COASTAL CONSTRUCTION CONTROL LINE REVIEW AND REESTABLISHMENT STUDY FOR PINELLAS COUNTY

Sponsored By

Office of Beaches and Coastal Systems
Department of Environmental Protection

Submitted By

Beaches and Shores Resource Center
Institute of Science and Public Affairs
Florida State University
Tallahassee, Florida 32306

December 1999
(Revised December 2000)

FOREWORD

This report was prepared by Dr. R.G. Dean, Dr. T.Y. Chiu and Dr. S.Y. Wang for the Beaches and Shores Resource Center (BSRC) at Florida State University. The Florida Department of Environmental Protection, Office of Beaches and Coastal Systems (OBCS), contracted with the BSRC to conduct scientific studies in support of the reestablishment of the Coastal Construction Control Line (CCCL) for Pinellas County.

This report has been prepared to describe and document the storm tide studies related to the CCCL reestablishment. The storm tide report is entitled Combined Total Storm Tide Frequency Analysis for Pinellas County, Florida. The storm tide report contains an addendum entitled Additional Storm Tide Analyses for Pinellas County.

There is a separate, related three-volume set of reports summarizing work performed in the CCCL reestablishment studies. Volume 1 of the set of summary reports is entitled Coastal Construction Control Line Review and Reestablishment Study for Pinellas County, by Dr. T.Y. Chiu and Dr. S.Y. Wang. The companion, supplemental reports are Volume 2, Beach-Dune Erosion Calculations for the Reestablishment of Coastal Construction Control Line, by Dr. T.Y. Chiu and Dr. Robert G. Dean, and Volume 3, Wave Height Calculations for the Reestablishment of the Coastal Construction Control Line, by Dr. T.Y. Chiu and Dr. Robert G. Dean.

At the time of this report completion, Mark E. Leadon was the contract manager for the OBCS contract with BSRC, Eugene E. Chalecki was the Program Administrator for the OBCS, and Dr. Alfred B. Devereaux, Jr. was the Director of the OBCS. This report is being accepted herein by the Office of Beaches and Coastal Systems in acknowledgement of completion of these reports in support of the CCCL reestablishment for Pinellas County.

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I. INTRODUCTION

Chapter 161.053, Florida Statutes, enacted by the 1971 session of the State Legislature, provides that the Department of Environmental Protection shall set a Coastal Construction Control Line along the Gulf and Atlantic shores of the State. The purpose of the CCCL program is to preserve and protect Florida's beach-dune system from imprudent construction which can jeopardize the system's stability, accelerate erosion, provide inadequate protection to upland structures, endanger adjacent property, or interfere with lateral public beach access. The law provides that the setting of this line shall be based on data resulting from comprehensive scientific studies and topographic surveys, erosion trends, predictable storm tides, wave runup, the vegetation line, and other technical data. Since 1971, all twenty-four counties which have sandy beaches have had a setback (or control) line established.

The 1978 session of the State Legislature amended the statute which changed the Coastal Construction Setback Line to Coastal Construction Control Line and permitted counties and municipalities to adopt coastal zoning and building codes in lieu of the state administered Coastal Construction Control Line Program.

This 1978 enactment also clarified that the lines should be established to represent the area subject to the effects of a 100-year storm surge, and that major habitable structures located seaward of these lines be designed to withstand the combined wind and wave loads associated with a 100-year storm surge.

Pursuant to Subsection 161.053 (3), Florida Statutes, it is the intent of the Legislature that any CCCL that has not been updated since June 30, 1980, shall be considered a critical priority for reestablishment by the Department.

Under a contract between the Office of Beaches and Coastal Systems, Florida Department of Environmental Protection, and the Beaches and Shores Resource Center of the Florida State University's Institute of Science and Public Affairs, Pinellas County becomes the twenty-fourth and last county to have the review studies as required by Florida Statutes 161.053. This report, Volume 1 of the Coastal Construction Control Line Study report, presents the procedure and the results (including the revised results) of the required studies. The revisions resulted from refinements to the corrections in the beach-dune profile data set and the addition of three intermediate storm tide simulation profiles (transect lines) as described in the Addendum of Reference (9).

Two supplementary reports, Volumes II and III of the Coastal Construction Control Line report, have have

been prepared which present study results in terms of application of criteria for reestablishment of the CCCL through erosion calculations and landward penetration of a 3-foot storm waves. Those reports are entitled "Wave Height Calculations for the Reestablishment of Coastal Construction Control Line in Pinellas County" and "Beach-Dune Erosion Calculations for the Reestablishment of Coastal Construction Control Line in Pinellas County".

II. BACKGROUND AND DESCRIPTION

The Gulf of Mexico shore of Pinellas County extends northerly about thirty-nine miles from the main entrance to Tampa Bay, Egmont Channel, to the vicinity of Anclote Key with 35.4 miles of sand beach and 7 passes. The Pinellas County coastline consists of numerous keys or barrier islands, which range in width from 200 to 2,000 feet with elevations varying from 5 to 10 feet above mean low water and run generally northwest-southeast in the southern half, and almost north-south in the northern half of the county. The keys approach nearest to the mainland at Indian Rocks Beach, where the lagoon through the Narrows is only 200 to 300 feet wide. The Narrows connects Boca Ciega Bay on the south with Clearwater Harbor and St. Josephs Sound on the north. The main keys and intervening passes within Pinellas County, from north to south, are as follows:

Keys	Passes
Honeymoon Island	Hurricane Pass
Caladesi Island	Dunedin Pass
Clearwater Beach Island	Clearwater Pass
Sand Key	Johns Pass
Treasure Island	Blind Pass
Long Key	Pass-a-Grille Pass
Cabbage, Pine and Shell Keys and adjacent small keys	Bunces Pass
Mullet Key	Egmont Channel

The above keys and islands are of various lengths, widths and elevations. Both Honeymoon and Caladesi Islands are very low and are in natural state without coastal development. The beach on Clearwater Beach Island varies from 0 to 300 feet. There are numerous seawalls and groins throughout the island. The beaches on Sand Key vary considerably in width, ranging from 0 to 150 feet, with numerous vertical seawalls. Beach nourishments have been used to alleviate the erosion problems from time to time since 1961. The beaches of Treasure Island range from 20 to 200 feet at the northern half and 30 to 70 feet at the south half. Beach nourishments have also been used to combat erosion since 1964. The beaches of Long Key vary in width 45 to 200 feet with some beach nourishments since 1968. The beach on Mullet Key is very low and very narrow, averaging about 50 feet.

The Pinellas County barrier islands, except Honeymoon, Caladesi Islands and Mullet Key, are either highly developed or being developed at a rapid rate. The islands contain several incorporated communities. Each of

those communities has shops, hotels, motels, apartments, and other service establishments, devoted exclusively, either directly or indirectly, to the accommodation and entertainment of the numerous visitors to this popular resort area. The locality is shown on Figure 1 of this report.

A more detailed description of the study area can be obtained from References (1), (2), (3), (4)and (5)*.

Figure 1 Location Map of Pinellas County

*Numbers in parentheses indicate the references listed at the end of this report.

III. CONTROL LINE FACTORS

The location of a control line (CL) from a coastal scientific point of view depends upon certain physical conditions. Factors to be considered in a broad sense are shoreline stability (fluctuations, erosion trends) and topography concerning storm/hurricane surges and wave action.

The first step in a study is to investigate the area in question to determine the need, if any, for a review (or study) of the control line. When the need is established, as it has been in Pinellas County, all available data should be collected; and a topographic and hydrographic survey of the area should be carried out if no recent surveys are available.

The general case in Florida will show a lack of historical and good statistical data. Therefore, much reliance must be made on the recent topo-hydro studies correlated with the measured and predicted physical parameters of the area.

The following sections describe some study factors for the control line investigation.

1. Field Program

A monumented baseline was initially placed from the north end of Honeymoon Island to the east end of Mullet Key. Monumented stations approximately 1,000 ft. apart were placed on the baseline (see Figure 2) in 1974, and have, since then, been maintained by the Florida Department of Natural Resources or the Florida Department of Environmental Protection. Beach profiles from behind the dune line (where existing) to a wading depth were surveyed for all the 192 monumented stations during the months of September and October, 1974. Sixty offshore sounding lines were also surveyed during the same period. Surveys of selective beach profiles were carried out in August 1982, October 1985, April 1987, August 1988, February 1989 and September 1989. Survey data used in the study was acquired in 1997. by the Office of Beaches and Coastal Systems (OBCS), Florida Department of Environmental Protection (FDEP). The survey data consisted of upland and bathymetric profiles obtained at OBCS 192 range monument locations throughout Pinellas County shoreline. The sounding lines were surveyed to a distance of about 5,000 to 6,000 ft. offshore at a water depth of 14 to 20 ft. The 1997 data was supplemented with 1999 data collected by OBCS at some of the range locations to provide better ground definition upland of the range monument locations. The survey data was also supplemented by 2000 data at a few ranges where 1997 data was problematic.

Figure 2 shows the location of the beach profiles (R-1through R-192).

In addition to the OBCS-generated data, the OBCS received two LIDAR (Airborne Light Detection and Ranging) surveys from Pinellas County, one from 1998 and one from 2000. The OBCS found general agreement between the LIDAR and OBCS data. However, it was found that the LIDAR cannot penetrate dense vegetation or manmade structures resulting in inability to establish ground elevation in such areas. The Pinellas County surveying office would only certify the LIDAR to +/- 4 ft. accuracy. The OBCS has concluded that the OBCS survey data is the recommended survey data to use for purposes of conducting studies for reestablishment of the CCCL in Pinellas County.

A high percentage of the Pinellas County shoreline fronting the Gulf of Mexico has been restored by placement of beach fill sand from offshore sources. Most of the developed areas along the coast are located within beach restoration projects, including areas on Sand Key, Treasure Island, and Long Key. These restored areas are incorporated into the CCCL studies in an appropriate manner through use of the OBCS 1997 survey data.

The 1997 data reflects the beach restoration after the fill sand has adjusted to natural littoral conditions over a period of years. Further, the 1997 data accounts for fill sand still present on the beach, but also reflects an adjusted, recessed condition just prior to sand renourishment for much of the restoration project areas. The OBCS considers the 1997 data to be appropriate in accounting for the beach restoration in a generally conservative manner with regard to CCCL reestablishment. A complete set of beach profiles along with offshore soundings has compiled for public review (Exhibit B).

Controlled stereoscopic aerial plan photographs of the study area were made in August 1974 and on May 5, 1997. For the present study, the controlled stereoscopic aerial plan photographs taken on May 5, 1997 were used for the purposes of graphic presentation of the study area and the relocated coastal construction control line. Elevation contours generated from the controlled aerial plan photographs of July 1990 have been used as reference in the study. A complete set of the controlled aerial plan photographs of May 1997 for the study area at a scale of 1" = 100' has been compiled for public review (Exhibit C).

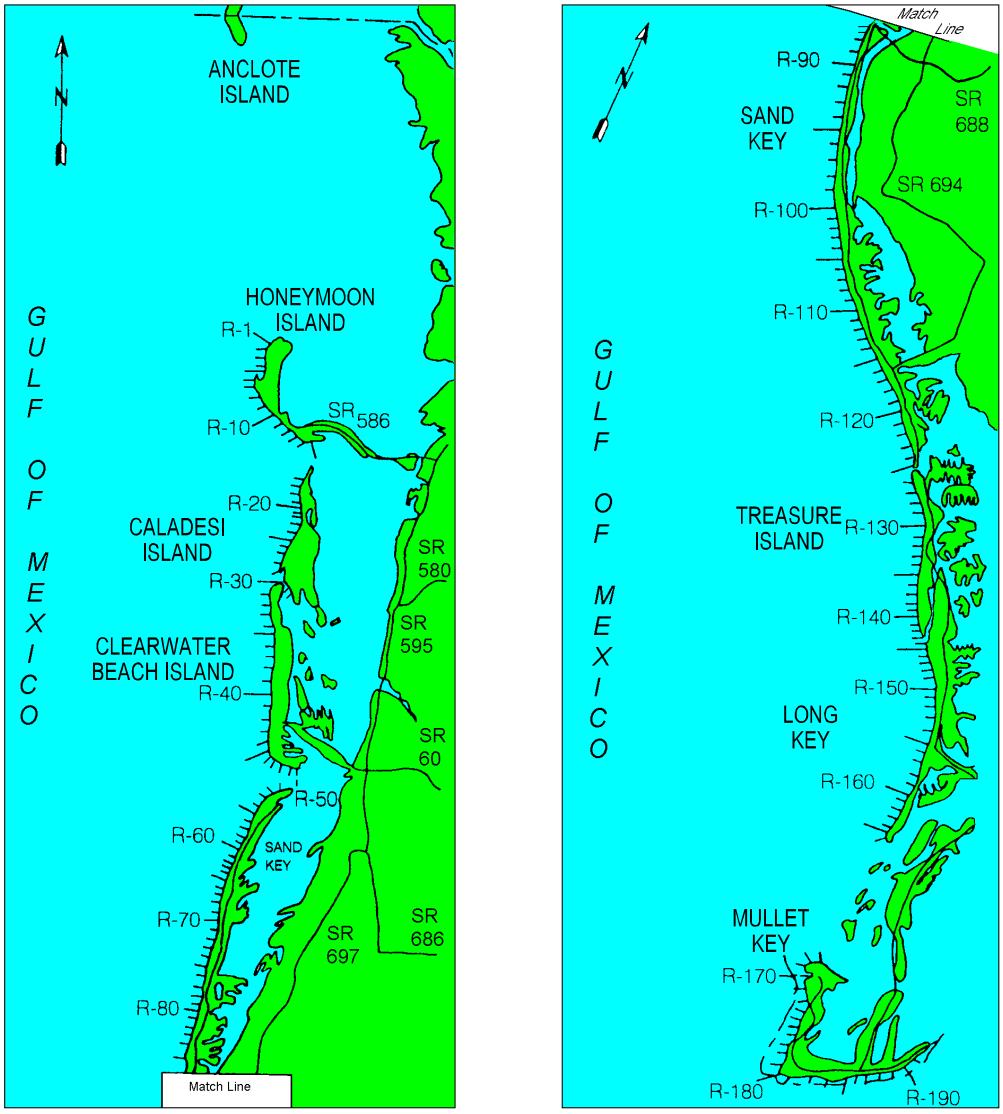

Figure 2 Location Map of Study Area and Range Lines for Pinellas County

2. Shoreline History

Much historical data has been obtained from the National Shoreline Study (1) and Erosion Control Study on Pinellas County, Florida (3, 4, 5).

This data has been supplemented by maps, survey records, aerial photographs and prior studies obtained from various sources such as U. S. Coast and Geodetic Survey, Florida Survey Records, Army Corps of Engineers, U. S. Department of Agriculture and the University of Florida. The historical information spans from 1873 to 1983.

Results of the historical investigations are briefly described in Section II, Background and Description and Section V, Discussion of Analysis and Reasoning for Recommended Control Line. A more detailed historical analysis may be obtained by reading the above mentioned reports.

3. Littoral Forces

A. Tides - Tide records in this area, both collected in previous studies and during the present study, show that tides in the study area are a mixture of semi-diurnal and diurnal. Tide tables of the National Ocean Service show the mean diurnal tidal range at Indian Rocks Beach and Clearwater as 2.6 feet.

B. Winds - The most comprehensive wind speed and direction data in the offshore area are compiled by the U.S. Naval Weather Service Command (SSMO). According to its publication, 55.1% of the wind speed is between 7 and 16 knots. The most frequent wind directions are 18.2% from east and 17.6% from north.

C. Waves - In accordance with the wind direction, a higher percentage of waves are from the east (23.5%). Waves with heights between 1 and 2 ft. are the most frequent ones (33.3%). Waves higher than 6 ft. have a frequency of 13.2%. The average deep water wave height is 3.9 ft. The prevailing wave periods are less than 6 sec. (59.5%). Periods of 6 sec. to 7 sec. and 8 sec. to 9 sec. waves have a percentage frequency of 25.0% and 6.7%, respectively. Here, only sea waves generated by local winds in the vicinity of the observer are summarized.

D. Longshore current and littoral transport - The main current affecting the surf zone is the longshore current created by waves breaking at an angle to the shore. The magnitude of the longshore current depends on the breaking wave characteristics, breaking angle and local bottom and shore configurations.

The longshore currents are responsible for sand transport along the coast. For the study area, the net littoral transport is generally toward the south. The annual net southerly drift rate along the Pinellas County shore is estimated to range from 10,000 cubic yards at the north end to 50,000 cubic yards at the south end (4). There

locations within the county where net litteral drift reversals exist, such as at the north end of Sand Key where net drift is toward the north.

E. Storms/Hurricanes - During the impact of storms/hurricanes, the wind, wave, current and littoral transport patterns are drastically altered from that described in B, C, and D above for normal conditions. Severe erosion and damage (i.e., loss of vegetation, and structures, etc.) caused by the greatly increased water level and wind and wave forces can take place in a very short period of time. The rise or fall of the astronomical tide aids or reduces the wave action on the dune or beach face and can be an important factor in flooding and beach-dune erosion during the events of storms/hurricanes.

A number of damaging storms/hurricanes have affected the study area in the past. Among them were the hurricanes of October 1921, September 1935 (Labor Day Hurricane), September 1950 (Easy), September 1960 (Donna), June 1966 (Alma), and June 1972 (Agnes) and August-September 1985 (Elena. Juan). The 1921 hurricane made direct landfall on the Pinellas County shoreline resulting in severe flooding and coastal damage to bridges, piers, seawalls, beaches and houses (6). Hurricane Agnes did not reach close to Pinellas County but still resulted in severe flooding to beaches and causeways with loss estimated at $12.5 millions in Pinellas County (7).

4. Storm Surge and Wave Setup

In addition to the astronomical tide, storms/hurricanes and waves are capable of creating extreme high water levels, especially on shallow coastal areas.

Storm surge is the vertical rise in the still water level near the coast caused by reduction of atmospheric pressure and wind stresses on the water surface. Wave setup is the superelevation of the water surface above storm surge level due to onshore mass transport of the water by wave action alone. There exist only a very limited number of reliable records of water levels on the open coast during major hurricanes which have occurred in the past. In the study of storm tides in Florida (6), the Coastal and Oceanographic Engineering Department of the University of Florida has analyzed the normal yearly high tides and high water levels caused by storms/hurricanes and expressed the results as frequency of occurrence for a certain water level to be equaled or exceeded. In that study, all available normal yearly high tide and storm surge data along the coast of Florida before 1959 were analyzed and correlated to provide the tidal level-frequency information for the open coast of Florida. The National Oceanic and Atmospheric Administration (NOAA) and the Federal Emergency Management Agency (FEMA) has done numerical modeling of storm surge in Pinellas County. For the present

study, refined joint probability numerical modeling of hurricanes has been carried out to obtain sufficient details of the storm tide frequency in Pinellas County. In the joint probability numerical modeling, the hurricane parameters, astronomical tide, dynamic wave setup and Coriolis force are all taken into consideration to obtain the combined total storm tide frequencies. A separate report (7) with addendum made in November 2000 present all the details in the analysis. Figure 3 shows the combined total storm tide frequencies resulting from the numerical analysis at Profiles 1, 2, 3 and 4. Figure 4 shows the same for Profiles 1a, 2a and 3a as described in the Addendum of Reference (7). The locations of the seven profiles, i.e., Profiles 1,1a, 2, 2a, 3, 3a and 4 are depicted in Figure 5.

Another factor which may cause an increase in water level but is not included in the analysis is the effect of rainfall. Since tropical storms/hurricanes are often associated with excessive rainfall, an increase in storm tide levels may occur in coastal areas in the neighborhood of creeks, rivers and inlets/passes.

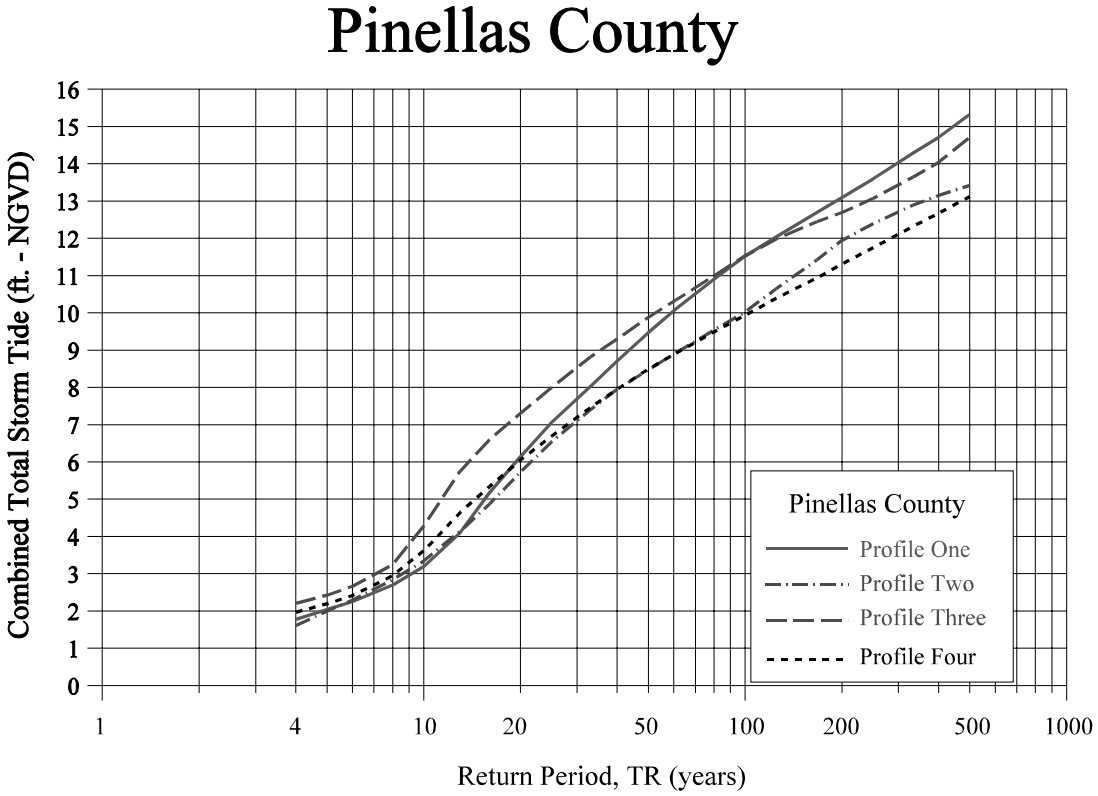

Figure 3 Combined Total Storm Tide Elevations Versus Return Period for the Original FourTransect Lines in Pinellas County

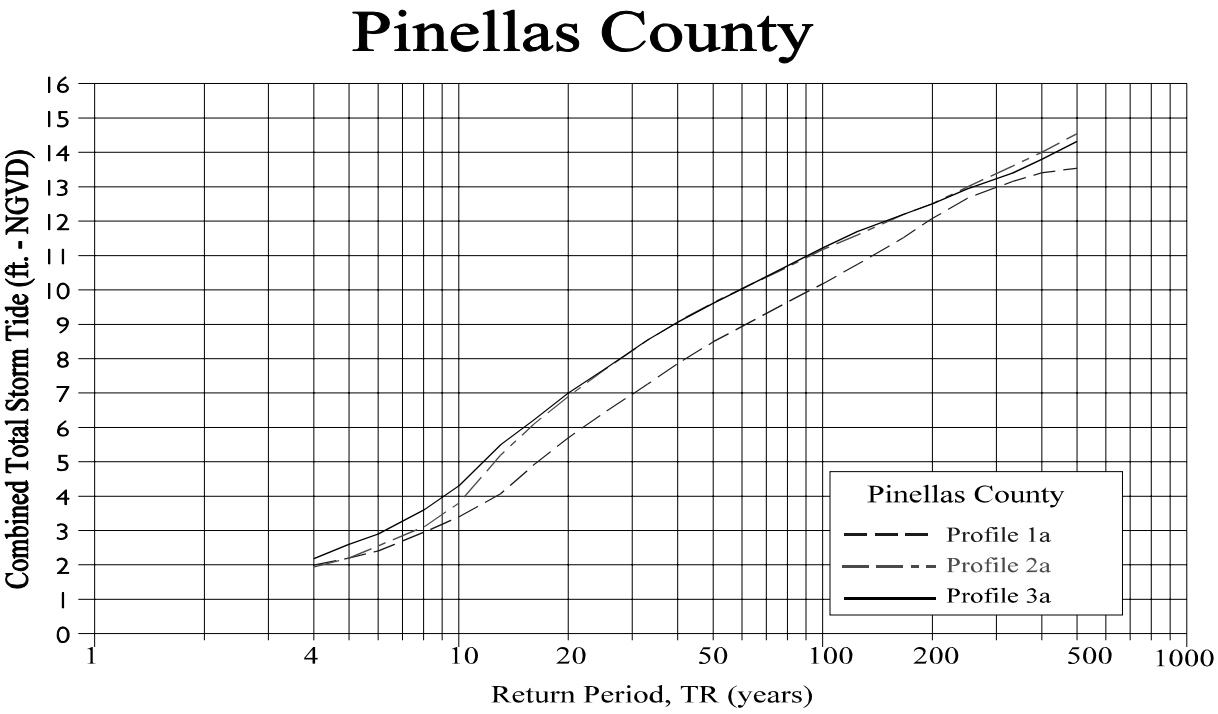

Figure 4 Combined Total Storm Tide Elevations Versus Return Period for the Three Intermediate Transect Lines in Pinellas County

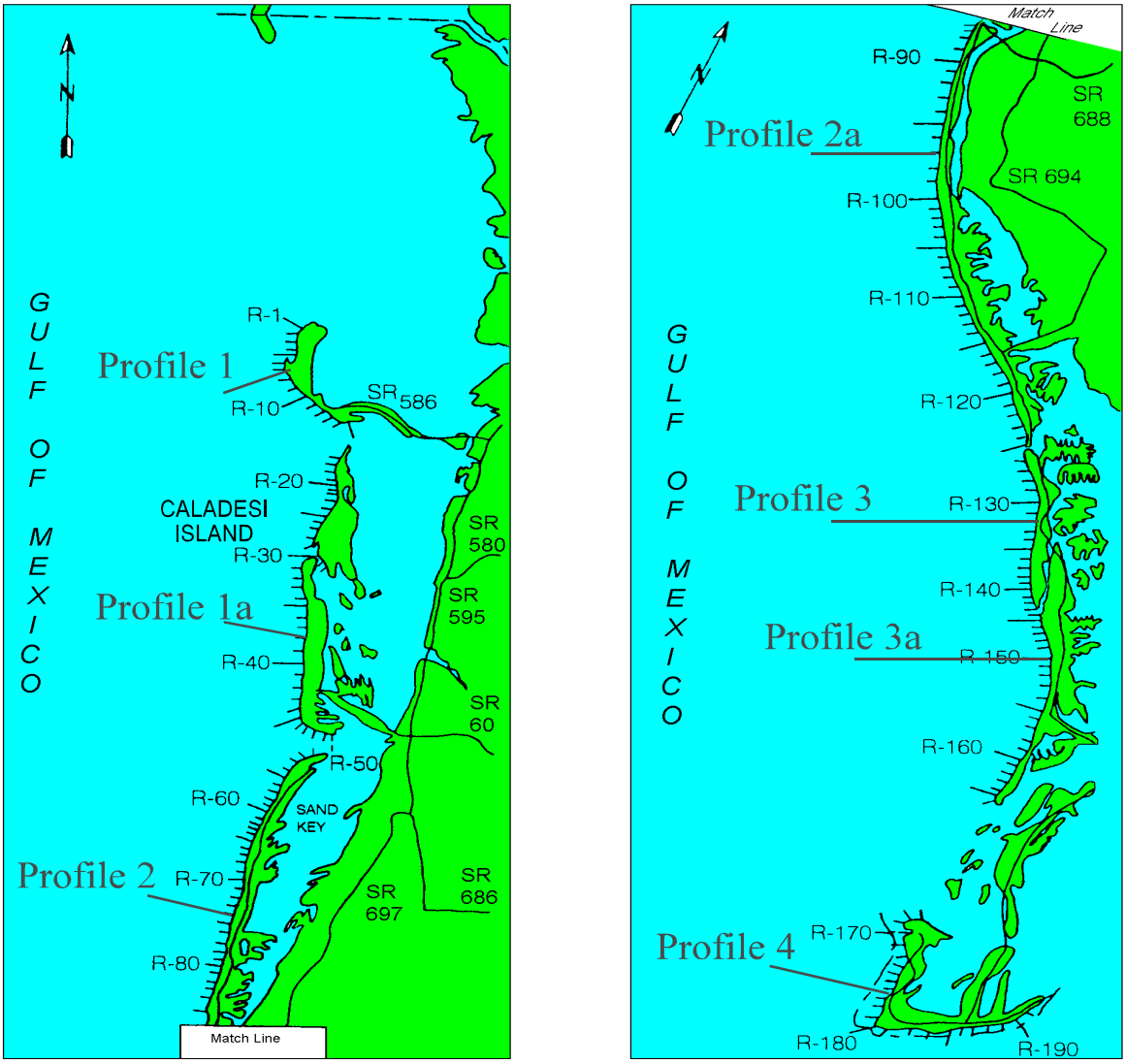

Figure 5 Location of Storm Tide Simulation Profiles

IV. CONTROL LINE CRITERIA

In making the analysis for the control line (CL), the objectives were: to prevent beach encroachment that would endanger the existing beach-dune system, and to help prevent existing and future structures from being unreasonably subject to great or irreparable harm.

In the analysis, the following criteria were considered when placing the control line:

1. Guided by the methodology in Reference (10), the one hundred year frequency combined total storm tide level of 9.9 to 11.5 ft. as shown in Figures 3 and 4 are employed for calculating:
    A. Beach-dune erosion limits by a numerical model (11) - The model takes into account the storm tide characteristics in the erosion process and was calibrated against the measured beach-dune erosion caused by Hurricane Eloise of September 1975 in Walton County (12) before applying it to the calculation of erosion limits associated with the 100 year frequency storm tide for Pinellas County. The calibration of the erosion model against erosion caused by Hurricane Eloise in Walton County was necessary because of the existence of extensive erosion data on that hurricane. The site near the landward erosion limit as calculated by the erosion model was used as a guide for the CCCL location.
    B. Wave action effects associated with the combined total storm tide for the flooded coastal area (where existing) according to the procedures established by the National Academy of Sciences (13, 14) - The site near the calculated 3 ft. wave height (10, 15) was used as a guide for the CCCL location.
    C. Wave runup on a composite slope (16).
2. The calculated erosion limits and wave action effects together with the historical data and topo-hydrographic information gathered from the surveys and field inspections are finally utilized to arrive at a suitable CL.

In short, the CL analysis considered the following factors: the most recently measured topographic factors which include dune elevations, foreshore slopes, offshore slopes, beach widths, adjacent profiles, upland development and vegetation-bluff lines and the newly developed or measured dynamic factors which include storm tide elevations and erosion, erosion trends, wave action effects, and fluctuations of the beach profiles.

Consideration is given to the results of the erosion and wave analyses and to the associated, resulting location of the CCCL. This CCCL location is reviewed and may be adjusted from the computed location determined from erosion and wave limits. An adjustment may be performed based on site-specific factors that may justify the adjustment.

In Pinellas County, there were 15 range monument locations where the CCCL was maintained at its existing position. These locations included areas near tidal inlets where uncertainties in terms of inlet effects warrant maintaining the existing CCCL position. Other such areas are where maintaining the existing position provides a more consistent, uniform CCCL and prevents compromising the CCCL position on properties adjacent to those range locations.

There are also a number of range locations on Caledesi Island and Mullet Key where the CCCL is not defined as a result of the CCCL extending into inland bay waters inland of these barrier islands. The entire width of the barrier island is considered to be within the CCCL at these locations.

V. DISCUSSION OF ANALYSIS AND REASONING OF RECOMMENDED CONTROL LINE

Shore history, as outlined in previous sections and references, indicates that the beach erosion has been a serious problem in Pinellas County for many years. The beaches of Pinellas County are sandy and narrow being composed of fine sand and shell fragments which are easily moved by currents and wave action. The presence of seven intervening passes between the islands and a major navigation channel greatly contribute to the problem. It is a well known fact that tidal passes intersecting a sandy shoreline affect the stability of adjacent beaches - especially if the passes are "improved" by the construction of jetties which interferes with the natural sand bypassing of the inlet. Large waves that strike the shoreline generally produce strong littoral currents. The forces resulting from those currents are the primary movers of beach material.

Comparative positions of the shoreline and depth contours over the period of record show considerable recession and advancement. However, advancement has generally occurred as accretion adjacent to passes and as a result of local interests providing beach fill and other works. The presence of many coastal protective works (seawalls, groins, jetties, etc.) coupled with the many beach fill projects dramatically point out the beach erosion problem that has historically confronted the county's Gulf coast. Unfortunately, many protective works have adverse effects on the natural beaches. If structures are built close to the Gulf, depriving nature of a material supply in its defense effort of limiting wave's growth, higher waves will directly attack the structures, causing a lowered profile and an accelerated erosion of beach. Only the provision of sufficient width of sediment material for the bar formation and beach slope adjustment can effect a defense against wave attack of the shoreline if maintenance of recreational beach is desired.

Long term erosion rates, however important, do not always indicate the short tern fluctuations that occur on the beach. These fluctuations can be quite large in magnitude over a short term as a result of certain tide-wave conditions. A shoreline which may have an apparent long term trend of stability can suffer quite severe erosion with subsequent accretion-erosion, etc. These events are dependent on tide-wave conditions, however, severe damage (i.e.: loss of vegetation, structure, etc.) may result during these fluctuations.

The entire coastline of Pinellas County has a very low topographic profile. Natural ground elevations are generally 10 ft. and in many cases much below. The entire beachfront study area is in great danger of flooding and wave overtopping as a result of a severe storm and/or hurricane. The 100-year frequency combined total storm tide of 9.9 to 11.5 ft. would result in almost the entire study area flooded or overtopped by waves. Although the coastal protective structures provide a level of protection to upland development from high frequency (lower intensity) storms, the protective structures cannot be considered to prevent damage from a 100-year frequency

storm tide impact. The structures will be overtopped by the storm surge and waves compromising their capability to survive and provide protection. Therefore, the protective value of these structures is not incorporated into the CCCL study.

The disastrous destruction of water front structures and the magnitude of sediment material required by nature (in the form of beach-dune erosion) in its defense against Hurricane Eloise (1975) in Bay and Walton Counties serve as a grim reminder of what can happen to coastal construction. A total of 2.1 million cubic yard of beach material was eroded from the beach-dune area (12) by the rather fast moving hurricane. In addition to beach-dune erosion, the highly developed shoreline of Bay County suffered severe structure damage. Figure 5 shows the damage per structure (at 1975 dollar value) versus structure location in relation to the Coastal Construction Setback Line (CCSL) which was in effect at that time in Bay County. The data are taken from a study made by Shows (17) after Hurricane Eloise of 1975. The damage per structure in the figure clearly shows that: 1) increases sharply seaward from the CCSL to reach $203,000 at -150 feet seaward of the CCSL; 2)

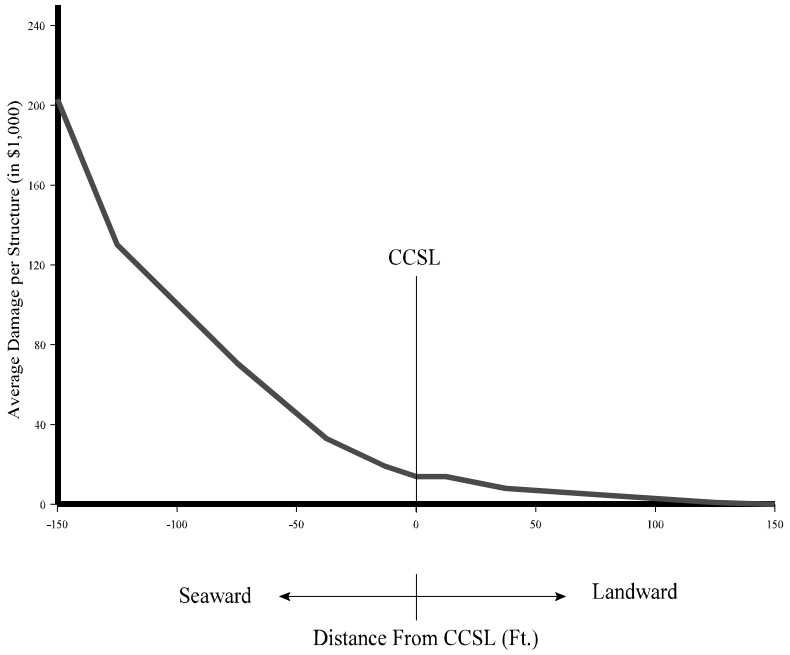

Figure 6 Damage to Structure in Relation to its location with CCSL (resulting from study of 540 structures in Bay County after Hurricane Eloise, By Shows, 1976)

levels off to $14,000 at the CCSL location; 3) reduces gradually landward to $0 at +150 feet landward of the CCSL.

It is, therefore, obvious that coastal development in Pinellas County carries a high "risk factor". So, it cannot be emphasized too strongly that future development should be carefully planned and engineered to minimize the risks as much as possible. It is possible to develop the shoreline in a manner which will enhance rather than destroy its natural beauty. Every effort must be made to protect, preserve and encourage growth of dunes. Beaches must not be encroached upon to avoid accelerated erosion and adverse effect on adjacent property. In view of the results from the refined analysis in this study, the damage from erosion and flooding by a hundred year frequency hurricane must be recognized. It is for these reasons that the present control line location is recommended. However, it should be strongly pointed out that 'COMPLIANCE WITH THE RECOMMENDED CONTROL LINE DOES NOT IMPLY THAT STRUCTURES WILL BE SAFE OR EVEN RISK FREE'. Property owners and developers are again strongly urged to seek the assistance of design professionals who are familiar with ocean/gulf-front construction so that they may have safe structures which will have a minimum adverse effect on the beach-dune area.

VI. CONTROL LINE DESCRIPTION

As required by law and mentioned in Section III, a monumented baseline was placed and surveyed along the Gulf shoreline of Pinellas County in 1974 and has, since then, been maintained. Each concrete monument has a 3½ inch diameter brass cap on top. The cap is identified as a Florida Department of Natural Resources Monument or Florida Department of Environmental Protection Monument and has a range line designation (R-1, etc.). The monuments run south from the north end of the county along the Gulf shoreline and are placed approximately 1,000 ft. apart to the south end of the county. The northern-most monument near the north county line is designated as Range One (R-1) and the remaining monuments are numbered consecutively to R-192.

The monuments have been surveyed by a registered land surveyor and each monument is referenced to the State System of Plane Coordinates. Location of the monuments are also shown on Exhibit C (Aerial Plan).

The recommended coastal construction control line (CL) is shown in Exhibit C as a broad line. Exhibit C is controlled aerial plan photographs, taken on May 5, 1997 along the shoreline of Pinellas County.

The aerial plan photographs of Exhibit C are reproduced at a scale of 1 inch equals to 100 ft.

Upon adoption of the control line (CL), the line will be referenced to the monumented baseline and described using the State System of Plane Coordinates.

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APPENDIX A

TYPICAL BEACH PROFILES

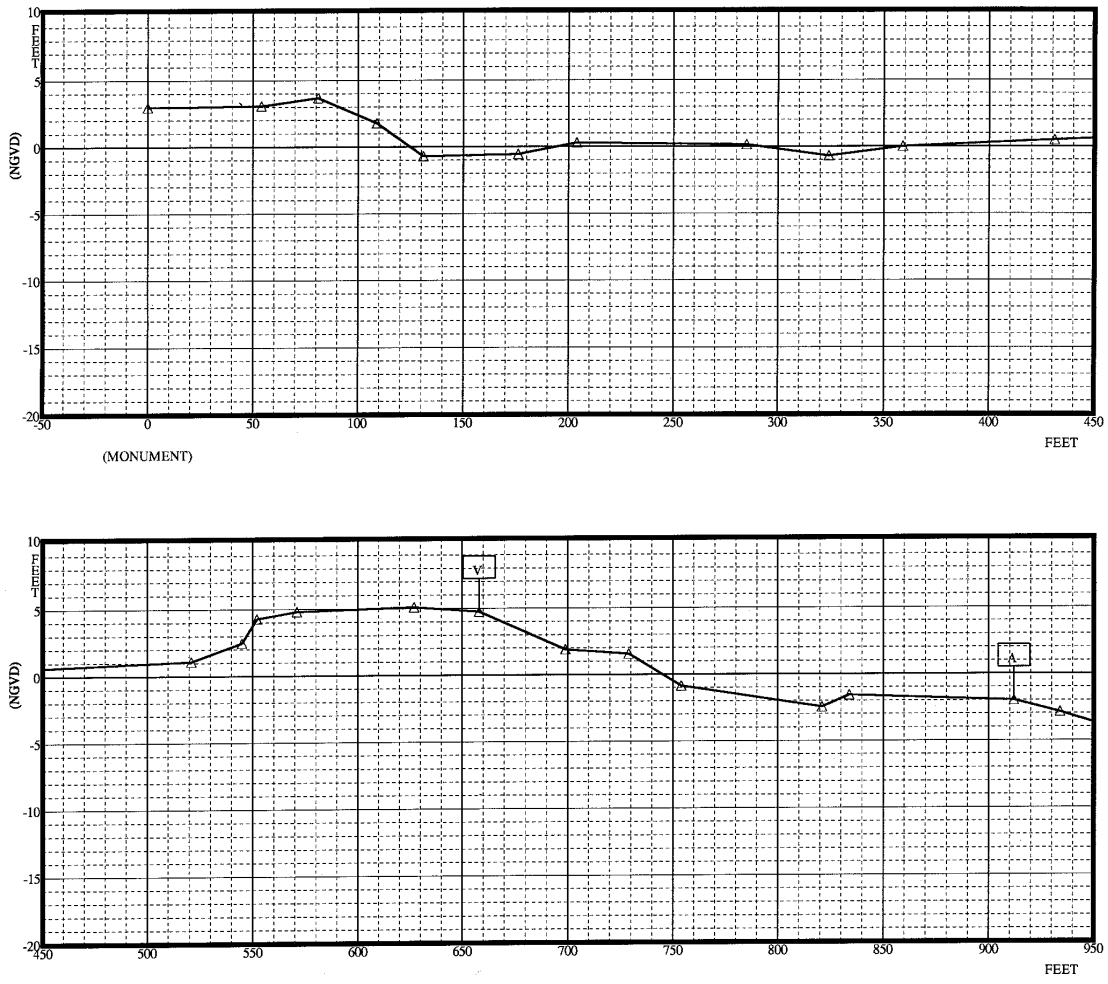


Figure A1 Beach Profile at Range No. 6 (R-6)

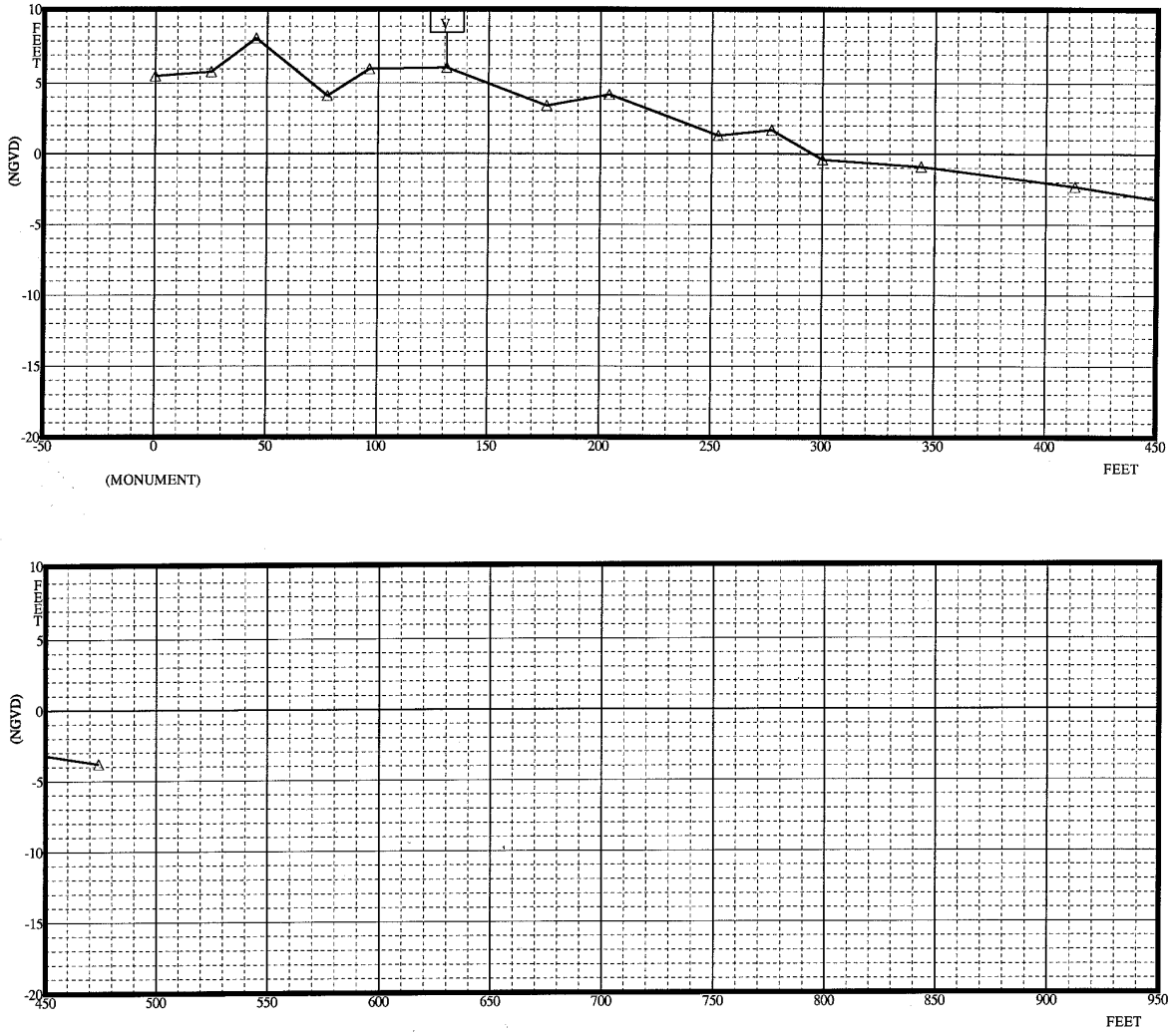


Figure A2 Beach Profile at Range No. 26 (R-26)

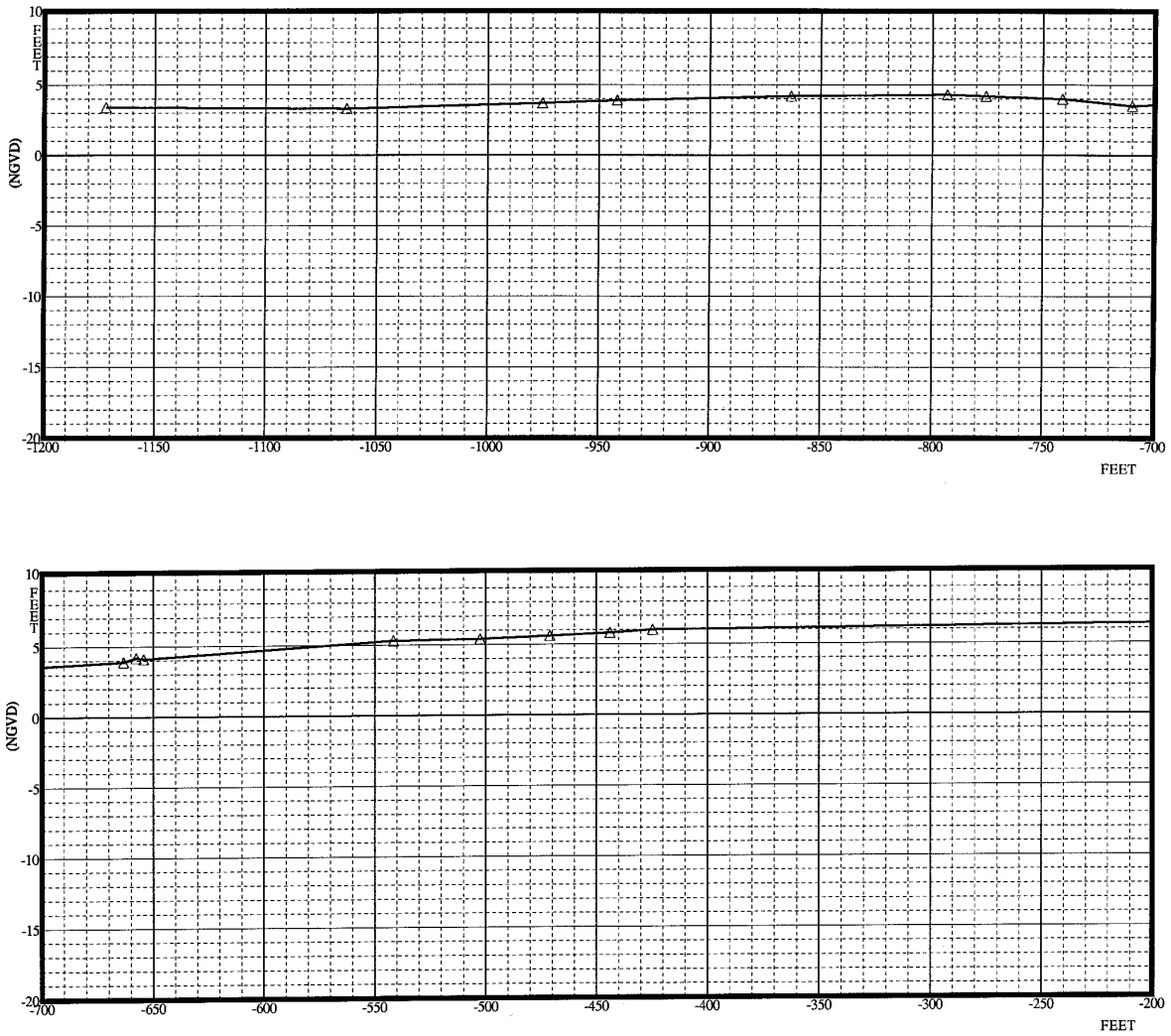
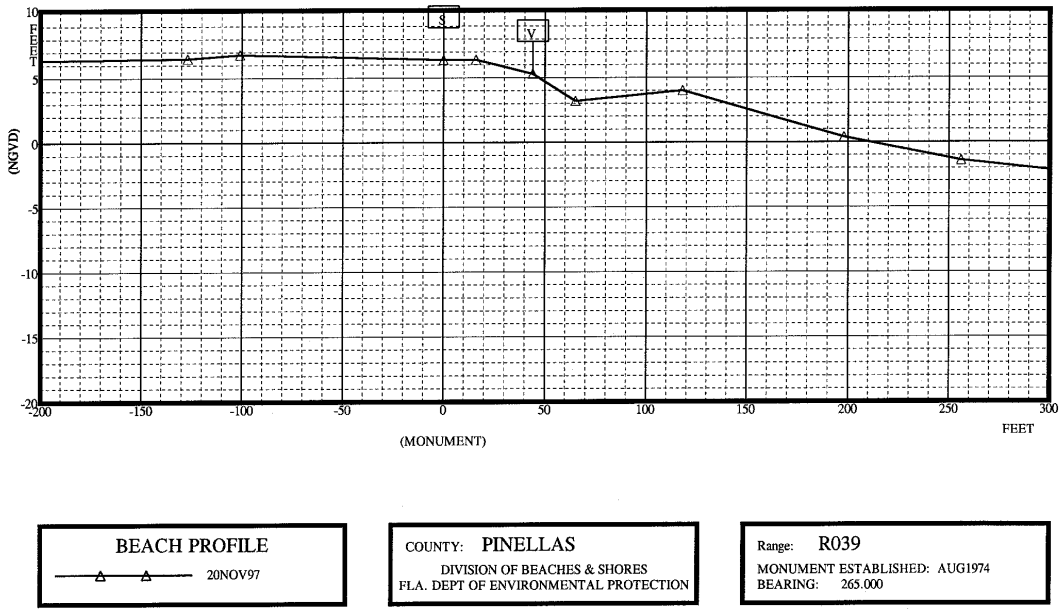
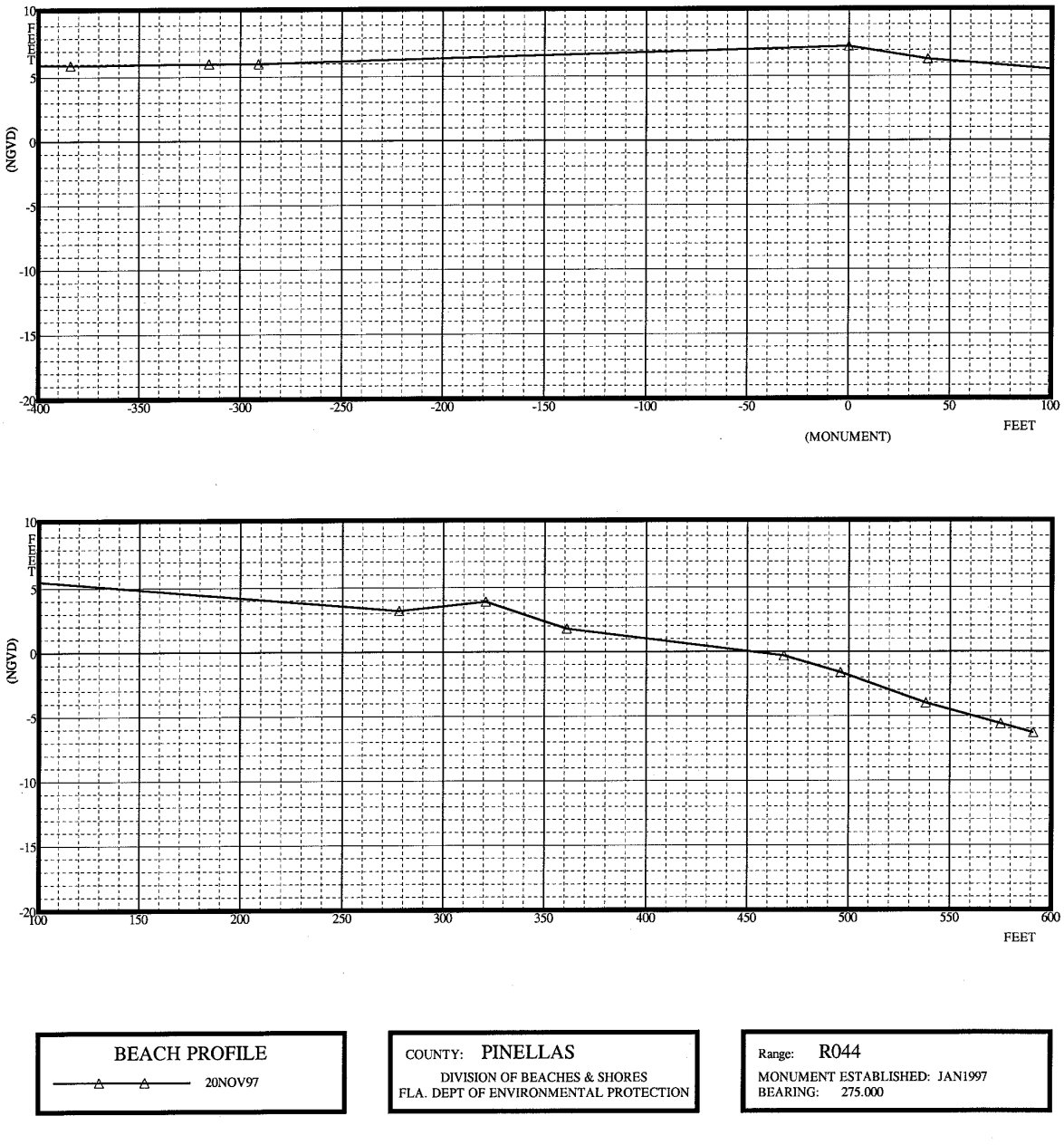


Figure A3a Beach Profile at Range No. 39 (R-39)



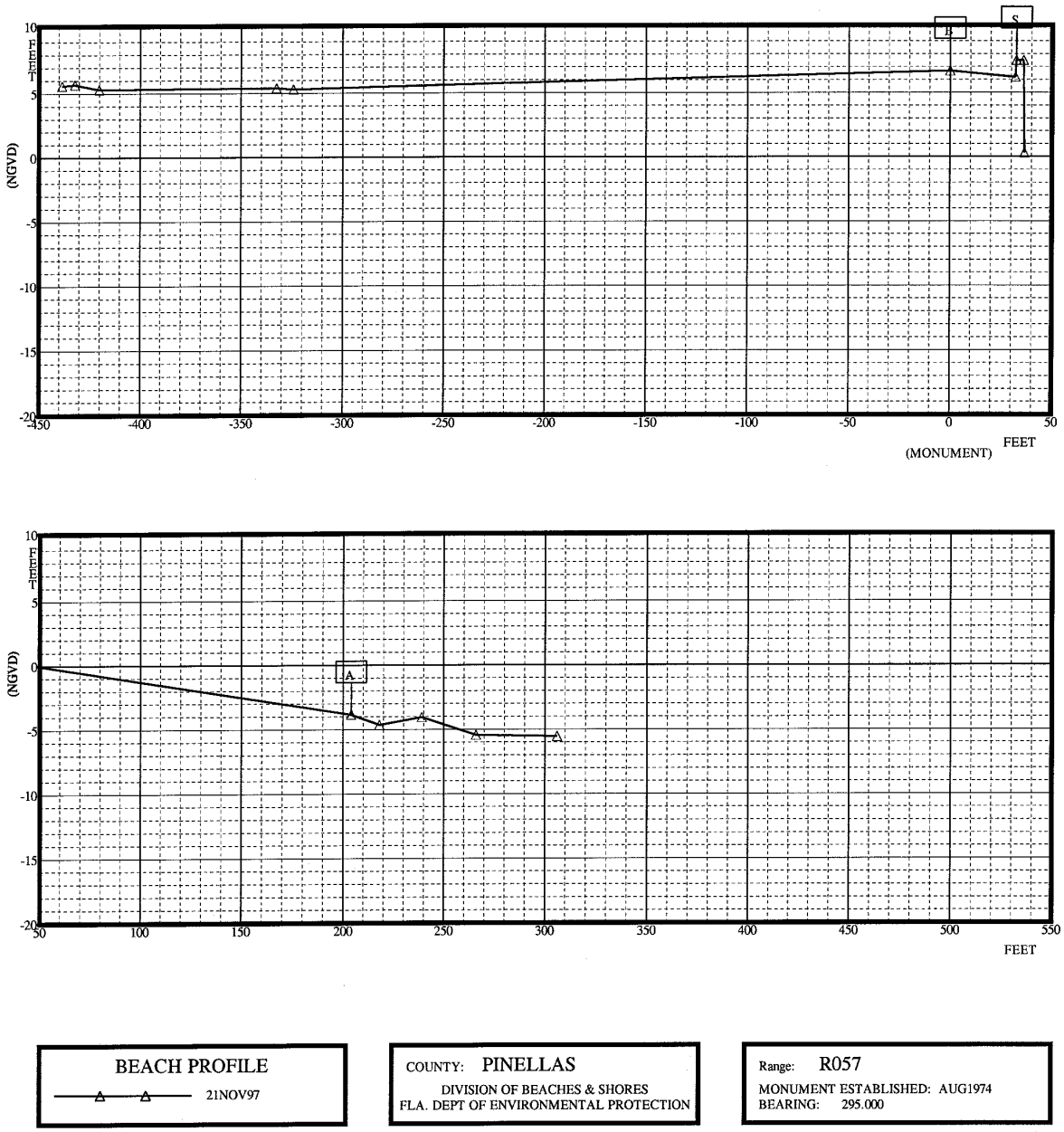
V-vegetation, SW-sea wall, R-rocks, B-building, CC-CCCL line

Figure A3b Beach Profile at Range No. 39 (R-39)



V-vegetation, SW-sea wall, R-rocks, B-building, CC-CCCL line

Figure A4 Beach Profile at Range No. 44 (R-44)



V-vegetation, SW-sea wall, R-rocks, B-building, CC-CCCL line

Figure A5 Beach Profile at Range No. 57 (R-57)

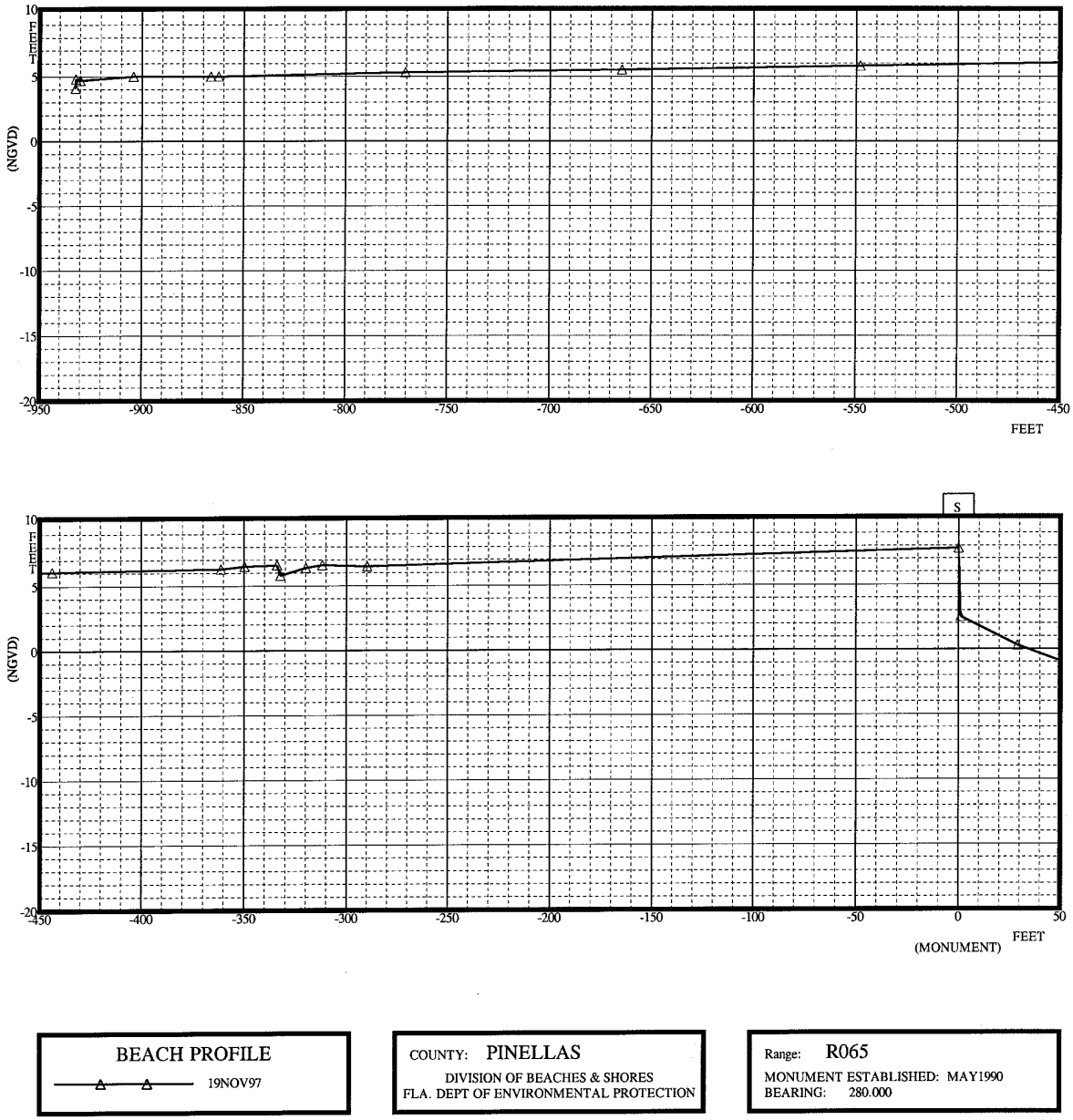


Figure A6 Beach Profile at Range No. 65 (R-65)

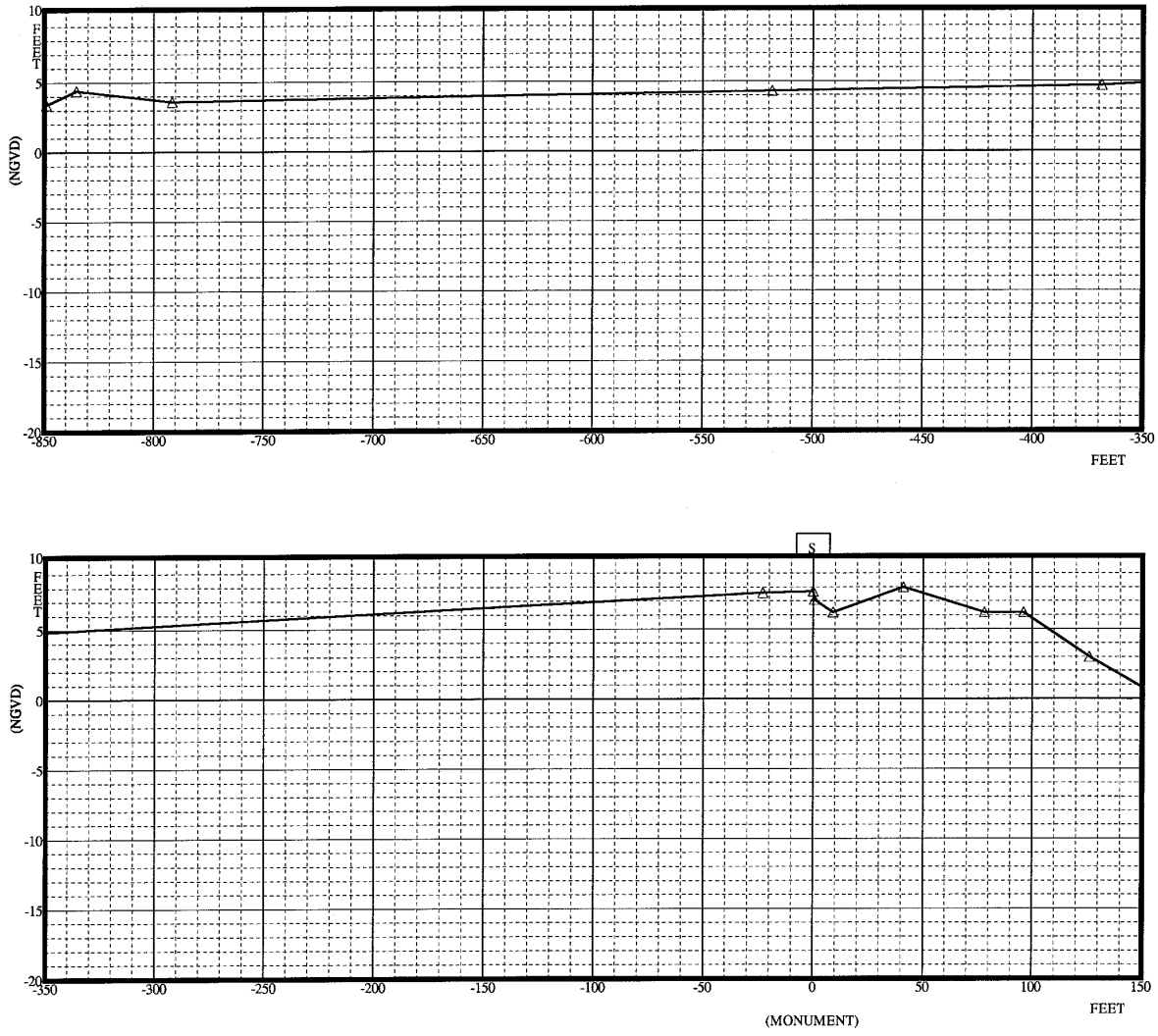


Figure A7 Beach Profile at Range No. 79 (R-79)

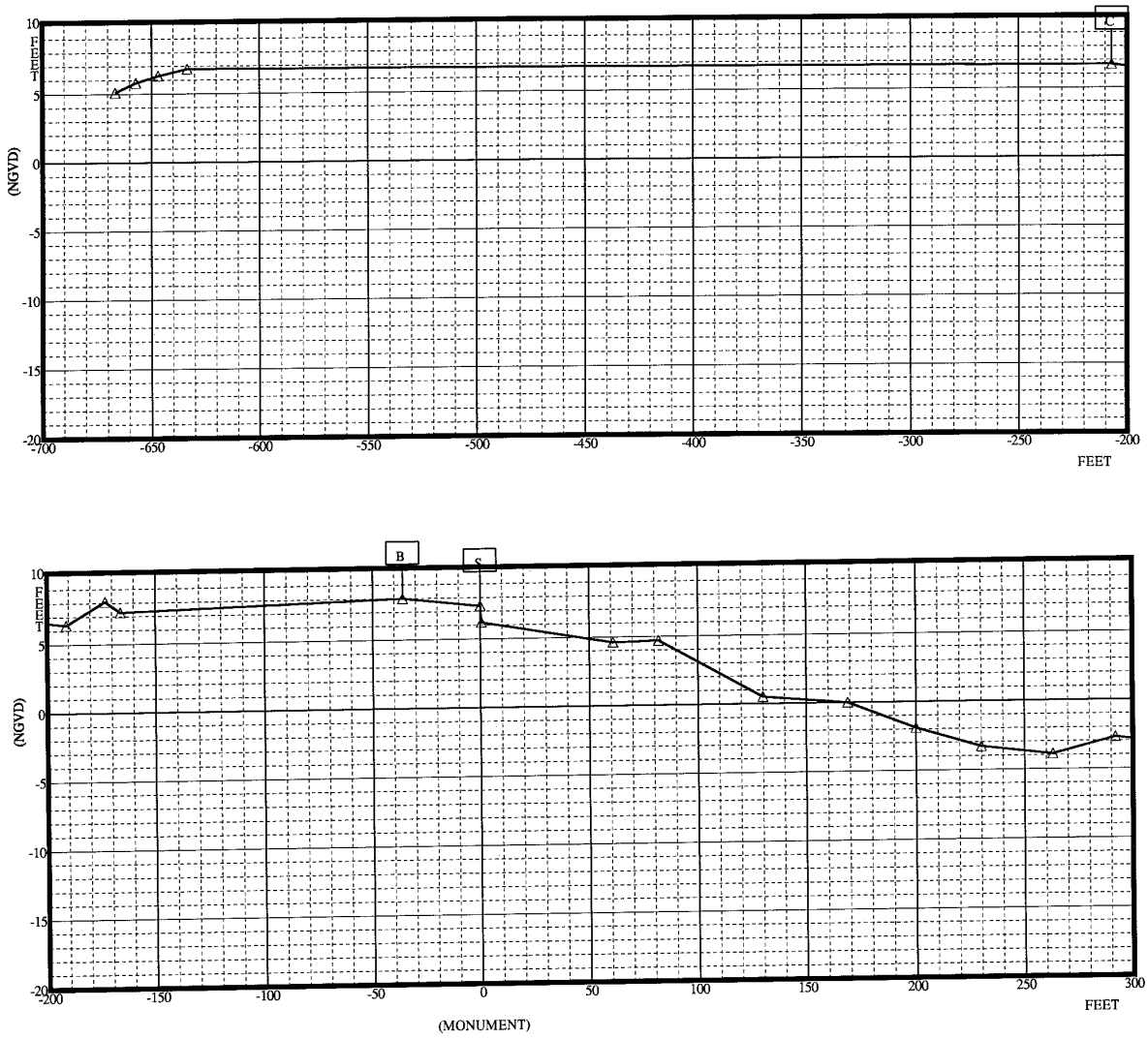


Figure A8 Beach Profile at Range No. 94 (R-94)

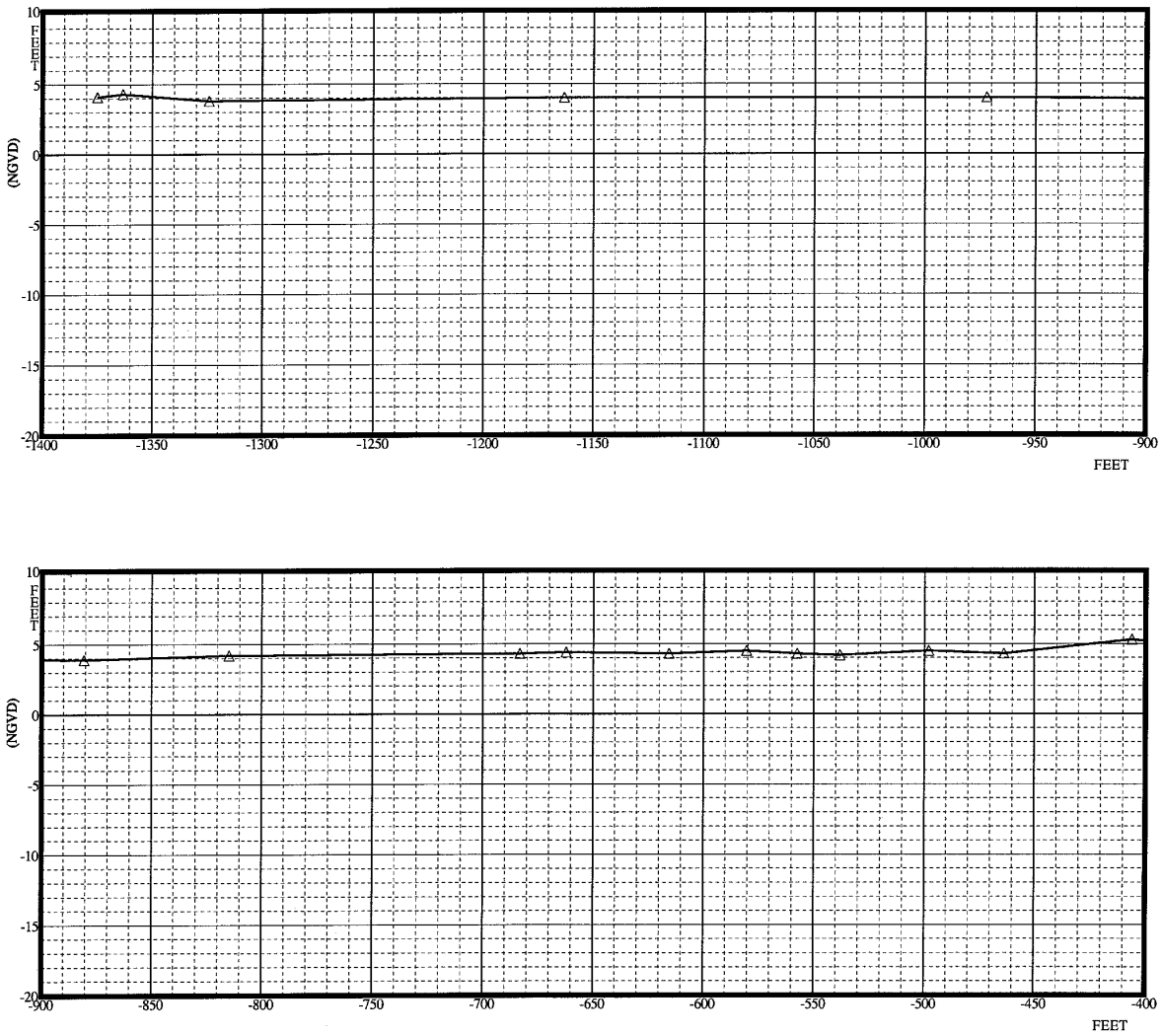
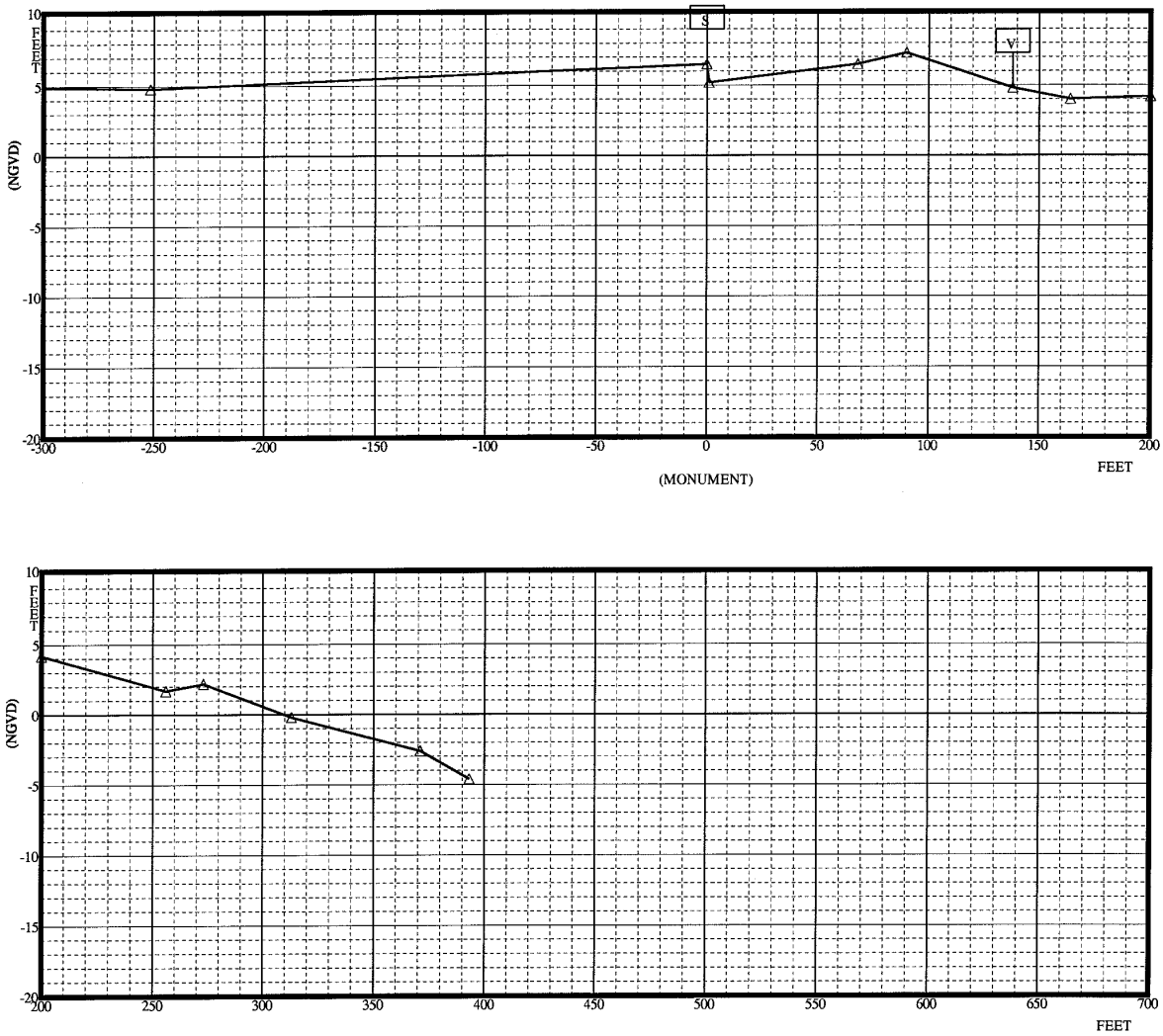


Figure A9a Beach Profile at Range No. 106 (R-106)



BEACH PROFILE

07NOV97

COUNTY: PINELLAS

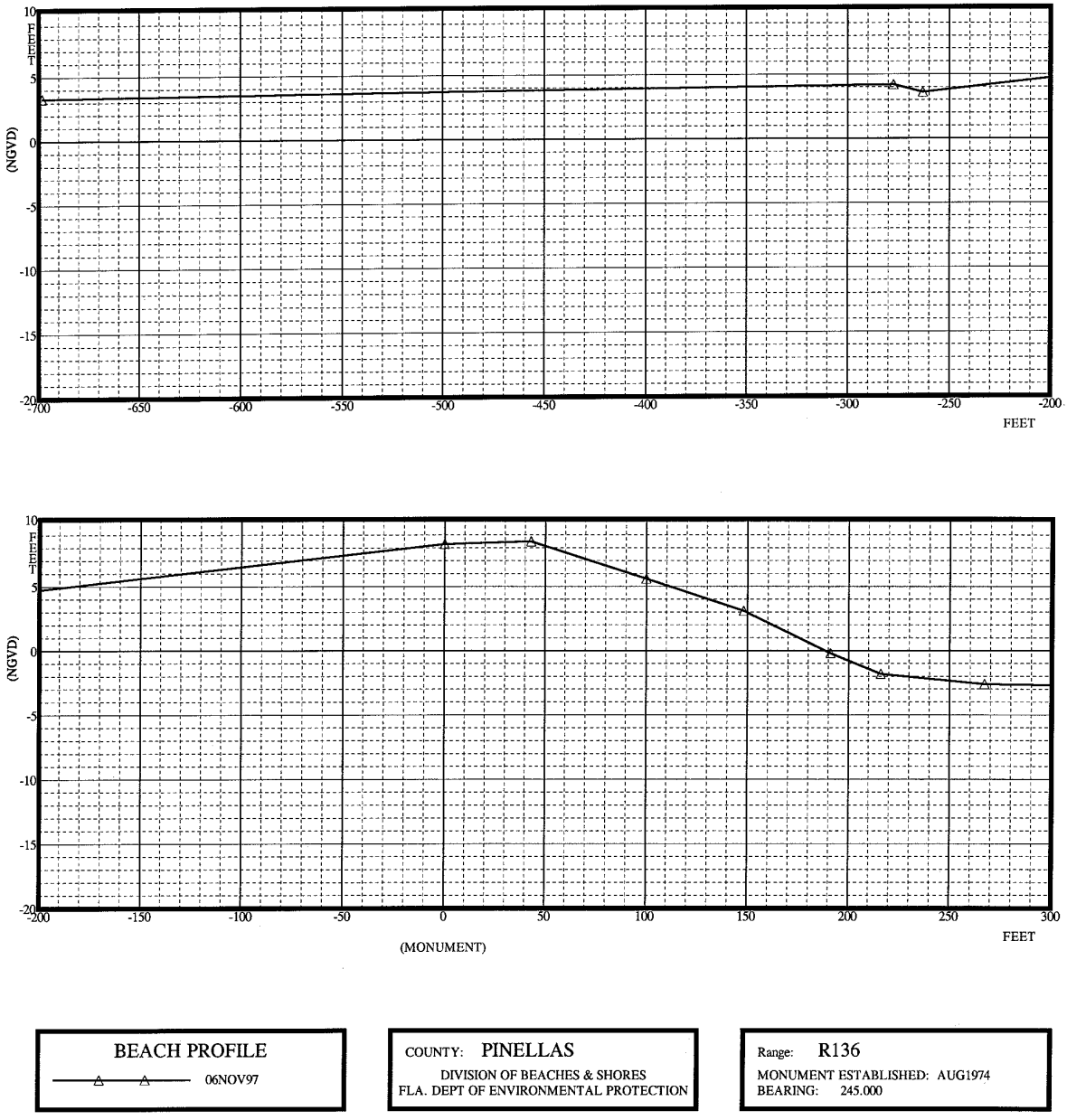
DIVISION OF BEACHES & SHORES
FLA. DEPT OF ENVIRONMENTAL PROTECTION

Range: R122

MONUMENT ESTABLISHED: MAY1990
BEARING: 230.000

V-vegetation, SW-sea wall, R-rocks, B-building, CC-CCCL line

Figure A10 Beach Profile at Range No. 122 (R-122)



V-vegetation, SW-sea wall, R-rocks, B-building, CC-CCCL line

Figure A11 Beach Profile at Range No. 136 (R-136)

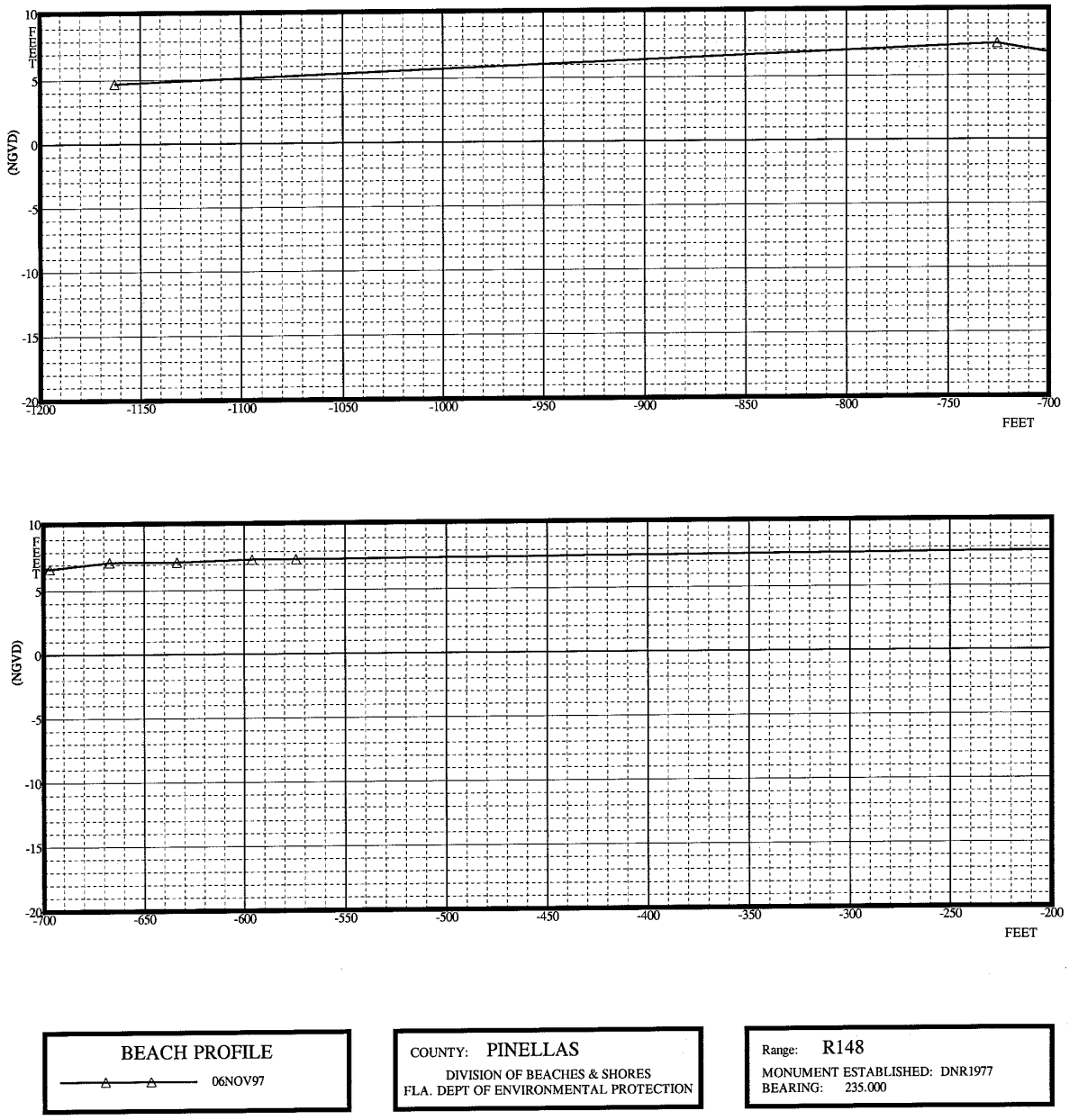


Figure A12a Beach Profile at Range No. 148 (R-148)

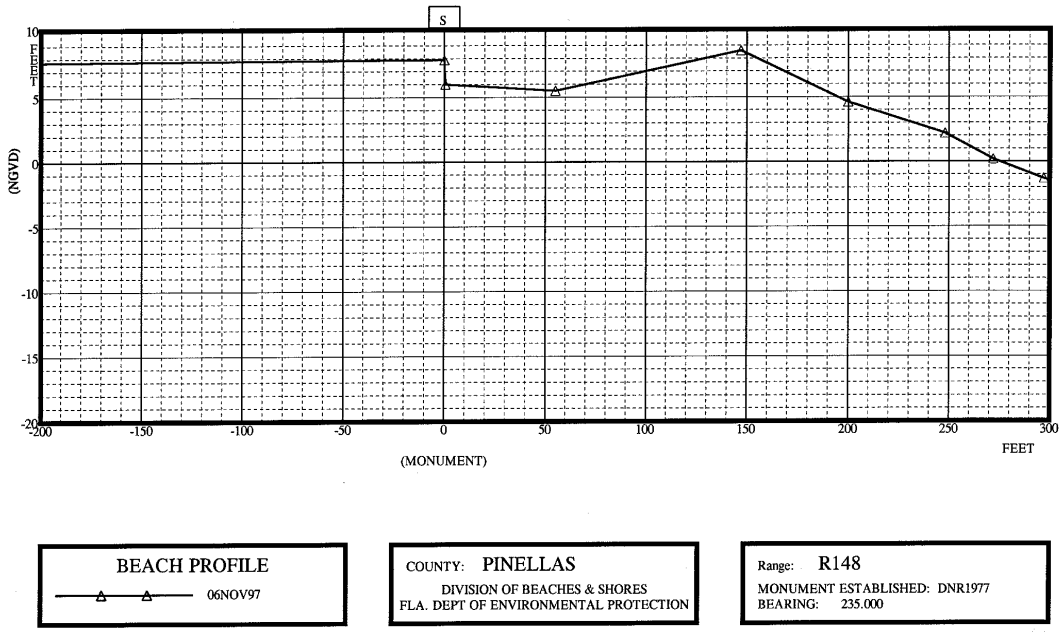


Figure A12b Beach Profile at Range No. 148 (R-148)

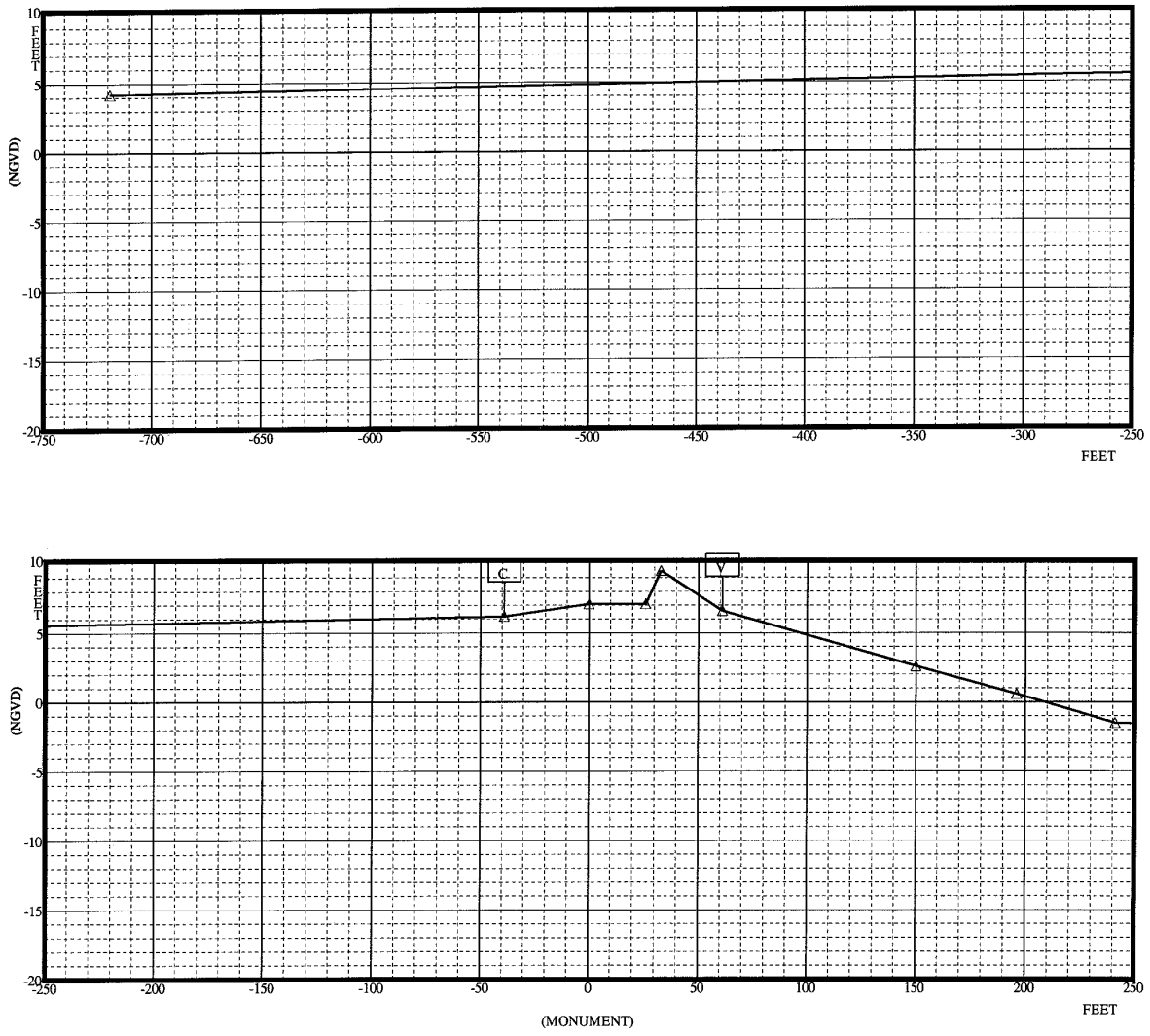
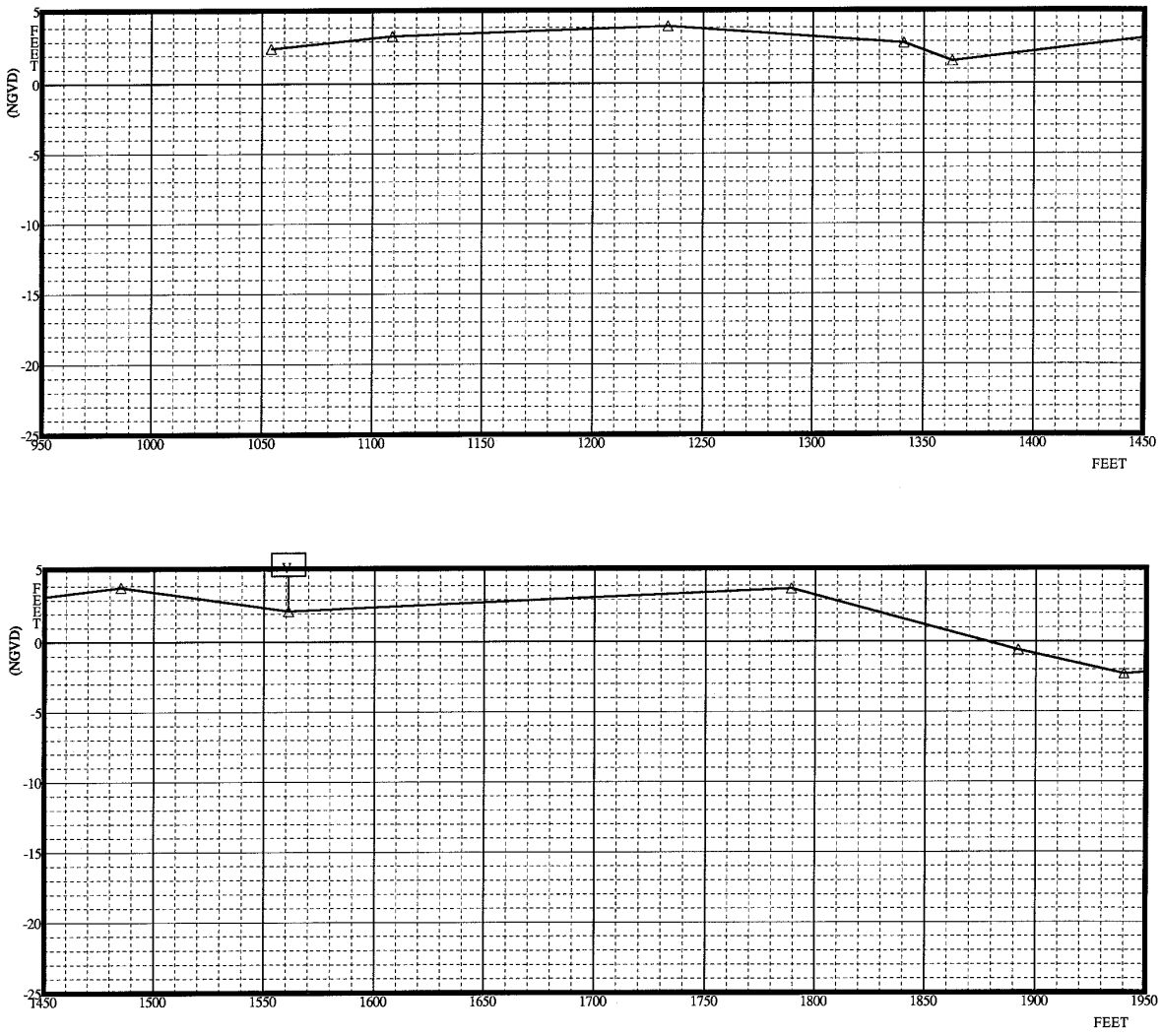
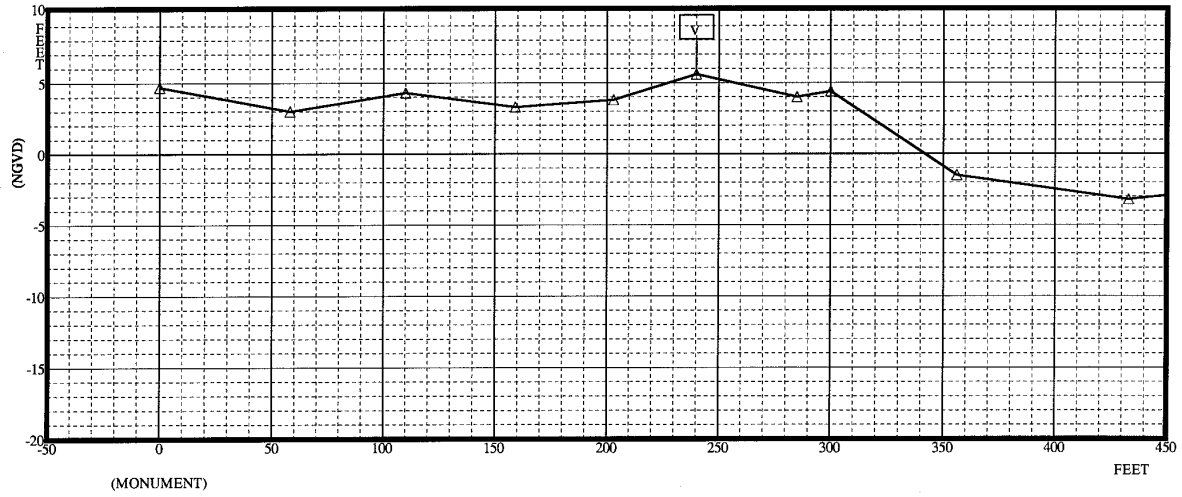


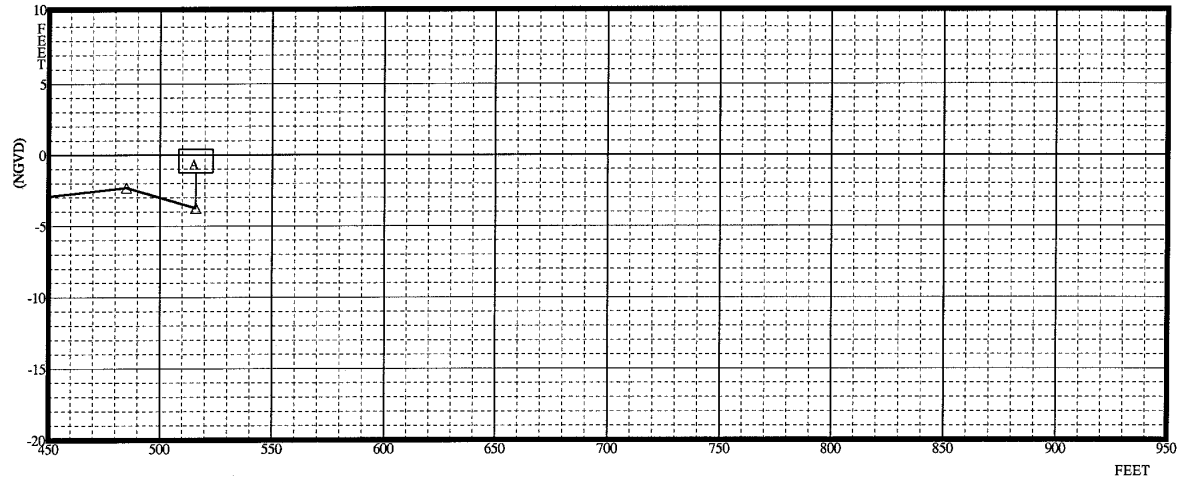
Figure A13 Beach Profile at Range No. 163 (R-163)



V-vegetation, SW-sea wall, R-rocks, B-building, CC-CCCL line

Figure A14 Beach Profile at Range No. 173 (R-173)





BEACH PROFILE

04NOV97

COUNTY: PINELLAS

DIVISION OF BEACHES & SHORES
FLA. DEPT OF ENVIRONMENTAL PROTECTION

Range: R187

MONUMENT ESTABLISHED: DNR1977
BEARING: 155.000

V-vegetation, SW-sea wall, R-rocks, B-building, CC-CCCL line

Figure A15 Beach Profile at Range No. 187 (R-187)

APPENDIX B

TABLE OF LOCATION OF CCCL FOR PINELLAS COUNTY

Pinellas County – revised CCCL distances December 2000

Range No.	CL. Dist. (ft.)	Guid. Crit.	Range No.	CL. Dist. (ft.)	Guid. Crit.	Range No.	CL. Dist. (ft.)	Guid. Crit.
R-1	-595	W	R-32	existing		R-63	-179	E
R-2	-920	W	R-33	existing		R-64	-185	E
R-3	-830	bridged	R-34	existing		R-65	-150	E
R-4	-700	W	R-35	existing		R-66	-106	E
R-5	-510	W	R-36	-46	E	R-67	-97	E
R-6	-1200	W	R-37	-104	E	R-68	-70	E
R-7	-1350	W	R-38	-131	E	R-69	-66	E
R-8	-795	W	R-39	-80	E	R-70	-52	E
R-9	-725	W	R-40	-36	E	R-71	-10	E
R-10	-1060	W	R-41	-67	E	R-72	-58	E
R-11	-1030	W	R-42	9	E	R-73	-103	E
R-12	-1195	W	R-43	-11	E	R-74	-50	E
R-13	-775	W	R-44	-20	E	R-75	-45	E
R-14	x		R-45	-254	W	R-76	-40	E
R-15	x		R-46	-146	W	R-77	-37	E
R-16	x		R-47	-190	E	R-78	-23	E
R-17	x		R-48	-87	E	R-79	-20	E
R-18	x		R-49	34	E	R-80	-41	E
R-19	x		R-50	-39	E	R-81	12	E
R-20	-510	W	R-51	missing		R-82	-30	E
R-21	-540	W	R-52	existing		R-83	-135	E
R-22	-500	W	R-53	existing		R-84	-125	E
R-23	existing		R-54	existing		R-85	-130	E
R-24	existing		R-55	-38	E	R-86	-130	E
R-25	-1250	W	R-56	-115	E	R-87	-92	E
R-26	-1475	W	R-57	-200	E	R-88	-105	E
R-27	-1470	W	R-58	-232	E	R-89	10	E
R-28	-1720	bridged	R-59	x	bridged	R-90	-54	E
R-29	-1460	W	R-60	-122	E	R-91	-86	E
R-30	-1375	W	R-61	-190	E	R-92	-67	E
R-31	-1340	W	R-62	-185	E	R-93	-92	E

Pinellas County – revised CCCL distances December 2000

Range No.	CL. Dist. (ft.)	Guid. Crit.
R-94	-80	E
R-95	-90	E
R-96	-84	E
R-97	-134	E
R-98	42	E
R-99	-146	E
R-100	-96	E
R-101	-39	E
R-102	23	E
R-103	-125	E
R-104	-209	E
R-105	-175	E
R-106	-235	E
R-107	-215	E
R-108	60	E
R-109	-198	E
R-110	-112	E
R-111	-210	E
R-112	-105	E
R-113	-190	E
R-114	-196	E
R-115	-249	E
R-116	22	E
R-117	0	E
R-118	0	W
R-119	-118	E
R-120	48	W
R-121	-46	W
R-122	-47	W
R-123	existing	
R-124	-192	W
R-125	-10	W
R-126	-260	E
R-127	-135	E
R-128	49	E
R-129	-315	W
R-130	-173	W
R-131	-103	W
R-132	-42	W
R-133	-101	W
R-134	-91	W
R-135	-86	E
R-136	-175	E
R-137	-40	W
R-138	-100	E
R-139	-76	E
R-140	-11	E
R-141	-41	E
R-142	existing	
R-143	existing	
R-144	-185	W
R-145	21	E
R-146	-130	E
R-147	existing	
R-148	-65	E
R-149	-118	E
R-150	-32	E
R-151	-51	W
R-152	-131	W
R-153	-109	W
R-154	-93	E
T-155	19	E
R-156	-60	E
R-157	-91	W
R-158	-100	W
R-159	-110	bridged
R-160	-148	E
R-161	-215	E
R-162	-257	E
R-163	-218	E
R-164	-66	E
R-165	-66	E
R-166	-120	E
R-167	x	
R-168	x	
R-169	-2680	W
R-170	x	
R-171	-1760	W
R-172	-410	W
R-173	-145	W
R-174	-130	W
T-175	existing	
R-176	existing	
T-177	existing	
T-178	existing	
R-179	x	
R-180	x	
R-181	x	
R-182	-770	W
R-183	-550	W
R-184	-600	bridged
R-185	-690	W
R-186	-660	W

Pinellas County – revised CCCL distances December 2000

Range No.	CL. Dist. (ft.)	Guid. Crit.	Range No.	CL. Dist. (ft.)	Guid. Crit.	Range No.	CL. Dist. (ft.)	Guid. Crit.
R-187	-645	W						
R-188	-680	W						
R-189	-750	W						
R-190	-415	W						
R-191	-855	W						
R-192	-680	W						

LEGEND:

1. E or w indicates erosion or wave criterion, respectively, used to locate the CCCL.

2. x indicates that neither the erosion nor wave criterion was used to locate the CCCL.