Contract Report CERC-95-3
December 1995

US Army Corps of Engineers
Waterways Experiment Station

Longshore Suspended Sediment Transport at the Mouth of the Colorado River, Matagorda, Texas

by Reginald A. Beach,
Oregon State University

Prepared for Headquarters, U.S. Army Corps of Engineers

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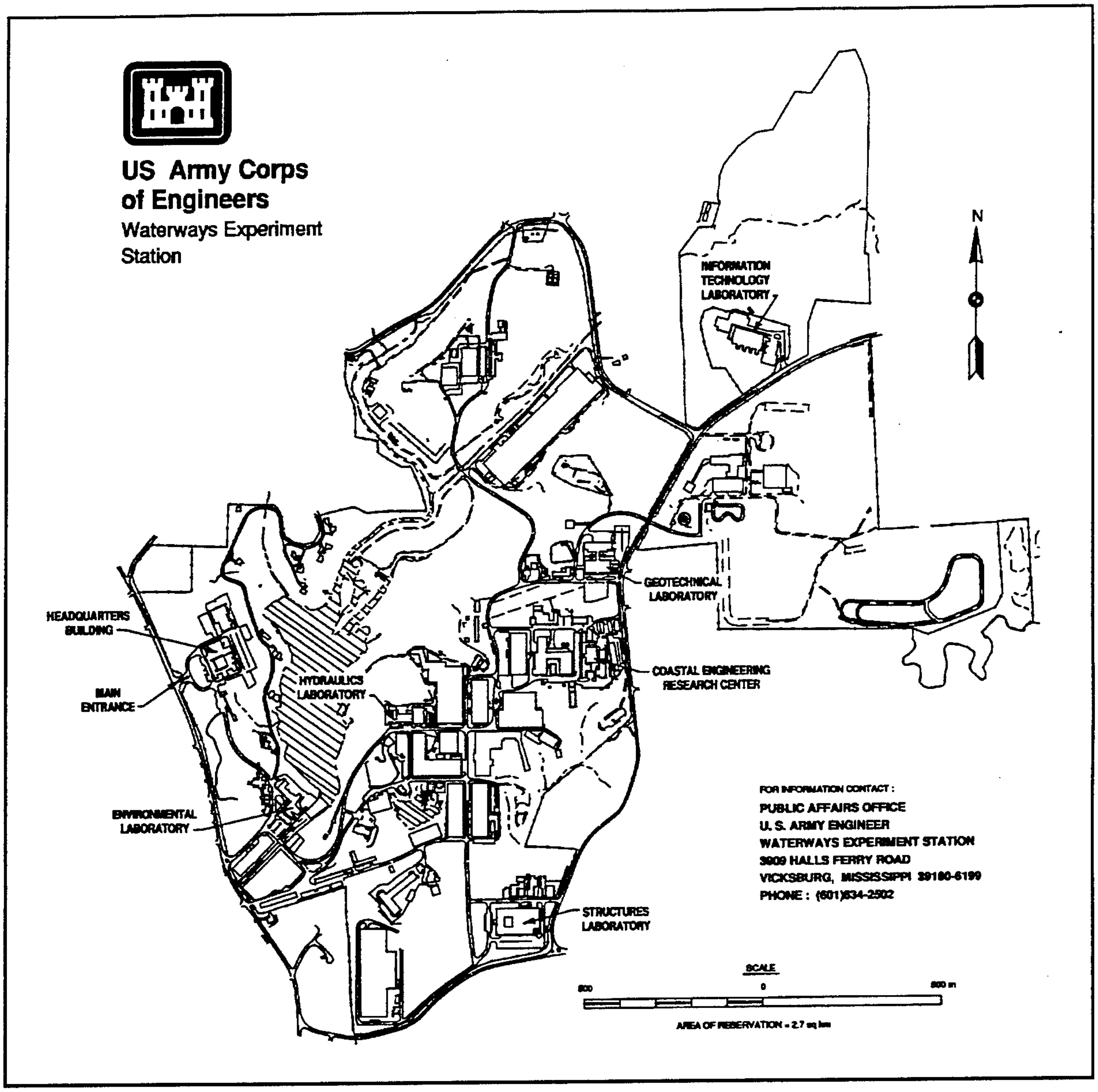

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Preface

This contract report on longshore sediment-transport rates at the Colorado River mouth. Texas, was prepared in partial fulfillment of Contract No. DACW39-90-K-0009 with the U.S. Army Engineer Waterways Experiment Station's (WES's) Coastal Engineering Research Center (CERC).

Data for the report were collected from 1990 to 1992 by Universities of Washington and Oregon personnel. Logistics and data-acquisition support were provided by CERC's Prototype Measurement and Analysis Branch (PMAB) personnel with Principal Investigator Thomas White in Work Unit No. 22113 "Mouth of the Colorado River, Texas" in the Monitoring Completed Coastal Projects (MCCP) Program at CERC. The support of the CERC staff during the field projects is most appreciated. Postprocessing of the data was enhanced by the efforts of M. Muddarm.

The principal investigator on this contract, Reginald Beach, was primarily responsible for data collection, analysis, and report writing, both as a postdoctoral researcher at the University of Washington and as a professor at the University of Oregon. Advice and supervision were provided by Richard Sternberg of the University of Washington. Technical oversight and cooperation were performed by the project Principal Investigator, Thomas E. White, at CERC.

This near-bed transport data set collected by the university investigators is part of a more comprehensive data collection effort for the Colorado River site. Together with the water-column suspended transport data collected by CERC personnel, the combined data sets are intended as the principal test data for certain categories of sediment transport.

This report was prepared under the supervision of William L. Preslan, Chief, PMAB; Thomas W. Richardson, Chief, Engineering Development Division, CERC; Carolyn M. Holmes, Program Manager, MCCP; Charles C. Calhoun, Assistant Director, CERC; and Dr. James R. Houston, Director, CERC.

At the time of publication of this report, Director of WES was Dr. Robert W. Whalin. Commander was COL Bruce K. Howard, EN.

1 Introduction

Background

One of the goals of the study documented in this report was to quantify the wave and current regime and resulting sediment transport, both along the beach and at the mouth of the Colorado River. Suspended sediment sensors now used at the U.S. Army Engineer Waterways Experiment Station (WES) are limited in their ability to measure close to the seabed. During fair weather conditions (summer waves) and in general, the low energy conditions present on the gulf, the flux of sediment primarily occurs close to the seabed, below the deployable height of standard suspended sediment sensors (optical backscatter sensors, OBS). In order to observe and measure this flux of sediment, a miniaturized OBS has been fabricated which uses encapsulated fiber optics as the light transmitting and receiving medium. Initial tests in the swash zone at Twin Harbors Beach, WA, indicate that the probe is deployable within 0.5 cm of the seabed and has performance characteristics equal to the standard OBS. Use of this instrument in the mid to inner surf zone under low energy conditions will help to document nearbed transport of sediment.

Analyses of existing field data have led to the development of a sediment transport model that applies one-dimensional, time-dependent sediment transport theory to describe sediment resuspension processes and sediment movements in the nearshore zone; e.g., suspended load and longshore and cross-shore suspended sediment flux (Beach and Sternberg 1992). This model is able to calculate the net longshore suspended sediment flux within a factor of 2-3 under high energy conditions. It is highly desirable to further test its ability on other beaches under varying wave and current conditions.

Objectives

The primary objective of this investigation was to increase understanding of mean suspended sediment concentration and longshore sediment transport rates in response to varying offshore wave conditions. Explicit objectives were as follows: (a) assist and advise in the deployment and collection of field data using optical suspended sensors during WES experiments at Colorado River, TX, (b) assist in the analysis and interpretation of such data, (c) use such data to evaluate the ability of wave-current interaction sediment transport theory to calculate the observed suspended load and longshore flux of sediment, (d) prepare and deploy fiber-optic suspended sediment sensors during WES experiments at Colorado River, TX, and (e) analyze data collected with the fiber-optic sensor. Addressing these objectives requires accurate measurement of the time-varying concentration field and fluid forcing.

Scope

During the Texas field projects, up to 12 suspended sediment sensors, 2 current meters, and 1 pressure sensor were simultaneously deployed in the mid to inner surf zone. Typically, these sensors were deployed at two positions on a cross-shore transect. A total of 27 experimental runs were collected during three field projects, encompassing a wide range of wave and breaking conditions. This report contains background information on equipment and procedures employed during the Texas field projects and provides coefficients for the conversion of the raw sensor output to scientific units, approximate instrument positions (x, z), basic statistics of sensor output for all runs, calculation of observed mean suspended load and longshore flux of sediment.

2 Experimental Apparatus

Instrument Description

Suspended sediment concentration measurements were made using OBS. OBS used in this project had two configurations, but utilized the same principle of operation. This principle is that the amount of light backscattered from a turbid suspension is linearly proportional to the mass concentration of the suspension (see Chapter 3 for calibration results). The two OBS configurations used during the project included fiber-optic backscatter sensors (FOBS) and the more standard OBS manufactured by Downing and Associates.

An instrument naming convention was adopted for use in this project and consists of two letters followed by a two-digit number. The first letter indicates the type of instrument: C, concentration sensor, S, current meter, or P, pressure sensor. The second letter indicates sensor location in terms of instrument clusters (A or B in this case). The two-digit number indicates the relative vertical position in a stack of sensors, increasing with distance above the seabed.

FOBS: CA01-CAO5, CBO1-CBO5. These two arrays of five sensors each were developed at the University of Washington for monitoring suspended sediment concentration in close proximity to the seabed ($z < 4$ cm). The five individual sensors are housed in a vertical stack with inter-sensor distances of 7.5, 7.5, 8, and 12 mm for a total vertical coverage of 35 mm. An article entitled "A Fiber Optic Sensor for Monitoring Suspended Sediment" provides further information (Beach, Sternberg, and Johnson 1992).

OBS: CA06, CB06. These two sensors are Model OBS-1P from Downing and Associates. They are individual sensors and were primarily deployed with an FOBS stack but higher in the flow to provide vertical coverage above the incident wave bottom boundary layer ($z = 6$ cm). A typical OBS sensor houses an infrared emitting diode (IRED) with peak radiant intensity at 950 nm, a silicon photo-voltaic cell with peak spectral response at 900 nm, and an appropriate filter to limit transmittance from incident light. The optical components are encapsulated in the sensor head with clear epoxy resin. When operating, a scattering volume of approximately 1.3 cc is irradiated through a 5.6-mm aperture at the geometric center of the photo-detector by an IR-beam with a half cone angle of 14 deg. Backscattered radiation (110-165 deg) from suspended solids is converted to photocurrent by the detector oriented in a plane normal to the emitter beam axis and located close to it (Downing, Sternberg, and Lister 1981).

Pressure sensor: PBO1. This is a strain gauge pressure transducer used to measure sea surface fluctuations.

Current meters: SA01, SA02. These current meters are 4 cm in diameter and consist of a ducted impeller with magnets on several of the blades (Smith 1978). A detector in the sting counts impeller rotation, which is linearly proportional to the speed of the flow. Because these sensors are 'flow through,' they can be deployed in close proximity to the seabed without causing scour. The duty cycle of the frequency output indicates the direction of flow.

Location

All instrumentation was deployed on two small mobile tripods (Kraus, Gingerich, and Rosati 1989) and deployed in water depths that varied between 0 and 160 cm. Each tripod consisted of an FOBS stack, a single OBS, and a current meter. Tripod "A" had an added pressure sensor. The pressure sensor on tripod "A" would be attached directly to a tripod leg, nearest to the current meter.

Table 1 lists all the data runs and the cross-shore measurement location in descriptive terms, (e.g., O = outer surf zone, M = mid-surf zone, I = inner surf zone, S = swash zone, T = longshore trough, and B = bar crest). Generally, tripod locations were not changed over the course of a day, so that several runs will have the same location, yielding some insight into the role of tidal influences. Table A1 in Appendix A details the individual sensor elevations above the bed, z (cm) for each run. The naming convention for data runs is: YYMMDDHHmm.X, where YY is the year, MM is the month, DD is the day, HHmm is the time of the run (24-hr clock), and X indicates whether it is tripod 'A' or 'B.'

Instrument Characteristics

The OBS-1P series of sensors are mature instrumentation, while the FOBS are prototype sensors and have only been used in pilot studies. Both series of sensors have a linear response to suspended particulates (see Table 2), a wide dynamic range and a 10-Hz bandwidth. The OBS-1P have built-in temperature compensation to reduce sensor drift. The OBS-1P have a voltage output range of 0-3.5 V, whereas the output range of the FOBS is 0-5 V. One shortcoming of the FOBS is that it does not subtract ambient light from the signal. In the Pacific northwest, where it is commonly overcast, this doesn't usually present a problem. In Texas, however, conditions were often characterized by cloudless days and bright sun. Consequently, sensors were often saturated by sunlight, yielding spurious results.

The current meters are mechanical and exhibit a lag in sensor response relative to fluid forcing, which it is possible to correct for during post-processing. Generally, these sensors perform best in steady, or slowly varying flows. Oscillatory flows with periods of less than 5 sec are difficult for these current meters to resolve accurately because of the mechanical lag and also because it takes a finite number of impeller rotations for the electronics to determine the direction of rotation. Such flows can reverse their direction prior to detection by the electronics. Unfortunately, these short-period, relatively small-amplitude oscillations were typical of fluid forcing during the Texas project and were often not resolvable by these current meters.

The 10-bit analog-to-digital converter (a/d) used to record all sensors is a TattleTale IV (Onset Computer Corporation), which sampled all sensors simultaneously at a 10-Hz rate. Because all of the suspended sediment sensors have different responses to suspended particulates, their absolute sensitivity is limited by the 10-bit resolution of the a/d. For 1-bit accuracy and a typical OBS (FOBS) sensor response of 10 g l^{-1} v^{-1} (40 g l^{-1} v^{-1}), the resolution of the a/d is 0.04 g l^{-1} (0.195 g l^{-1}).

Instrument Development

One of the attractive aspects of the FOBS sensor arrays is their compact design and close spacing of sensors in the vertical. This design allows for both deployment in close proximity to the bed and also resolves the sharp vertical gradient in suspended sediment concentration near the seabed. For coverage higher in the flow where sensor size and compact design are not quite as critical, alternatives to fiber-optic probes become viable. The existing OBS-1P by Downing and Associates fills this gap readily with two important exceptions: (a) the OBS-1P is expensive, approximately $3,000 per instrument, and (b) it is difficult to use in a compact vertical array due to the sensor head size and cable protrusion. This contract supported the design and fabrication of an alternative optical backscatter sensor which combines both low cost and a compact array, for use above 5-6 cm from the seabed.

The prototype sensor is comprised of a 30-cm-long integrated circuit board (ICB) with locations for paired light sources (IRed LED's) and detectors (photo diodes) spaced every centimeter. A schematic of the ICB is shown in Figure 1. A fully populated ICB would have 30 sensors with a 1-cm spacing.

Table 1
Deployment Location, Mean Water Depth, Cross-Shore (Positive is Offshore) and Longshore (Positive is East) Velocity, Suspended Load, and Longshore Transport of Sediment for Each Data Run[1]

Run I.D.	Location	Depth	U	V	S-Load	L-Transport
9005021420.b	M	(75)	0.32		0.0549	
9005041310.b	M	(75)	10.58		0.1818	
9005041455.b	S	(15)	12.31		0.1651	
9005041624.b	S	(15)	12.03		0.1284	
9005051130.b	I	(55)	-5.19		0.0337	
9005051300.b	M	(75)	-5.89		0.0305	
9107191243.b	O	(100)	-14.70			
9107201345.a	I	25.79		10.57		
9107201345.b	I	(15)	-12.45		0.0080	
9107201610.a	O	52.57		-6.27		
9107201610.b	M		-16.78		0.0078	
9107201758.a	M	44.48		18.92		
9107201758.b	I		-18.08		0.0040	
9107210955.a	I	23.99		21.33	0.0108	0.2312
9107210955.b	M		-12.84		0.0042	
9107211330.a	I	23.19		24.67	0.0205	0.5050
9107211330.b	M		-11.84		0.0037	
9107211555.a	I	22.00		25.09	0.0610	1.5301
9107211555.b	M		-10.19		0.0037	
9107220915.a	I	30.96		-6.34		
9107220915.b	M		3.34		0.0045	
9107221120.a	I	31.25		-9.18		
9107221120.b	M		3.08		0.0076	
9107231100.a	M	35.53		-3.26	0.0036	-0.0117
9107231100.b	I		-3.43		0.0069	
9107231340.a	M	37.00		13.95	0.0253	0.3529
9107231340.b	I		-19.62	-19.62	0.1281	-2.5128

(Continued)

[1] Numbers in parentheses are estimated.

Table 1 (Concluded)

Run I.D.	Location	Depth	U	V	S-Load	L-Transport
9107241025.a	M	34.90		-3.53	0.0020	-0.0071
9107241025.b	I			-7.36	0.0057	-0.0419
9107241130.a	M	32.78		-2.56	0.0022	-0.0055
9107241130.b	I			-11.96	0.0035	-0.0415
9107241347.a	M	25.87		-1.33	0.0027	-0.0036
9107241347.b	M			-20.60	0.0067	-0.1384
9107250850.a	M	42.15		-6.18	0.0037	-0.0231
9107250850.b	I			-23.96	0.0053	-0.1276
9107251058.a	M	38.98		-11.16		
9107251058.b	I			-25.04	0.0048	-0.1203
9201121611.a	T	159.19		-2.54	0.0119	-0.0302
9201121611.b	B		-1.91		0.0180	
9201131351.a	B	78.82	-13.97		0.1625	
9201131351.b	T			-3.02	0.0227	-0.0687
9201131556.a	B	86.53	-9.63		0.0761	
9201131556.b	T			0.29	0.0109	0.0032
9201161255.a	B	140.92	-0.73		0.0233	
9201161255.b	T			2.97	0.0105	0.0311

The circuit board is cast in a transparent material (epoxy or selastic) to make it both waterproof and rugged. It can then be deployed with standard techniques. Figures 2-4 show top and two side views, respectively, of the sensor prototype with the waterproof material removed. The sensor configuration is such that two LED's are used for each photo diode, assuring that signal levels are large and readily resolvable. A plot of voltage output versus concentration is shown in Figure 5 and indicates a relatively linear response to concentrations below 40 g/l^{-1} and a large dynamic range (>120 g/l^{-1}). Further refinement could extend this linear range to higher concentrations.

This prototype provides a low-cost alternative to standard OBS sensors and has the added advantage of a compact sensor array to provide high resolution vertical profiles of suspended sediment. A further investment should result in a rugged field instrument.

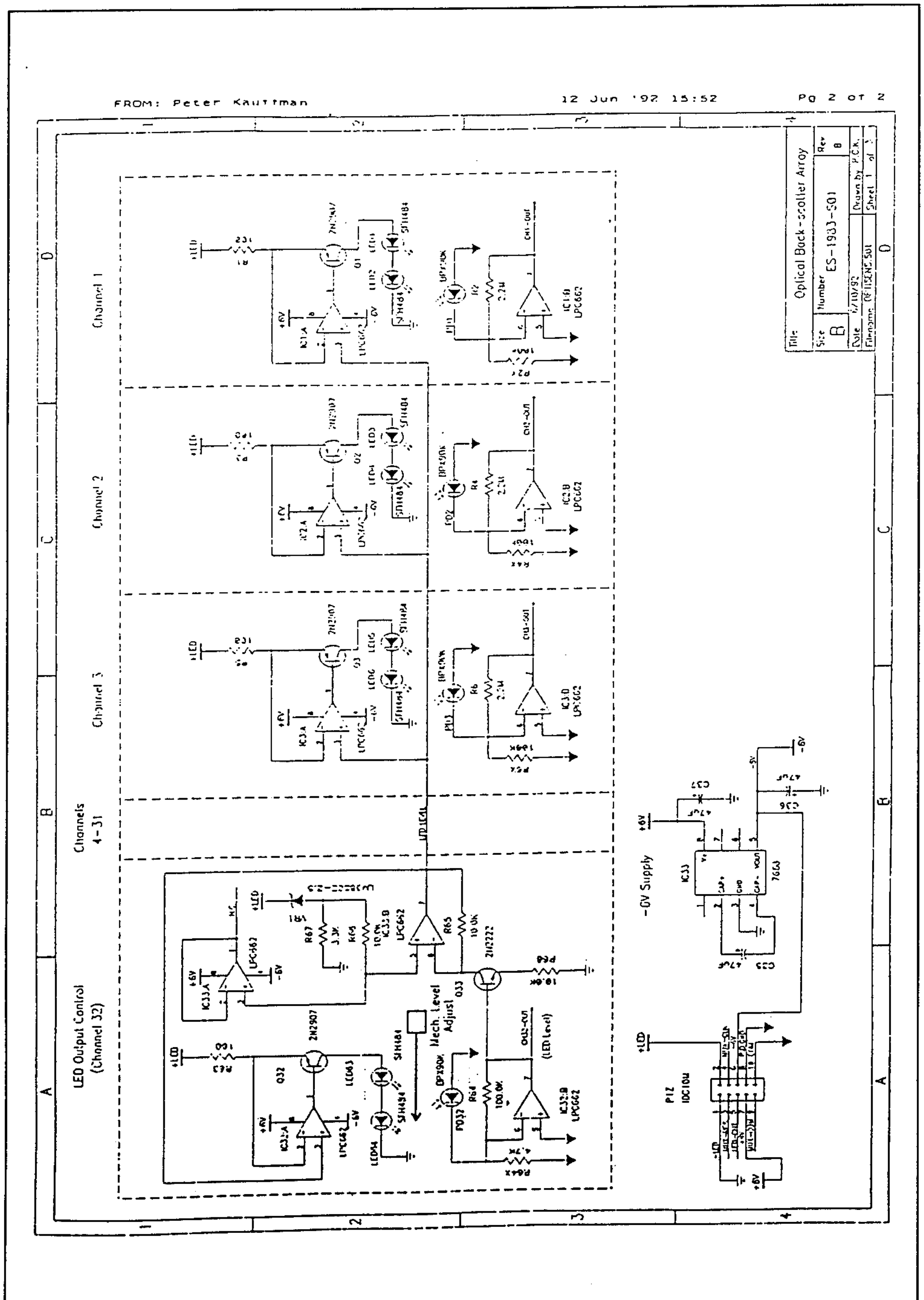

Figure 1. Schematic of prototype optical backscatter sensor, integrated circuit board. Only the first three channels (of thirty) are shown

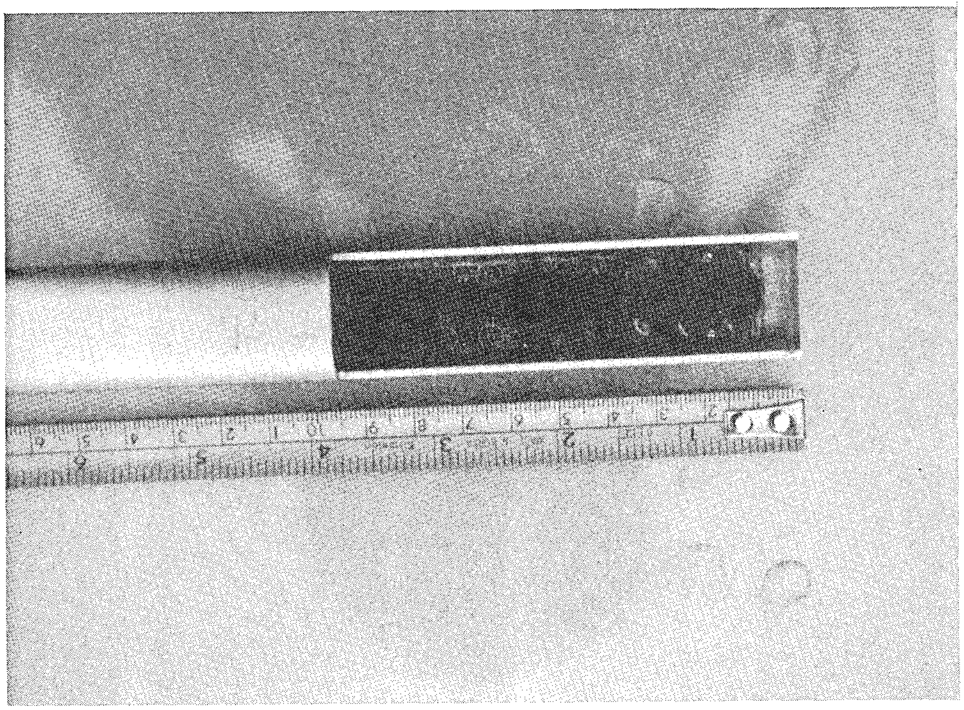

Figure 2. Photograph of prototype sensor, top view. Sensor spacing is 1 cm, only first five sensor locations have been filled

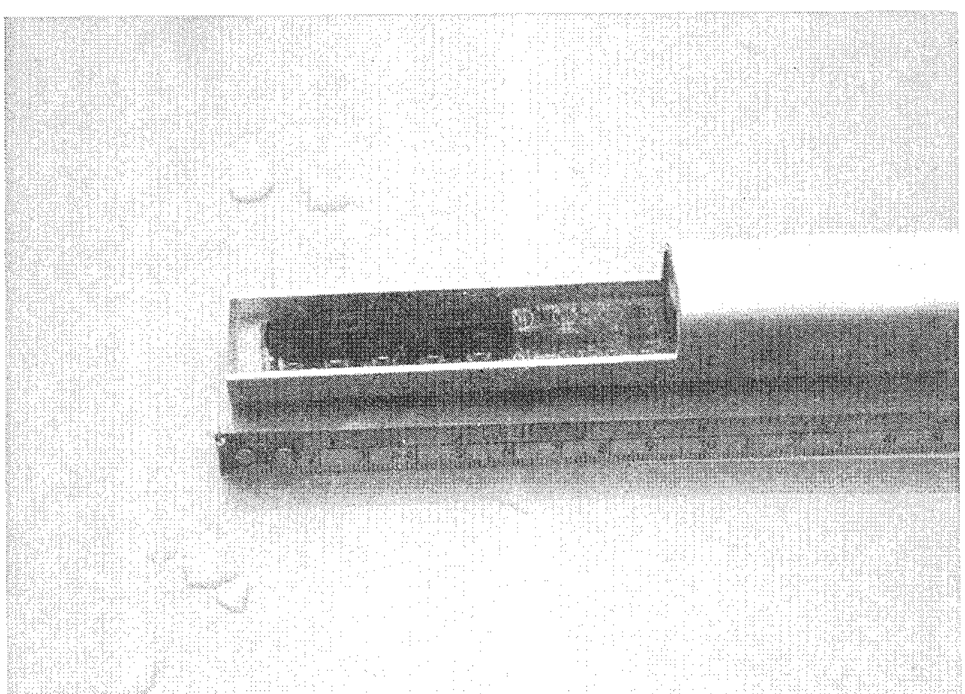

Figure 3. Photograph of prototype sensor, side view. Sensor spacing is 1 cm, only first five sensor locations have been filled

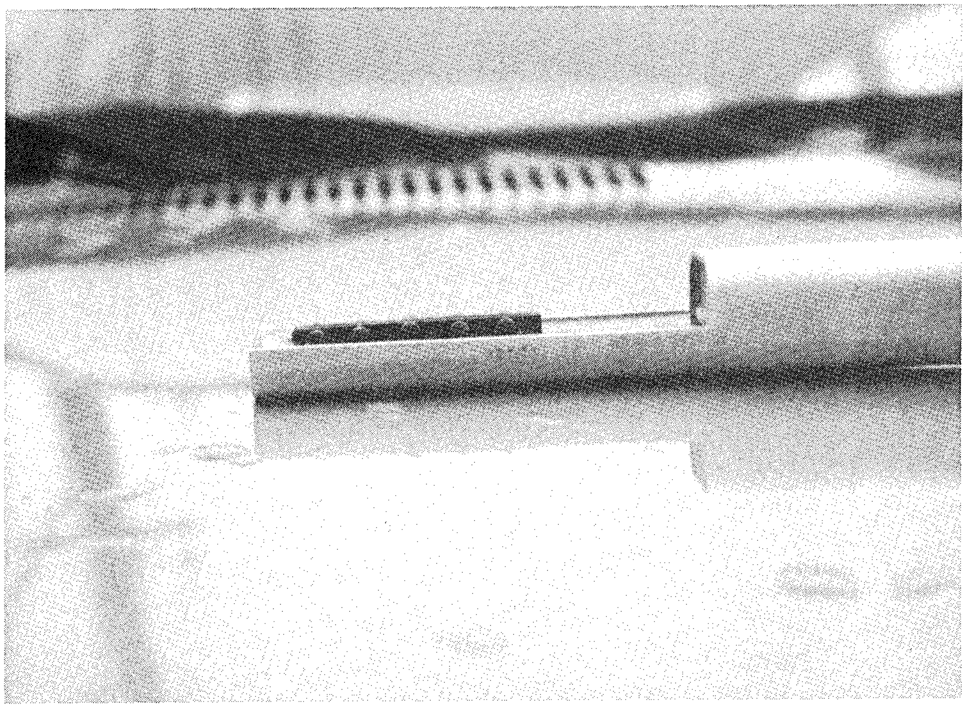

Figure 4. Photograph of prototype sensor, side view. Sensor spacing is 1 cm, only five sensor locations have been filled

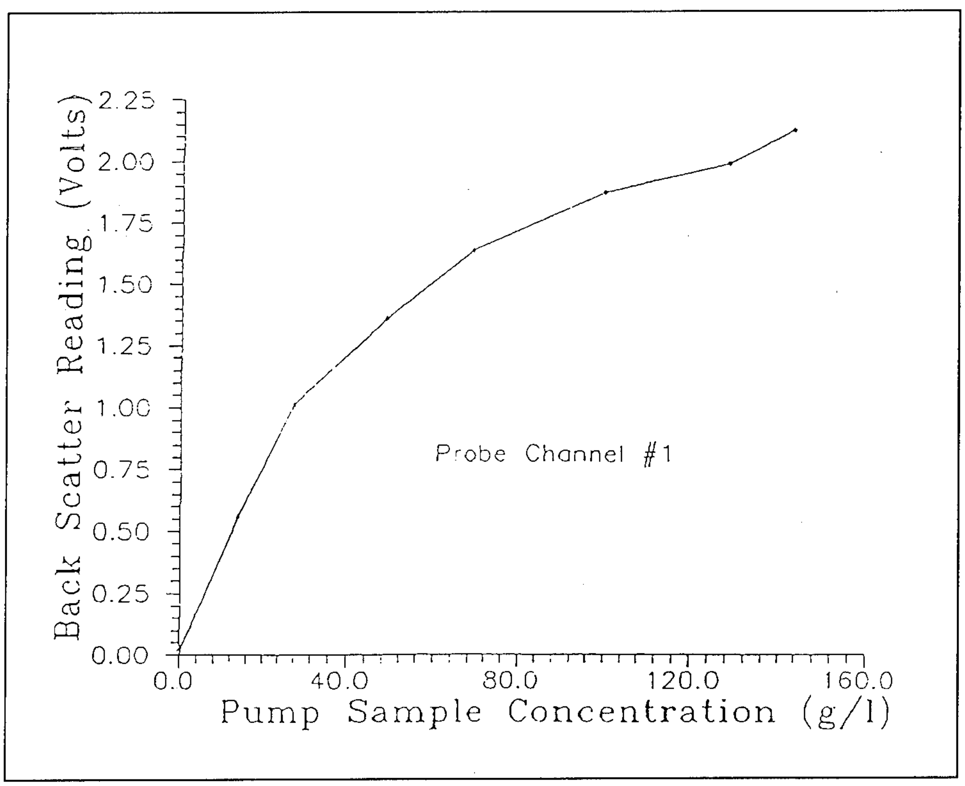

Figure 5. Calibration curve of the first channel of the prototype sensor

3 Experimental Procedures

Sequence of Events

After rigging the sensors on the tripods and establishing the hard-wire connection to the data logger, each sensor was tested for functionality prior to deployment. Deployment consisted of carrying the tripod(s) out to the desired position in the surf and forcing the 'legs' into the bed to provide a secure anchor. The shore cable was attached to a vertical pole, located approximately 5 m away, as a strain relief. This kept the tripod from being overturned during strong longshore currents when the drag on the shore cable was large. A diver would monitor the tripod at least every 15 min to eliminate fouling by debris and maintain sensor orientations and elevation above the bed. The data logger, located inside the WES instrument van, recorded sensor output on hard disk for periods up to 130 min. At the end of the day, all data were backed up on tape.

Sampling and Time Reference

The analog-to-digital conversion of sensor output was performed by a Tattletale Model IV microprocessor at a 10-Hz rate. No pre-processing or filtering of analog signals was performed prior to digitization. This unit was located on the tripods in a watertight housing. Data were transmitted digitally up the shore cable (9,600 baud), to the data logger (PC) and stored on disk. The time sync to the WES data collection was 'by hand' and is typically within 0.1 s (1 data sample). Data runs coincided with WES sled and platform runs.

Calibration and Zero Reference

The sizes and refractive indices of sediment particles strongly influence light-scattering characteristics and, consequently, OBS and FOBS must be calibrated with the sediment from the area where they were deployed. Calibrations are performed in the laboratory using a recirculating tank from which pump samples of the ambient concentration can be drawn (Downing and Beach 1989). The procedure consists of adding sediment, recording sensor output, and drawing a pump sample. This procedure is repeated for increasing sediment concentrations until the range of sensor output in the field is covered. After a calibration 'run,' the water is decanted from each pump sample and the volume of water recorded. The sediment is dried, its weight and volume are determined, and are then used in conjunction with the known volume of water to calculate a mass concentration. Response, typically, is linear over a wide concentration range. Table 2 lists the gains and linear regression coefficients which have been calculated for the sensors used during the field experiments for each of the three field deployments.

Offsets, or 'zero' reference values, were determined for each sensor for each run and are included in Table A1. These offsets represent 'clear' water values and are indicative of background turbidity of the water (also ambient light for the FOBS). These offsets change from run to run and day to day, depending on the external environmental conditions. Changes in background turbidity are seen by the instruments as a DC shift. Because the gains of each sensor are different, removal of this DC shift prior to conversion to scientific units is essential. Consequently, the value in the offset column represents an electronic offset seen by the instrument and is in a/d units. The offset value was established for each sensor as the most frequently observed value in the lower 5 percent of observed values when observed output is plotted in a 'frequency of occurrence' (histogram) diagram. The low pass trend of these offsets is also removed. Typically, these offset trends had slopes of O(10) a/d units or less for the entire run. Table A1 provides a listing of the instrument offsets as a function of instrument and run.

Table 2
Gain (per volt) and Linear Regression Coefficient (R^2) of Instrumentation

1990		
Instrument ID	**Gain (C: g l^{-1};S, cm/s)**	**Regression Coefficient**
CB01	45.61	0.985
CB02	64.49	0.987
CB03	39.69	0.981
CB04	59.20	0.991
CB05	41.63	0.994
SB01	38.88	[1]
1991		
Instrument ID	**Gain (C: g l^{-1};S, cm/s; P, cm)**	**Regression Coefficient**
CA01	81.48	0.985
CA02	47.62	0.988
CA03	54.62	0.982
CA04	39.07	0.990
CA05	56.50	0.980
CA06	7.46	0.999
SA01	38.88	[1]
PA01	105.00	0.999
CB01	28.13	0.995
CB02	43.95	0.990
CB03	38.27	0.995
CB04	28.51	0.995
CB05	44.19	0.995
CB06	65.17	0.997
SB01	38.88	[1]

(Continued)

[1] Factory gain.

Table 2 (Concluded)		
1992		
Instrument ID	**Gain ($g\ l^{-1}$)**	**Regression Coefficient**
CA01	78.85	0.980
CA02	52.49	0.989
CA03	71.38	0.985
CA04	42.10	0.991
CA05	45.27	0.992
CA06	13.55	0.996
SA01	38.88	[1]
PA01	105.00	0.999
CB01	32.52	0.991
CB02	88.87	0.980
CB03	49.09	0.989
CB04	42.57	0.993
CB05	45.41	0.994
CB06	14.56	0.999
SB01	38.88	[1]

4 Experimental Results

Data Reduction and Interpretation Methods

All raw data files, in DOS format, were transferred to a Sun workstation, converted to UNIX format, and archived on optical disk. All subsequent data reduction and processing were performed on a SUN workstation.

The raw suspended sediment sensor's output, R (a/d units), was converted to concentration, C (g l^{-1}), with the following algorithm

$$C = G * [(R - O - S*n) / V] + B$$

where

G = sensor gain (g l^{-1} v^{-1})

O = clear-water offset (a/d units)

S = trend of the data (g l^{-1} n^{-1})

n = sample number

V = conversion factor from a/d units to volts (equal to 204.8)

B = background turbidity (g l^{-1})

Measurements of background turbidity were not made during the project and, consequently, B is assumed to be zero.

The raw current meter output R (a/d units), was converted to speed, S (cm s^{-1}), with the following algorithm

$$S = G * R / V$$

and then converted to a vector, S (speed and direction),

$$S = S * D$$

where D was either positive or negative, depending on the direction of the flow.

The raw pressure sensor output, R (a/d units), was converted to sea surface fluctuation, P (cm), with the following algorithm

$$P = G * R / V + E$$

and E is the pressure sensor elevation (offset) above the bed and equals 22 cm.

Data File Format

Data were recorded on a PC in binary format. Each sample record consists of 10 channels of data and included: 5 FOBS, 1 OBS, 1 current speed, 1 current direction, 1 pressure, and 2 extra channels. Two data files were recorded simultaneously, one for each instrument tripod. A typical data run was 68-130 min in duration.

For 10 channels of output recorded, the corresponding record would be 20 bytes in length. Subsequent records (at 10 Hz) are simply appended to the file. Typically a 70-min run had 42,000 records and was 840 Kb in size. All data files have been archived on optical disk in UNIX format.

Sample Data

A 20-min segment of cross-shore velocity and suspended sediment concentration data collected in 1990 (run No. 9005041310, 70 min duration) from the inner surf zone is shown in Figure 6. Figure 6 shows the time-dependence of cross-shore velocity (cm s^{-1}, z = 5 cm, panel A) and nearbed concentration (g l^{-1}) at five elevations above the seabed progressing from z = 1 cm (panel B) to z = 4.5 cm (panel F). General observations of sediment dynamics evident in Figure 6 are as follows: (a) sediment resuspension occurs extremely rapidly and is intermittent, (b) while suspension events associated with individual waves are evident, the largest observed concentrations are associated with low-frequency motions, (c) suspension events associated with low-frequency motions persist in the water column for a considerably longer time than those associated with individual waves; and (d) this low-frequency modulation of sediment resuspension is present at all cross-shore locations, but is most evident in the inner surf zone and swash.

Summary of Data Characteristics

Table A1 summarizes the output of the sensors for all runs collected. The latter two columns indicate the mean and standard deviation of sensor output

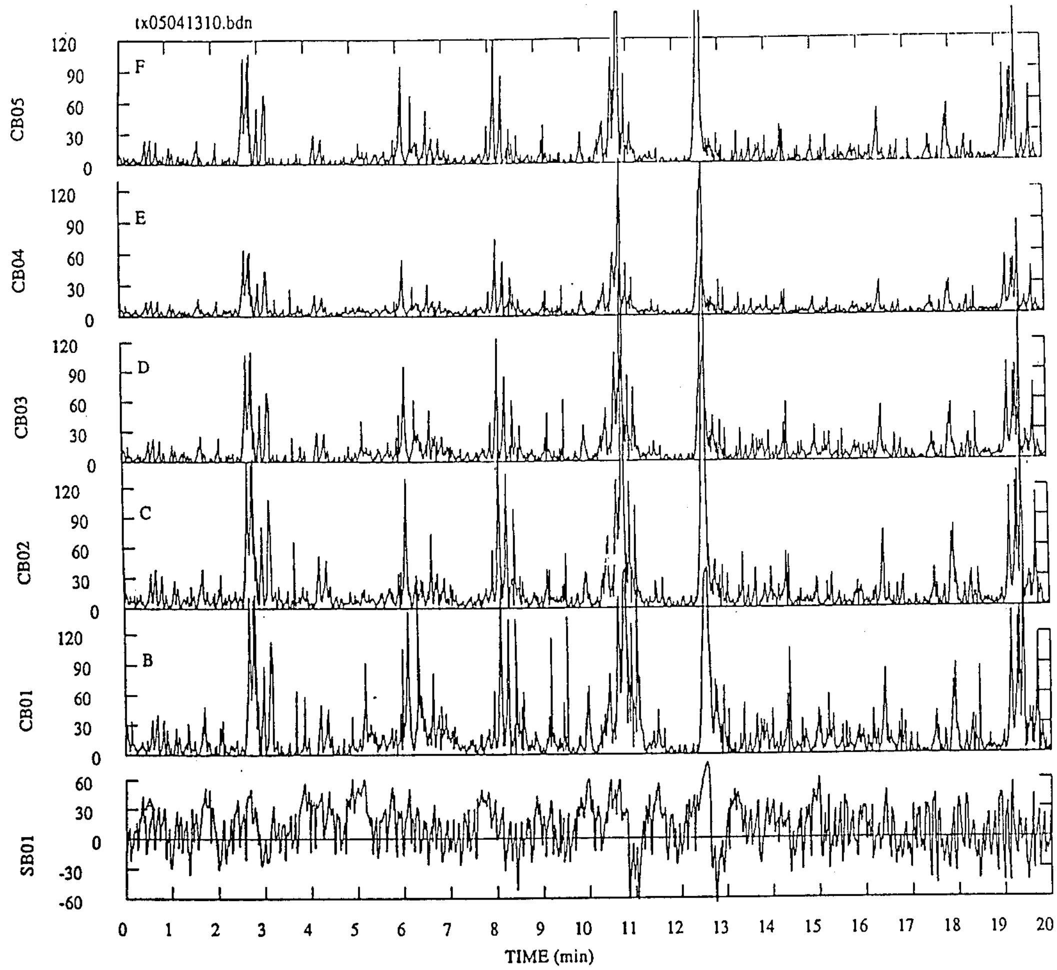

Figure 6. Time-dependence of cross-shore velocity (cm s^{-1}, z = 5 cm, panel A) and nearbed concentration (g l^{-1}) at five elevations above the seabed, progressing from z = l cm (panel B) to z = 4.5 cm (panel F)

(g l^{-1}) for all runs. These mean and standard deviation values may be used to identify data sets which have larger dynamic signals and hence, may be of more interest for study. Table 1 summarizes the observed mean water depth(centimeters), cross-shore and longshore velocity (cm/s^{-1}, positive offshore and east, respectively), the mean suspended load over the observed sensor range (g/cm^{-2}) and calculated longshore transport of sediment (g/cm^{-1}/s^{-1}). Mean suspended load and longshore transport of sediment for the 1991 field project are calculated using only the OBS sensors (CA06 and CB06), because of saturation of the FOBS sensors by sunlight (see below). It is apparent from Table 1 that longshore transport of sediment in the mid to inner surf zone is generally of low magnitude and does not have a preferred direction.

Identification of Marginal Data Sets

Of the three field projects, 1990 and 1992 are considered to be of good quality overall. While there are often 'bad' sensors in each run, all of the data runs have usable data. The 1991 data set was conducted during June and had very clear weather. Consequently, bright sun was ever-present, resulting in saturation of the FOBS sensors and compromising of the data. The OBS-1P sensors, the two current meters, and the pressure sensor functioned normally, however. Table 3 lists the data runs for 1992 where known problems with sensors exist. The data runs from 1991 have been excluded from this list.

Table 3
Identification of Marginal Data Sets

Run I.D.	Location	Explanation
9005021420.b	M	SB01 had sticky bearings
9005041624	M	CB05 saturated
9201121611.a	T	CA01-05 noisy
9201121611.b	B	River effluent causes fluctuating offsets in C
9201131351.a	B	CB01-05, SB01, noisy
9201131351.b	T	River effluent causes fluctuating offsets in C
9201131556.a	B	SB01 fouled
9201131556.b	T	River effluent causes fluctuating offsets in C
9201161255.a	B	Strong trend in C data, inexplicable
9201161255.b	T	CB01, CB02 noisy, SB01 fouled

5 Longshore Sediment Transport Model

A longshore sediment transport model incorporating wave-current interactions was used to calculate mean suspended load and longshore sediment transport in the mid-surf zone (Beach, Sternberg, and Johnson 1992,). The model, used in its direct calculation mode, requires the following fluid forcing and sediment characteristics as input: (a) speed and direction of the current at a height above the bed (U,V); wave period (T); oscillatory velocity amplitude (U_o); angle of wave approach with respect to the current (a); and (b) sediment diameter (D), sediment settling velocity (W_s), and critical shear stress for sediment movement (T_c) (obtained from bottom samples and existing literature sources). The direct calculation mode was used rather than using time-series of field observations as input because not all of the measurements were simultaneously observed on the two tripods. Model output consists of vertical profiles of longshore velocity and suspended sediment and mean suspended load. The longshore transport of sediment is calculated by taking the product of the longshore current and suspended sediment profile.

Model inputs used in this calculation were chosen to represent the typical fluid motions observed during the field programs and are: $U(z{=}40) = 10$ cm/s^{-1} offshore, $V(z{=}40) = 20$ cm/s^{-1} East, $T = 5$ s, $U_o = 120$ cm/s^{-1}, shore-normal wave approach, $D = 0.170$ mm,[1] $W_s = 1.34$ cm/s^{-1}, and $T_c = 1.58$ dynes/cm^{-2}. Table 4 summarizes results of the model output and indicates the modeled suspended sediment profile corresponding to instrument elevations for CA01-06. The resulting mean suspended load of sediment in the lower 6 cm of the water column is 0.026 g/cm^{-2}, and the mean longshore transport rate of sediment is 0.154 g/cm^{-1}/s^{-1}. These values are comparable to the middle range of observed values found in Table 1. More extensive comparisons can be made utilizing input from the WES sled, which simultaneously measured all the required inputs.

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[1] Personal Communication, 29 May 1993, Thomas E. White, Coastal Engineering Research Center, U.S. Army Engineer Waterways Experiment Station, Vicksburg, MS.

Table 4
Summary of Model Output: Mean Suspended Sediment Profile, Mean Suspended Load, and Mean Longshore Transport Rate of Sediment

Elevation Above the Bed, *z* (cm)	Mean Concentration, C (g/l^{-1})
1.00	9.814
1.75	5.827
2.50	3.726
3.30	2.426
4.50	1.493
6.20	0.947
Mean suspended load (g/cm^{-2})	0.026
Mean longshore transport rate ($g/cm^{-1}\ s^{-1}$)	0.154

6 Summary and Recommendations

Review of Experiments and Results

Measurements made during the Texas field projects were some of the first to date on the gulf coast of the United States. The data cover a broad range of offshore wave conditions and allow comparison of suspended sediment response to both incident and infragravity band forcing. The data indicate that longshore transport of sediment at the mouth of the Colorado River is variable in strength and direction, but overall, is of relatively low magnitude. When combined with the WES hydrodynamic and beach profile change data, the potential for understanding the littoral transport in this region is greatly enhanced. This report is the first step towards achieving this goal by providing necessary background information (Tables 1, A1) required for future studies.

Recommendations

It is suggested that future analysis should combine this data set with the WES data set to provide a more comprehensive picture of the longshore sediment transport regime. Furthermore, the WES data set could be used to initialize model inputs and make more extensive model comparisons with data. Instrument development that occurred during this study has produced a functional, inexpensive alternative to the OBS-1P sensor which can be placed in vertical stacks. A small amount of development would enable this laboratory prototype to be used in the field. Revision of the FOBS sensors to remove the effects of ambient light is well underway and should enhance their usefulness in future studies.

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Appendix A
Instrument Characteristics

Table A1
Instrument Gain, Offset, Evaluation and Statistics

Run I.D.	Sensor	Gain	Offset	Z(cm)	Mean	Std. Dev.
9005021420.b	CB01	45.61	61	1.00	20.643	23.741
9005021420.b	CB02	64.49	38	1.75	14.816	18.141
9005021420.b	CB04	39.69	43	3.30	4.900	6.484
9005021420.b	CB03	59.20	63	2.50	10.067	12.600
9005021420.b	CB05	41.63	0	4.50	1.536	6.949
9005021420.b	SB01	38.88	0	6.00	0.323	21.319
9005041310.b	CB01	45.61	189	1.00	47.702	55.222
9005041310.b	CB02	64.49	151	1.75	47.958	68.184
9005041310.b	CB04	39.69	140	3.30	22.231	35.558
9005041310.b	CB03	59.20	226	2.50	35.015	51.690
9005041310.b	CB05	41.63	-1	4.50	32.052	49.886
9005041310.b	SB01	38.88	0	6.00	10.578	23.168
9005041455.b	CB01	45.61	186	1.00	49.535	55.872
9005041455.b	CB02	64.49	165	1.75	35.519	49.955
9005041455.b	CB04	39.69	137	3.30	15.488	24.483
9005041455.b	CB03	59.20	236	2.50	32.251	37.670
9005041455.b	CB05	41.63	13	4.50	25.999	31.945
9005041455.b	SB01	38.88	0	6.00	12.313	23.756
9005041624.b	CB01	45.61	185	1.00	44.517	52.644
9005041624.b	CB02	64.49	168	1.75	27.110	38.803
9005041624.b	CB04	39.60	147	3.30	11.716	17.536
9005041624.b	CB03	59.20	248	2.50	23.413	28.639
9005041624.b	CB05	41.63	53	4.50	14.675	20.053
9005041624.b	SB01	38.88	0	6.00	12.029	21.824
9005051130.b	CB01	45.61	160	1.00	9.179	13.898
9005051130.b	CB02	64.49	145	1.75	9.326	8.198
9005051130.b	CB04	39.69	131	3.30	3.026	3.418
9005051130.b	CB03	59.20	311	2.50	6.147	6.818

(Sheet 1 of 11)

Table A1 (Continued)

Run I.D.	Sensor	Gain	Offset	Z(cm)	Mean	Std. Dev.
9005051130.b	CB05	41.63	38	4.50	5.682	5.484
9005051130.b	SB01	38.88	0	6.00	-5.194	15.166
9005051300.b	CB01	45.61	156	1.00	11.309	23.123
9005051300.b	CB02	64.49	138	1.75	5.618	10.489
9005051300.b	CB04	39.69	125	3.30	2.185	4.106
9005051300.b	CB03	59.20	312	2.50	5.773	8.548
9005051300.b	CB05	41.63	37	4.50	2.791	3.367
9005051300.b	SB01	38.88	0	6.00	-5.888	13.194
9107191243.b	CB01	28.13	472	1.00	55.501	24.483
9107191243.b	CB02	43.95	185	1.75	66.045	46.244
9107191243.b	CB04	28.51	155	3.30	24.922	19.539
9107191243.b	CB03	38.30	218	2.50	52.755	38.211
9107191243.b	CB05	44.19	67	4.50	73.152	54.102
9107191243.b	SB01	38.88	0	6.00	-14.696	24.801
9107201345.a	CA01	81.48	300	1.00	53.867	49.878
9107201345.a	CA02	47.63	403	1.75	15.400	13.121
9107201345.a	PA01	105.00	0	22.0	25.788	40.817
9107201345.a	CA03	54.62	199	2.50	45.798	40.712
9107201345.a	CA04	39.07	89	3.30	14.970	12.096
9107201345.a	SA01	38.88	0	6.00	10.568	13.358
9107201345.a	CA05	56.50	207	4.50	79.247	61.402
9107201345.b	CB01	28.13	352	1.00	48.587	30.327
9107201345.b	CB02	43.95	179	1.75	26.465	20.984
9107201345.b	CB04	28.51	149	3.30	9.715	7.753
9107201345.b	CB03	38.30	296	2.50	35.591	29.566
9107201345.b	CB06	65.17	7	6.20	1.283	4.539
9107201345.b	CB05	44.19	38	4.50	54.939	46.905
9107201345.b	SB01	38.88	0	6.00	-12.449	25.762
9107201610.a	CA01	81.48	273	1.00	11.569	16.462

(Sheet 2 of 11)

Table A1 (Continued)

Run I.D.	Sensor	Gain	Offset	Z(cm)	Mean	Std. Dev.
9107201610.a	CA02	47.63	381	1.75	5.067	5.776
9107201610.a	PA01	105.00	0	22.0	52.573	43.679
9107201610.a	CA03	54.62	157	2.50	9.319	9.790
9107201610.a	CA04	39.07	61	3.30	4.374	4.929
9107201610.a	SA01	38.88	0	6.00	-6.270	30.580
9107201610.a	CA05	56.50	148	4.50	15.138	15.493
9107201610.b	CB01	28.13	410	1.00	58.257	28.257
9107201610.b	CB02	43.95	180	1.75	41.600	31.859
9107201610.b	CB04	28.51	148	3.30	14.434	11.502
9107201610.b	CB03	38.30	319	2.50	51.208	36.187
9107201610.b	CB06	65.17	3	6.20	1.259	3.470
9107201610.b	CB05	44.19	50	4.50	71.745	54.789
9107201610.b	SB01	38.88	0	6.00	-16.776	25.278
9107201758.a	CA01	81.48	274	1.00	7.864	9.937
9107201758.a	CA02	47.63	384	1.75	4.146	5.493
9107201758.a	PA01	105.00	0	22.0	44.476	32.983
9107201758.a	CA03	54.62	153	2.50	6.613	7.558
9107201758.a	CA04	39.07	58	3.30	3.617	4.658
9107201758.a	SA01	38.88	0	6.00	18.920	12.761
9107201758.a	CA05	56.50	146	4.50	12.131	15.944
9107201758.b	CB01	28.13	291	1.00	36.597	30.241
9107201758.b	CB02	43.95	110	1.75	24.177	21.485
9107201758.b	CB04	28.51	126	3.30	8.026	7.245
9107201758.b	CB03	38.30	307	2.50	19.990	19.920
9107201758.b	CB06	65.17	4	6.20	0.645	1.852
9107201758.b	CB05	44.19	3	4.50	24.947	26.377
9107201758.b	SB01	38.88	0	6.00	-18.080	22.449
9107210955.a	CA01	81.48	302	1.00	20.075	13.239
9107210955.a	CA02	47.63	439	1.75	49.417	29.812

(Sheet 3 of 11)

Table A1 (Continued)						
Run I.D.	Sensor	Gain	Offset	Z(cm)	Mean	Std. Dev.
9107210955.a	PA01	105.00	47	22.0	23.989	3.702
9107210955.a	CA03	54.62	226	2.50	29.455	18.113
9107210955.a	CA04	39.07	140	3.30	54.158	34.225
9107210955.a	SA01	38.88	0	6.00	21.334	12.830
9107210955.a	CA05	56.50	220	4.50	35.626	21.613
9107210955.b	CB01	28.13	295	1.00	30.036	20.066
9107210955.b	CB02	43.95	190	1.75	57.106	42.793
9107210955.b	CB04	28.51	139	3.30	20.605	16.914
9107210955.b	CB03	38.30	339	2.50	15.388	10.755
9107210955.b	CB06	65.17	3	6.20	0.684	0.920
9107210955.b	CB05	44.19	67	4.50	20.739	13.961
9107210955.b	SB01	38.88	0	6.00	-12.837	22.090
9107211330.a	CA01	81.48	476	1.00	70.879	47.487
9107211330.a	CA02	47.63	472	1.75	18.699	13.518
9107211330.a	PA01	105.00	0	22.0	23.186	24.887
9107211330.a	CA03	54.62	445	2.50	60.663	37.151
9107211330.a	CA04	39.07	166	3.30	18.421	14.103
9107211330.a	SA01	38.88	0	6.00	24.668	13.127
9107211330.a	CA05	56.50	576	4.50	76.007	34.354
9107211330.b	CB01	28.13	589	1.00	43.131	18.138
9107211330.b	CB02	43.95	289	1.75	33.634	21.041
9107211330.b	CB04	28.51	194	3.30	12.332	9.641
9107211330.b	CB03	38.30	352	2.50	46.492	33.295
9107211330.b	CB06	65.17	3	6.20	0.600	1.221
9107211330.b	CB05	44.19	180	4.50	63.726	48.757
9107211330.b	SB01	38.88	0	6.00	-11.838	22.636
9107211555.a	CA01	81.48	644	1.00	116.110	40.823
9107211555.a	CA02	47.63	491	1.75	50.378	38.561
9107211555.a	PA01	105.00	0	22.0	22.000	0.000

(Sheet 4 of 11)

Table A1 (Continued)						
Run I.D.	Sensor	Gain	Offset	Z(cm)	Mean	Std. Dev.
9107211555.a	CA03	54.62	617	2.50	84.865	28.934
9107211555.a	CA04	39.07	184	3.30	53.700	49.181
9107211555.a	SA01	38.88	0	6.00	25.091	14.403
9107211555.a	CA05	56.50	835	4.50	45.360	13.436
9107211555.b	CB01	28.13	721	1.00	36.067	10.901
9107211555.b	CB02	43.95	266	1.75	60.870	44.842
9107211555.b	CB04	28.51	186	3.30	26.215	21.168
9107211555.b	CB03	38.30	424	2.50	69.377	33.730
9107211555.b	CB06	65.17	4	6.20	0.601	0.992
9107211555.b	CB05	44.19	208	4.50	105.361	56.628
9107211555.b	SB01	38.88	0	6.00	-10.188	20.956
9107220915.a	CA01	81.48	283	1.00	18.419	21.485
9107220915.a	CA02	47.63	391	1.75	9.256	8.070
9107220915.a	PA01	105.00	0	22.0	30.958	9.237
9107220915.a	CA03	54.62	168	2.50	16.971	18.478
9107220915.a	CA04	39.07	61	3.30	8.525	7.691
9107220915.a	SA01	38.88	0	6.00	-6.341	23.724
9107220915.a	CA05	56.50	174	4.50	27.975	31.602
9107220915.b	CB01	28.13	258	1.00	14.005	16.150
9107220915.b	CB02	43.95	91	1.75	11.396	9.867
9107220915.b	CB04	28.51	125	3.30	3.166	3.465
9107220915.b	CB03	38.30	305	2.50	8.060	8.409
9107220915.b	CB06	65.17	6	6.20	0.726	0.701
9107220915.b	CB05	44.19	0	4.50	6.568	11.457
9107220915.b	SB01	38.88	0	6.00	3.341	20.039
9107221120.a	CA01	81.48	283	1.00	36.800	61.655
9107221120.a	CA02	47.63	385	1.75	14.137	23.743
9107221120.a	PA01	105.00	0	22.0	31.254	9.214
9107221120.a	CA03	54.62	166	2.50	19.001	36.665
						(Sheet 5 of 11)

Table A1 (Continued)

Run I.D.	Sensor	Gain	Offset	Z(cm)	Mean	Std. Dev.
9107221120.a	CA04	39.07	58	3.30	13.220	28.148
9107221120.a	SA01	38.88	0	6.00	-9.184	27.344
9107221120.a	CA05	56.50	171	4.50	28.101	42.811
9107221120.b	CB01	28.13	269	1.00	37.941	27.848
9107221120.b	CB02	43.95	122	1.75	26.625	23.587
9107221120.b	CB04	28.51	127	3.30	9.456	8.577
9107221120.b	CB03	38.30	304	2.50	15.848	14.402
9107221120.b	CB06	65.17	6	6.20	1.233	8.842
9107221120.b	CB05	44.19	0	4.50	15.548	18.342
9107221120.b	SB01	38.88	0	6.00	3.080	18.809
9107231100.a	CA01	81.48	294	1.00	23.722	22.322
9107231100.a	CA02	47.63	353	1.75	10.577	8.273
9107231100.a	PA01	105.00	0	22.0	35.535	9.717
9107231100.a	CA03	54.62	165	2.50	20.937	18.020
9107231100.a	CA06	7.46	138	6.20	0.579	0.465
9107231100.a	CA04	39.07	62	3.30	10.640	8.047
9107231100.a	SA01	38.88	0	6.00	-3.262	17.818
9107231100.a	CA05	56.50	188	4.50	37.035	32.083
9107231100.b	CB01	28.13	425	1.00	40.980	24.631
9107231100.b	CB02	43.95	235	1.75	31.685	22.177
9107231100.b	CB04	28.51	161	3.30	11.112	7.751
9107231100.b	CB03	38.30	355	2.50	29.501	23.108
9107231100.b	CB06	65.17	7	6.20	1.109	4.027
9107231100.b	CB05	44.19	51	4.50	36.039	29.767
9107231100.b	SB01	38.88	0	6.00	-3.435	20.039
9107231340.a	CA01	81.48	307	1.00	45.875	263.510
9107231340.a	CA02	47.63	367	1.75	27.589	37.881
9107231340.a	PA01	105.00	0	22.0	37.003	1081.679
9107231340.a	CA03	54.62	179	2.50	49.110	270.152

(Sheet 6 of 11)

Table A1 (Continued)

Run I.D.	Sensor	Gain	Offset	Z(cm)	Mean	Std. Dev.
9107231340.a	CA06	7.46	135	6.20	4.081	55.222
9107231340.a	CA04	39.07	84	3.30	42.388	253.519
9107231340.a	SA01	38.88	0	6.00	13.947	357.893
9107231340.a	CA05	56.50	212	4.50	59.164	143.856
9107231340.b	CB01	28.13	550	1.00	51.457	150.593
9107231340.b	CB02	43.95	342	1.75	86.238	283.064
9107231340.b	CB04	28.51	224	3.30	47.472	254.153
9107231340.b	CB03	38.30	401	2.50	64.267	365.228
9107231340.b	CB06	65.17	6	6.20	20.658	438.269
9107231340.b	CB05	44.19	107	4.50	56.930	151.908
9107231340.b	SB01	38.88	0	6.00	-19.619	394.705
9107241025.a	CA01	81.48	299	1.00	12.337	8.244
9107241025.a	CA02	47.63	359	1.75	15.673	12.262
9107241025.a	PA01	105.00	13	22.0	34.901	8.989
9107241025.a	CA03	54.62	193	2.50	14.044	9.524
9107241025.a	CA06	7.46	111	6.20	0.324	0.402
9107241025.a	CA04	39.07	59	3.30	15.033	11.856
9107241025.a	SA01	38.88	0	6.00	-3.533	22.915
9107241025.a	CA05	56.50	193	4.50	18.954	12.468
9107241025.b	CB01	28.13	34	1.00	63.054	51.757
9107241025.b	CB02	43.95	185	1.75	80.093	69.109
9107241025.b	CB04	28.51	298	3.30	36.720	22.414
9107241025.b	CB03	38.30	247	2.50	47.237	26.055
9107241025.b	CB06	65.17	0	6.20	0.918	0.955
9107241025.b	CB05	44.19	94	4.50	56.313	42.669
9107241025.b	SB01	38.88	0	6.00	-7.363	10.056
9107241130.a	CA01	81.48	324	1.00	25.916	18.998
9107241130.a	CA02	47.63	373	1.75	13.652	10.060
9107241130.a	PA01	105.00	0	22.0	32.783	8.423

(Sheet 7 of 11)

Table A1 (Continued)

Run I.D.	Sensor	Gain	Offset	Z(cm)	Mean	Std. Dev.
9107241130.a	CA03	54.62	222	2.50	23.239	16.246
9107241130.a	CA06	7.46	114	6.20	0.349	0.341
9107241130.a	CA04	39.07	80	3.30	13.258	10.029
9107241130.a	SA01	38.88	0	6.00	-2.562	20.216
9107241130.a	CA05	56.50	247	4.50	36.875	26.043
9107241130.b	CB01	28.13	820	1.00	20.580	7.758
9107241130.b	CB02	43.95	488	1.75	50.957	25.250
9107241130.b	CB04	28.51	279	3.30	21.170	12.118
9107241130.b	CB03	38.30	577	2.50	35.069	20.794
9107241130.b	CB06	65.17	3	6.20	0.559	0.649
9107241130.b	CB05	44.19	178	4.50	53.073	38.910
9107241130.b	SB01	38.88	0	6.00	-11.964	9.535
9107241347.a	CA01	81.48	347	1.00	33.571	24.703
9107241347.a	CA02	47.63	380	1.75	9.777	6.537
9107241347.a	PA01	105.00	0	22.0	25.870	5.728
9107241347.a	CA03	54.62	241	2.50	27.698	18.889
9107241347.a	CA06	7.46	126	6.20	0.435	0.444
9107241347.a	CA04	39.07	91	3.30	9.135	5.519
9107241347.a	SA01	38.88	0	6.00	-1.326	14.527
9107241347.a	CA05	56.50	291	4.50	46.948	31.449
9107241347.b	CB01	28.13	937	1.00	9.241	3.176
9107241347.b	CB02	43.95	384	1.75	35.174	19.876
9107241347.b	CB04	28.51	238	3.30	13.582	8.415
9107241347.b	CB03	38.30	638	2.50	36.918	17.907
9107241347.b	CB06	65.17	4	6.20	1.084	2.690
9107241347.b	CB05	44.19	281	4.50	62.915	38.074
9107241347.b	SB01	38.88	0	6.00	-20.597	10.121
9107250850.a	CA01	81.48	289	1.00	5.994	5.346
9107250850.a	CA02	47.63	349	1.75	6.407	5.283

(Sheet 8 of 11)

Table A1 (Continued)						
Run I.D.	**Sensor**	**Gain**	**Offset**	**Z(cm)**	**Mean**	**Std. Dev.**
9107250850.a	PA01	105.00	0	22.0	42.152	8.029
9107250850.a	CA03	54.62	148	2.50	6.560	4.973
9107250850.a	CA06	7.46	143	6.20	0.604	0.414
9107250850.a	CA04	39.07	46	3.30	6.423	5.187
9107250850.a	SA01	38.88	0	6.00	-6.178	21.162
9107250850.a	CA05	56.50	165	4.50	10.170	7.809
9107250850.b	CB01	28.13	397	1.00	36.555	22.803
9107250850.b	CB02	43.95	285	1.75	61.036	40.487
9107250850.b	CB04	28.51	192	3.30	23.693	18.082
9107250850.b	CB03	38.30	433	2.50	22.046	15.482
9107250850.b	CB06	65.17	6	6.20	0.859	0.691
9107250850.b	CB05	44.19	0	4.50	18.385	16.444
9107250850.b	SB01	38.88	0	6.00	-23.964	10.720
9107251058.a	CA01	81.48	293	1.00	5.964	4.690
9107251058.a	CA02	47.63	357	1.75	7.486	6.165
9107251058.a	PA01	105.00	0	22.0	38.976	7.449
9107251058.a	CA03	54.62	151	2.50	6.948	5.196
9107251058.a	CA06	7.46	157	6.20	0.347	0.473
9107251058.a	CA04	39.07	54	3.30	7.880	6.491
9107251058.a	SA01	38.88	0	6.00	-11.157	21.767
9107251058.a	CA05	56.50	172	4.50	10.027	7.097
9107251058.b	CB01	28.13	452	1.00	30.159	18.615
9107251058.b	CB02	43.95	361	1.75	66.647	38.884
9107251058.b	CB04	28.51	232	3.30	26.819	19.002
9107251058.b	CB03	38.30	450	2.50	17.773	11.771
9107251058.b	CB06	65.17	7	6.20	0.775	0.713
9107251058.b	CB05	44.19	0	4.50	15.316	12.335
9107251058.b	SB01	38.88	0	6.00	-25.044	10.165
9201121611.a	CA01	78.85	271	1.00	3.572	21.806
						(Sheet 9 of 11)

Table A1 (Continued)

Run I.D.	Sensor	Gain	Offset	Z(cm)	Mean	Std. Dev.
9201121611.a	CA02	52.49	349	1.75	2.726	12.488
9201121611.a	PA01	105.00	0	22.0	159.194	25.428
9201121611.a	CA03	71.38	149	2.50	3.215	12.734
9201121611.a	CA06	13.55	63	6.20	1.787	1.294
9201121611.a	CA04	42.10	38	3.30	1.520	8.971
9201121611.a	SA01	38.88	0	6.00	-2.535	15.765
9201121611.a	CA05	45.27	137	4.50	1.573	8.944
9201121611.b	CB01	32.52	172	1.00	4.979	17.615
9201121611.b	CB02	88.87	155	1.75	7.850	25.036
9201121611.b	CB04	42.57	96	3.30	1.743	4.008
9201121611.b	CB03	49.09	306	2.50	3.120	8.270
9201121611.b	CB06	14.56	85	6.20	1.163	1.603
9201121611.b	CB05	45.41	0	4.50	1.007	3.711
9201121611.b	SB01	38.88	0	6.00	-1.911	34.940
9201131351.a	CA01	78.85	297	1.00	31.487	37.053
9201131351.a	CA02	52.49	381	1.75	26.060	28.211
9201131351.a	PA01	105.00	0	22.0	78.822	22.598
9201131351.a	CA03	71.38	174	2.50	46.316	51.801
9201131351.a	CA06	13.55	126	6.20	2.629	1.789
9201131351.a	CA04	42.10	71	3.30	32.533	36.066
9201131351.a	SA01	38.88	0	6.00	-13.968	22.123
9201131351.a	CA05	45.27	200	4.50	52.104	48.930
9201131351.b	CB01	32.52	203	1.00	5.691	11.559
9201131351.b	CB02	88.87	180	1.75	11.441	24.983
9201131351.b	CB04	42.57	125	3.30	3.859	2.962
9201131351.b	CB03	49.09	354	2.50	3.993	6.173
9201131351.b	CB06	14.56	135	6.20	3.194	2.332
9201131351.b	CB05	45.41	0	4.50	0.838	2.097
9201131351.b	SB01	38.88	0	6.00	-3.020	26.821

(Sheet 10 of 11)

Table A1 (Concluded)

Run I.D.	Sensor	Gain	Offset	Z(cm)	Mean	Std. Dev.
9201131556.a	CA01	78.85	290	1.00	14.231	16.469
9201131556.a	CA02	52.49	374	1.75	12.520	11.848
9201131556.a	PA01	105.00	0	22.0	86.526	20.676
9201131556.a	CA03	71.38	165	2.50	20.220	19.532
9201131556.a	CA06	13.55	148	6.20	1.688	1.533
9201131556.a	CA04	42.10	62	3.30	-15.814	15.414
9201131556.a	SA01	38.88	0	6.00	-9.632	20.504
9201131556.a	CA05	45.27	185	4.50	26.122	24.765
9201131556.b	CB01	32.52	210	1.00	2.302	2.254
9201131556.b	CB02	88.87	179	1.75	6.304	5.537
9201131556.b	CB04	42.57	130	3.30	2.385	2.280
9201131556.b	CB03	49.09	351	2.50	2.191	2.202
9201131556.b	CB06	14.56	159	6.20	1.658	1.391
9201131556.b	CB05	45.41	0	4.50	0.020	1.281
9201131556.b	SB01	38.88	0	6.00	0.294	2.176
9201161255.a	CA01	78.85	270	1.00	6.781	11.294
9201161255.a	CA02	52.49	349	1.75	4.510	4.386
9201161255.a	PA01	105.00	0	22.0	140.921	6.950
9201161255.a	CA03	71.38	142	2.50	5.842	4.536
9201161255.a	CA06	13.55	60	6.20	1.989	1.197
9201161255.a	CA04	42.10	38	3.30	3.143	3.880
9201161255.a	SA01	38.88	0	6.00	-0.729	16.683
9201161255.a	CA05	45.27	156	4.50	4.835	4.866
9201161255.b	CB01	32.52	172	1.00	3.272	3.536
9201161255.b	CB02	88.87	161	1.75	5.283	6.419
9201161255.b	CB04	42.57	88	3.30	1.759	10.042
9201161255.b	CB03	49.09	330	2.50	1.420	5.482
9201161255.b	CB06	14.56	103	6.20	0.941	1.547
9201161255.b	CB05	45.41	0	4.50	0.051	2.171
9201161255.b	SB01	38.88	0	6.00	2.974	13.023

(Sheet 11 of 11)

REPORT DOCUMENTATION PAGE

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The primary objective of this investigation was to increase understanding of mean suspended sediment concentration and longshore sediment transport rates in response to varying offshore wave conditions. Explicit objectives were as follows: (a) assist and advise in the deployment and collection of field data using optical suspended sensors during WES experiments at Colorado River, TX, (b) assist in the analysis and interpretation of such data, (c) use such data to evaluate the ability of wave-current interaction sediment transport theory to calculate the observed suspended load and longshore flux of sediment, (d) prepare and deploy fiber-optic suspended sediment sensors during WES experiments at Colorado River, TX, and (e) analyze data collected with the fiber-optic sensor. Addressing these objectives requires accurate measurement of the time-varying concentration field and fluid forcing.

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