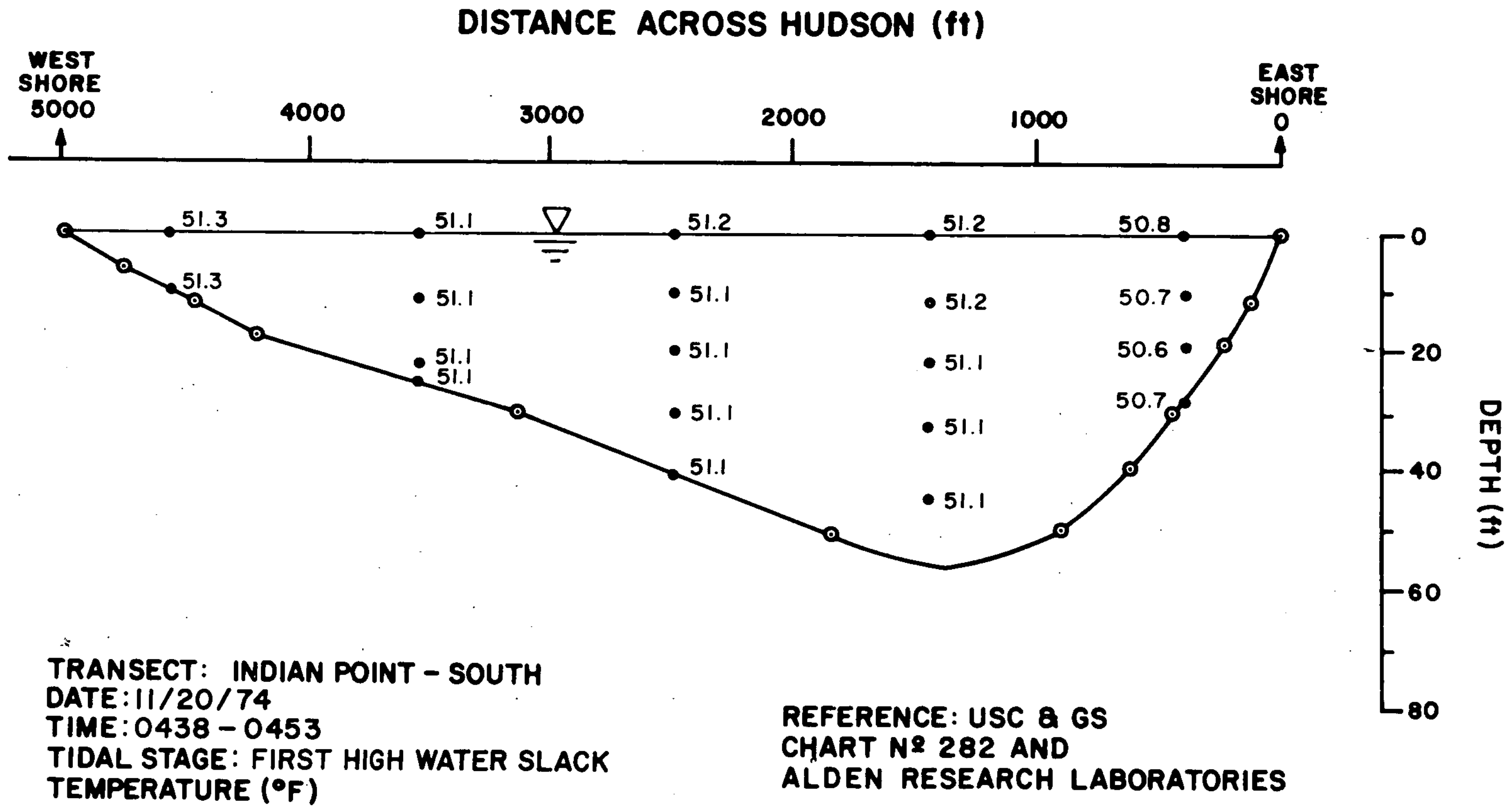
CE-EC
DWG. Nº 76-91



TEMPERATURE PROFILE MEASUREMENTS
CROTON POINT
FIRST HIGH WATER SLACK

FIGURE: 7.2

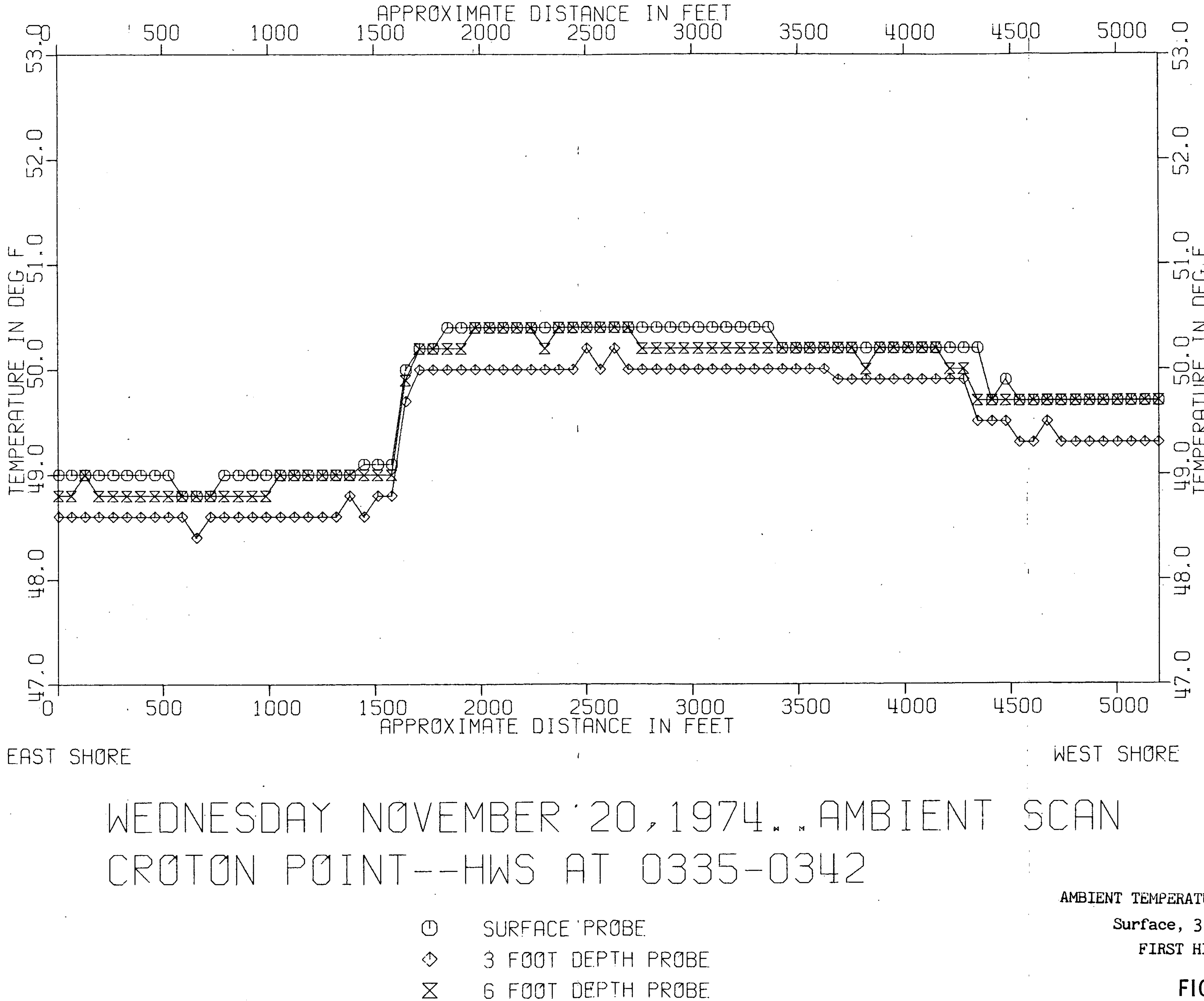
CE-EC
DWG. NO. 76-92



TEMPERATURE PROFILE MEASUREMENTS AT INDIAN POINT-SOUTH: FIRST HIGH WATER SLACK

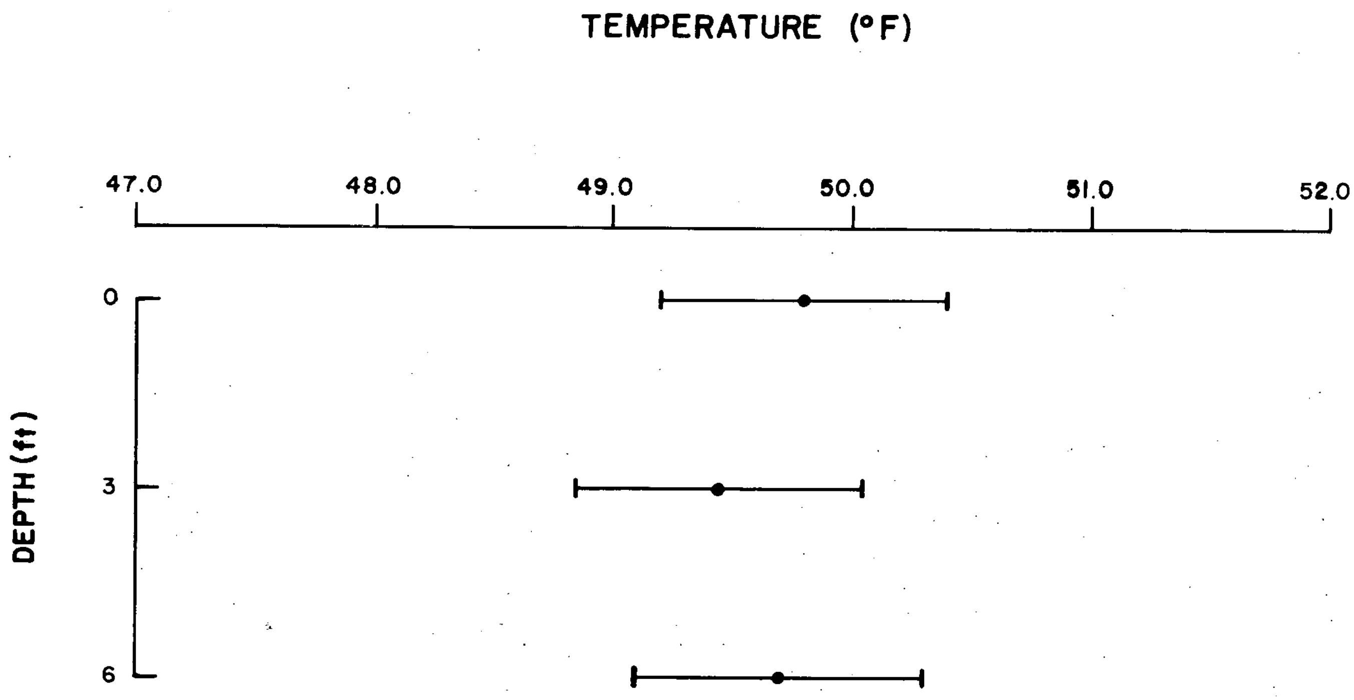
FIGURE 7.3

CE-EC
DWG.NO.76-93



AMBIENT TEMPERATURE SCAN at CROTON POINT
Surface, 3 and 6 Foot Depths
FIRST HIGH WATER SLACK

FIGURE 7.4

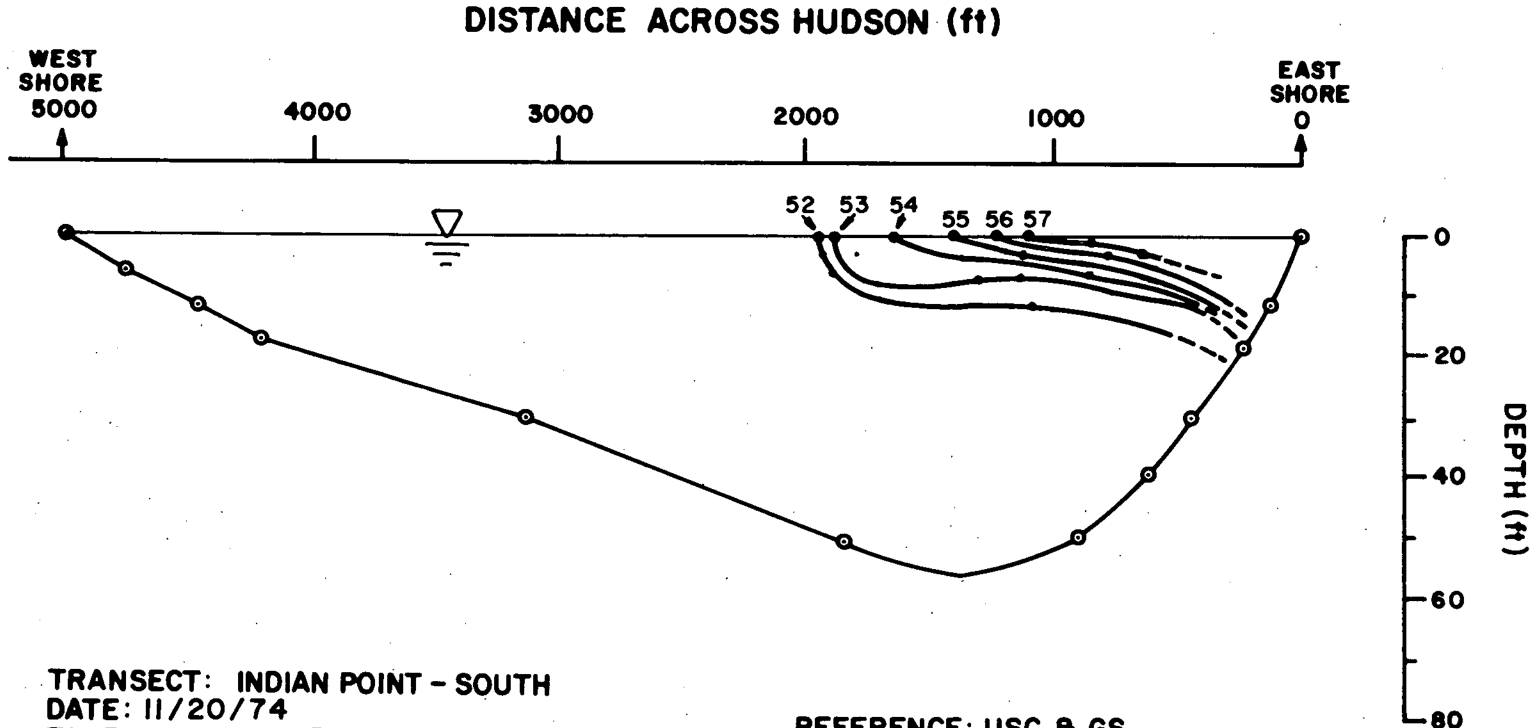


SCAN TRANSECT: CROTON POINT
DATE: 11/20/74
TIME: 0335-0342
TIDAL STAGE: FIRST HIGH WATER SLACK

FIGURE 7.5

AMBIENT SCAN TEMPERATURES vs DEPTH
CROTON POINT
FIRST HIGH WATER SLACK

CE-EC
DWG. Nº 76-94



TRANSECT: INDIAN POINT - SOUTH
DATE: 11/20/74
TIME: 0448-0615
TIDAL STAGE: FIRST HIGH WATER SLACK
TEMPERATURE (°F)

REFERENCE: USC & GS
CHART Nº 282 AND
ALDEN RESEARCH LABORATORIES

CROSS-SECTIONAL TEMPERATURE PATTERN AT INDIAN POINT - SOUTH
FIRST HIGH WATER SLACK

FIGURE 7.6

CE-EC
DWG.NO.76-95

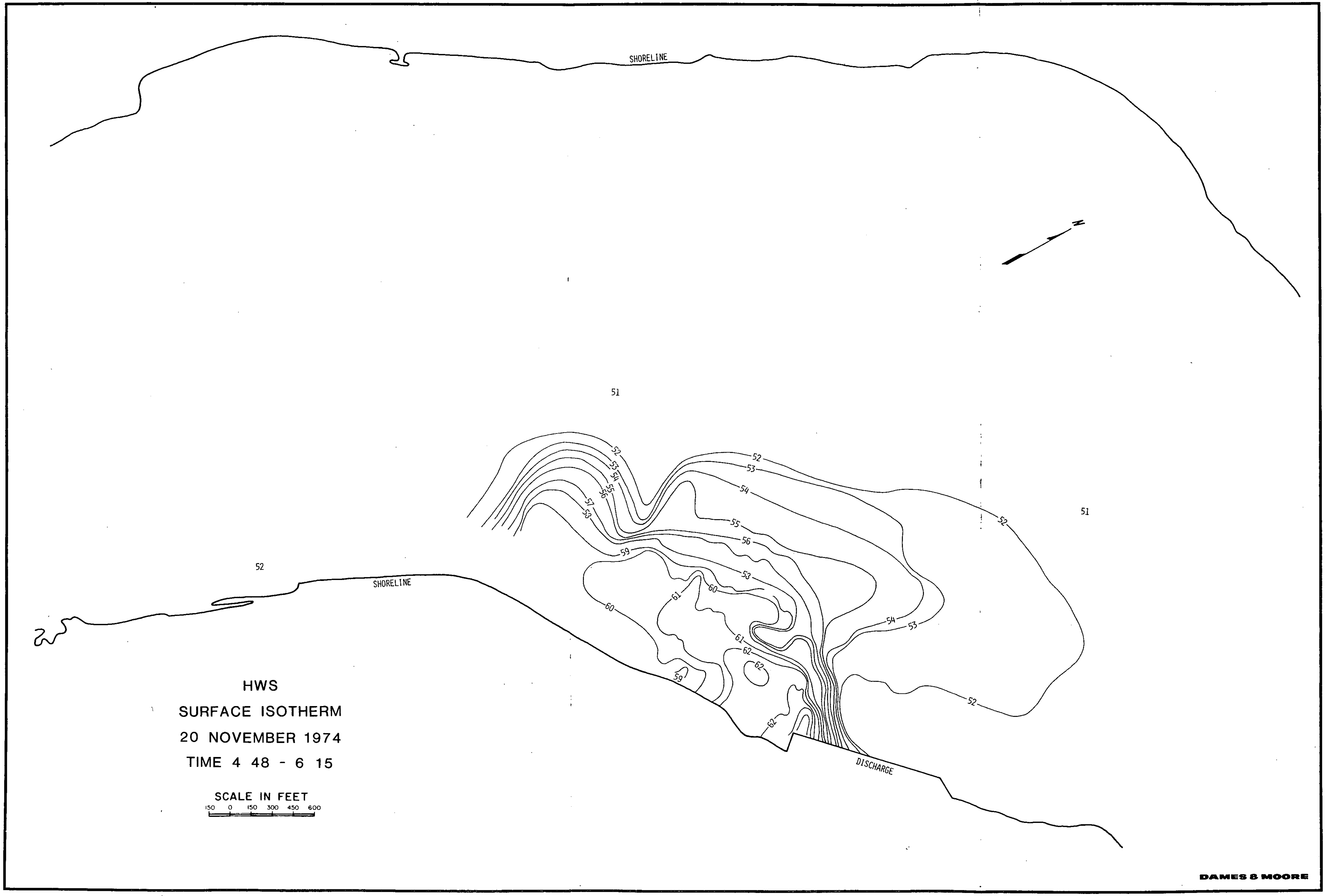

SHORELINE
51
52
53
54
55
56
57
58
59
60
61
62
SHORELINE
DISCHARGE
HWS
SURFACE ISOTHERM
20 NOVEMBER 1974
TIME 4 48 - 6 15
SCALE IN FEET
150 0 150 300 450 600
N
DAMES & MOORE

FIGURE 7.7

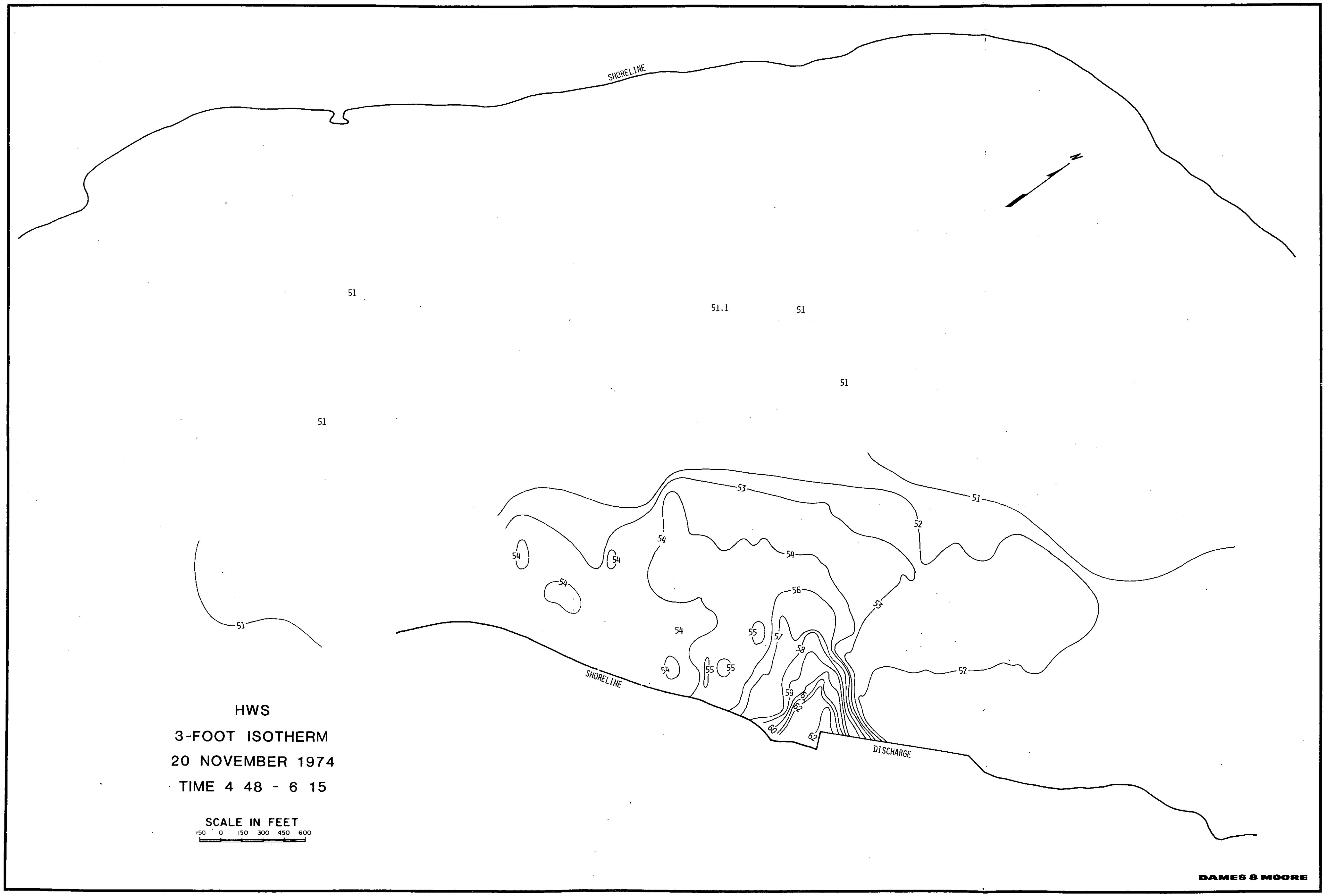
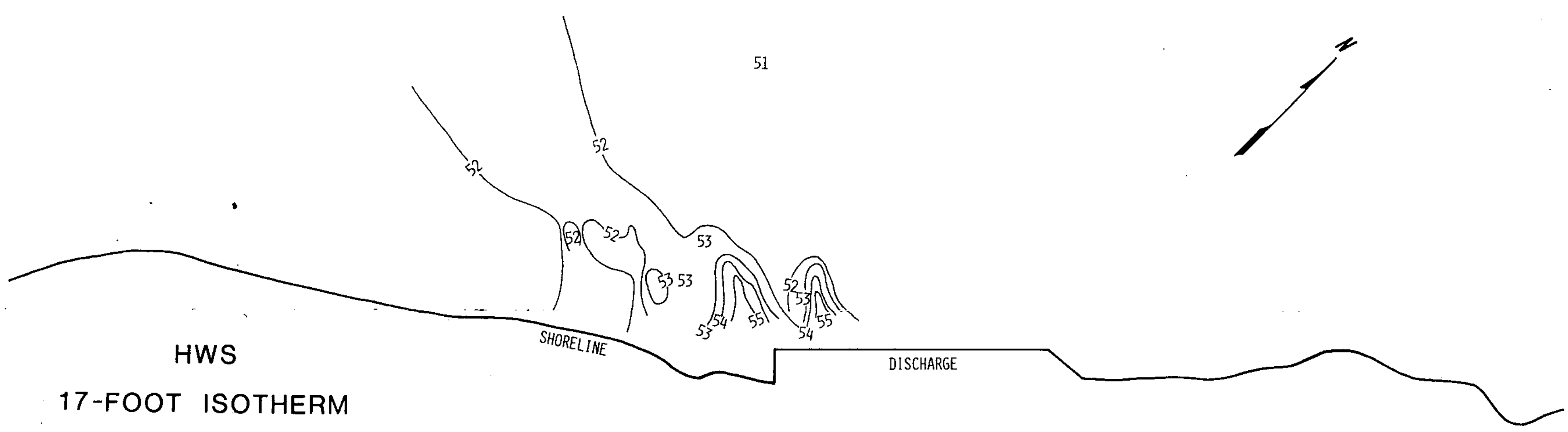

SHORELINE
N
51
51.1
51
51
51
51
53
51
52
54
54
54
54
54
56
53
55
57
54
58
54
55
55
52
59
61
62
60
62
SHORELINE
DISCHARGE
HWS
3-FOOT ISOTHERM
20 NOVEMBER 1974
TIME 4 48 - 6 15
SCALE IN FEET
150 0 150 300 450 600
DAMES & MOORE

FIGURE 7.8

HWS
23-FOOT ISOTHERM
20 NOVEMBER 1974
TIME 6 20 - 6 44

SCALE IN FEET
150 0 150 300 450 600

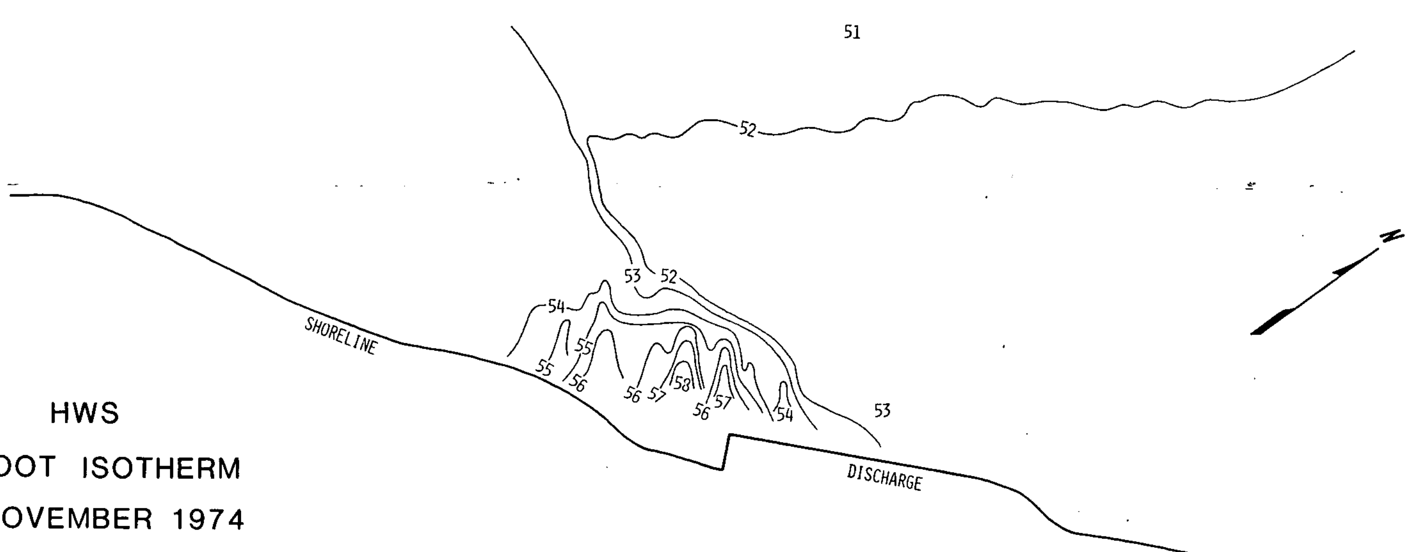
FIGURE 7.10



HWS
17-FOOT ISOTHERM
20 NOVEMBER 1974
TIME 6 20 - 6 44

SCALE IN FEET
150 0 150 300 450 600

FIGURE 7.11



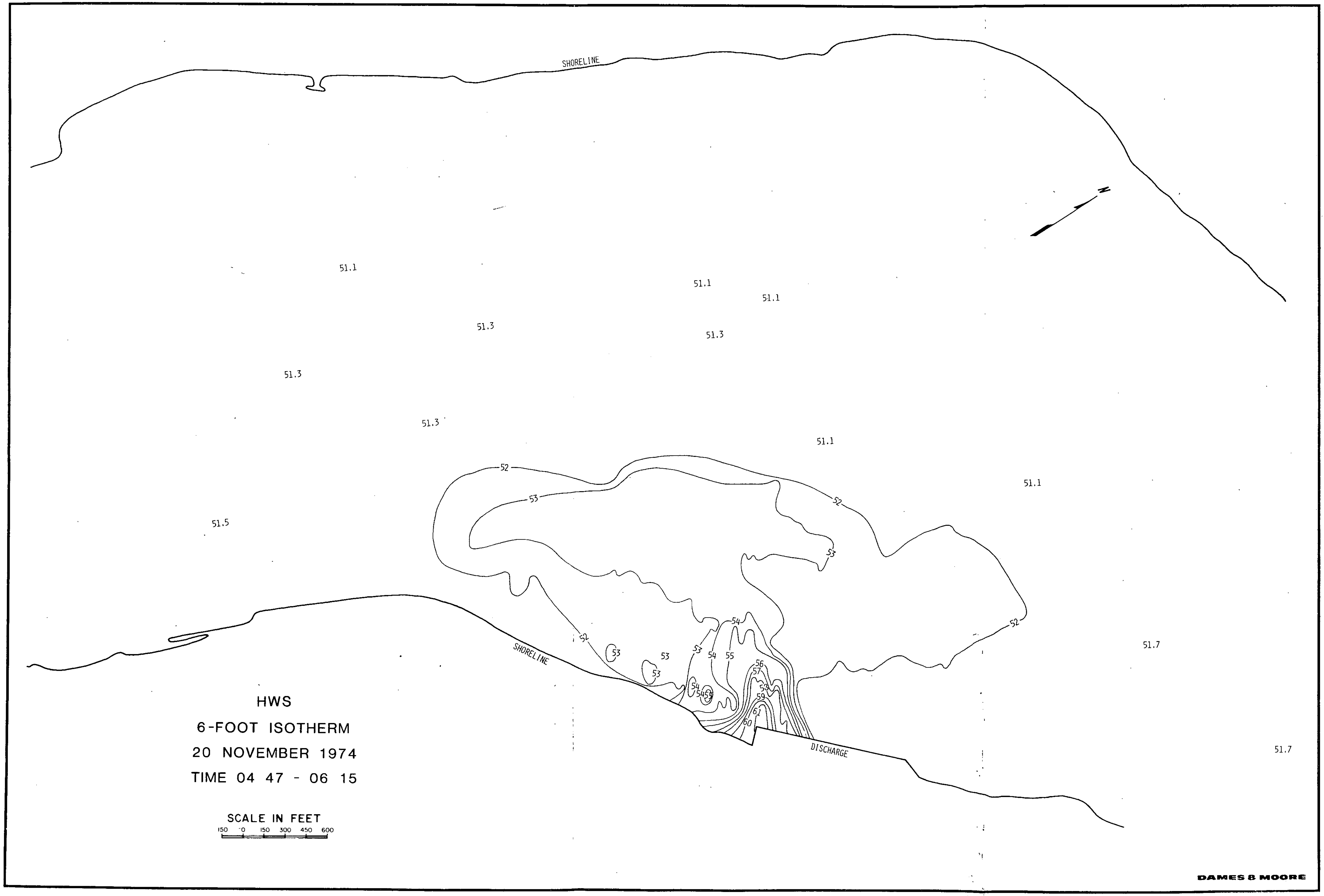
HWS
11-FOOT ISOTHERM
20 NOVEMBER 1974
TIME 6 20 - 6 44

SCALE IN FEET
150 0 150 300 450 600

FIGURE 7.12

DAMES & MOORE

FIGURES 7.10 - 7.12



SHORELINE
N
51.1
51.1
51.1
51.3
51.3
51.3
51.3
51.1
51.1
51.5
52
53
54
55
56
57
58
59
60
61
51.7
51.7
SHORELINE
DISCHARGE
HWS
6-FOOT ISOTHERM
20 NOVEMBER 1974
TIME 04 47 - 06 15
SCALE IN FEET
150 0 150 300 450 600
DAMES & MOORE

FIGURE 7.9

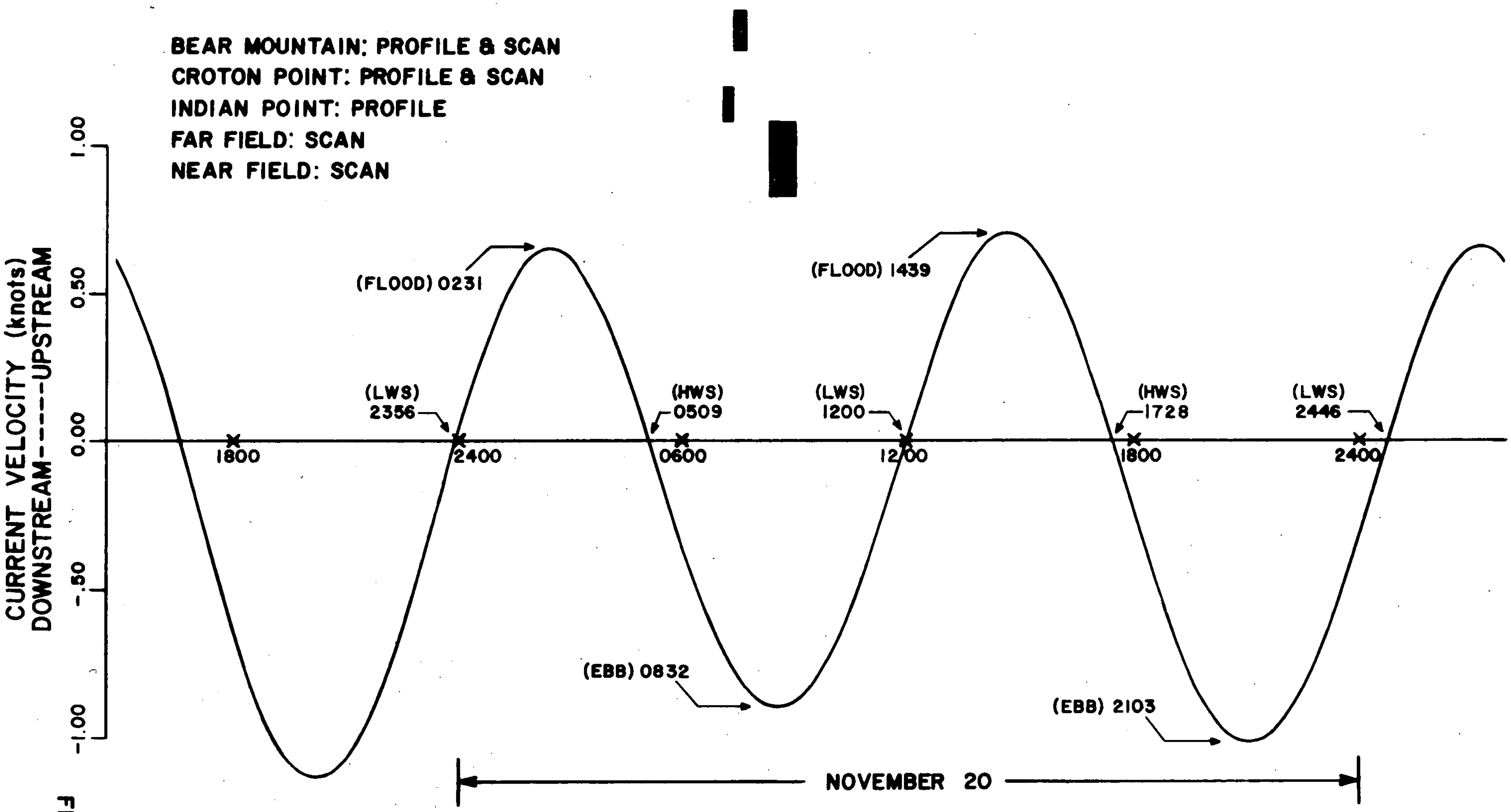
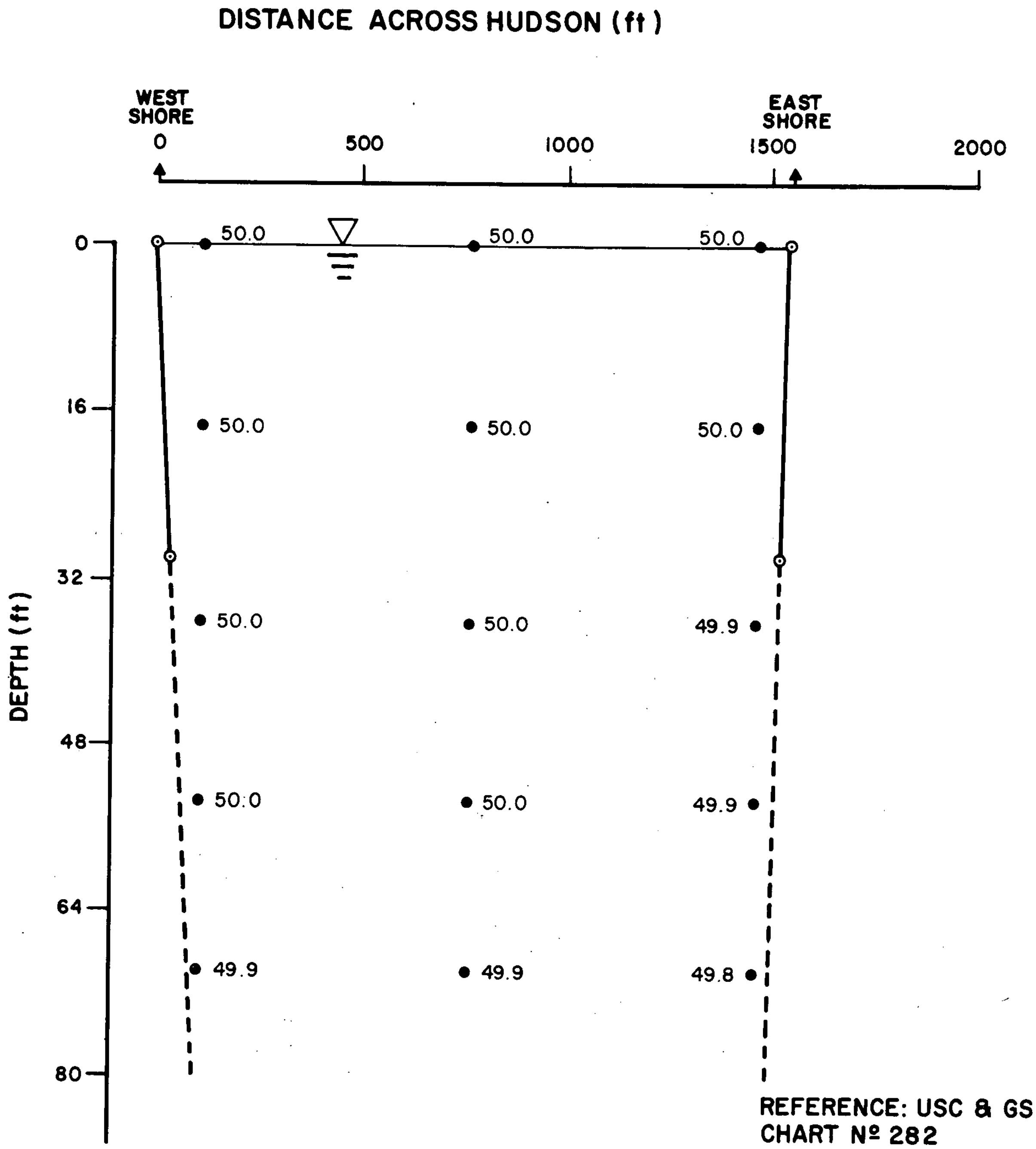


FIGURE 8.1

TIDAL CURRENTS AND
TIME SEQUENCE OF TEMPERATURE MEASUREMENTS
NOVEMBER 20, 1974
——(EBB)——
(REF: TIDAL CURRENT TABLES, 1974, ATLANTIC COAST OF NORTH AMERICA [AT PEEKSKILL], NOAA)

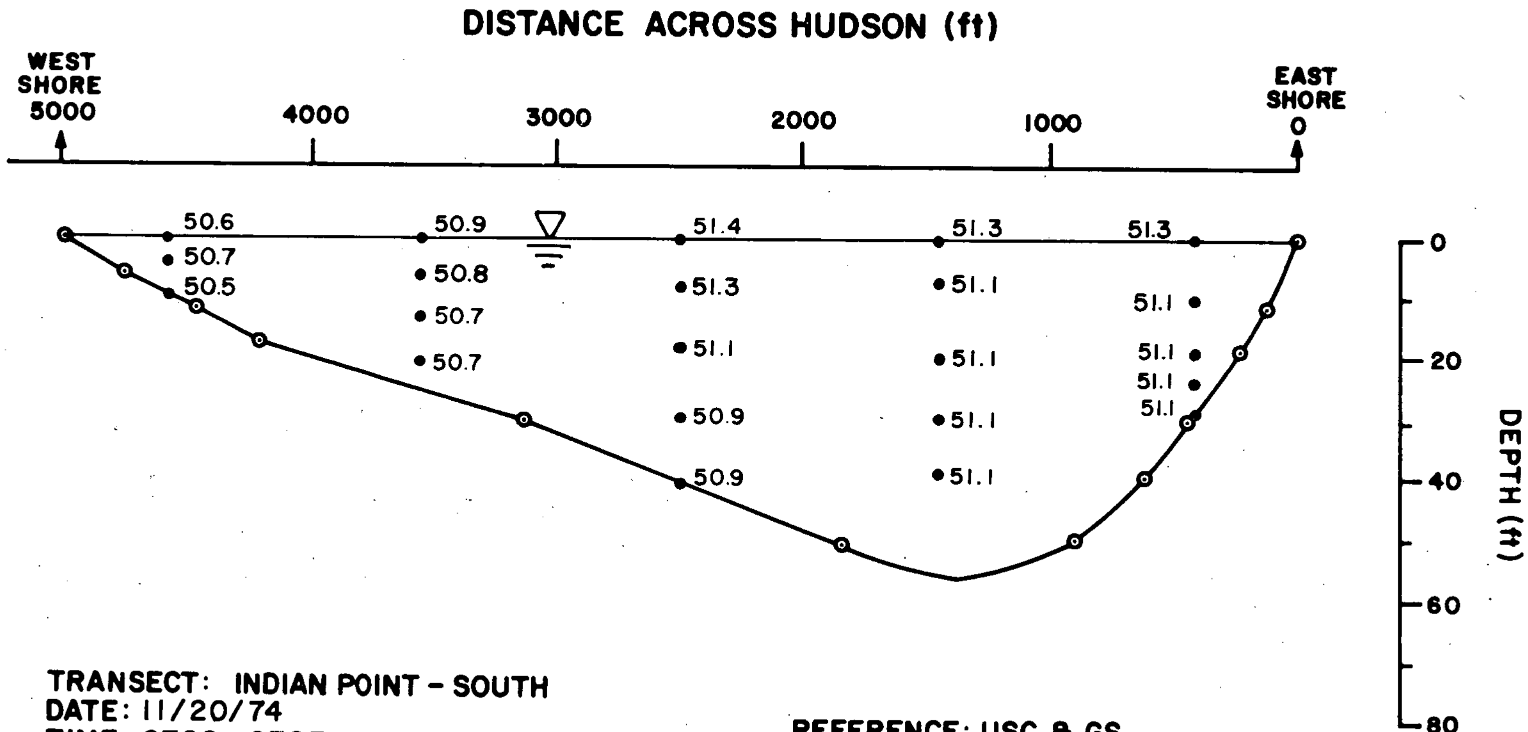
CE-EC
DWG. Nº 76-96



TRANSECT: BEAR MOUNTAIN BRIDGE
DATE: 11/20/74
TIME: 0720-0732
TIDAL STAGE: EBB
TEMPERATURE: (°F)

TEMPERATURE PROFILE MEASUREMENTS
BEAR MOUNTAIN BRIDGE-EBB

FIGURE: 8.2



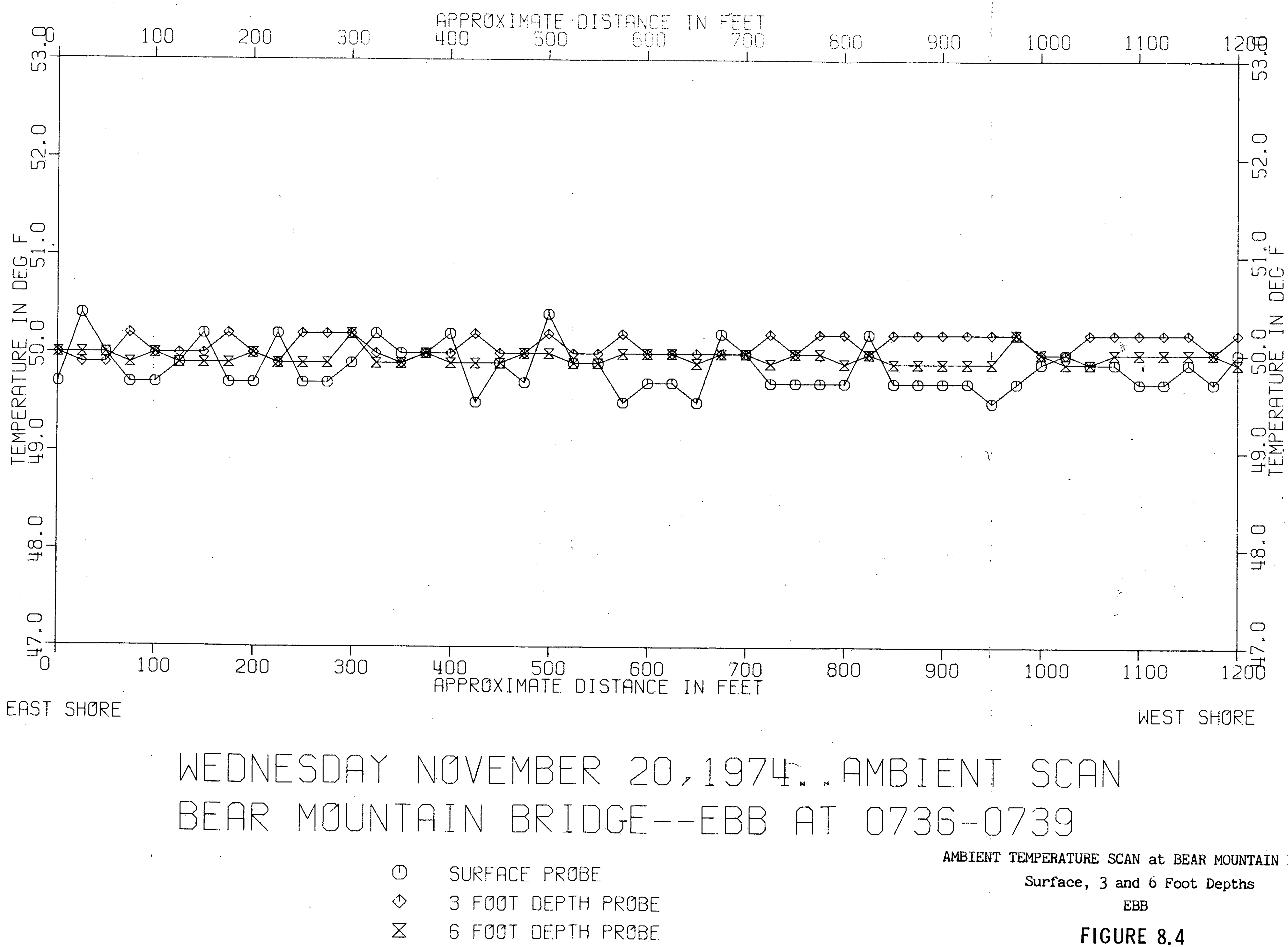
TRANSECT: INDIAN POINT - SOUTH
DATE: 11/20/74
TIME: 0708-0723
TIDAL STAGE: EBB
TEMPERATURE (°F)

REFERENCE: USC & GS
CHART Nº 282 AND
ALDEN RESEARCH LABORATORIES

FIGURE 8.3

TEMPERATURE PROFILE MEASUREMENTS AT
INDIAN POINT-SOUTH: EBB

CE-EC
DWG.NO.76-98

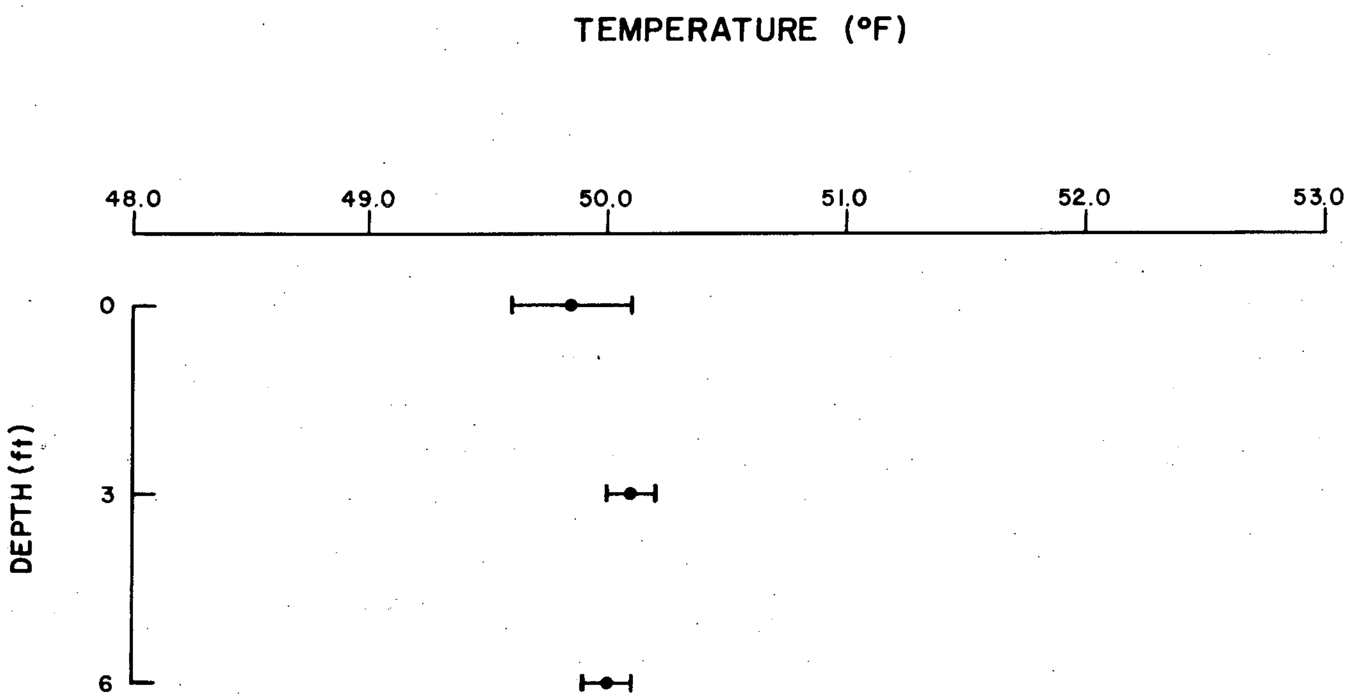


AMBIENT TEMPERATURE SCAN at BEAR MOUNTAIN BRIDGE

Surface, 3 and 6 Foot Depths

EBB

FIGURE 8.4

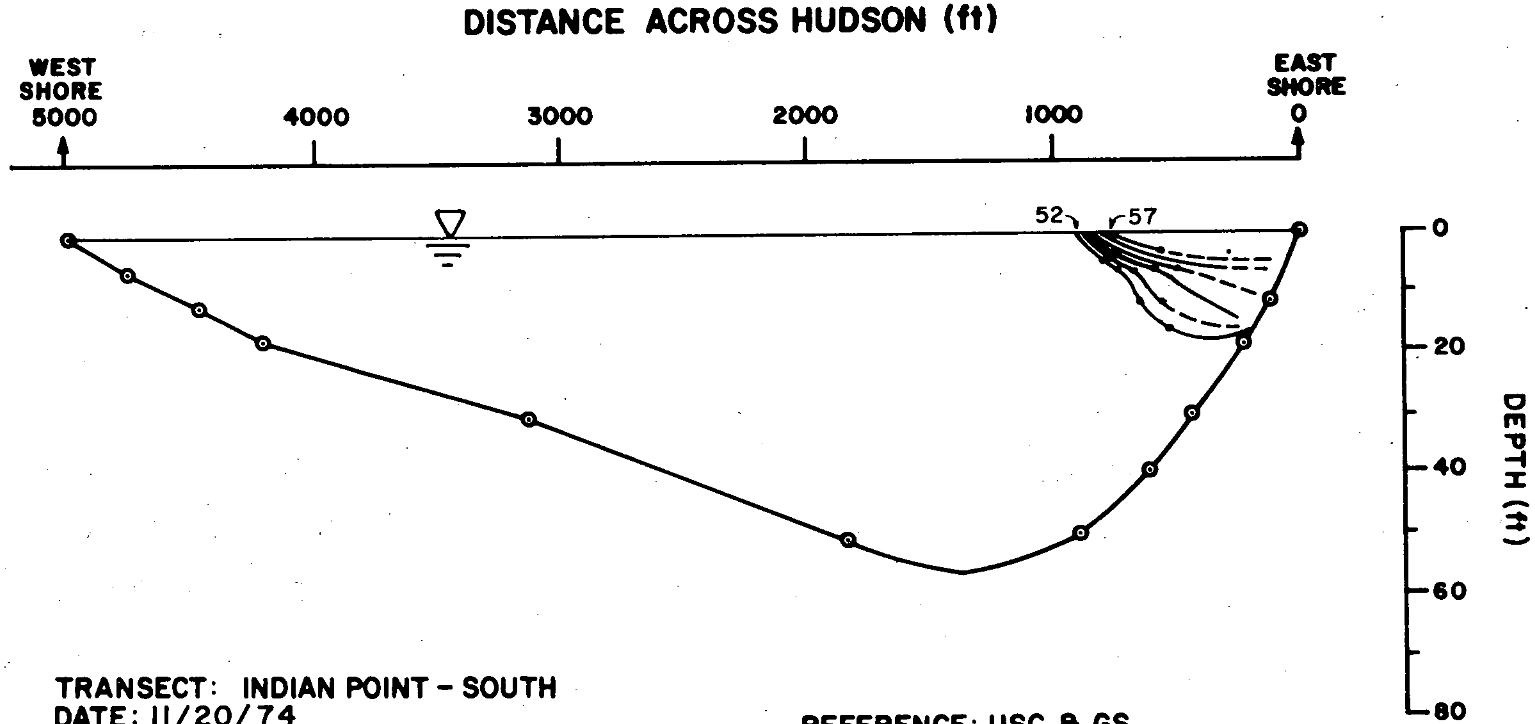


SCAN TRANSECT: BEAR MOUNTAIN BRIDGE
DATE: 11/20/74
TIME: 0736-0739
TIDAL STAGE: EBB

FIGURE 8.5

AMBIENT SCAN TEMPERATURES vs DEPTH
BEAR MOUNTAIN BRIDGE
EBB

CE-EC
DWG. Nº 76-99



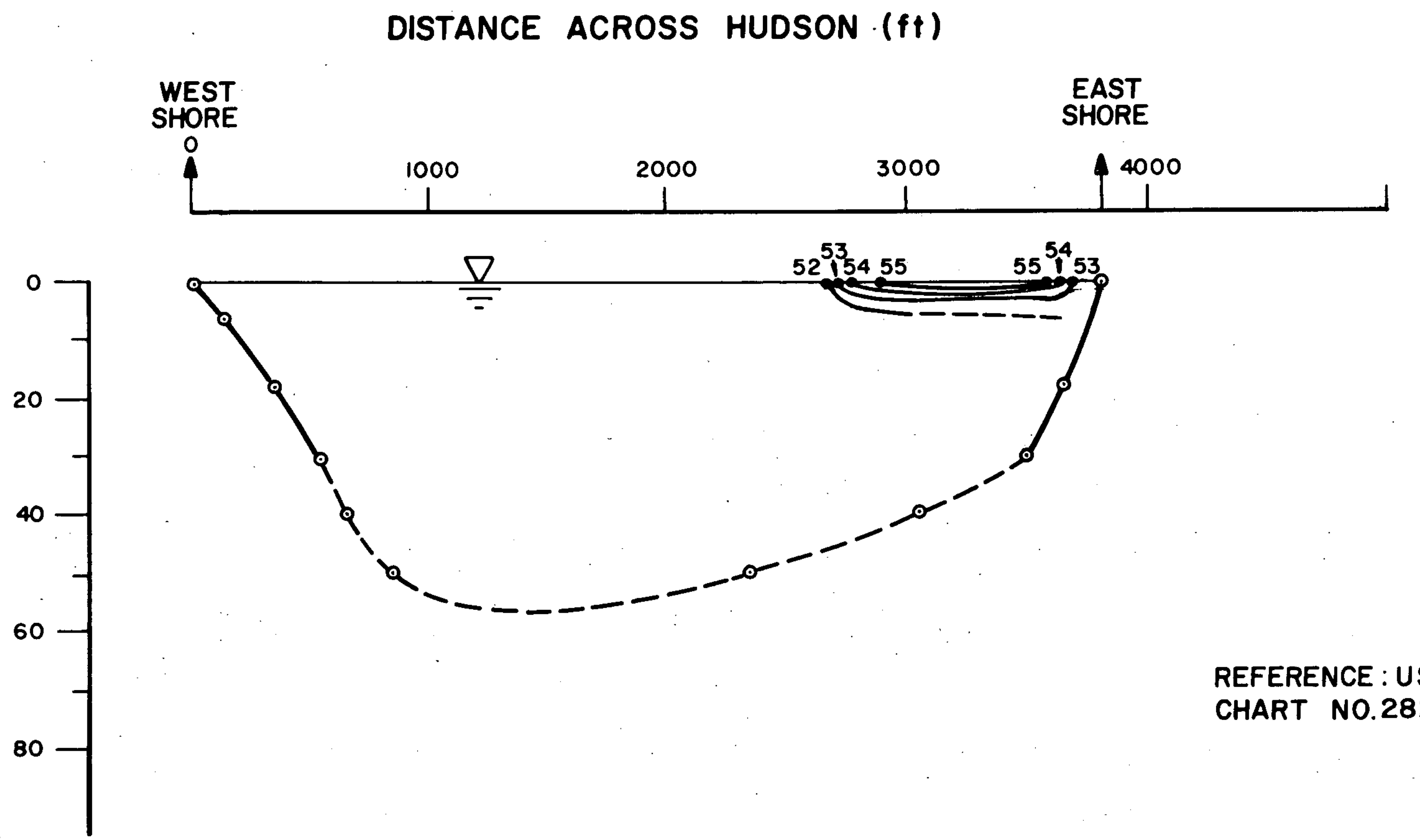
TRANSECT: INDIAN POINT - SOUTH
DATE: 11/20/74
TIME: 0816 -0852
TIDAL STAGE: EBB
TEMPERATURE (°F)

REFERENCE: USC & GS
CHART Nº 282 AND
ALDEN RESEARCH LABORATORIES

FIGURE 8.6

CROSS - SECTIONAL TEMPERATURE PATTERN AT INDIAN POINT - SOUTH
EBB

CE-EC
DWG. NO. 76-100



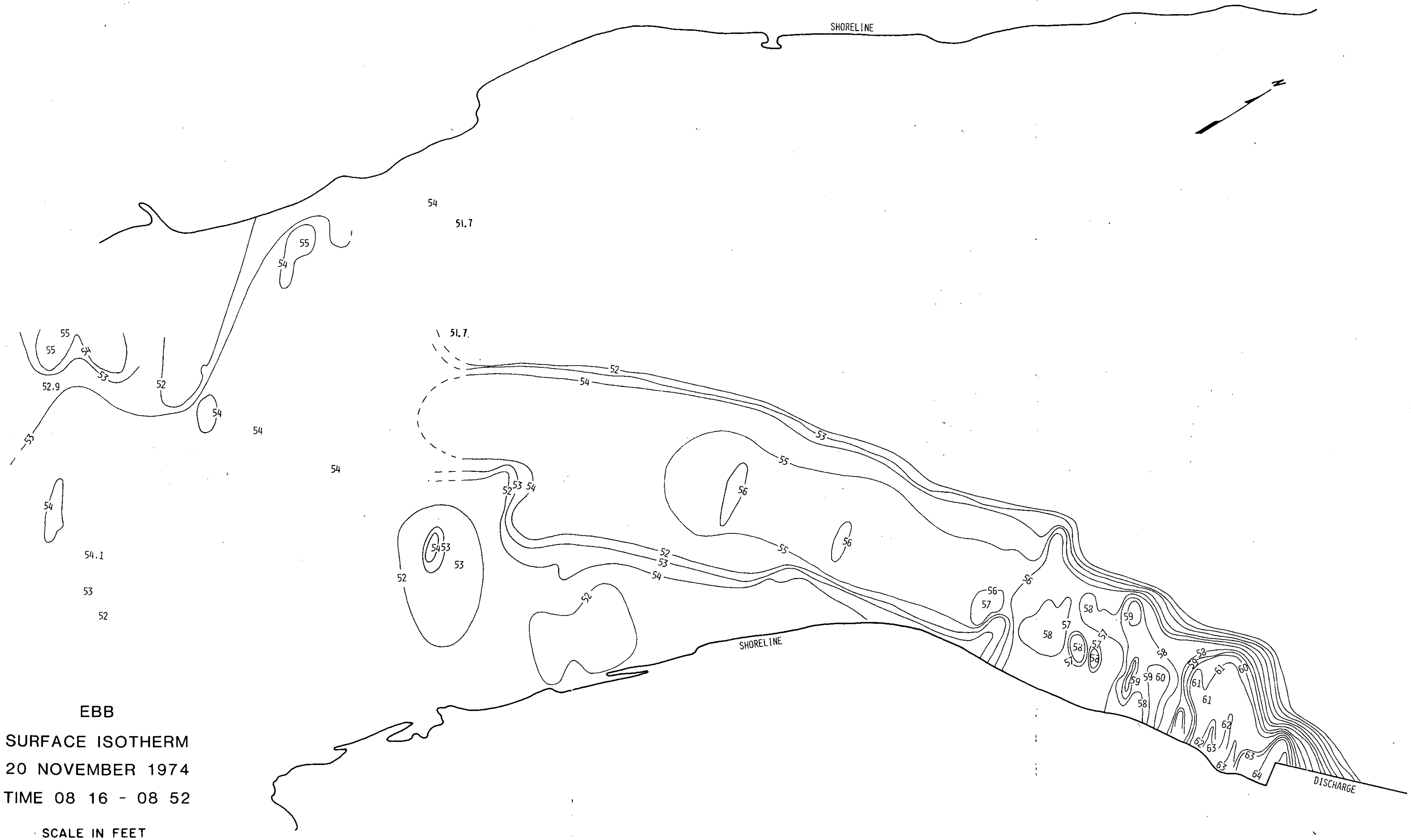
REFERENCE: USC & GS
CHART NO. 282

TRANSECT: TRANSMISSION LINES
DATE: 11/20/74
TIME: 0816-0852
TIDAL STAGE: EBB
TEMPERATURE (°F)

CROSS-SECTIONAL TEMPERATURE PATTERN
TRANSMISSION LINES
EBB

FIGURE 8.7

CE-EC
DWG. NO. 76-101



EBB
SURFACE ISOTHERM
20 NOVEMBER 1974
TIME 08 16 - 08 52

SCALE IN FEET
150 0 150 300 450 600

DAMES & MOORE

FIGURE 8.8

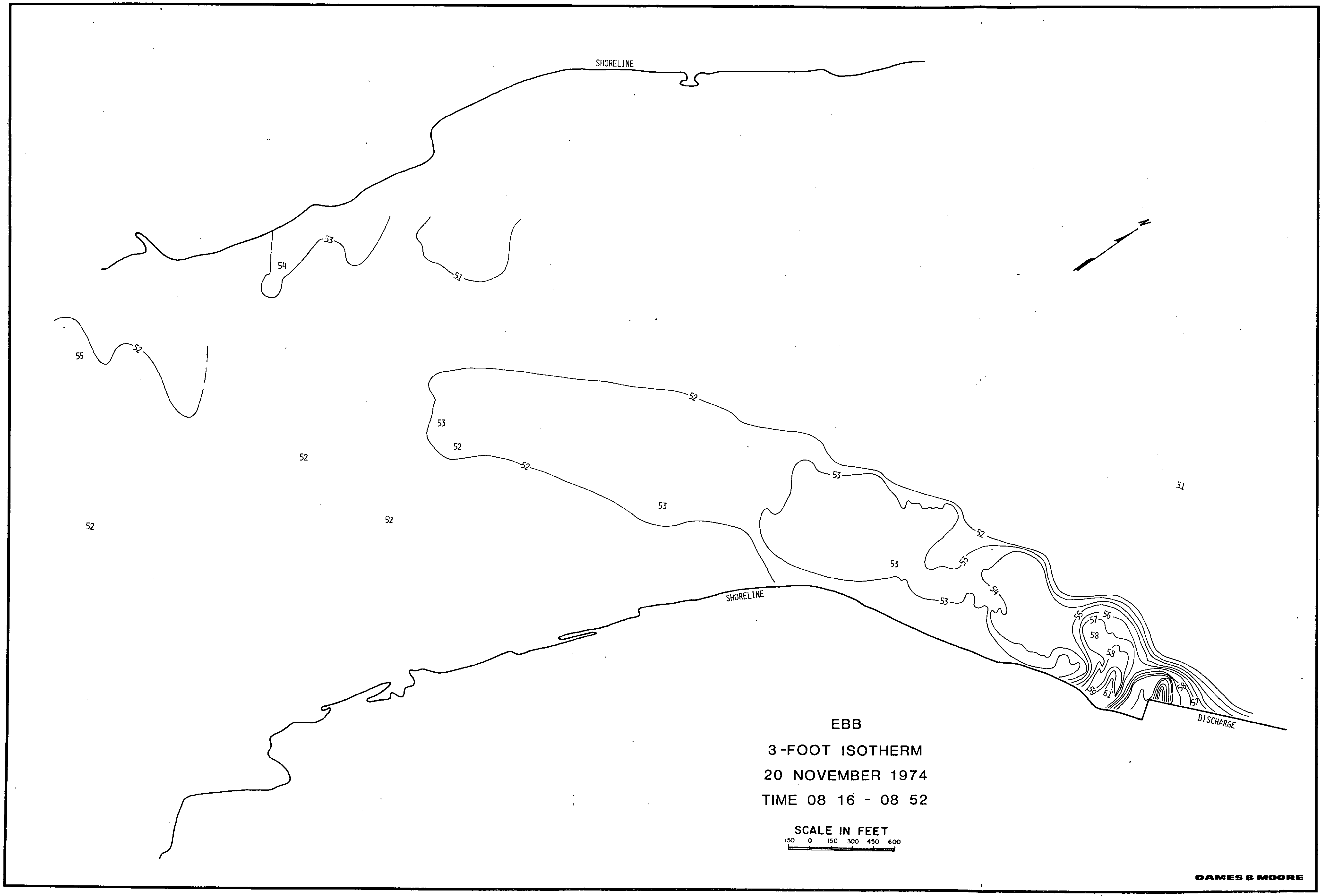
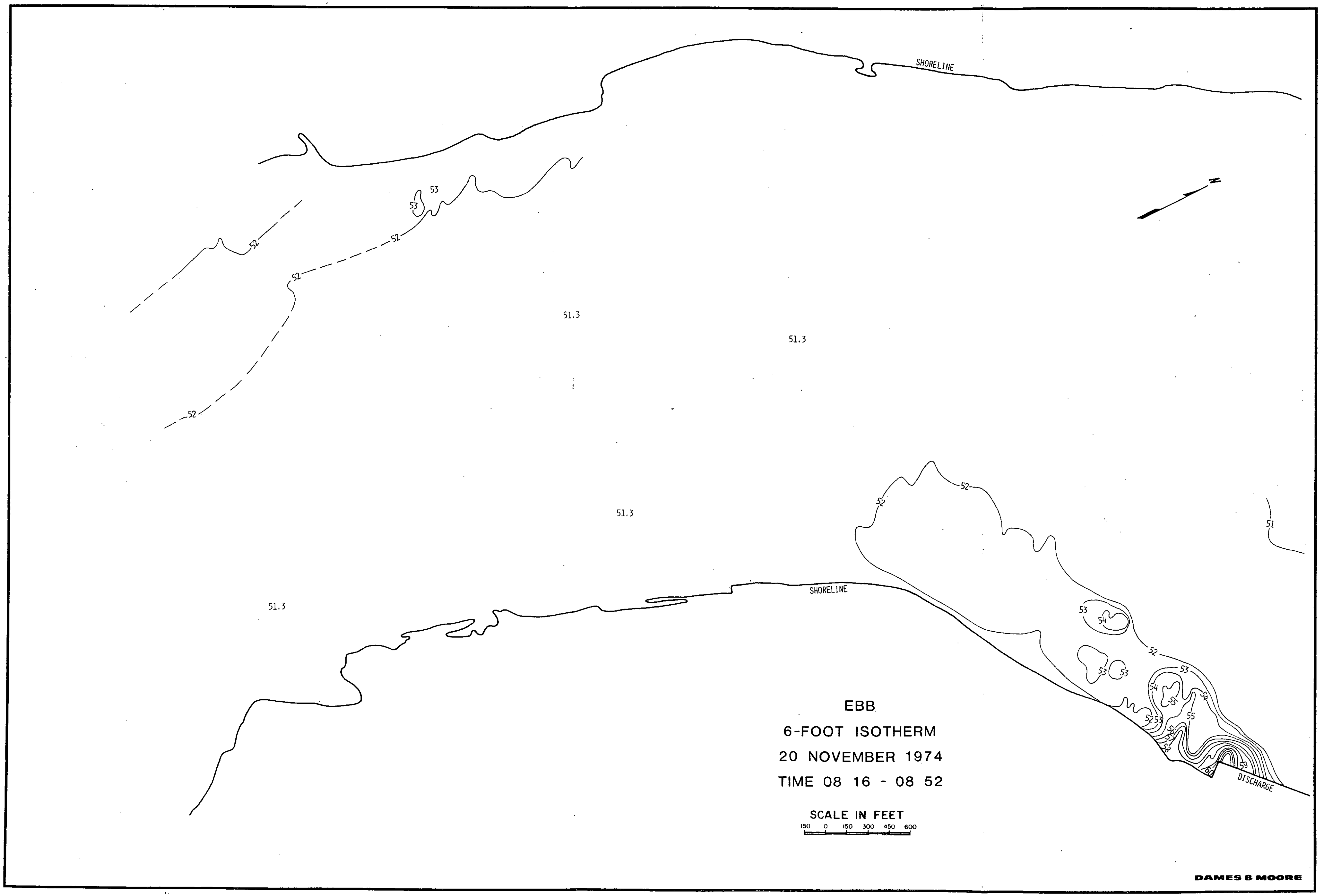

SHORELINE
SHORELINE
DISCHARGE
EBB
3-FOOT ISOTHERM
20 NOVEMBER 1974
TIME 08 16 - 08 52
SCALE IN FEET
150 0 150 300 450 600
DAMES & MOORE

FIGURE 8.9


SHORELINE
N
53
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52
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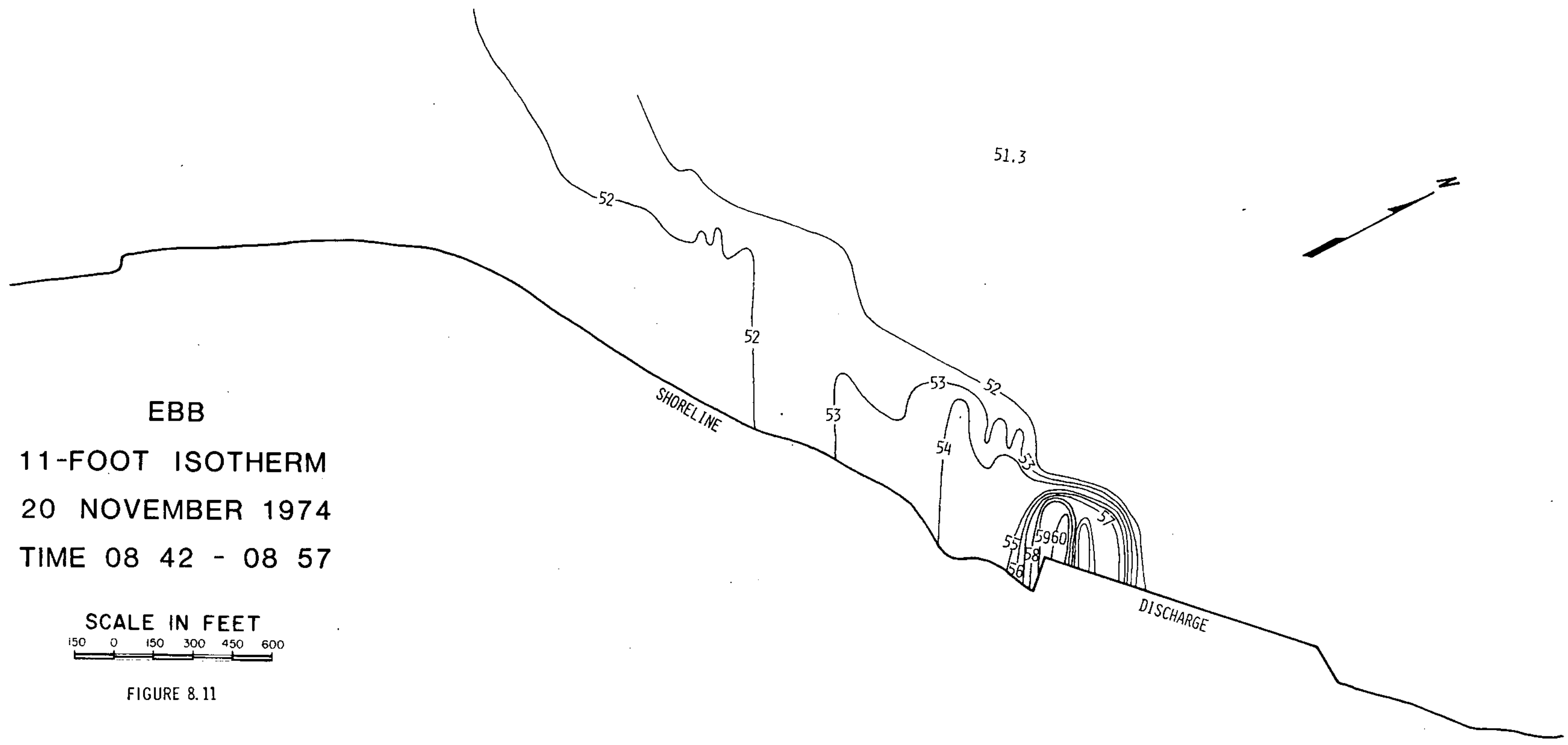
51.3
51.3
52
51.3
52
52
51
51.3
SHORELINE
53
54
52
53
53
53
54
55
54
55
52
53
59
60
DISCHARGE
EBB
6-FOOT ISOTHERM
20 NOVEMBER 1974
TIME 08 16 - 08 52
SCALE IN FEET
150 0 150 300 450 600
DAMES & MOORE

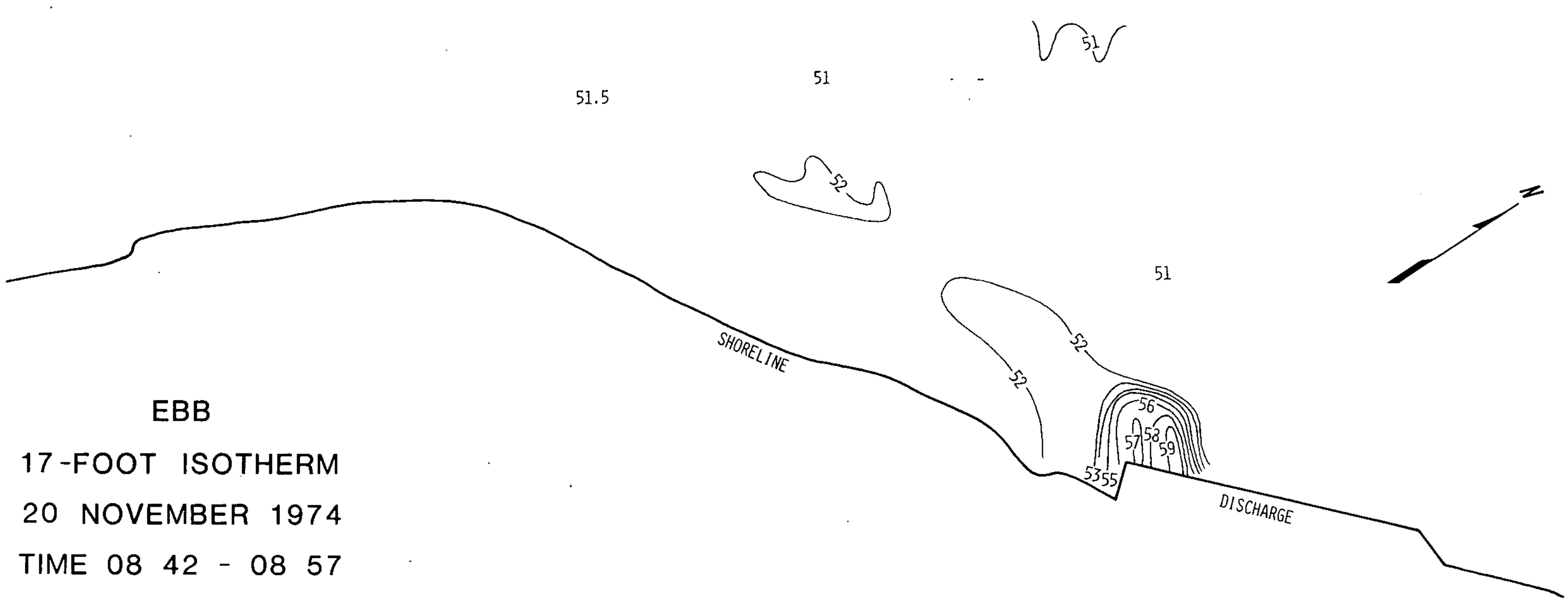
FIGURE 8.10



EBB
11-FOOT ISOTHERM
20 NOVEMBER 1974
TIME 08 42 - 08 57

SCALE IN FEET
150 0 150 300 450 600

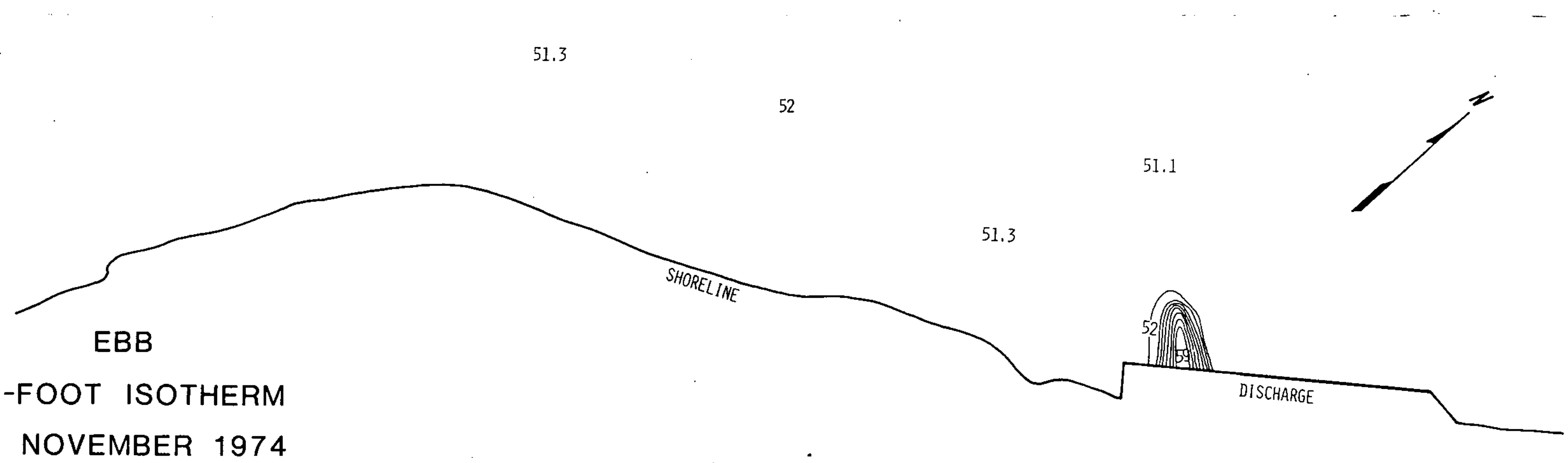
FIGURE 8.11



EBB
17-FOOT ISOTHERM
20 NOVEMBER 1974
TIME 08 42 - 08 57

SCALE IN FEET
150 0 150 300 450 600

FIGURE 8.12



EBB
23-FOOT ISOTHERM
20 NOVEMBER 1974
TIME 08 42 - 08 57

SCALE IN FEET
150 0 150 300 450 600

FIGURE 8.13

DAMES & MOORE

FIGURES 8.11 - 8.13

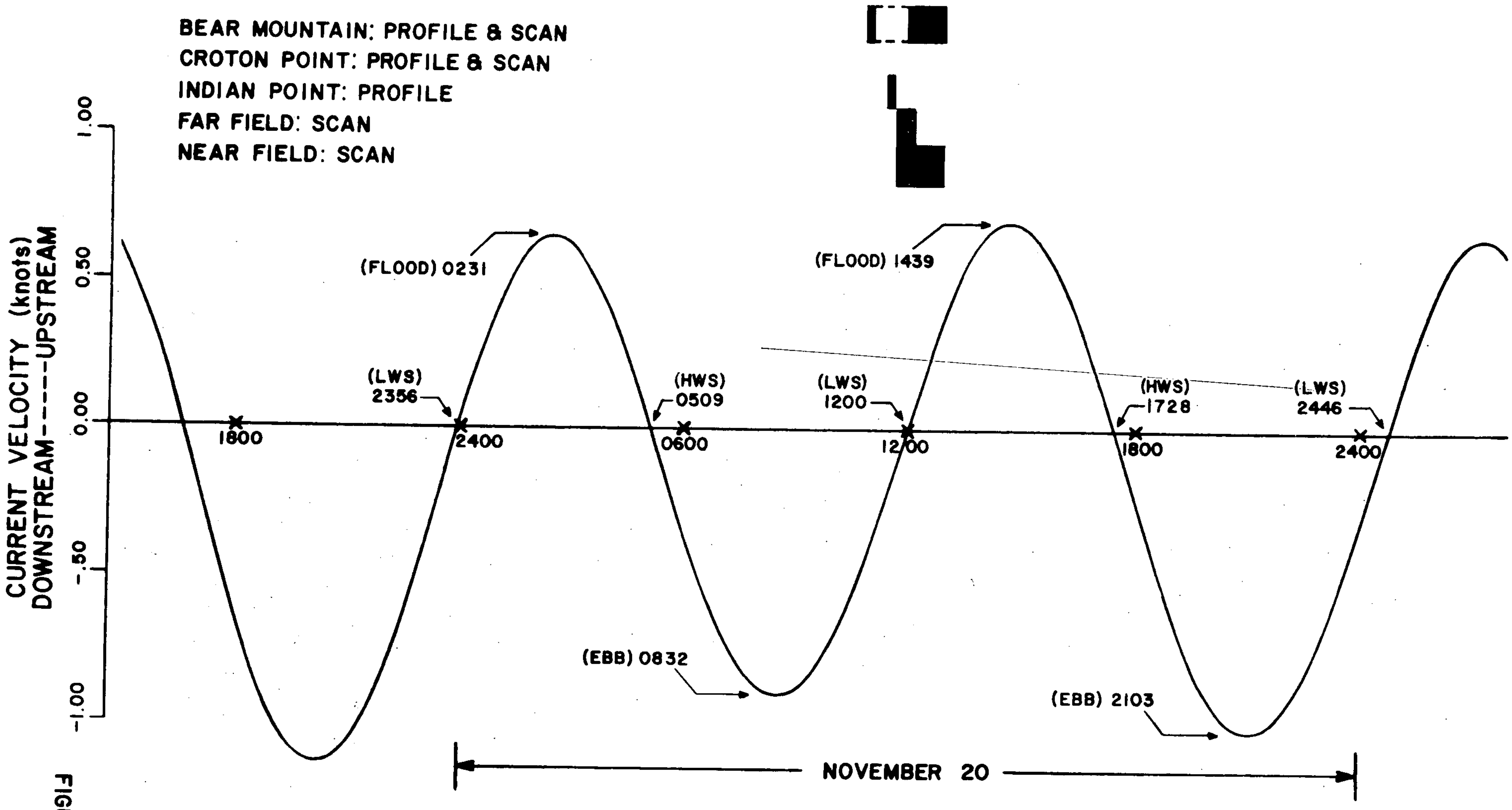
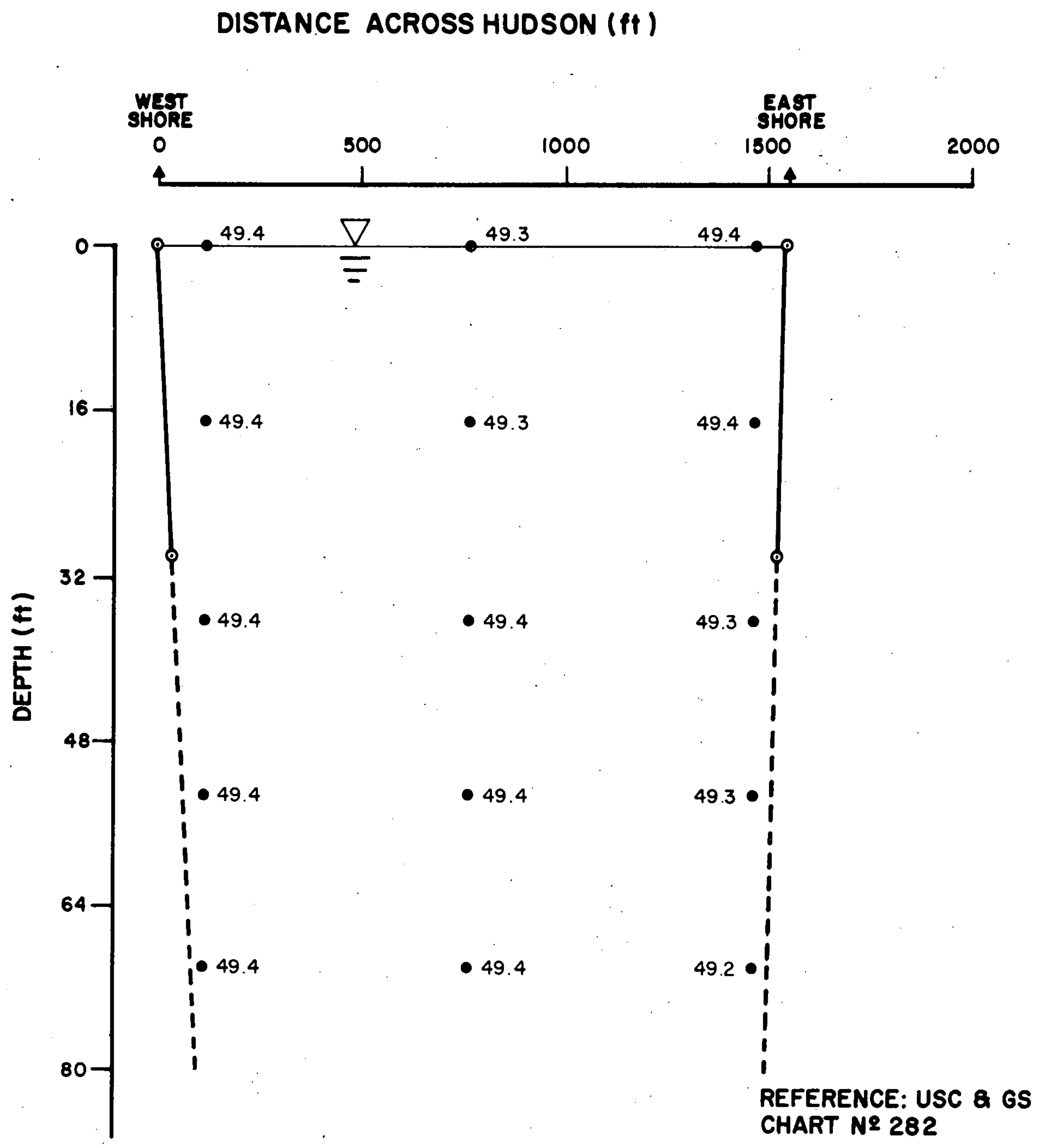


FIGURE 9.1

TIDAL CURRENTS AND
TIME SEQUENCE OF TEMPERATURE MEASUREMENTS
NOVEMBER 20, 1974
—(LOW WATER SLACK)—
(REF: TIDAL CURRENT TABLES, 1974, ATLANTIC COAST
OF NORTH AMERICA [AT PEEKSKILL], NOAA)

CE-EC
DWG. Nº76-102



TRANSECT: BEAR MOUNTAIN BRIDGE
DATE: 11/20/74
TIME: 1153-1253
TIDAL STAGE: LOW WATER SLACK
TEMPERATURE: (°F)

TEMPERATURE PROFILE MEASUREMENTS
BEAR MOUNTAIN BRIDGE-LOW WATER SLACK

FIGURE: 9.2

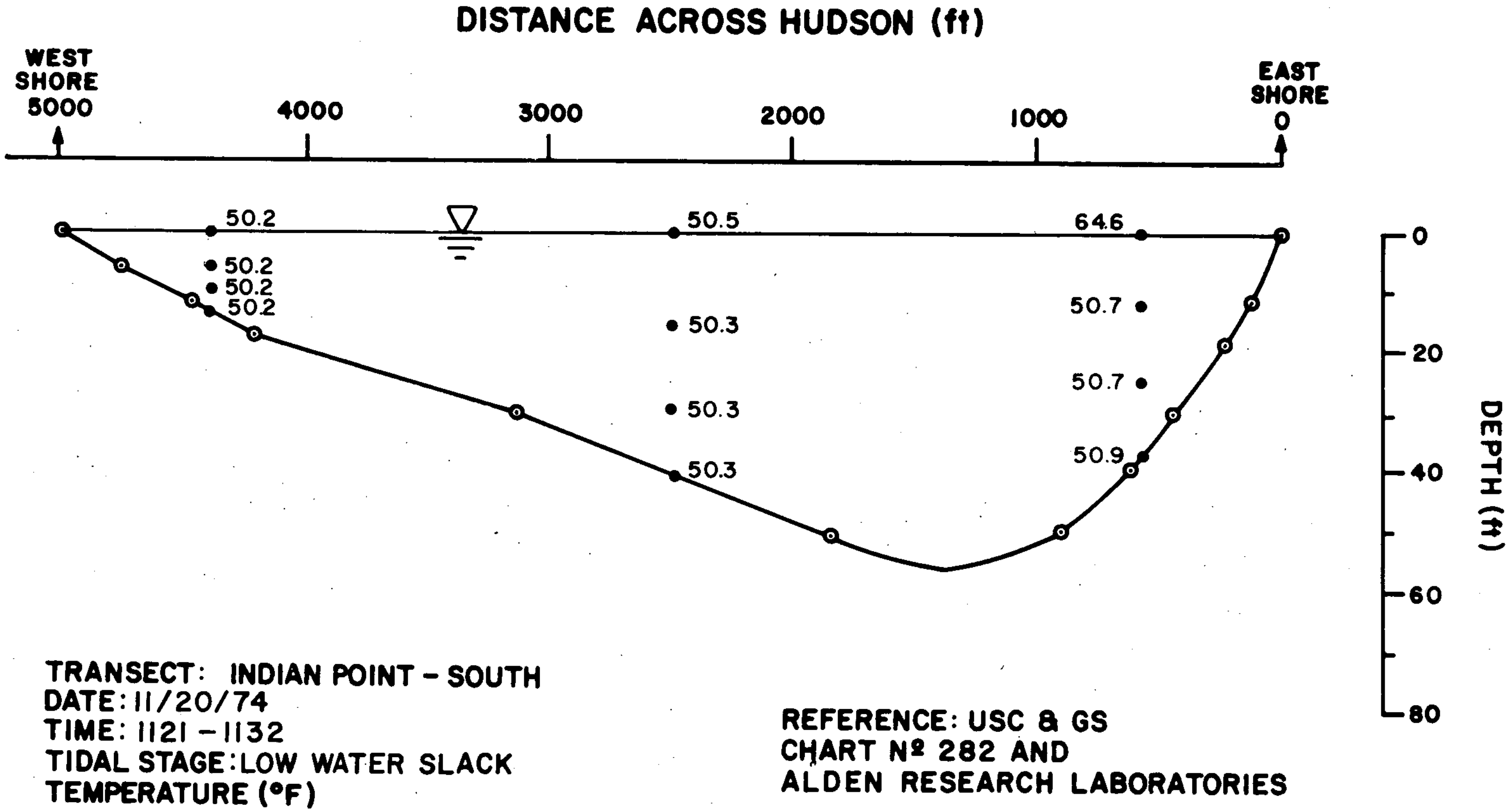
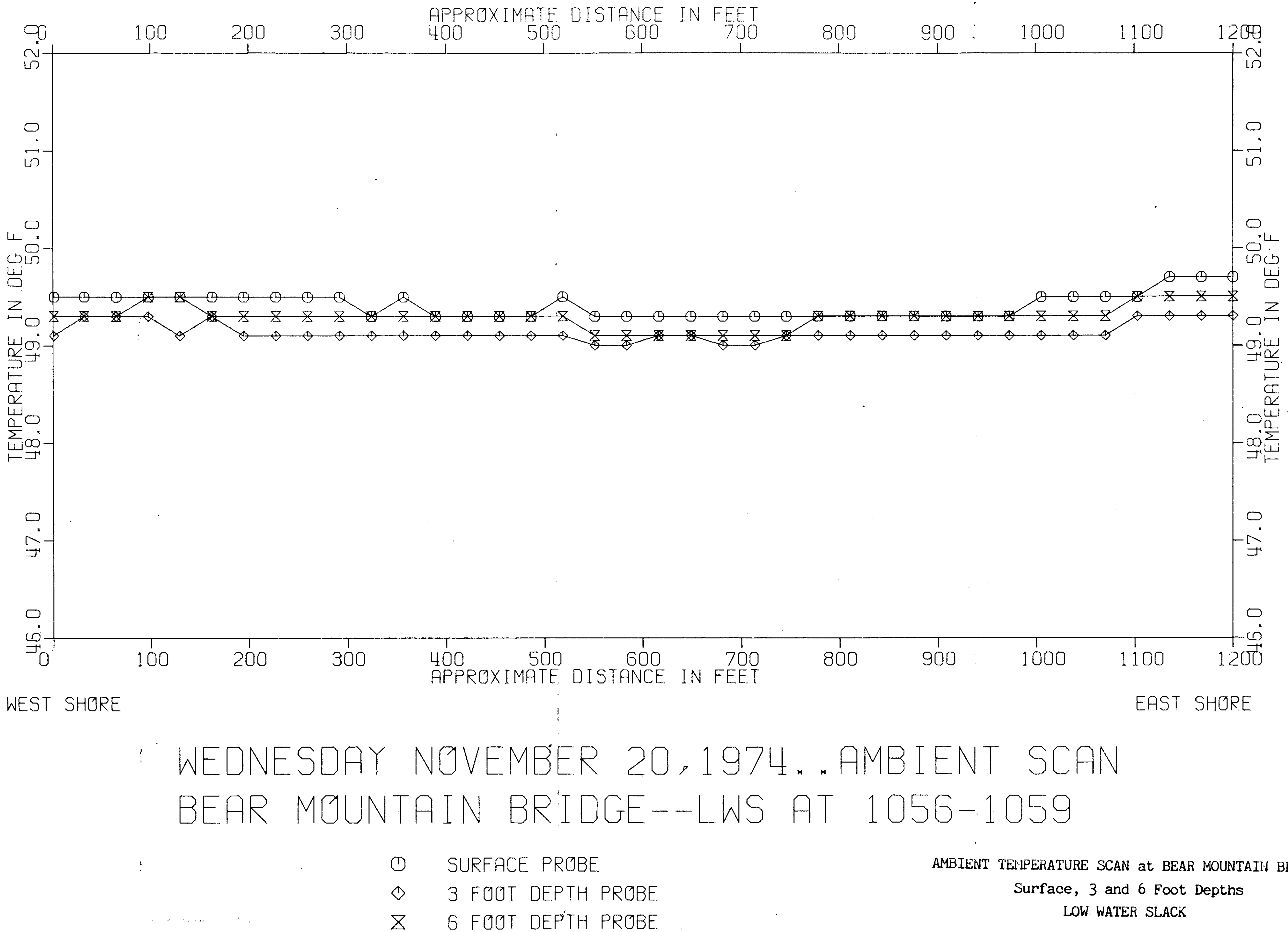


FIGURE 9.3

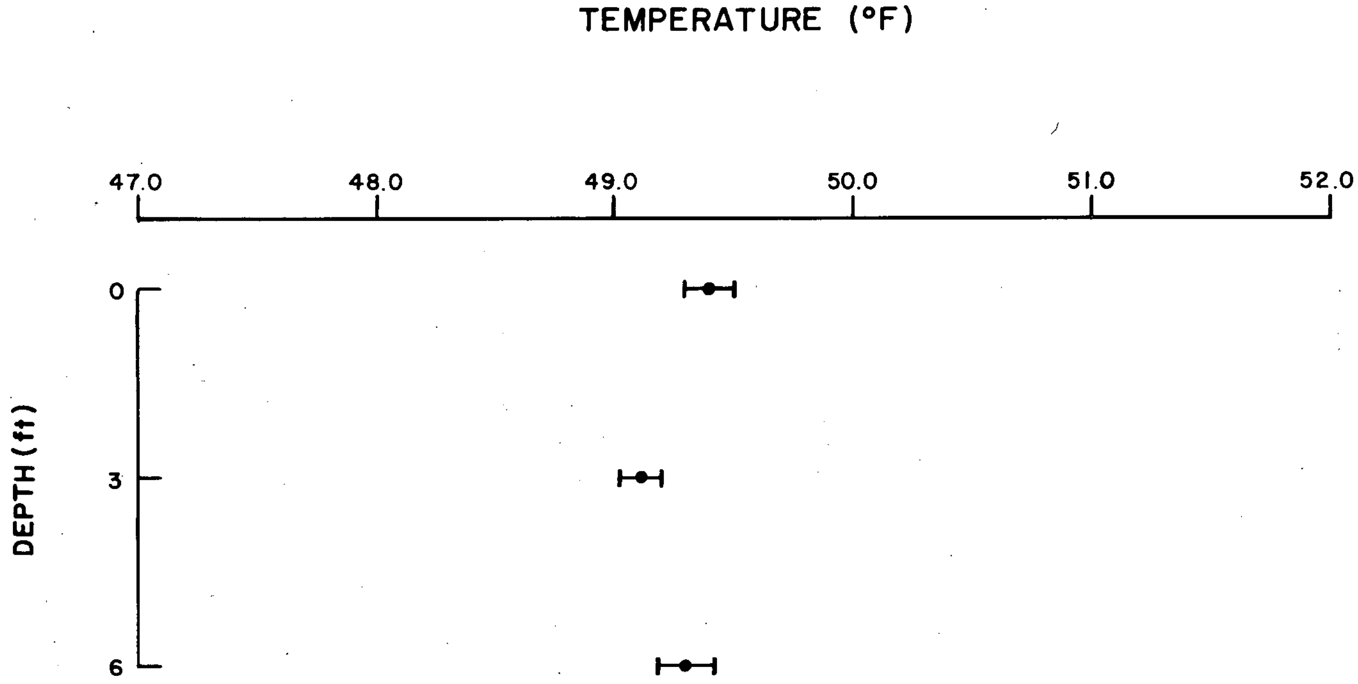
TEMPERATURE PROFILE MEASUREMENTS AT INDIAN POINT - SOUTH: LOW WATER SLACK

CE-EC
DWG.NO.76-104



AMBIENT TEMPERATURE SCAN at BEAR MOUNTAIN BRIDGE
Surface, 3 and 6 Foot Depths
LOW WATER SLACK

FIGURE 9.4

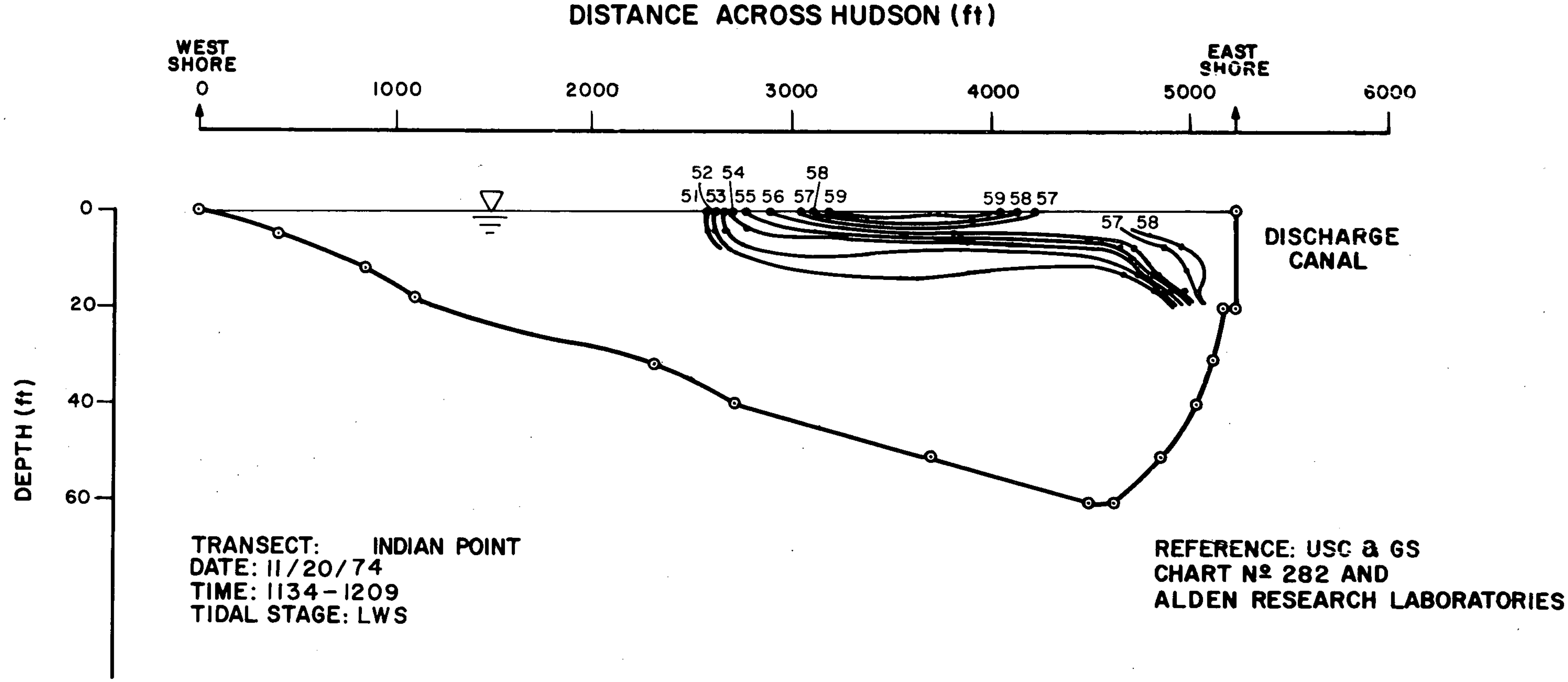


SCAN TRANSECT: BEAR MOUNTAIN BRIDGE
DATE: 11/20/74
TIME: 1056-1059
TIDAL STAGE: LOW WATER SLACK

FIGURE 9.5

AMBIENT SCAN TEMPERATURES vs DEPTH
BEAR MOUNTAIN BRIDGE
LOW WATER SLACK

CE-EC
DWG. Nº 76-105



CROSS-SECTIONAL TEMPERATURE PATTERN
INDIAN POINT DISCHARGE
LWS

FIGURE 9.6

CE-EC
DWG.NO.76-106

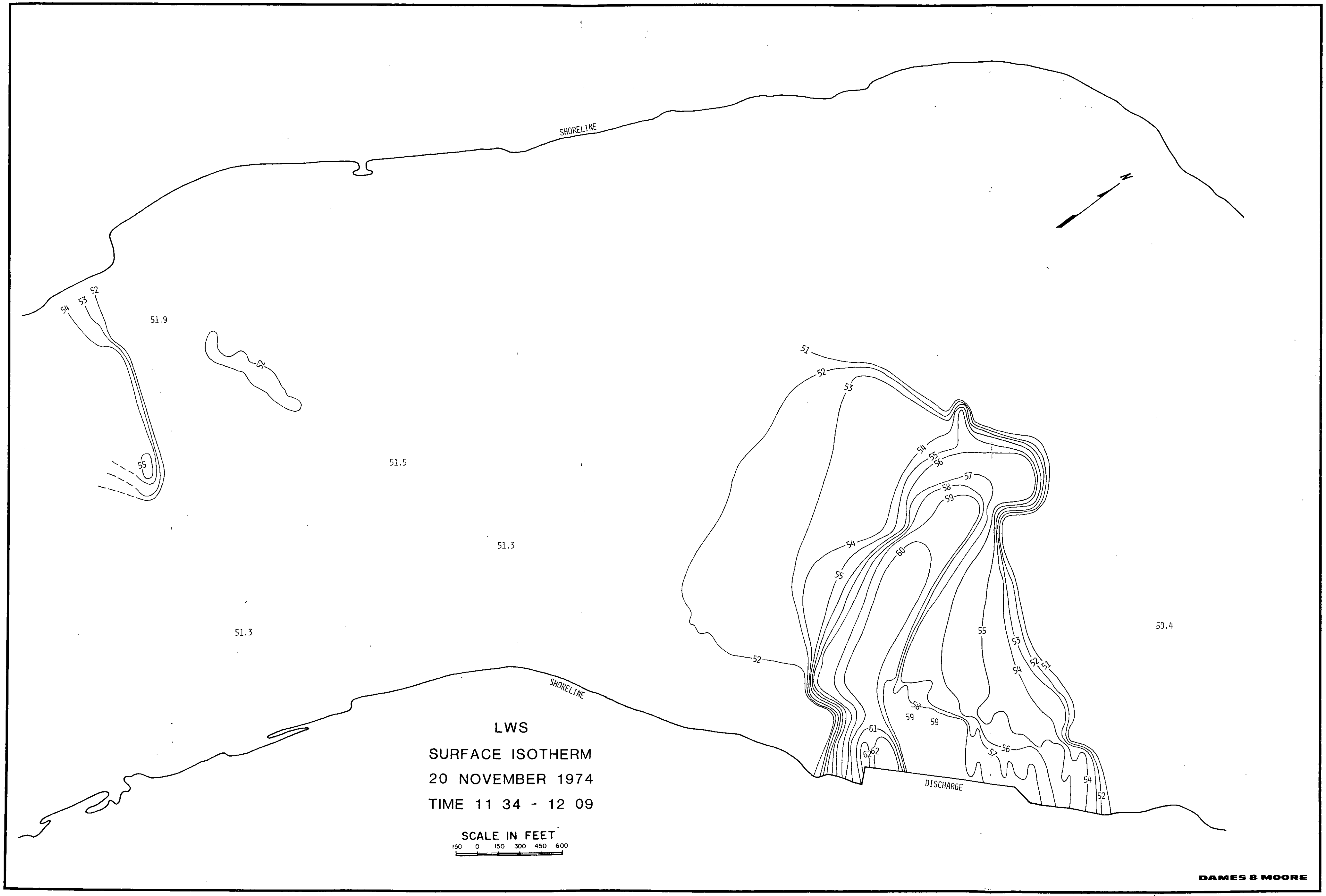

SHORELINE
SHORELINE
DISCHARGE
N
51.9
51.5
51.3
51.3
50.4
LWS
SURFACE ISOTHERM
20 NOVEMBER 1974
TIME 11 34 - 12 09
SCALE IN FEET
150 0 150 300 450 600
DAMES & MOORE

FIGURE 9.7

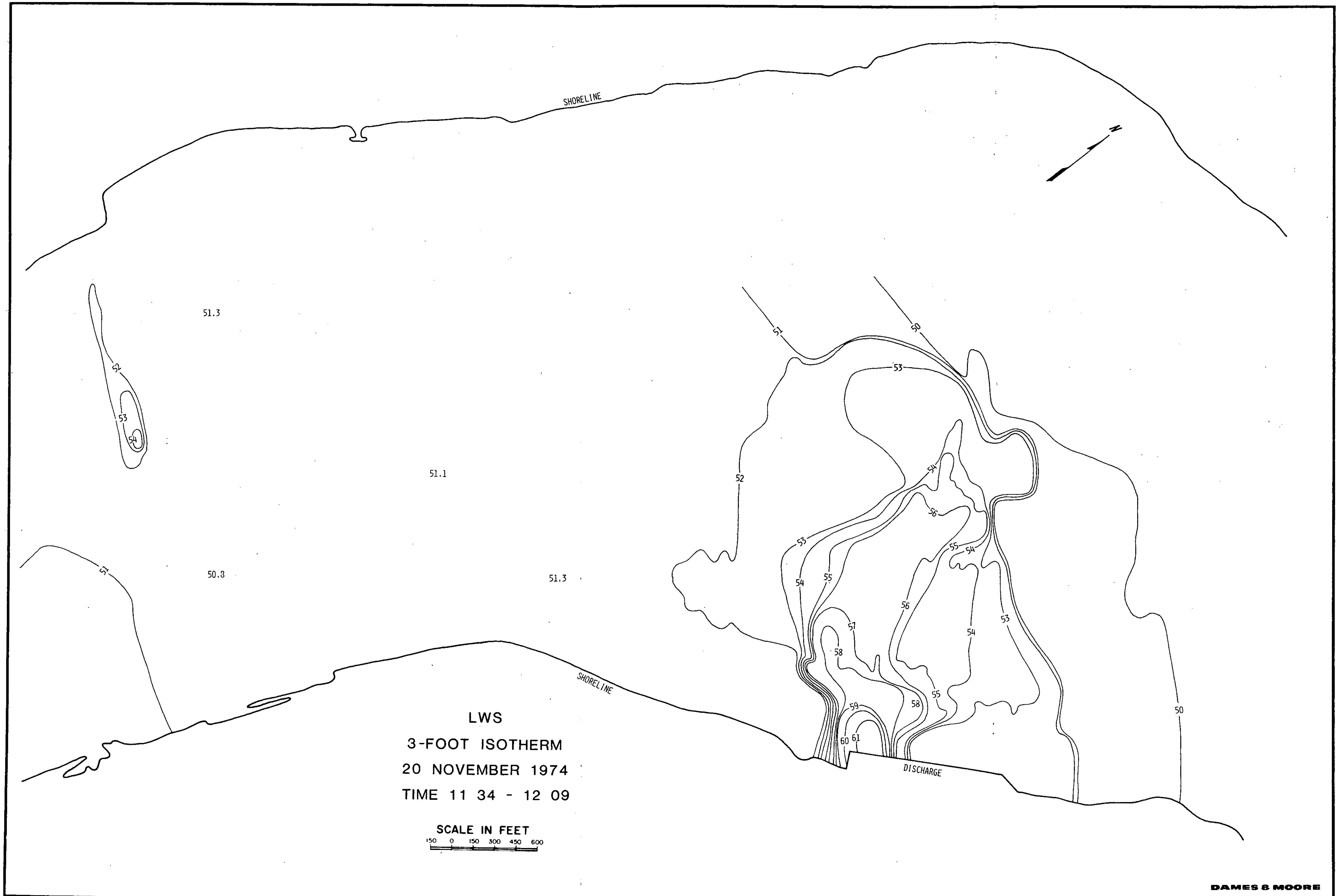

SHORELINE
SHORELINE
N
51.3
51.1
50.8
51.3
51
52
53
54
50
51
52
53
54
55
56
57
58
59
60
61
DISCHARGE
LWS
3-FOOT ISOTHERM
20 NOVEMBER 1974
TIME 11 34 - 12 09
SCALE IN FEET
150 0 150 300 450 600
DAMES & MOORE

FIGURE 9.8

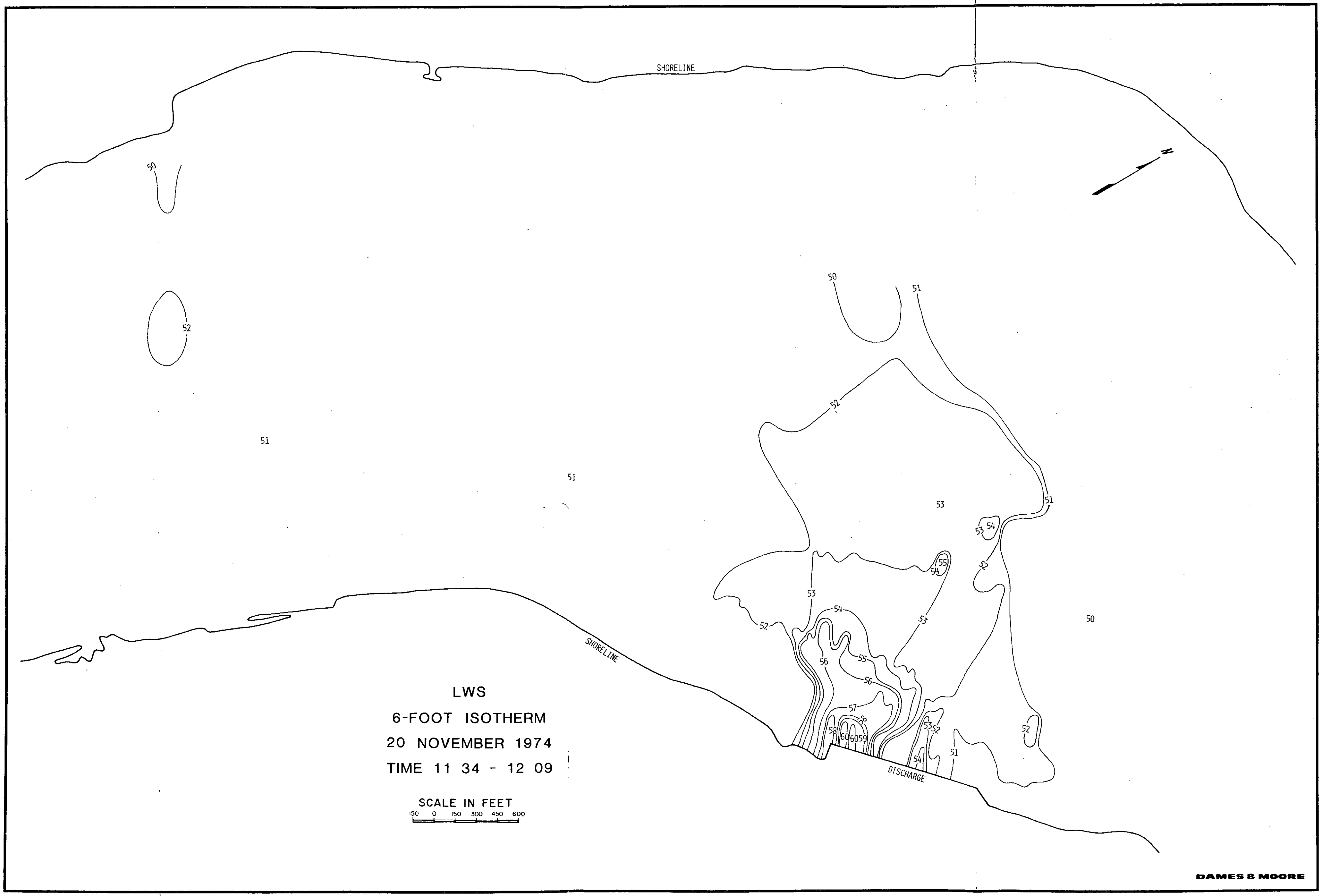
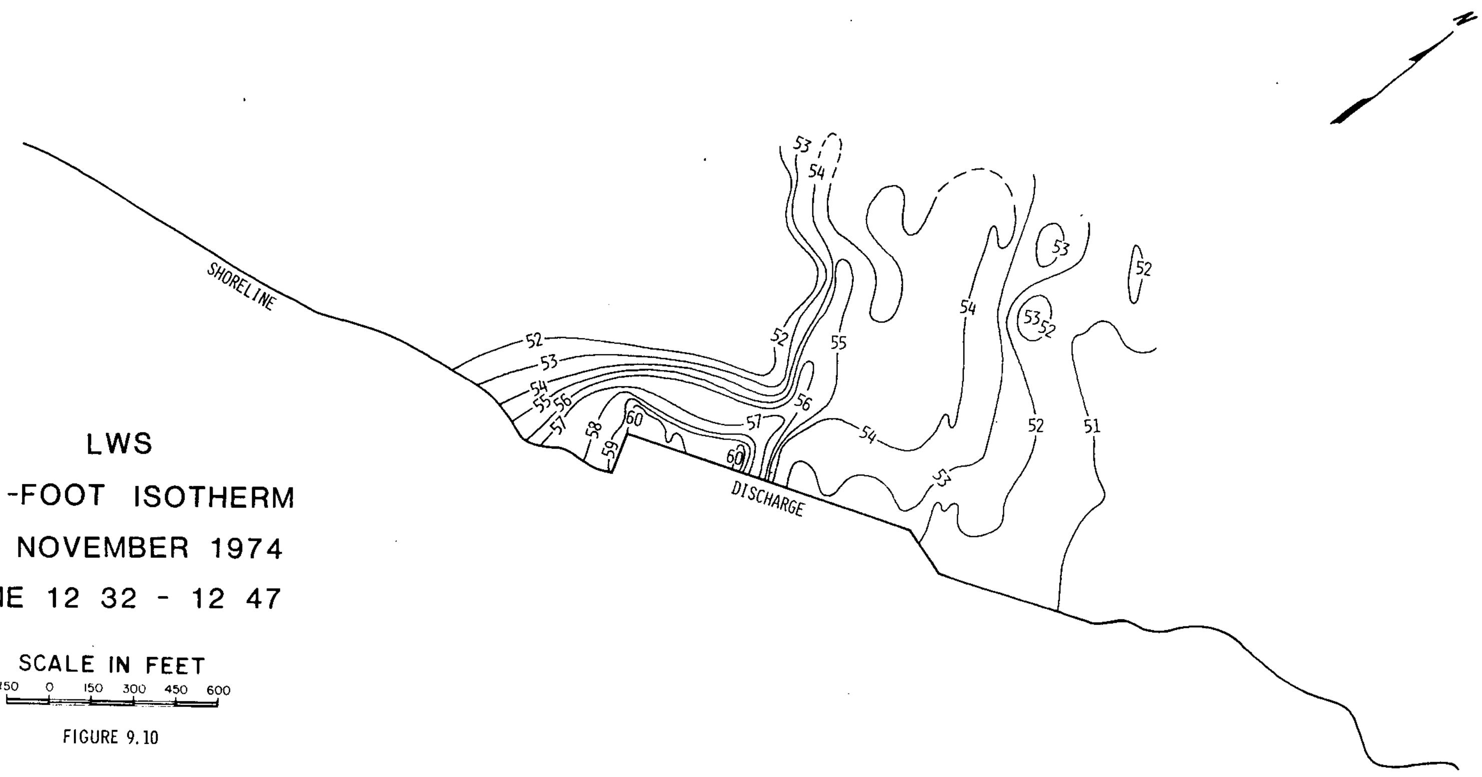

SHORELINE
SHORELINE
DISCHARGE
N
50
51
52
53
54
55
56
57
58
59
60
LWS
6-FOOT ISOTHERM
20 NOVEMBER 1974
TIME 11 34 - 12 09
SCALE IN FEET
150 0 150 300 450 600
DAMES & MOORE

FIGURE 9.9



LWS

13.8-FOOT ISOTHERM

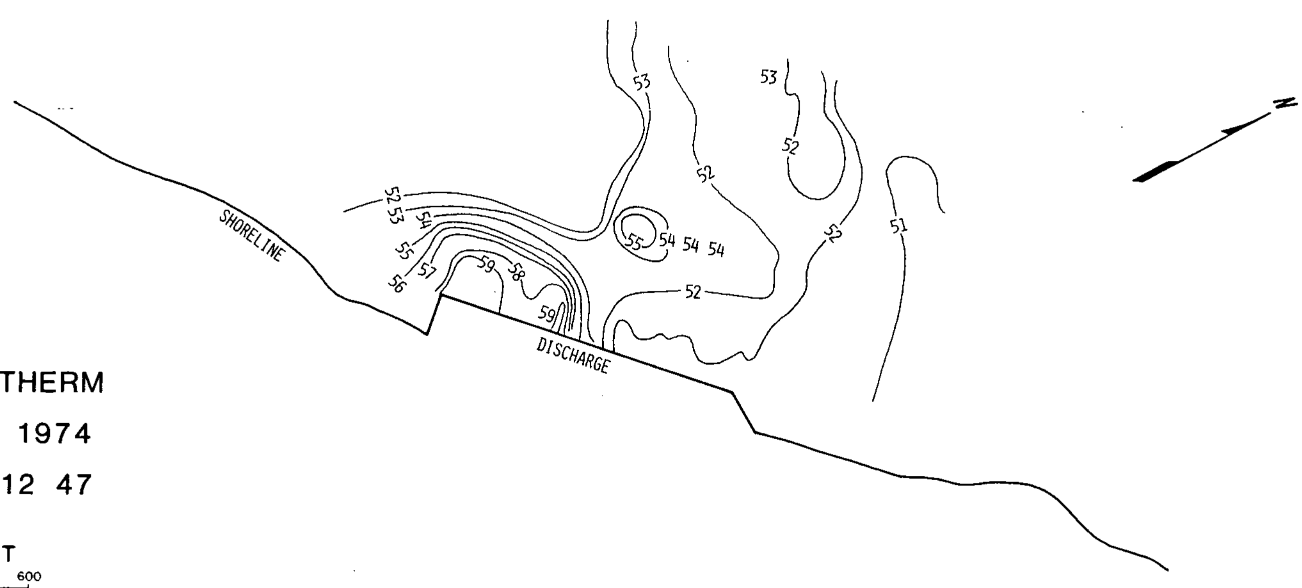
20 NOVEMBER 1974

TIME 12 32 - 12 47

SCALE IN FEET

150 0 150 300 450 600

FIGURE 9.10



LWS

16.2-FOOT ISOTHERM

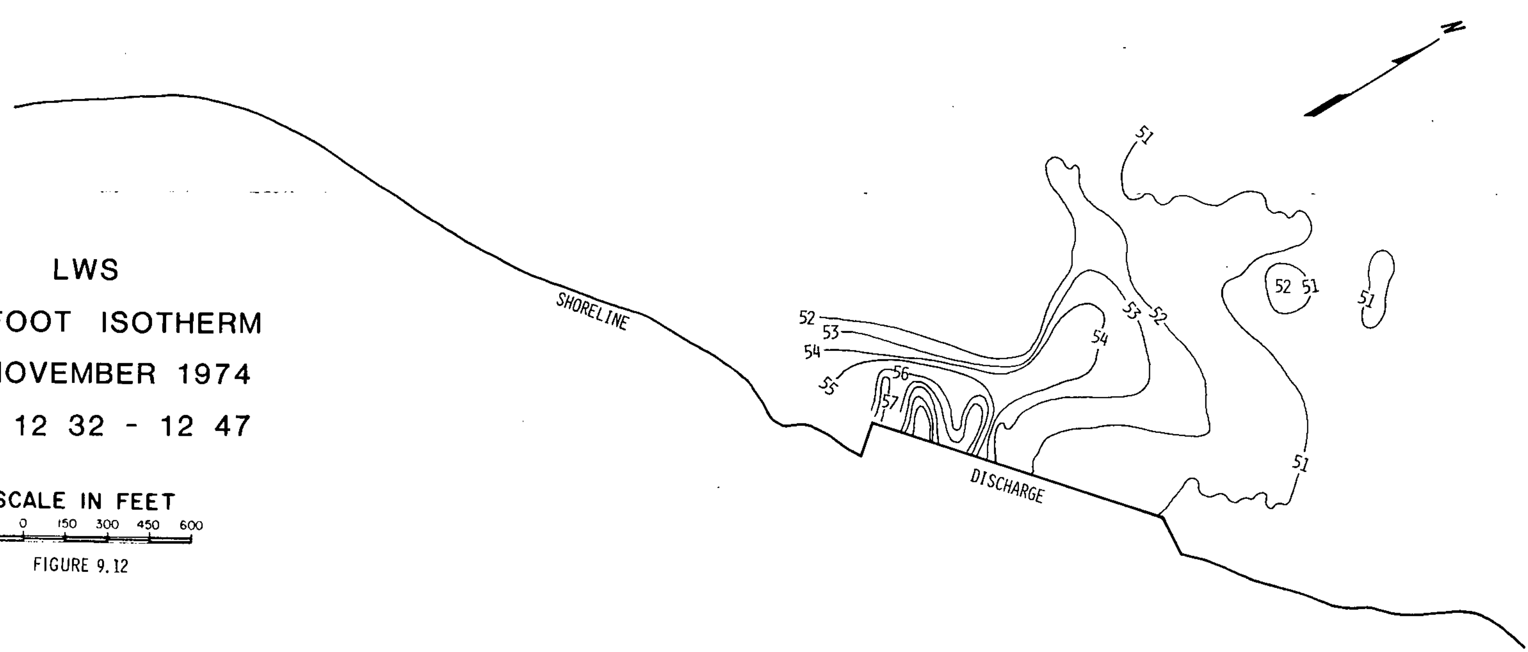
20 NOVEMBER 1974

TIME 12 32 - 12 47

SCALE IN FEET

150 0 150 300 450 600

FIGURE 9.11



LWS

18.7-FOOT ISOTHERM

20 NOVEMBER 1974

TIME 12 32 - 12 47

SCALE IN FEET

150 0 150 300 450 600

FIGURE 9.12

FIGURES 9.10 - 9.12

DAMES & MOORE

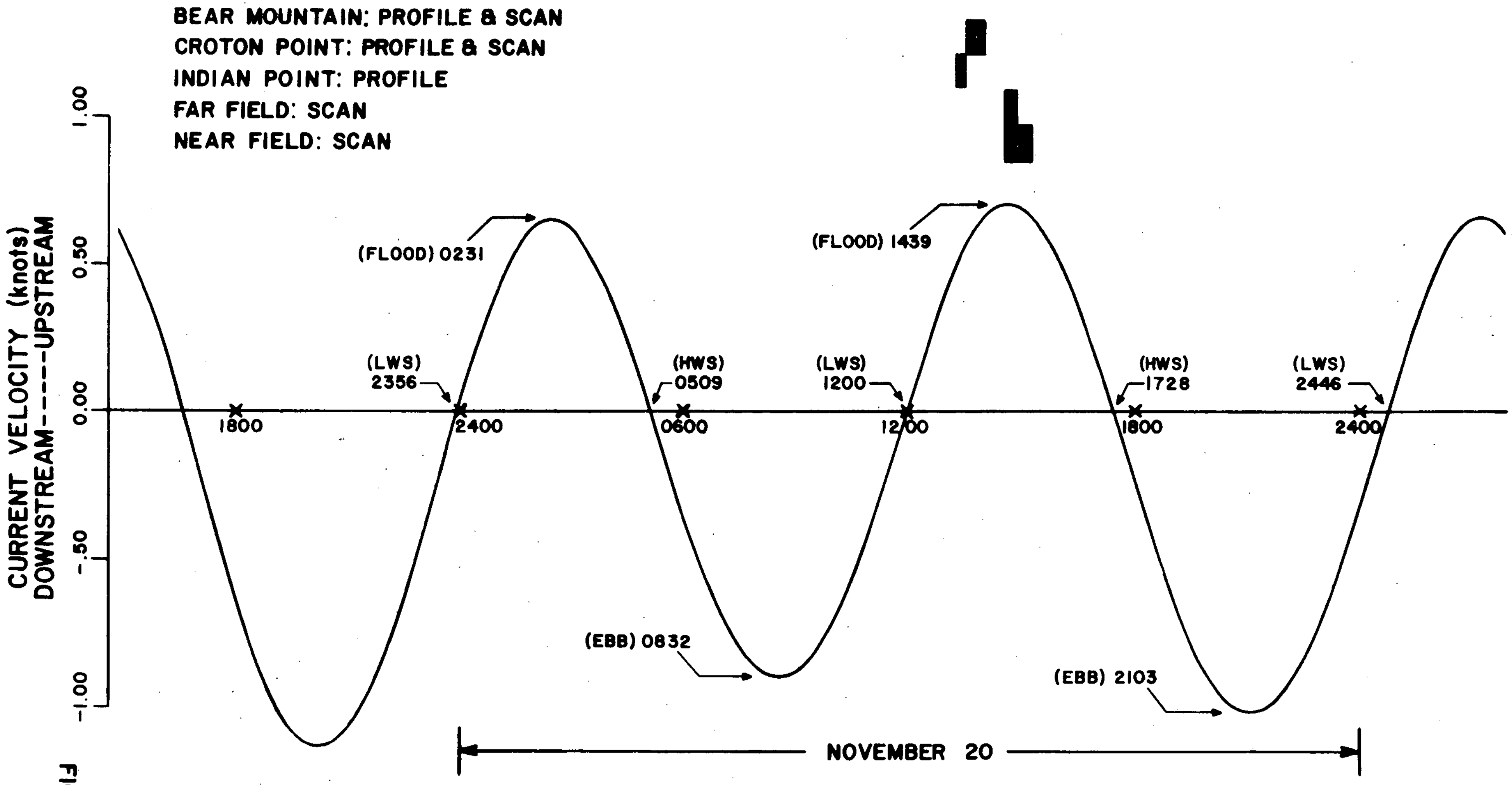
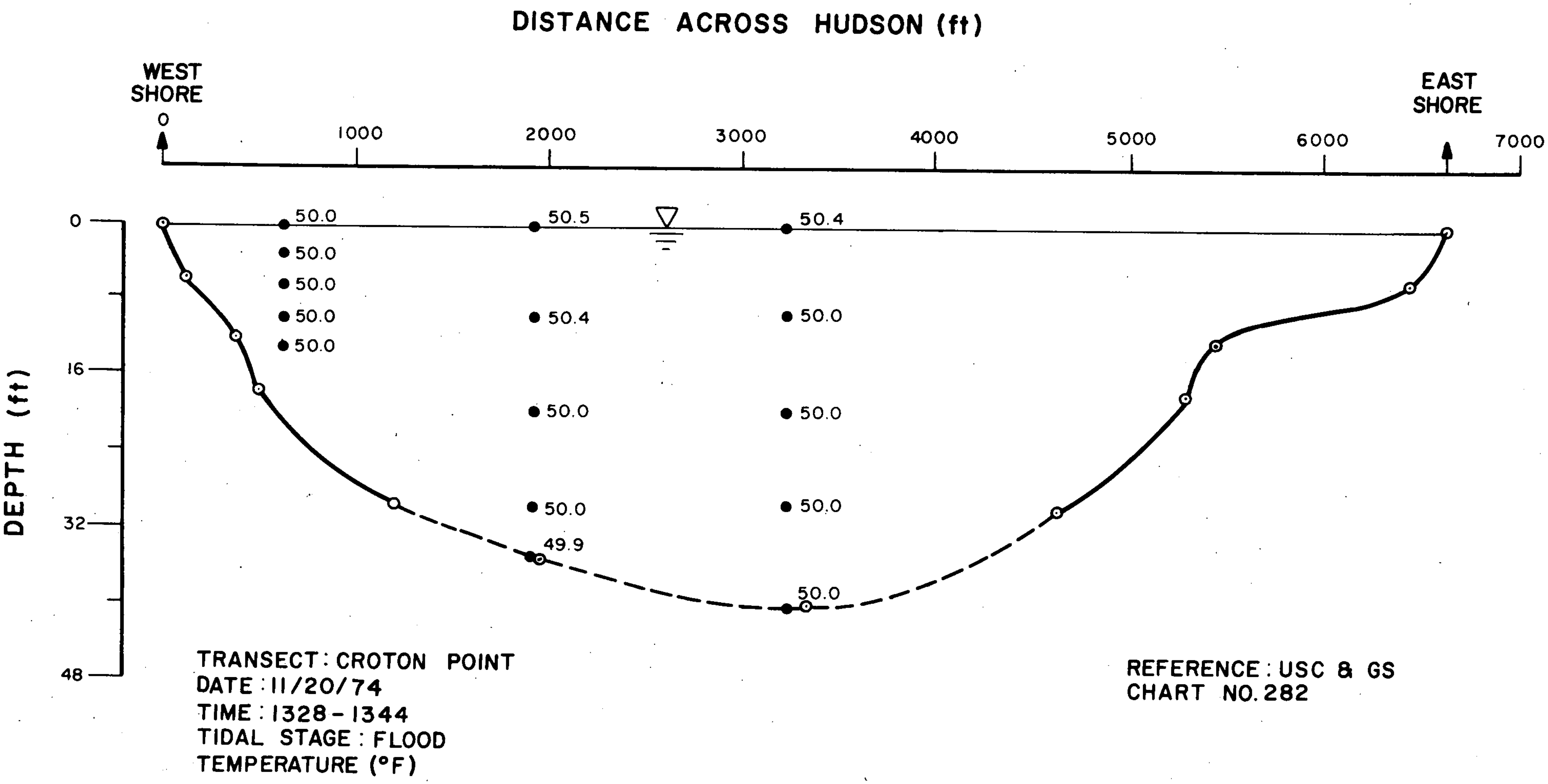


FIGURE 10.1

TIDAL CURRENTS AND
TIME SEQUENCE OF TEMPERATURE MEASUREMENTS
NOVEMBER 20, 1974
—(FLOOD)—
(REF: TIDAL CURRENT TABLES, 1974, ATLANTIC COAST
OF NORTH AMERICA [AT PEEKSKILL], NOAA)

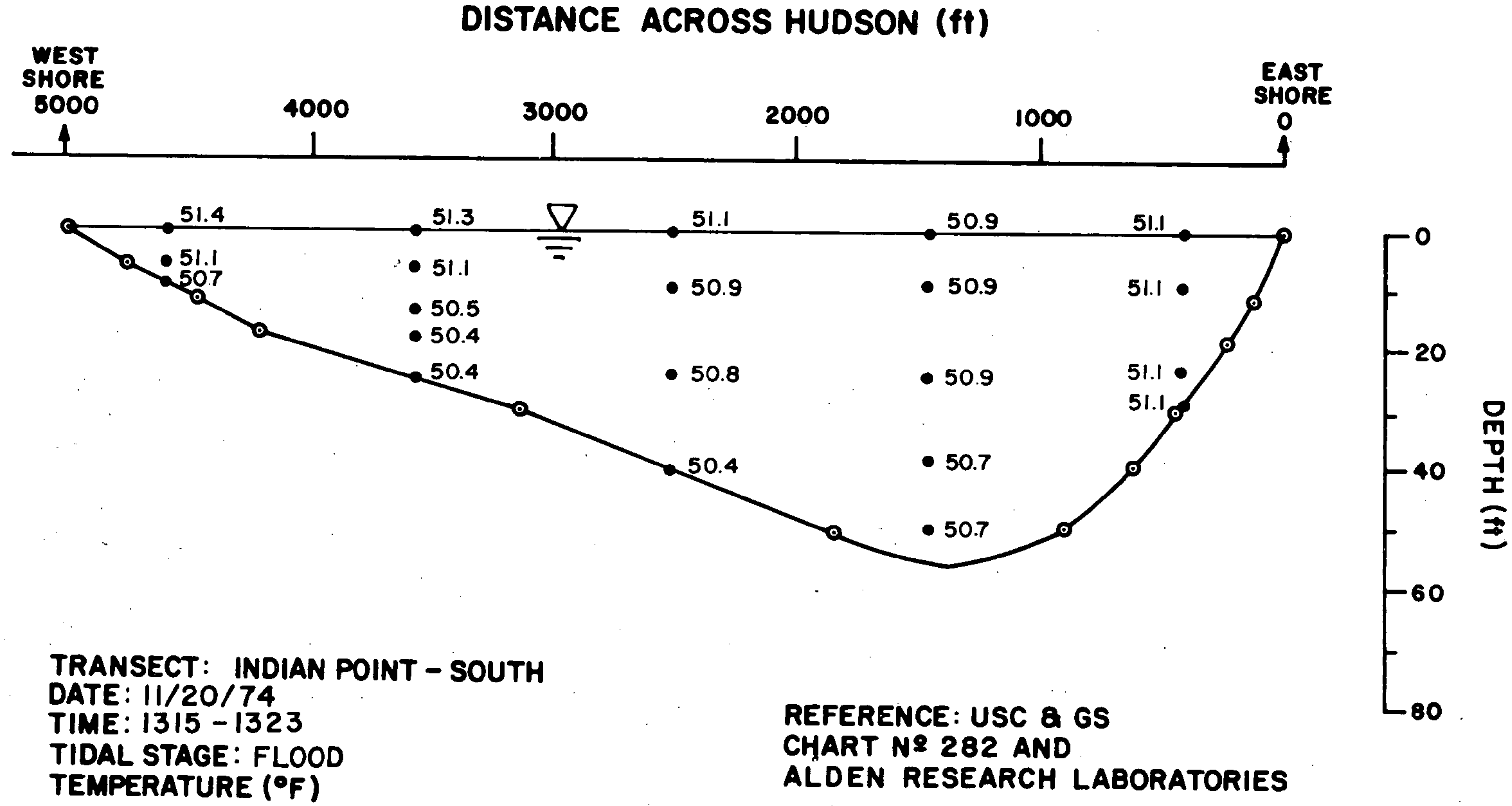
CE-EC
DWG. Nº76-107



TEMPERATURE PROFILE MEASUREMENTS
CROTON POINT
FLOOD

FIGURE: 10.2

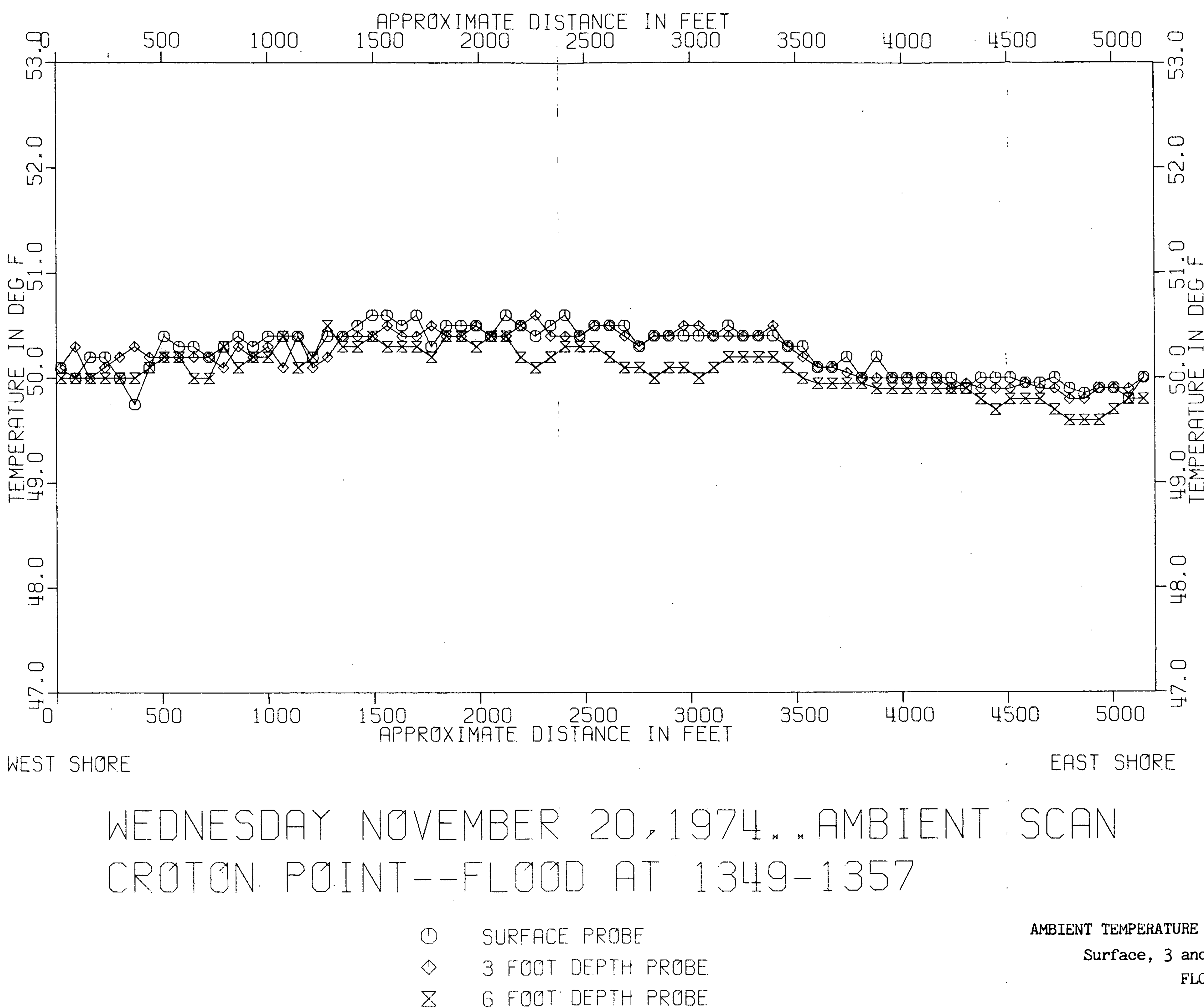
CE-EC
DWG. NO. 76-108



TEMPERATURE PROFILE MEASUREMENTS AT
INDIAN POINT - SOUTH: FLOOD

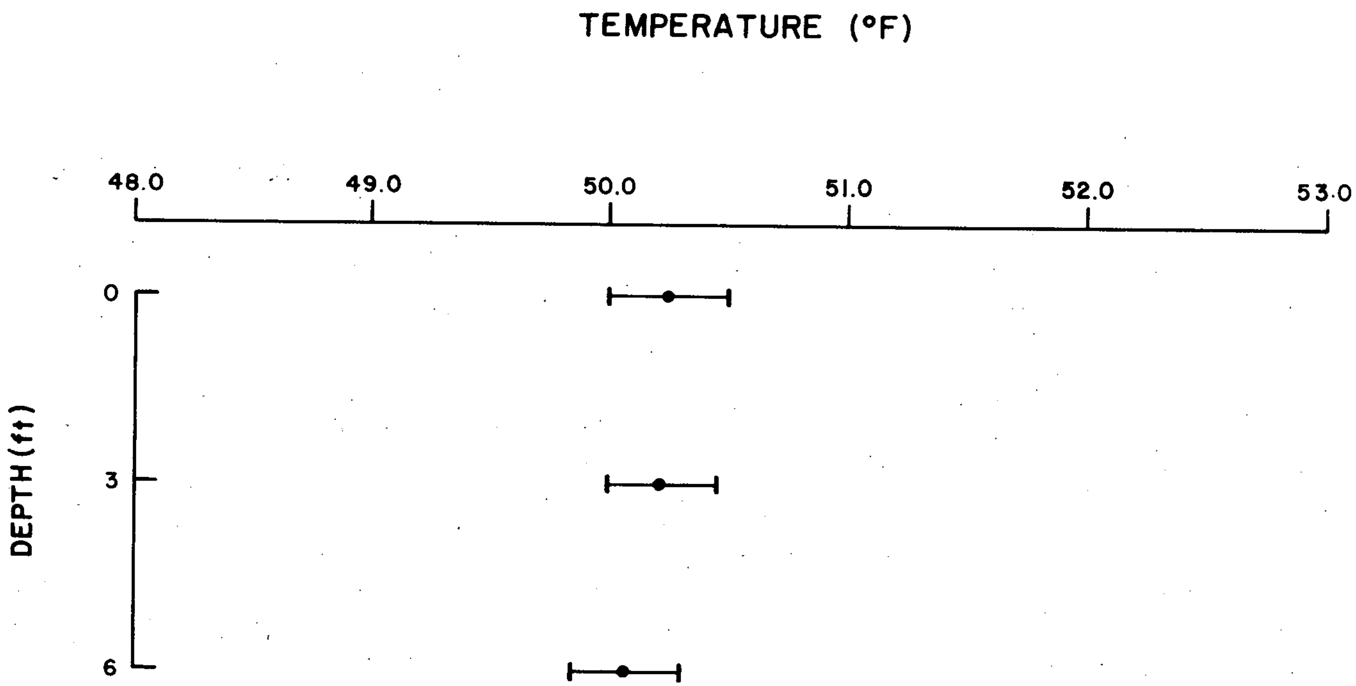
FIGURE 10.3

CE - EC
DWG. NO. 76 - 109



AMBIENT TEMPERATURE SCAN at CROTON POINT
Surface, 3 and 6 Foot Depths
FLOOD

FIGURE 10.4

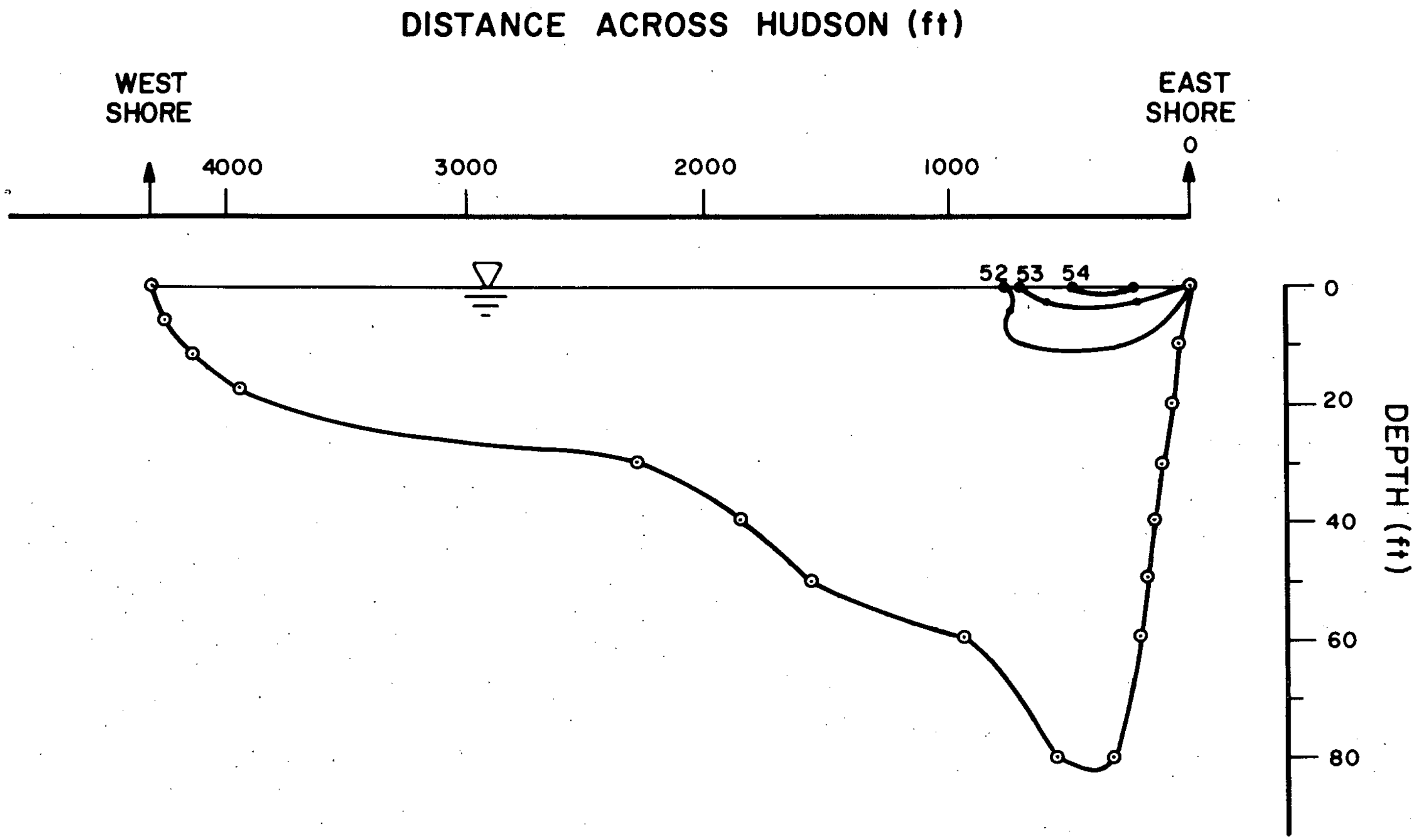


SCAN TRANSECT: CROTON POINT
DATE: 11/20/74
TIME: 1349-1357
TIDAL STAGE: FLOOD

FIGURE 10.5

AMBIENT SCAN TEMPERATURES vs DEPTH
CROTON POINT
FLOOD

CE-EC
DWG. Nº 76-110

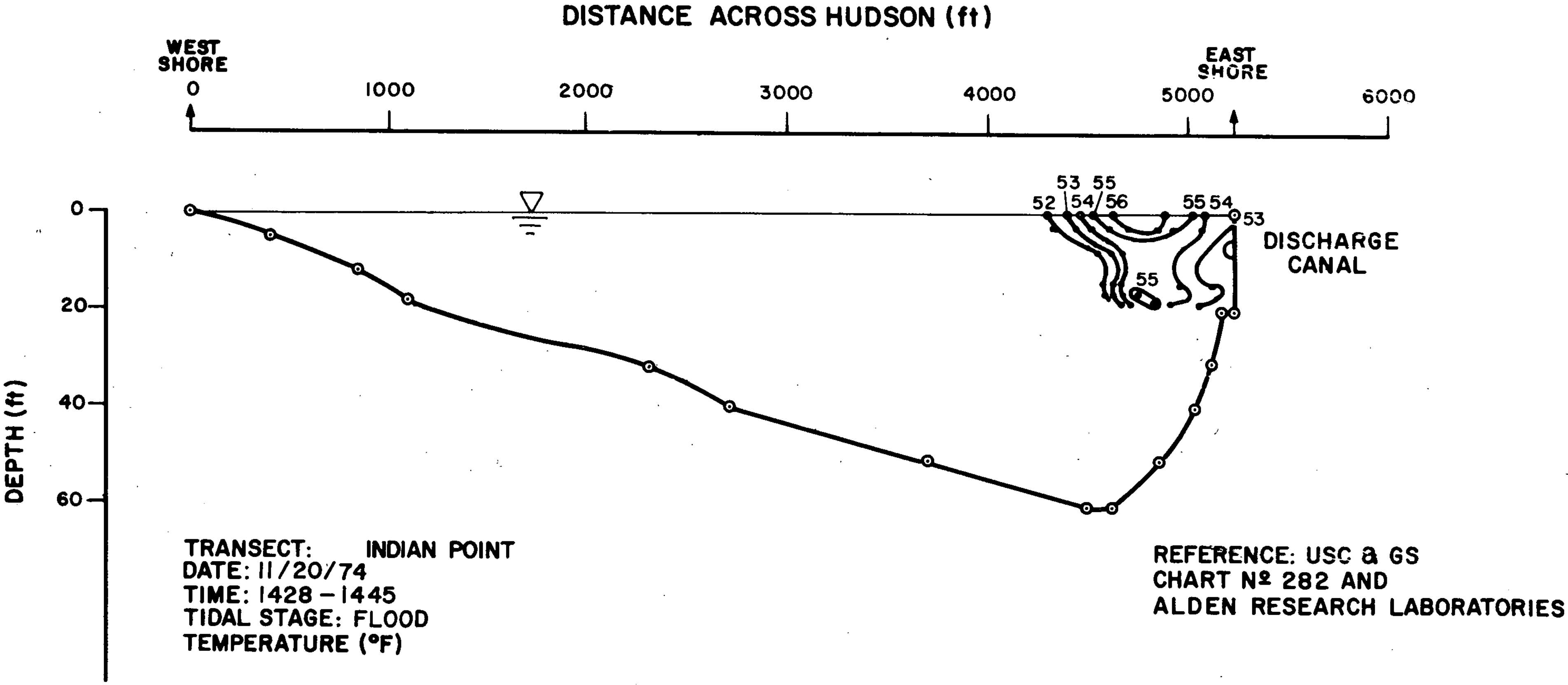


TRANSECT: LENT
DATE: 11/20/74
TIME: 1428-1445
TIDAL STAGE: FLOOD
TEMPERATURE (°F)

FIGURE 10.6

CROSS-SECTIONAL TEMPERATURE PATTERN
LENT
FLOOD

CE-EC
DWG. NO. 76-111



CROSS-SECTIONAL TEMPERATURE PATTERN
INDIAN POINT DISCHARGE CANAL
FLOOD

FIGURE 10.7

CE-EC
DWG. NO. 76-112

FLOOD
SURFACE ISOTHERM
20 NOVEMBER 1974
TIME 14 28 - 14 45
SCALE IN FEET
150 0 150 300 450 600
SHORELINE
52
51.1
51.7
51.7
51
51.1
51.3
53
54
55
57
60
64
62
56
53
54
53
52
DISCHARGE
DAMES & MOORE

FIGURE 10.8

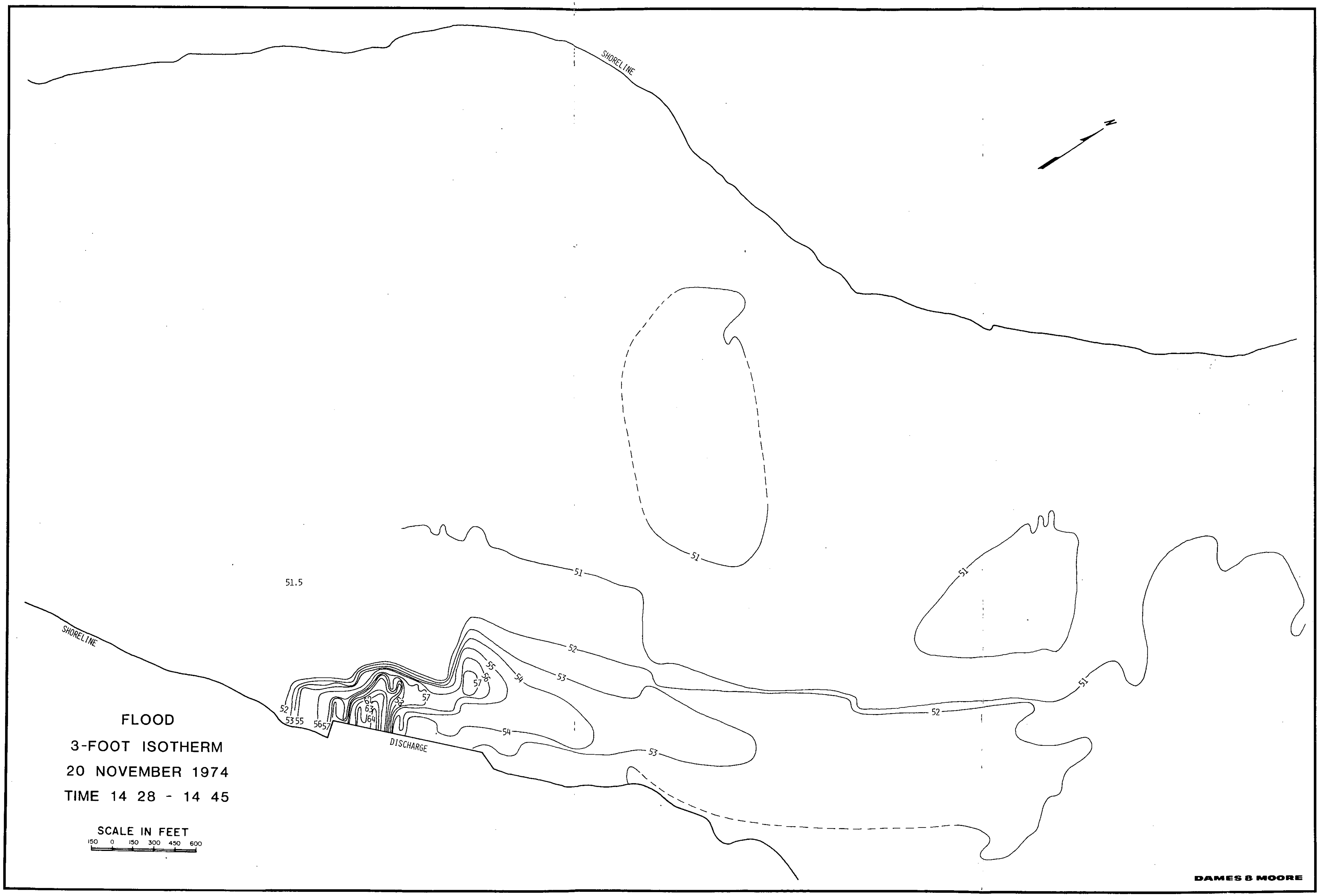
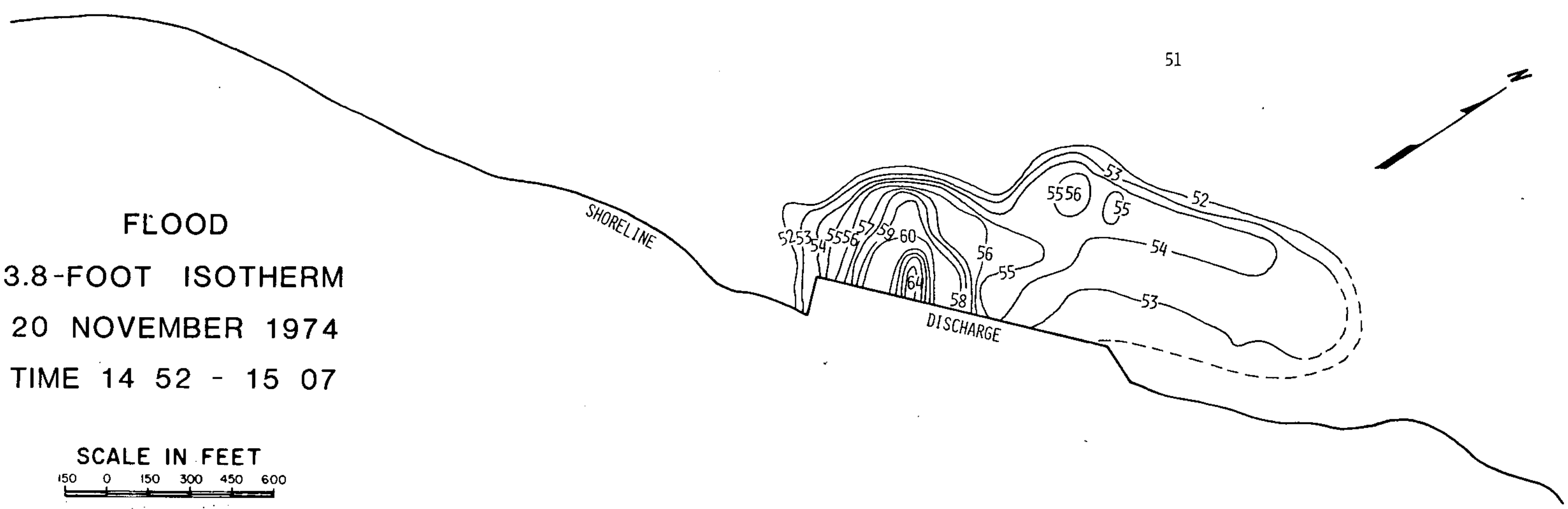

SHORELINE
N
51
51.5
51
51
SHORELINE
52
52
53
54
55
56
57
52
53 55
56 57
62
63
64
54
53
DISCHARGE
52
51
FLOOD
3-FOOT ISOTHERM
20 NOVEMBER 1974
TIME 14 28 - 14 45
SCALE IN FEET
150 0 150 300 450 600
DAMES & MOORE

FIGURE 10.9


SHORELINE
N
51.1
51.3
51.1
51
51
51.2
51.3
51.1
51
51.1
51.1
51
50.9
52
53
54
55
56
57
58
59
60
61
62
63
SHORELINE
DISCHARGE
FLOOD
6-FOOT ISOTHERM
20 NOVEMBER 1974
TIME 14 28 - 14 45
SCALE IN FEET
150 0 150 300 450 600
52
51.7
DAMES & MOORE

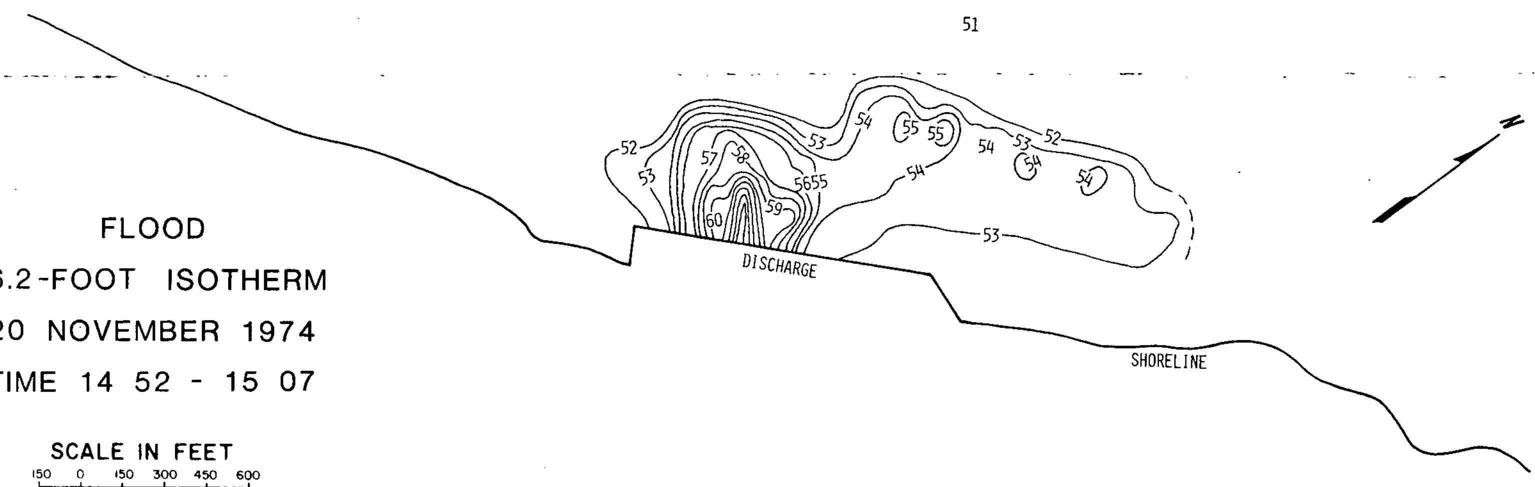
FIGURE 10.10



FLOOD
13.8-FOOT ISOTHERM
20 NOVEMBER 1974
TIME 14 52 - 15 07

SCALE IN FEET
150 0 150 300 450 600

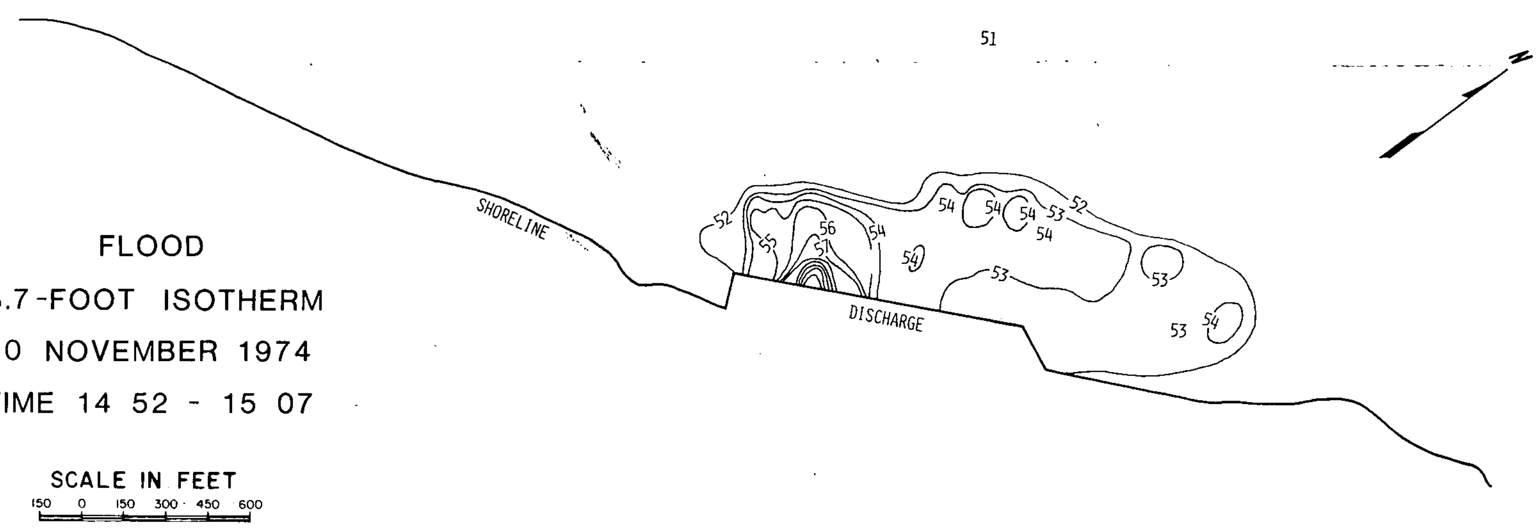
FIGURE 10.11



FLOOD
16.2-FOOT ISOTHERM
20 NOVEMBER 1974
TIME 14 52 - 15 07

SCALE IN FEET
150 0 150 300 450 600

FIGURE 10.12



FLOOD
18.7-FOOT ISOTHERM
20 NOVEMBER 1974
TIME 14 52 - 15 07

SCALE IN FEET
150 0 150 300 450 600

FIGURE 10.13

FIGURES 10.11 - 10.13

DAMES & MOORE

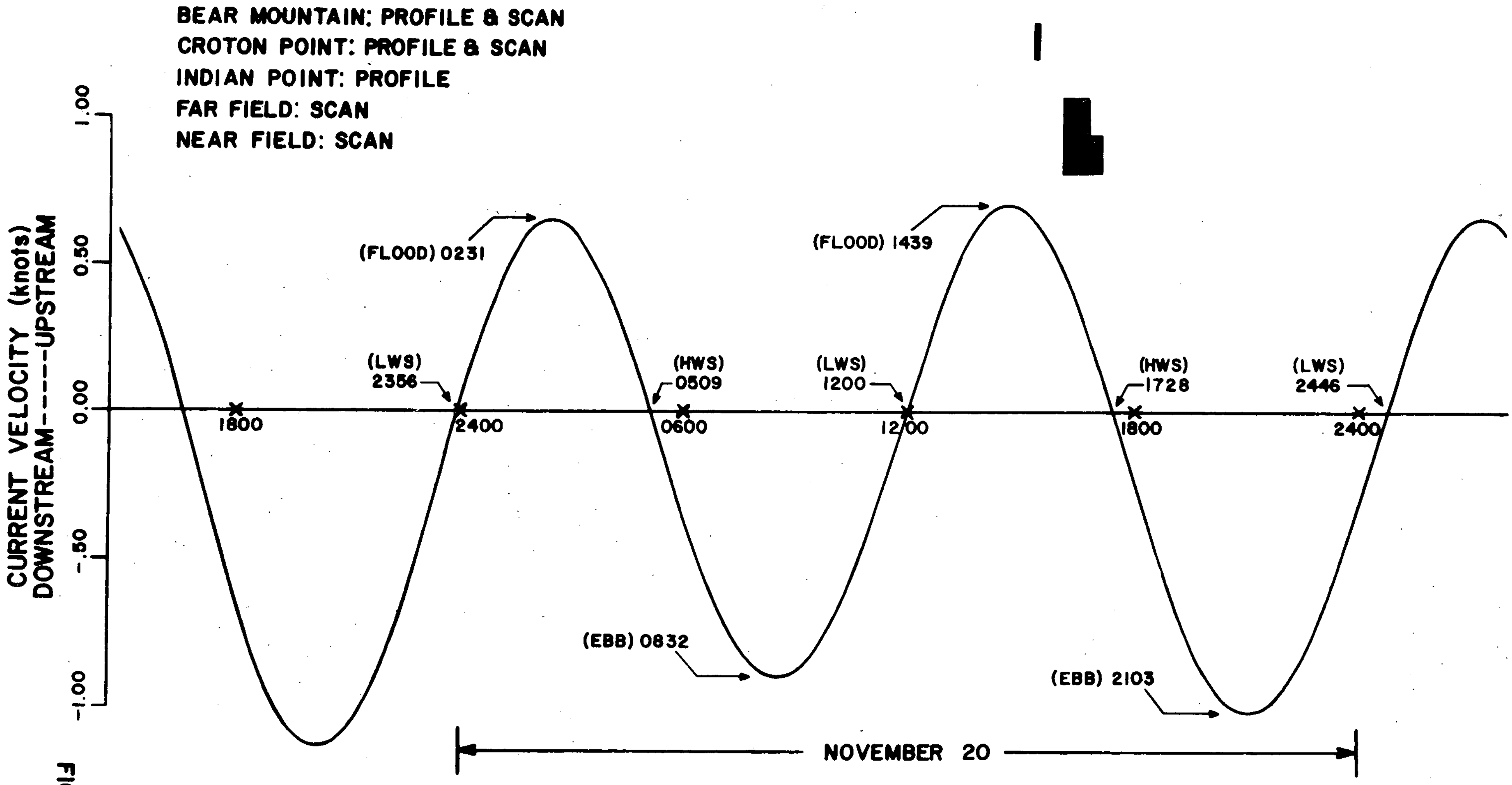
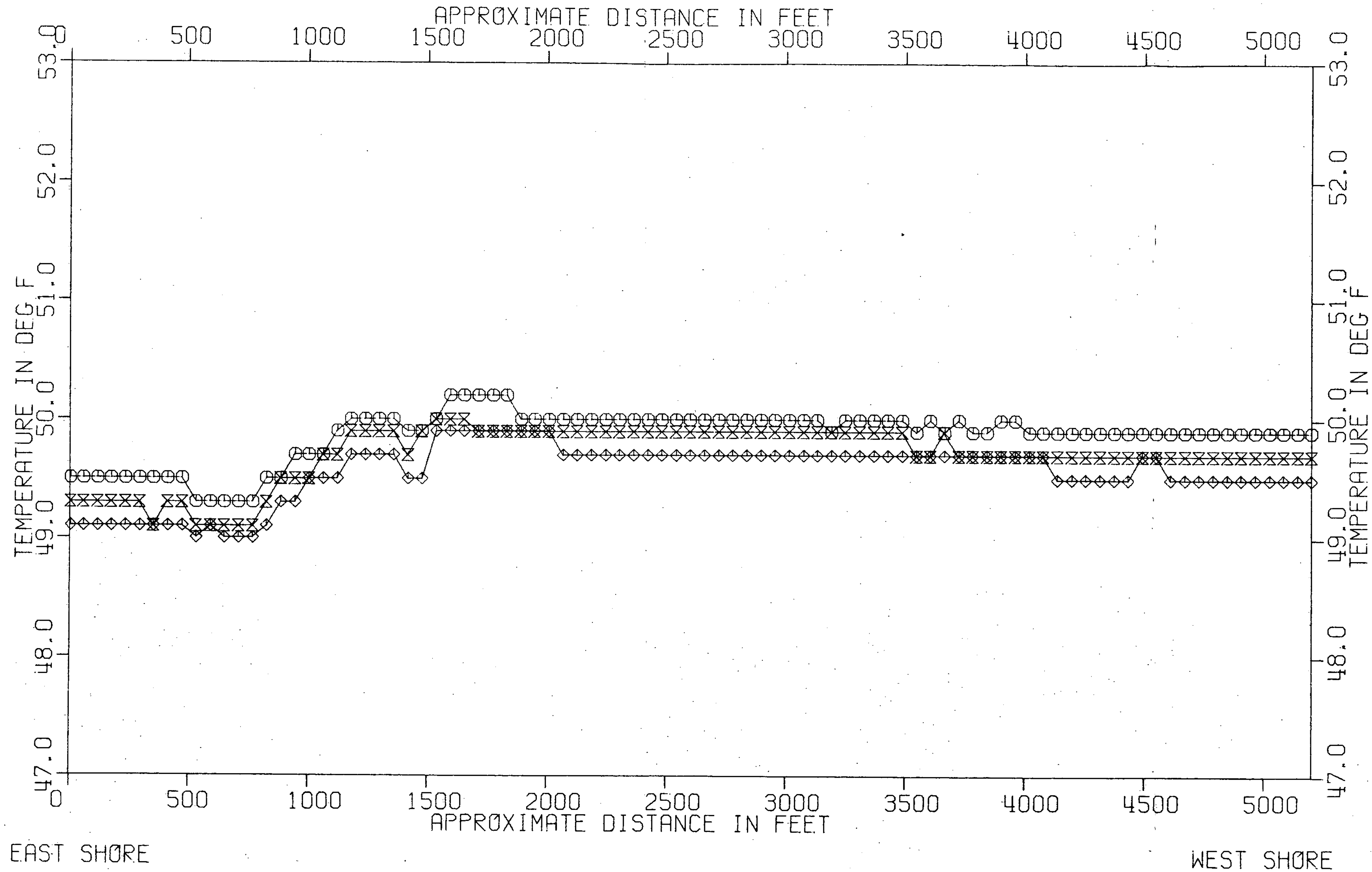


FIGURE 11.1

TIDAL CURRENTS AND
TIME SEQUENCE OF TEMPERATURE MEASUREMENTS
NOVEMBER 20, 1974
——(SECOND HIGH WATER SLACK)——
(REF: TIDAL CURRENT TABLES, 1974, ATLANTIC COAST
OF NORTH AMERICA [AT PEEKSKILL], NOAA)

CE-EC
DWG. № 76-113

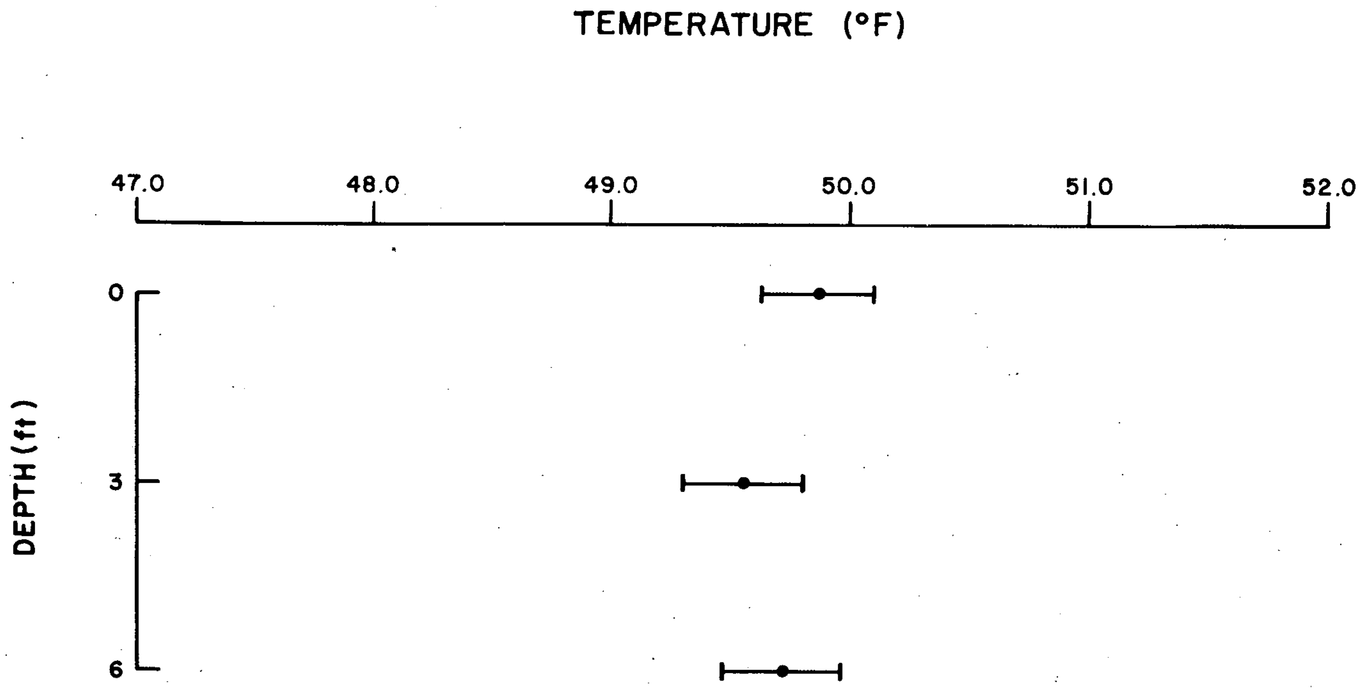


WEDNESDAY NOVEMBER 20,1974..AMBIENT SCAN
CROTON POINT--HWS AT 1522-1528

⦶ SURFACE PROBE
◇ 3 FOOT DEPTH PROBE
⧖ 6 FOOT DEPTH PROBE

AMBIENT TEMPERATURE SCAN at CROTON POINT
Surface, 3 and 6 Foot Depths
SECOND HIGH WATER SLACK

FIGURE 11.2

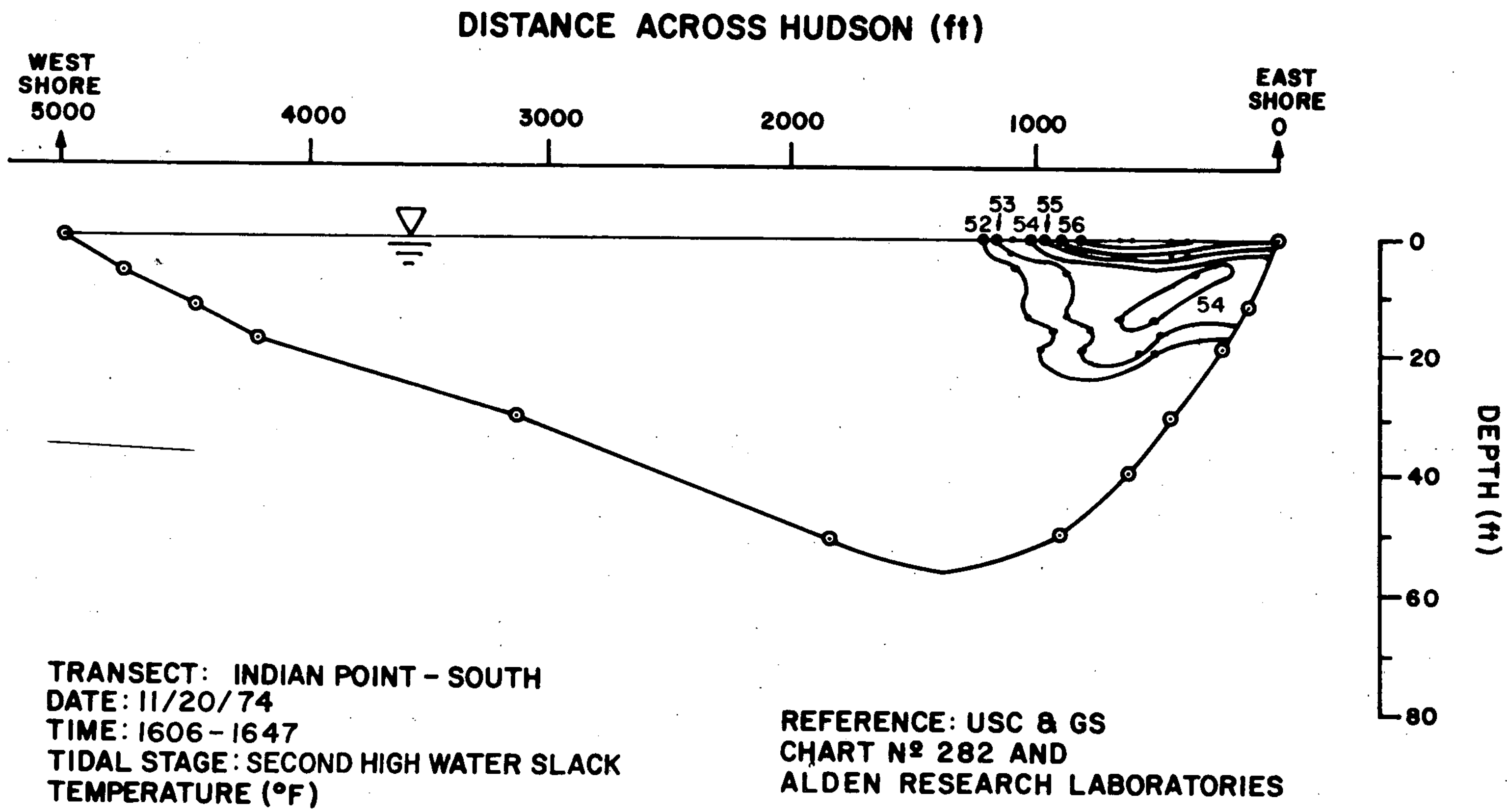


SCAN TRANSECT: CROTON POINT
DATE: 11/20/74
TIME: 1522-1528
TIDAL STAGE: SECOND HIGH WATER SLACK

FIGURE 11.3

AMBIENT SCAN TEMPERATURES vs DEPTH
CROTON POINT
SECOND HIGH WATER SLACK

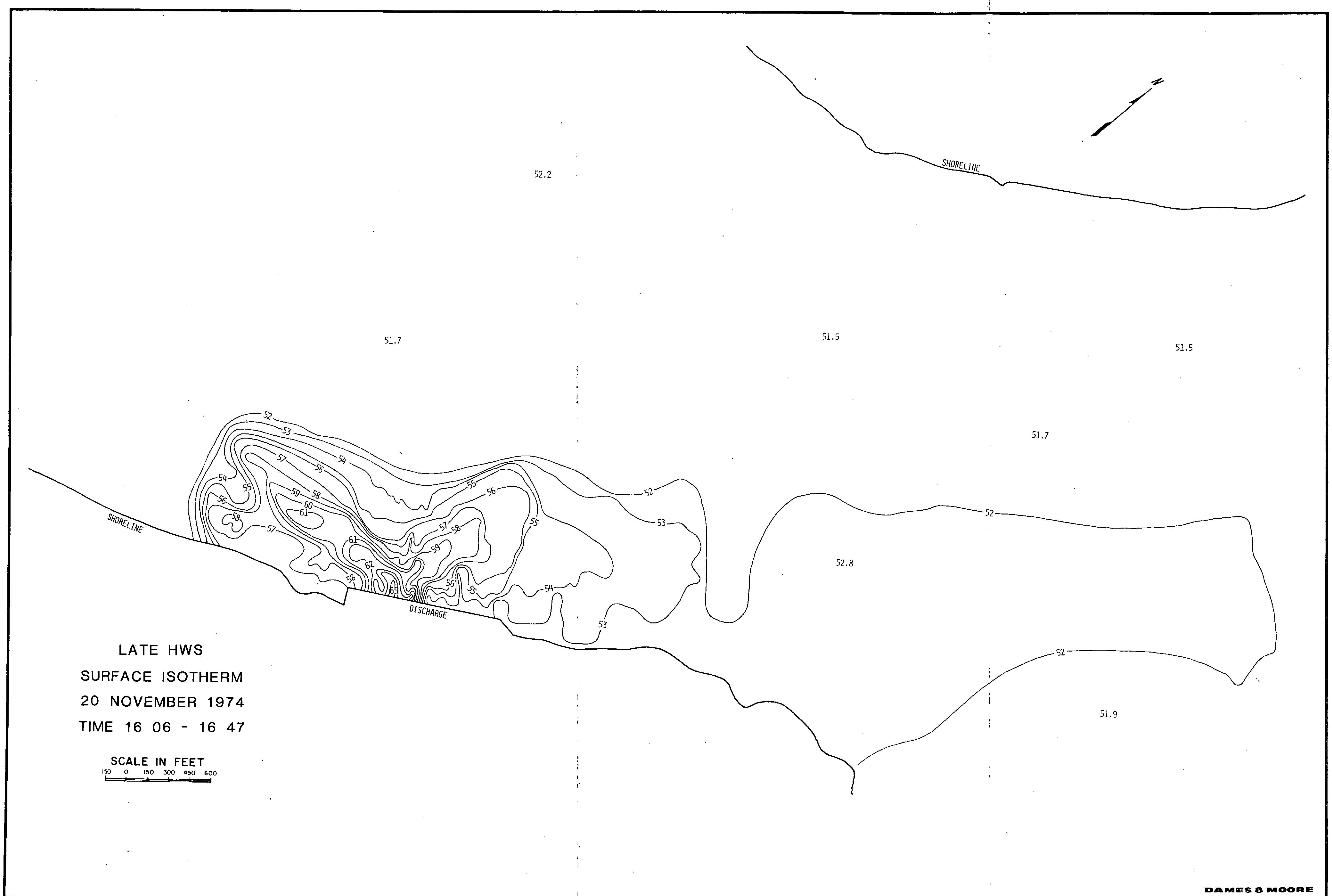
CE-EC
DWG. Nº 76-114



CROSS-SECTIONAL TEMPERATURE PATTERN AT INDIAN POINT - SOUTH
SECOND HIGH WATER SLACK

FIGURE 11.4

CE-EC
DWG. NO. 76-115



SHORELINE
52.2
51.7
51.5
51.5
51.7
SHORELINE
DISCHARGE
52
53
54
55
56
57
58
59
60
61
62
63
52.8
51.9
LATE HWS
SURFACE ISOTHERM
20 NOVEMBER 1974
TIME 16 06 - 16 47
SCALE IN FEET
150 0 150 300 450 600
DAMES & MOORE

FIGURE 11.5

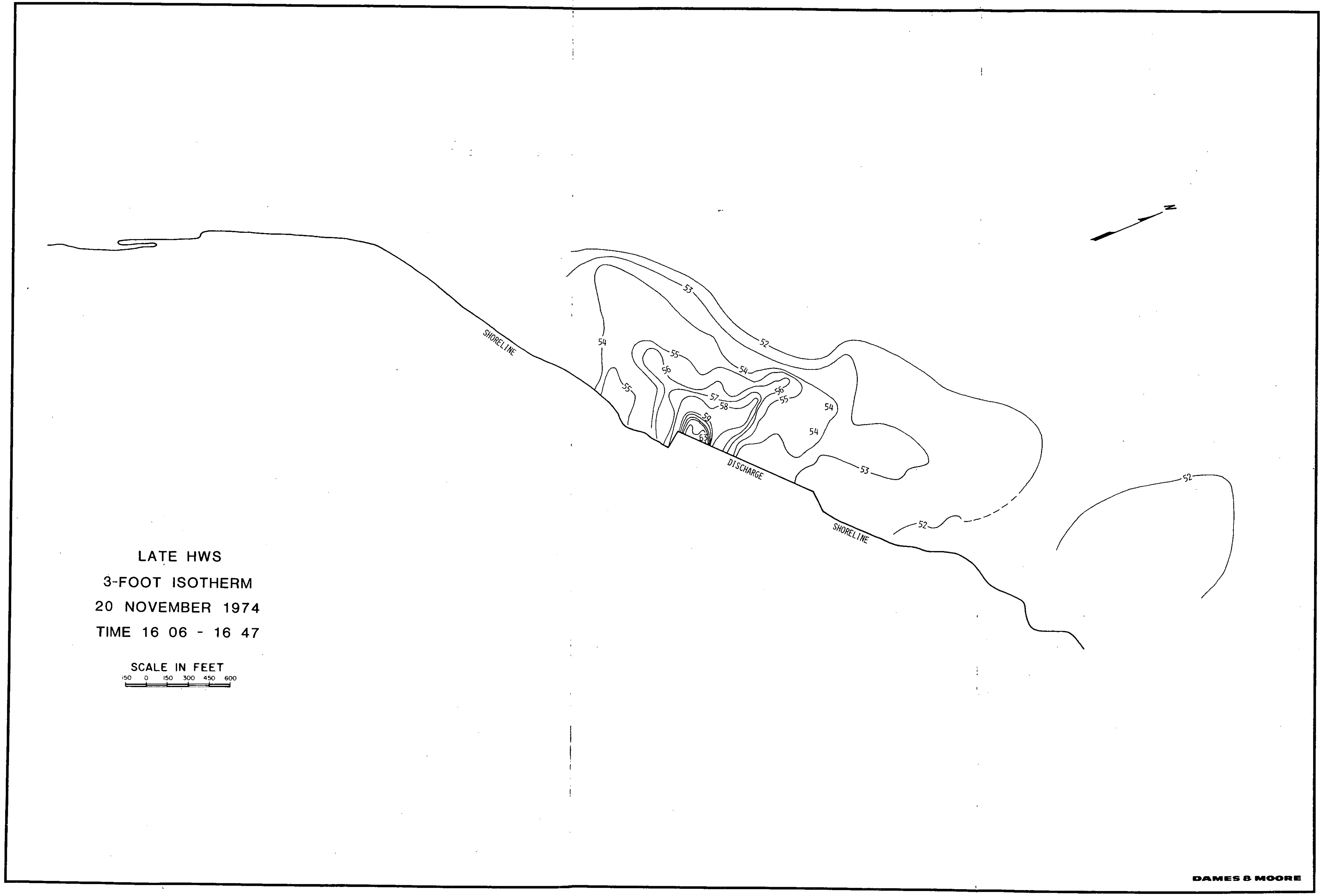
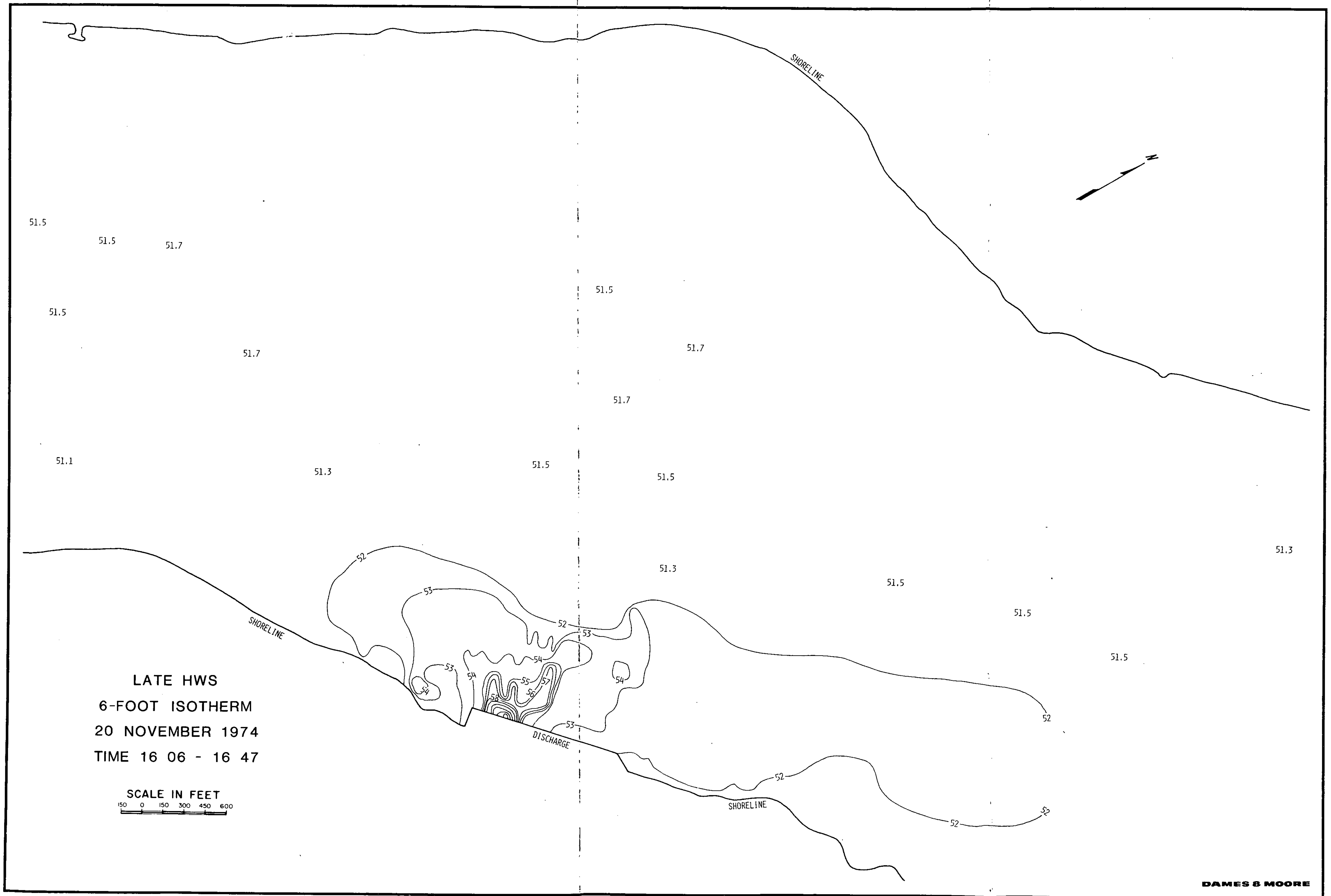
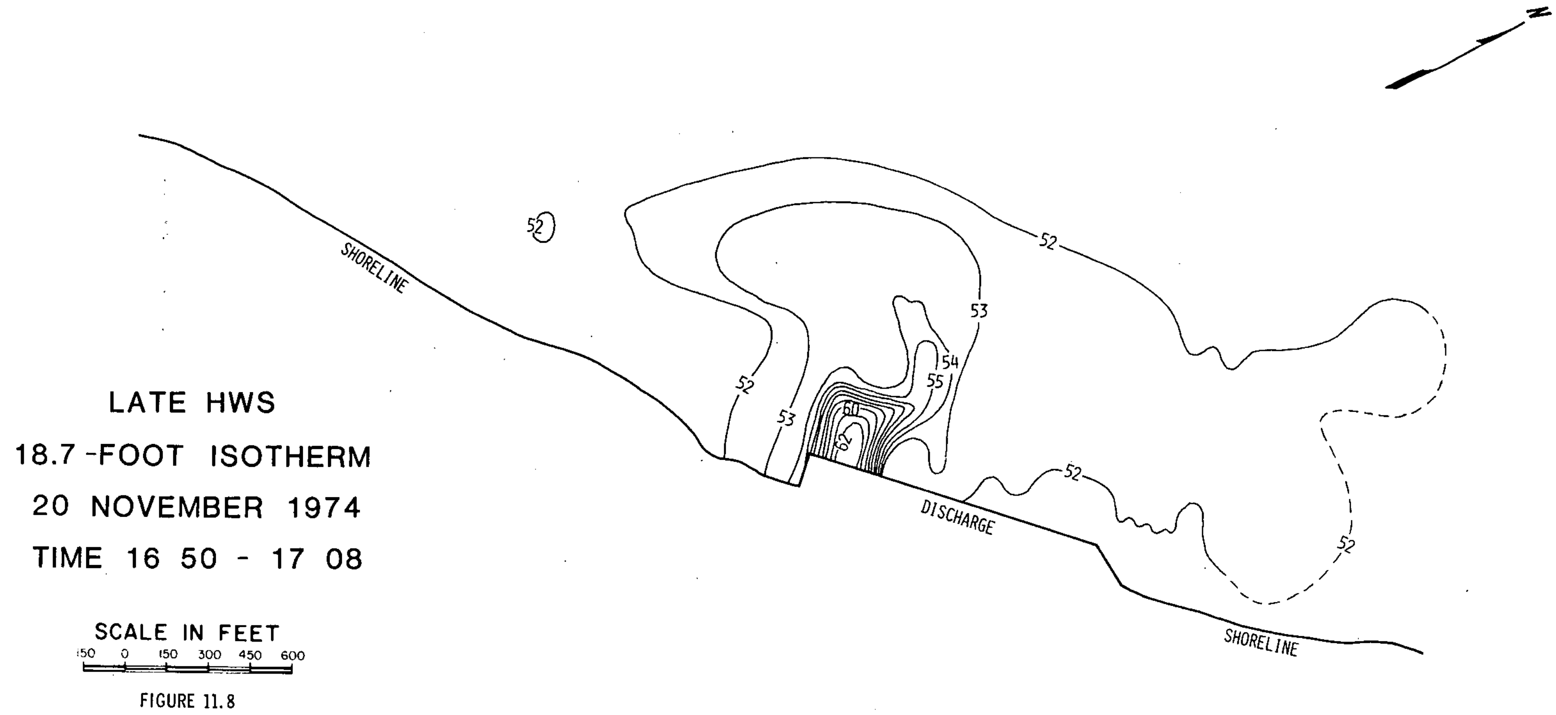

LATE HWS
3-FOOT ISOTHERM
20 NOVEMBER 1974
TIME 16 06 - 16 47
SCALE IN FEET
150 0 150 300 450 600
SHORELINE
DISCHARGE
SHORELINE
N
52
53
54
55
56
57
58
59
DAMES & MOORE

FIGURE 11.6



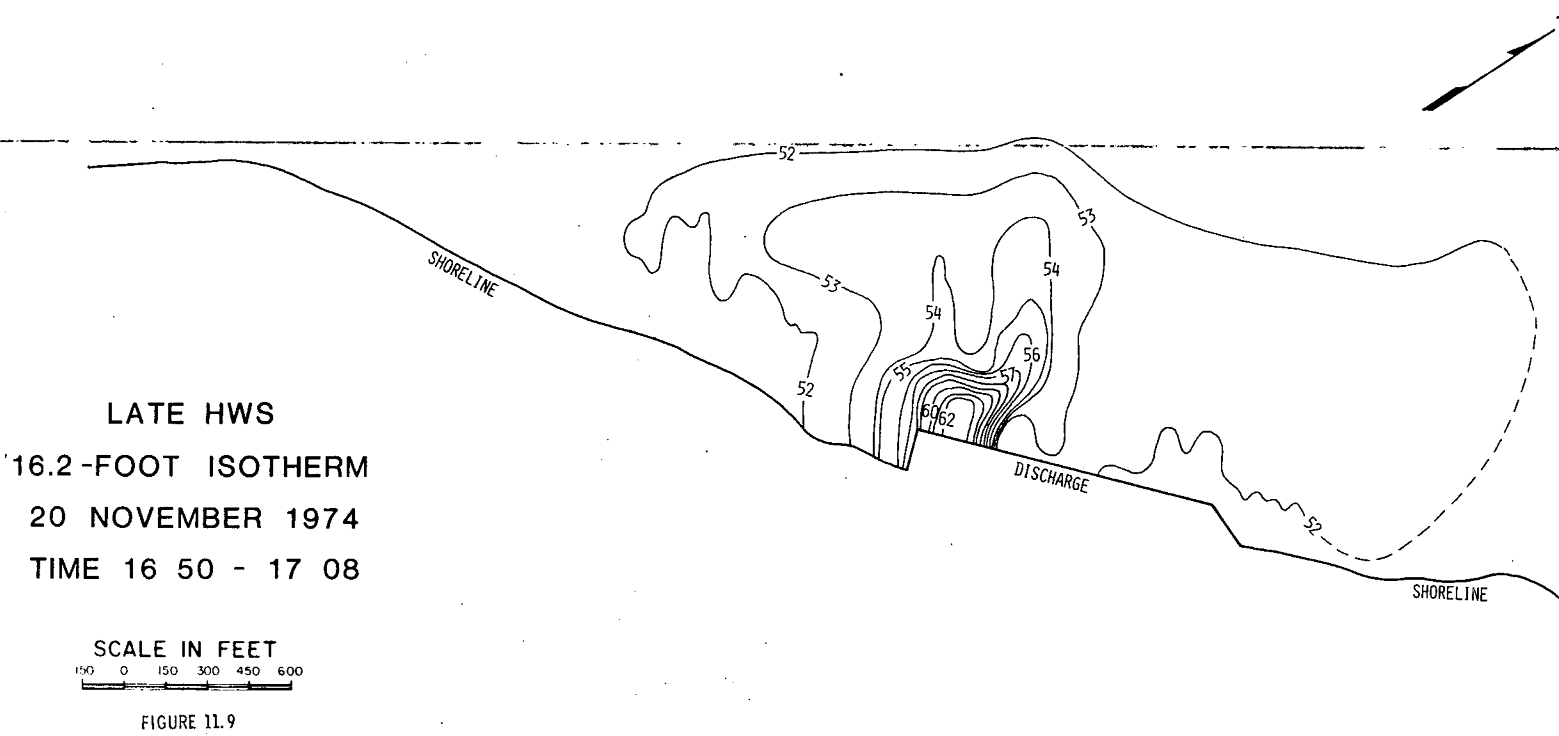
SHORELINE
51.5
51.5
51.7
51.5
51.5
51.7
51.7
51.7
51.1
51.3
51.5
51.5
51.3
51.3
51.5
51.5
51.5
52
53
52
53
54
53
54
54
55
56
57
58
54
53
52
52
52
SHORELINE
DISCHARGE
SHORELINE
LATE HWS
6-FOOT ISOTHERM
20 NOVEMBER 1974
TIME 16 06 - 16 47
SCALE IN FEET
150 0 150 300 450 600
N
DAMES & MOORE

FIGURE 11.7



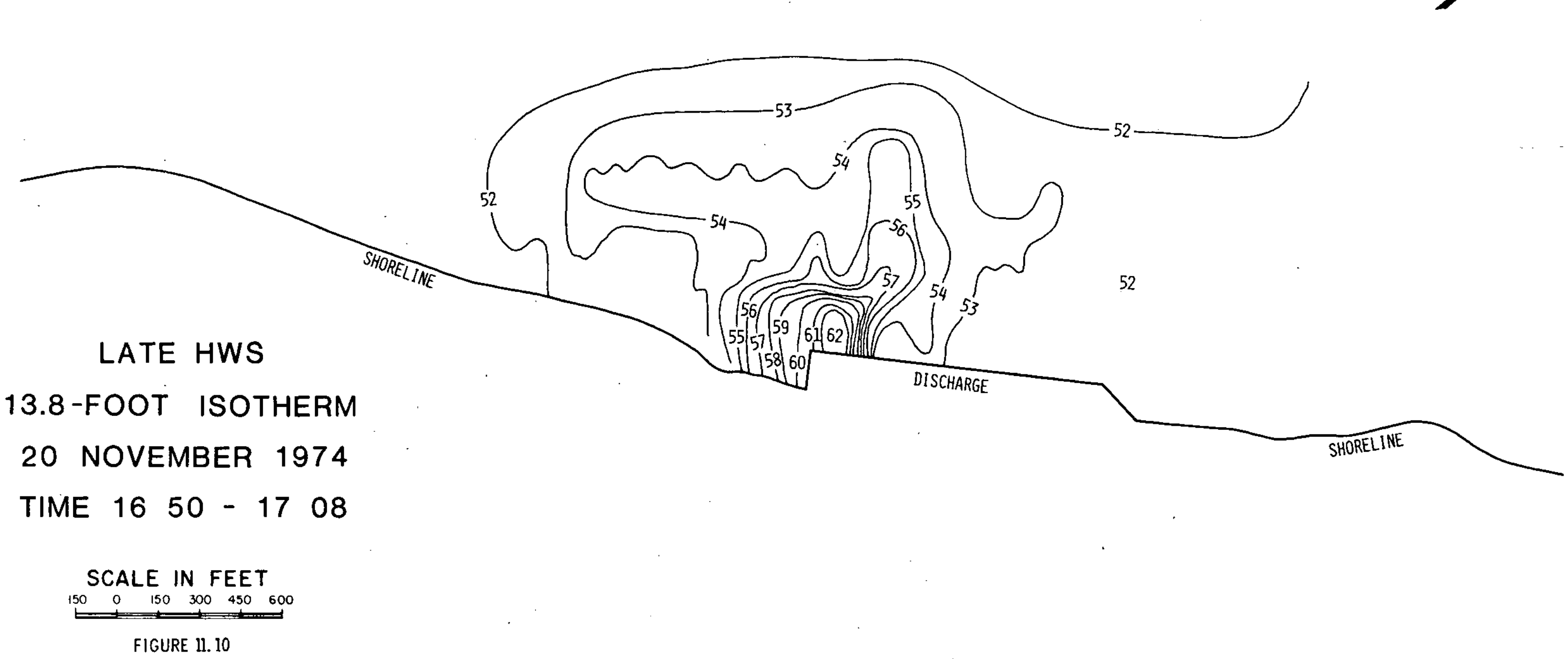
LATE HWS
18.7-FOOT ISOTHERM
20 NOVEMBER 1974
TIME 16 50 - 17 08

FIGURE 11.8



LATE HWS
16.2-FOOT ISOTHERM
20 NOVEMBER 1974
TIME 16 50 - 17 08

FIGURE 11.9



LATE HWS
13.8-FOOT ISOTHERM
20 NOVEMBER 1974
TIME 16 50 - 17 08

FIGURE 11.10

DAMES & MOORE

FIGURES 11.8 - 11.10