NOAA Technical Memorandum NOS OES 004

EFFECTS OF HURRICANE ANDREW ON WATER LEVELS IN COASTAL FLORIDA AND LOUISIANA DATA REPORT

Rockville, Maryland
December 1992

noaa National Oceanic And Atmospheric Administration

U.S. DEPARTMENT OF COMMERCE
National Ocean Service

Office of Ocean and Earth Sciences
National Ocean Service
National Oceanic and Atmospheric Administration
U.S. Department of Commerce

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EFFECTS OF HURRICANE ANDREW ON WATER LEVELS IN COASTAL FLORIDA AND LOUISIANA

DATA REPORT

I. INTRODUCTION

This report provides descriptive information on the effects of Hurricane Andrew on water levels observed at the National Water Level Observation Network (NWLON) stations in southern Florida and along the northern coast of the Gulf of Mexico during the period August 23-29, 1992.

The Ocean and Lake Levels Division (OLLD), Office of Ocean and Earth Sciences (OES), National Ocean Service (NOS), National Oceanic and Atmospheric Administration (NOAA) manages the operation of a national water level observation program; collects, processes, and analyzes water level and ancillary data; and produces standard time series and water level datum products. OLLD operates a network of approximately 190 long-term continuously operating stations in the U.S. coastal waters, in the Great Lakes and their connecting channels, and in the U.S. territories and possessions. OLLD also installs, operates, and maintains short-term water level stations for state and federal agencies.

This report presents the results of analysis of the data collected at NWLON stations in operation during Hurricane Andrew. Maximum water levels observed during the hurricane are reported and compared to historical maximum water levels observed for the entire period of record at each gauge location. Storm surge, as defined in this report, is the difference between the observed water levels and predicted water levels. Predicted water levels are computed using standard NOS harmonic analysis and tide prediction algorithms. The results of the storm surge analyses are presented as a series of time series plots. The observed and predicted water levels are plotted for each station.

As predicted by the National Weather Service (NWS), Hurricane Andrew struck south Florida at 0300 hours (EST) on August 24, 1992. The storm track carried it directly over Homestead, Florida, which is approximately 20 miles south of Miami. Appendix A contains a copy of the best track positions for Hurricane Andrew as obtained from a NWS preliminary report, and the NWS Daily Weather Maps for the period August 23-29, 1992. A damage assessment team from the OLLD Atlantic Operations Section (AOS) visited the stations in south Florida following the hurricane's passage. The stations at Naples, Key Colony Beach, Vaca Key, and Key West weathered the storm with no damage to the tide gauges or their supporting structures.

The NWLON station at Haulover Pier, North Miami Beach, sustained considerable damage. The fishing pier leading to the elevated platform supporting the station was shattered in three places.

The section of the pier next to the platform was destroyed. The platform itself suffered substantial lateral stress, as evidenced by bent stilling wells, a fractured cross brace, and a sheared cross brace on the north side of the platform. The station could only be reached by boat, and by climbing the horizontal well braces and twisted steel ladder to get to the gauge house. The parallel plates on the analog-to-digital recorder (ADR) float stilling well and the protective well for the Next Generation Water Level Measurement System (NGWLMS) acoustic sensor were missing. Also, the backup pressure gauge orifice was missing. The northeast corner piling was broken off below the low water line. It is possible that the piling was weakened by marine borers and previous storm events and then washed out by Hurricane Andrew.

GOES satellite data transmissions continued through 0400 hours (EST) on August 24, 1992. Apparently, satellite transmissions ceased when the flat plate antenna blew off the sensor tower after 0400 hours. The NGWLMS continued to collect and save the data on internal storage. The ancillary sensors also continued to function with measurements of air temperature, barometric pressure, and wind speed, gust, and direction. Appendix B contains time series plots of these parameters for the period August 20-27, 1992. The data were retrieved on floppy disk by the damage assessment team on August 27, 1992. A second team visited the station September 22-24, 1992 and downloaded the data collected since August 27, 1992. Due to the deteriorated condition of the station tower and pier, data collection was discontinued and all equipment was removed.

The damage assessment team also visited the stations in Louisiana the first week of September. At South Pass, the storm surge caused elevated water levels sufficient to inundate the ADR and bubbler gauges. The ADR gauge, weatherproof cover, nitrogen tank and regulator were replaced and the station was restored to operational status. The stations at New Canal and Grand Isle were undamaged. The station at Cocodrie was inundated and the ADR gauge was replaced. The data was retrieved from the gauges at all four stations.

II. MAXIMUM ELEVATIONS AND DATUM RELATIONSHIPS

Tables I and II present information on the observed maximum water elevations during Hurricane Andrew. The tables include the following information: date, time and height of the maximum elevations above Mean Lower Low Water (MLLW), Mean Higher High Water (MHHW), and National Geodetic Vertical Datum (NGVD); date and height of the maximum historical observed water elevations above MLLW; and the Mean Great Diurnal Range of tide (GT) at each location. Appendix C is a set of station location chartlets for each station listed.

The elevations are referenced to the computed MLLW and MHHW datums at each location relative to the 1960-78 National Tidal Datum Epoch. MLLW is the reference datum for NOAA nautical charts and the NOS published tide prediction tables. The MHHW datum is the mean of the daily higher high waters. Historical maximum values are based on the entire period of record for each location. These periods of record are different for each location.

The extreme observed elevations and the historical extreme observed elevations are presented in Tables I and II. Recorded water elevation effects on the Atlantic side of Florida through the Florida Keys were not significant except at Haulover Pier, North Miami Beach, FL (see section IV). At Haulover Pier, the nearest station to the eye of the hurricane, the observed elevation exceeded the historical maximum elevation by 0.7 ft.

Negative elevation effects were initially observed at Florida west coast stations near the track of Hurricane Andrew. Naples, FL, the closest station to the eye of the hurricane, recorded an elevation drop that exceeded the historical low elevation by 0.4 ft. Reduction in water elevation was caused by hurricane winds blowing water away from the Florida coast while the eye was over land. Observed elevations did not exceed historical maximums along the Gulf Coast from Florida to Eastern Louisiana.

Hurricane Andrew made second landfall along Western Louisiana after skirting around the southern tip of Louisiana. Historical elevations were exceeded at two Louisiana locations, South Pass and Cocodrie. The station at South Pass, situated near the mouth of the Mississippi, registered a record high elevation even before the full effect of the hurricane reached the station. At the onset of the storm, the gauge at South Pass ceased operating due to high winds and inundation. Recorded water level elevation exceeded the historical maximum elevation by 0.1 ft. However, water level continued to rise after the gauge stopped operating and the maximum water elevation was probably much higher. At Cocodrie, LA, the gauge recorded water levels during the storm until it was inundated. The marigram indicates that water level rose by 1.5 feet during the last hour of gauge operation. The actual maximum elevation at Cocodrie is probably higher than the maximum recorded value found in Table II.

TABLE I. **EXTREME OBSERVED WATER LEVEL ELEVATIONS AND HISTORICAL DATA COMPARISON SOUTHERN FLORIDA**

STATION	DATE/TIME	HURRICANE ANDREW ELEVATION ABOVE MLLW			HISTORICAL ELEVATION ABOVE MLLW		
		MLLW	MHHW	NGVD	DATE	ELEV.	GT RANGE
Settlement Pt., BA	*				1/87	4.54	3.05
Haulover Pier, Fl	8/24 0354	5.42	2.69	4.50	11/84	4.69	2.73
Key Colony Bch, FL	*				10/90	3.46	2.10
Vaca Key, FL	8/24 0712	1.56	0.55	1.44	10/74	2.64	1.01
Key West, FL	*				9/65	3.97	1.84
Naples, FL	8/25 0924	3.64	0.70	2.49	12/72	6.14	2.94
+	8/24 0942	-2.74	-5.68	-3.89	3/88	-2.32	
Fort Myers, FL	8/25 1230	2.13	0.94	2.13	11/88	4.83	1.19
+	8/24 1312	-1.06	-2.25	-1.06	1/72	-2.04	
St. Petersburg, FL	8/25 1000	3.78	1.54	2.99	8/85	6.46	2.24
+	8/24 1706	-0.92	-3.16	-1.71	9/65	-2.27	
Clearwater Bch, FL	8/25 0754	4.51	1.77	-	8/85	6.10	2.74
+	8/24 1412	-2.01	-4.75	-	1/77	-2.38	
Cedar Key, FL	8/25 1018	5.48	1.72	3.77	6/72	8.14	3.76
+	8/24 1712	-1.19	-4.95	-2.90	9/47	-4.07	
Turkey Point, FL	8/25 1006	4.66	1.96	-	11/85	8.82	2.70
+	8/24 1830	-1.05	-3.75	-	1/77	-3.72	

NOTES:

Elevations are in feet (ft); MLLW is Mean Lower Low Water; NGVD is National Geodetic Vertical Datum; GT is Great Diurnal Range of Tide (MHHW minus MLLW); Times are in local standard time.

* Maximum Water level elevations not significantly effected by Hurricane Andrew.

\+ Extreme minimum water level.

TABLE II. EXTREME OBSERVED WATER LEVEL ELEVATIONS AND HISTORICAL DATA COMPARISON NORTHERN GULF COAST

STATION	DATE/TIME	HURRICANE ANDREW ELEVATION ABOVE MLLW			HISTORICAL ELEVATION ABOVE MLLW		
		MLLW	MHHW	NGVD	DATE	ELEV.	GT RANGE
Apalachicola, FL	8/25 1106	3.44	1.78	3.09	11/85	7.45	1.66
Panama City, FL	8/25 0842 8/27 0930	2.50	1.13	2.29	9/75	5.27	1.37
Panama City Beach, FL	8/25 0724	2.71	1.29	-	10/92	3.36	1.42
Pensacola, FL	8/26 0800	2.65	1.38	2.39	9/26	8.83	1.27
Dauphin Island, AL	8/26 0854	2.71	1.49	2.37	9/85	4.76	1.22
Bay Waveland, MS	8/26 0836	4.50	2.73	3.84	1/83	6.65	1.77
South Pass, LA @	8/25 0748	3.21	1.83	-	10/85	3.13	1.38
Grand Isle, LA	8/25 1854	3.79	2.68	3.64	10/85	4.79	1.11
New Canal, LA	8/26 1436	3.14	2.60	-	1/83	3.55	0.54
Cocodrie, LA @	8/25 2154	6.87	5.78	-	4/91	3.10	1.09

NOTES:

Elevations are in feet (ft); MLLW is Mean Lower Low Water; NGVD is National Geodetic Vertical Datum; GT is Great Diurnal Range of Tide (MHHW minus MLLW); Times are in local standard time.
@ Data record ends before full effect of Hurricane Andrew.

III. STORM SURGE CHARACTERISTICS

Tables III and IV present information on the maximum storm surge measured at each station. For this report, storm surge is the difference between the observed water levels and predicted water levels. Predicted water levels are computed using standard NOS harmonic analysis and prediction algorithms. The time and magnitude of maximum storm surge is primarily dependent upon the phase of tide and time of the storm's passage. Understandably, the maximum storm surge may not coincide with the occurrence of a predicted tidal high water. Tables III and IV provide information for each station on the date and time of the maximum storm surge; the observed elevation of the water above MLLW; the predicted elevation of the water above MLLW; and the storm surge value.

Time series of storm surge data are generated by subtracting predicted hourly height time series from observed hourly height time series. Figures 1 through 6 are simultaneous plots of storm surge for geographical areas near the storm's track. The Southern Florida stations are four day plots and the Northern Gulf Coast stations are nine day plots. Most figures use the same vertical scale to allow comparisons between stations.

Figure 1 shows little storm effect for the Bahamas and Florida Keys but a definite storm surge at Haulover Pier that coincides with high water elevation and hurricane landfall. Figures 2 - 4 show the negative surge that preceded the eye of the storm along the western coast of Florida, followed by a positive surge as the storm passed over the region on August 25, 1992. The most pronounced negative surge occurred at Naples, FL, which was the closest station north of the storm passage. Figures 3 and 4 show the expected maximum storm surge on August 25, 1992, but also show an interesting secondary maximum on August 27, 1992.

The negative surge effects were limited to the southern Gulf Coast areas of Florida north of the storm track. Figures 5 and 6 show a build up of water beginning on August 25, 1992, peaking late in the day. The high water continued through August 2, 1992. Where records are complete, peak surges generally occurred during the evening of August 25, 1992. Both South Pass and Cocodrie had interrupted records and it is expected that actual surges would have been greater than reported in Table IV. Note that both South Pass and Cocodrie had exceeded historic maximum elevations before the storm event. The station at New Canal, located along the western side of Lake Ponchartrain, had a peak surge occur at noon on August 26, 1992. The delayed surge coincides with Hurricane Andrew's passage east of Lake Ponchartrain after making landfall in Louisiana.

TABLE III. **STORM SURGE**
SOUTHERN FLORIDA

		ELEVATION ABOVE MLLW		
STATION	DATE/TIME	OBSERVED	PREDICTED	DIFFERENCE
Settlement Pt., BA	*			
Haulover Pier, Fl	8/24 0400	5.22	2.62	2.60
Key Colony Bch, FL	*			
Vaca Key, FL	8/24 0300	1.45	0.95	0.50
Key West, FL	*			
Naples, FL	8/23 2300	3.67	2.42	1.25
+	8/24 0900	-0.80	3.18	-3.98
Fort Myers, FL	8/25 0800	1.46	0.88	0.58
+	8/24 1200	-0.99	1.64	-2.63
St. Petersburg, FL	8/25 0800	3.57	1.91	1.66
+	8/24 1400	0.00	1.13	-1.13
Clearwater Bch, FL	8/25 0400	3.44	1.75	1.69
+	8/24 1400	-1.81	0.24	-2.05
Cedar Key, FL	8/25 0800	4.65	2.50	2.15
+	8/24 2300	1.72	2.62	-0.90
Turkey Point, FL	8/25 0800	4.26	2.32	1.94
+	8/24 1300	1.13	2.01	-0.88

NOTES:

Storm surge is the difference between observed and predicted elevations; Elevations are in feet; MLLW is Mean Lower Low Water datum; Times are in local standard time.

* No tidal surge effect by Hurricane Andrew.

\+ Negative tidal surge.

TABLE IV. **STORM SURGE**
NORTHERN GULF COAST

		ELEVATION ABOVE MLLW		
STATION	DATE/TIME	OBSERVED	PREDICTED	DIFFERENCE
Apalachicola, FL	8/25 1000	3.39	1.56	1.83
Panama City, FL	8/25 1600	1.55	0.25	1.30
Panama City Beach, FL	8/25 1200	2.01	0.65	1.36
Pensacola, FL	8/25 1800	1.44	0.15	1.29
Dauphin Island, AL	8/25 1600	2.04	0.45	1.59
Bay Waveland, MS	8/25 2200	3.91	0.00	3.91
South Pass, LA @	8/25 1600	2.45	-0.04	2.49
Grand Isle, LA	8/25 1800	3.66	0.03	3.63
New Canal, LA	8/26 1200	2.92	0.15	2.77
Cocodrie, LA @	8/25 2200	6.87	0.06	6.81

NOTES:

Storm surge is the difference between observed and predicted elevations; Elevations are in feet; MLLW is Mean Lower Low Water datum; Times are in local standard time.
@ Data record ends before full effect of Hurricane Andrew.

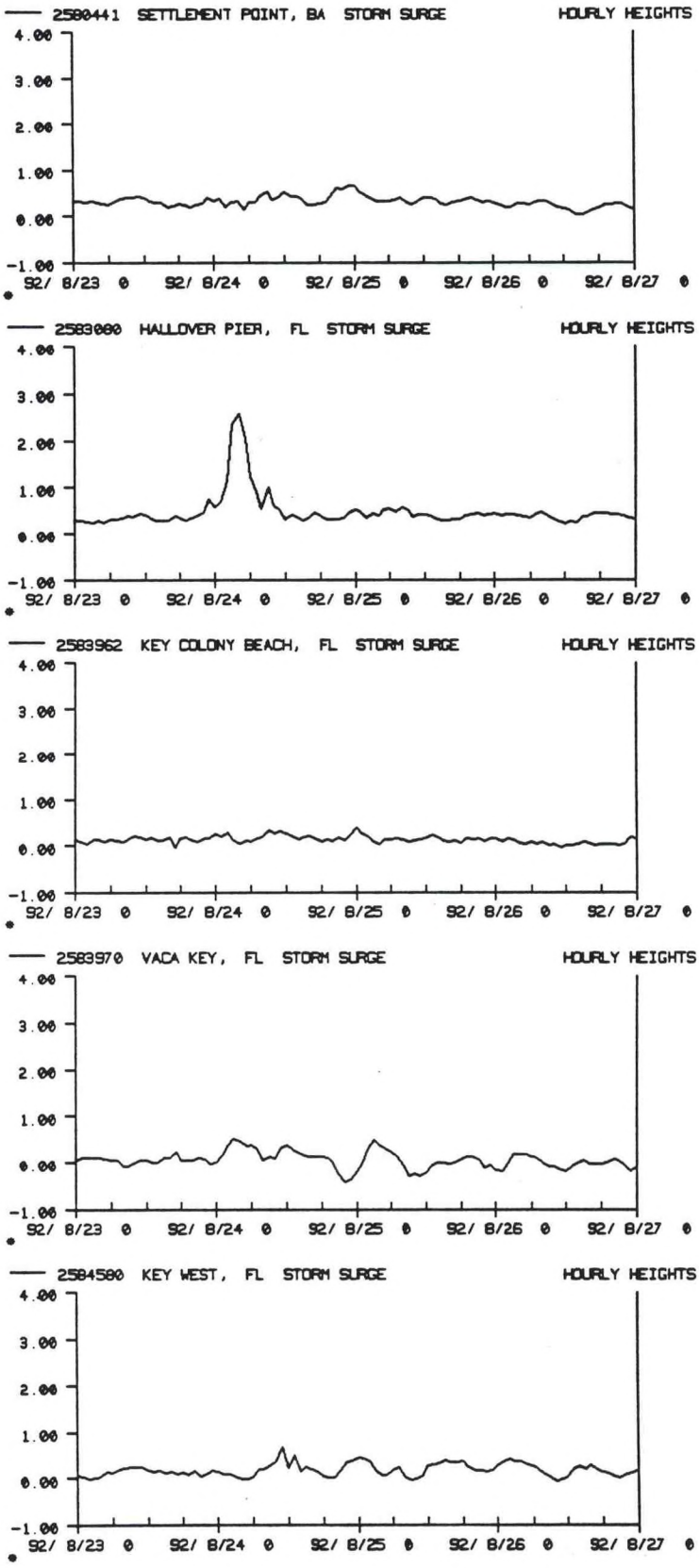


FIGURE 1. HURRICANE ANDREW STORM SURGE BAHAMAS, EAST FLORIDA AND KEYS

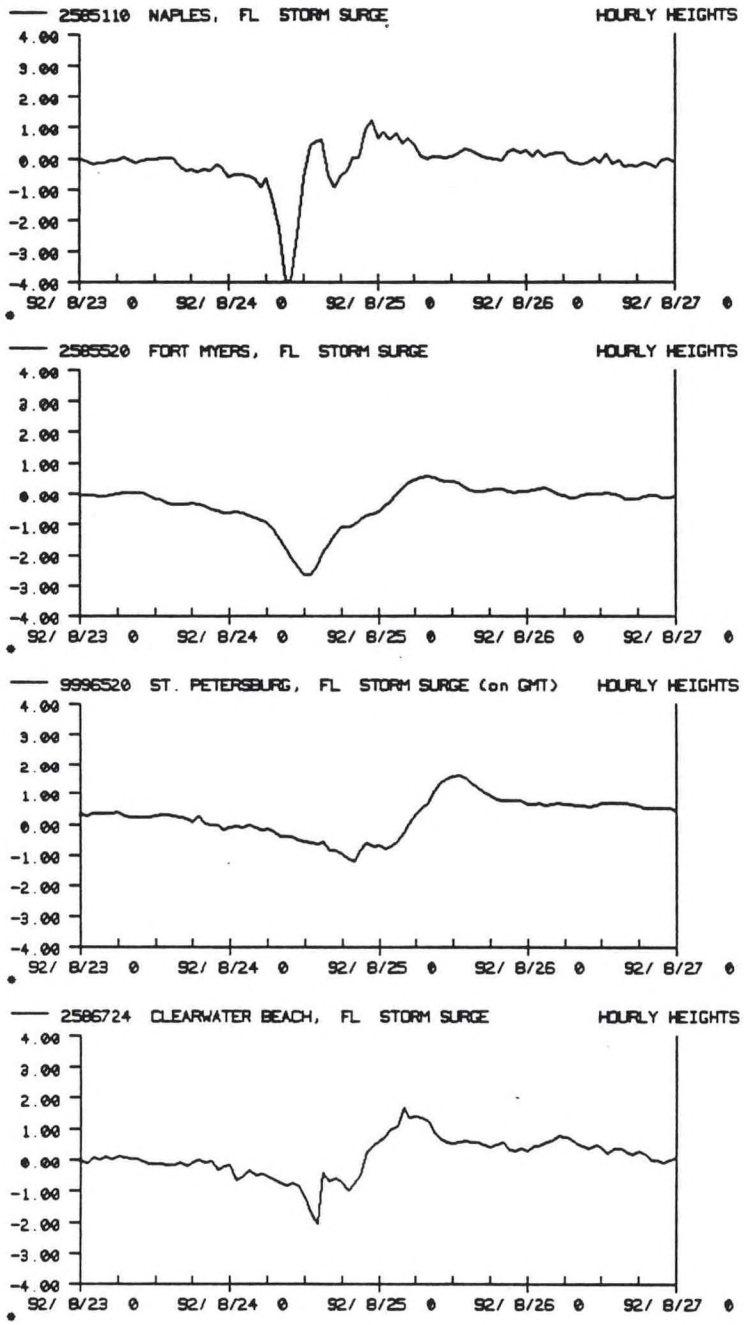
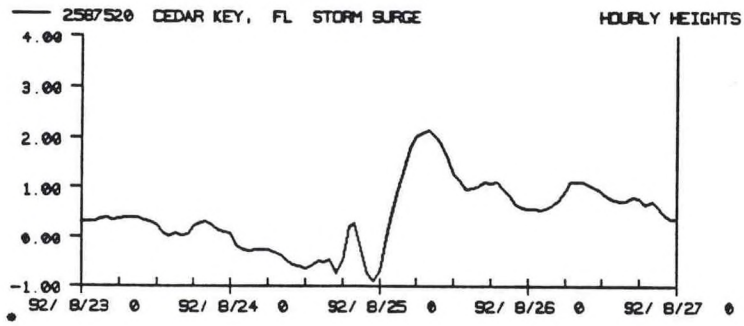


FIGURE 2. HURRICANE ANDREW STORM SURGE FLORIDA GULF COAST: NAPLES TO CLEARWATER BEACH



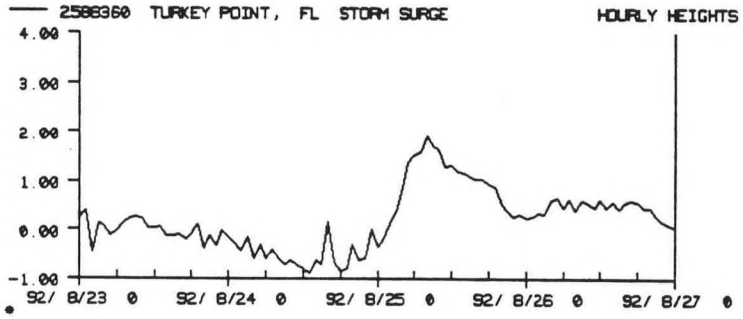


FIGURE 3. HURRICANE ANDREW STORM SURGE FLORIDA GULF COAST CEDAR KEY TO TURKEY POINT

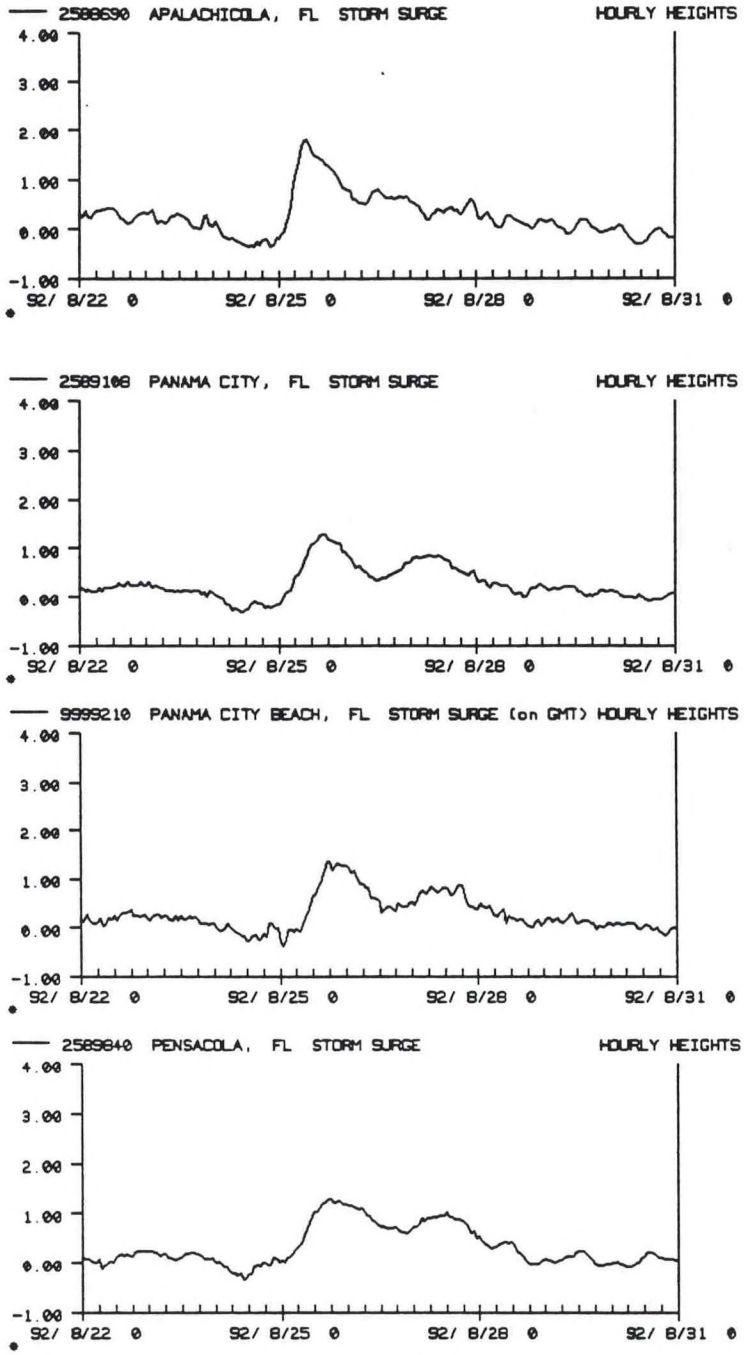


FIGURE 4. HURRICANE ANDREW STORM SURGE FLORIDA PANHANDLE

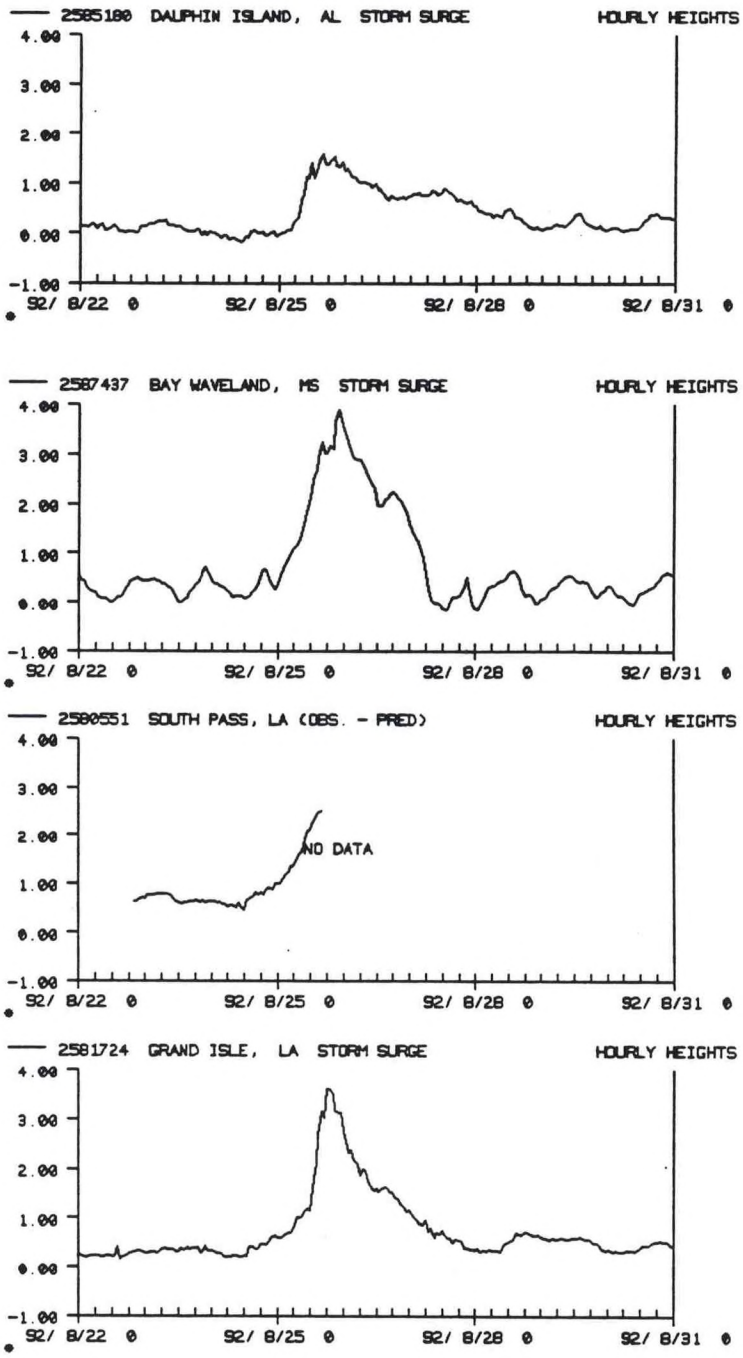


FIGURE 5. HURRICANE ANDREW STORM SURGE NORTHERN GULF COAST COASTAL STATIONS

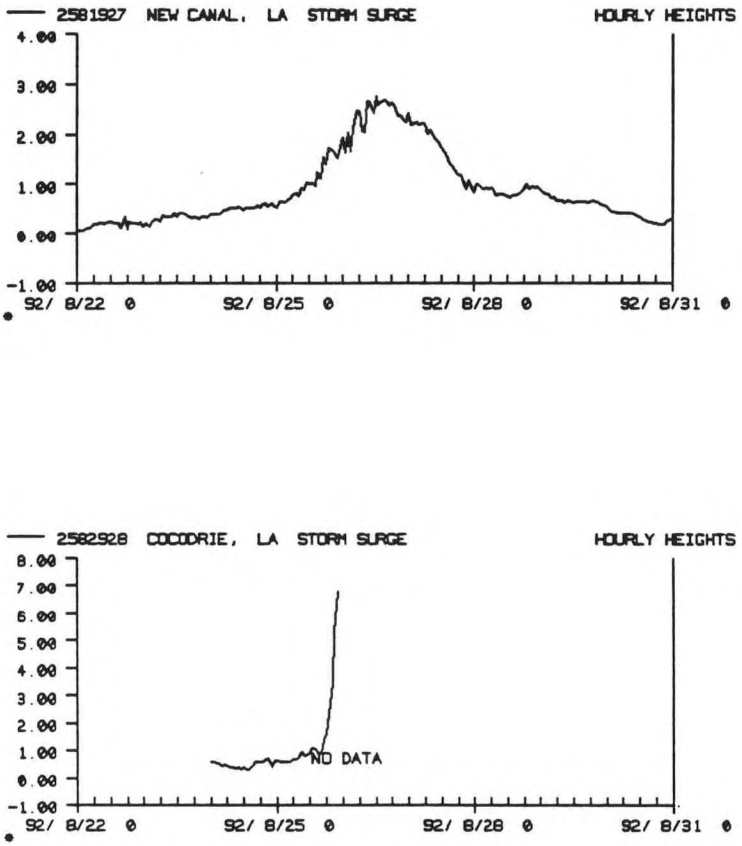


FIGURE 6. HURRICANE ANDREW STORM SURGE NORTHERN GULF COAST INLAND STATION

IV. COMPARISON PLOTS: OBSERVED VS. PREDICTED DATA

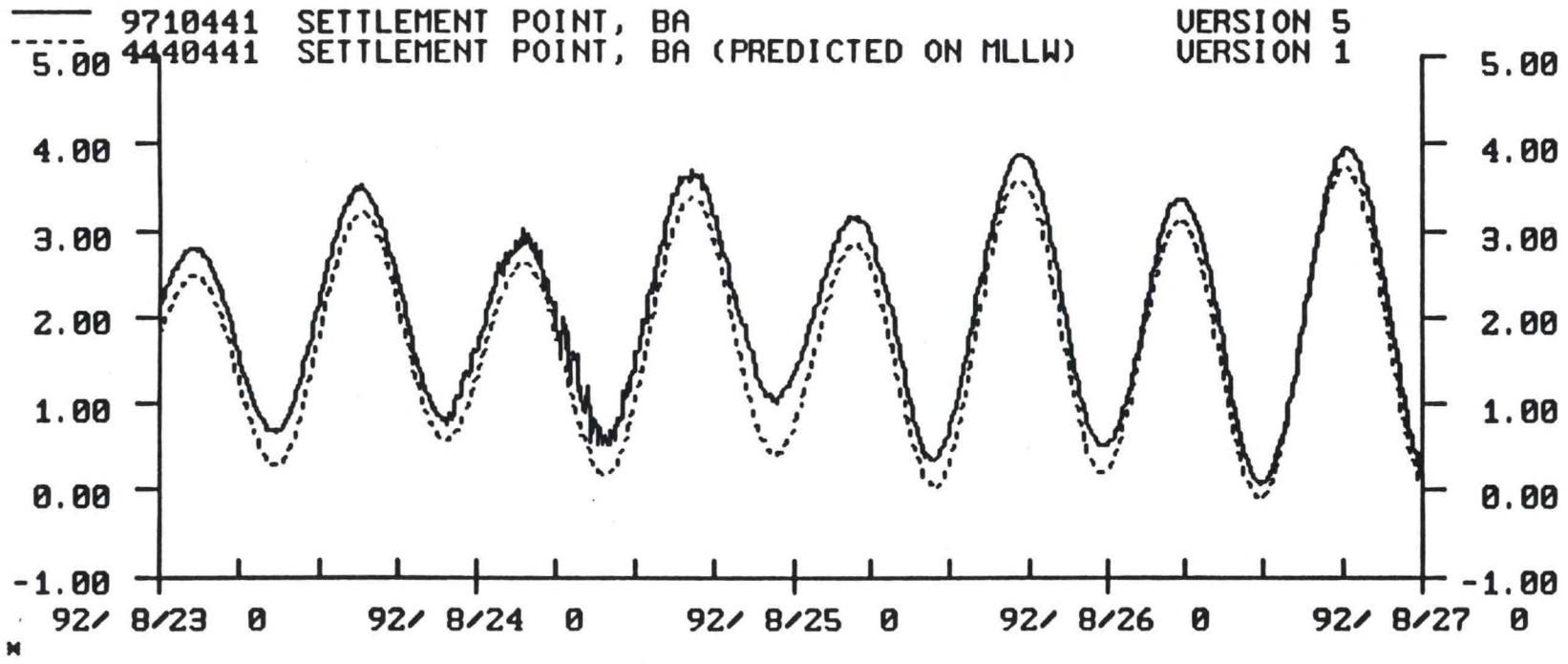
This section presents plots of the simultaneous observed and predicted six-minute interval time series for the stations in Section III. ADR data plots are on local Standard Time. NGWLMS data plots are on Universal Time Coordinates. All elevations on the plots are in feet relative to MLLW at each station.

The forcing effects of Hurricane Andrew on the observed water levels are exhibited when observed water levels are compared with predicted water levels. The degree of forcing was dependent on time and magnitude. The maximum storm surge occurred near the time of high water at Haulover Pier, on the morning of August 24, 1992. On the opposite side of the Florida peninsula at Naples, there was a rapid withdrawl of water at the predicted time of high water on the morning of August 24, 1992.

For stations along the northern coast of the Gulf of Mexico a continual pile up of water occurred as the hurricane approached the coastline on August 25, 1992. Maximum water level elevations occurred superimposed upon the predicted high water on the morning of August 26, 1992. The water levels at some stations remained high and masked the effects of the astronomical tidal signal for two to three days following the hurricane.

Note that the astronomical tides are not only stronger on the east coast of Florida than in the Gulf of Mexico, but are classified as semidiurnal tides. Tides in the Gulf of Mexico vary from mixed, to mixed-diurnal, to diurnal tides; with generally less range than found on the east coast of Florida.

Figure Set: Observed vs Predicted Data for All Stations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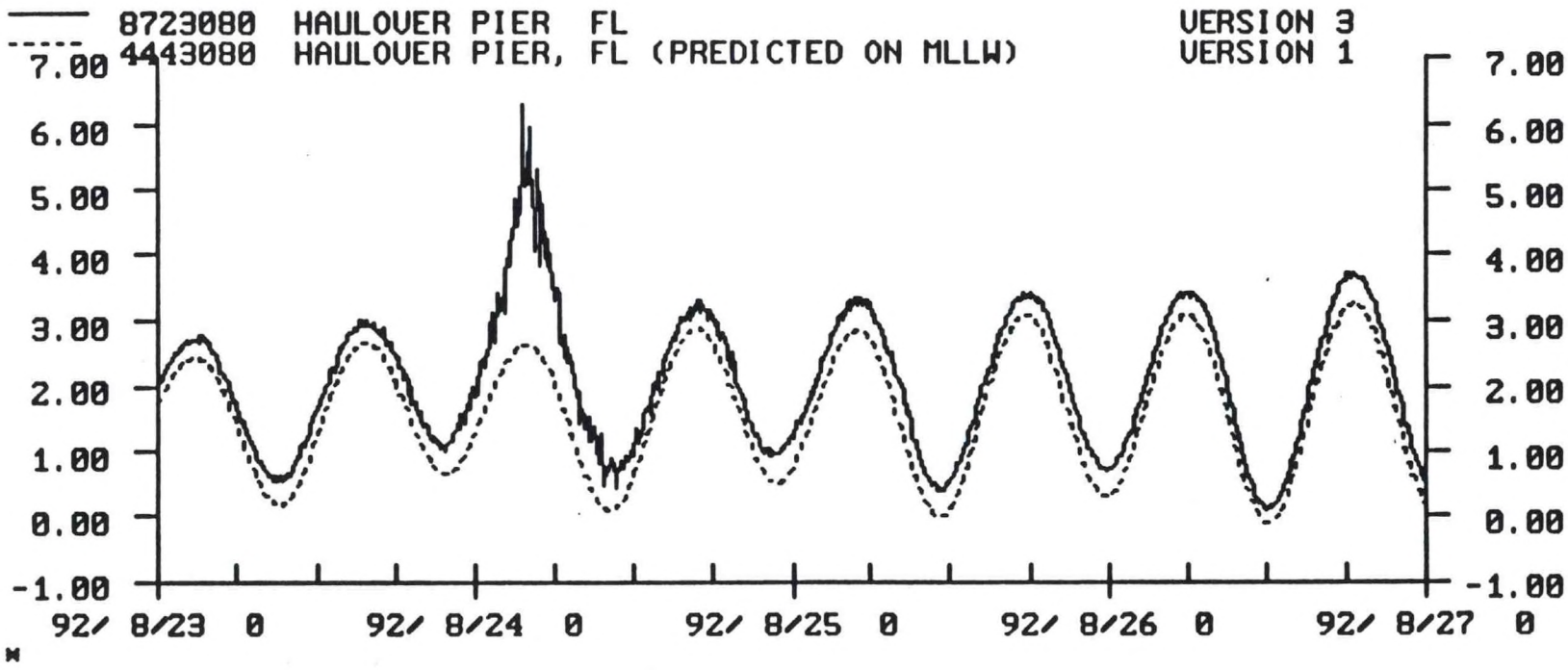
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VERSION 3
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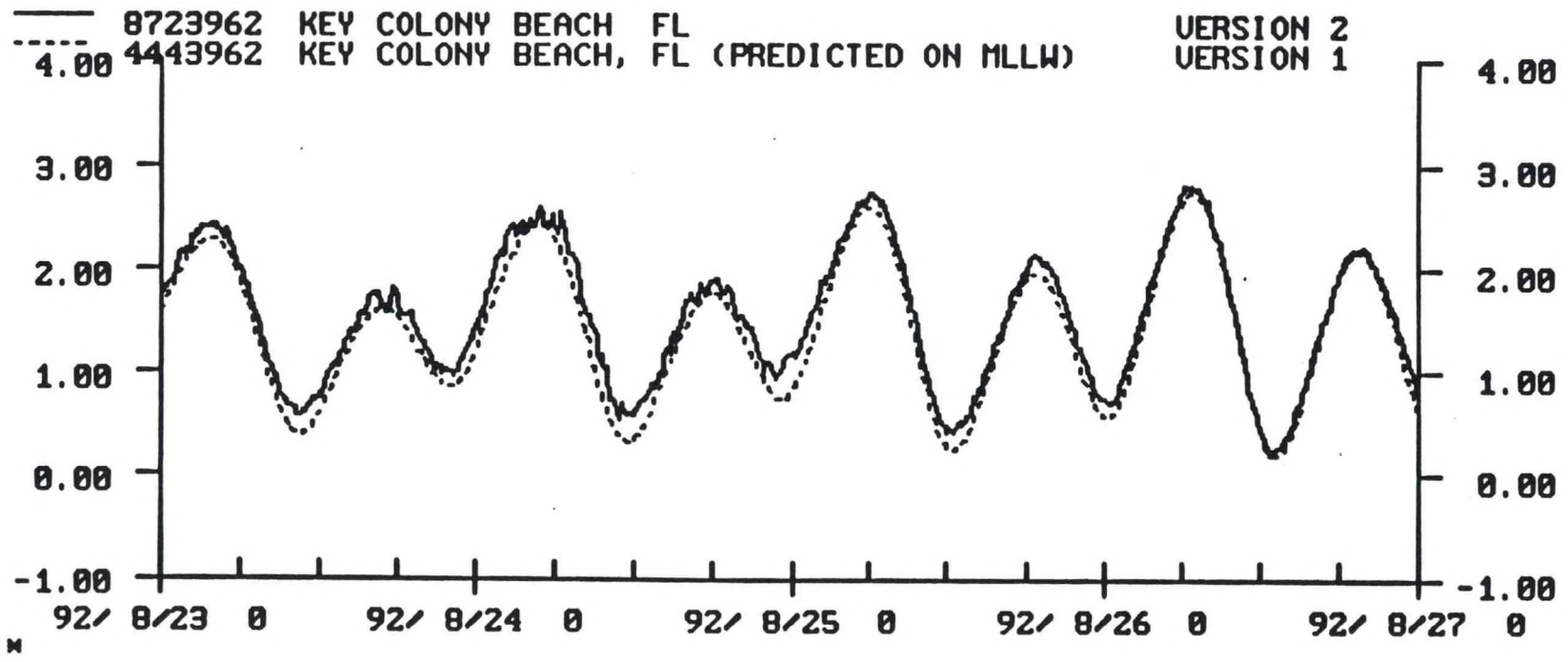
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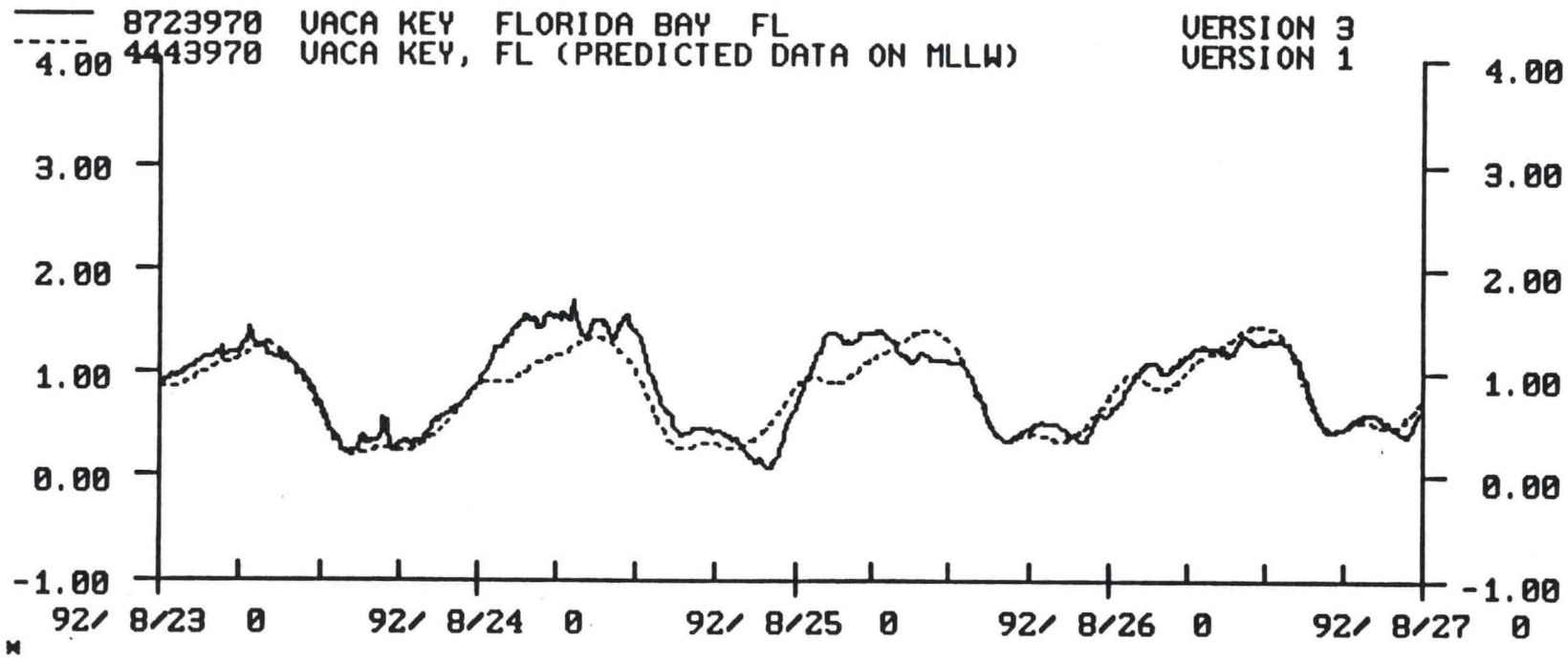
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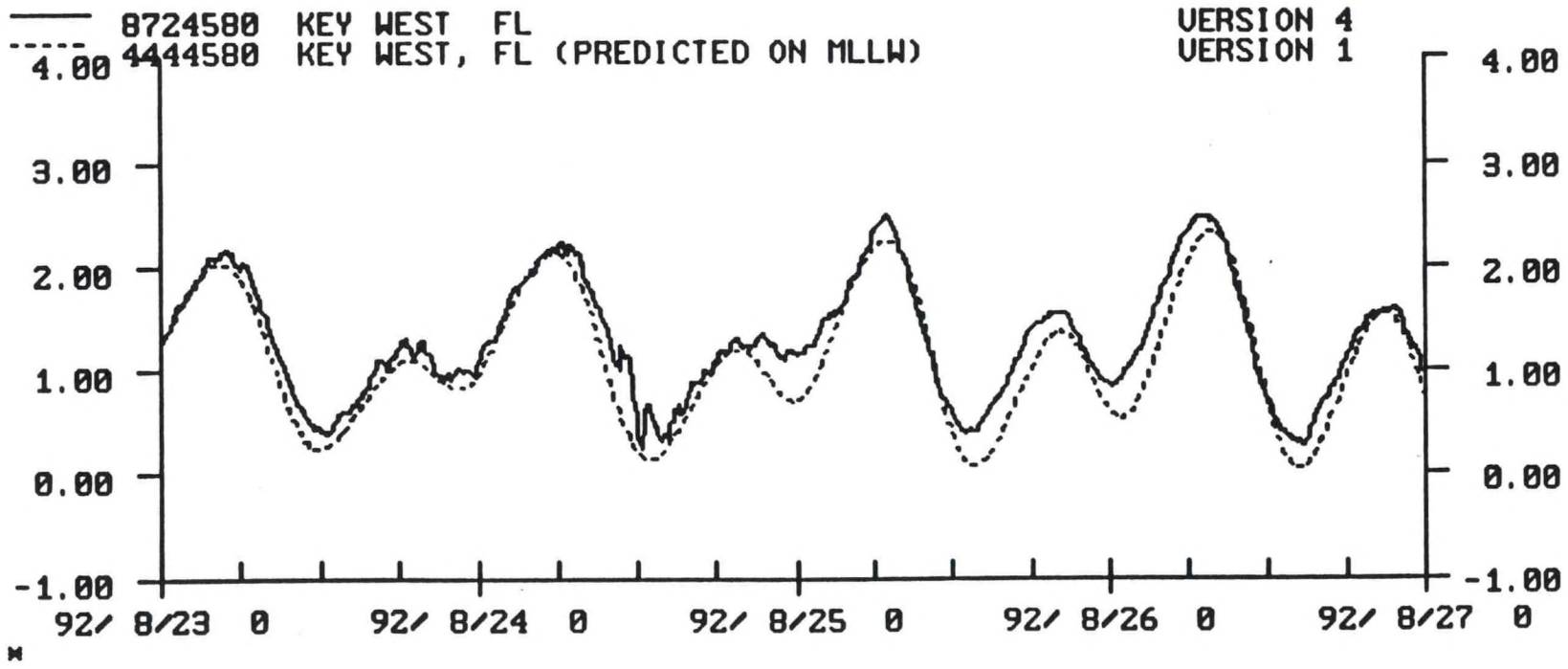
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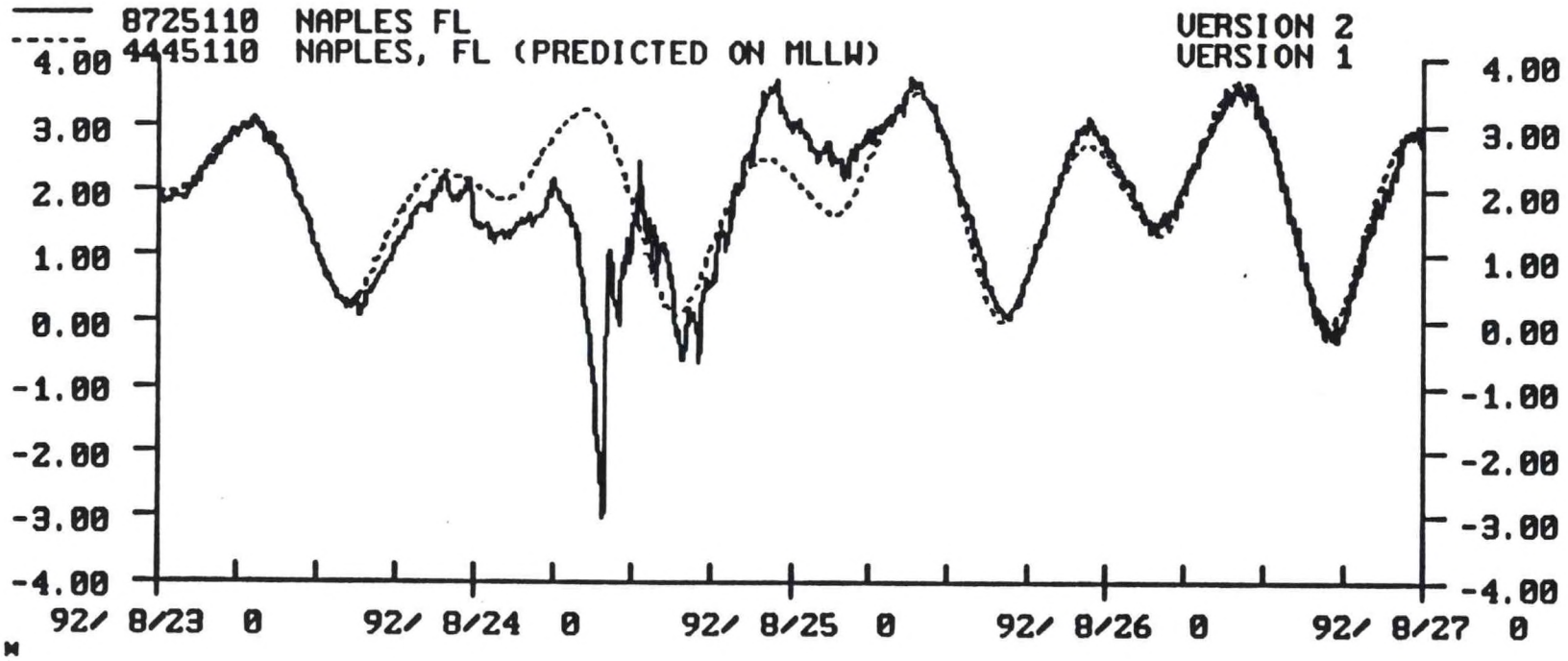
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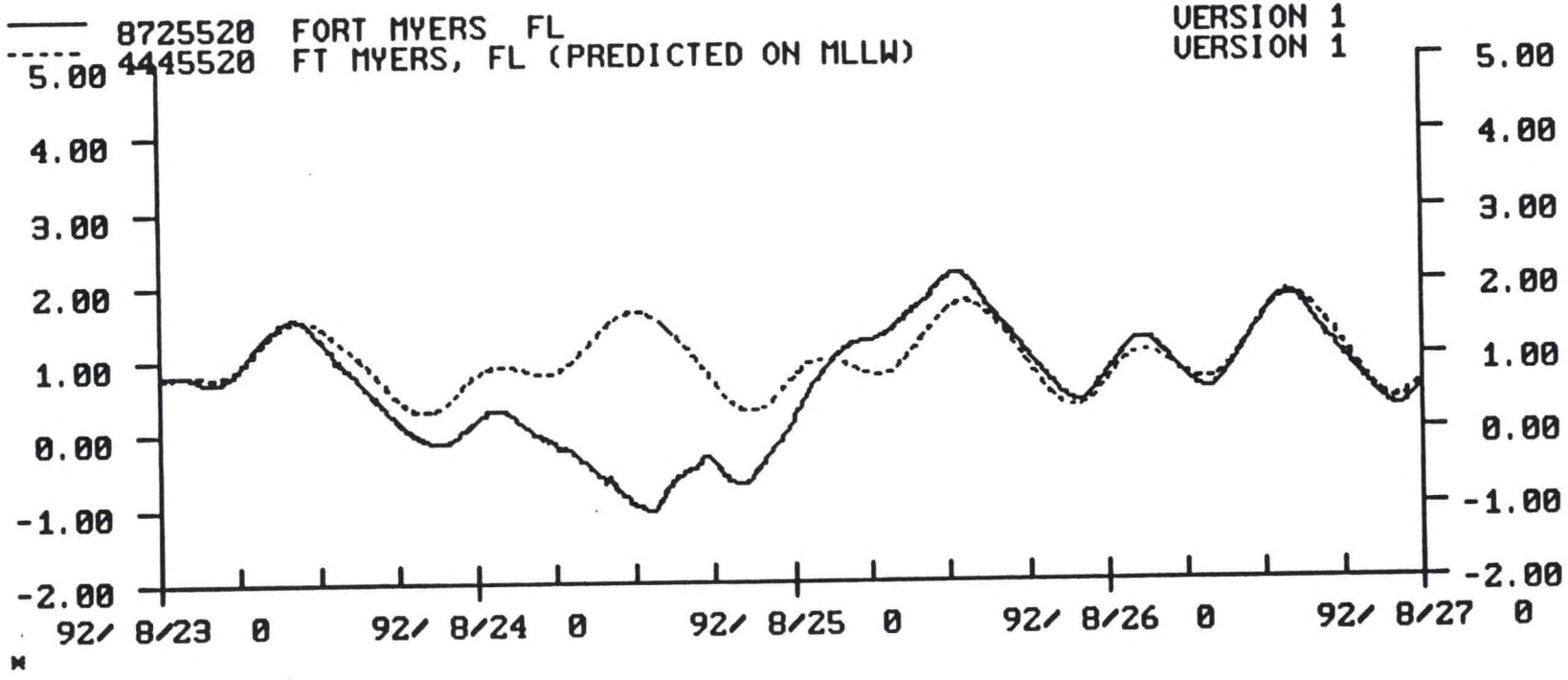
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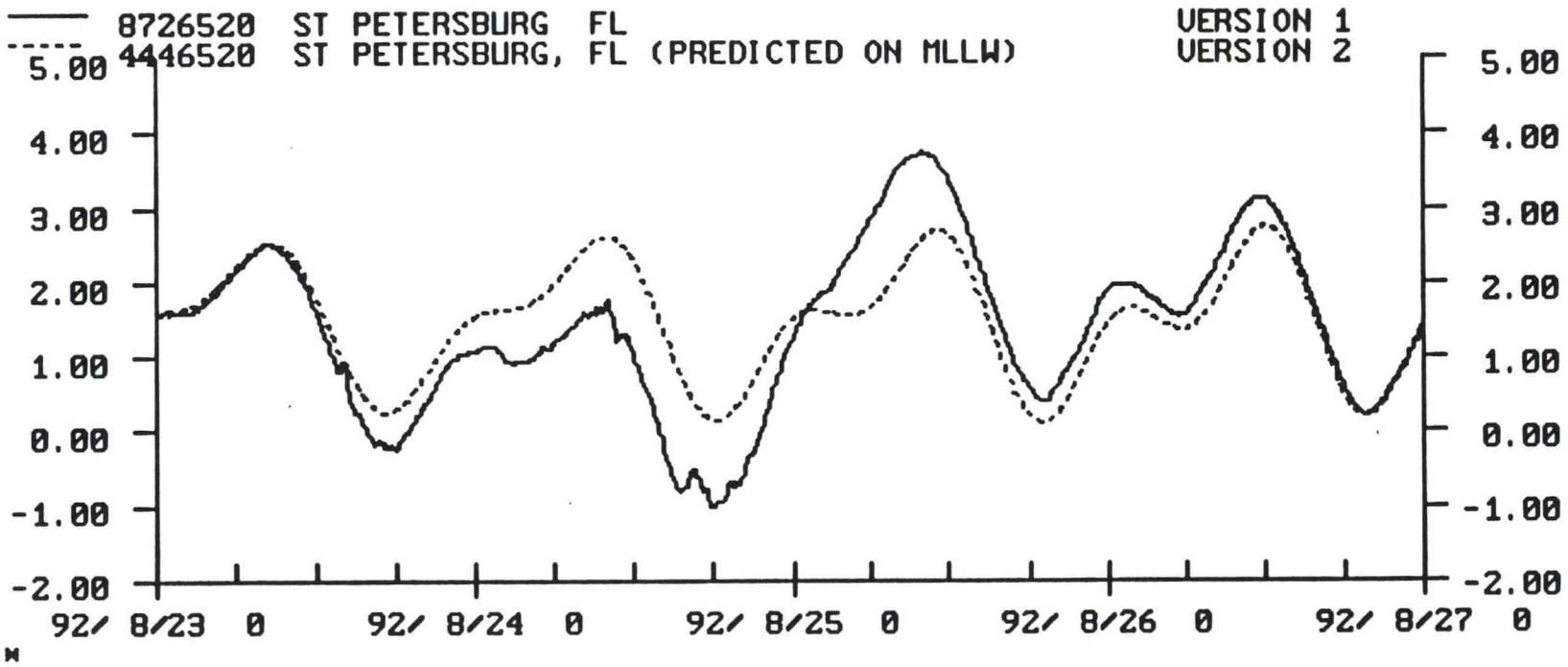
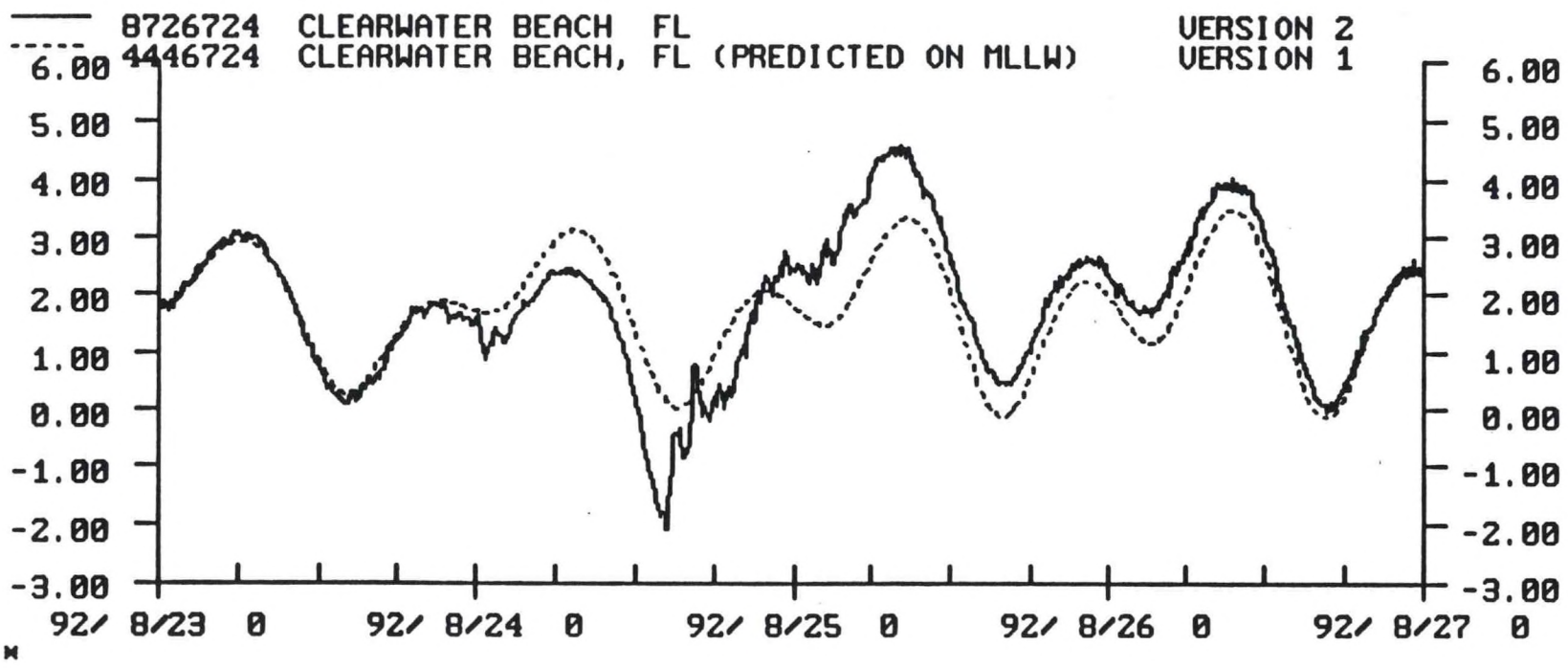
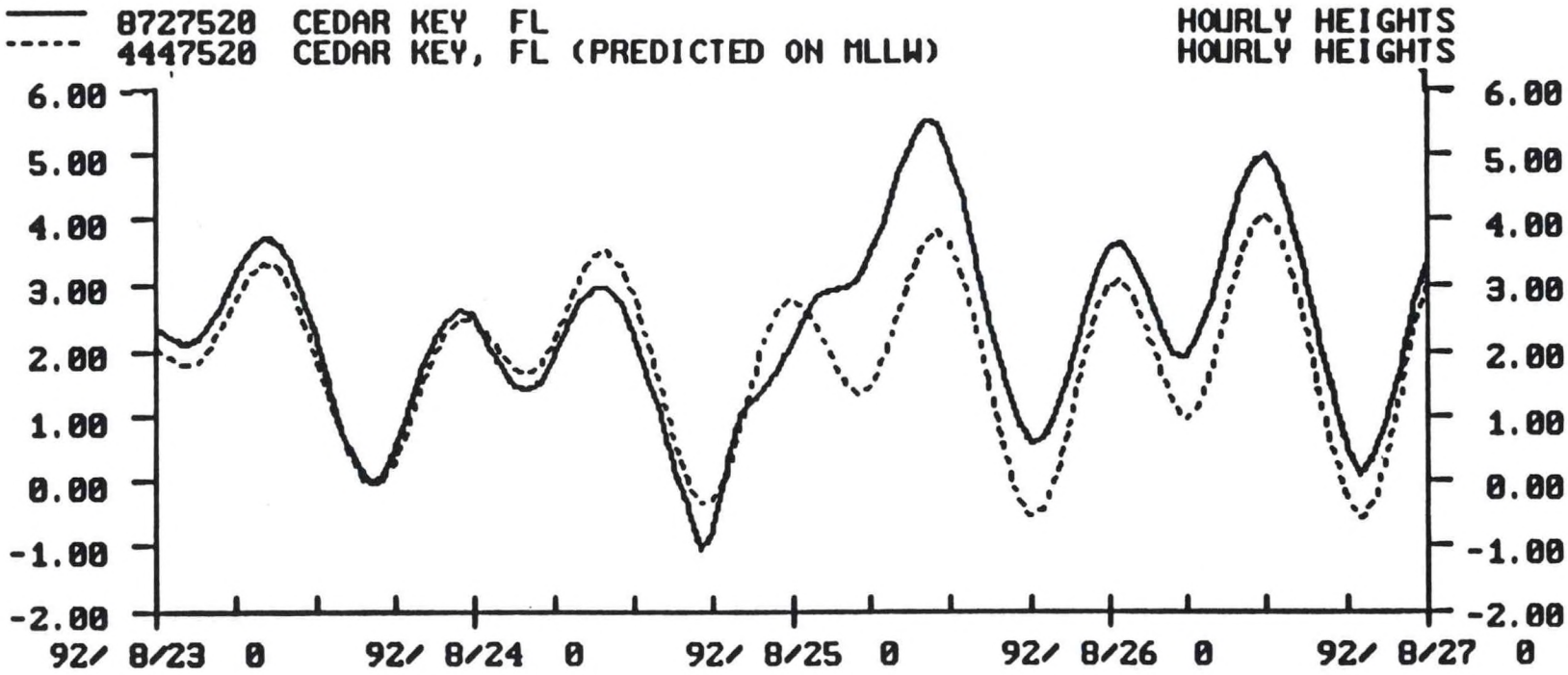
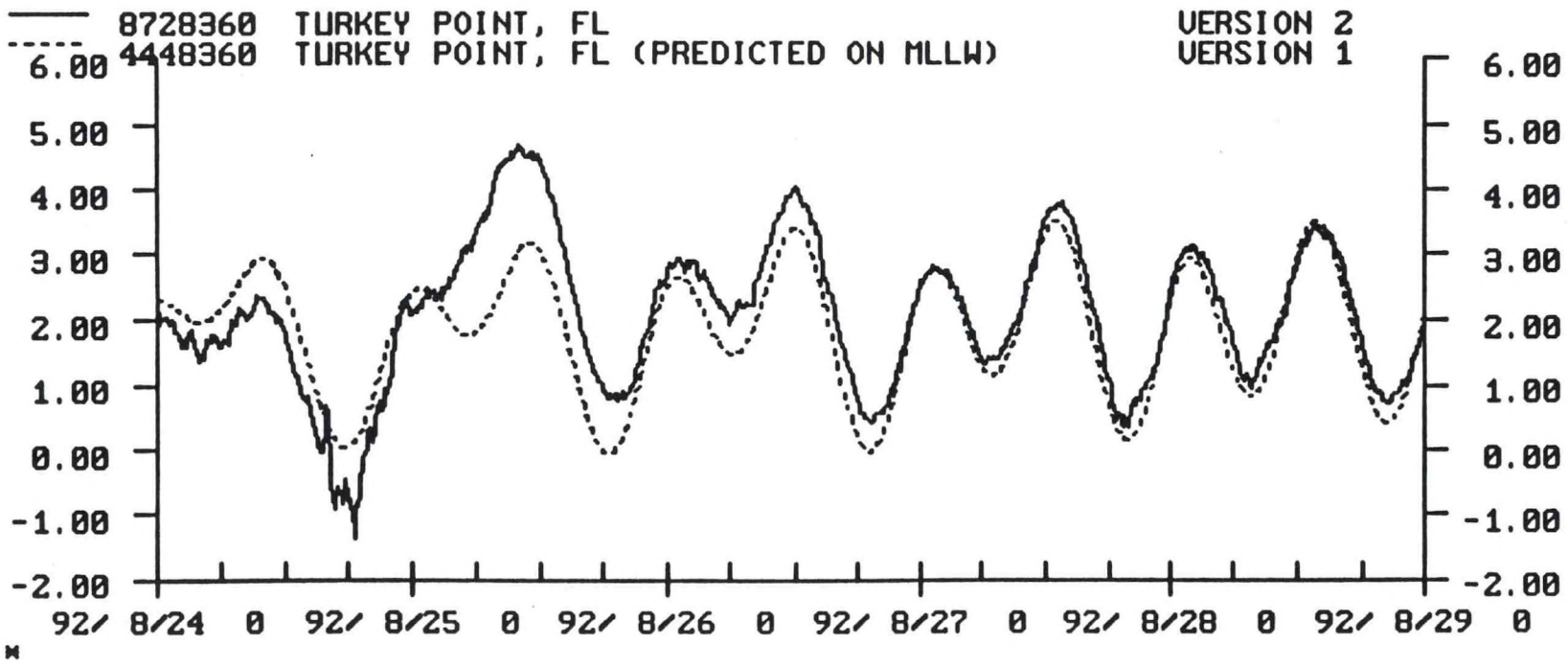
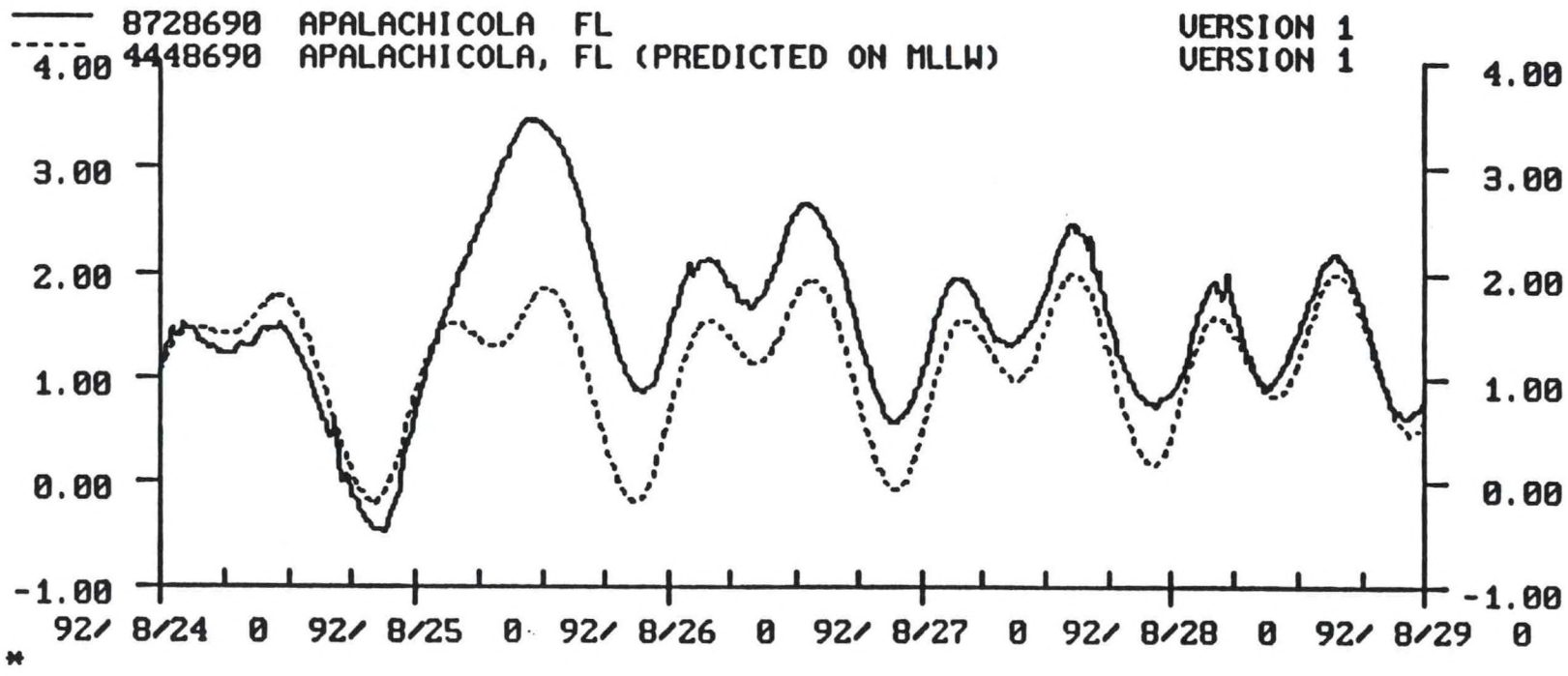
92/ 8/27 0

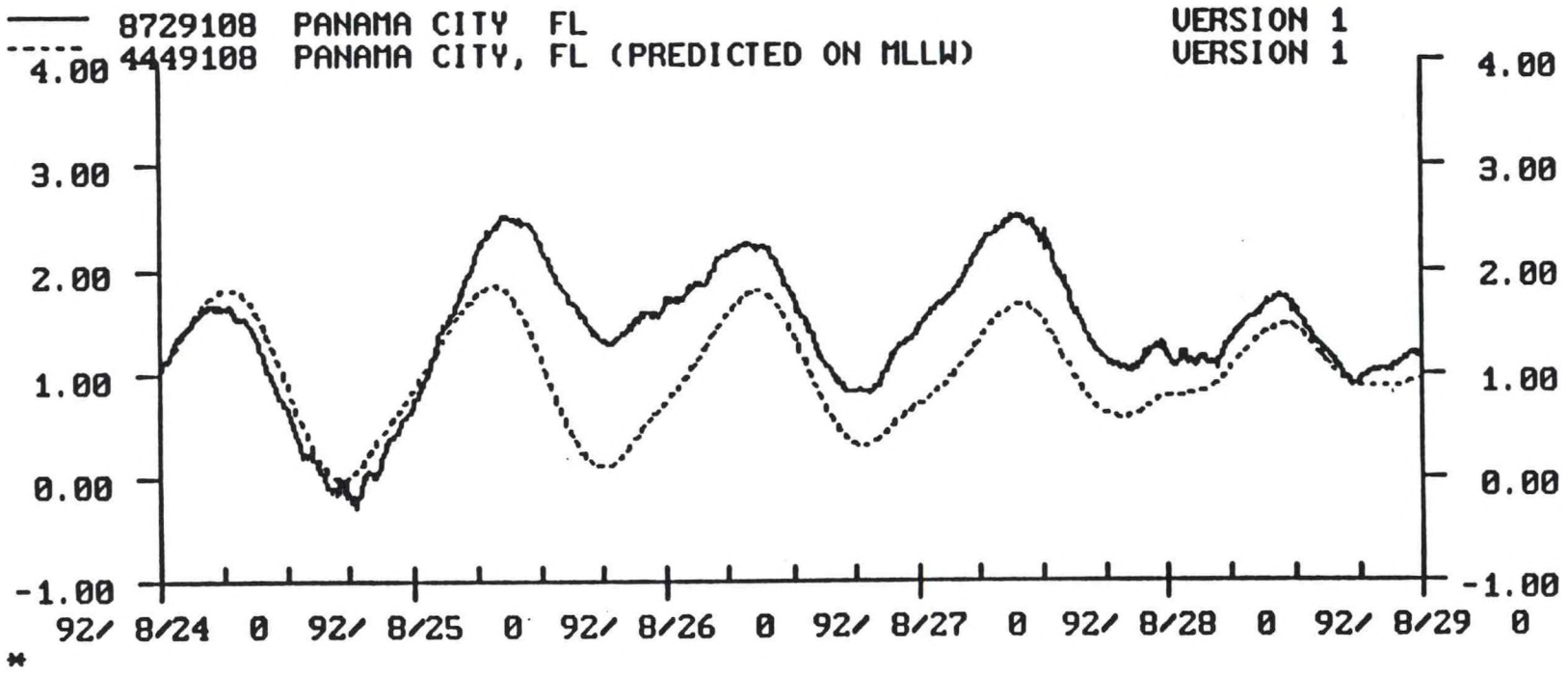

8726520 ST PETERSBURG FL
4446520 ST PETERSBURG, FL (PREDICTED ON MLLW)
VERSION 1
VERSION 2
5.00
4.00
3.00
2.00
1.00
0.00
-1.00
-2.00
92/ 8/23 0
92/ 8/24 0
92/ 8/25 0
92/ 8/26 0
92/ 8/27 0

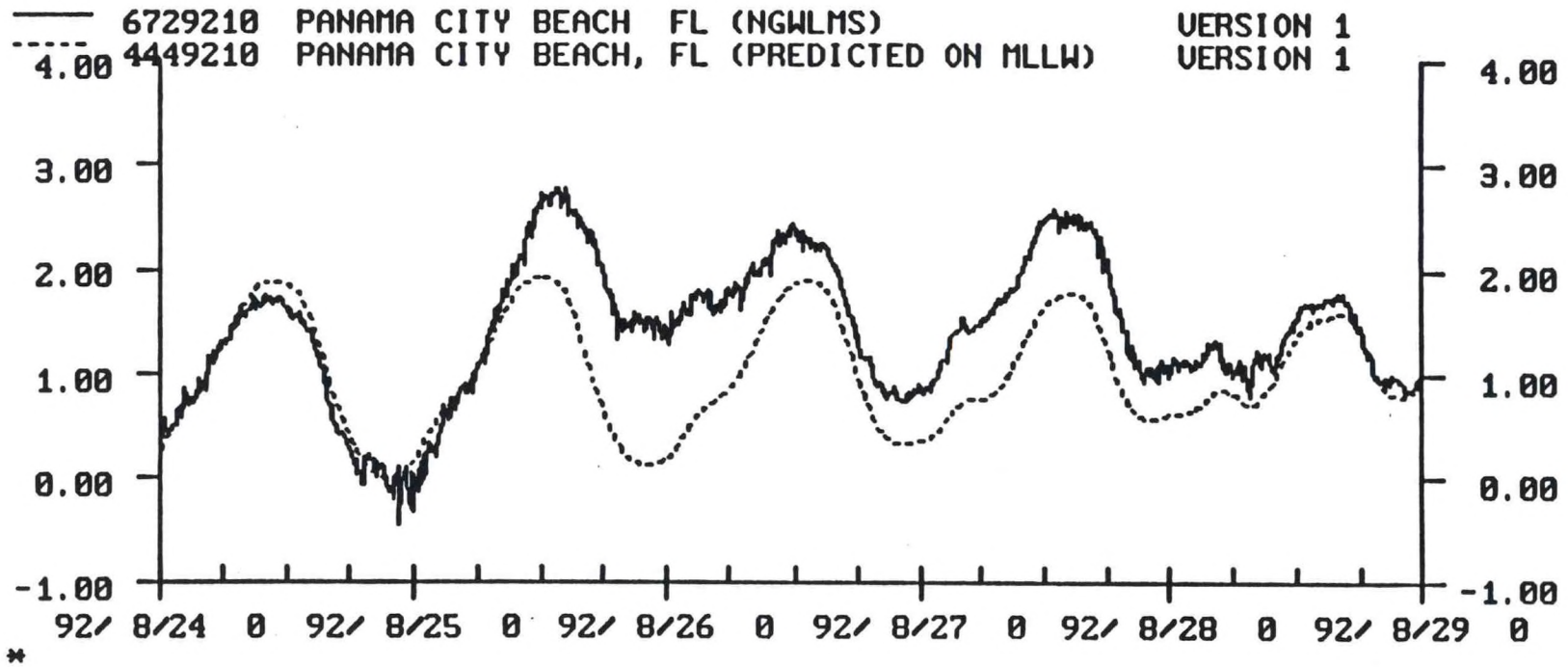

8726724 CLEARWATER BEACH FL
4446724 CLEARWATER BEACH, FL (PREDICTED ON MLLW)
VERSION 2
VERSION 1
6.00
5.00
4.00
3.00
2.00
1.00
0.00
-1.00
-2.00
-3.00
92/ 8/23 0
92/ 8/24 0
92/ 8/25 0
92/ 8/26 0
92/ 8/27 0

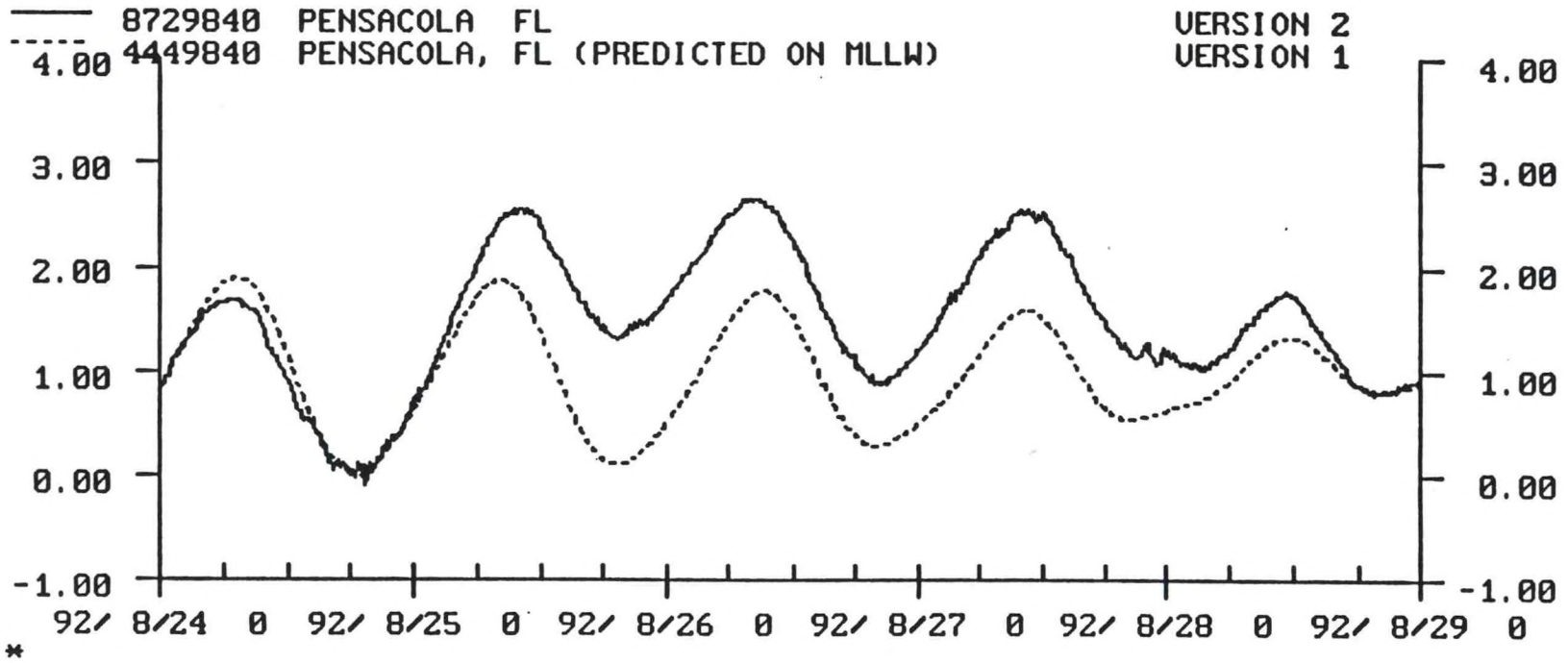

8727520 CEDAR KEY FL
4447520 CEDAR KEY, FL (PREDICTED ON MLLW)
HOURLY HEIGHTS
HOURLY HEIGHTS
6.00
5.00
4.00
3.00
2.00
1.00
0.00
-1.00
-2.00
92/ 8/23 0
92/ 8/24 0
92/ 8/25 0
92/ 8/26 0
92/ 8/27 0

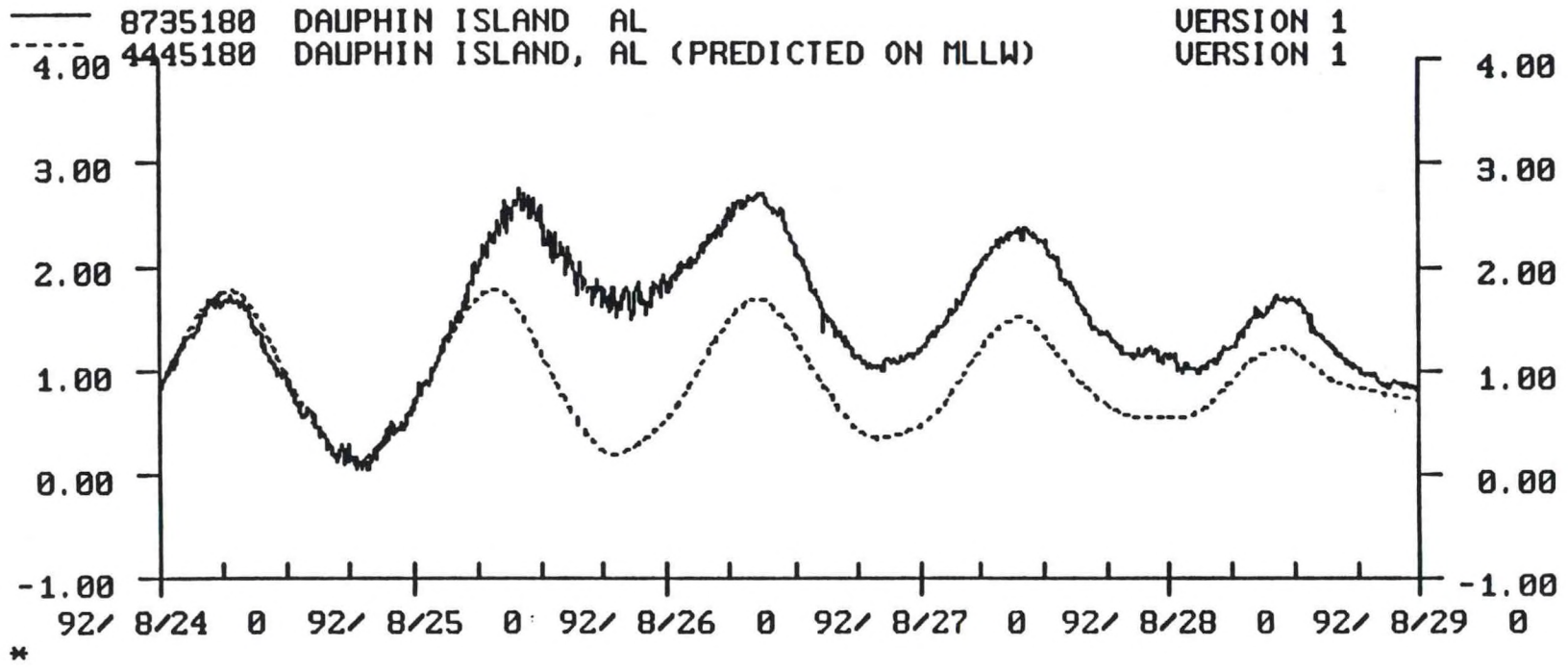

8728360 TURKEY POINT, FL
4448360 TURKEY POINT, FL (PREDICTED ON MLLW)
VERSION 2
VERSION 1
6.00
5.00
4.00
3.00
2.00
1.00
0.00
-1.00
-2.00
92/ 8/24 0
92/ 8/25 0
92/ 8/26 0
92/ 8/27 0
92/ 8/28 0
92/ 8/29 0

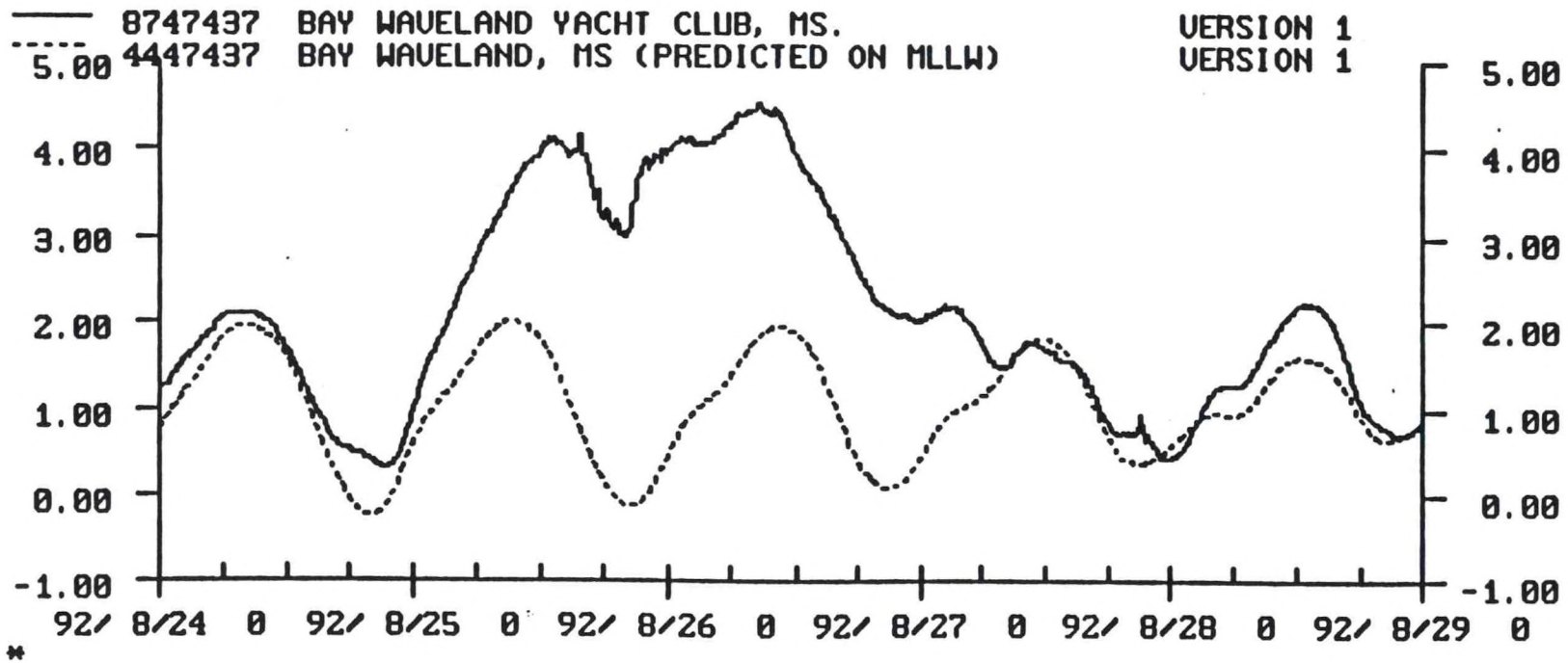

8728690 APALACHICOLA FL
4448690 APALACHICOLA, FL (PREDICTED ON MLLW)
VERSION 1
VERSION 1
4.00
3.00
2.00
1.00
0.00
-1.00
92/ 8/24 0
92/ 8/25 0
92/ 8/26 0
92/ 8/27 0
92/ 8/28 0
92/ 8/29 0

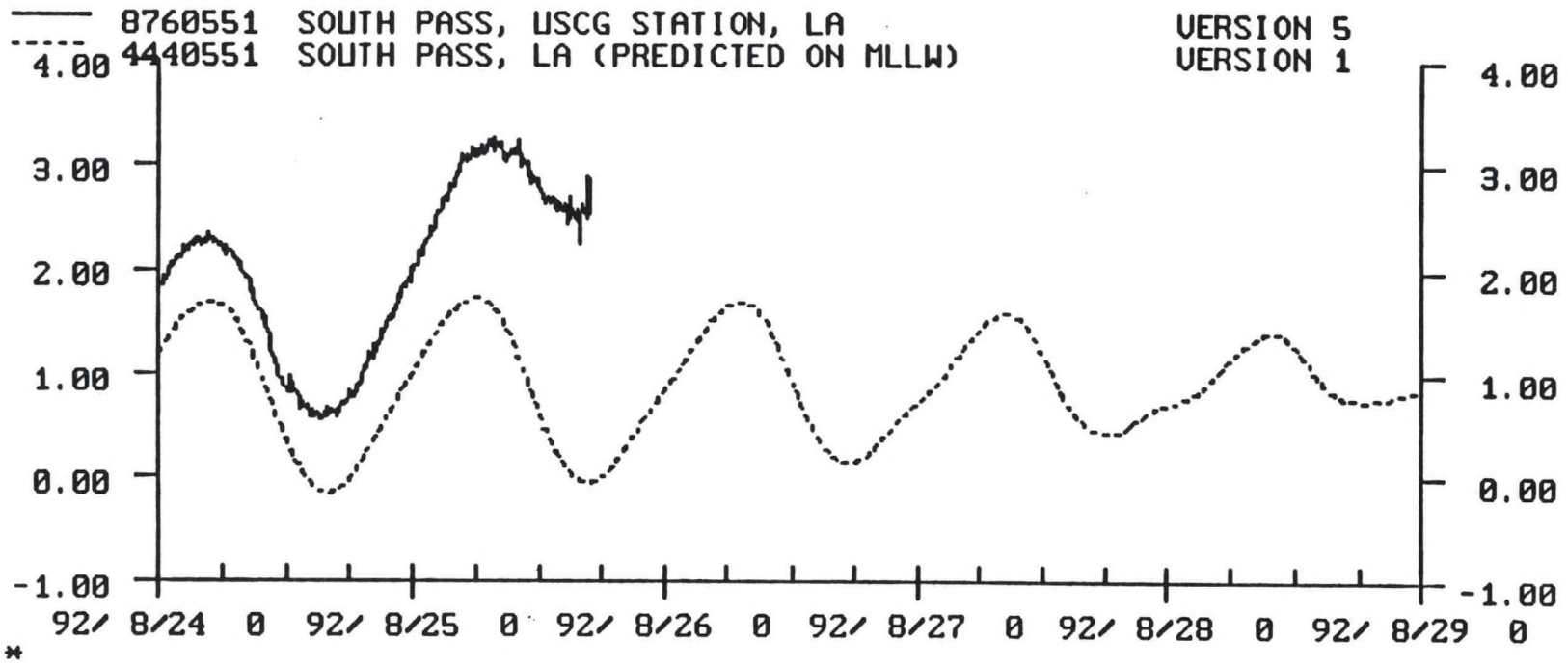

8729108 PANAMA CITY FL
4449108 PANAMA CITY, FL (PREDICTED ON MLLW)
VERSION 1
VERSION 1
4.00
3.00
2.00
1.00
0.00
-1.00
92/ 8/24 0
92/ 8/25 0
92/ 8/26 0
92/ 8/27 0
92/ 8/28 0
92/ 8/29 0


6729210 PANAMA CITY BEACH FL (NGWLMS) VERSION 1
4449210 PANAMA CITY BEACH, FL (PREDICTED ON MLLW) VERSION 1
4.00
3.00
2.00
1.00
0.00
-1.00
92/ 8/24 0
92/ 8/25 0
92/ 8/26 0
92/ 8/27 0
92/ 8/28 0
92/ 8/29 0


8729840 PENSACOLA FL
4449840 PENSACOLA, FL (PREDICTED ON MLLW)
VERSION 2
VERSION 1
4.00
3.00
2.00
1.00
0.00
-1.00
92/ 8/24 0
92/ 8/25 0
92/ 8/26 0
92/ 8/27 0
92/ 8/28 0
92/ 8/29 0


8735180 DAUPHIN ISLAND AL
VERSION 1
4445180 DAUPHIN ISLAND, AL (PREDICTED ON MLLW)
VERSION 1
4.00
3.00
2.00
1.00
0.00
-1.00
92/ 8/24 0
92/ 8/25 0
92/ 8/26 0
92/ 8/27 0
92/ 8/28 0
92/ 8/29 0


8747437 BAY WAVELAND YACHT CLUB, MS.
4447437 BAY WAVELAND, MS (PREDICTED ON MLLW)
VERSION 1
VERSION 1
5.00
4.00
3.00
2.00
1.00
0.00
-1.00
92/ 8/24 0
92/ 8/25 0
92/ 8/26 0
92/ 8/27 0
92/ 8/28 0
92/ 8/29 0


8760551 SOUTH PASS, USCG STATION, LA
4440551 SOUTH PASS, LA (PREDICTED ON MLLW)
VERSION 5
VERSION 1
4.00
3.00
2.00
1.00
0.00
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92/ 8/24 0
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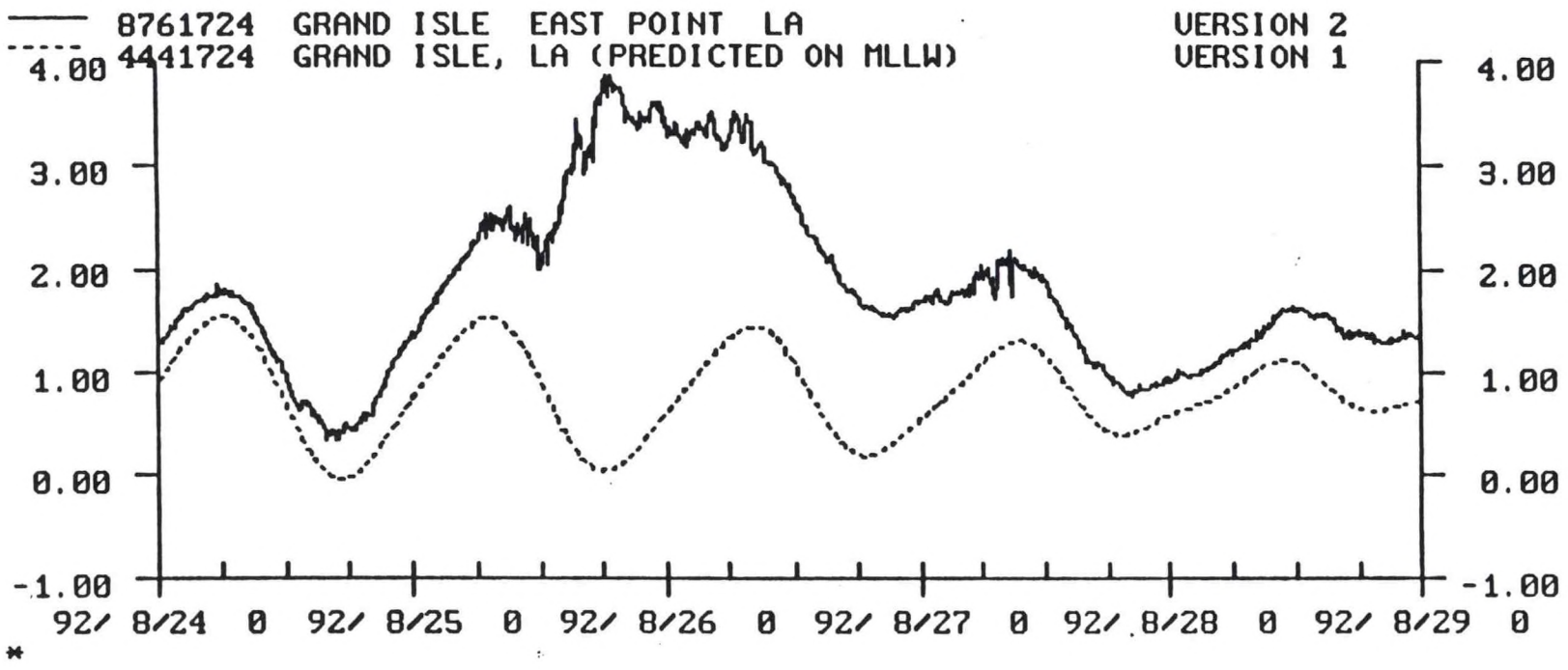
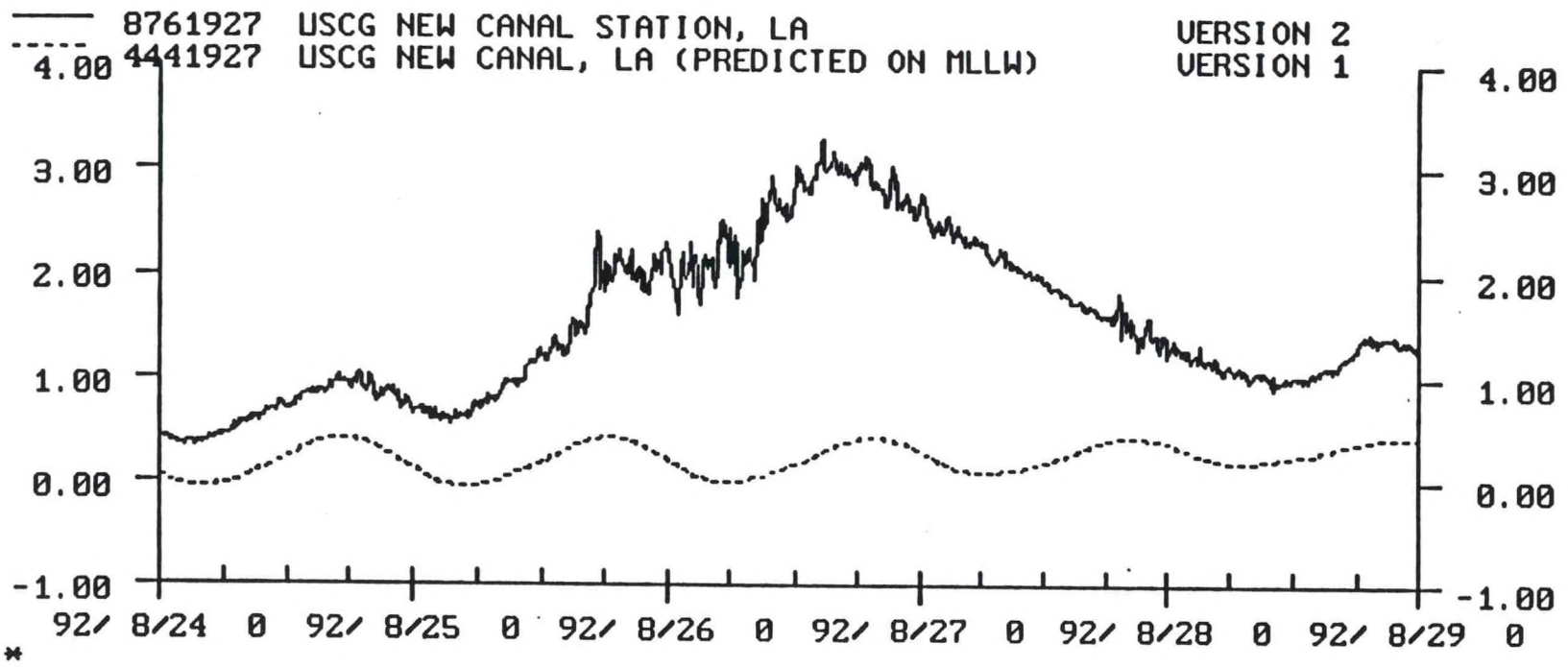
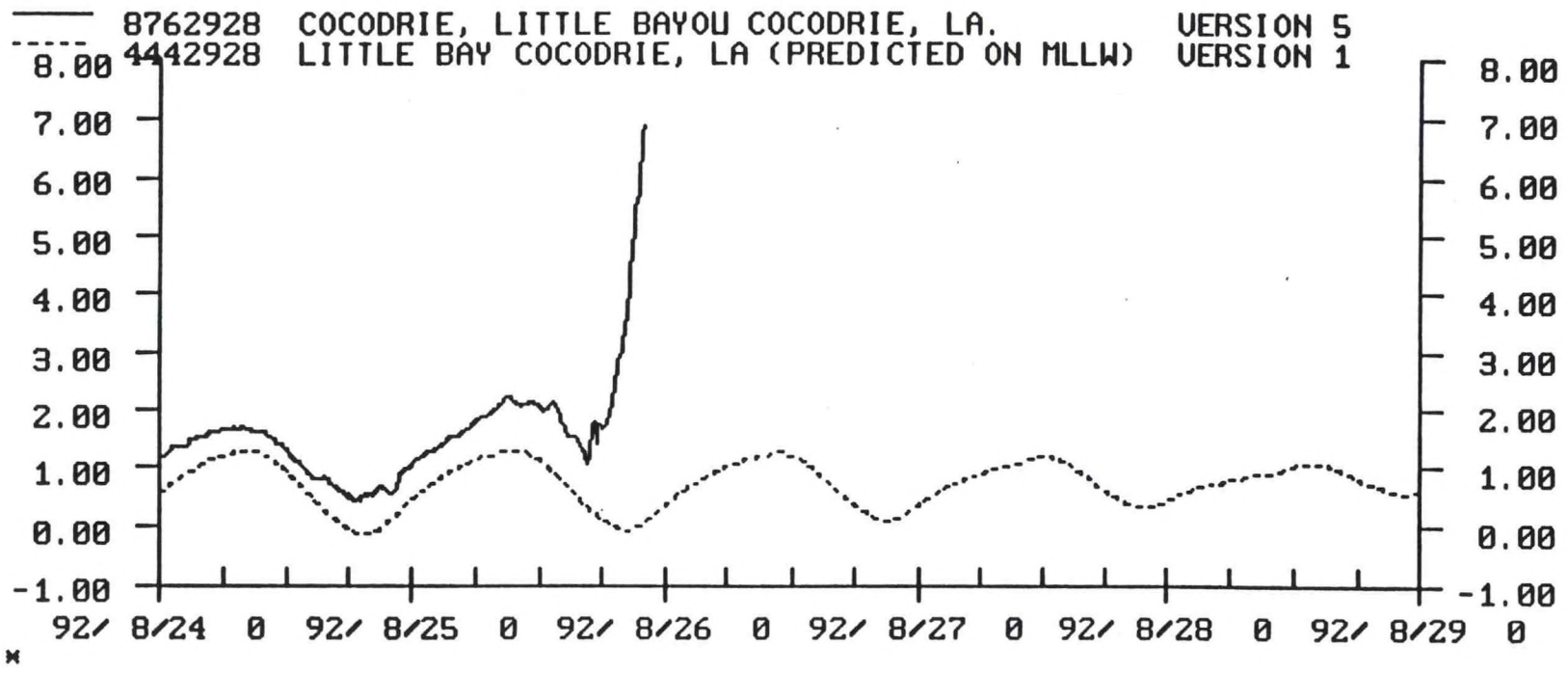
92/ 8/26 0
92/ 8/27 0
92/ 8/28 0
92/ 8/29 0


8761724 GRAND ISLE EAST POINT LA
4441724 GRAND ISLE, LA (PREDICTED ON MLLW)
VERSION 2
VERSION 1
4.00
3.00
2.00
1.00
0.00
-1.00
92/ 8/24 0
92/ 8/25 0
92/ 8/26 0
92/ 8/27 0
92/ 8/28 0
92/ 8/29 0


8761927 USCG NEW CANAL STATION, LA
4441927 USCG NEW CANAL, LA (PREDICTED ON MLLW)
VERSION 2
VERSION 1
4.00
3.00
2.00
1.00
0.00
-1.00
92/ 8/24 0
92/ 8/25 0
92/ 8/26 0
92/ 8/27 0
92/ 8/28 0
92/ 8/29 0


8762928 COCODRIE, LITTLE BAYOU COCODRIE, LA. VERSION 5
4442928 LITTLE BAY COCODRIE, LA (PREDICTED ON MLLW) VERSION 1
8.00
7.00
6.00
5.00
4.00
3.00
2.00
1.00
0.00
-1.00
92/ 8/24 0
92/ 8/25 0
92/ 8/26 0
92/ 8/27 0
92/ 8/28 0
92/ 8/29 0

V. SUMMARY

The continuous operation of the National Water Level Observation Network has provided a data set documenting the effects of Hurricane Andrew in southern Florida and along the northern coast of the Gulf of Mexico. Only the station at Haulover Pier, Fl sustained enough structural damage to the pier to warrent discontinuation of data collection and removal of all equipment. The Louisiana stations at South Pass and Cocodrie were inundated, but data collection resumed after repairs were completed.

Significant storm effects on water levels were found along the east coast of southern Florida only near and to the north of the storm track. Maximum recorded highest water levels were exceeded in Florida at Haulover Pier (5.41 ft above MLLW). Very little effect was recorded at stations in the Florida Keys south of the hurricane track. The reentry of the hurricane over water in the Gulf of Mexico after passing over southern Florida resulted in some unique effects on water levels. The minimum recorded lowest water level was exceeded at Naples, FL (2.74 ft below MLLW). The storm continued to effect water levels along the Florida Gulf Coast as it headed toward Louisiana. In Louisiana, maximum recorded highest water levels were exceeded at South Pass (3.21 ft above MLLW) and Cocodrie (6.87 ft above MLLW) even before the gauges were inundated. However, the historical maximums are from relatively short time periods. The Hurricane Andrew maximum elevation at Grand Isle, the station closest to the storm track, was 1.0 ft below the historical maximum recorded in October 1985.

Further information on tidal datums, storm surge, and time series analyses from the staions listed in this report and from other NOS stations can be obtained from:

NOAA/National Ocean Service
Office of Ocean and Earth Sciences
Ocean and Lake Levels Division
Products and User Services Section, N/OES23
6001 Executive Blvd.
Rockville, MD 20852

Telephone: (301) 443-8467
Fax: (301) 443-1920

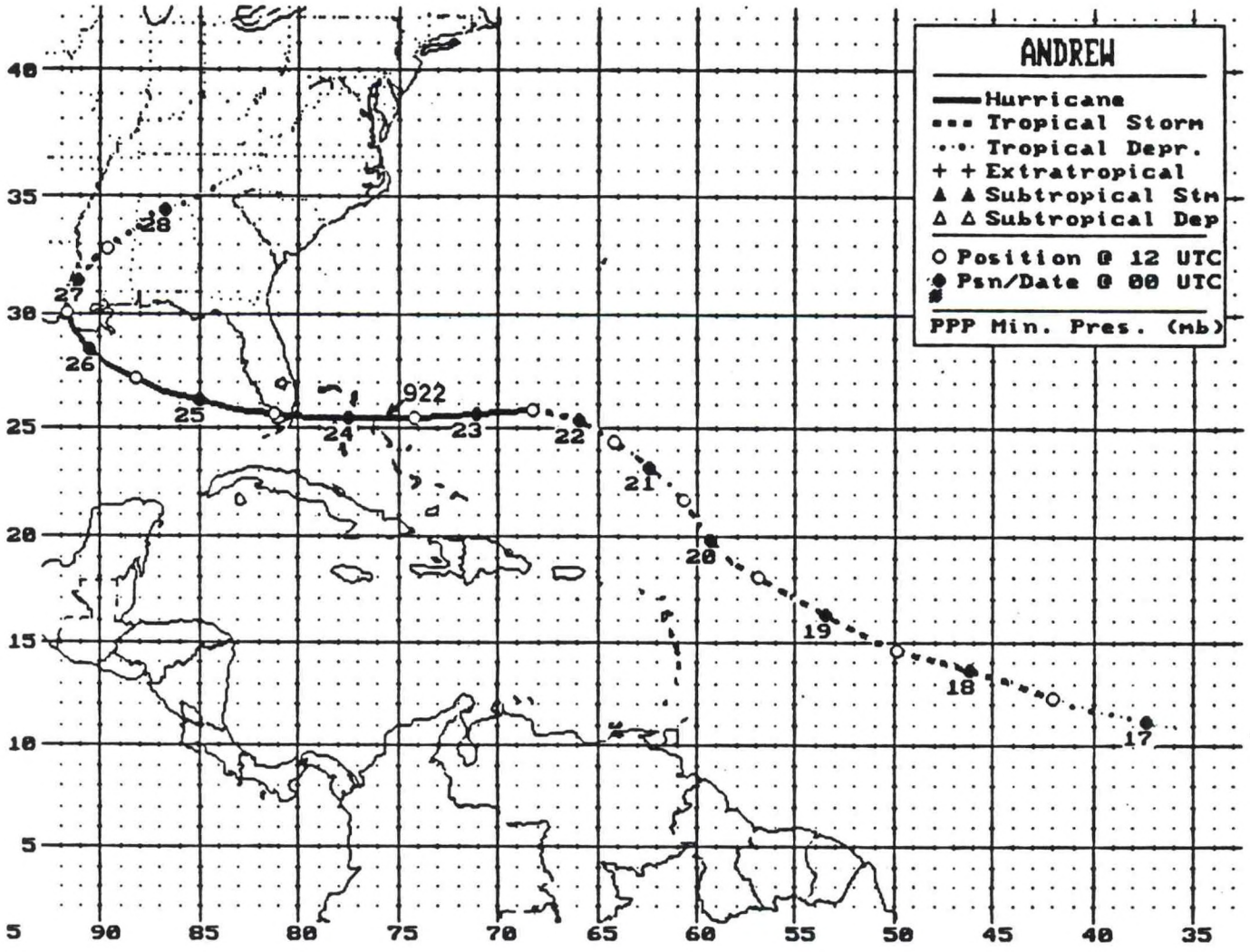
ACKNOWLEDGEMENTS

This report represents the cumulative efforts of Ocean and Lake Levels Division personnel. We would like to acknowledge the support of Measurement Branch personnel, who are responsible for the operation and maintenance of the water level stations; and, Tidal Analysis Branch and Products and Services Branch personnel, who are responsible for the processing and analysis of the data and input into the preparation of this report.

APPENDIX A

Storm Track Plot from National Weather Service Preliminary Report

Daily Weather Maps for August 23-29, 1992 from the National Weather Service



Best track positions for Hurricane Andrew

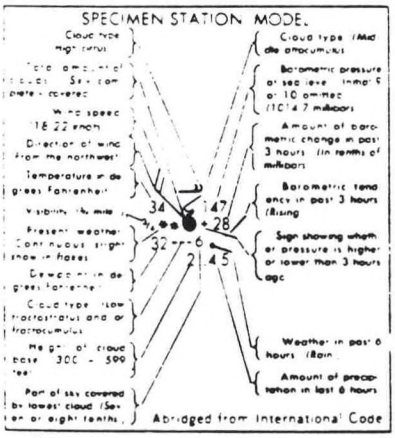
National Oceanic and Atmospheric Administration • National Weather Service • National Meteorological Center
Meteorological Operations Division & Climate Analysis Center

daily weather maps

Weekly Series **AUGUST 24 – 30, 1992**

The charts in this publication are the principal charts of the former Weather Bureau publication, "Daily Weather Map." They are the Surface Weather Map, the 500-Millibar Height Contours chart, the Highest and Lowest Temperatures chart, and the Precipitation Areas and Amounts chart. All charts for each day are arranged on a single page. They are derived from operational weather maps prepared by the National Meteorological Center, National Weather Service. The symbols on the Surface Weather Map and the 500-Millibar Height Contours chart are standard international symbols. Copies of an explanatory sheet are available from the Climate Analysis Center (address below). NOAA is responsible for managing, printing, and distributing these maps. The contents may be reprinted freely, with proper credit.

Orders for annual subscriptions and single copies may be sent to Daily Weather Maps, Climate Analysis Center, Room 808 World Weather Building, Washington, D.C. 20233.



For sale by the Climate Analysis Center, Room 808 World Weather Building, Washington, D.C. 20233

The price of the Daily Weather Maps is $60 per year for domestic mailing, $75 per year for foreign mailing and $1.50 for single issues. Only checks or money orders (including international postal money orders), made payable to the Department of Commerce, NOAA, are acceptable.

The Surface Weather Map shows station data and the analysis for 7:00 a.m., EST. Tracks of well-defined low pressure areas are indicated by a chain of arrows; locations of these centers at 6, 12, and 18 hours preceding map time are indicated by small white crosses in black squares. Areas of precipitation are indicated by shading. The weather reports printed here are only a fraction of those on which the analyses are based. Occasional apparent discrepancies between the printed station data and the analyses result from the absence of station reports not included here because of lack of space.

The 500-Millibar Height Contours chart shows height contours and isotherms of the 500-millibar surface at 7:00 a.m., EST. Height contours are shown as continuous lines labeled in dekameters above sea level. Isotherms are shown as dashed lines labeled in degrees Celsius. Arrows show the wind direction and speed at the 500-millibar level.

The Highest and Lowest Temperature chart shows the maximum temperature for the 12-hour period ending 7:00 p.m. EST of the previous day and the minimum temperature for the 12-hour period ending 7:00 a.m. EST. The names of the reporting points are shown on the Surface Weather Map. The maximum temperature is plotted above the station location, and the minimum temperature is plotted below.

The Precipitation Areas and Amounts chart shows areas (shaded) that had precipitation during the 24 hours ending at 7:00 a.m., EST, with amounts to the nearest hundredth of an inch. Incomplete totals are underlined. "T" indicates a trace of precipitation. Dashed lines, in season, show the depth of snow on the ground in inches at 7:00 a.m., EST.

IMMEDIATE U.S. Weather Report

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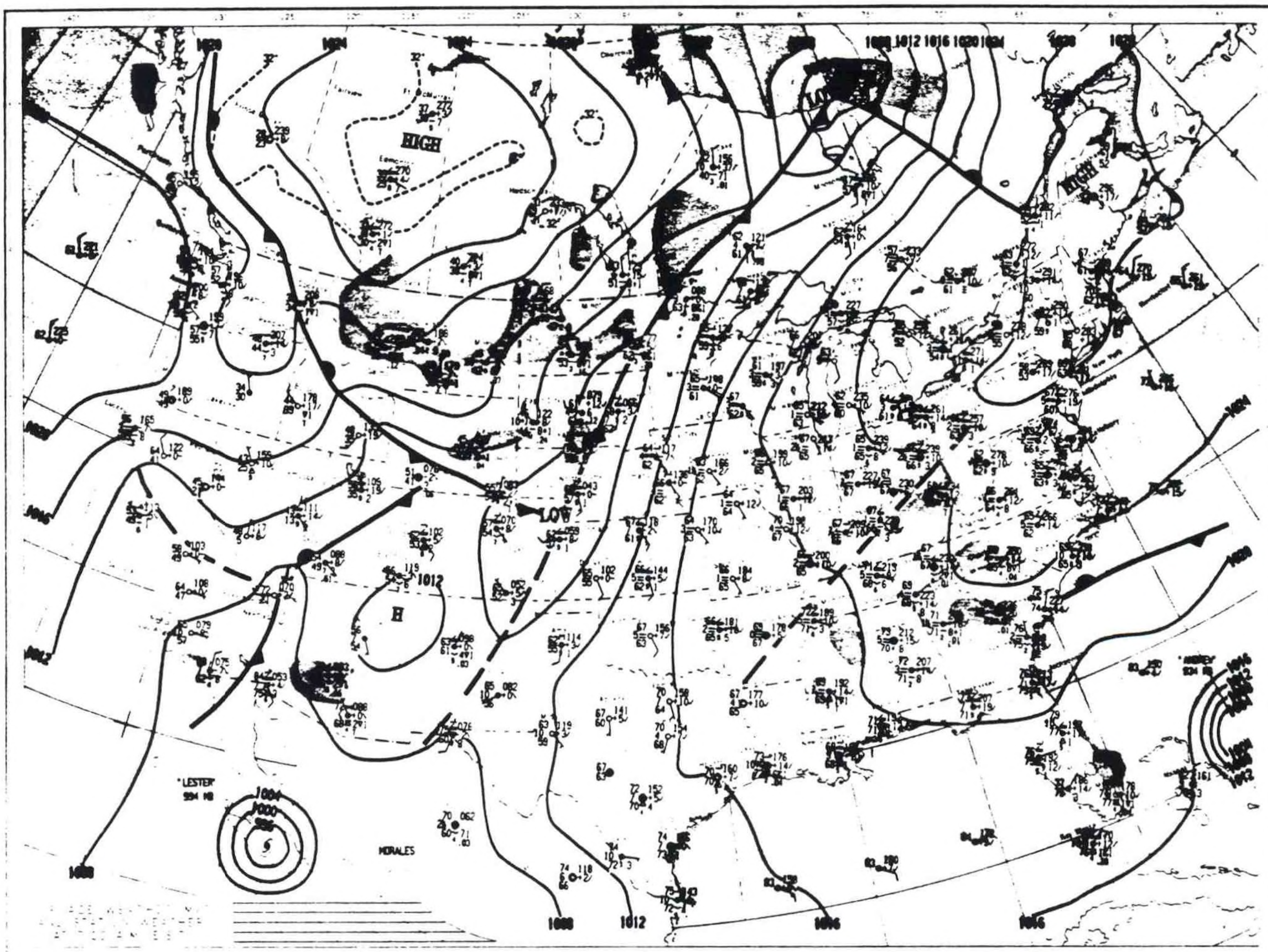
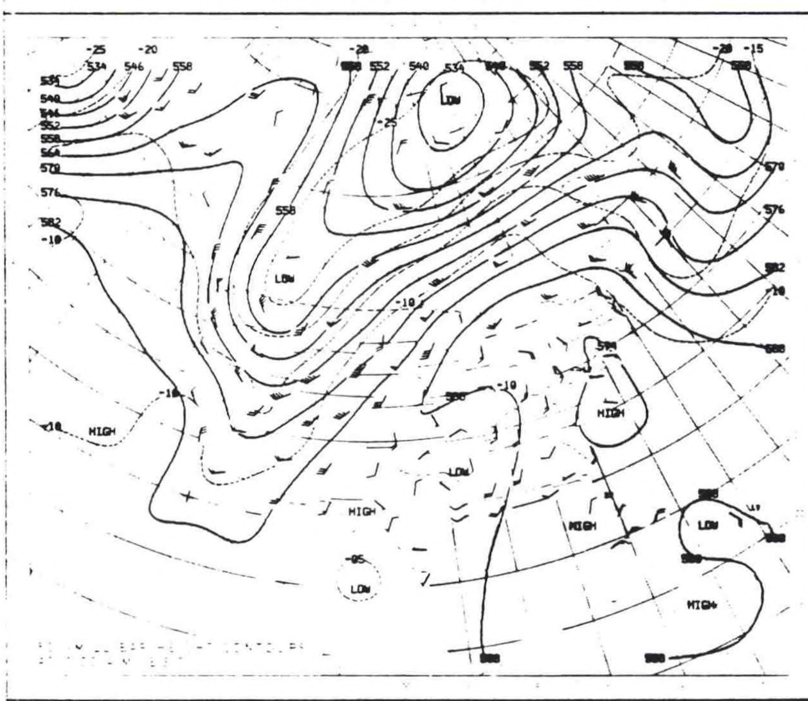
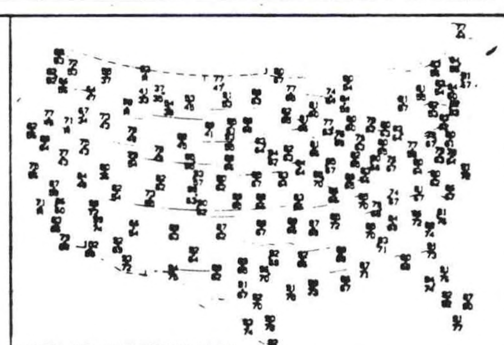
PERMIT NO. G-19

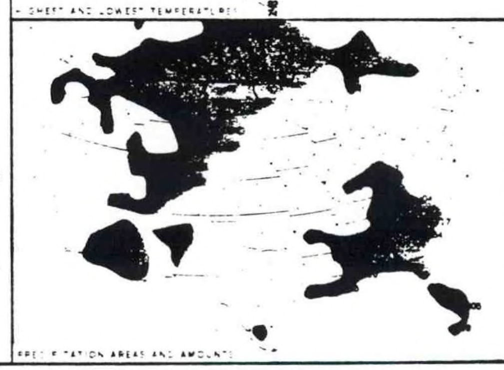
OFFICIAL BUSINESS
NOAA
Daily Weather Maps
Climate Analysis Center
Room 808 World Weather Building
Washington, D.C. 20233

SUNDAY, AUGUST 23, 1992

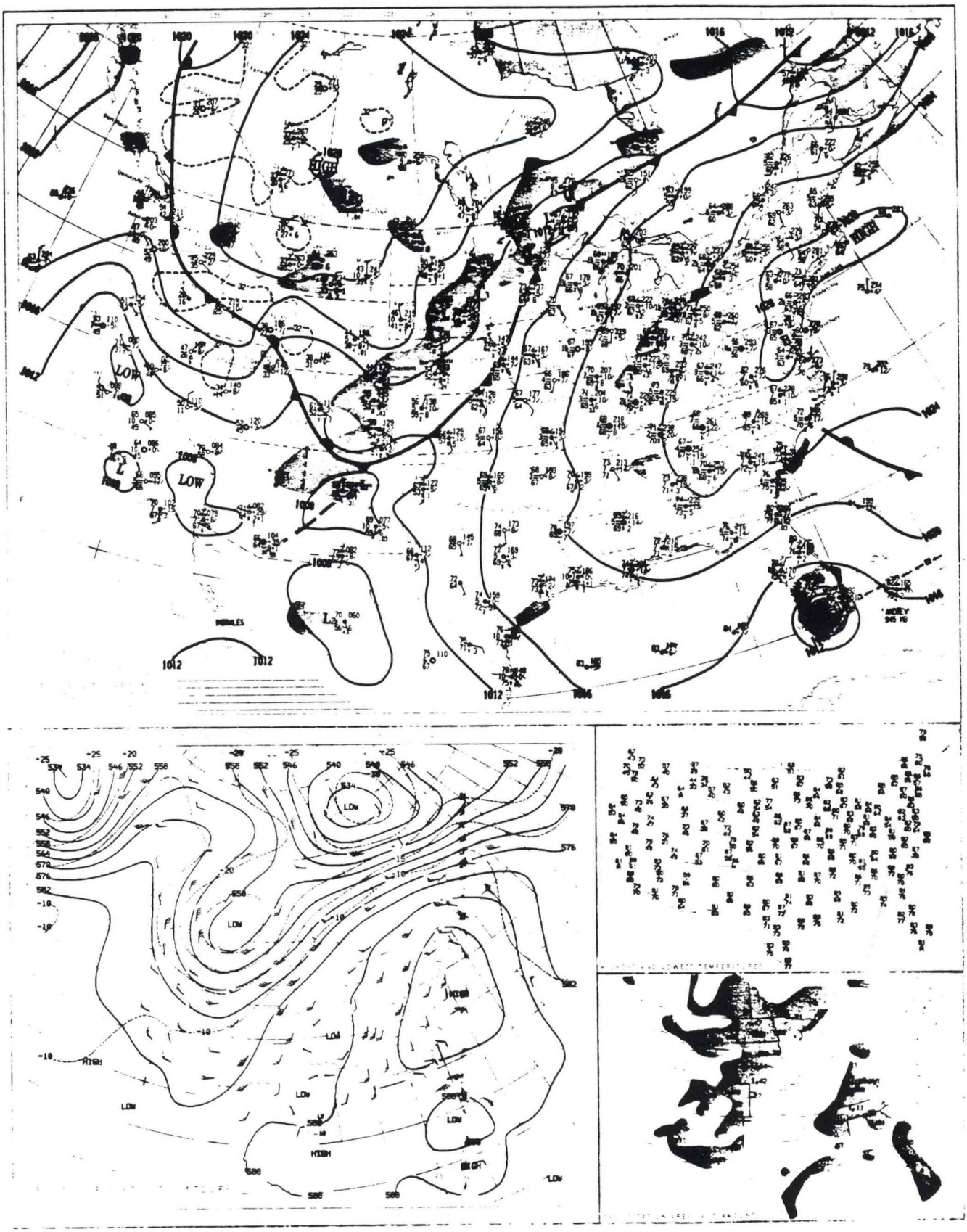




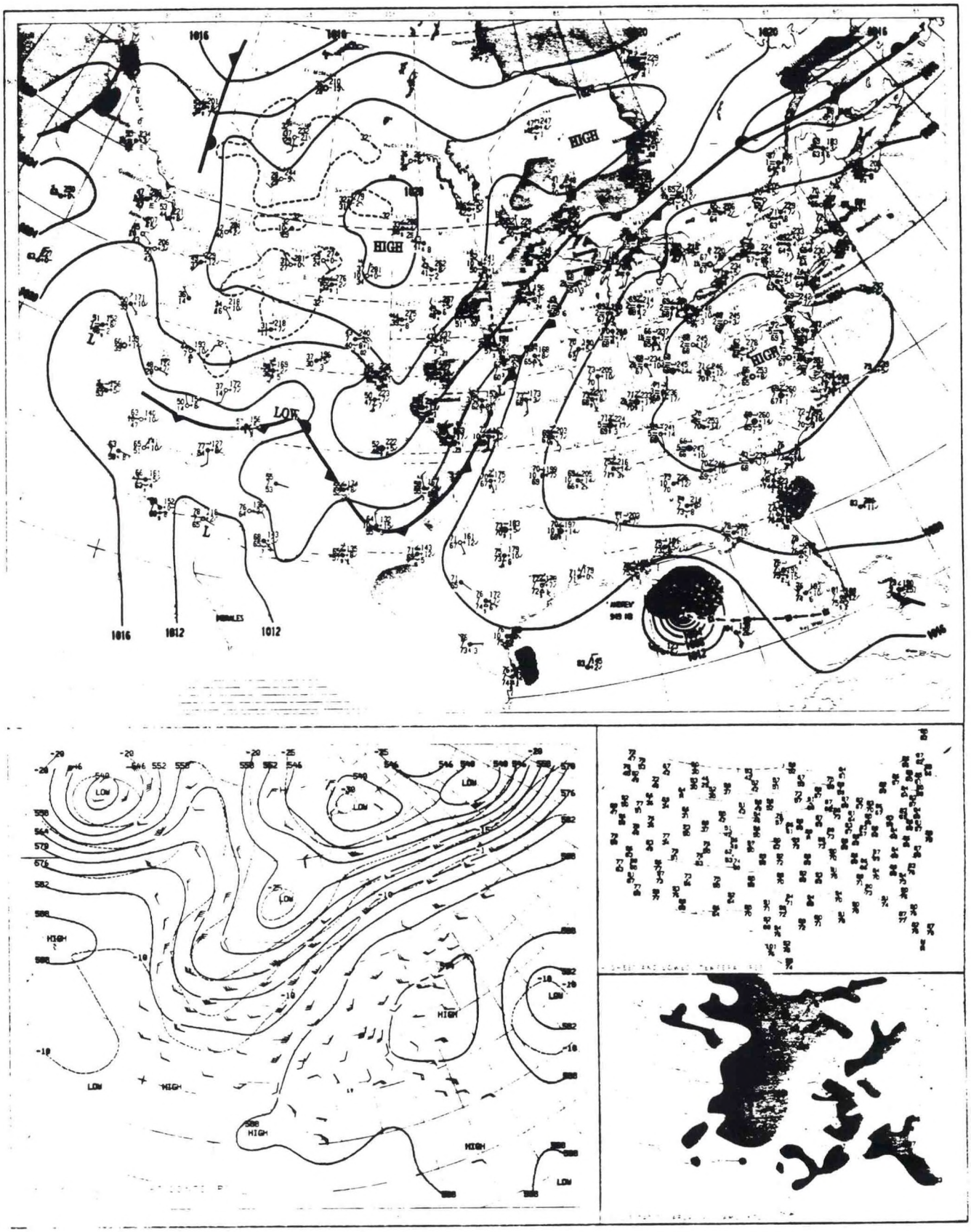




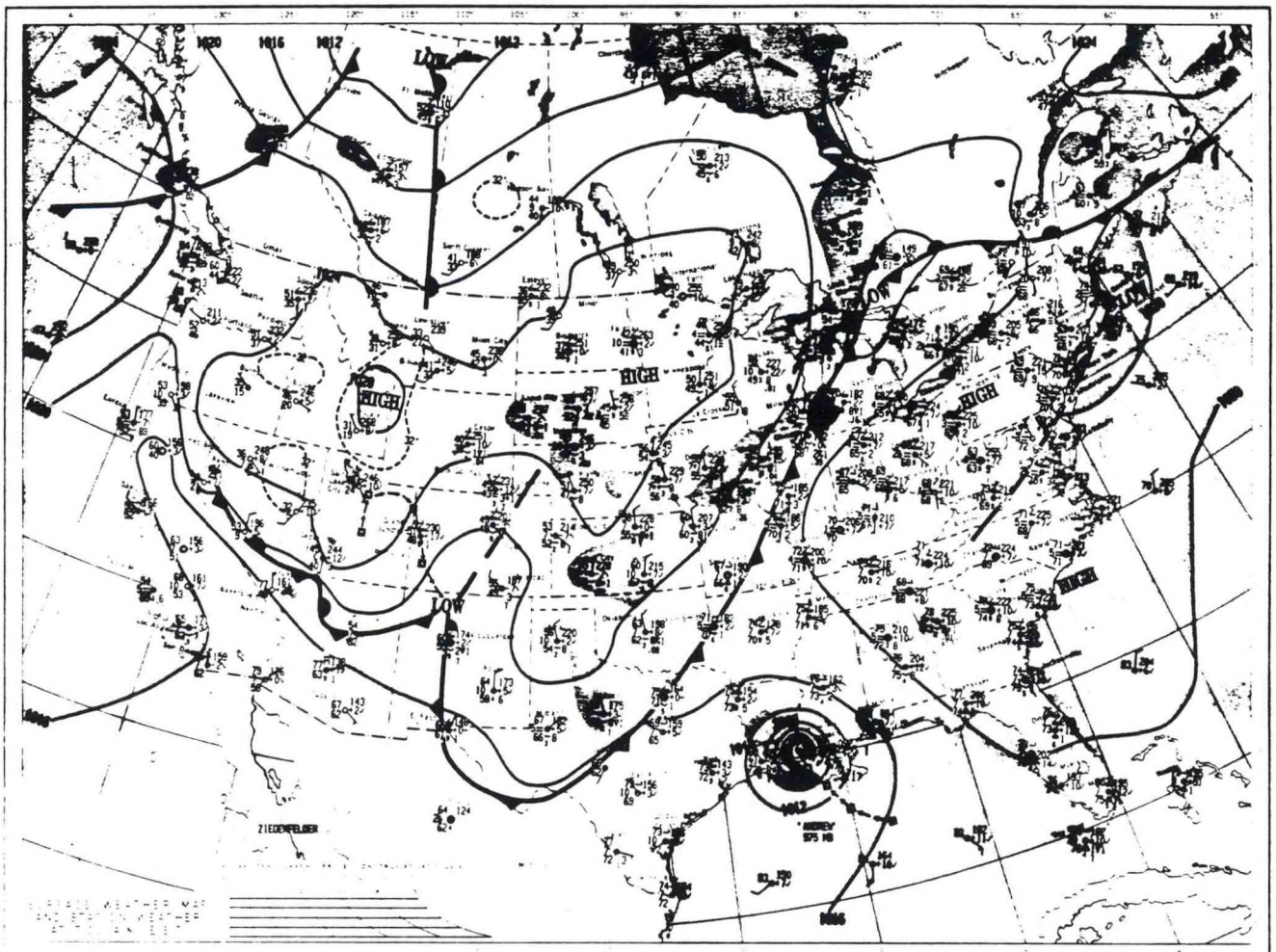
MONDAY, AUGUST 24, 1992

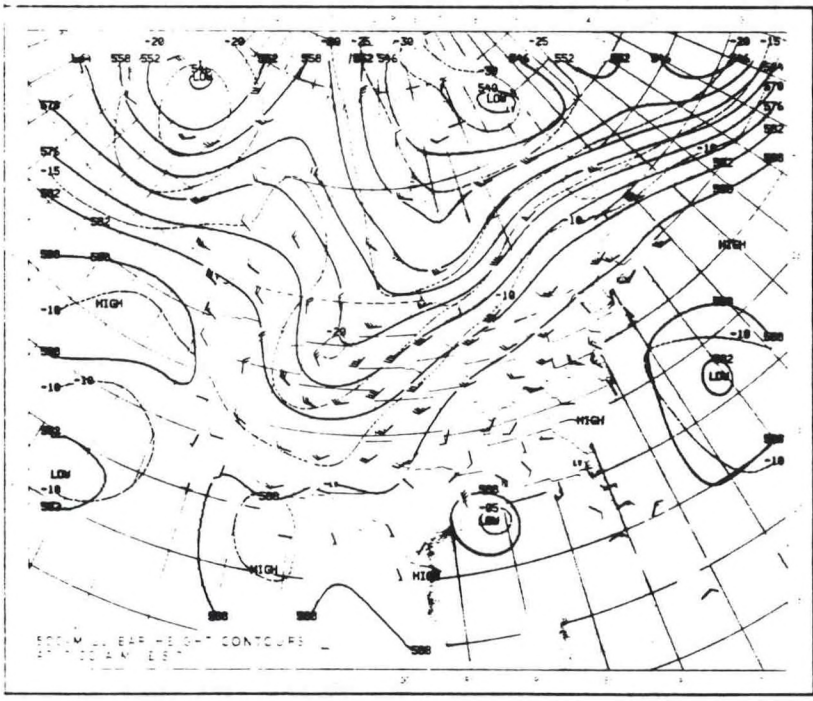


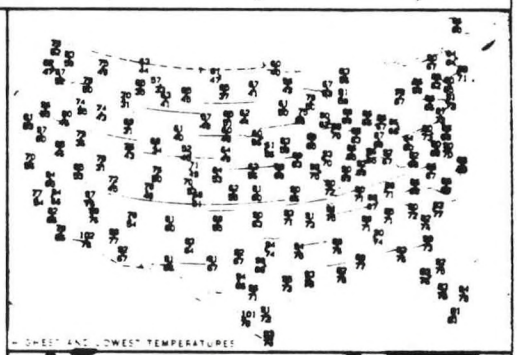
TUESDAY, AUGUST 25, 1992



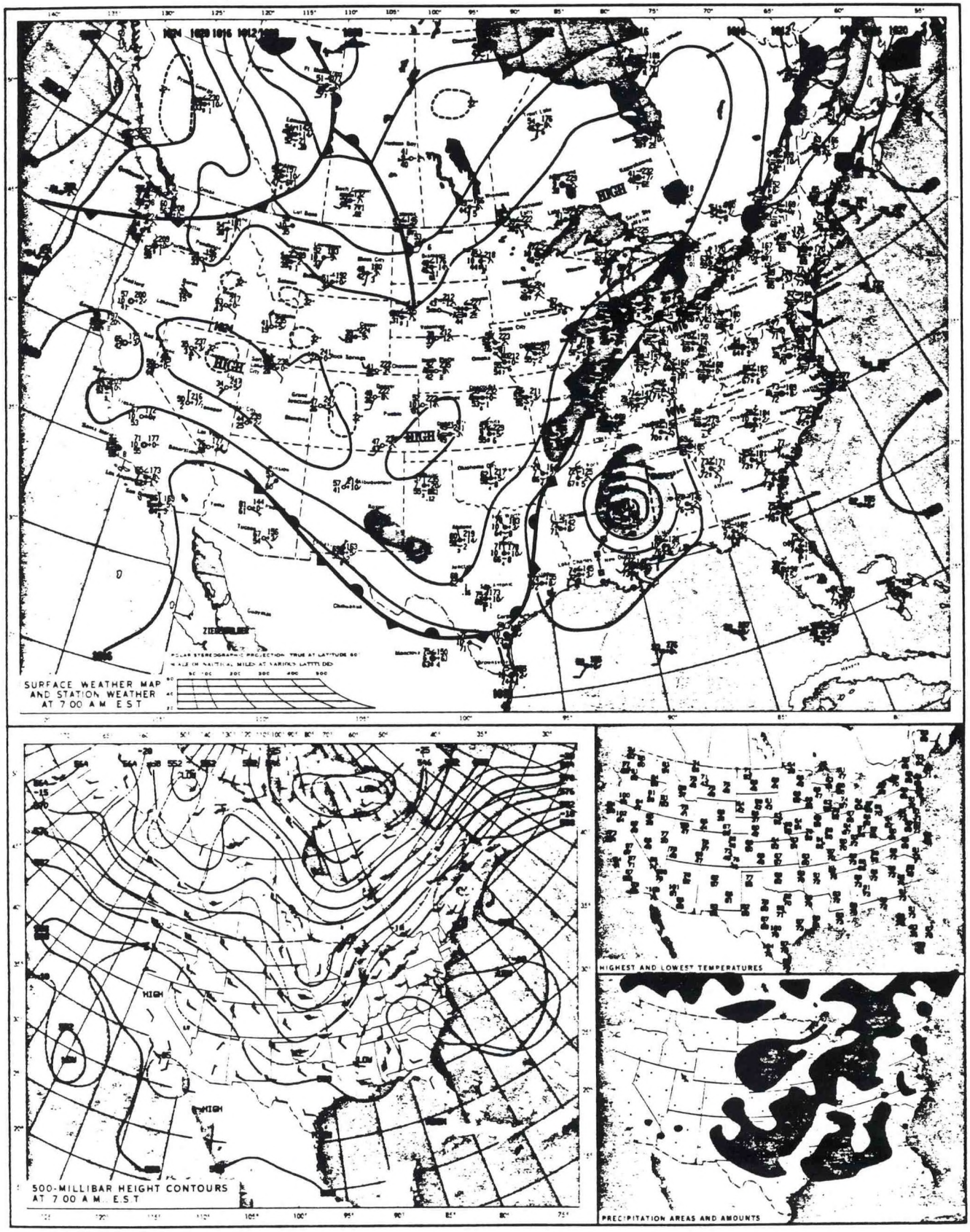
WEDNESDAY, AUGUST 26, 1992



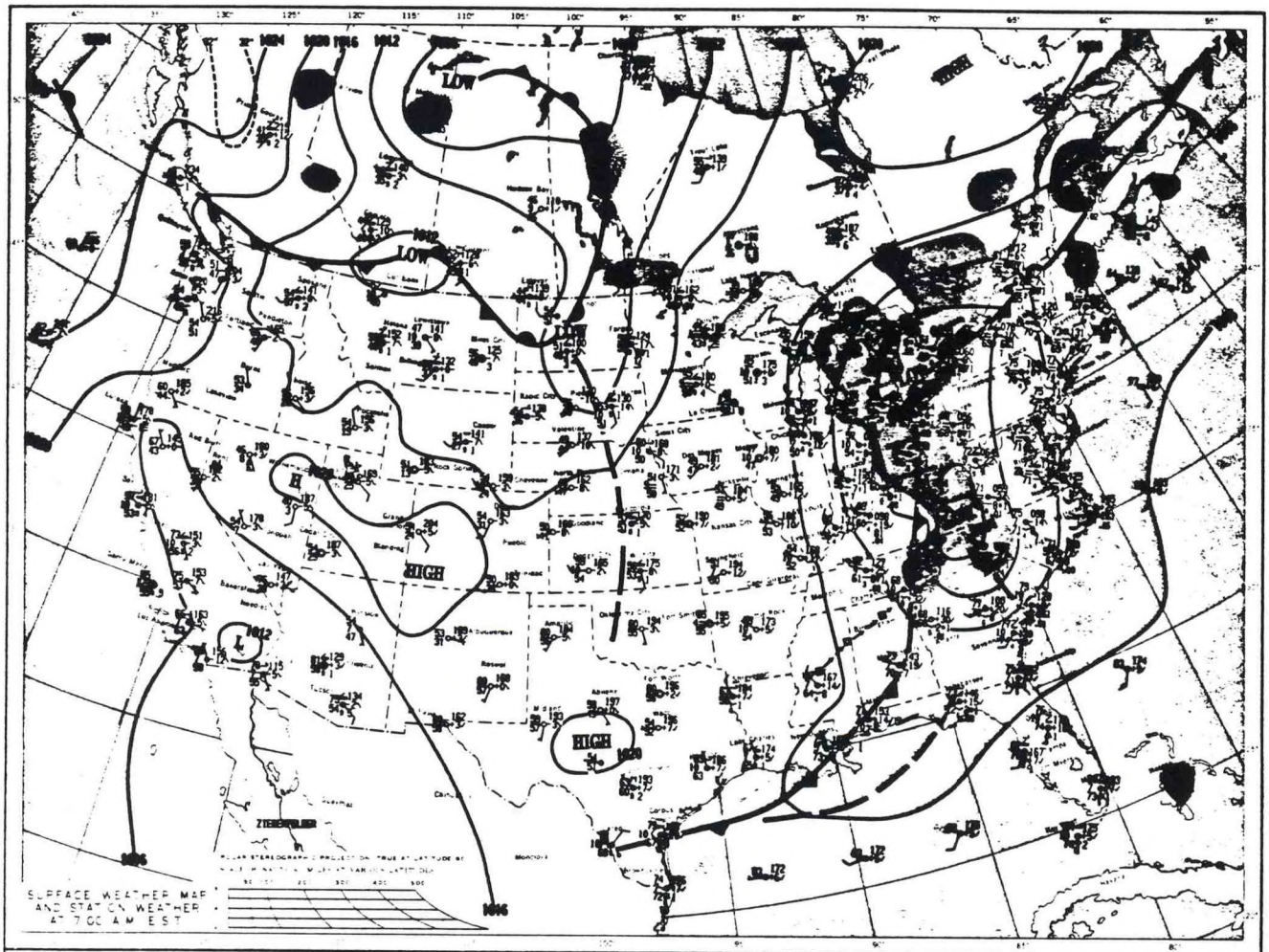


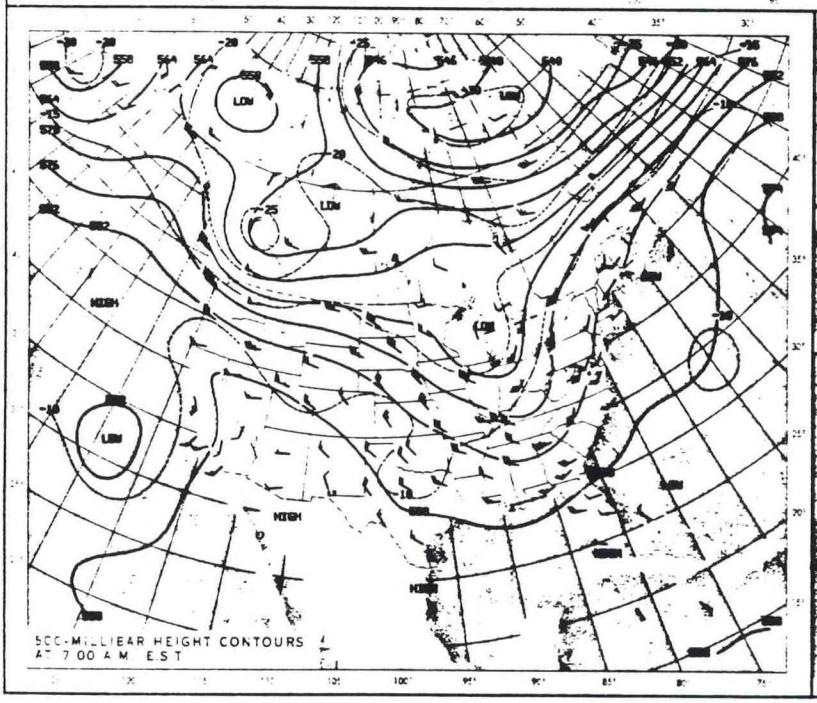


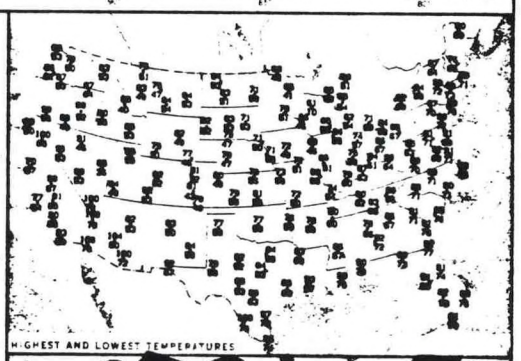
THURSDAY, AUGUST 27, 1992



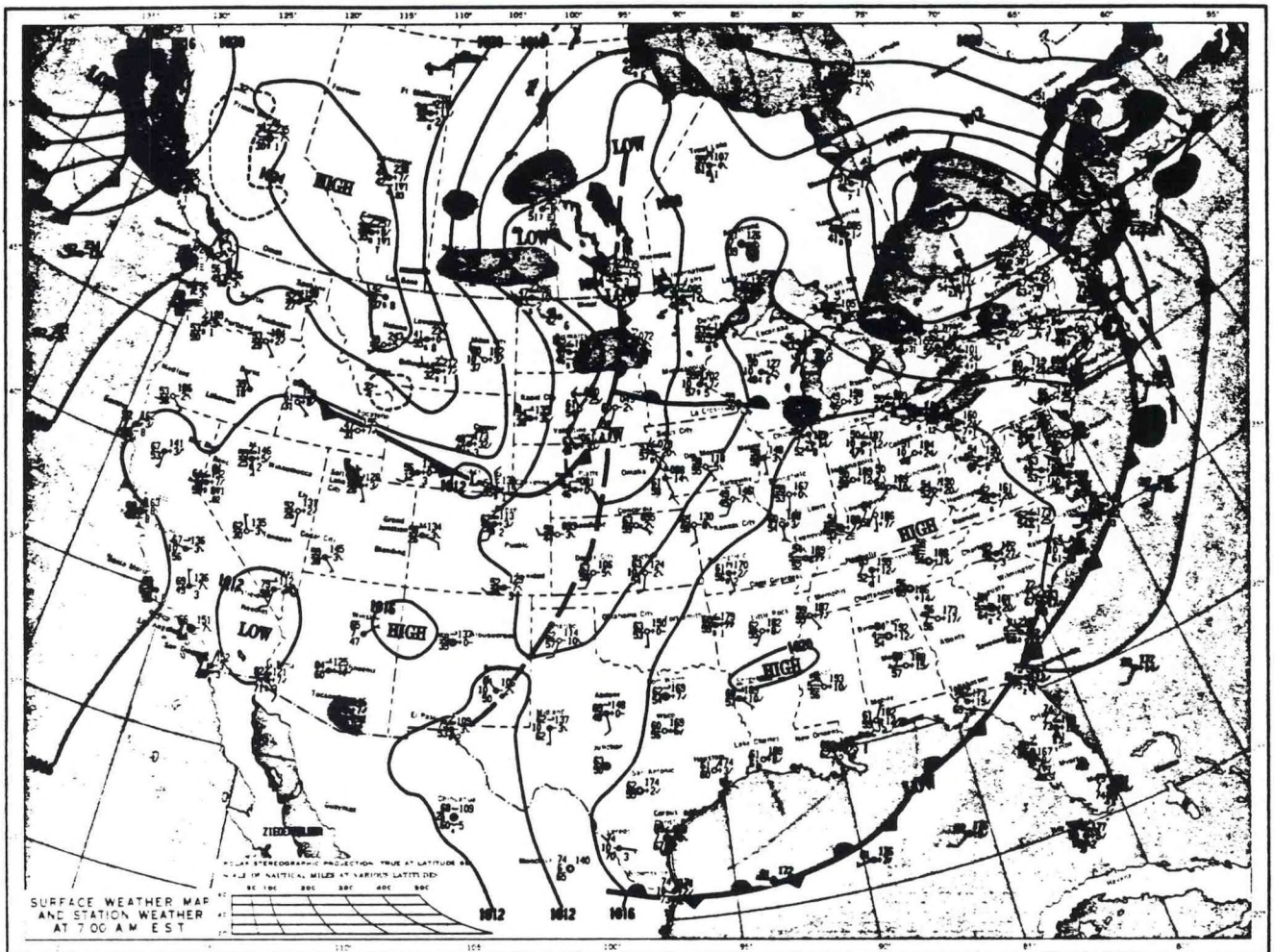
FRIDAY, AUGUST 28, 1992



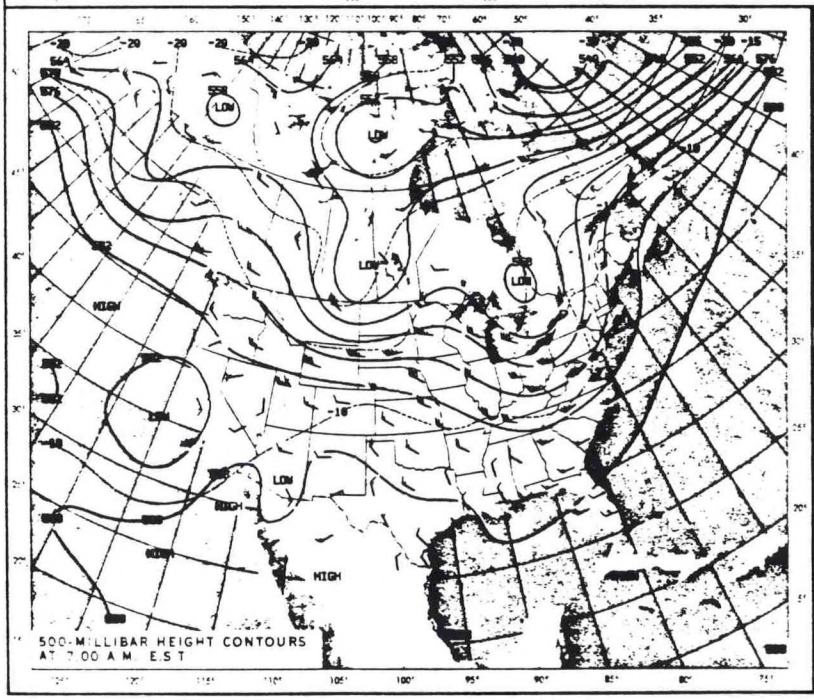




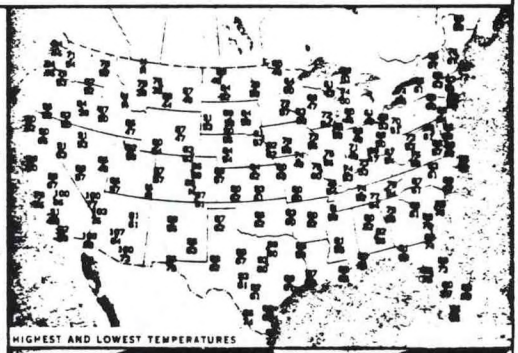
SATURDAY, AUGUST 29, 1992



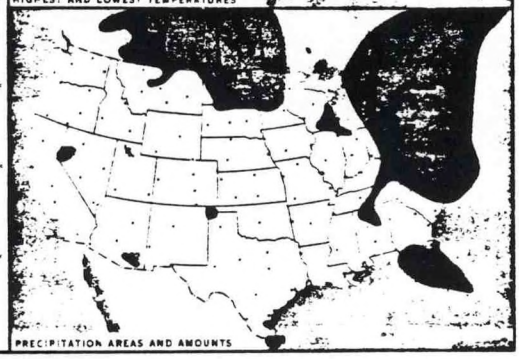
SURFACE WEATHER MAP AND STATION WEATHER AT 7:00 A.M. E.S.T.



500-MILLIBAR HEIGHT CONTOURS AT 7:00 A.M. E.S.T.



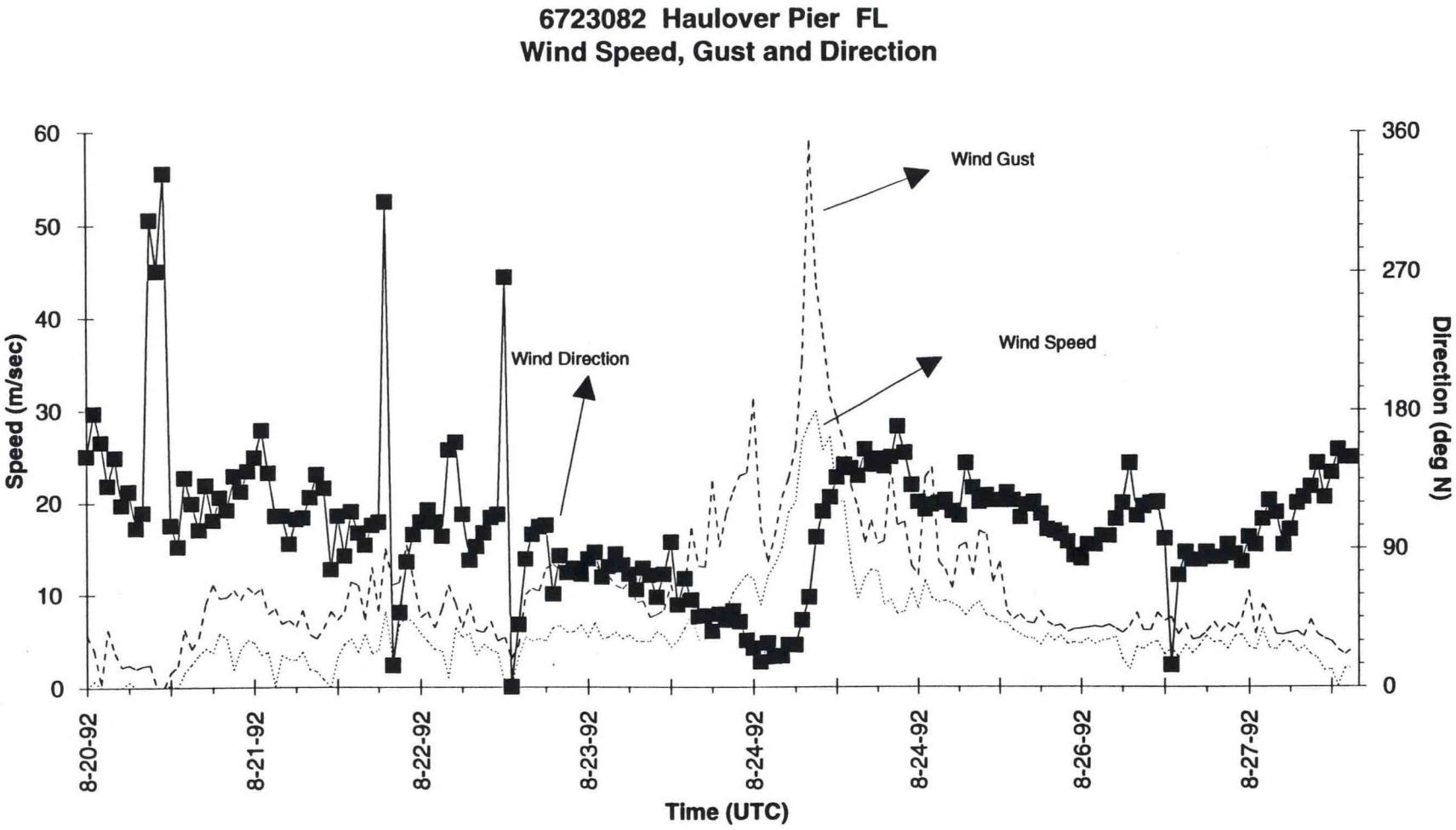
HIGHEST AND LOWEST TEMPERATURES

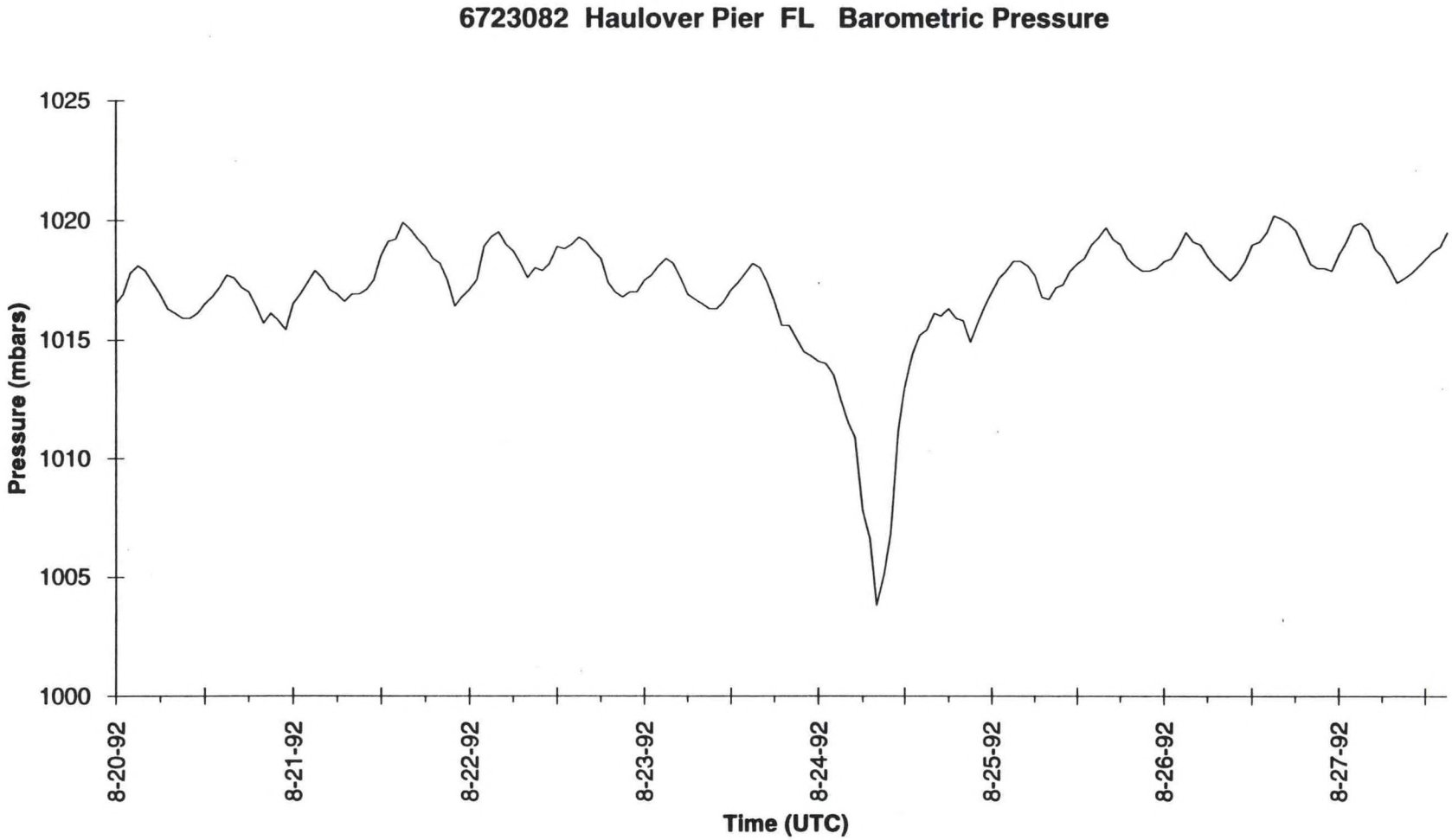


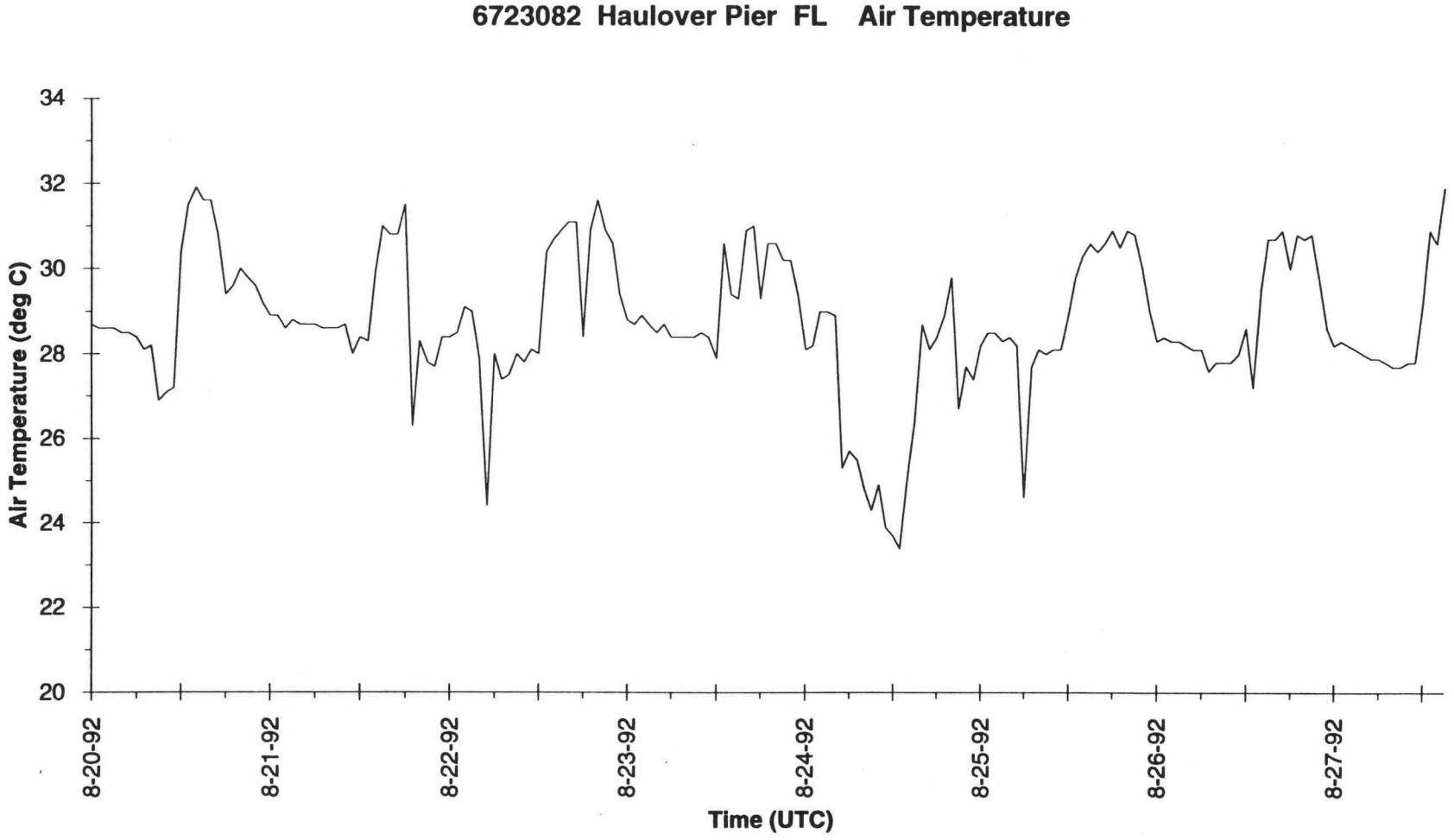
PRECIPITATION AREAS AND AMOUNTS

APPENDIX B

Set of plots of Next Generation Water Levels Measurement System ancillary data for August 20-27, 1992 from Haulover Pier, FL

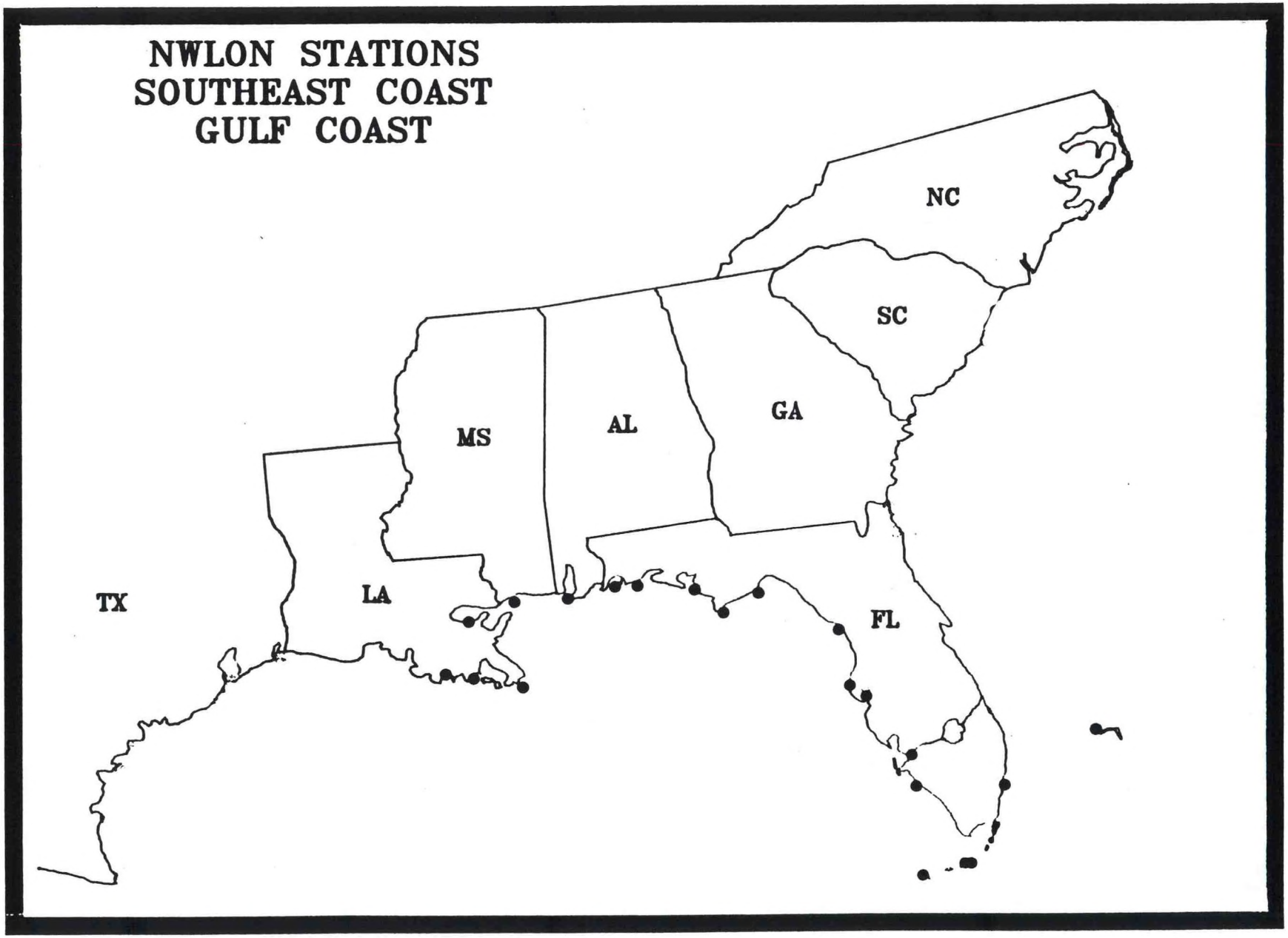

6723082 Haulover Pier FL
Wind Speed, Gust and Direction
Speed (m/sec)
Direction (deg N)
Time (UTC)
Wind Gust
Wind Direction
Wind Speed
60
50
40
30
20
10
0
360
270
180
90
0
8-20-92
8-21-92
8-22-92
8-23-92
8-24-92
8-24-92
8-26-92
8-27-92

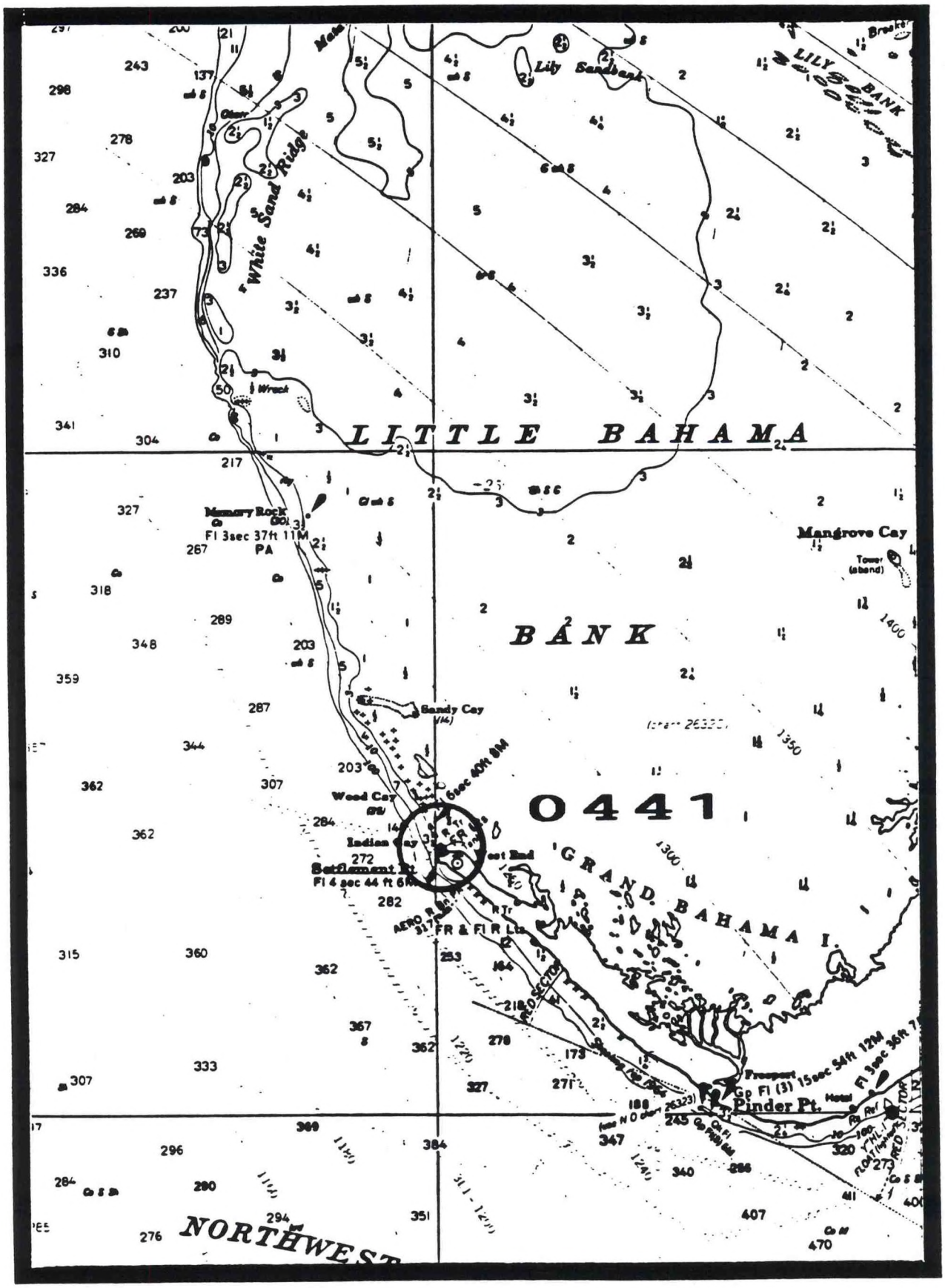

6723082 Haulover Pier FL Barometric Pressure
Pressure (mbars)
1025
1020
1015
1010
1005
1000
8-20-92
8-21-92
8-22-92
8-23-92
8-24-92
8-25-92
8-26-92
8-27-92
Time (UTC)


6723082 Haulover Pier FL Air Temperature
Air Temperature (deg C)
34
32
30
28
26
24
22
20
8-20-92
8-21-92
8-22-92
8-23-92
8-24-92
8-25-92
8-26-92
8-27-92
Time (UTC)

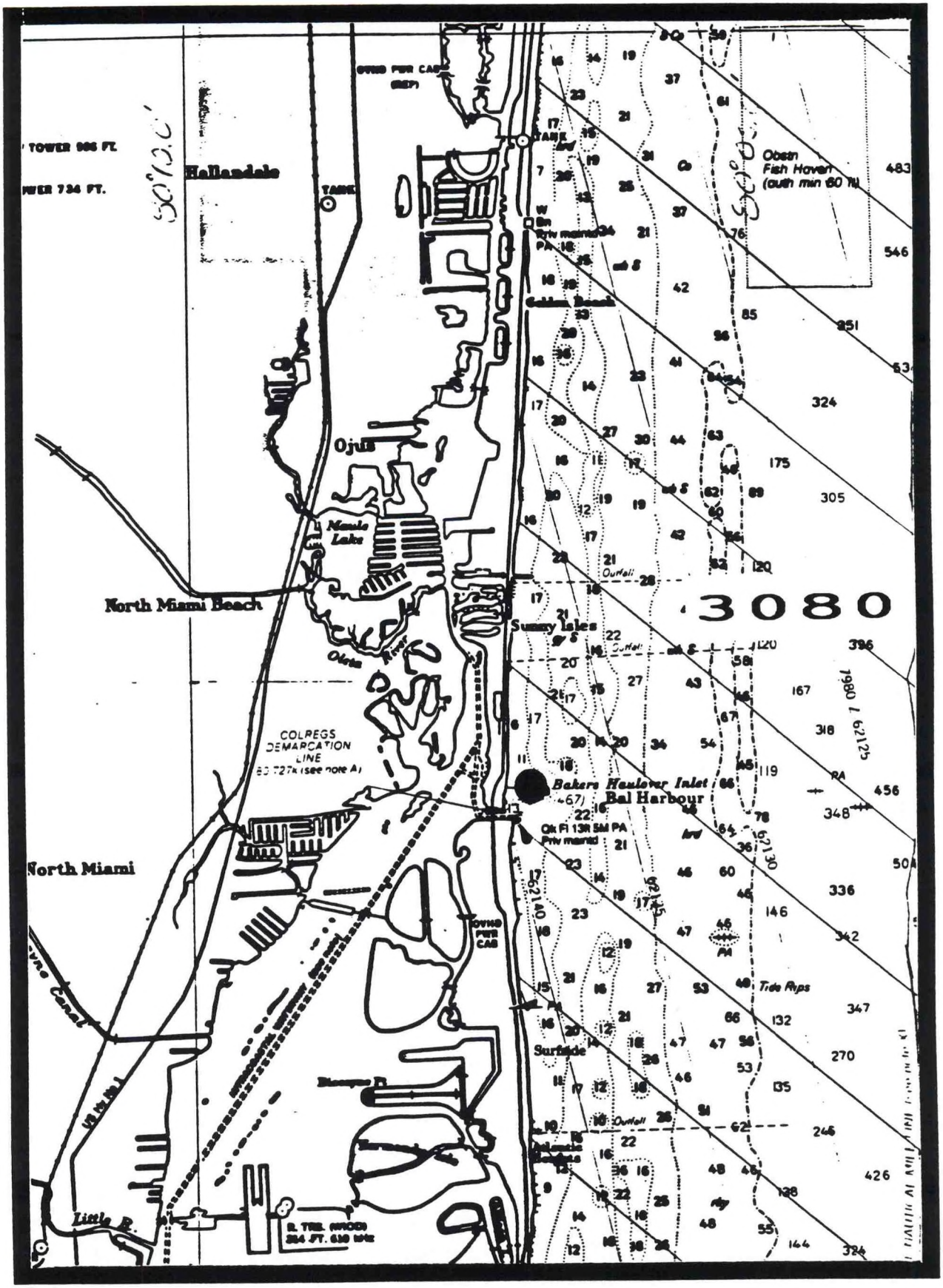
APPENDIX C

Set of National Water Level Observation Network station location chartlets

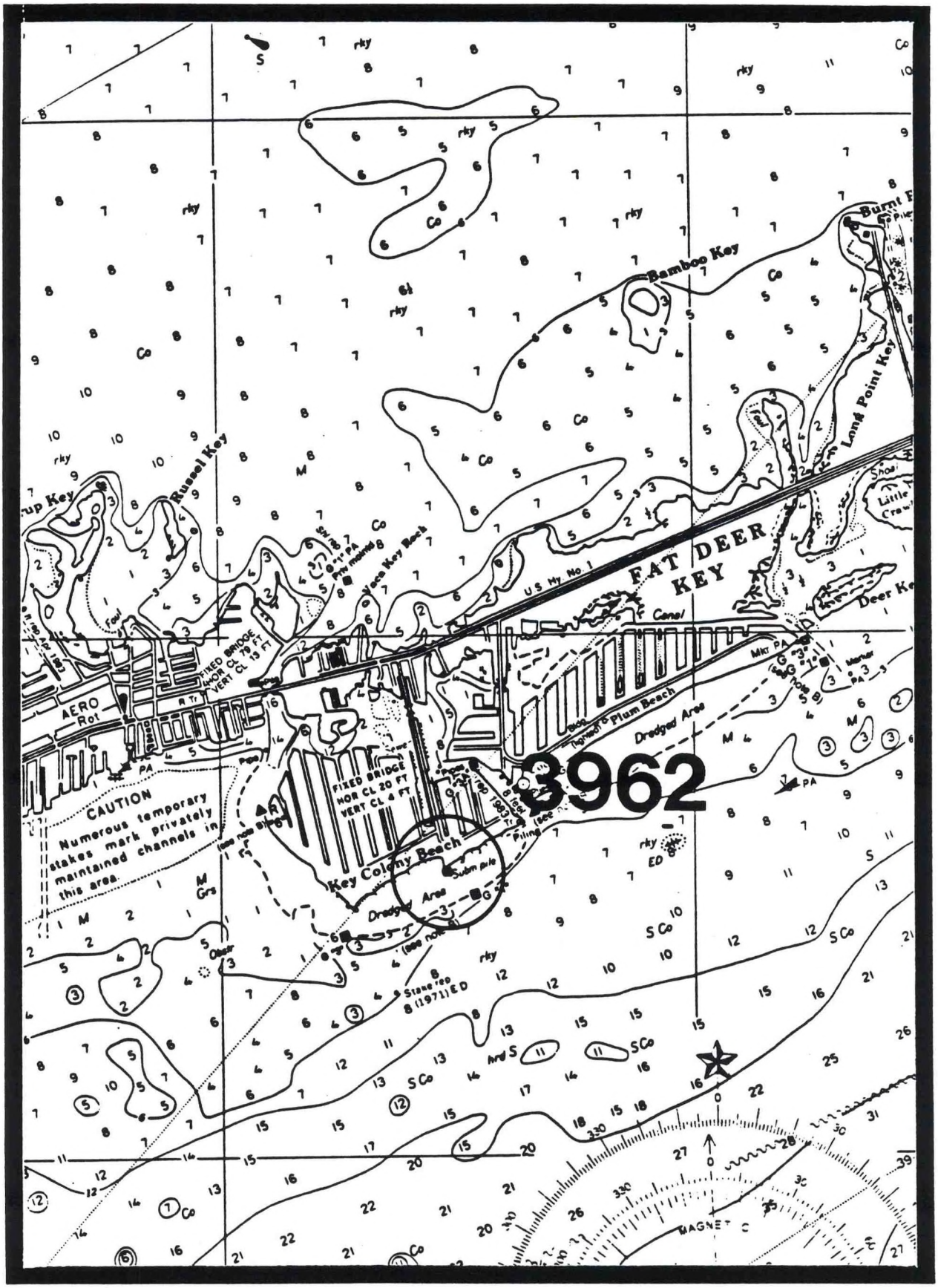

NWLON STATIONS
SOUTHEAST COAST
GULF COAST
NC
SC
GA
AL
MS
LA
TX
FL



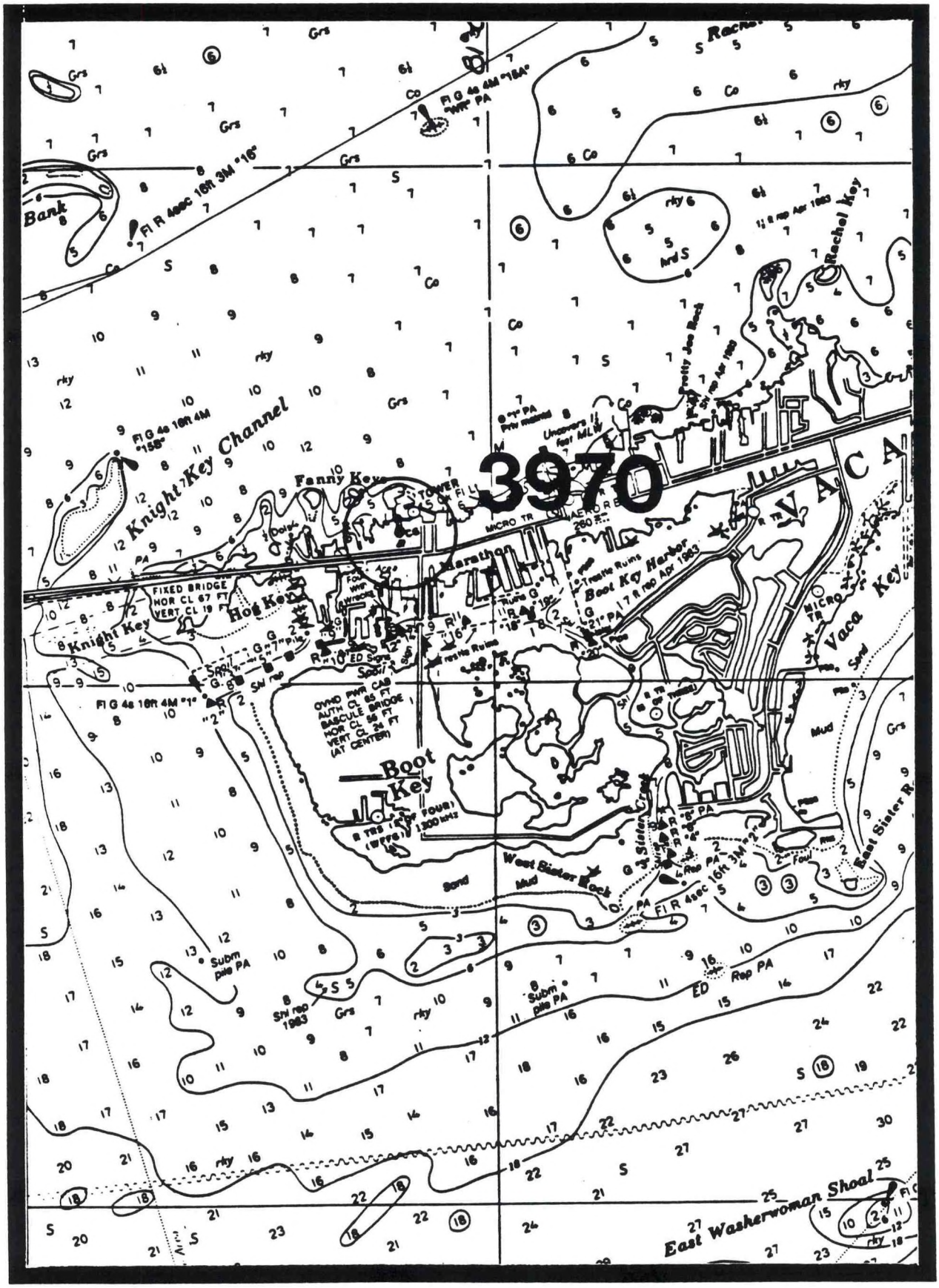
9410441 SETTLEMENT POINT, BA LAT. 26° 42.0'N LON. 79° 0.0'W



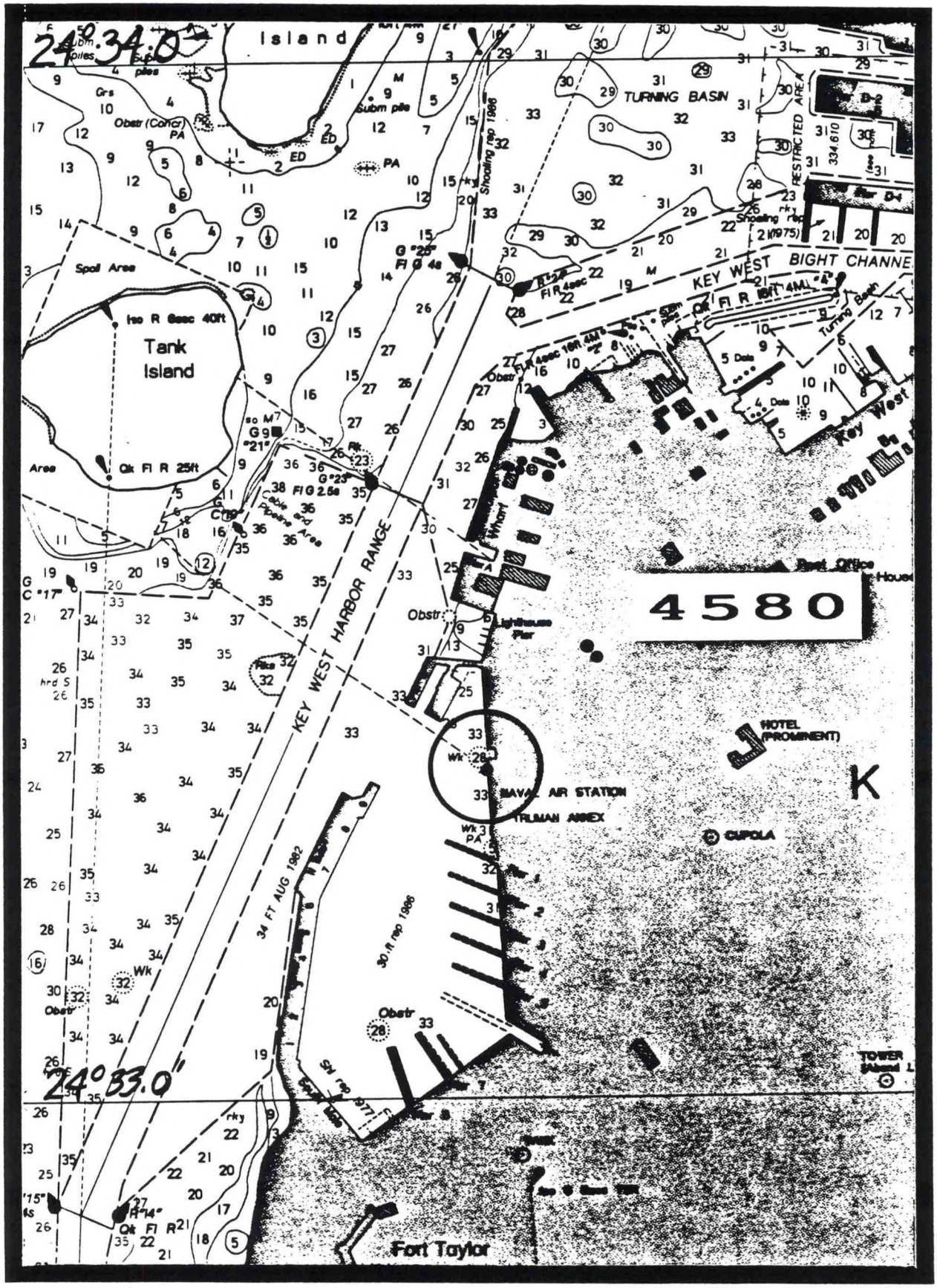
8723080 HAULOVER PIER, FL LAT. 25° 54.2'N LON. 80° 7.2'W



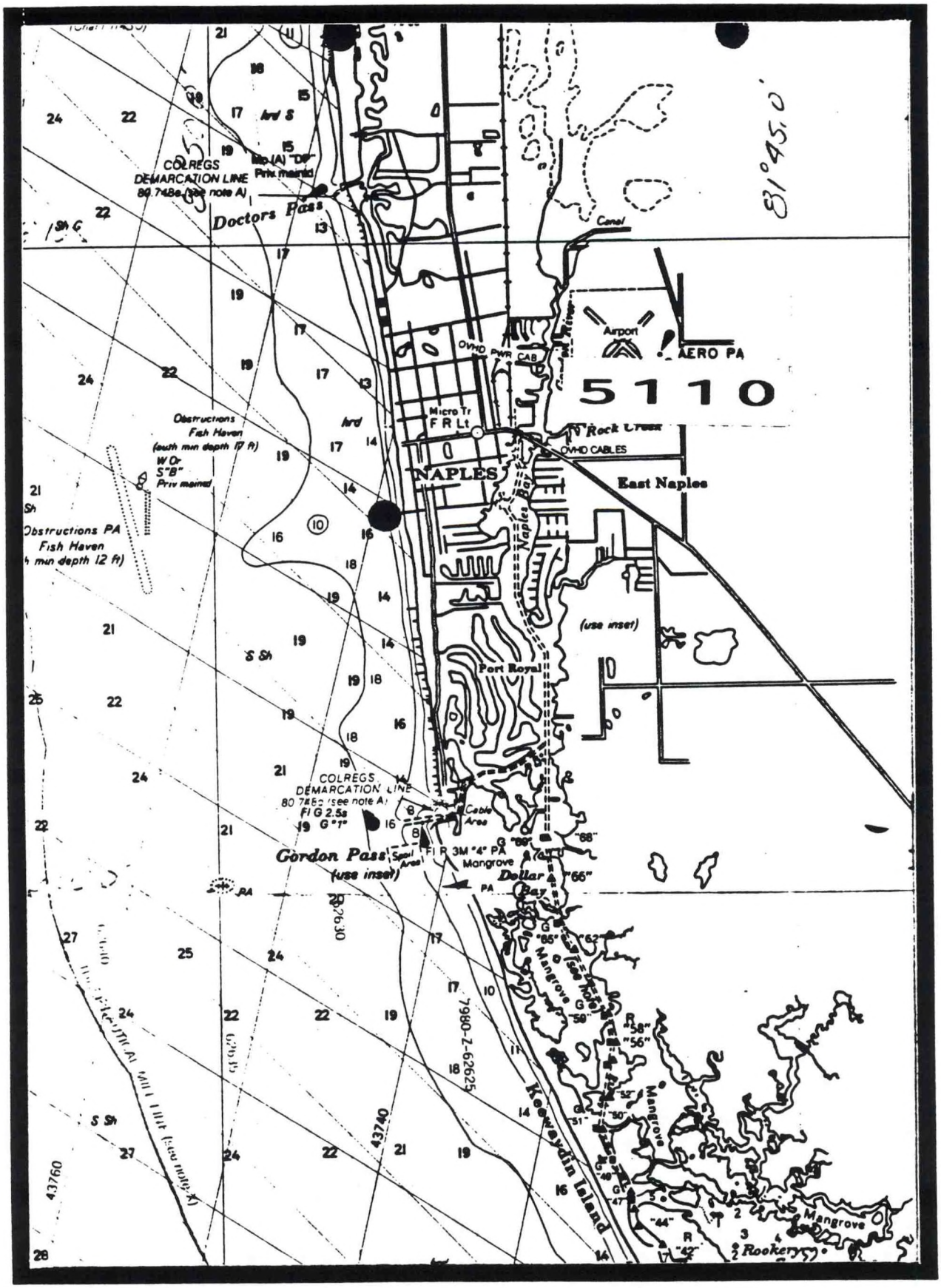
8723962 KEY COLONY BEACH, FL LAT. 24° 43.0'N LON. 81° 1.1'W



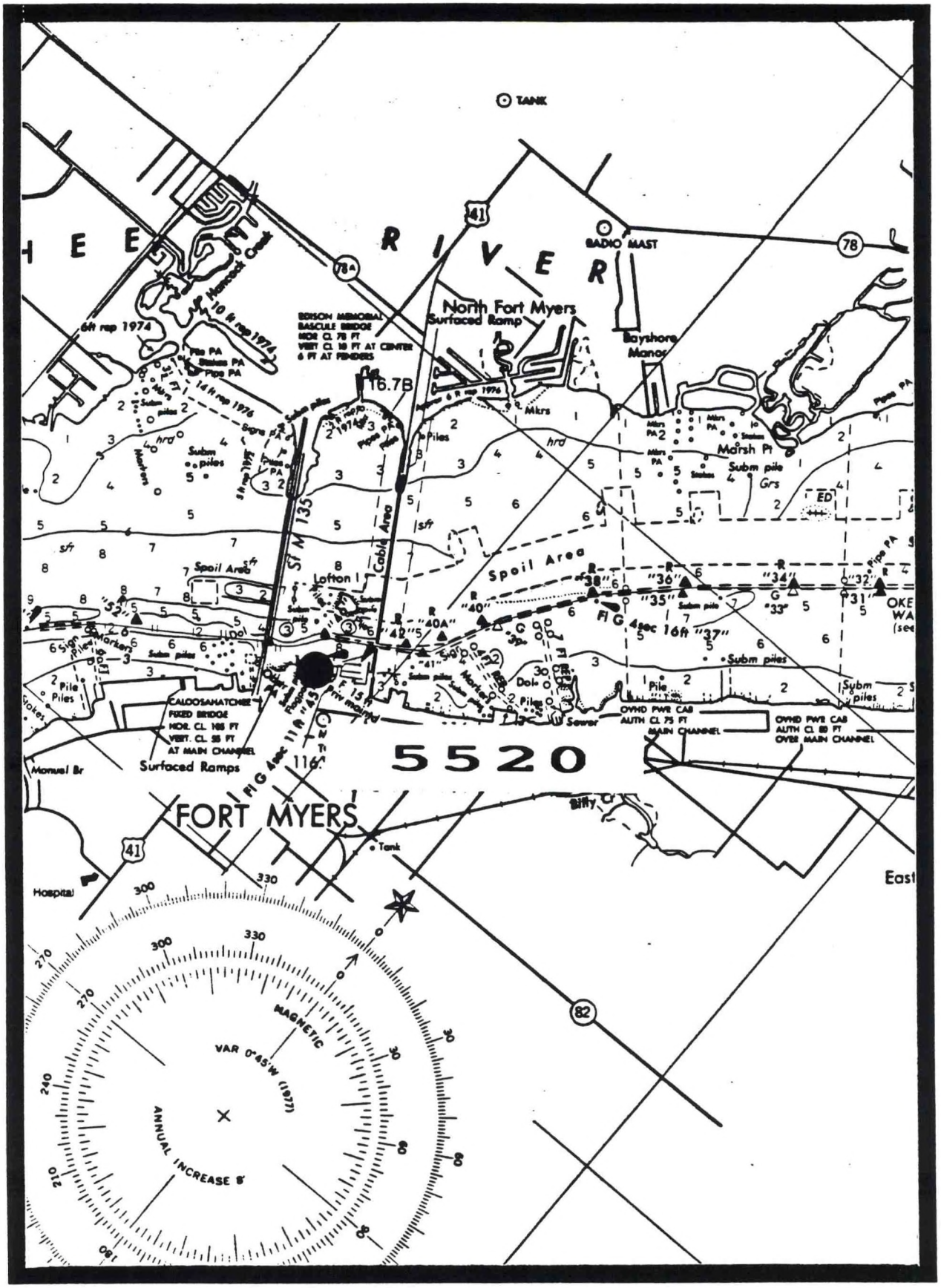
8723970 VACA KEY, FL LAT. 24° 42.7'N LON. 81° 6.3'W



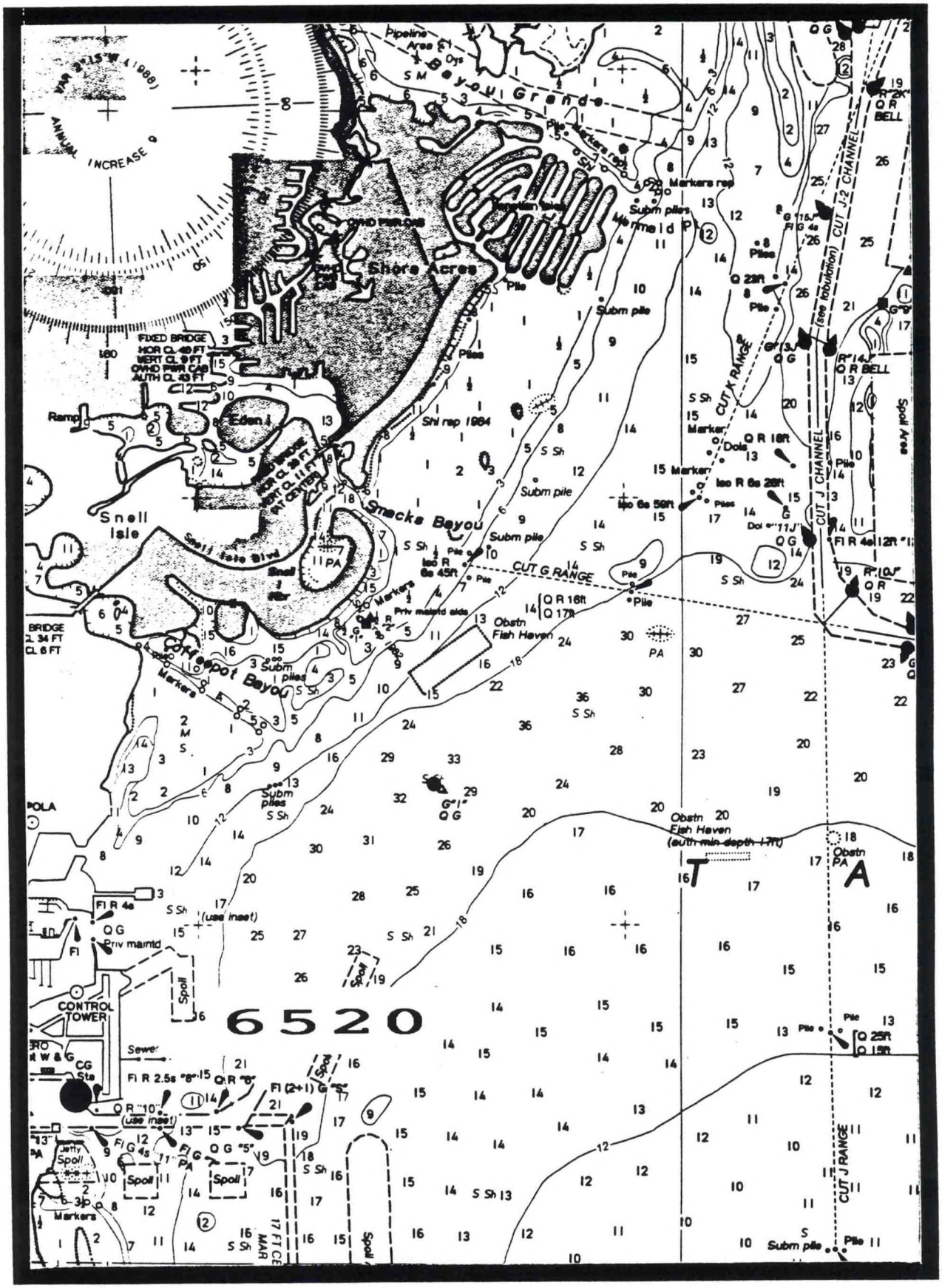
8724580 KEY WEST, FL LAT. 24° 33.2'N LON. 81° 48.5'W



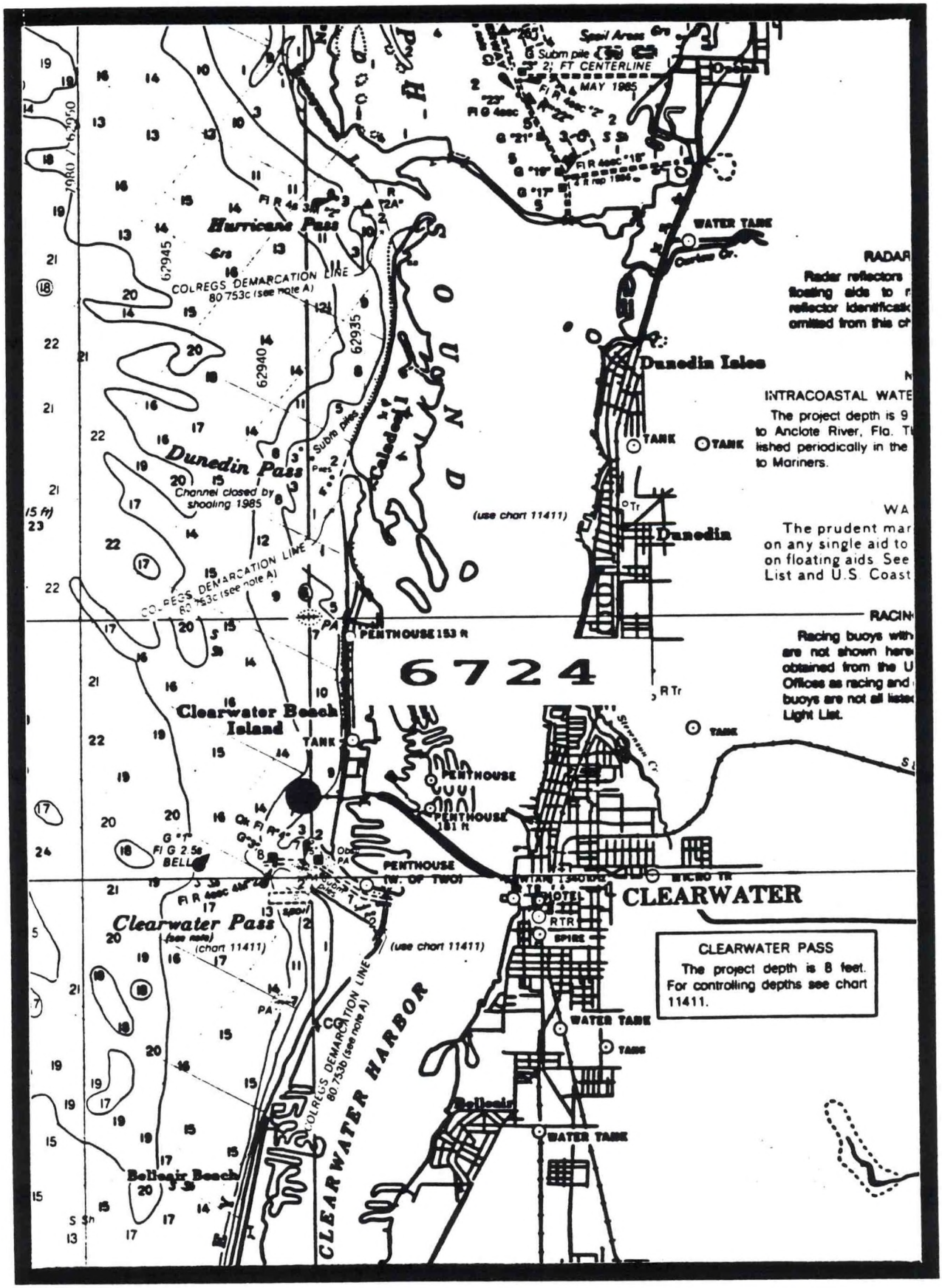
8725110 NAPLES, FL LAT. 26° 7.8'N LON. 81° 48.4'W



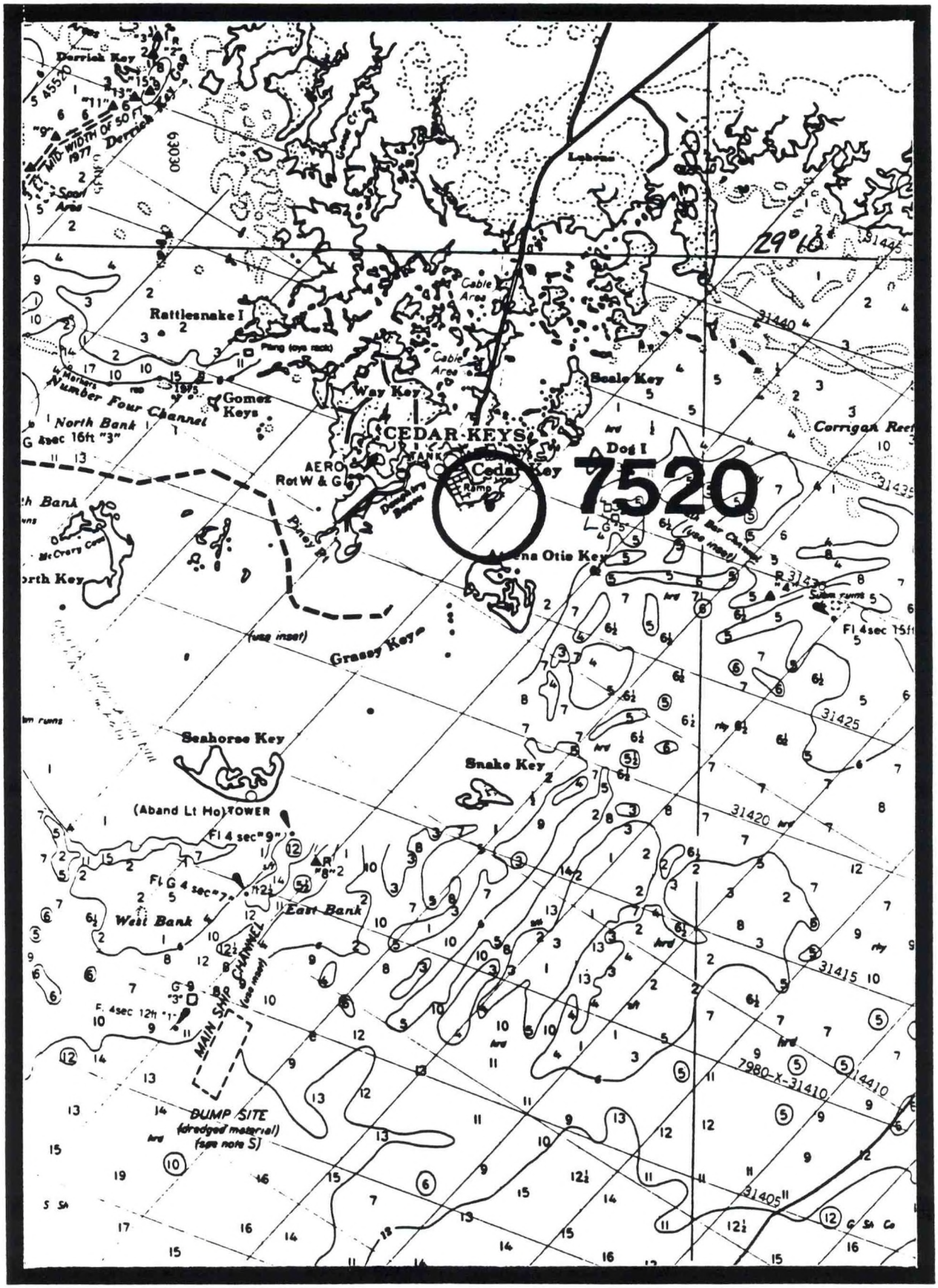
8725520 FORT MYERS, FL LAT. 26° 38.8'N LON. 81° 52.3'W



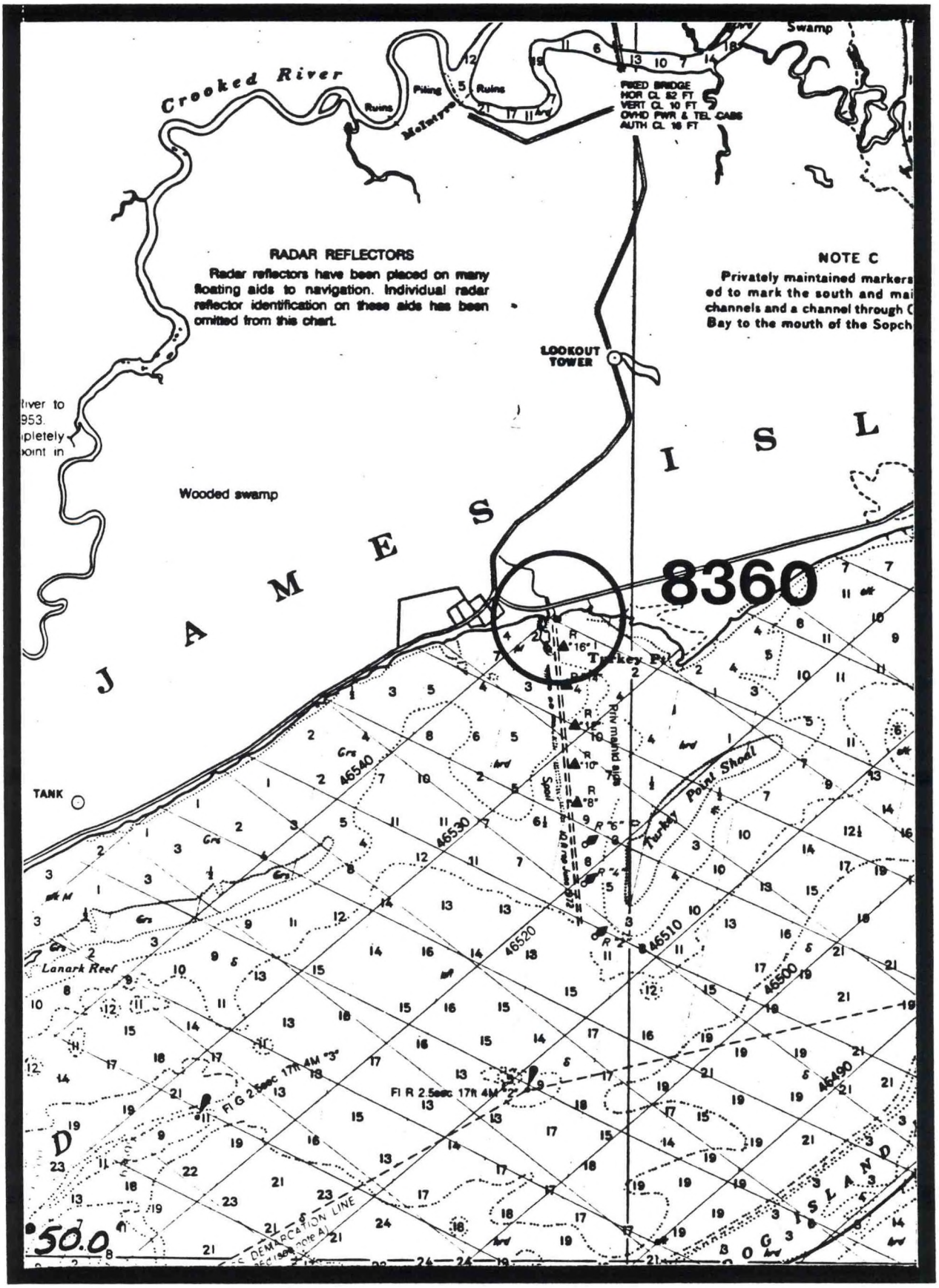
8726520 ST PETERSBURG, FL LAT. 27° 46.4'N LON. 82° 37.3'W



8726724 CLEARWATER BEACH, FL LAT. 27° 58.6'N LON. 82° 49.9'W

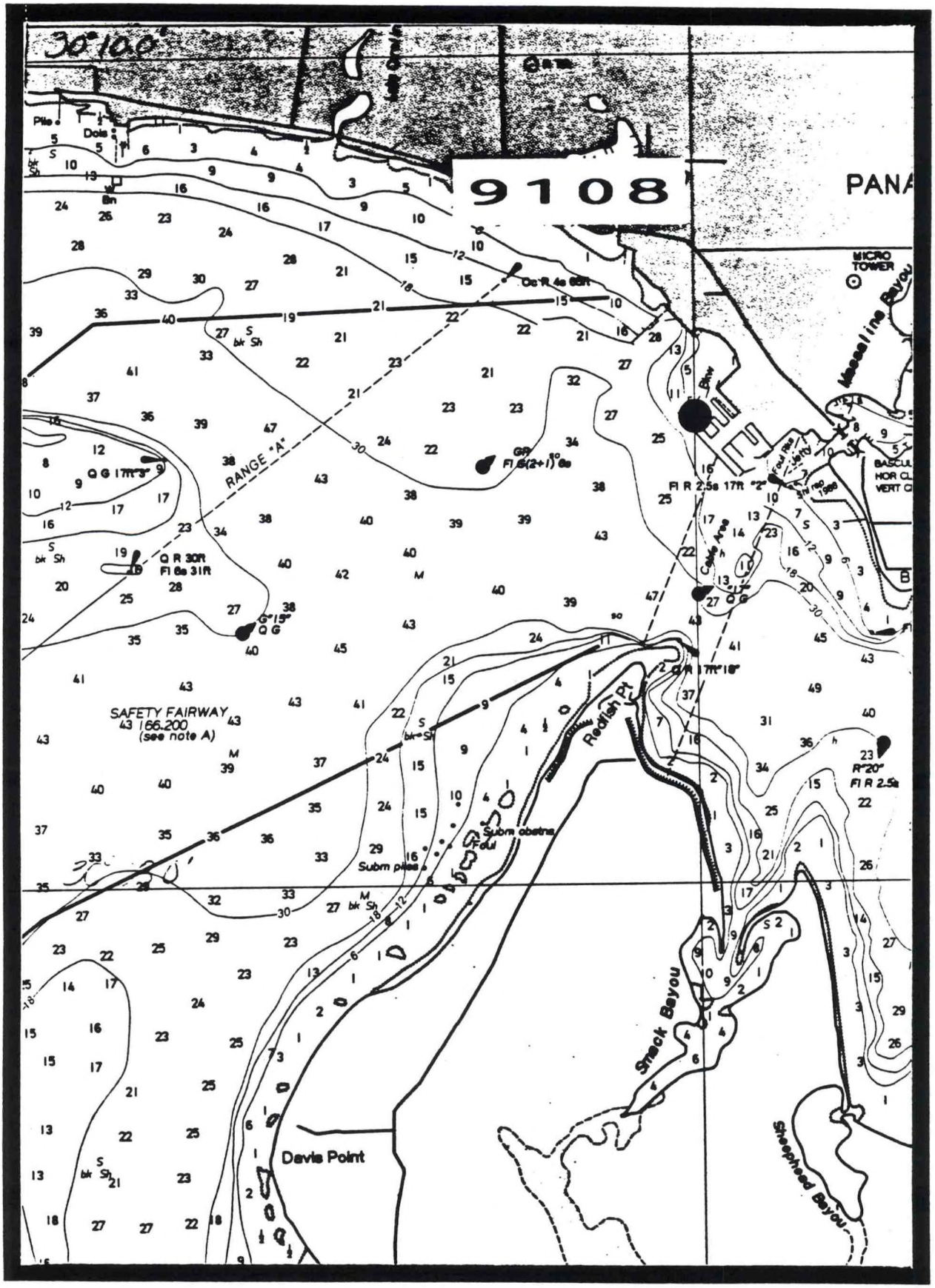


8727520 CEDAR KEY, FL LAT. 29° 8.1'N LON. 83° 1.9'W

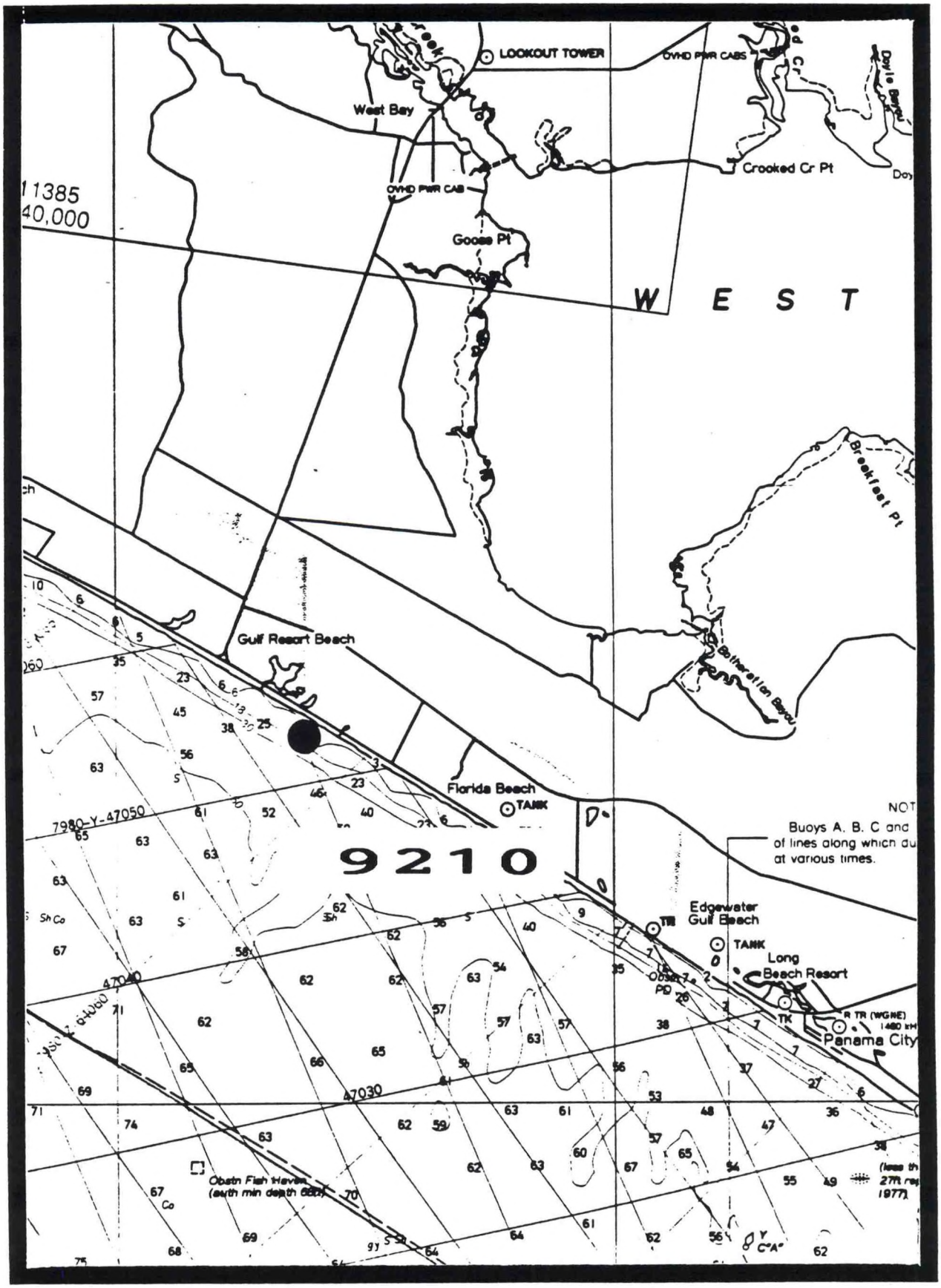


8728360 TURKEY POINT, FL LAT. 29° 54.9'N LON. 84° 30.7'W

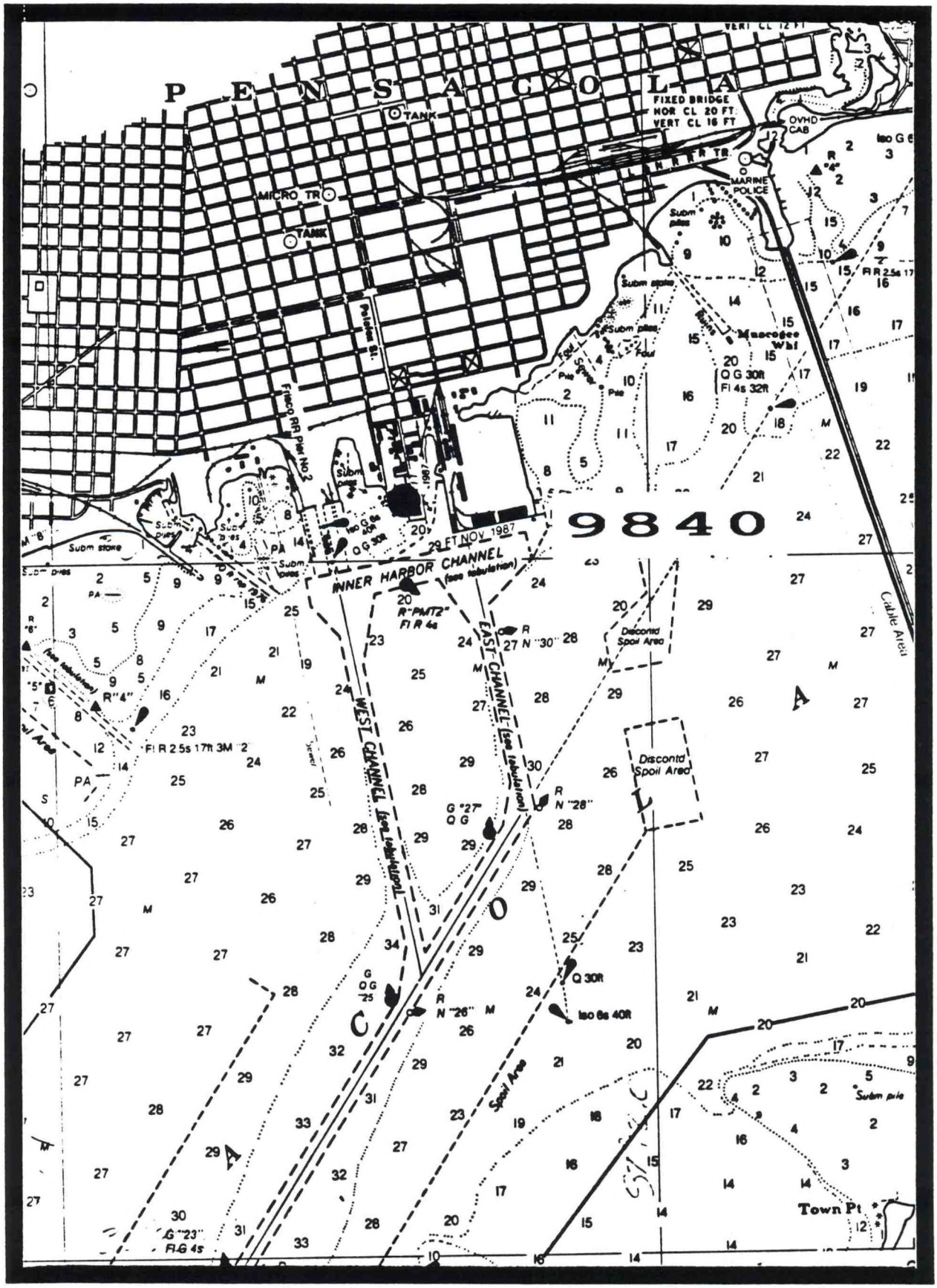
8728690 APALACHICOLA, FL   LAT. 29° 43.4'N LON. 84° 58.9'W



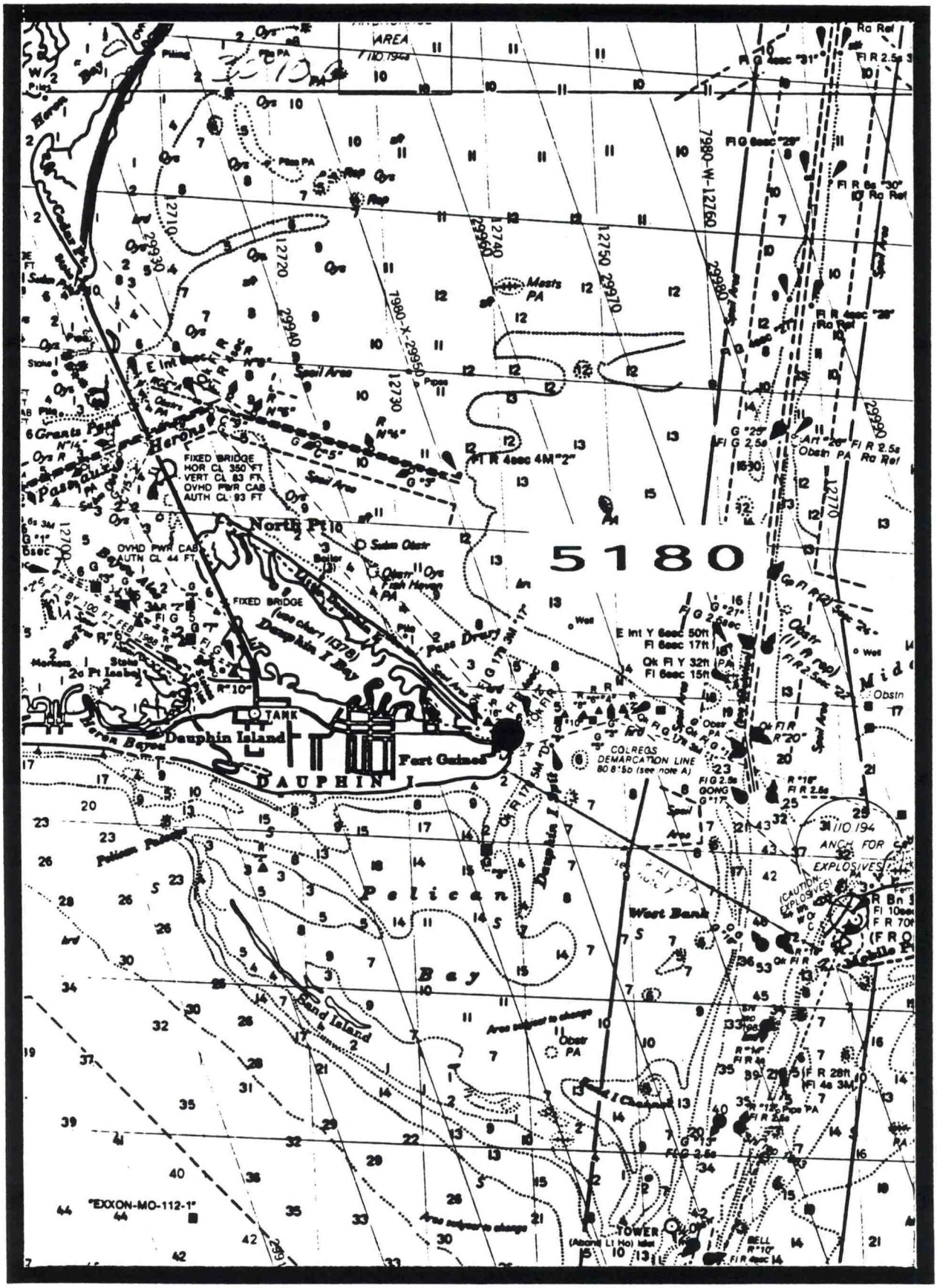
8729108 PANAMA CITY, FL LAT. 30° 9.1'N LON. 85° 40.0'W



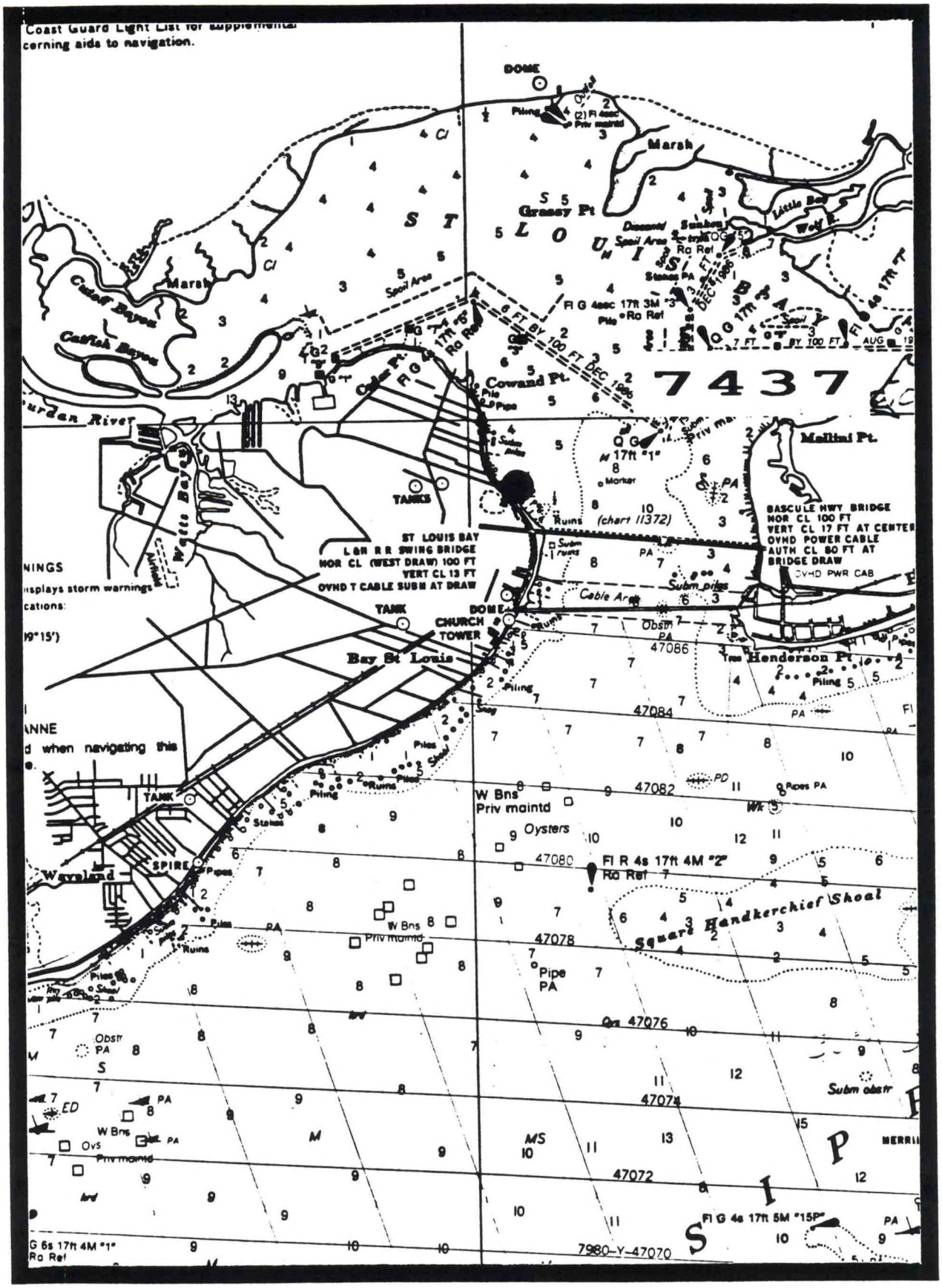
6729210 PANAMA CITY BEACH, FL LAT. 30° 12.8'N LON. 85° 52.8'W



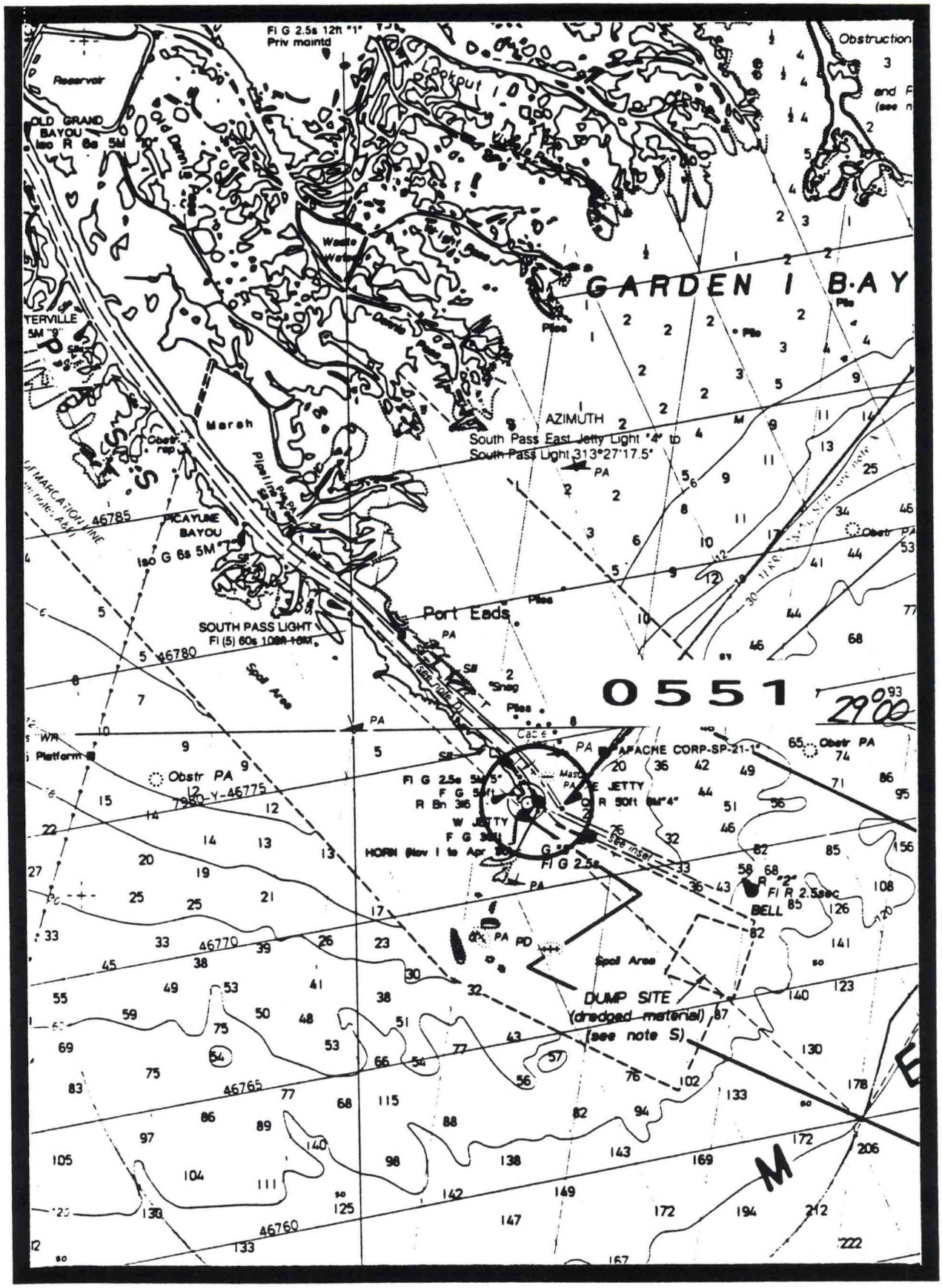
8729840 PENSACOLA, FL LAT. 30° 24.2'N LON. 87° 12.8'W



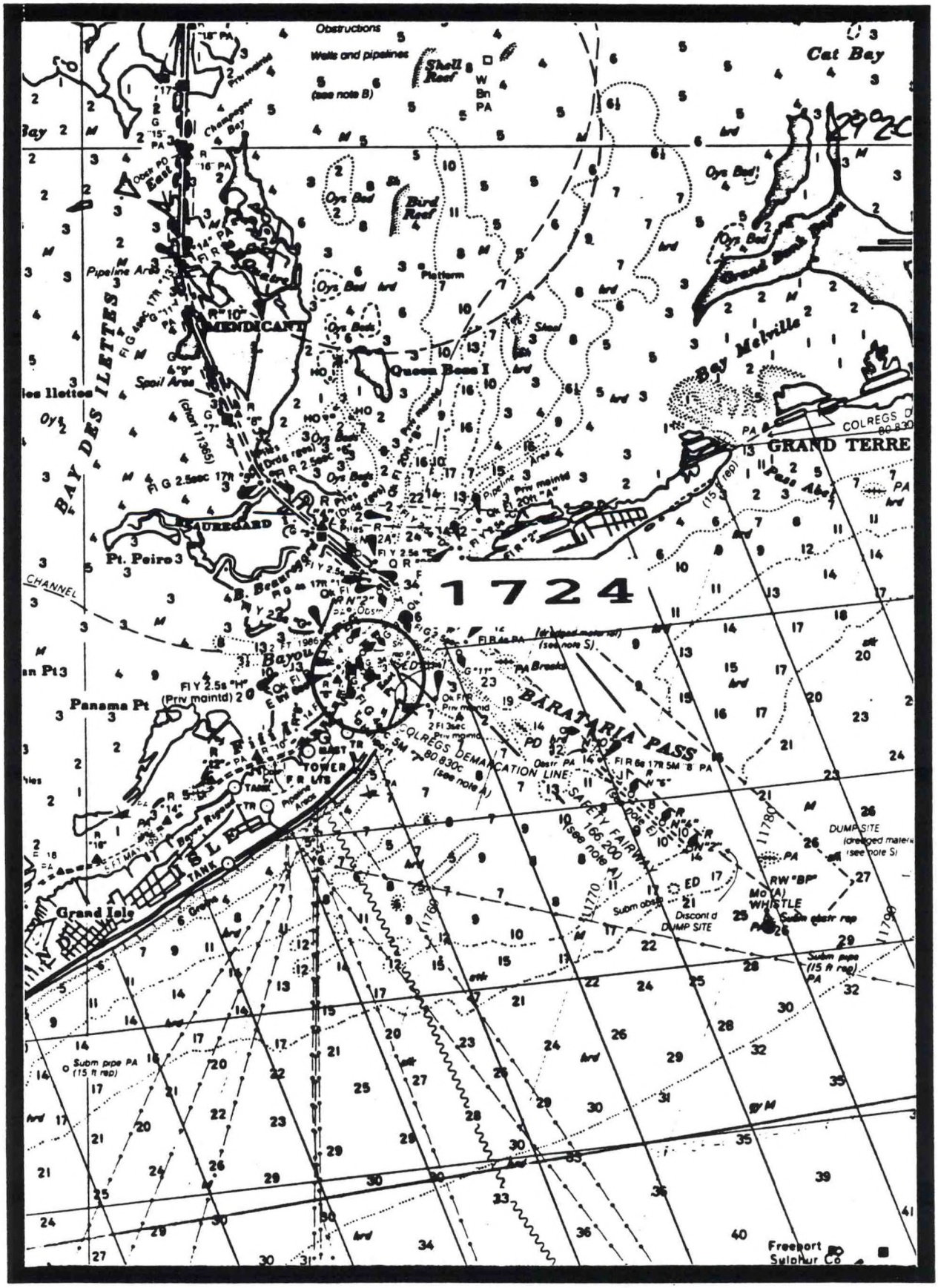
8735180 DAUPHIN ISLAND, AL LAT. 30° 15.0'N LON. 88° 4.5'W



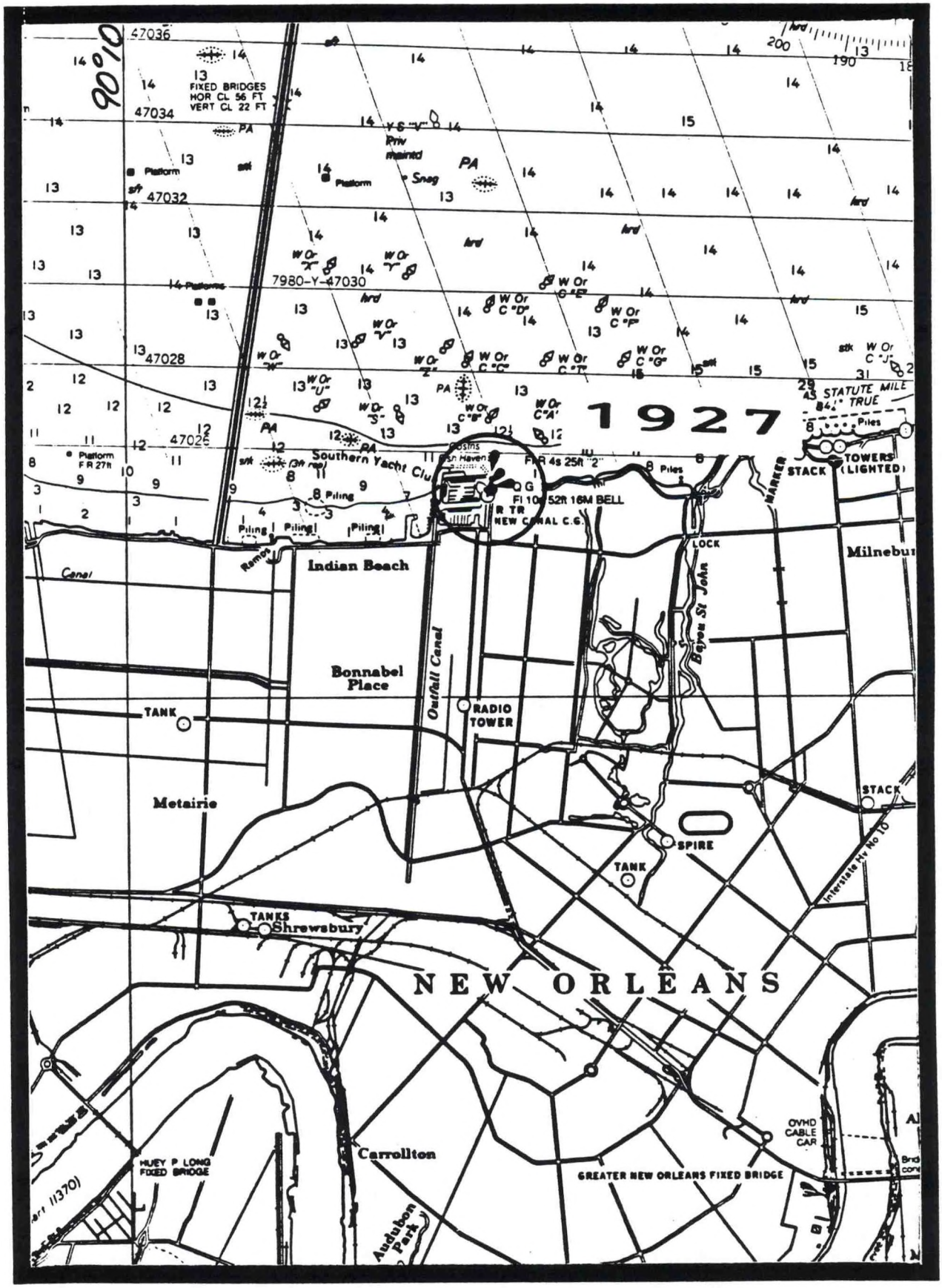
8747437 BAY WAVELAND, MS LAT. 30° 19.5'N LON. 88° 19.5'W



8760551 SOUTH PASS, LA LAT. 28° 59.4'N LON. 89° 8.4'W



8761724 GRAND ISLE, LA LAT. 30° 7.4'N LON. 89° 13.3'W



8761927 USCG NEW CANAL, LA LAT. 30° 1.6'N LON. 90° 6.8'W

8762928 COCODRIE, LA LAT. 29° 14.7'N LON. 90° 39.7'W