PART 2

COASTAL SEDIMENT PROBLEMS

CHAPTER 17

SYSTEMATIC COLLECTION OF BEACH DATA

Dennis W. Berg Coastal Engineering Research Center Washington, D. C

ABSTRACT

Theoretical considerations of beach behavior are often hampered by a lack of systematically obtained data sets which reflect the beach environment. For specific studies, lack of time and money often prevent the collection of such data sets. Thus, any opportunity for the collection of such data, on a routine basis, should be fully exploited 1

In 1967, the U S Army Corps of Engineers and the State of California initiated a cooperative program to collect empirical data at selected locations along the California coast. The objective was to establish a reservoir of repetitive, systematic observations, by qualified personnel, with the hope of securing a better understanding of the physical characteristics of the California shore and the littoral processes occurring there.

Once a sufficient volume of data has been collected, analysis of the data will begin with the aim of determining meaningful correlations between the various recorded parameters.

The number of distinct observations and sites dictated standardized observational procedures and recording methods amenable to automatic processing Observational methods and a recording form were designed to provide a base of comparison and an efficient means of processing the expected large volume of data Investigation of various methods of recording data led to the design of a suitable optical scanning form. This form, completed in the field by individual observers, can automatically be converted to punched cards for further processing Experience in collecting similar data in connection with other studies of the Coastal Engineering Research Center influenced the selection of comparatively inexpensive instruments for data collection.

Approximately 50 observation sites, extending from the Oregon-California boundary to the United States-Mexican border are presently contributing data. These sites represent a wide variety of shore types, beach sediments, geographic orientations, and morphology It is anticipated that future expansion of this program will include sites other than those directly controlled by State agencies and will allow a more detailed description of the California shore Although not presently programmed, the extension of this study to other coastal areas of the United States where little or no information is presently available would be desirable, and could provide the necessary background for more comprehensive description of the overall behavior of the littoral zone

INTRODUCTION

BACKGROUND

Although increasing emphasis is being placed on investigative study of the deep oceans, the boundary zones of the lands and seas remain generally unknown areas and of concern to relatively few investigators. In some respects, this classically forsaken zone should invite greater concern, for it is here that man leaves one environment

¹The field collection of data, laboratory procedures and consequent study here reported are being carried out in connection with the general research program of the U S Army Corps of Engineers, Coastal Engineering Research Center However, the interpretations expressed are those of the author and are not necessarily concurred in by the Corps of Engineers. Permission granted by the Chief of Engineers to publish the information contained herein is appreciated to enter another This general lack of active interest can certainly be partially attributed to the complex problems that confront those investigators intrepid enough to evince an interest, this boundary or littoral zone has all these forces and problems associated individually with land or sea occurring here in strange and unwonted interfusion.

However, despite this somewhat bleak prognosis, knowledge of the littoral zone and its many interacting forces has increased markedly in recent times, although a great deal is still to be learned Theoretical studies of shorelines, designed to increase our understanding of the environment are often hampered by a lack of systematically obtained data sets which adequately reflect the dynamic character of the littoral zone. For specific, project-oriented studies, a lack of time and money generally prevents the collection of statistically significant data sets, this expediency often imposes misleading conclusions, resulting in projects that fail from the outset or are of only limited success. Thus, whenever an opportunity for the collection of suported and supported.

In late 1966, such an opportunity occurred when the State of California proposed the collection of empirical data at selected sites along the California Coast, utilizing available State Park employees in order to document beach configurations. Due to the large volume of information that would ultimately be developed in a program of this type, the U. S. Army Corps of Engineers was asked to cooperatively participate in the study and act as custodian of all collected data with a possible overview toward compiling the data so obtained to eventually prepare a suitable ' summary report. The Coastal Engineering Research Center (CERC), the primary representative of the Corps in this field, accepted the proposal, provided that the data would be obtained and furnished in reasonably complete sets on a regular and systematic basis

The ultimate aim of the proposed data collection program was to establish a reservoir of repetitive, systematic observations which would be compiled and made available to the scientific community for applicable analytic study. The results of such studies would hopefully result in an increased understanding of the littoral environment and more particularly, greater knowledge of the physical characteristics of the California shore and the littoral processes taking place.

STUDY CONCEPT

Early in 1967, after a series of meetings between representatives of all interested parties, the State of California began a test collection of field data at New Brighton State Beach located at the north end of Monterey Bay, primarily for the purpose of evaluating the extent of effort required by individuals to make a specified number of observations. Since the proposed study would utilize the employees of California as the observers, the collection of any data would necessarily be in addition to their regular duties, and could not unduly interfere with their normal routine. This initial test satisfactorily confirmed the feasibility of using such employees as observers. During the test, twice daily observations were made of surf characteristics, i.e., wave height and period, as well as direction of wave origin, tide level, and measurements of the location and elevation of the beach berm crest with respect to a reference point and an arbitrary datum Additionally, panoramic photographs of the beach were taken weekly.

At the outset of planning and coordination of this study, it was readily apparent that the intended scope of the study would yield a large volume of data, of the order of 30,000 bits of information per month, which if improperly recorded and processed would negate the value of the data collected It was envisioned that approximately 70 observation sites would be included in the study in order to yield data on a variety of shore conditions. The number of distinct observations and sites dictated standardized observational procedures for logical compatibility of data and recording methods amenable to automatic processing of the data Experience in collecting similar data in connection with other studies of the Coastal Engineering Research Center influenced the selection of the particular observations and a limited number of comparatively inexpensive instruments for making the observations. The experiences of the Center and of others in various methods of recording data was investigated, and this led to the design of a specialized form employing optical scanning techniques to facilitate automatic processing of data

Based on the results of the test at New Brighton State Beach and of other similar studies, the parameters selected for observation include

- 1 Surf observation (twice daily)
 - a. Wave period
 - b. Wave height
 - c. Wave direction
 - d. Type of breaking wave
- 2. Wind observations (twice daily)
 - a. Velocity
 - b. Direction
- 3 Beach observations (once daily)
 - a. Beach berm crest elevation referred to some specific datum
 - b. Beach berm crest distance from an established
 - reference station c. Foreshore slope angle
- 4 Littoral current observations (once daily)
 - a. Velocity
 - b. Direction
- 5 Tide level (twice daily)
- 6. Presence of rip currents (twice daily)

- 7. Presence of beach cusps (twice daily)
- 8. Panoramic photographs of the observation site (monthly)
- 9. Collection of representative beach materials (monthly)
- Water temperature (twice daily, this factor is observed only if it is obtained for other purposes as a normal procedure at a particular site).
- 11. Reports of any unusual occurrences.

Additionally, periodic visits by Corps of Engineers personnel to each observation site will be made to ensure that correct observational procedures are being consistently practiced and to emphasize and explain the importance to the study of doing so.

PROCEDURES

SITE SELECTION

As originally proposed by the State of California, observation sites would be established at selected beaches and shoreline parks, operated and staffed on a full year basis by the Department of Natural Resources, Division of Beaches and Parks. In the final selection of the observation sites, consideration beyond personnel availability was given to the need for data to assist in the planning, design, construction or maintenance of coastal works in an area, correlation of the observed data with existing or planned basic data collection programs, general shore conditions, i.e., a variety of shore exposures, orientations and beach configurations, and spacing of sites to give the greatest coverage with the fewest locations. Within those shoreline segments where there are no State operated beaches but where the collection of data is desirable, locally operated beaches and parks have been included.

Of over 80 beaches operated under State direction, 39 observation sites have been established and are submitting data Additional sites will be added as the State expands its recreational program, and stations personnel at more beaches. Further, there are approximately 20 observation sites operated by local agencies which are being added to the study. A map of California with the locations of the active observation sites is shown in Figure 1. As previusly noted, the shoreline conditions vary at each site and typical illustrations of these conditions are shown in Figure 2. Conditions vary from pocket beaches to long, uninterrupted shores, and from heavily populated areas to remote, uninhabited shores.

INSTRUCTIONS, RECORDING FORMS AND INSTRUMENTS

To minimize variance in data collection methods by the large number of individuals involved, a set of instructions describing the preferred methods of observation was prepared and distributed to each site The instructions for each item, arranged in the same sequence as these items appear on the actual recording form, consist of short, concise statements relative to each individual parameter and the manner in which each observation is to be made. These instructions, illustrated in Figure 3, have been laminated with plastic to facilitate their use in the field as a ready reference at the actual site In addition to these instructions, brief statements concerning individual observations have also been printed on the data recording form to facilitate the observational procedures.

The form on which the observations are recorded has been designed for automatic processing through an IBM 1231/1232, optical mark page reader, which converts the data to acceptable computer language (4)*. Once the value of an individual observation has been determined, the data is recorded on the form shown in Figure 4 by filling in the appropriate blanks with an ordinary lead pencil.

Two comparatively inexpensive instruments have been selected for measurement of the three parameters, wind velocity, elevation of the beach berm crest and the angle of the foreshore slope. A Dwyer Wind Meter, shown in Figure 5, is used to measure the wind velocity rather than using visual estimates such as Beaufort Wind Scales. The instrument's simplicity of construction and use, as well as its comparative accuracy assures compatibility of data between observation sites An Abney Topographic Hand Level allows the measurement of the beach berm crest elevation in the normal manner, the angle of the foreshore slope is measured by using the level as an inclinometer. Use of the Abney Level in the latter fashion is shown in Figure 6.

Each site has also been supplied with a measuring tape, a supply of plastic bags for collecting samples of the beach materials, a supply of fluorescein or rhodamine B dye for use in observing the littoral current patterns, cameras, film and sturdy envelopes for mailing the data to the Coastal Engineering Research Center.

METHODS OF OBSERVATION

At each observation site, a permanent reference point with a known elevation has been established near the shoreline. Observations are referred to this station so that all subsequent data sets can be used to reflect variations of the littoral environment from a fixed reference. The observations are made during a normal inspection of the shoreline by personnel assigned to the area. These inspection tours usually occur twice a day so that two sets of observations are possible each day at each site. The various instruments, instructions and recording forms require no special handling and can easily be carried by the observer during his normal tour. Once on station, observation of the desired parameters by following the procedures outlined in the instructions and on the data-recording form is a simple task requiring approximately 20 minutes.

Observed data is forwarded to the Coastal Engineering Research Center on a weekly basis, samples of the beach materials and photographs (obtained monthly) are mailed as taken

OFFICE PROCEDURES

At CERC, the data is processed through an optical mark page reader and converted

*Numbers in parentheses refer to References at end of report.

to standard punched data cards which are stored for analysis in future studies The only data reduction now planned is the compilation and data printout of the observations. However, once a statistically significant volume of data has been accumulated, detailed studies of data will be started to seek meaningful correlations between the various parameters.

Granulometric analysis of beach materials is accomplished on a routine basis by the Geology Branch of the Coastal Engineering Research Center as the samples are received. Utilizing a rapid sediment analyzer similar to that described by Schlee(5), size distributional characteristics of the samples are calculated by computer techniques and include cumulative size-frequency distribution, median and mean diameters, standard deviation, skewness and kurtosis of each sample. Presently, this is the only analysis being made of the beach material samples, however, the samples are being retained so that other types of analysis (compositional, heavy mineral, etc.) can be made by investigators in the future if deemed desirable.

EXAMPLES OF USE FOR COLLECTED DATA

Although no detailed studies of the submitted data have yet been accomplished, several possible methods of investigation are discernible when scanning the observation forms and the results of beach material analysis and photographs. Examples of these methods of investigation are illustrated, but are not intended as a complete catalogue of possible uses. Illustrative examples represent only minimum analysis. It is believed that the information will have many more uses beyond those suggested by the author

SURF AND BEACH OBSERVATIONS

Data from an observation site has been randomly selected to illustrate the possible correlations of the surf and beach observations. Approximately 60 days of record for Seacliff State Beach on Monterey Bay, collected during the spring of 1968, are shown in Figure 7 Although there are lapses of several days each in the record, apparently caused by lack of manpower at these times to collect the data, the record is essentially complete and is open to several qualitative interpretations.

For example, the data in Figure 7 shows for the recorded period that the waves were small, varying from 1 to 4 feet in height, had rather long periods, averaging slightly higher than 10 seconds and they originated from a distant generating area in the southwest quadrant. Generally, the waves broke on the shore as spilling waves. The overall response of the shore to these waves resulted in an accreting beach characterized by a lowering berm crest with a gentle foreshore slope.

Qualitatively, it can be stated that the predominant wave climate during this period was conducive to movement of available littoral materials toward the observation site and allowed it to remain in the area. Additional data will, in all probability, record varying responses during other periods of the year. Studies by Shepard⁽⁶⁾ and Trask⁽⁷⁾ have shown that California beaches undergo annual cycles with general erosion of the beaches occurring during the winter months when large, steep waves accompanying storms out of the northwest predominate, and accretion during the summer months of southwesterly sea swells which return sand to the upper portion of the beach

This type of data, once more of it has been accumulated and processed, will assist various individuals and agencies in project oriented studies of the California shores. A case in point is a recent report of the Corps of Engineers Los Angeles District on Newport Beach, California⁽⁸⁾, using data on beach sidths observed since 1954 by Mr. Robert E. Reed, Chief Lifeguard of that city This information, in conjunction with studies of a more conventional nature was used to predict the time when the beach would erode to a dangerous position, and require restoration by placing sand fill on the shore. A summary of Reed's data as used by the Los Angeles District is shown in Figure 8 This dat is similar to that being obtained in the cooperative program reported on, as indicated in the instructions and observation form and Figure 7.

Surf observations at locations on parts of the U.S. Coast other than those shown on Figure 1 are presently being analyzed at CERC under a different study⁽²⁾ (co-operation with USCG), but data collected under any of these studies will be correlated with any that may be available from any of the other study programs Observations of the surf are intended to supplement more detailed study of waves using recording wave gages installed at various locations on the coastline of the United States⁽¹⁾

Compilations of the observed data on surf characteristics and beach response should also prove useful in studies directed primarily toward the recreational aspects of the shore The ability to predict the overall characteristics of a beach for such uses as swimming and surfing will allow the appropriate agencies to assign various classifications for safety and use to the beaches.

BEACH MATERIALS ANALYSIS

As previously mentioned, analysis of sample beach materials received at CERC under this program is made by the Geology Branch The results of the analysis from the rapid sand analyzer are processed by computer methods yielding the size-frequency distributions of the individual samples as well as the computation of the statistical parameters which are descriptive of size distributions. Several typical examples of this process are shown in Table 1. The samples listed were all obtained on 1 July of this year and are representative of the type of analyses presently being made

Availability for comparison of the various parameters of the beach materials for many beach locations should result in additional understanding of the geomorphology of the California shore, and when correlated with all the other observed data, should enhance the understanding of shore characteristics in relation to the materials composing the beach. An example of such a comparison is shown in Table 2 where mean diameters and standard deviations of the besch samples have been listed for a number of observation sites. The data listed in Table 2 is based on analyses of samples taken during the spring of 1968. The locations are listed in a north to south direction as shown on Figure 1 and the variance in the physical characteristics of beach materials at different locations is indicated.

As directed in the study instructions shown in Figure 3, the samples of beach material are obtained from the wetted zone of the beach and although sampling is small compared to the whole beach area, hopefully the results of the sample analysis will bear some significant relationship to the physical characteristics of the materials forming the entire beach. It is already clear that there is substantial variation in

COASTAL ENGINEERING

PHI Size	MM. Sıze	Frequency Percent	Cumulative Percent	
Wright'	<u>s</u> Beach	<u>No 05021</u>		Sample taken 1 July 1968
-1.00	2.000	.00	00	STATISTICAL PARAMETERS
50 .00 .50 1.00 1.50 2.00 2.50 3.00 3.50 4.00	1.414 1.000 .707 .500 .354 .250 .177 125 .088 .062	87.55 10.98 1.48 .00 .00 .00 .00 .00 .00	87.55 98.52 100.00 100.00 100.00 100.00 100.00 100.00 100.00	PHI MM Median - 64 1.562 Mean 63 1.552 Stand Dev. 18 1.136 Skewness 1.38 hurtosis 6.85 6.85
San Sin	neon Beach	No 05009		Sample taken 1 July 1968
.50 1.00 2.00 2.50 3.00 3.50 4.00	.707 .500 .354 .250 .177 .125 .088 .062	.00 23.17 35.56 29.18 9.92 2.16 .00 00	.00 23.17 58 73 87 91 97 84 100.00 100.00 100.00	STATISTICAL PARAMETERSPHIMMMedian1.40380Mean1 42372Stand Dev.471 383Skewness46Kurtosis2 62
Carpinte	eria Beach	No. 05011	<u>+</u>	Sample taken 1 July 1968
1.00 1.50 2.00 2.50 3.00 3.50 4.00	.500 .354 .250 .177 .125 .088 .062	.00 11 25 29.71 37.91 19.67 1.45 .00	00 11.25 40.96 78.88 98.55 100.00 100.00	STATISTICAL PARAMETERSPHIMMMedian2.13.229Mean2 11.232Stand. Dev.451.365Skewness.03Kurtosis2.13
Huntingt	on Beach	No. 05027		Sample taken 1 July 1968
.50 1.00	.707 .500 354	.00 11.79 16.61	.00 11 79 28.40	STATISTICAL PARAMETERS PHIMM
2.00 2.50 3.00 3.50 4.00	.250 .177 .125 .088 .062	22.21 31.59 16.34 1.46 .00	50.61 82.20 98.54 100.00 100.00	Median 1.99 .252 Mean 1.90 269 Stand. Dev64 1.553 Skewness36 Kurtosis 2.28

TABLE 1 - Typical Results of Computer Analysis of Beach Material Samples Littoral Environment Observations

BEACH DATA

TABLE 2 - Comparison of Computer Derived Statistical Parameters for Beach Material Samples - Littoral Environment Observations

Location	Date of Sample	Mean Diameter ¢ Unitsmm	Standard I	Deviation mm.		
Mackerricher	l Apr 68	-0.05 1 04	+0 30	0.82		
Russian Gulch	25 Apr 68	+1 70 0 31	+0.53	0.69		
Van Damme	8 Apr 68	+0 10 0 93	+1 02	049		
Manchester	11 May 68	+0.80 0.57	+0 80	0.57		
Goat Rock	15 Apr 68	+0 10 0.93	+0.80	0.57		
Wright's	15 Apr 68	+0.70 0 62	+0 87	0 55		
Stinson	17 Apr 68	+2.15 0 23	+0.39	0 76		
Thornton	15 Apr 68	+1 85 0 28	+0.39	0.76		
Half Moon Bay	15 Apr 68	+0 50 0.71	+0.45	0.73		
Natural Bridges	1 Apr 68	+1 60 0.33	+0.57	0.67		
Twin Lakes	8 Apr 68	+1.25 0 42	+0.48	0 72		
New Brighton	24 Mar 68	+2 10 0.23	+0 50	0.71		
Seacliff	6 Apr 68	+2 00 0 25	+0 48	0.72		
Sunset	5 Apr 68	+1 90 0.27	+0.42	0.75		
Carmel River	6 Feb 68	+0.25 0 84	+0 57	0 67		
San Simeon	9 Apr 68	+1.40 0.38	+0 45	0.73		
Montana de Oro	l Nov 67	+1 00 0.50	+0.63	0.65		
Pismo	1 Apr 68	+2.40 0 19	+0.30	0.81		
El Capitan	l Apr 68	+2.10 0 23	+0 36	0.78		
Carpinteria	1 Feb 68	+1.90 0 27	+0.42	0.75		
San Buenaventura	1 Apr 68	+2.10 0.23	+0 42	0 75		
McGrath	l Apr 68	+0.70 0 62	+0.33	0 80		
Point Mugu	1 May 68	+2 00 0.25	+0.36	0.78		
Leo Carrillo	3 Jan 68	+1.35 0 39	+0,50	0 71		
Bolsa Chica	6 Apr 68	+0 75 0.59	+0.60	0 66		
Huntington	1 May 68	+1.75 0 30	+0.50	0.71		
Newport	l Apr 68	+1.40 0.38	+0.45	0.73		
Doheny	26 Apr 68	+0.90 0 54	+0.70	0.62		
San Clemente	19 Apr 68	+1 45 0 37	+0.50	0.71		
Torrey Pines	18 Apr 68	+1.75 0 30	+0.42	0.75		

COASTAL ENGINEERING

		Locations of Beaches													
		Thorn	nton	San Si	lmeon	San Buenav	ventura	Bolsa Chica							
Date		<u> </u>	3 mm.	∮ Units	; mm.		mm	φ Units	mm						
0ct	67	1 60	0 33	1.05	0.48	2 15	0 22	2 20	0 22						
Nov	67	2 00	0 25	1 25	0.42	2 10	0 23	1 30	0.41						
Dec	67	2 05	0.24	1 45	0.37	2 00	0 25	0 95	0 52						
Jan	68	1 95	0.26	1 45	0 37	2 10	0,23	1 10	0 47						
Feb	68	1 95	0,26	0.80	0.57	2.10	0 23	0,50	0,71						
Mar	68	1 90	0 27	0 60	0 66	1.60	0 33	0.70	0 62						
Apr	68	1.85	0 28	1 40	0.38	2 30	0 20	0.75	0 59						
May	68	1 55	0.34	0 75	0 59	1.20	0 44	1,50	0 35						
Jun	68			1 20	0 44	1,80	0 29	1 40	0 38						

TABLE 3 - Comparison of Variations in Mean Diameters of Beach Materials Littoral Environment Observations the composition of samples at different points in time from the same locations Table 3 lists the results of part of the beach material analyses for four observations sites for a 9-month period. It can be seen that the mean diameter of the materials varies considerably, especially for the observation sites at San Simeon and Bolsa Chica State Beaches. This variation may be a result of resorting and redistributing by increased storm action that is typical along the California Coast during the winter months but it cannot be directly attributed to any one factor until sufficient data has been collected and interpreted.

PHOTOGRAPHS OF OBSERVATION SITES

Photography has long been an accepted method of documenting the condition of beaches and shoreline structures and in many cases has been the only evidence gathered. The use of such photography in a number of studies has revealed changes which would otherwise have been impossible to describe without having resorted to difficult, expensive and time-consuming surveying techniques. A historical record of the New Jersey shoreline by Vesper and Essick⁽⁹⁾ is an example of the judicious use of photography, a capsule commentary on the variations of a large segment of the coastline of the United States is placed in one brief, easy-to-comprehend, volume. However, ground photographs by themselves do not allow quantitative descriptions of the shoreline variations which occur, and therefore can only complement data of a more conventional nature. For this reason, panoramic photographs of each observation site are taken monthly. The photographs reveal the general conditions at each site which cannot be recorded on the observation form. It is felt that the photographs will allow an investigator studying the data to form impressions of the observation sites which would not be otherwise possible unless he actually visited each site, and will hopefully assist in the interpretations of the data.

A series of photographs, acquired under this study, are shown in Figures 9 and 10. Three overall views of El Capitan State Beach, plus three views to the south of the actual observation point at this beach are shown in Figure 9. Several recognizable landmarks are clearly discernible in all six photographs, such as the small grove of trees and the stone groin in the background, and these assist in the evaluation of the general beach condition. It can be seen that in November 1967 the beach was generally broad, with a gentle foreshore slope, and had at least two berms, in January 1968 the beach was slightly marrower, having been recently affected by storm waves as indicated by the cuspate tonal difference of the sand above the waterline in the left photograph and the beach scarp in the right photograph. An added inference is that wave conditions were conducive to the formation of beach cusps at the time the photographs were taken By March 1968, the beach is still narrower and again shows recent effects of storms as denoted by seaweed and debris on the shown in the photograph for January 1968, on the right.

Figure 10 is a series of six photographs taken at Natural Bridges State Beach over the period November 1967 through April 1968 The variation in the condition of the beach which is easily noted in these photographs reflects a seasonal cycle at this observation site.

Detailed analysis of other observed data should be concurrently considered in order to confirm these conclusions but the photographs do allow rather quick analysis of overall beach conditions. All of the photographs taken at each observation site are being filed at the Coastal Engineering Research Center and will become a part of the data bank for future analytic studies.

STUDY SUPPORT

As stated, this study is a cooperative effort of the State of California and the U. S. Army Corps of Engineers. The State, acting through the Department of Natural Resources Division of Beaches and Parks provides the necessary manpower for the colleciton of data. The cost of this manpower contribution at present far exceeds the other efforts in a mometary sense. A typical observation site can be initially equipped for under \$100 and requires sustaining funds of approximately \$30 per year. The funds for this support are budgeted under the general research program of the Coastal Engineering Research Center. It should be noted, however, that without the cooperation of the State of California, the collection of this type of data could not be unlaterally carried out by the Center.

The distant location of the Coastal Engineering Research Center from California makes assistance from other branches of the Corps of Engineers a requirement, the South Pacific Division and the Los Angeles and San Francisco District Engineer offices have been instrumental in the coordination and implementation of this study by providing the necessary technical liaison between the Center and local park employees at each observation site. Personnel of these offices, by their knowledge and experience, have contributed immeasurably in the selection of individual observation sites, in obtaining the excellent cooperation experienced to date from a large number of individual observers located at many distant points.

The initial compilation and reduction of the collected data will be made by CERC as part of a much broader program of data collection and analysis, seeking full understanding of littoral environment around the United States.

It is presently contemplated that this study will continue for three years, however, the value of the data could concervably extend the life of the program well beyond this period. Specific analysis of the data will ultimately be made by scientists and engineers of the Center, but all data will be available to any interested investigator who desires to make use of it.

CLOSURE

This study of the California shoreline is in no way unique or original. The Netherlands $^{(3)}$ has long led the world in documenting coastal variations, and the Coastal Engineering Research Center itself has conducted or supported similar studies of the shores of the United States, including those of California in more limited scope. However, it is felt that the frequency and number of observations, and the number of observation sites, place this study in a novel status. It is expected that future analysis of collected data will enhance understanding of the lintoral environment and allow greater utilization of this zone by man.

ACKNOWLEDGEMENTS

This study, entitled Littoral Environment Observations, is being carried out in connection with the general research program of the U. S. Army Corps of Engineers, Coastal Engineering Research Center in cooperation with the State of California, Department of Natural Resources. The success of the study will be primarily the result of the efforts of those many individuals who have shown an unbounded interest in observing the California shoreline and faithfully recording their observations for the future use of scientists and engineers Without these individuals, a study of this scope could not exist

NOTE Use of trade names or manufacturers in this report does not constitute an official indorsement or approval of the use of such commercial hardware or software.

REFERENCES

- J. Darling, J M., The Wave Record Program at CERC, U S Army Coastal Engineering Research Center Miscellaneous Paper 1-67 January 1967.
- Darling, J M., Surf Observations Along the United States Coasts, Journal of Waterways and Harbors Division, Proceedings of the American Society of Civil Engineers, WW1, Feb 1968, pp 11-21.
- 3 Edelman, T.; Systematic Measurements Along the Dutch Coast, Proc., Coastal Engineering Conference, September 1966, Vol. 1, Part 2, pp 483-501.
- IBM Corp , IBM 1231,1232 Optical Mark Page Readers, IBM Systems Reference Library, 1963, File No. 1231-03.
- Schlee, J A., A Modified Woods Hole Rapid Sand Analyzer, Journal of Sedimentary Petrology, Vol. 36, No 2, June 1966, pp. 403-413.
- 6 Shepard, F P; Beach Cycles in Southern California, U S. Army Beach Erosion Board Technical Memorandum 20, July 1950
- 7. Trask, P D, Changes in Configuration of Point Reyes Beach, California, U. S Army Beach Erosion Board Technical Memorandum 91, September 1956
- 8, U, S. Army Corps of Engineers, Los Angeles District, Design Memorandum for Beach Stabilization, Stage 2, Construction in the Segment from Santa Ana River to Newport Pier, Orange County, California, August 1967, Plate 6
- 9 Vesper, W H and Essick, M G., A Pictoral History of Selected Structures Along the New Jersey Coast, U. S Army Coastal Engineering Research Center Miscellaneous Paper 5-64, October 1964



Fig. 1. Map of California showing the locations of Littoral Environment Observation Sites.



a. Goat Rock State Beach,Sonomo Coast.



 Son Buenoventuro Stote Beach ond McGroth State Beach.



c. Stinson State Beach.



d. Newpart Beach, City of Newport Beach.

Fig. 2. Aeriol photographs of typical California Littoral Environment Observation sites.

BEACH DATA

LITTORAL ENVIRONMENT OBSERVATIONS	
CRC form No. 32 has been designed for processing by optical acanning equipment Thiss equipment sutematically reads the observat forms and converts the recorded data to punched cards which will then allow analysis of the data by computer methods it is therefore recommended that a number 2 black. Lead pencil be used to mark the forms. When data positions are marked the mark should be made her length of the mark positions and should fill at least two-thirds of the space between the top and bottom of the guide lines The marks should not extend more than 1/10 beyond the ends of the guide lines and in no case should they be extended beyond the margin on the right hand side of the form. Marks beyond the margin will result in erroneous reading of the data form. If an error is made in recording dat erasures should always be made carefully and <u>completely</u> . An incomplete erasure will be read as a mark	.on [u11 t
STATION IDENTIFICATION Each site in the Littoral Environment Observation study has been assigned a numerical code consisting of 5 digits. The first two Each site in the station territory in which the site is located and the remaining 3 digits define the particular beach or park within state or territory A space has also been provided to write in the name of the particular beach or park at which the observation is taking place	the ng
DATE Indicate in the spaces provided the year month and day on which an observation is made	
TIME Indicate the tame to the mearest quarter hour at which the observations are being made. The 24 hour system of recording time has b selected in order to eliminate any confusion between AM and FM. The hour UO refers to midmaght 07 to 700 AM 13 to 100 FM etc	ten
SURF CORSERVATIONS a Nave Period - Record the time in seconds for eleven (11) wave crests to pass some stationary point Eleven "crests"will incl the complete waves (crests and troughs) The first (1) crest selected for observation is recorded as time zero and the eleventh (11) crest will be the stop or cut time. Record this time in seconds in the spaces provided b Nave Height - This observation is based solely on the widgement of the observer. Natural or manmade features on the shoreline or in the surf some whose dimensions are known may add in judging the height of a wave Utherwave the observer is best estimate will he sufficient. Record the wave for the meaners for the approximation of the observer number of the observer is best estimate orientation of the beach with respect to north. The observer can then determine the direction <u>from which</u> the waves are approaching the beach d Type of Breaking Wave.	ıde
producing an inregular found water surface (see figure 1 on feetres sue) Plunging - Plunging occurs when the wave creat curls over the front face of the wave and fails into the base of the wave producing a high splash and much foam (see figure 2 on reverse side) Surging - Surging occurs when the wave creats remains unbroken while the base of the front face of the wave advances up the beach (see figure 3 on reverse side)	
WIND OBSERVATIONS a Wind Velocity - A wind meter is provided to each observer and it is recommended that the instructions provided with the meter b Gollowed to obtain wind velocity measurements b Wind Decition - After the approximate orientation of the beach with respect to north has been defined the observer can determing the direction <u>from which</u> the subject coming	ne
BEACH GESERVATIONS a Elevation of most seaward beach berm creat. To obtain this measurement a graduated reference pole has been installed on the be a between the been provided bits a hand level. The band level will be used as a surveying level therefore it is suggested that t and surveying level interform and and the band level of the most seaward between the surveying level therefore it is suggested that t is suggested by the seaward beach berm creat of the most seaward between the seaward between the seaward beach bere creating of the graduated reference pole. This seaward beach bere created is been installed indicated on the form in the spaces provided Space is also provided on the form to indicate whether the elevation is plus or manus b bistance of nois teaward beach berm creat from reference pole. This observer will neasure the distance from the most assured graduated reference pole to where he takes has level reading c Angle of the foreshore slope and pluse the takes the long axis perpendicular to the share line the stall be built in the foreshore slope and pluse the toro and level on the board with the long axis perpendicular to the share line the stall be built in the foreshore slope and pluse the toroshore in the board with the long axis perpendicular to the share line. Next losen the built is the foreshore slope and pluse the tooshore in the board with the long axis perpendicular to the share line. Next losen the built is the toroshore slope and pluse the tooshore in the board with the are set score wand not the recading not the foreshore slope and pluse the tooshore in the board with the arc set score wand not the recading not the foreshore slope and pluse the tooshore slope	ach ne
LITTORAL CURRENT OBSERVATIONS a Current Velocity For this measurement the observer has been provided with dye The dye should be thrown into or just forward the breaker zone. The observer will note the position of the dye at entry into the br aker zone and the position of the dye after an el time of one (1) minute Measure the distance between these two positions and enter the value in the spaces provided on the form b Current direction Having already established the approximate orientation of the beach the observer can readily determine the direction an which the dye or current is moving	of apsed
TIDE LEVEL The times of low and high tide for a particular area can be obtained from local newspapers or from tide tables published by various agencies. The relative state of the tide at the time of observation can readily be deducted from this information	
ALE RIP CURRENTS PRESENT? Rip currents are defined as seaward moving channels of water which return the water that has been plied up along the shore by incoming waves Rip currents are fed by feeder currents, water moving along the shore (see figure at right) The currents on and extent moving along the shore the med and dissipates If such rip currents recent risk ciles and if multiple currents exist record the distance between such rip currents are currents exist record the distance between such rip currents Rip currents exist record the distance between such rip currents recent recent right of the distance between such rip currents Rip currents exist record the distance between such rip currents Rip currents exist record the distance between such rip currents Rip currents exist record the distance between such rip currents Rip currents exist record the distance between such rip currents Rip currents exist record the distance between such rip currents Rip currents exist record the distance between such rip currents Rip currents exist record the distance between such rip currents Rip currents exist record the distance between such rip currents Rip currents exist record the distance between such rip currents Rip currents exist record the distance between such rip currents Rip currents exist record the distance between such rip currents Rip currents exist record the distance between such rip currents Rip currents exist record the distance between such rip currents Rip currents exist record the distance between such rip currents Rip currents exist record the distance between such rip currents Rip currents exist record the distance between such rip currents Rip currents exist record the distance between such rip currents Rip currents exist record the distance between such rip currents Rip currents exist record the distance between such rip currents Rip currents exist record the distance between such rip currents Rip currents exist record the distance between such rip currents Rip curren	

Fig. 3.a. Obverse side of Littoral Environment Observations instructions.

COASTAL ENGINEERING



Fig. 3.b. Reverse side of Littoral Environment Observations instructions.

									52	01 Liti	le	Falls	Roa	ad N	W,	Wa	shing	gton,	DC	200)16
THC	N IDENT	FICAT	ION				State of	Territo	ry		6	, 1 , ; ;	4	:3-	4		1\$c.	.6.:	-#.	~8 :	9:
						, L		*****			•	:12-	.2	3-	4.	* .	-\$	6:	: 7;	-8-	8.
							Beach c	r Park		, '*	œ,	517-	-2-	-3:	:4 44		-\$.	- ¢ -	5 P **	:,\$:	* \$
		•			-					*0	¢	- 1-	2	3.	• 4		· • 5 ·	6	÷ ¥ *	-° 18 -	- 8-
~~~	Na	me of b	eách or	park							6.		2	3367	**			<u>,</u>	<u>. 7 -</u>	-8:	
	Year	68	69	76		Month		alam .	Feb		// of ~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	Apr 	Wey		414		Aug	Sen	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~		0,66
r F		01	02	-03	D4	-05	08	07	08	-1	1997 N	-10	<b>FI</b>	12	33		.14	-13	115:	17	18
~ ~		19				23	- 299	223	. 25		67 107	-200	10	11	 					00	15
A,	Hour	60	49	02 14	16	104	4.7	40	10		83- 100	346 33	+0 23	11- 92	+3		Neares	l quarte	r hour	30	10
e SU	RF OBSER	VATIC	#3 N5	Filese observ	stions a	e to be		twice l	19 21 dath	00000 10	the	-2-1	and	-24	the at	lernoot					
Ŵ	we Period	Give	the tim	e un seconds	for elec	en brev	ker cre	sts to r	distr.			1	7	<b>b</b> :		(100-)			. 7		
a :	point Elev	en cres	is will i	nclude ten o	omplete	breake	rs (cres	ts plus		-	a	- 1				1104	Б.:	•.6	., <del>,</del> ,	Ŕ	s.
	agini cre	at 1 /2	2010 10	ile, crest i i	13 000 1	11.14					<b>8</b>		2		-4	(14)	-6	6	7	Ð.	9.
s ₩	we Haight	Give	the ave	rage wave h	eight fro	m crest	to tro	ugh in i	teet *		8	.1.	.21	.3.	.4.	(10s)	-6	8	7	8.	39
fo fo	r the highe	st time	of the	observed bi	eakers.	f less i	then on	e half (	1/2}	`a:	0		2	x13 *	4-	(15)	\$		7:	8	-9
W	we Directi	on Ne	te the	direction fro	m which	the w	aves an	e comia	a	, c	alm		M	:14£			.84.	3	'SW	3W	NW
		Şe	e unstru	ctions for ill	ustration	ъ. ¹ 2	1		*	4			· .				~				
Ty	pe of Bre.	iking W	ave S	ee instructio	ns for il	lustratio	m of m	péş		\$p	Ning		3	******	Plu	ngung		Şu	rgitug		
WI	VD OBSER	VATIO	INS T	hese observa	tions ar	e to be	made	twice (2	) daily	at the sa	me t	irne tha	at the	surt ob	servatu	ons are	made				
W	nd Veloci	у то	be mea	sured to the	nearest	mile p	er hour	(mph)	P. 1997 1		ġ .	1	.2	3	4	(10s)	\$	.6.	<i>\$</i> .	8	8
											0	1	2	3:	4.	(1s)	•÷\$ .	-6	2	-8	8
Ŵ	nd Directi	on No	te the	direction fro	m which	the w	ind			0	Ishor	e	• •		~~~~~	*******	Offs	aron			
		IS	coming							Ci	ulerni		.N.	NE	£		⁺SE	s	·s₩	₩	₩₩
86	ACH OBSE	RVAT	ONS	The beach o	neasuren	nents a	e to be	once (	1) a di	ay prefera	biy a	it the s	ame ti	me obc	h đay	betwee	n 1300	and 1	900		
8 48 be	easure the low a refe	elevatio ence o	n of th	e most seaw	and Beac	h Berm	crest	above o	r	ý 1	à	:: <b>:</b> :::::::::::::::::::::::::::::::::	. 2.	-3	4.	(10s)	5.	-16	7	-8	.9:
										ه	Q#-	:4:5	<b>t</b> .	:3	-4 -	{1s}	<b>:\$</b> -	者.	• • •	-8	<b>9</b> :-
	P	u\$	· ·				Vienus	•*•,•			D*.	et		.3:~	-4	(0 Ts)	16	<b>B</b>	3	8	19
> M	asure the	distance	of the	most seawa	rd Beac	h Berm	crest f	rom a			Q.	120	.2:_	3	:4	(100s)	8	-16	- 7.	8	4
30	erence por	na 10 t	18 110-001	51 1004						1	<b>0</b>	-1 1	-2-	:3	- 4	(10s)	.5		7-	.8	~9
	P	<b>US</b>	•		ne photosta		Minus			ړ. مديني مدين	9	:1	2	-37	-4	{i#	•£	-8	-7	~#	<b>.9</b> ,
: Ar	igle of the	Foresh	ore Slo	ne measured	in the	area of	the wa	ive ,		× 1	94	4	- 2	3	4	(10s)	٠ <b>6</b>	• 6 =	• 7	· 8·	\$
		6 /164/4	st Degra	se see mise			au attor	, 		وم <del>محمد محمد م</del>	<u>.</u>	-1	-2:	-3	-4 *	(1s)	<u>6</u> -	6	. 7:	-8	
<u>u</u> 1	TURAL C	URREI	IT_OBS	ERVATION	S To I	e made	onco	(1) 1 da	y pret	erably at	the s	ame tir	ne eac	h day	betwee	n 0700	and 1	200			~~~~~
IS IS	pbserved t	city P 5 move	leasure during	a one (1) a	distance ninute p	that the	ie dye i	pátch		1	0.	ł	2.	з.	4	(100s)	5	:6	7	- 18	9
										ال	0-	- 1	2	з	4	(10s)	8	-6	7	8	9
5	rent Due	-tuon	Obtanya	direction in	which	a creat	· · ·		~~~		•		• 2 •	3	_ 4 _	(1s)	8	*	_ T_	្ទ	9
			moving	toward	which	correin		·····		C	alm			:NE	÷		SE	-s	.SW-	₩	
ΠC	E LEVEL	if ku	own it	idicate the r	elative s	tate of	the tid	ė				to		to			to	-	to		
	K	\$ung					Falling				~~~~		1/4	· · · ·	1/2			3/4		High	•
AR	E RIP CUP	RENT	PRES	ENT? (See in	ist for i	iustratio	u <b>n</b> )			7	ARE	BEAC	HCUS	SPS PR	ESENT	? (5ee	Inst	for illus	aration)		
	No	, 		yes indicat	e spacin	g in fee					es		No		if y	es indi	cate sp	acing in	teet		
WE	RE PHOTO	GRAP	HS TA	KEN?	Yes	 	No		-	9	WAS	SANE	SAM	PLE O	BTAIN	ED?	Yes		No		
₩A	TER TEM	FRAT	URE	To the nerro	est degre	e if av	ailable				0	,	2,	3	4	(10s)	5	6.	7	9	-9-
								*****		ا جامبرمیوس	0	1	2	3	-4	(1s)	8	-6.	"	8	*
MAR	KS	Yes			No		If yes"	use re	worse s	ide of fori	n as	necessi	ary								



Fig. 5. Photograph of Dwyer Wind Meter used in measuring predominate wind velocities.



Fig. 6. Phatograph of Abney Tapagraphic Hand Level being used as an inclinameter ta measure the angle of the foreshare slope.







NOTE

I WIDTH FIGURE SHOWN IS WIDTH OF LEVEL BEACH FROM SOUTHERLY LINE OF PRIVATE PROPERTY LOCATION FROM 1954 TO 1964 IS 36th ST, FROM 1965 ON IS 41st ST 2.PLOTTED FROM DATA FURNISHED BY CITY OF NEWPORT BEACH, PUBLIC WORKS DEPARTMENT DATA OBSERVED BY MR ROBERT E REED, CHIEF LIFEGUARD

Fig 8. Graphical presentation of observed beach widths, Newport Beach.



Fig. 9. Panoramic photographs of El Capitan State Beach, California taken during Nov. 1967, Jan. and March 1968.



11 NOV. 1967



11 FEB. 1968



11 DEC. 1967



11 MAR. 1968



11 JAN. 1968

11 APR. 1968

Fig. 10. Panaramic phatagraphs af Natural Bridges State Beach, California taken during the period Nav. 1967 through April 1968.