FY '91 Task 55

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VA Coastal Resources Mgt. Program

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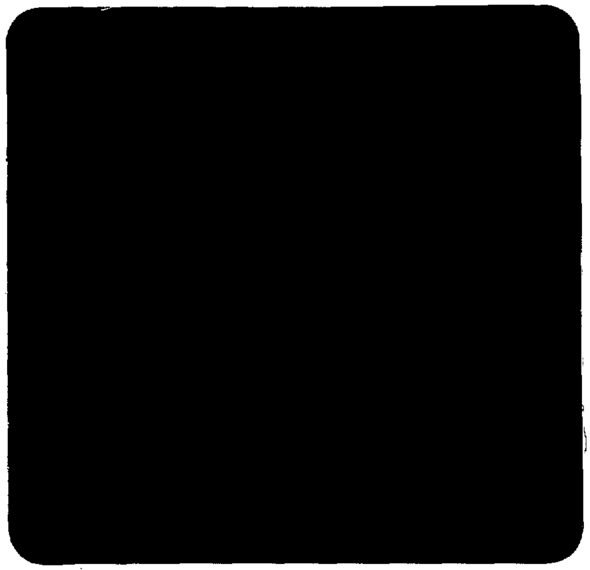

URS CONSULTANTS

Hampton Shoreline
Coastal
Resources Management
Monitoring and Performance
Report

Prepared For:

City of Hampton

Under a Grant From:

The Virginia Council on the Environment

November 1992

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HAMPTON SHORELINE
COASTAL RESOURCES MANAGEMENT
MONITORING AND PERFORMANCE REPORT

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November, 1992

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INTRODUCTION

The shoreline of Hampton extends approximately five and a half miles along the Chesapeake Bay and includes Buckroe Beach, Salt Ponds Beach, White Marsh and Grandview (see Figure 1.) The southern beaches, Buckroe and Salt Ponds are separated from the northern beaches of White Marsh and Grandview by Salt Ponds Inlet. Salt Ponds Inlet is a dredged and stabilized navigational channel which provides recreational boat access between the Salt Ponds and the Chesapeake Bay. Fort Monroe, which supports a federally owned shoreline, extends an additional 2.8 miles south of Buckroe Beach.

The shoreline along the city of Hampton is oriented approximately 17 degrees north. Local tides are semi-diurnal with a mean range of approximately 2.5 ft. As a result of the shoreline orientation and location, the Hampton beaches are exposed to waves from both the north-northeast and the east-southeast. Rosen (1976) suggested that the winds vary directionally with the seasons. During the winter, prevailing winds are from the northwest, while during the summer winds are predominantly from the southwest. Windroses local to the area indicate that winds occur from the southwest approximately 48 percent of the time and from the northeast with a frequency of 25 percent. The strongest winds, however, are from the northern quadrant. Since these winds blow across the longest fetch area, they typically have the greatest affect on the Hampton City beaches. Rosen (1976) suggested that waves created by these wind fields generate an increase in the longshore sediment transport to the south and are probably responsible for the majority of the erosion along these beaches.

HISTORICAL SHORELINE CHANGE

Espey, Huston and Associates, Inc. and Langley and McDonald (1988) provide rates of shoreline change for various reaches along the Hampton beaches. Shoreline positions from bathymetric charts and topographic maps dated 1853 and 1965 were analyzed at 1000 ft intervals to determine patterns of erosion and accretion. Note, however, that these patterns of shoreline change were documented prior to the construction of several shoreline protection structures along the beaches, as well as the stabilization of Salt Ponds Inlet in 1979. The groins, bulkhead, and jetty along the shoreline can significantly alter natural coastal

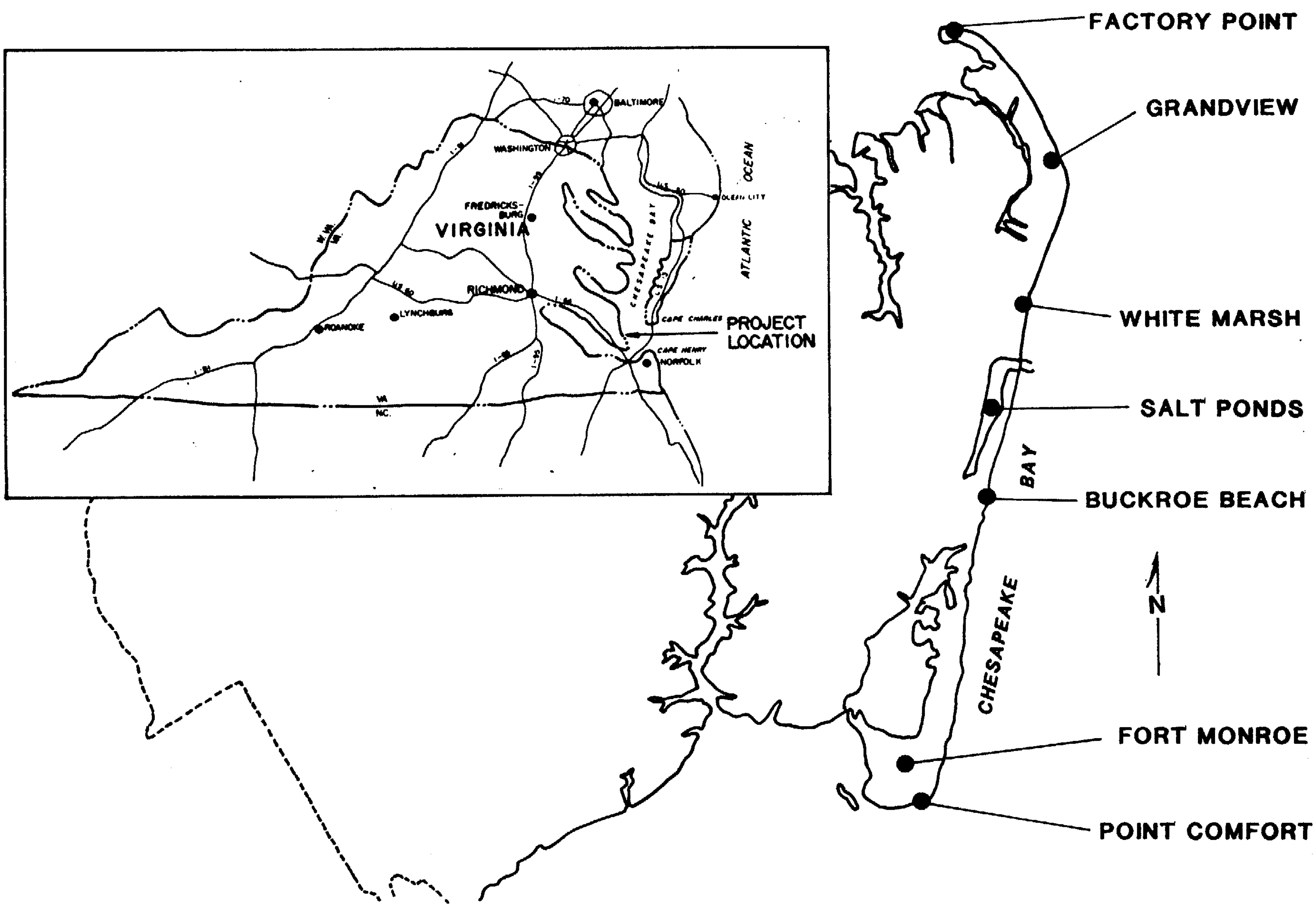


FIGURE 1: SITE LOCATION MAP OF THE HAMPTON CITY BEACHES.

processes and therefore affect patterns of erosion and accretion. The net longshore transport along the Hampton shoreline is to the south; the only reported exception is in the vicinity of Lighthouse Point where there is a reversal to the north.

The southernmost section of shoreline along Hampton is Dog Beach which is part of the Fort Monroe shoreline. Historical shoreline rates suggest that this area has been eroding at rates of -1.5 to -2.0 ft/yr. Similarly, Buckroe Beach, to the north has eroded at approximately -2.0 ft/yr. Rates of erosion continue to increase to the north. Salt Ponds Beach (just south of Salt Ponds Inlet) has eroded at approximately -3.5 ft/yr. Due to the interruption of the southerly transport across the inlet, this rate of erosion has probably increased since the time of construction of the north jetty at the entrance. Conversely, White Marsh which historically eroded at -4.5 ft/yr has probably experienced a decrease in recession as a result of impounded sediment on the north jetty. Grandview continues to support the highest rates of erosion with rates averaging between -5.0 and -6.0 ft/yr. (The northernmost tip of Lighthouse Point is the only segment of beach that showed any accretion. This northern tip is, however, very unstable and can accrete, as well as rapidly erode.)

BUCKROE BEACH

The most readily available beach in terms of public access and parking in the City of Hampton is Buckroe Beach which extends from Buckroe Fishing Pier to Pilot Avenue (see Figure 2.) This beach is easily reached via several major roads including Mallory Street and Pembroke Avenue. Buckroe Beach fronts approximately .75 miles along the Chesapeake Bay and supports Buckroe Park, a city park with public parking and beach facilities. As a result, this public area supports the greatest density of recreational activity.

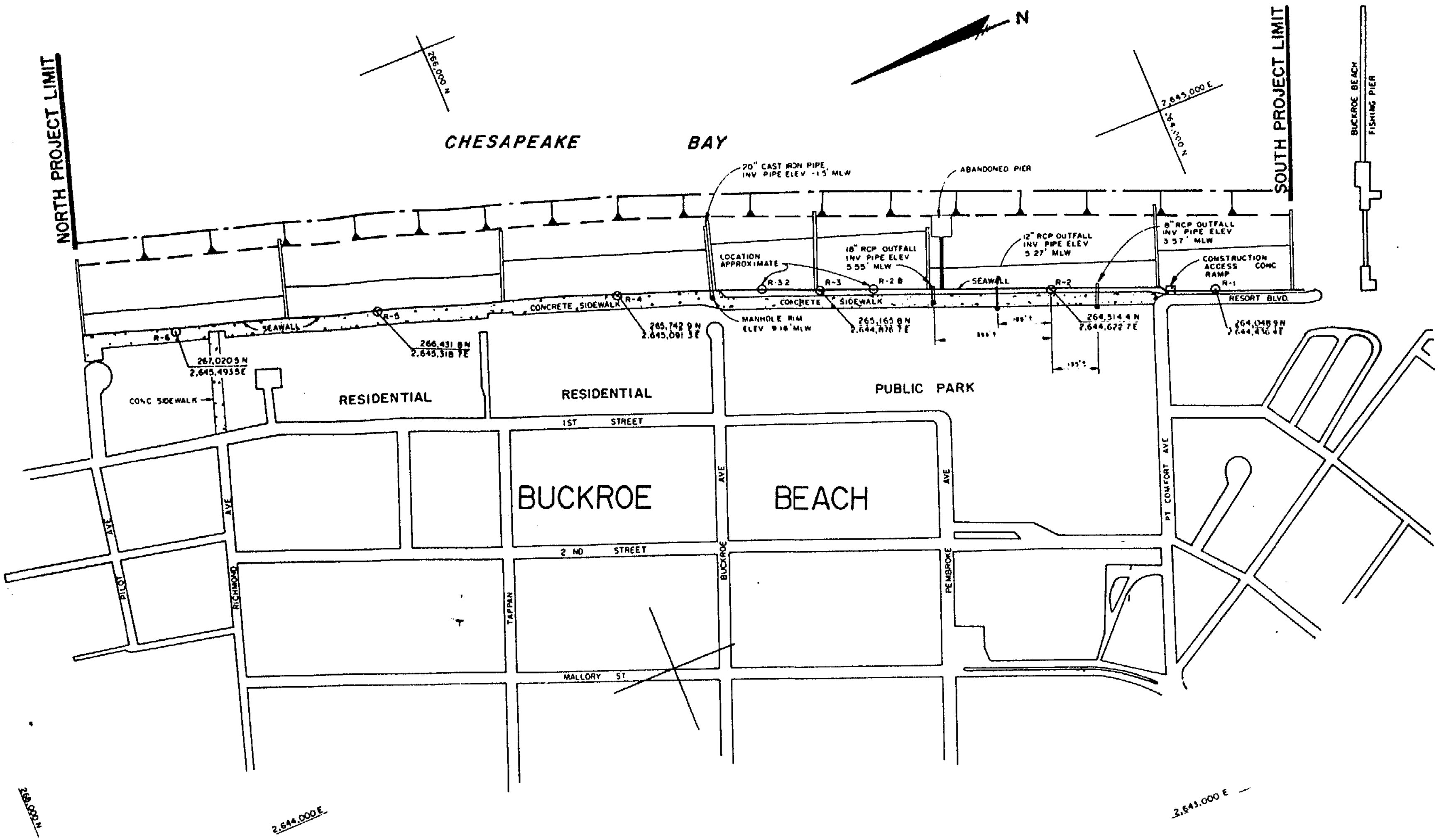


FIGURE 2: LOCATION MAP OF BUCKROE BEACH IN HAMPTON, VIRGINIA. (REVISED FROM COASTAL PLANNING AND ENGINEERING, INC.)

As previously stated, Espey, Huston, et al. (1988) evaluated shoreline change along the Hampton beaches using bathymetric charts and topographic maps dating from 1855 to 1965. The results of this analysis indicated that the shoreline fronting Buckroe Beach eroded at an average rate of approximately -2.0 ft/yr. Beach profiles surveyed between 1974 and 1988 by the City of Hampton were also analyzed to determine shoreline erosion. These data primarily document the influence of small emergency beach fill projects. Since the surveys were often measured after the projects, the data generally indicate that the beach accreted. However, if the time period 1976 to 1986 is analyzed (a period without nourishment), the average background erosion rate is approximately -1.5 ft/yr. This background rate corresponds closely to the historical rate of erosion as reported by Espey, Huston, et al. (1988). Therefore, Buckroe Beach is characterized by moderate erosion experiencing average rates of -1.5 to -2.0 ft/yr. Storms, however, especially the northeasters have a significant impact on the City's beaches and various structural solutions have been constructed to protect upland areas from high tides and wave impact.

SHORELINE PROTECTION STRUCTURES

Espey, Huston, et al. (1988) reported on the existing shoreline protection structures along the coast of Hampton, Virginia. An assessment was provided regarding the condition and predicted life of the structures at the time of the report. The primary structures along the project area include timber and sheetpile groins, a timber bulkhead with a concrete cap, and a rock jetty on the north side of Salt Pond inlet. Figure 3 depicts the approximate location and extent of the structures along the limits of the project area.

Within the limits of Buckroe Beach there are seven (7) existing timber groins of varying lengths ranging from 210 ft to 350 ft. Reportedly, these structures were built during the mid to late 1960's. Additional groins exist to the south and north of the fill area with the northernmost groin flanking the south side of Salt Ponds Inlet. In the 1988 report, Espey, Huston, et al. assessed the groins to be in generally poor condition as much of the sheeting between the piles had deteriorated by that time, thus limiting the effectiveness of each structure. The proposed structure life was estimated at up to five (5) years, which currently puts the groins near the end of the proposed time limit of effectiveness.

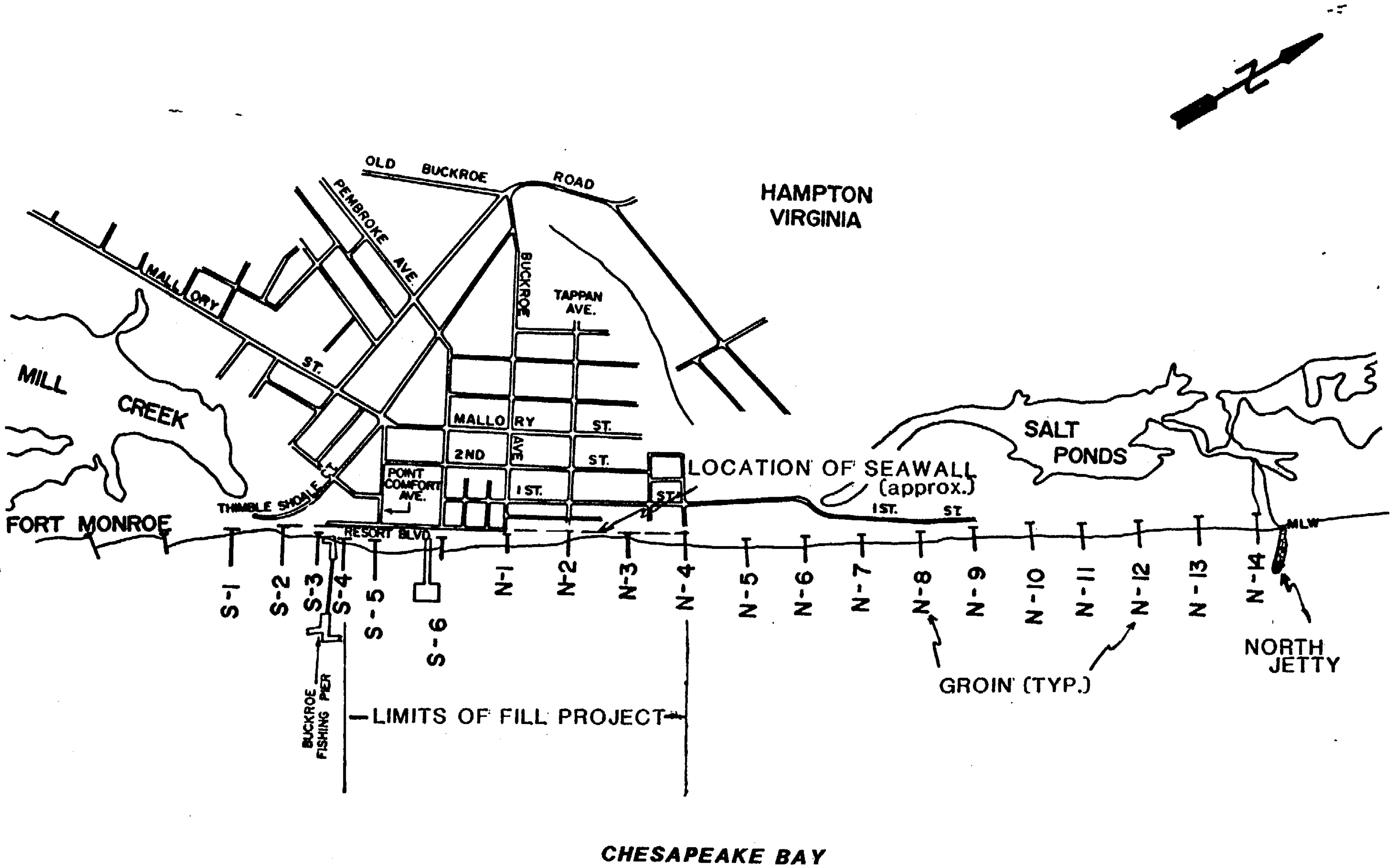


FIGURE 3:
LOCATION OF SHORELINE PROTECTION STRUCTURES IN THE VICINITY OF BUCKROE BEACH.
(REVISED FIGURE FROM ESPEY-HUSTON, 1988).

A timber bulkhead with a concrete cap extends the length of the fill area. The bulkhead also supports a concrete walkway which serves as a boardwalk. It is estimated that the bulkhead was constructed during 1967 (Mann, Curtis, and Daniel, 1992.) Espey, Huston, et al. (1988) assessed the condition of the bulkhead as fair with some deterioration at the toe. The majority of the cap was in fair to good condition; however, the cap was cracked at several places in the vicinity of Tappan and Pilot Avenues. The proposed remaining life of the timber bulkhead was an additional fifteen years. Few repairs were recommended.

Coastal Planning and Engineering, Inc. (1992) reported that the entrance channel at Salt Ponds inlet was dredged and stabilized with a rock jetty in 1979. Project plans specified that the entrance channel should have a bottom width of 250 ft and a controlling depth of at least -6 ft MLW. Prior to construction, the channel was shifted southward from its original proposed location to take advantage of an existing groin which would supposedly aid in the stabilization of the south side of the inlet. Espey, Huston, et al. (1988) reported that the north jetty was in good condition and that the it should provide adequate protection in excess of 20 years. More recently, CPE (1992) suggested that the jetty appeared sand-tight, with the major mode of sand transport into the inlet occurring around the end of the jetty. CPE (1992) also reported that the timber groin stabilizing the south side of the inlet should be replaced with a steel sheet pile jetty with a concrete cap. Additionally, it was suggested that the terminal groin should have a crest elevation of 6 ft MLW and extend 100 ft seaward of its current length. Reportedly, in September of 1992, City forces repaired the south groin.

BEACH NOURISHMENT

In more recent years, beach nourishment activities have been conducted to alleviate erosion problems along the beach, as well as to provide storm protection. In a letter to consultants, Daniel (1989) provided information on fill activity prior to the nourishment project of 1990. There have been four such projects that were documented. In 1975/1976 Hampton City records indicate that approximately 20,000 cy of sand were placed along Buckroe Beach between Beach Avenue and Pilot Avenue. Approximately 13,000 cy were placed along this same area in 1986. In 1987, more than 80,000 cy of sand were dredged from the channel at Salt Ponds Inlet and hydraulically pumped to the beaches between Pilot Avenue and Buckroe Avenue. Finally, in 1988, due to the erosion resulting from a spring storm, 5,000 cy of sand were placed along a critical section of beach between Pembroke Avenue and Point Comfort Avenue.

As a result of the erosion along Buckroe Beach and the shoreline's susceptibility to storm damage, the City of Hampton determined that Buckroe Beach supported a need for beach nourishment and the construction of a proposed 224,000 cy project was initiated in July, 1990.

FILL DESIGN

Coastal Planning and Engineering, Inc. designed the Buckroe Beach project to provide storm protection against a 10-year storm condition along the fill area throughout a 10-year project life. Figures 2 and 4 show the project area and the typical cross-sectional design of the fill profile, respectively. The berm was designed to a fill elevation of 7.3 ft MLW which is the expected peak water level expected from a 10-year storm. A 52 ft beach width at that elevation was required to protect the existing bulkhead from storm damage. In order to account for background erosion and fill equilibration, a design width of 227 ft relative to the bulkhead (or 200 ft relative to existing conditions) was suggested for the 10-year project life. Approximately 224,000 cy was required to fill the design template along the 3700 ft length of the nourishment area.

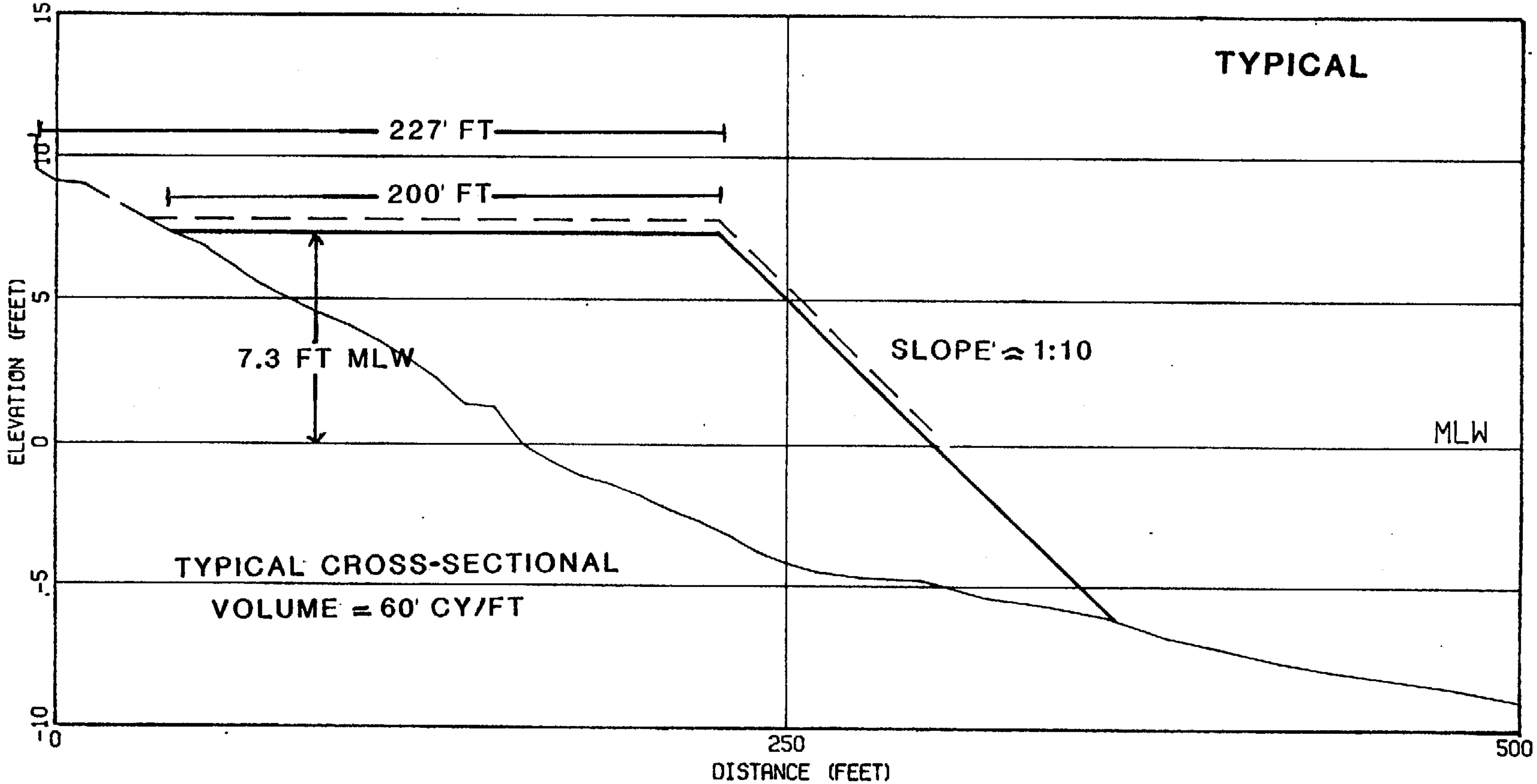


FIGURE 4: TYPICAL CROSS-SECTIONAL DESIGN FOR BUCKROE BEACH NOURISHMENT.

BORROW AREA

The borrow area was located on Horseshoe Shoal approximately two miles east of Buckroe Beach (see Figure 5.) Initially, the area was designated as a potential source for beach quality material through a Sand Resources Inventory as performed by Virginia Institute of Marine Science (VIMS). A more complete geotechnical investigation completed in October, 1989 by Coastal Planning and Engineering and EXMAR identified an area along the shoal that contained approximately 4.18 million cubic yards of quality fill material. The design dredge area was 1000 ft long by 1200 ft wide and the dredge depth was set at 10.5 ft below the seabed. Sediment cores sampled within the borrow site indicated that 4 to 5 ft of fine quartz sand was overlying approximately 10 to 12 ft of coarse quartz sand. The composite sediment characteristics of the borrow material were a mean grain size of 0.4 mm with 5 to 6 percent fines, while the native beach material at the project site was characterized by a mean grain size of .28 mm and 1 to 2 percent fines.

At the time of the October, 1989 geotechnical investigation, a benthic survey was also conducted by VIMS to determine negative environmental impacts due to dredging at the borrow site. Results indicated that Horseshoe Shoal was not significantly used by fish or shellfish and there was no subaquatic vegetation in the area. Therefore, the conclusions of the study suggested that benthic resource value was relatively low and while dredging would temporarily destroy the benthic fauna, repopulation would occur within a year.

In order to identify potential "submerged cultural resources", a magnetometer survey was conducted along the borrow area in June, 1990 by Tidewater Atlantic Research, Inc. A single anomaly was targeted which indicated a submerged ferrous object of high mass. This type of anomaly was typical of a small ship anchor, cannon, or boat engine. A recommendation was made to flag this particular section and to notify the dredge operator to stay away from it.

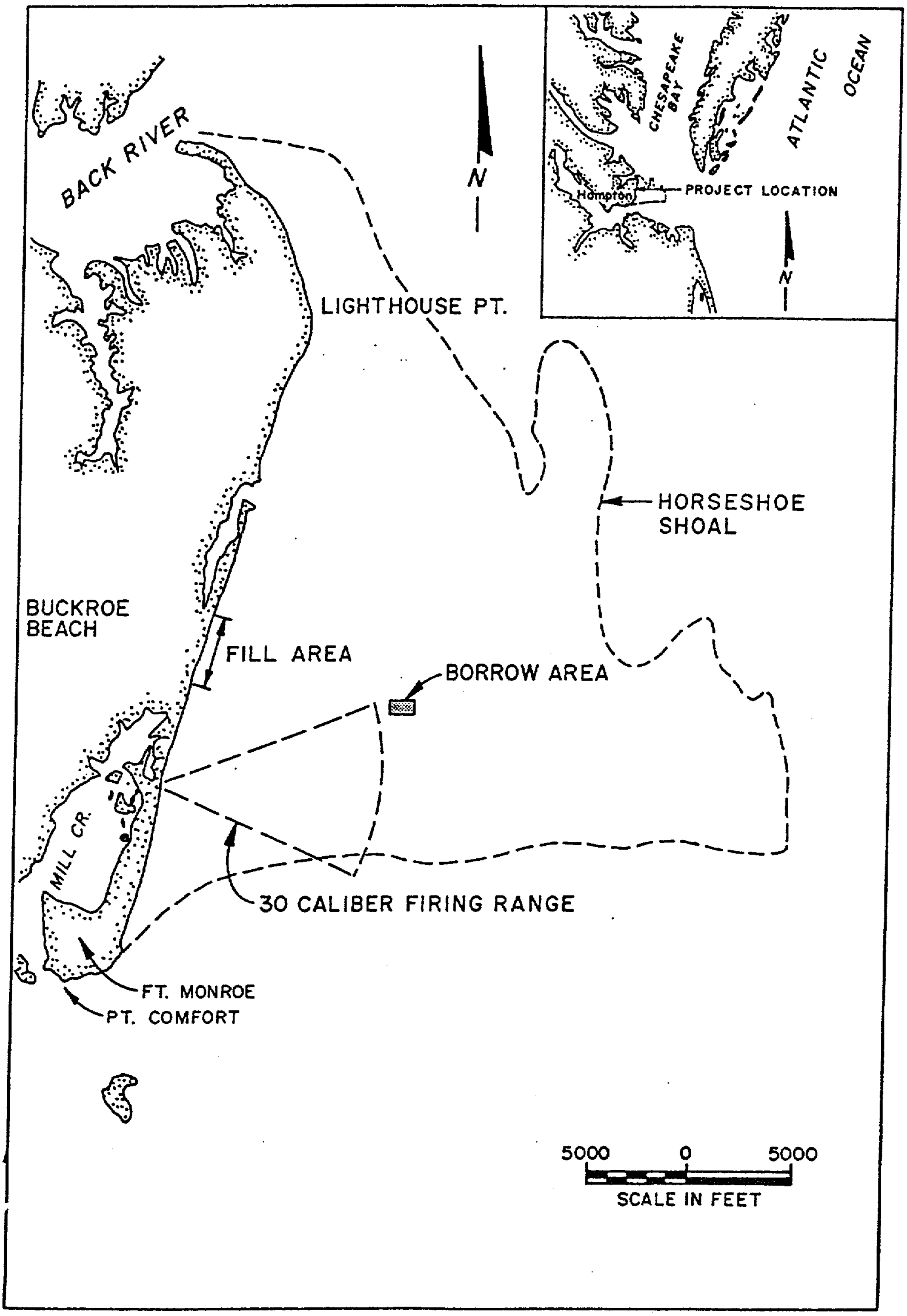


FIGURE 5: LOCATION OF BORROW SITE RELATIVE TO THE FILL AREA (REVISED FROM MANN, ET AL, 1992).

PROJECT CONSTRUCTION

During the last two weeks in July of 1990, Norfolk Dredging positioned the dredge and pipeline at the borrow site and earth moving equipment along the Buckroe Beach shoreline in preparation for construction of the project. Pumping began on the morning of August 3, 1990 at a point approximately 200 feet north of Buckroe Avenue and berm construction progressed southward. Initially, the berm was overfilled to an elevation of 7.8 ft MLW to allow for compaction down to the 7.3 ft MLW template elevation. This over-fill in conjunction with an additional pre-project erosion factor of approximately 8000 cy more than the design pre-project condition greatly increased the amount of sand that was required to finish the original project design volume of 224,000 cy. In order to decrease volume requirements and keep the project within the budget, the southernmost and northernmost sections of the project were redesigned without tolerance for overfill and with a reduced beach width. The project was completed on August 20, 1990.

MILITARY ORDNANCE

The only major problem documented during the construction of the project were the deposition of "shells" or unexploded ordnance and munitions on to the beach from the outfall pipe. Even though the borrow area was positioned several thousand feet from the old bombing target, it was apparently close enough to contain scattered deposits of ordnance. The magnetometer survey conducted prior to project construction failed to locate these "shells." The munitions consisted of a variety of "shells" ranging from 76 mm artillery projectiles to small arms rounds. The age of the munitions ranged from possible civil war relics to a predominance of World War II vintage stock.

Of primary concern was the risk factor for residents and visitors to Buckroe Beach from these munitions. Some of the larger shells found were 'live' meaning that the explosive projectile had not been detonated (the propulsion charge in the shell casing had been spent.) Once the problem became apparent, the beach was temporarily closed and several municipally organized teams, as well as the Corps of Engineers and the U.S. Navy searched the beach for the ordnance and transported them to the Yorktown Naval Weapons Station for proper disposal.

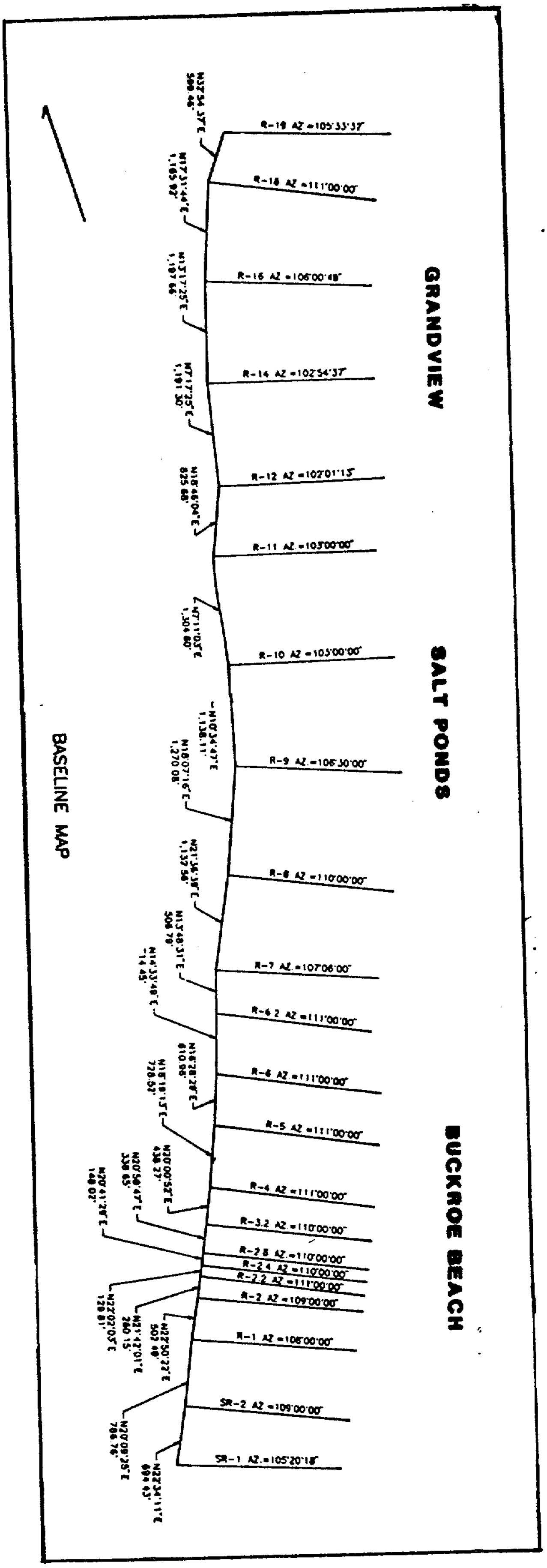
There were continued incidence of ordnance findings both during construction and after the completion of the project. In each case, the proper authorities were notified and the ordnance were removed. A six-month ordnance monitoring program for the beach was initiated and has continued to date.

The U.S. Army Corps of Engineers, who is responsible for oversight and clean-up of these problems, rates the Buckroe project as a significant risk. However, the quantity of high quality fill material, accessibility, and low cost per cubic yard continues to make this particular borrow area a primary choice for future renourishment projects.

SURVEY BASELINE AND MONITORING DATA

A survey baseline has been established along the Hampton City shoreline from the southern limits of Buckroe Beach north to Factory Point (see Figure 6). This baseline includes the survey monuments located within the fill limits (R-1 to R-6), as well as survey control for future monitoring programs along the remainder of the Hampton shoreline to the south and north of the fill project. Figure 6 lists the northing and easting coordinates of each monument along the baseline, as well as the survey azimuth.

The beach berm and intertidal zone were surveyed using a rod and level to measure elevation and a survey tape to measure distance. Survey azimuths of each profile line were established nearly perpendicular to the shoreline. Elevations were generally documented at 20 to 25 foot increments and at slope breaks along the profile. The offshore region was surveyed with a fathometer to measure water depth and a range-azimuth microwave system was used for positioning. The offshore points were then merged with the beach berm and inter-tidal zone survey to complete the profile. The established survey criteria included a minimum depth of 10 ft MLW or at least 1000 ft offshore. Both conditions were satisfied on all profile lines in each survey.



MON	NORTHING	EASTING
S1	262,672	2,643,890
S2	263,313	2,644,156
1	264,051	2,644,428
2	264,514	2,644,623
2.2	264,756	2,644,719
2.4	264,877	2,644,767
2.8	265,015	2,644,820
3.2	265,331	2,644,941
4	265,743	2,645,091
5	266,435	2,645,319
6	267,020	2,645,493
6.2	267,712	2,645,673
7	268,204	2,645,794
8	269,257	2,646,211
9	270,464	2,646,606
10	271,583	2,646,815
11	272,877	2,646,978
12	273,659	2,647,244
14	274,839	2,647,408
16	276,004	2,647,684
18	277,116	2,648,035
19	277,620	2,648,361

FIGURE 6: LOCATION OF BASELINE AND MONUMENTS ALONG THE HAMPTON SHORELINE.

To date, there are five (5) surveys available which document the nourishment project and the performance of the fill. These surveys include the pre-project survey (July, 1990), the post-project survey (August, 1990), and three additional monitoring surveys (May/June, 1991, June/July, 1992, and October, 1992.) The June/July, 1992 survey also established a baseline survey period for profiles at all monuments on the baseline throughout the City of Hampton. All five surveys are presented as a set of comparative profiles for each monument and are located in Appendix A. Appendix A also includes the July, 1992 survey for all monuments along the monitoring baseline.

Profiles were compared and analyzed through time to determine changes in shoreline position, beachface slope, and volume. Volume change calculations for the various survey periods are provided in tables following each monitoring section of this report. Volumes for comparative profiles were calculated relative to three different elevations: above 0 ft MLW, above -5 ft MLW, and above -10 ft MLW. Each table indicates the length of the "volume" cell that is defined by the relevant monument, the cross-sectional volume (cy/ft) at the monument, and the total volume change (cy) for each cell. The cell "volumes" are totalled to provide a change of sediment volume within the limits of the fill project. Two profiles north and south of the project are also included in the tables in an attempt to document movement of sediment. Aerial photography, however, indicates that fill material moved outside the range of monitoring. Estimates are provided which list total volume of fill moving both north and south of the project area.

Profile plots were also compared to locate any potential survey errors (survey "bust") and to determine if corrections were necessary. There did appear to be one potential problem with the survey data. The offshore region of the June, 1991 survey averaged 0.3 ft lower in elevation than the post-project survey. Consequently, the July, 1992 survey generally shows a similar 0.3 ft increase above the June, 1991 offshore (to the approximate post-project offshore elevation.) This indicates a potential bust in the offshore of the June, 1991 survey, especially since any material moving offshore from the equilibration of the nourishment project should have initially increased the offshore depth.

Volume change calculations were conducted using the original offshore as well as the adjusted offshore (an elevation increase of 0.3 ft). The elevation bust does not significantly affect any comparison above the -5 ft MLW contour. The possible bust does potentially affect offshore comparisons directly between the questionable survey data of June, 1991 and any other survey period. This potential error, however, is evened or essentially canceled out after the two years of monitoring. As a result, the profile data and the volume tables include the original offshore data. The individual sections of this report describing performance, however, present the original and the adjusted data for above -10 ft MLW.

FILL MONITORING - JULY 1990 TO AUGUST 1990

The Buckroe Beach nourishment project was completed on August 20, 1990. The final pay volume of the nourishment project was 224,000 cy of sand; however, an estimated 276,000 cy were placed along the beach as a result of over-pumping (Mann, et al. 1992). Figure 7 presents an aerial view (as provided by Virginia Institute of Marine Science) of pre- and post- project conditions. The pre-project photo depicts an extremely recessed shoreline for typical "summer" conditions. The post-project photo shows an extremely wide beach system with relatively no taper north or south of the project.

Table 1 and Figure 8 depict the volume of sand placed within each cell compartment. A comparison of pre- and post-construction profiles (July, 1990 and August, 1990) indicate that approximately 267,000 cy of sand were placed within the fill limits above -5 ft MLW. The volume of sand placed along the dry beach (above 0 ft MLW) was calculated as 188,500 cy and the total volume of sand placed above -10 ft MLW was 285,200 cy. Table 1 does not list an addition of fill material outside the project limits. For the purpose of this monitoring report, it was determined that there was not a significant background volume change during the period of fill construction.

TABLE 1: PRE- AND POST- NOURISHMENT VOLUME CHANGE ALONG BUCKROE BEACH BETWEEN JULY, 1990 AND AUGUST, 1990. NOTE THAT ALL ELEVATIONS ARE RELATIVE TO THE MLW CONTOUR.

MON NO.	LENGTH (FT)	ABOVE 0 FT (CY/FT)	ABOVE -5 FT (CY/FT)	ABOVE -10 FT (CY/FT)	ABOVE 0 FT (CY)	ABOVE -5 FT (CY)	ABOVE -10 FT (CY)
1	405	45.1	71.0	86.5	18266	28755	35033
2	690	62.3	92.8	101.3	42987	64032	69897
2.8	335	54.1	71.8	71.9	18124	24053	24087
3.2	345	50.0	63.5	64.1	17250	21908	22115
4	615	51.6	67.4	68.0	31734	41451	41820
5	660	52.7	79.6	85.0	34782	52536	56100
6	620	40.9	55.2	58.3	25358	34224	36146
ESTIMATED CHANGE WITHIN FILL LIMITS (CY)					**188500**	**266959**	**285197**
SOUTH	0	0.0	0.0	0.0	0	0	0
S1	790	0.0	0.0	0.0	0	0	0
S2	990	0.0	0.0	0.0	0	0	0
ESTIMATED CHANGE SOUTH OF PROJECT (CY)					**0**	**0**	**0**
6.2	675	0.0	0.0	0.0	0	0	0
7	525	0.0	0.0	0.0	0	0	0
NORTH	0	0.0	0.0	0.0	0	0	0
ESTIMATED CHANGE NORTH OF PROJECT (CY)					**0**	**0**	**0**
NET CHANGE THIS SURVEY INTERVAL (CY)					**188500**	**266959**	**285197**

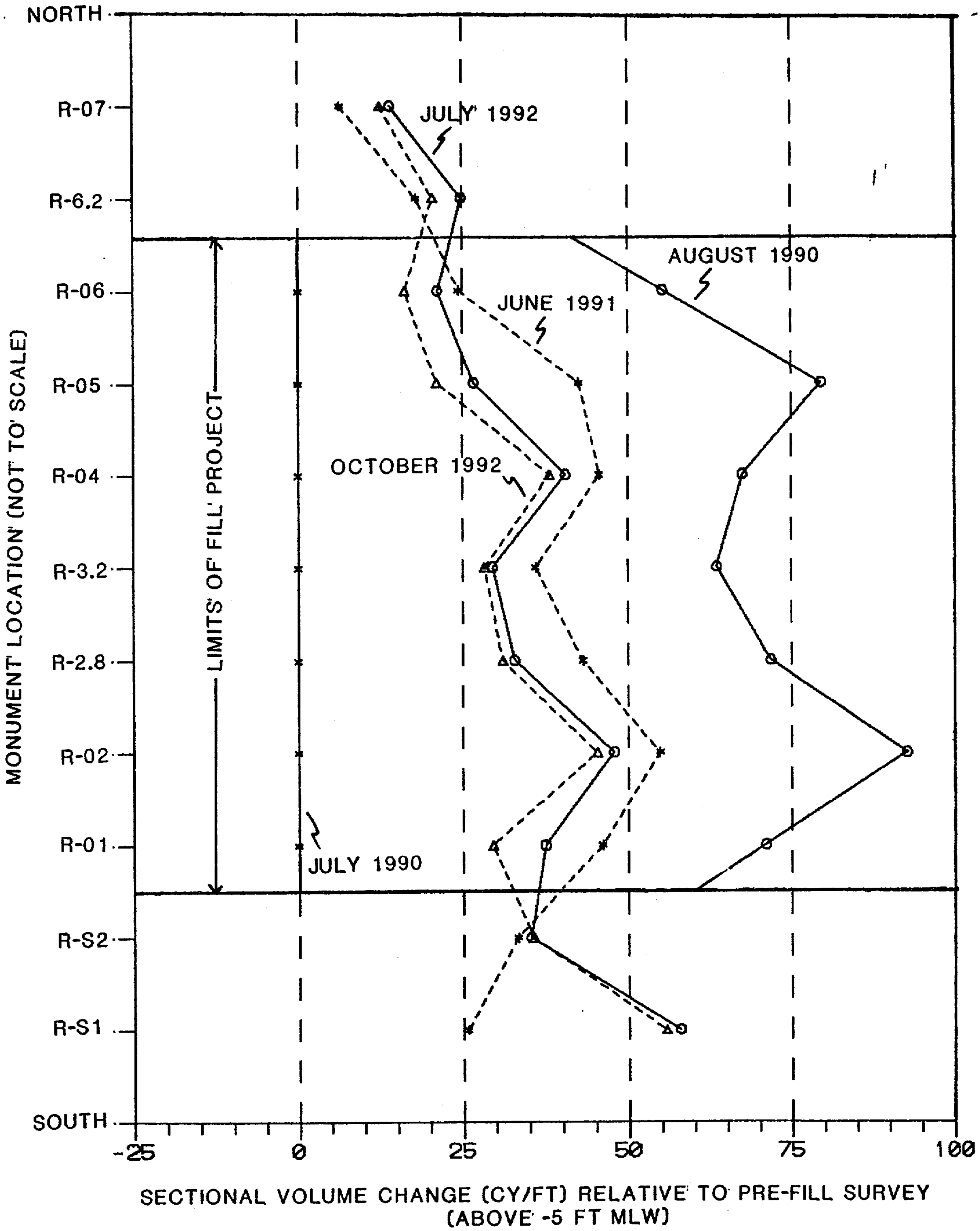


FIGURE 8:
VOLUME CHANGE (CY/FT) ALONG BUCKROE BEACH SHORELINE.

Beach width and slope changes were also documented during this survey period. Figure 9 documents the average fill width for each cell (+7 ft MLW contour). Note that the northernmost (represented by R-6) and southernmost (represented by R-1) cells were significantly under-filled relative to the center of the project. A comparison of the pre- and post-fill surveys indicate that the average increase in beach width along the project was 196 ft. This was slightly more narrow than the design fill width increase at that contour of 200 ft. As designed, the post-project inter-tidal slope was slightly more steep than the pre-project slope. The average gradient along the project area in July, 1990 was 1:16; whereas, the average gradient after project construction was 1:14.

FILL MONITORING - AUGUST 1990 to JUNE 1991

The monitoring period of August, 1990 to June, 1991 denotes the performance of the nourishment project approximately one year after construction. Clarke (1991) reported on the changes in the fill area after the first monitoring survey. Preliminary estimates indicated that 94,950 cy of fill were lost from the project limits. Of this loss, it was estimated that 40,000 cy were transported to the beaches south of the fill area, while 10,000 cy were transported north of the fill area. The remaining 45,000 cy were not accounted for, but it was not assumed that this volume was completely lost from the system. This letter report estimated that 181,000 cy of fill remained within the limits of the nourishment area.

A comparison of August, 1990 to June, 1991 profiles indicate that there was a loss of 85,600 cy from the project area along the dry beach (above 0 ft MLW), a loss of 112,500 cy from above -5 ft MLW, and a loss of 117,100 cy from above -10 ft MLW. These volume change calculations are slightly higher than the previous estimates provided by Clarke (1991). Table 2 and Figure 8 show the volumetric change within each fill compartment. The greatest percent of fill loss by compartment was from the north end of the project, while losses decreased towards the south end. The upper berm also eroded during this monitoring period with an average recession of 65 ft (+7 ft MLW contour). Figure 9 indicates that greatest losses were from the north and south ends of the project. In conjunction with the recession of the fill-beach, the intertidal zone significantly steepened. The average gradient along the project area in June, 1991 was 1:12.

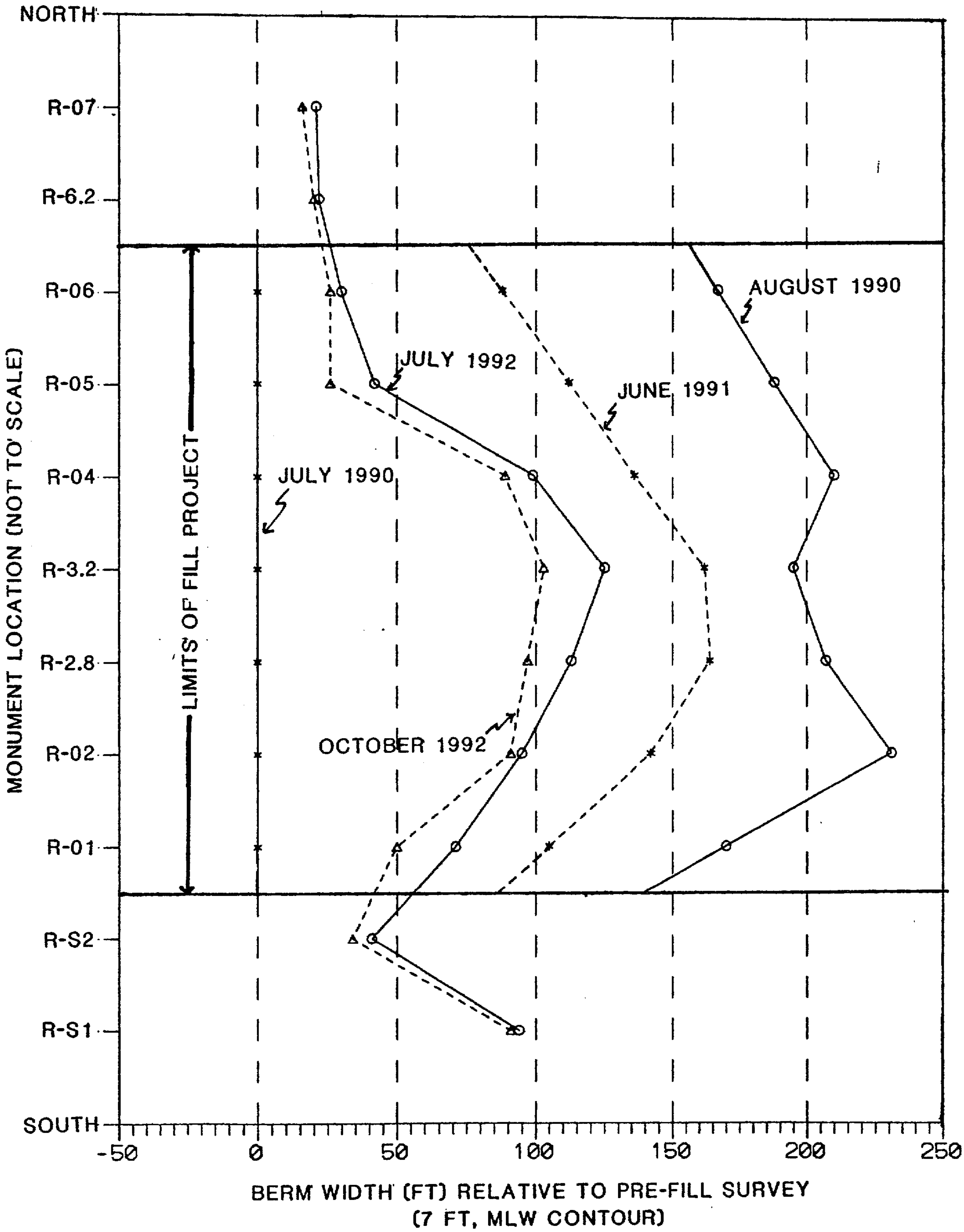


FIGURE 9:
CHANGE IN THE UPPER BERM (7FT MLW) ALONG BUCKROE BEACH.

The profiles, however, do not show a significant amount of material moving offshore. In fact, along the entire project area, there was only a total loss of 4600 cy from between the -5 and -10 ft MLW contours. There is, however, a potential total error of +/- 4000 cy as a result of the possible offshore bust in the June, 1991 survey. If the offshore data is adjusted +0.3 ft, then the section of beach between -5 ft and -10 ft MLW would increase in volume approximately 4000 cy. This potential error would account for less than 3 percent of the total fill above the -10 ft MLW contour and is not really significant when compared to the total volumetric losses from the project area.

Since the offshore did not show significant accretion, it does not appear that the material is moving in an offshore direction. This is expected, since the fill material from the borrow area was reportedly more coarse than the native beach sand. In typical onshore/offshore models of sediment transport, coarser material placed on an equilibrium beach moves in the onshore direction, while the finer material moves offshore. Since it does not appear that the sand is moving offshore, it is then necessary to determine where the nourishment sand is being deposited.

A review of aerial photography flown immediately after the construction of the project and in October and April, 1991 (see Figure 10, courtesy of Virginia Institute of Marine Science) indicate that the beaches north and south of the fill limits accreted significantly during this time period. Unfortunately, profiles outside the project limits were not surveyed in August, 1990. In order to quantitatively document movement of material outside the fill area, post-project profiles were created. MHW shoreline positions (denoted by the "wetted sand line") were compared for the post-project and April, 1991 aerial photography. This comparison indicated that north of the project at R-6.2 the MHW line accreted 55 ft, while at R-7 the MHW accreted 20 ft. Additionally, south of the project limits, the MHW accreted 85 ft and 75 ft at R-S2 and R-S1, respectively. The June, 1991 profile shapes at these monument locations were then shifted landward the calculated distance in an attempt to re-create approximate post-project (August, 1990) conditions. Note that the offshore areas below -5 ft MLW were not adjusted. The assimilated profiles are plotted with the measured profiles in Appendix A.

TABLE 2: VOLUME CHANGE ALONG BUCKROE BEACH BETWEEN AUGUST, 1990 AND JUNE, 1991. NOTE THAT ALL ELEVATIONS ARE RELATIVE TO THE MLW CONTOUR.

MON NO.	LENGTH (FT)	ABOVE 0 FT (CY/FT)	ABOVE -5 FT (CY/FT)	ABOVE -10 FT (CY/FT)	ABOVE 0 FT (CY)	ABOVE -5 FT (CY)	ABOVE -10 FT (CY)
1	405	-20.7	-25.1	-28.7	-8384	-10166	-11624
2	690	-27.9	-38.1	-37.9	-19251	-26289	-26151
2.8	335	-21.5	-28.7	-29.3	-7203	-9615	-9816
3.2	345	-16.8	-27.5	-29.1	-5796	-9488	-10040
4	615	-20.5	-21.8	-20.0	-12608	-13407	-12300
5	660	-25.8	-37.1	-40.3	-17028	-24486	-26598
6	620	-24.7	-30.7	-33.2	-15314	-19034	-20584
ESTIMATED CHANGE WITHIN FILL LIMITS (CY)					**-85583**	**-112484**	**-117112**
SOUTH	770	7.6	12.8		5852	9856	
S1	790	15.1	25.7		11929	20303	
S2	990	14.8	33.2		14652	32868	
ESTIMATED CHANGE SOUTH OF PROJECT (CY)					**32433**	**63027**	
6.2	675	10.8	18.1		7290	12218	
7	525	4.0	6.5		2100	3413	
NORTH	0	0.0	0.0		0	0	
ESTIMATED CHANGE NORTH OF PROJECT (CY)					**9390**	**15630**	
NET CHANGE THIS SURVEY INTERVAL (CY)					**-53150**	**-33827**	

Volume calculations from the "assimilated" post-nourishment and the June, 1991 survey (Table 2) indicate that approximately 15,650 cy migrated north above -5 ft MLW, while 63,050 cy migrated to the south above -5 ft MLW. These estimates are not unreasonable since the project, by design, was bound to experience "spreading" losses predominantly in the direction of net longshore transport. This results in a total unaccounted for loss of 33,800 cy from the project area above the -5 ft MLW contour which is a 13 percent loss of fill. Similarly, Clarke (1991) estimated an approximate 16 percent loss from the project area.

FILL MONITORING - JUNE 1991 TO JULY 1992

The second year of project performance is documented by the surveys of May/June, 1991 and June/July, 1992. The June/July, 1992 survey also establishes a baseline for future monitoring along the remaining shoreline in Hampton.

Table 3 and Figure 7 show that the fill within the project limits continued to erode. Losses were predominantly from the middle of the project area. An inspection of the survey data indicates that the shoreline started to straighten towards a pre-project shape as the fill continued to equilibrate. Interestingly, the average intertidal slope in July, 1992 was a gradient of 1:13, which was nearly equal to the pre-project intertidal gradient of 1:14. Volume loss above 0 ft MLW was -22,800 cy, above -5 ft MLW was -29,500 cy, and above -10 ft MLW was -15,550 cy. (A 0.3 ft adjustment to the June, 1991 offshore would indicate a loss of -24,000 cy from above the -10 ft MLW contour). As of July, 1992 approximately 125,000 cy of material had been transported out of the project limits from above the -5 ft MLW contour. Additionally, the upper berm continued to recede. The average horizontal decrease in the +7 ft MLW contour along the fill area was 50 ft, resulting in an average remaining fill width of 81 ft.

The beaches north and south of the project limits continued to accrete and likewise benefitted from the spreading losses from the beach nourishment. Table 3 shows that the beaches to the north of the project accreted 9,650 cy above -5

TABLE 3: VOLUME CHANGE ALONG BUCKROE BEACH BEWEEN JUNE, 1991 AND JULY, 1992. NOTE THAT ALL ELEVATIONS ARE RELATIVE TO THE MLW CONTOUR.

MON NO.	LENGTH (FT)	ABOVE 0 FT (CY/FT)	ABOVE -5 FT (CY/FT)	ABOVE -10 FT (CY/FT)	ABOVE 0 FT (CY/FT)	ABOVE -5 FT (CY/FT)	ABOVE -10 FT (CY/FT)
1	405	-3.6	-8.6	3.3	-1458	-3483	1337
2	690	-4.0	-6.9	-3.1	-2760	-4761	-2139
2.8	335	-9.2	-10.3	-6.4	-3082	-3451	-2144
3.2	345	-9.1	-6.5	-3.8	-3140	-2243	-1311
4	615	-3.7	-5.1	-1.5	-2276	-3137	-923
5	660	-11.5	-15.8	-14.5	-7590	-10428	-9570
6	620	-4.0	-3.2	-1.3	-2480	-1984	-806
ESTIMATED CHANGE WITHIN FILL LIMITS (CY)					**-22785**	**-29486**	**-15556**
SOUTH	770	0.0	0.0		0	0	
S1	790	21.8	32.1		17222	25359	
S2	990	4.0	2.0		3960	1980	
ESTIMATED CHANGE SOUTH OF PROJECT (CY)					**21182**	**27339**	
6.2	675	2.4	6.8		1620	4590	
7	525	5.8	7.6		3045	3990	
NORTH					822	1077	
ESTIMATED CHANGE NORTH OF PROJECT (CY)					**5487**	**9657**	
NET CHANGE THIS SURVEY INTERVAL (CY)					**-781**	**7511**	

ft MLW, while the southern beaches accreted 27,350 cy. As a result of the volumetric gains north and south of the project, the study area actually gained sand during this time period. The estimated net change for the fill project and the areas north and south totalled an increase of 7,500 cy

The accretion documented south of the project area appears slightly unrealistic since the increase in volume is nearly equal to the volumetric loss from the project area during this time period. The comparative plot in Appendix A for profile R-S1 shows a large increase in volume which is characterized by a sectional volume change of +21.8 cy/ft above -5 ft MLW. Note that in Table 3, there was no additional fill allowance included south of the cell compartment corresponding to R-S1. It was determined that in order for this compartment to gain so much sand, there either had to have been a seasonal reversal in the longshore transport or significant onshore movement of sediment. Since the profiles indicate continued berm and offshore erosion, then it is likely that some of the fill moved north during this time period. As a result, it was not realistic to assume any additional sediment gain further south than R-S1.

Since the increase in volume north and south of the project area was so high during this monitoring period, the net "unaccountable" loss of sediment since August of 1990 decreased to -26,350 cy (above -5 ft MLW). It is important to realize that although more than 50 percent of the fill material is not situated within the project limits, the beaches north and south of the project have accreted dramatically. This accretion is documented quantitatively in the monitoring profiles as well as qualitatively through beach inspection of Fort Monroe and north Buckroe Beach.

FILL MONITORING - JULY, 1992 TO OCTOBER, 1992

To determine short-term changes in the nourishment project, as well as to potentially document storm effects, a beach survey was completed along the project area in October of 1992. Note that at the time of this report, only the beach portion of the survey was available for analysis and was still designated as "Preliminary". Typically, the wading portion of the profile extended to a depth of -2 to -3 ft MLW. Profiles were extrapolated to the -5 ft MLW contour in order to provide estimates of volume change.

There was only one notable storm documented during the survey period of July, 1992 to October, 1992. Tropical Storm Danielle skirted the Hampton Roads area on September 25, 1992. Although no specific quantitative information is readily available on this storm, tides were higher than normal and there was an increase in the wind and wave activity along the study area.

Table 4 and Figure 8 indicate that the beach along the fill area continued to erode. Interestingly, the northern and southern-most compartments within the project limits showed the highest volumetric erosion. The fill area eroded -14,800 cy from above the 0 ft MLW contour and -14,200 cy from above -5 ft MLW. Average berm erosion within the project limits was -13 ft at +7 ft MLW. The intertidal beach slope flattened to an average gradient of 1:27. This flattening of the foreshore is typical of offshore sediment movement resulting from increased wave activity.

During this survey period, the areas north and south of the project also eroded at similar rates to the beach within the project limits. Although, it is not possible at this time to determine the actual direction of sediment transport; initially it appears that the material is moving offshore. Interestingly, it also appears that the southern sections of the study area (both within and outside the fill limits) eroded more than the northern sections. This would also possibly suggest a change in the short-term littoral transport to the north.

CONCLUSIONS

The beach nourishment project along Buckroe Beach has not only successfully created a wide and healthy recreational beach, it has also provided substantial storm protection for upland properties and investments - both within and outside the project limits. As of October, 1992, more than two years after the construction of the Buckroe Beach nourishment project, approximately 41 percent of fill material or 110,800 cy remained within the original design limits above the -5 ft MLW contour. Average remaining fill width at the +7 ft MLW contour was 68 ft or 35 percent of the original fill width. While this percentage appears extremely low for a projected design life of 10 years, there are several factors which should be considered in the evaluation of this project, including shoreline benefits to adjacent beaches.

TABLE 4: VOLUME CHANGE ALONG BUCKROE BEACH BETWEEN JULY, 1992 AND OCTOBER, 1992. NOTE THAT ALL ELEVATIONS ARE RELATIVE TO THE MLW CONTOUR.

MON NO.	LENGTH (FT)	ABOVE 0 FT (CY/FT)	ABOVE -5 FT (CY/FT)	ABOVE 0 FT (CY)	ABOVE -5 FT (CY)
1	405	-6.8	-7.9	-2754	-3200
2	690	-3.5	-2.6	-2415	-1794
2.8	335	-2.5	-1.8	-838	-603
3.2	345	-2.0	-1.2	-690	-414
4	615	-2.5	-2.4	-1538	-1476
5	660	-5.1	-5.5	-3366	-3630
6	620	-5.2	-5.0	-3224	-3100
ESTIMATED CHANGE WITHIN FILL LIMITS (CY)				**-14824**	**-14217**
SOUTH	770	-2.9	-1.0	-2233	-770
S1	790	-3.2	-2.2	-2528	-1738
S2	990	-2.5	0.4	-2475	396
ESTIMATED CHANGE SOUTH OF PROJECT (CY)				**-7236**	**-2112**
6.2	675	-2.8	-4.3	-1890	-2903
7	525	-3.3	-1.6	-1733	-840
NORTH	0	0.0	0.0	0	0
ESTIMATED CHANGE NORTH OF PROJECT (CY)				**-3623**	**-3743**
NET CHANGE THIS SURVEY INTERVAL (CY)				**-22060**	**-20071**

It is important to note that due to the short length of the project relative to the fill width, it was inherent that the project would initially erode as the beach receded towards an equilibrium condition with the surrounding shoreline. This longshore transport of sand from the project area is typically referred to as a "spreading loss". In the case of the Buckroe Beach nourishment project, the shoreline to the north and especially to the south received significant benefits from this project. As of October, 1992 an estimated net volume of 88,250 cy accreted above -5 ft MLW within .5 miles south of the project, while 21,550 cy accreted within .25 miles north of the project. Recent beach inspection of the Buckroe area supports the documented "spreading loss" from the fill location to the adjacent shoreline; thus providing increased storm protection and recreational area for a much longer shoreline reach.

In the conceptual design of the project, Coastal Planning and Engineering determined that a berm width of approximately 52 ft at the +7.3 ft MLW contour was necessary to prevent bulkhead damage during a 10-year storm event. Prior to project construction, an average upper berm width of 25 ft fronted the seawall. Currently, the beach supports an average protective berm width of 94 ft at +7 ft MLW. Obviously, the nourishment project has receded at much higher rates of erosion than the background rate of -1.5 to -2.0 ft/yr. This increased recession is expected to continue until the nourishment project is in equilibrium with the surrounding shoreline. At that point, the berm would then erode at a rate similar to the background rate. Since the design requires a 52 ft berm in order to protect the seawall, the project has an average width of 41 ft remaining prior to a suggested renourishment interval. (The plots in Appendix A, however, show that profiles R-5 and R-6 already have less berm than the project design requires for upland protection. This could possibly have resulted from under-filling these sections during project construction.) Since the rates of erosion have decreased since the initial construction of the project, it is estimated that the project will continue to provide protection from a 10-year storm event for an additional 2 to 3 years. Therefore, the actual renourishment interval is estimated at 4 to 5 years.

RECOMMENDATIONS

The results of background research and monitoring of the fill project suggest that Hampton's beaches (especially Buckroe Beach) recede at moderate rates of erosion, but are severely sediment starved. As a result, the shoreline and upland areas are extremely susceptible to storm impact. A wide, protective beach berm is perhaps one of the best defense mechanisms against upland storm damage. As suggested in this report, an area such as Buckroe Beach supports the need for a nourishment project. Although, the "spreading losses" to adjacent beaches are a realized benefit, it is unlikely that a fill project will remain within the design area due to the short length of the project. Therefore, it is suggested that for future nourishment design, the northern limit of fill should be increased into the private sector and the southern-most limit of Buckroe Beach account for the taper (since it will benefit from the equilibration of the project.) Naturally, this could be problematic as a result of legal consideration when extending a project onto private property. Another alternative is to remove the deteriorating groins along Buckroe Beach and to design and construct attached breakwaters to "anchor" the project. Regardless of action, additional surveys should be conducted in order to determine background erosion along the entire shoreline, as well as to further document fill performance. Project monitoring is extremely important in providing information for future design success.

When considering future projects along the remainder of the Hampton City shoreline, a definitive management plan for Salt Ponds Inlet is imperative. Dredge and fill activities resulting from inlet maintenance, as well as the interruption of typical coastal processes resulting from any structural change at the inlet will definitely have an impact on the shoreline and therefore management policies. Once decisions have been rendered regarding the inlet, Salt Ponds Beach remains a good candidate for future fill activities. A nourishment project in this area would not only provide storm protection and a recreational beach at the site, but would also provide benefits resulting from spreading losses to the downdrift beaches (i.e. towards Buckroe Beach). The beach along Grandview supports an extremely high background erosion rate. Although a fill project could potentially provide storm damage and recreational benefits to this area; a site specific study would be necessary in order to successfully design a project that would have any extended life due to the high erosion and reversal of longshore transport immediately north.

A policy on the use of the current borrow site is also necessary in order to determine the feasibility of future projects. This source of material contains a large quantity of readily available sand at a very reasonable price. As a result of sediment availability, cost, and quality, this is certainly a preferred borrow location, especially when considering upland sources. Safety factors and precautions with regards to dredge and fill activities, however, remain a primary concern.

There are several options available regarding the handling of ordnance relative to fill activities. The most obvious choice is to find a new borrow site along Horseshoe Shoal. It is possible that increased sensitivity in the anomaly scans or alternative scanning methods may allow the location of a site "clear" of ordnance. (Reportedly, Waterways Experiment Station in Vicksburg, Mississippi has researched and designed new-state-of-the-art equipment and procedures for locating ordnance.) The most efficient and safest method of handling the ordnance is to avoid them altogether. Another option is to intercept the ordinance during the dredging operation. It is important to note that the dredging firms have not objected to placing this material. Dredging operations would include screening the fluidized fill material at the discharge point and collecting the ordnance for disposal. The problem with this option is the increased risk of concentrating the ordnance in one place. A third option is to place the fill sand in shallow layers and scan each layer of placed material during fill operations. In terms of increased time and personnel this option would significantly increase the cost of fill. Also, the section of fill placed below the waterline could not be adequately scanned by this method.

While it is not within the scope of this report to discuss all of the ramifications of the military ordnance at Buckroe, it is important to understand its possible impact on future nourishment projects. These impacts may include; permit restrictions, increased costs, beach closure, and longer construction time. While the overall benefits of obtaining high quality sand may still balance the increased costs, an effort should be made to locate a source which is clear of ordnance.

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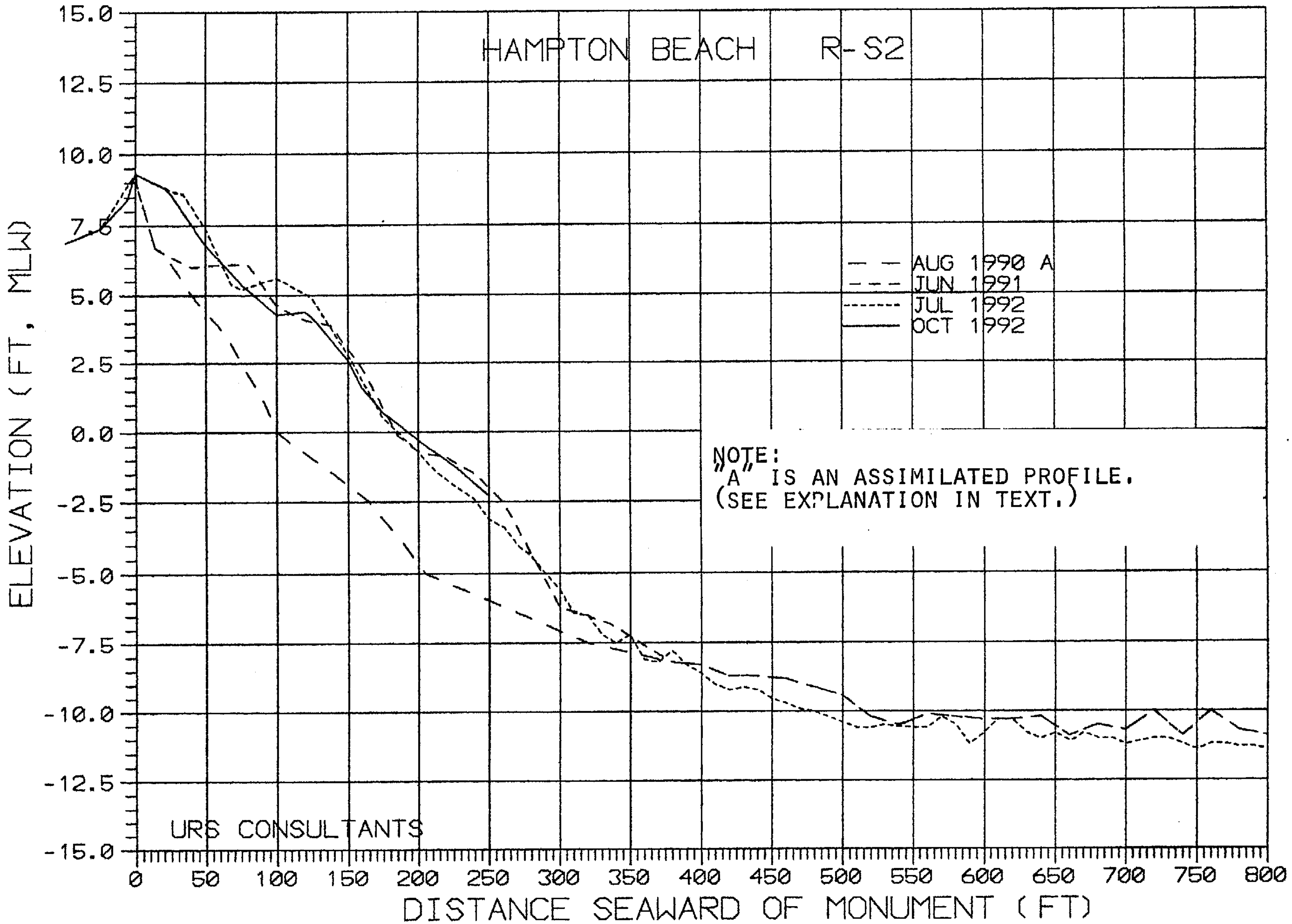
Mann, Douglas W., Lamont W. Curtis, and Thomas H. Daniel, 1992, "Short Beach Nourishment Fill Performance on an Irregular Coastline," Proc., Coastal Engineering Practice '92, Long Beach, California.

Rosen, P.S., 1976, "The morphology and Process of the Virginia Chesapeake Bay Shoreline," Ph.D. Dissertation, School of Marine Science, The College of William and Mary, Williamsburg, Virginia.

110 cm X 57

APPENDIX A

COMPARATIVE PROFILE PLOTS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JUL 1992
OCT 1992
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(SEE EXPLANATION IN TEXT.)
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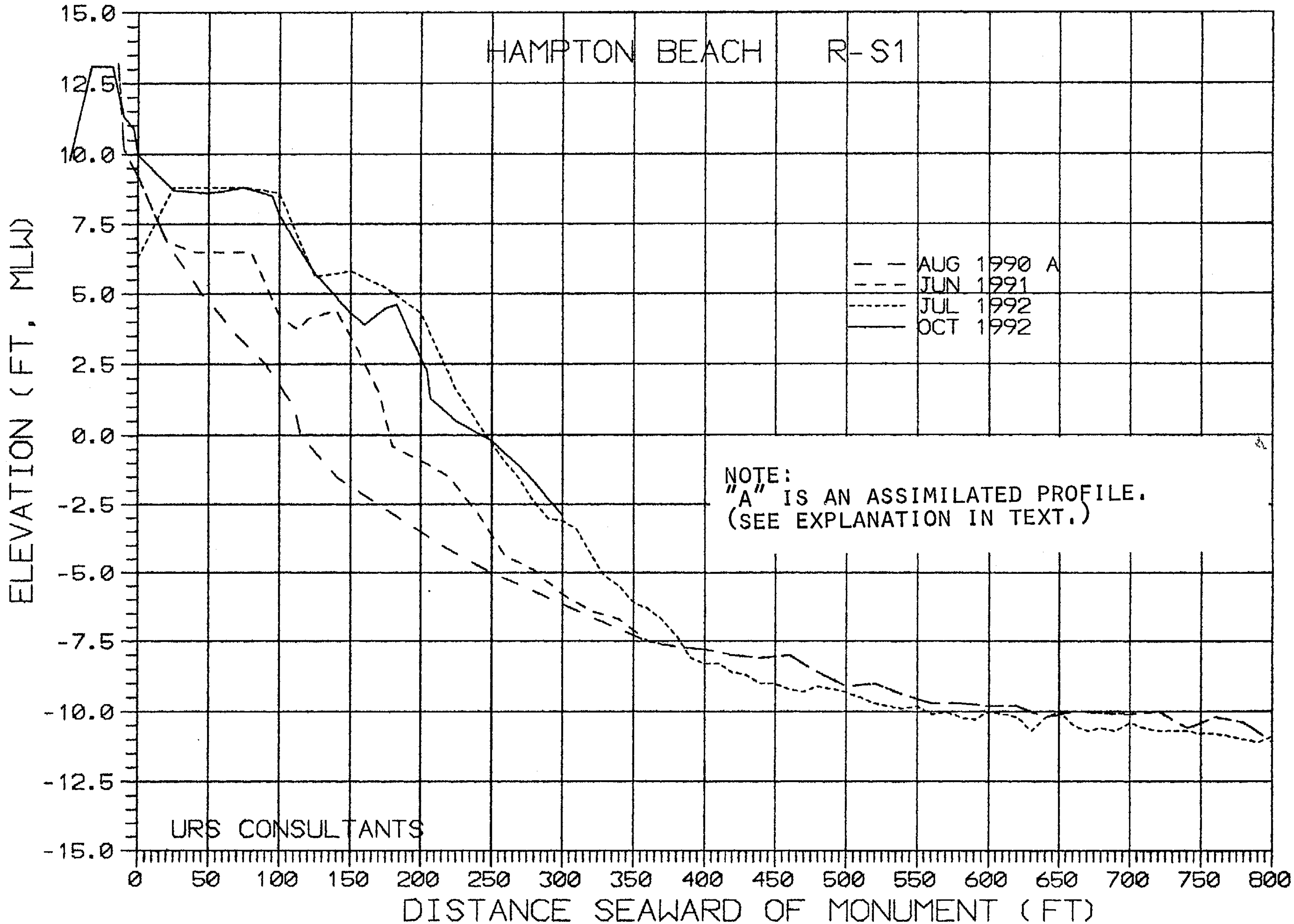

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(SEE EXPLANATION IN TEXT.)
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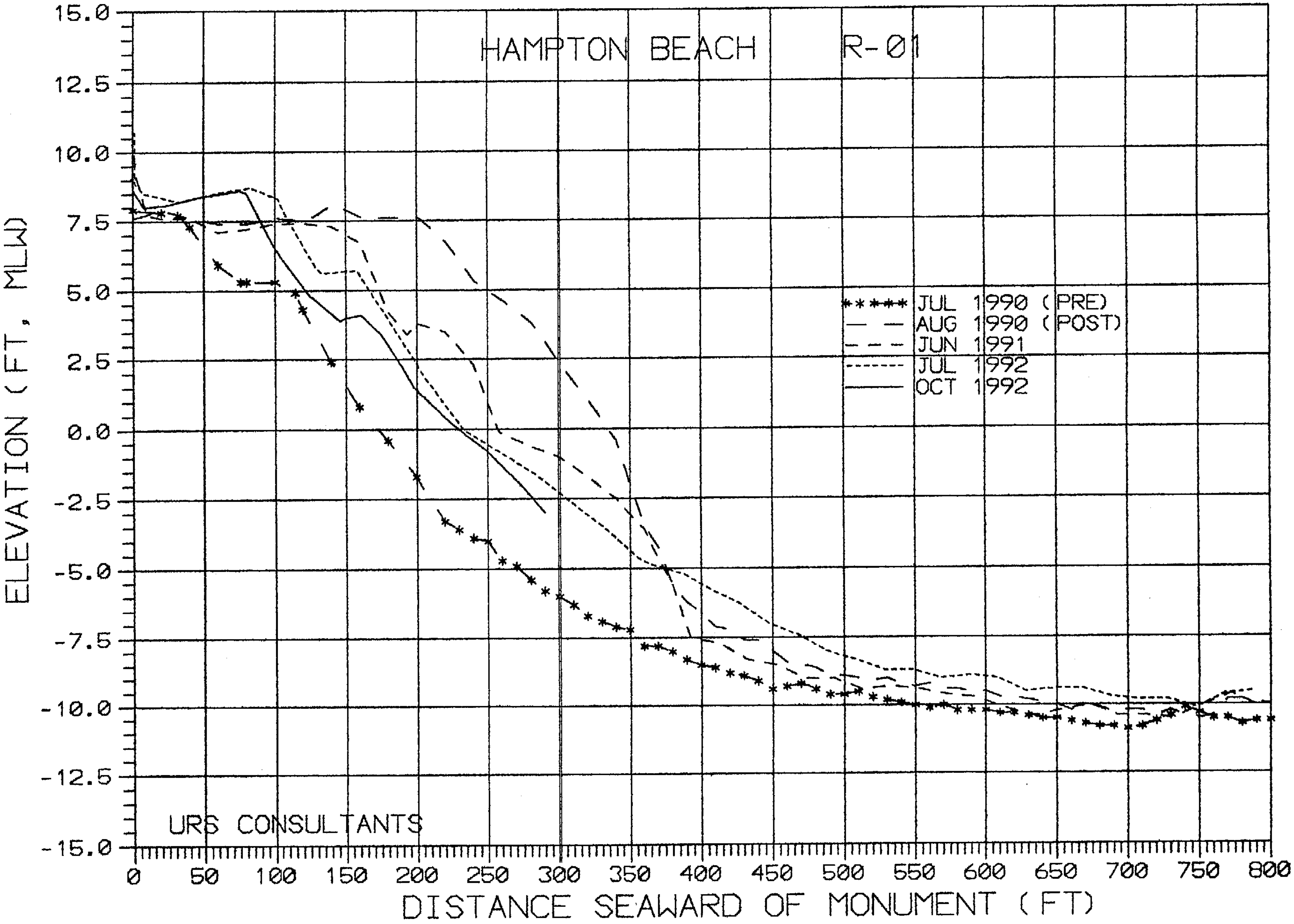
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OCT 1992
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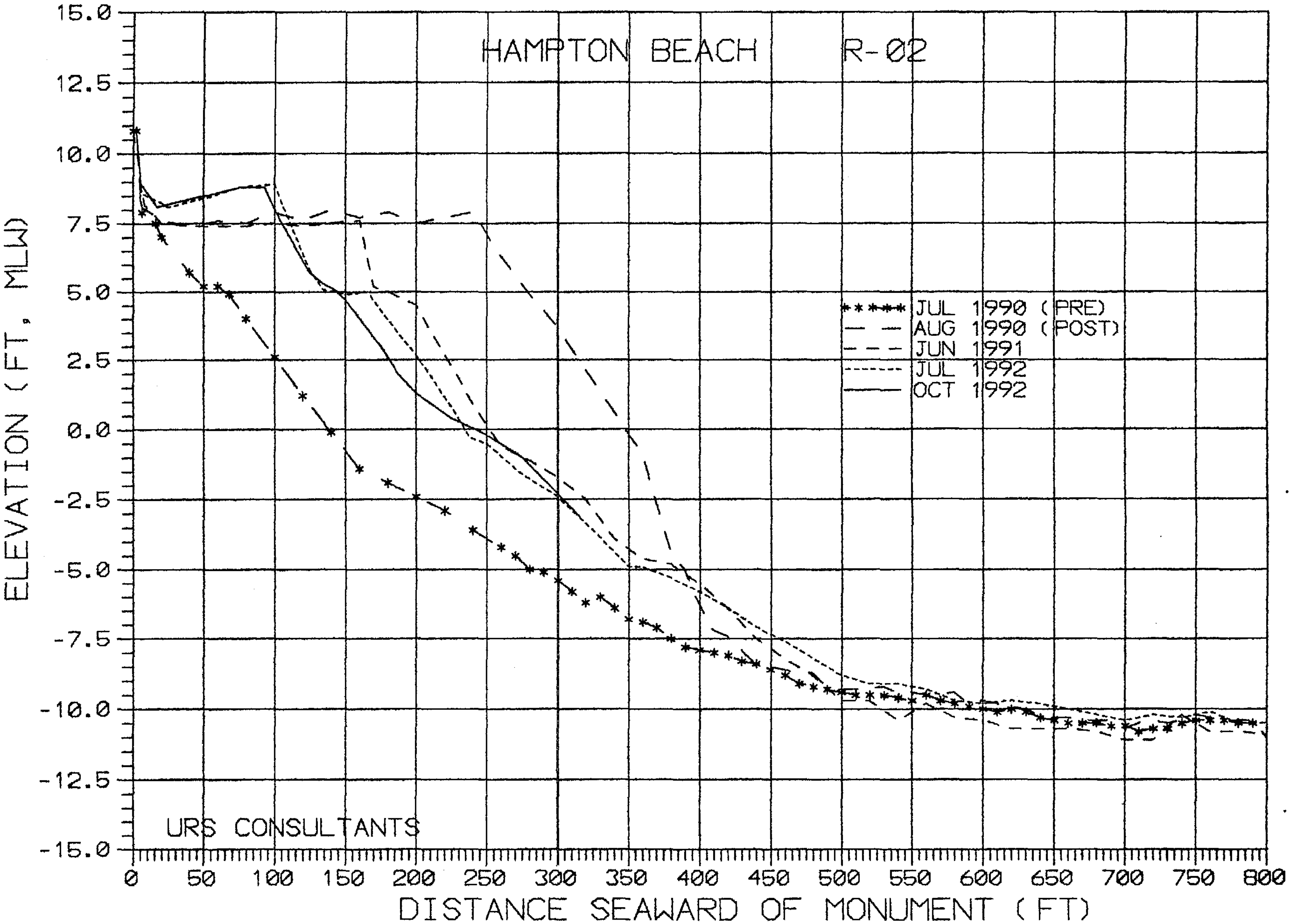

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JUL 1990 (PRE)
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JUL 1992
OCT 1992
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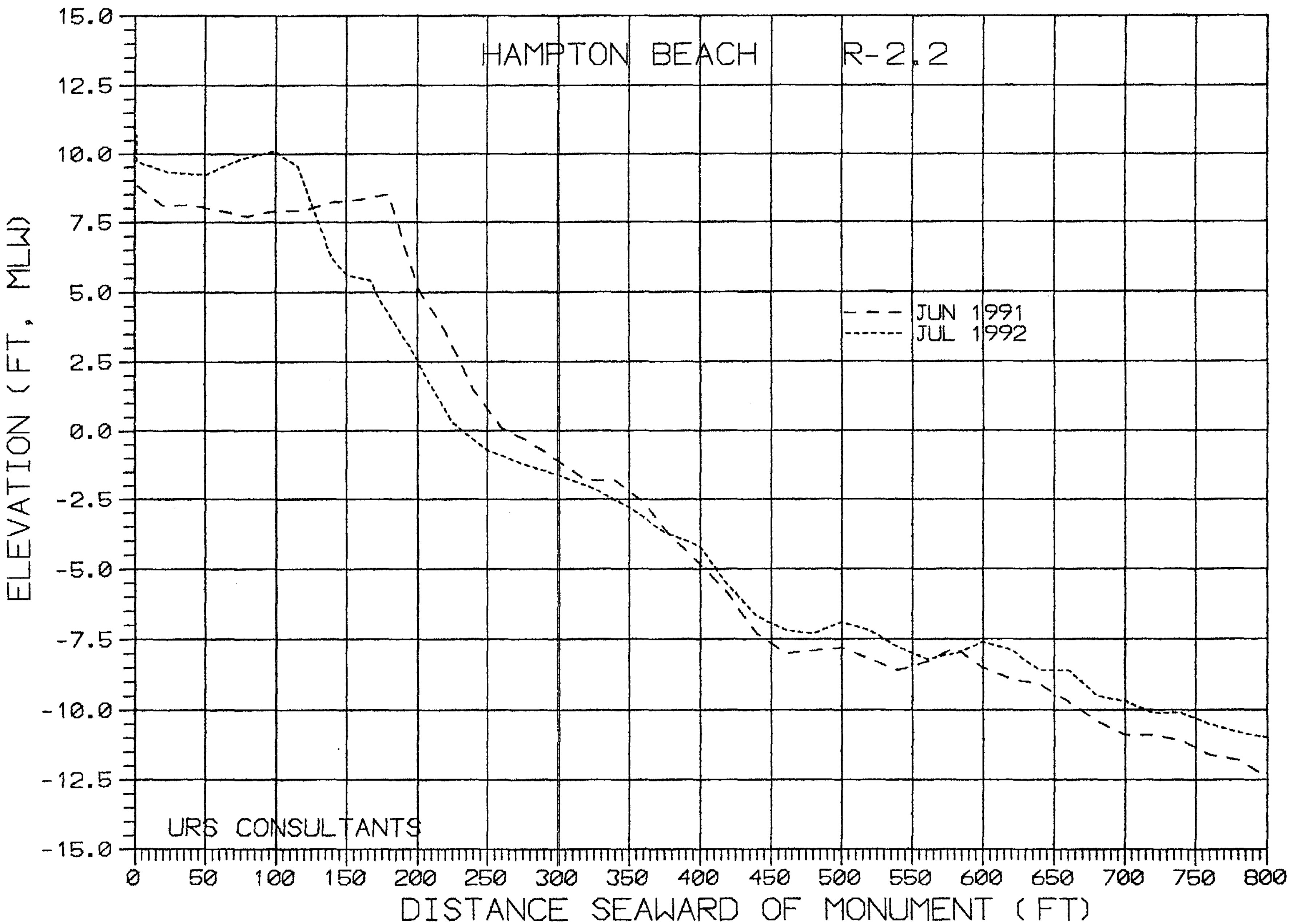
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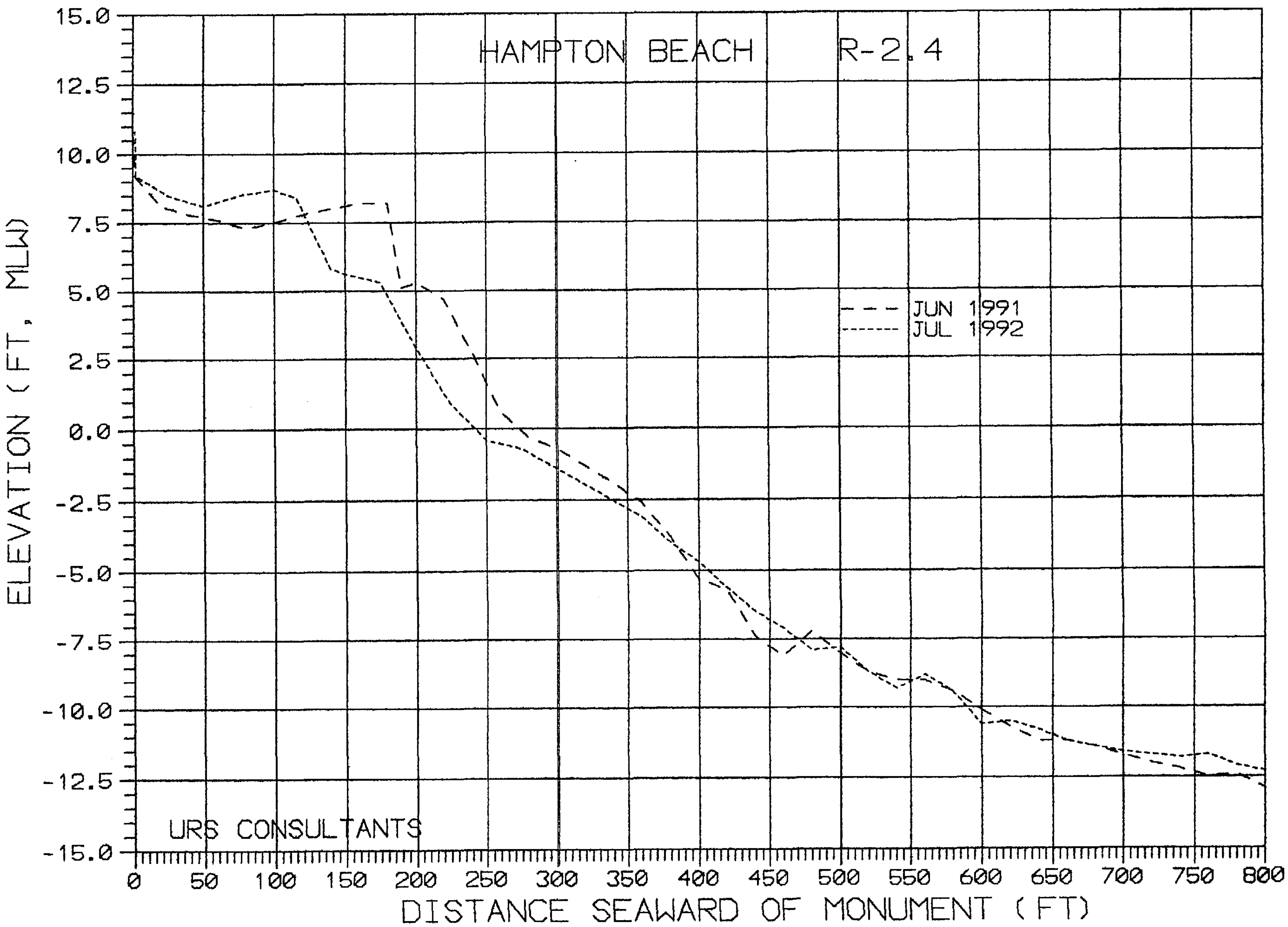
URS CONSULTANTS



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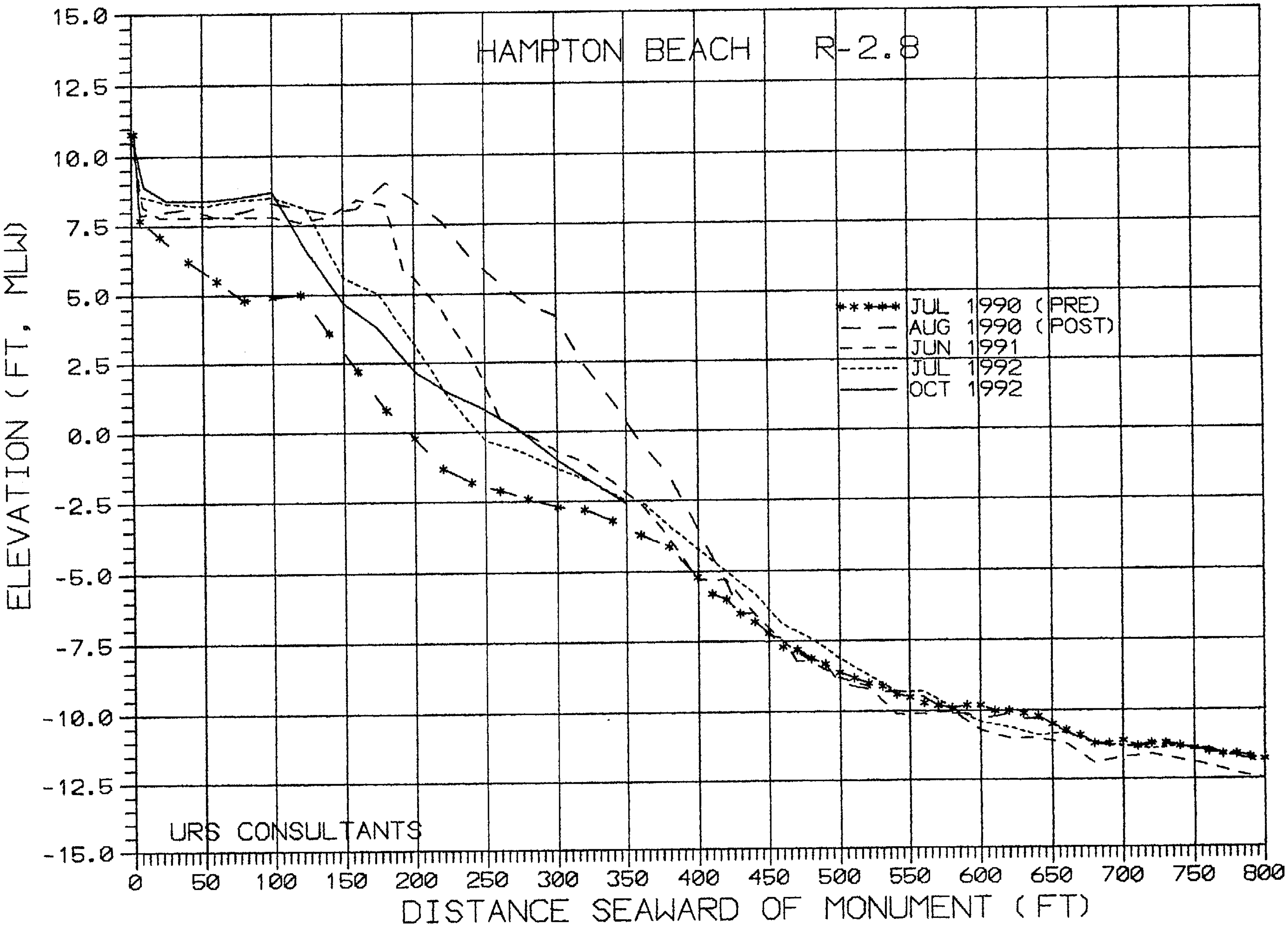
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-10.0
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-15.0
JUL 1990 (PRE)
AUG 1990 (POST)
JUN 1991
JUL 1992
OCT 1992
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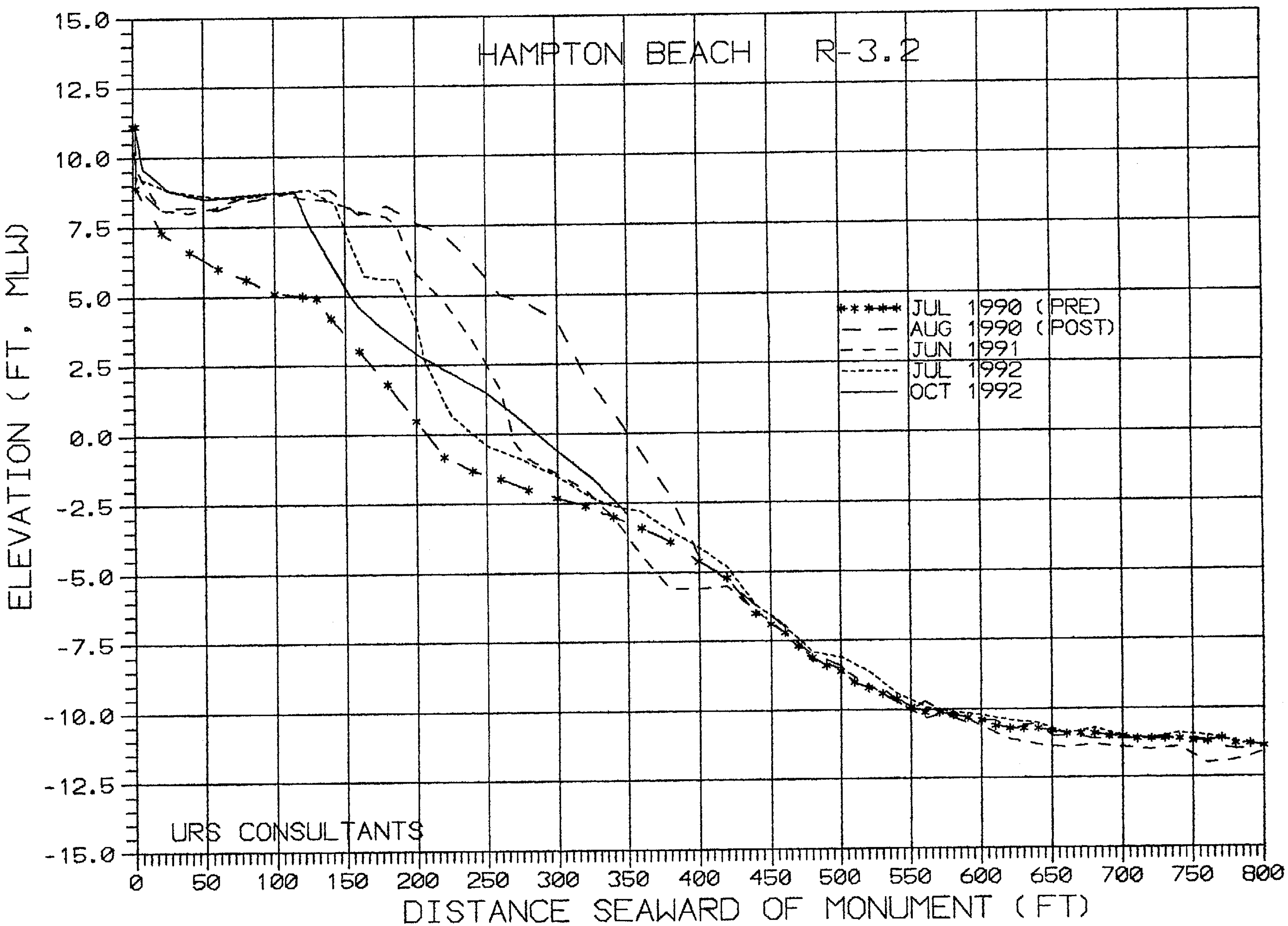
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JUL 1992
OCT 1992
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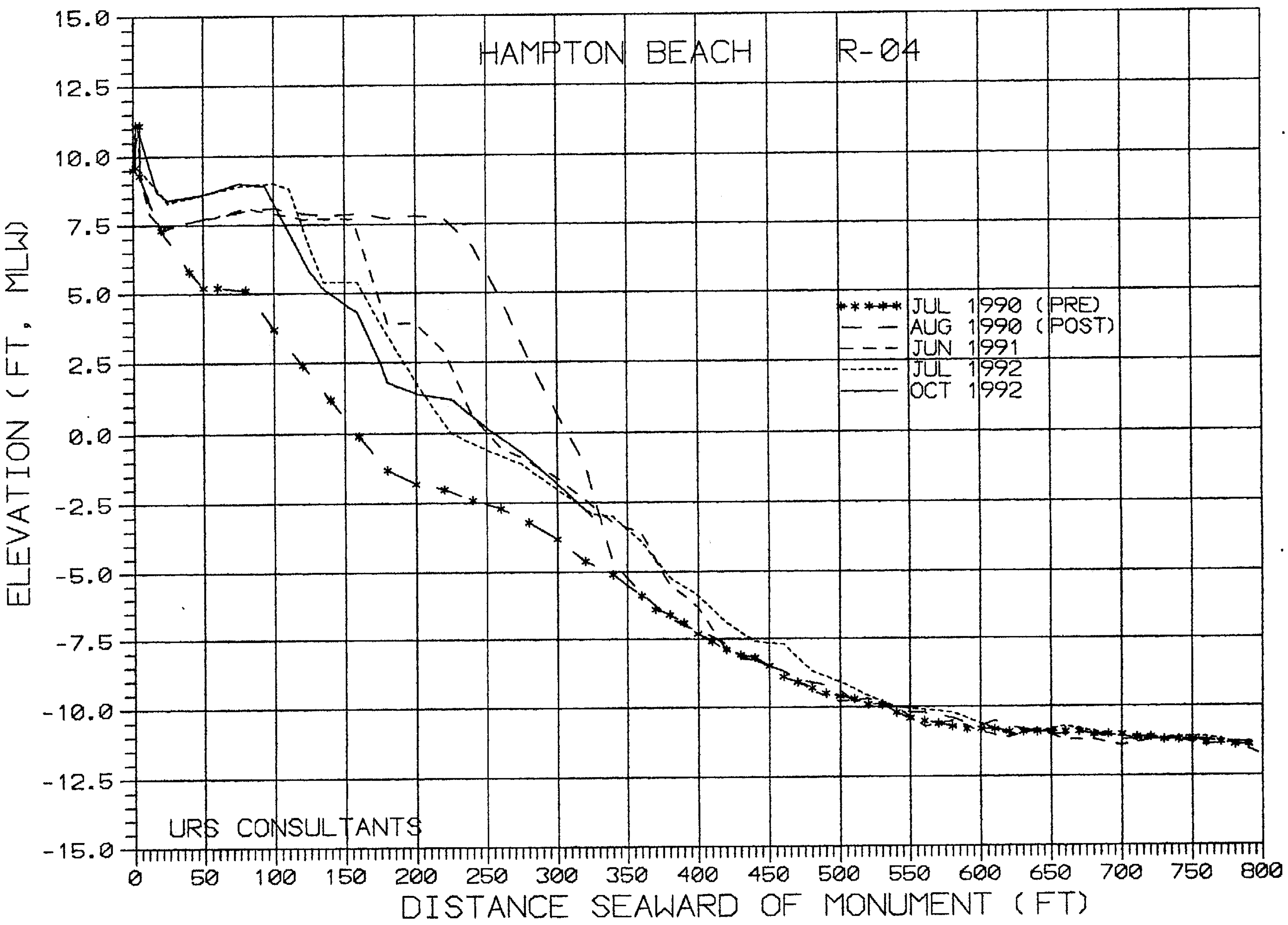
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OCT 1992
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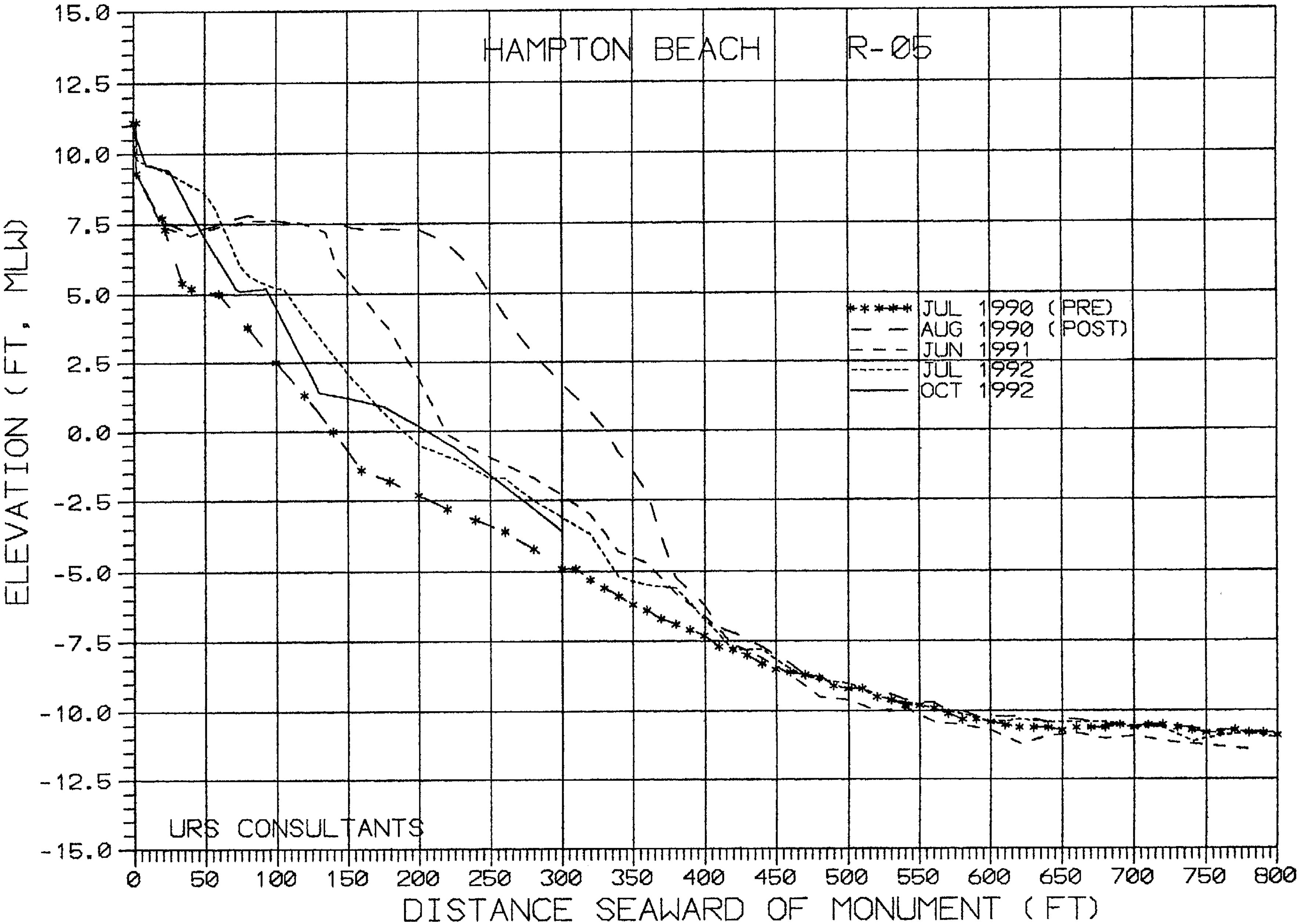
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OCT 1992
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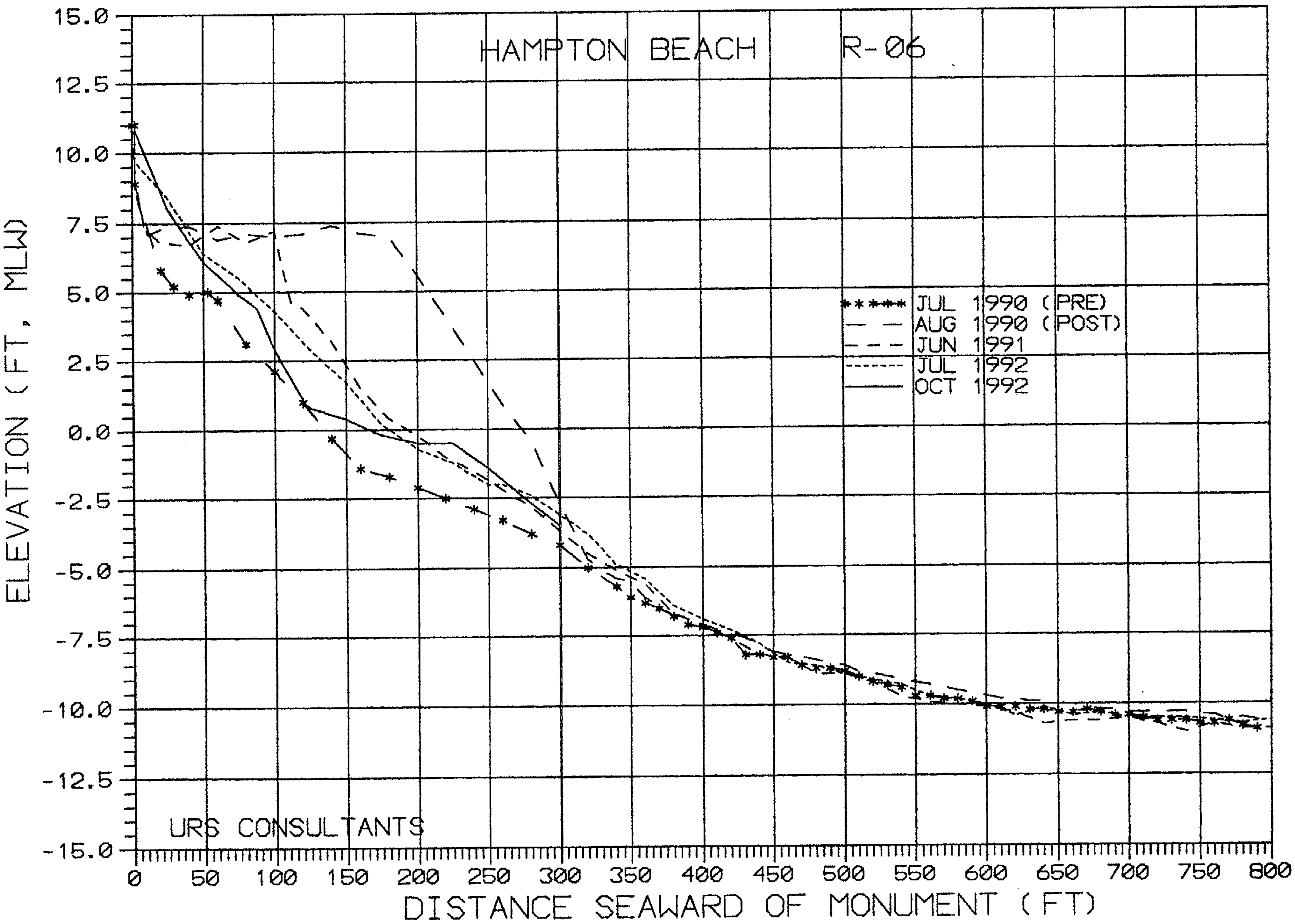
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-2.5
-5.0
-7.5
-10.0
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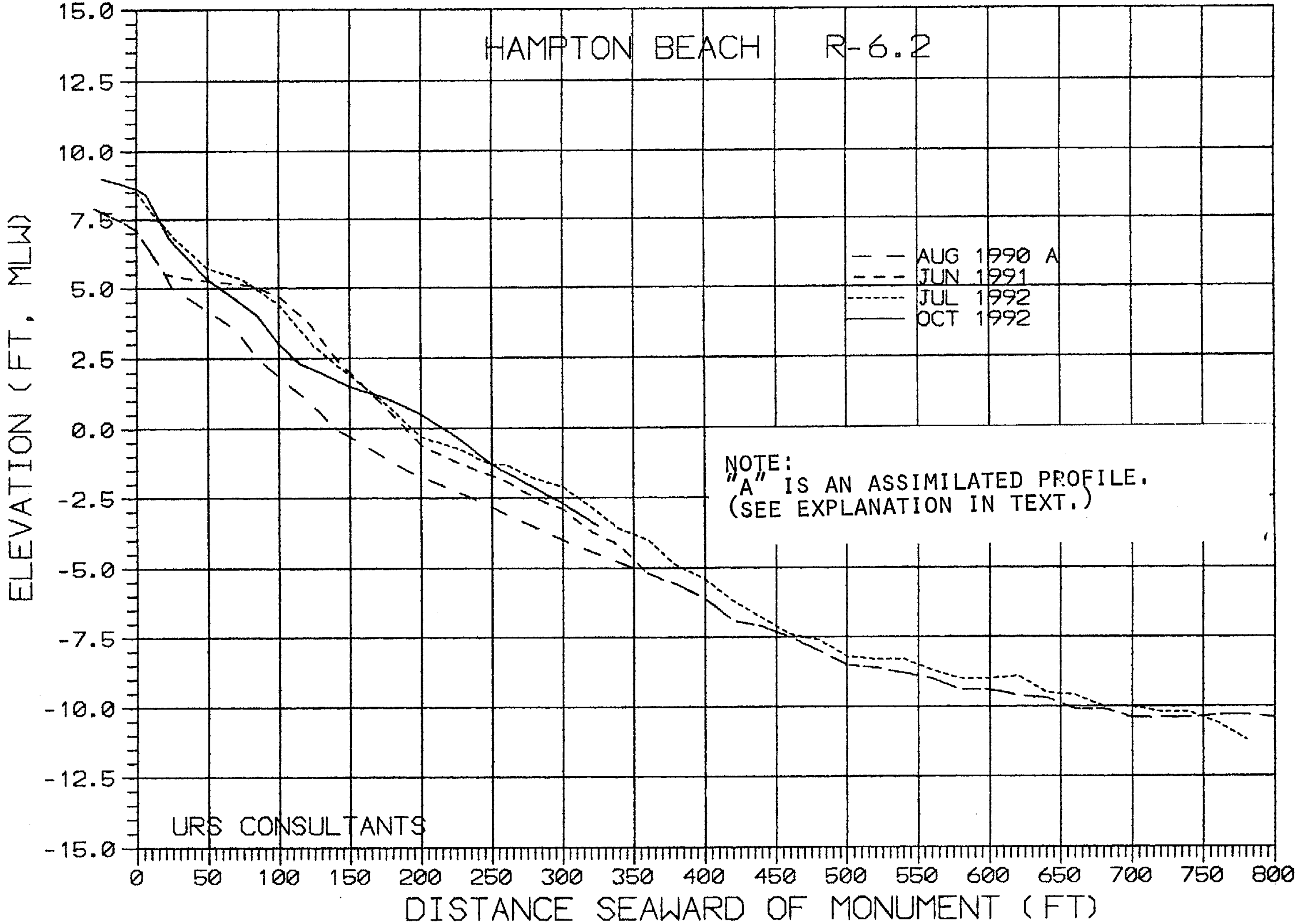

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NOTE:
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(SEE EXPLANATION IN TEXT.)
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-7.5
-10.0
-12.5
-15.0
0
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100
150
200
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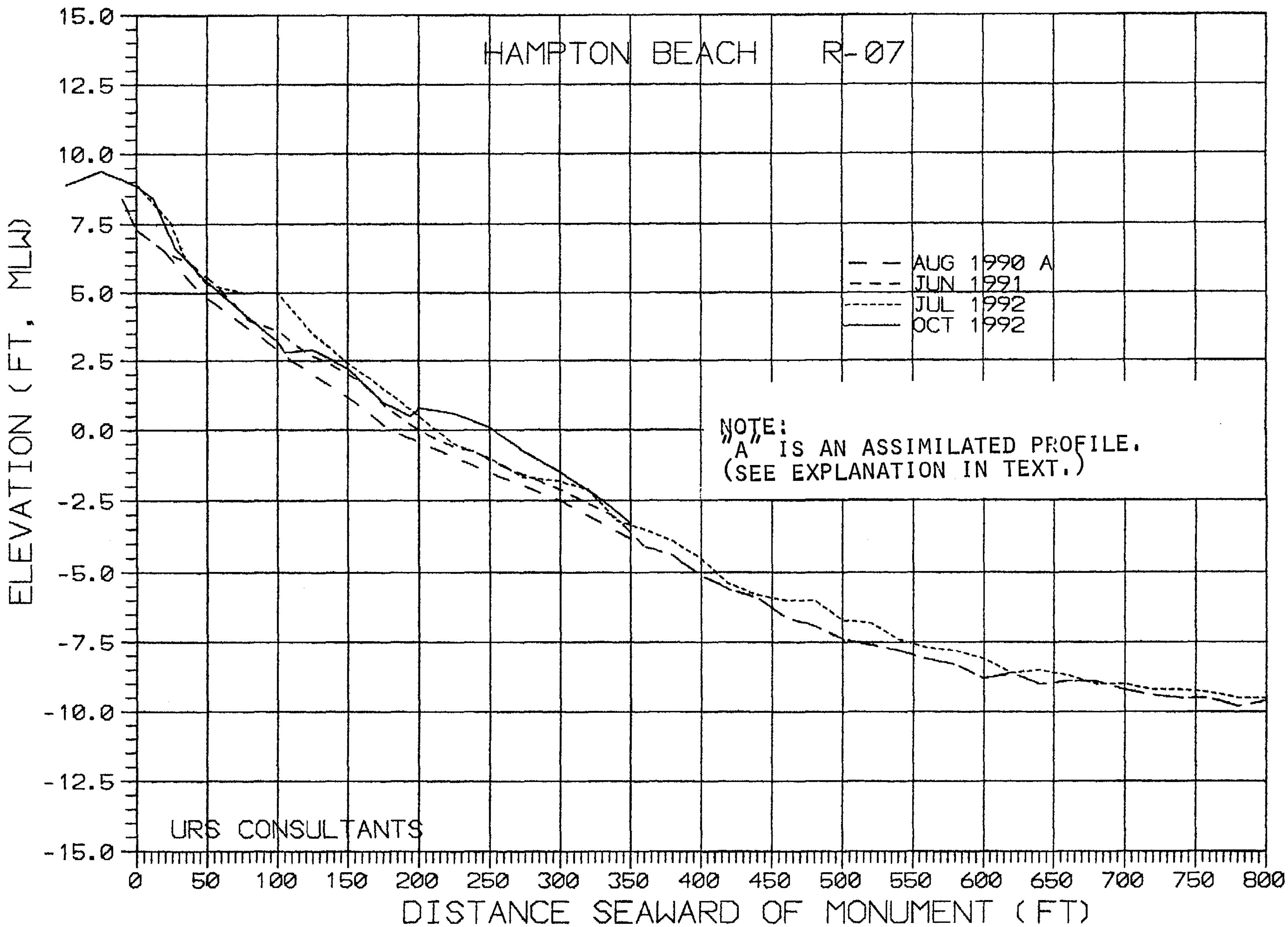
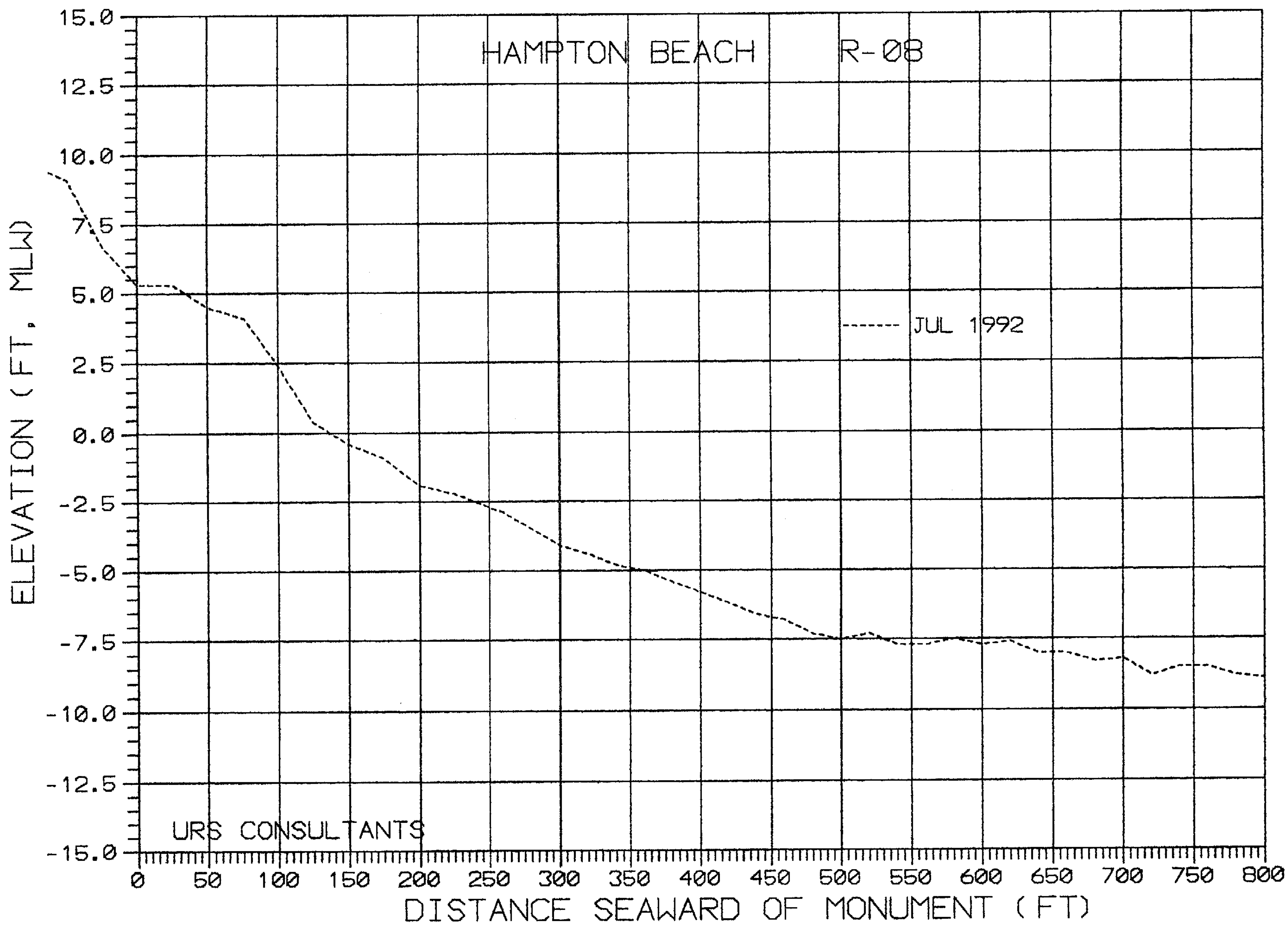
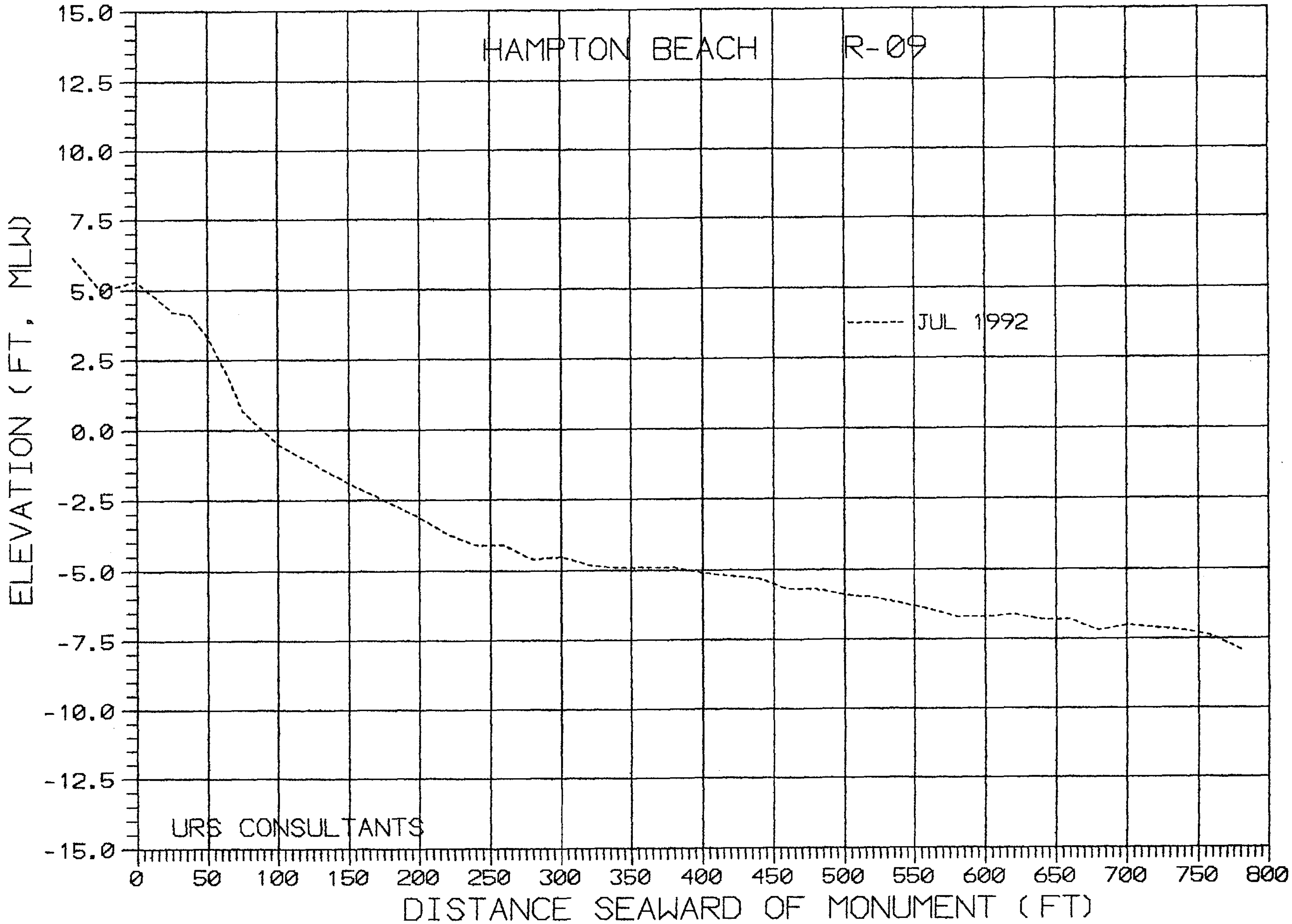
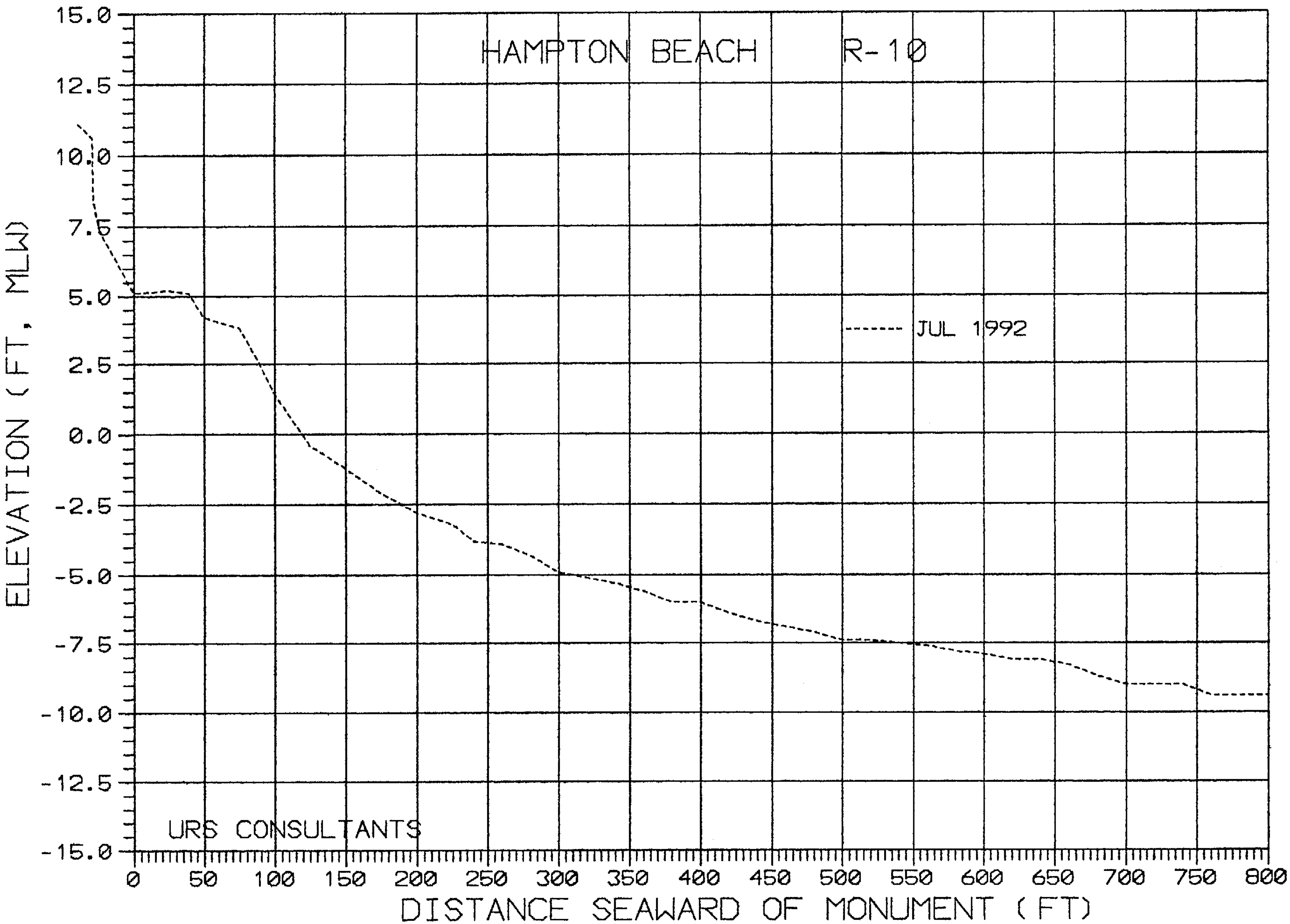
300
350
400
450
500
550
600
650
700
750
800


HAMPTON BEACH R-07
ELEVATION (FT, MLW)
DISTANCE SEAWARD OF MONUMENT (FT)
AUG 1990 A
JUN 1991
JUL 1992
OCT 1992
NOTE:
"A" IS AN ASSIMILATED PROFILE.
(SEE EXPLANATION IN TEXT.)
URS CONSULTANTS
15.0
12.5
10.0
7.5
5.0
2.5
0.0
-2.5
-5.0
-7.5
-10.0
-12.5
-15.0
0
50
100
150
200
250
300
350
400
450
500
550
600
650
700
750
800


HAMPTON BEACH R-08
JUL 1992
ELEVATION (FT, MLW)
15.0
12.5
10.0
7.5
5.0
2.5
0.0
-2.5
-5.0
-7.5
-10.0
-12.5
-15.0
0
50
100
150
200
250
300
350
400
450
500
550
600
650
700
750
800
DISTANCE SEAWARD OF MONUMENT (FT)
URS CONSULTANTS


HAMPTON BEACH R-09
JUL 1992
ELEVATION (FT, MLW)
DISTANCE SEAWARD OF MONUMENT (FT)
URS CONSULTANTS
15.0
12.5
10.0
7.5
5.0
2.5
0.0
-2.5
-5.0
-7.5
-10.0
-12.5
-15.0
0 50 100 150 200 250 300 350 400 450 500 550 600 650 700 750 800



HAMPTON BEACH R-10
JUL 1992
ELEVATION (FT, MLW)
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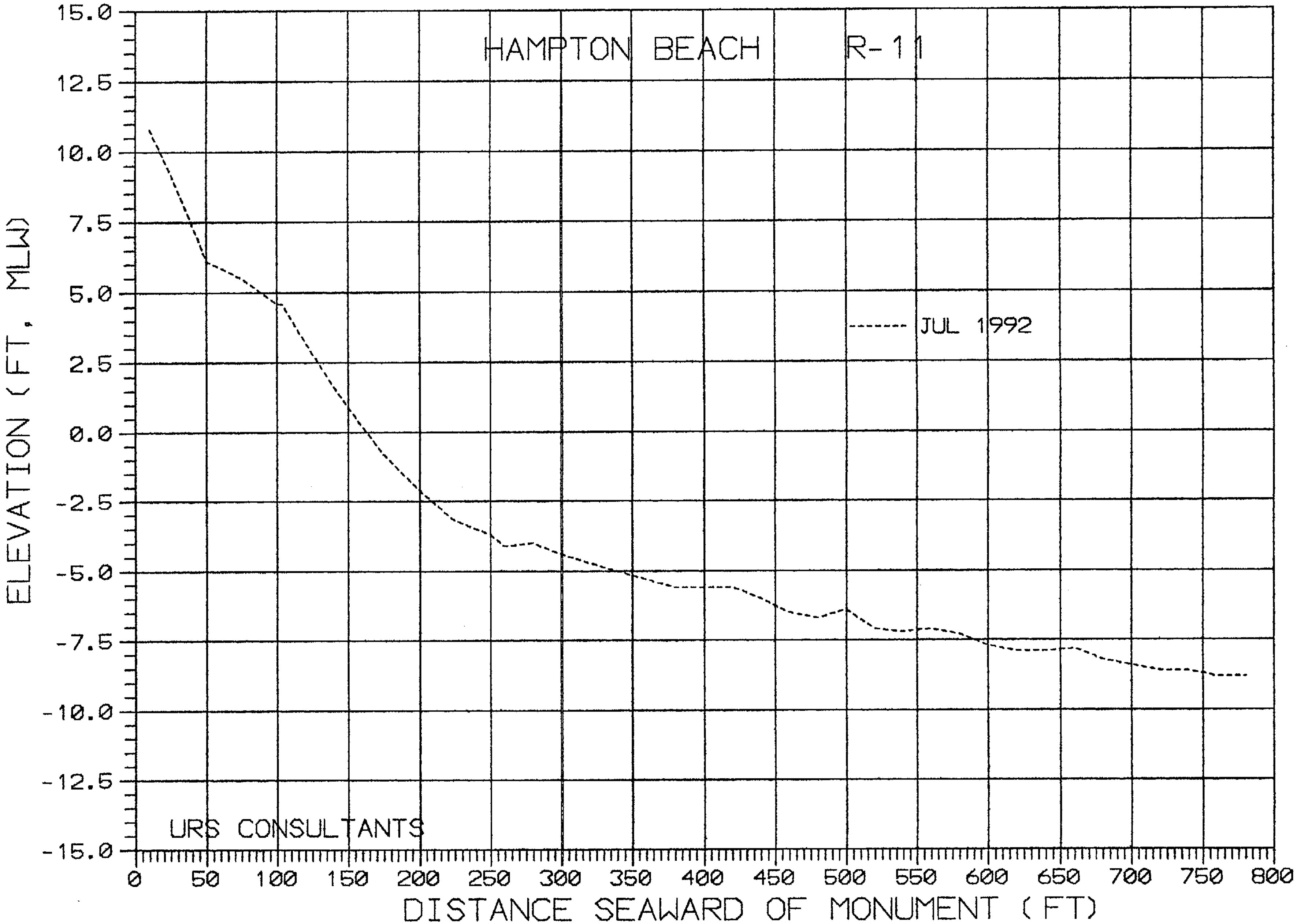
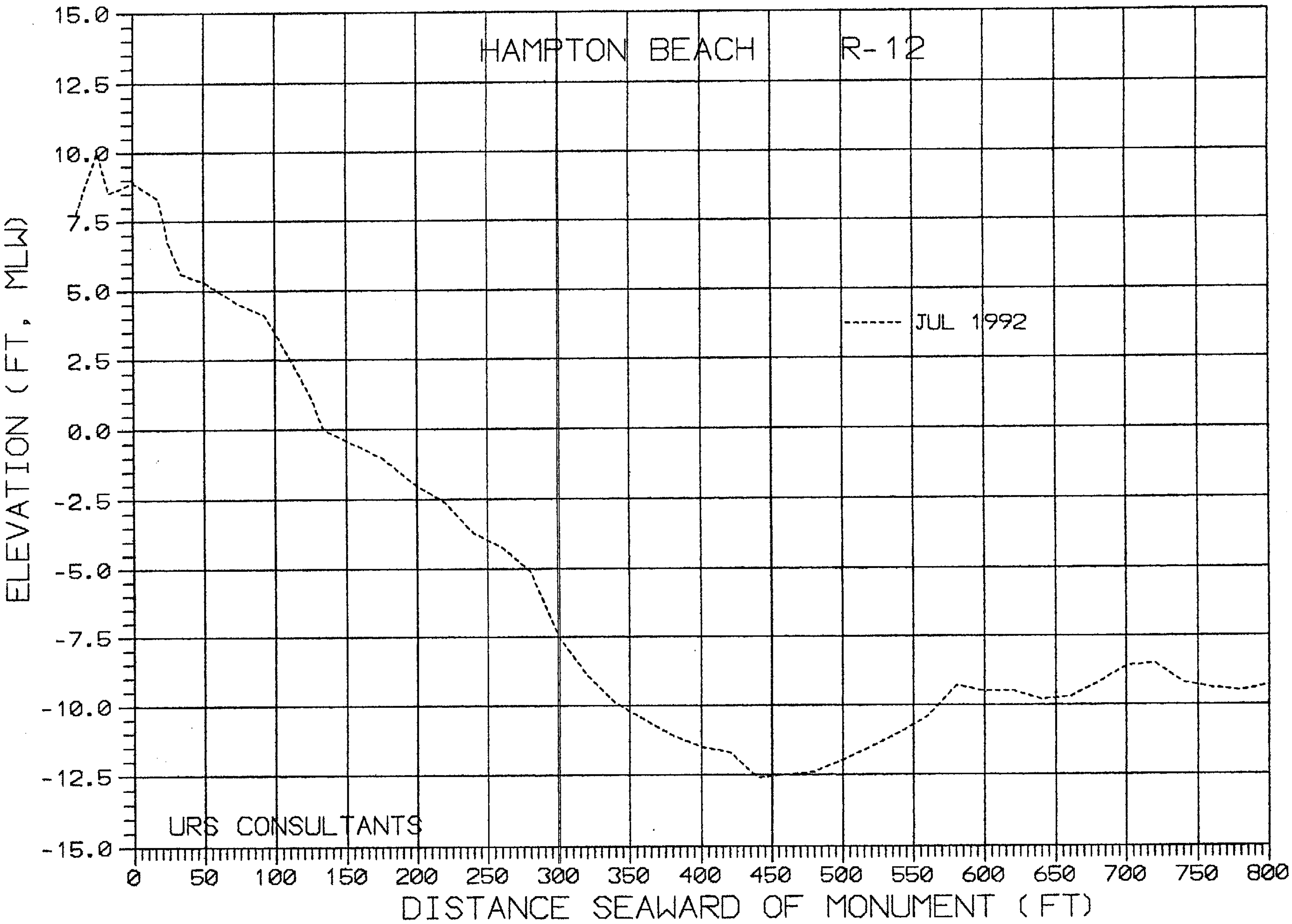
12.5
10.0
7.5
5.0
2.5
0.0
-2.5
-5.0
-7.5
-10.0
-12.5
-15.0
0
50
100
150
200
250
300
350
400
450
500
550
600
650
700
750
800
DISTANCE SEAWARD OF MONUMENT (FT)
URS CONSULTANTS


HAMPTON BEACH R-11
JUL 1992
URS CONSULTANTS
ELEVATION (FT, MLW)
15.0
12.5
10.0
7.5
5.0
2.5
0.0
-2.5
-5.0
-7.5
-10.0
-12.5
-15.0
0 50 100 150 200 250 300 350 400 450 500 550 600 650 700 750 800
DISTANCE SEAWARD OF MONUMENT (FT)


HAMPTON BEACH R-12
JUL 1992
ELEVATION (FT, MLW)
DISTANCE SEAWARD OF MONUMENT (FT)
URS CONSULTANTS
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12.5
10.0
7.5
5.0
2.5
0.0
-2.5
-5.0
-7.5
-10.0
-12.5
-15.0
0
50
100
150
200
250
300
350
400
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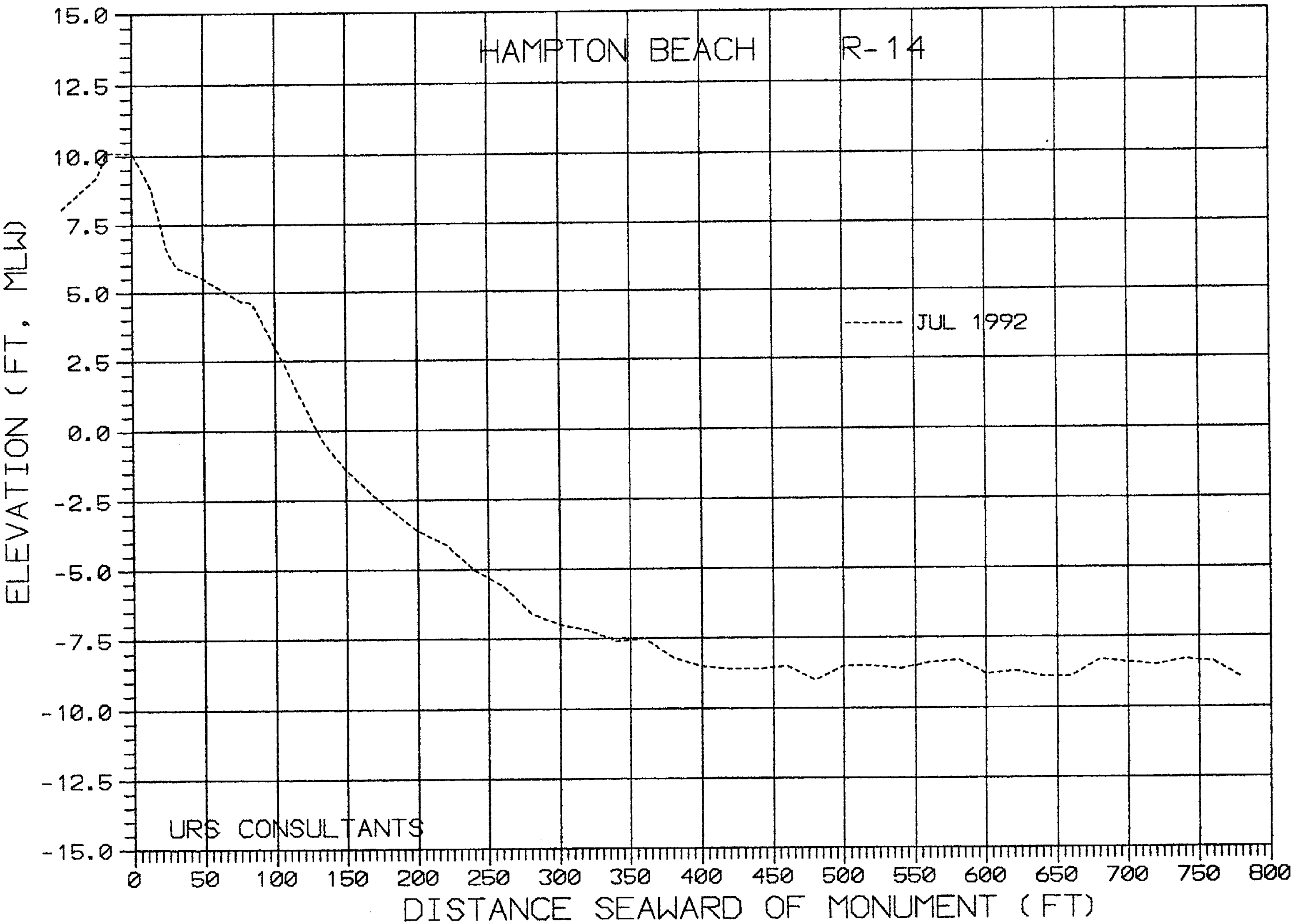
600
650
700
750
800


HAMPTON BEACH R-14
JUL 1992
ELEVATION (FT, MLW)
DISTANCE SEAWARD OF MONUMENT (FT)
URS CONSULTANTS
15.0
12.5
10.0
7.5
5.0
2.5
0.0
-2.5
-5.0
-7.5
-10.0
-12.5
-15.0
0
50
100
150
200
250
300
350
400
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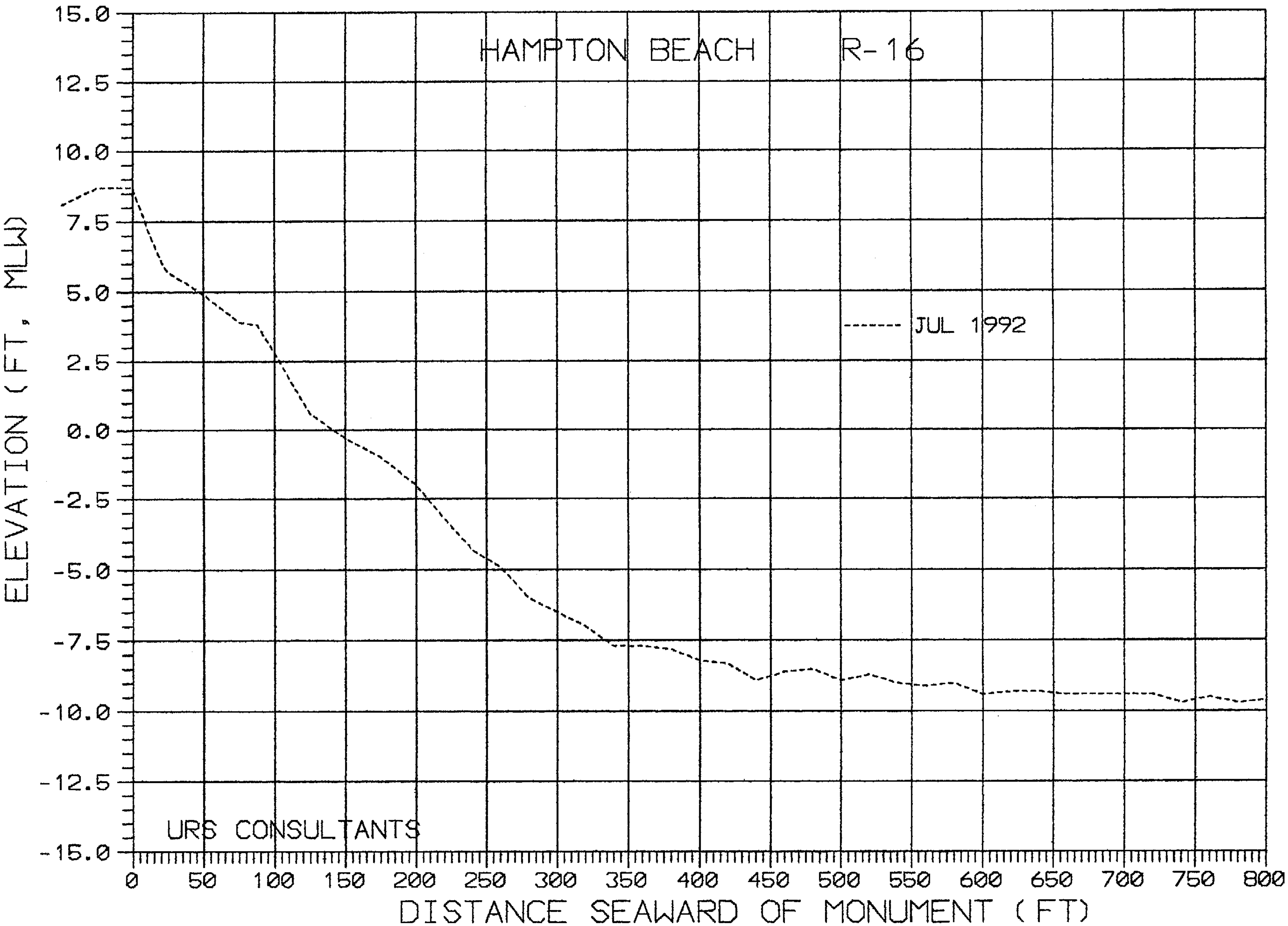
600
650
700
750
800


HAMPTON BEACH R-16
JUL 1992
URS CONSULTANTS
ELEVATION (FT, MLW)
DISTANCE SEAWARD OF MONUMENT (FT)
15.0
12.5
10.0
7.5
5.0
2.5
0.0
-2.5
-5.0
-7.5
-10.0
-12.5
-15.0
0
50
100
150
200
250
300
350
400
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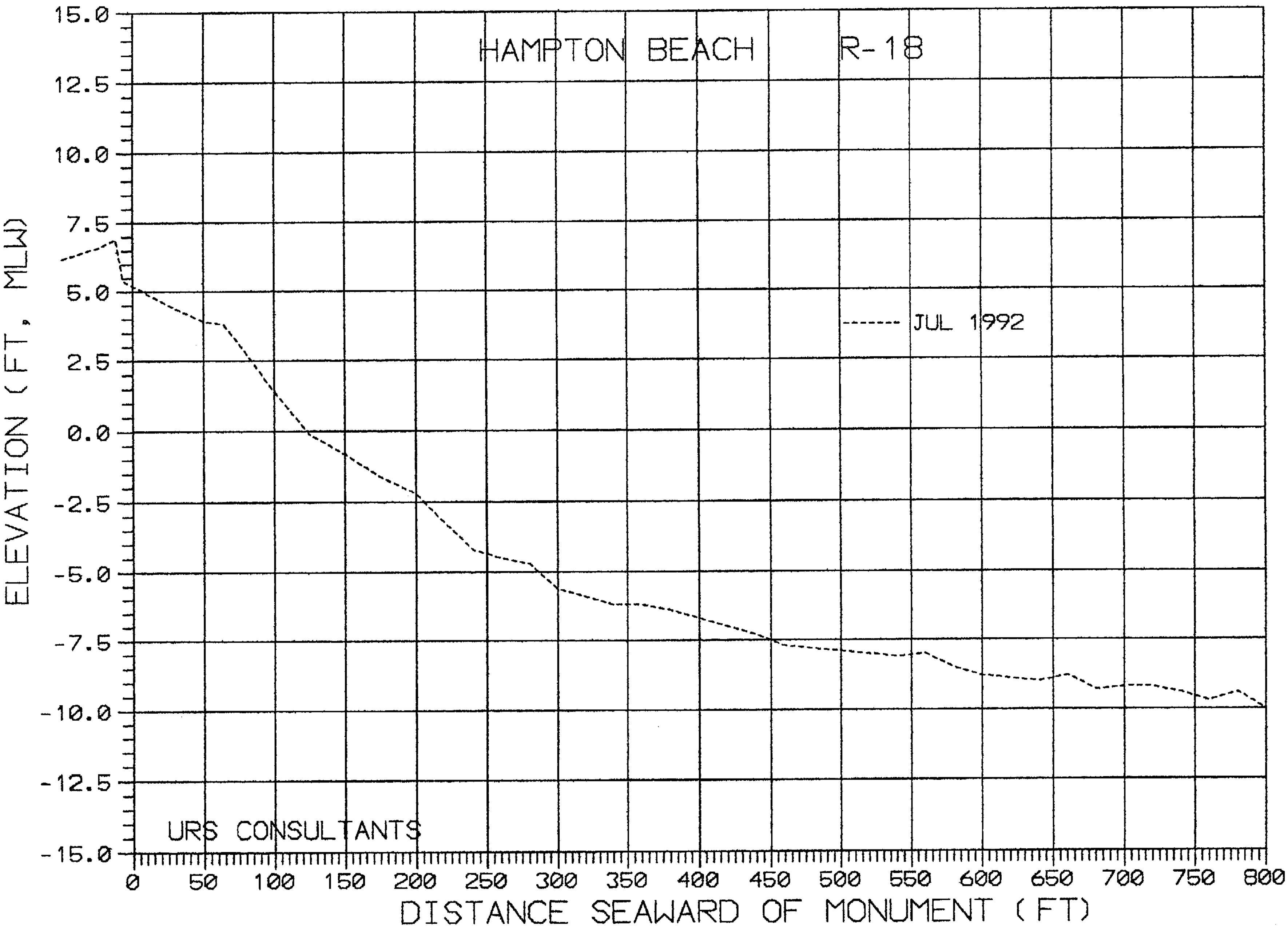
600
650
700
750
800


HAMPTON BEACH R-18
JUL 1992
URS CONSULTANTS
ELEVATION (FT, MLW)
DISTANCE SEAWARD OF MONUMENT (FT)
15.0
12.5
10.0
7.5
5.0
2.5
0.0
-2.5
-5.0
-7.5
-10.0
-12.5
-15.0
0
50
100
150
200
250
300
350
400
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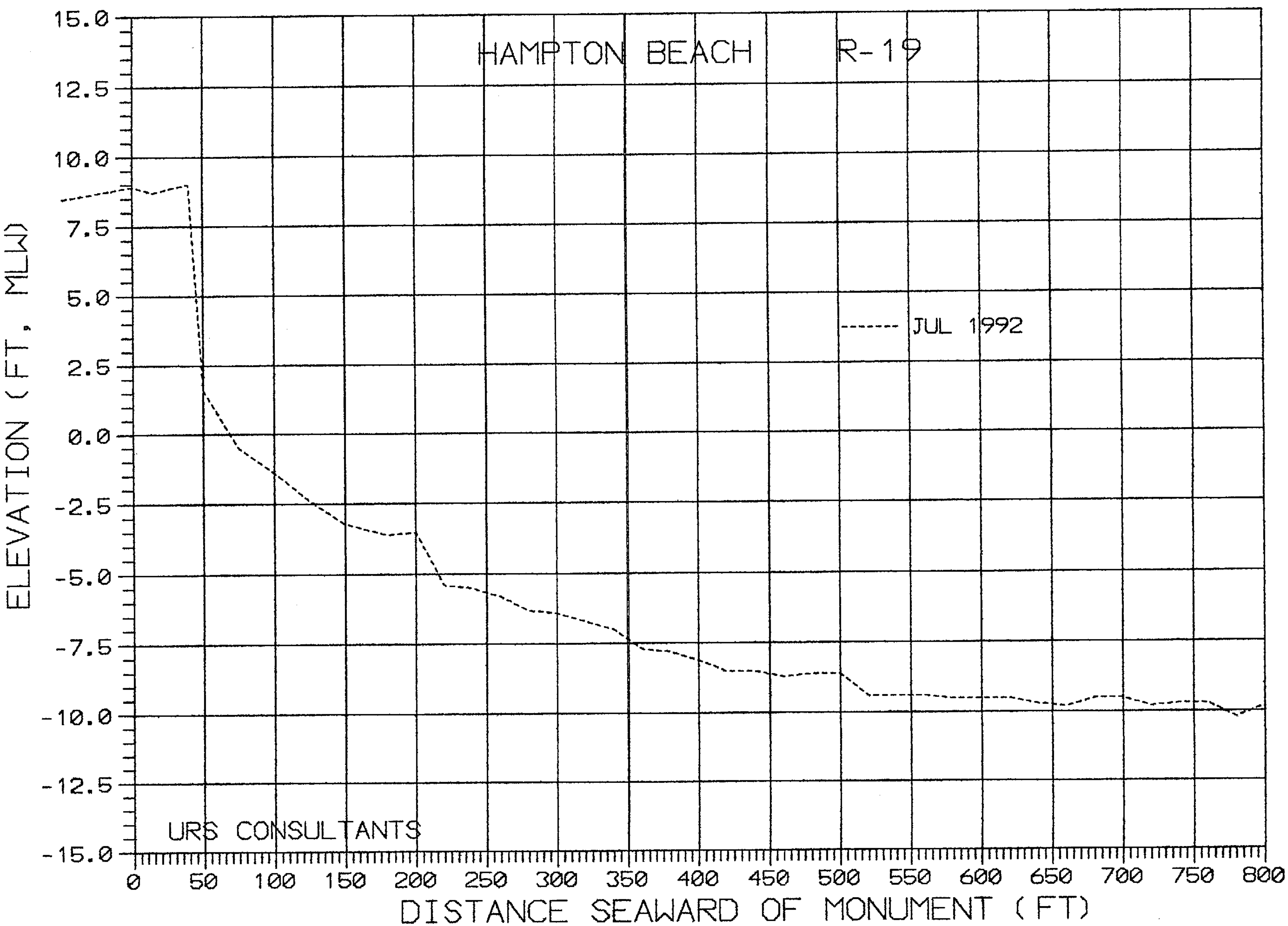
600
650
700
750
800


HAMPTON BEACH R-19
JUL 1992
ELEVATION (FT, MLW)
DISTANCE SEAWARD OF MONUMENT (FT)
URS CONSULTANTS
15.0
12.5
10.0
7.5
5.0
2.5
0.0
-2.5
-5.0
-7.5
-10.0
-12.5
-15.0
0 50 100 150 200 250 300 350 400 450 500 550 600 650 700 750 800