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Regional Coastal Photograph Archive of the Beach Erosion Board

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ABSTRACT

The U.S. Army Corps of Engineers' Beach Erosion Board, a predecessor organization to today's Coastal and Hydraulics Laboratory, amassed an extraordinary collection of aerial photographs, charts and other materials covering the period 1930 to 1960. The collection includes at least 20,000 vertical aerial images, covering most coasts of the United States. Many of these images may no longer be available from any other source. An effort is underway to inventory and organize the collection and scan selected images in support of coastal projects and research. The photographs are an invaluable source of data for studies of shoreline change and morphological evolution, particularly at regional scale, as well as for assessing population and development trends.

Additional Keywords: Fairchild Aerial Camera Company; Long Island; New Jersey; Coastal and Hydraulics Laboratory

BACKGROUND

The Beach Erosion Board (BEB) was one of the first Federal agencies in the United States to conduct broad inquiry into coastal processes and phenomena. The BEB, which was established by Section 2 of the River and Harbor Act approved July 3, 1930, was formed in response to a growing recognition by elected officials, scientists, and engineers that coastal erosion problems were too complex to be managed on a local basis by individual communities or even states. Congress authorized and directed the Chief of Engineers of the U.S. Army Corps of Engineers "to cause investigations and studies to be made in cooperation with appropriate agencies of the various states on the Atlantic, Pacific, and Gulf coasts and on the Great Lakes, and Territories, with a view of devising effective means of preventing erosion of the shores of coastal and lake waters by waves and currents . . ." (Wilson and Eaton 1960).

During the following 33 years, the BEB conducted many pioneering studies of sediment movement, currents, waves, and coastal processes and published over 140 technical memoranda and reports (Wiegel and Saville 1996; Moore and Moore 1991). Research conducted by BEB scientists was critical to military operations during the Second World War (Wiegel 1999). In 1963, the BEB was dissolved and its duties transferred to the Coastal Engineering Research Center (CERC) and the Board of Engineers for Rivers and Harbors (Moore and Moore 1991). In

1998, CERC and the Corps of Engineers' Hydraulics Laboratory merged to become the Coastal and Hydraulics Laboratory (CHL), now located in Vicksburg, Mississippi. The BEB archive passed through these successor organizations and is now at CHL.

AERIAL PHOTOGRAPHY

Researchers at the BEB adopted many innovative technical methods in the 1930s. One of these was the newly evolving tool of aerial photography, of which they took advantage to document rapid changes in coastal landforms. Before the era of aerial photography, it was laborious and difficult to map changes at the coast. In the 1930s, many barrier islands did not have roads, and the only way to map inlets, remote barriers, and coastal ponds was to send out survey teams in small boats or overland by cars and foot.

Aerial photography was an exciting new technology in 1920s and 1930s, and it revolutionized the way society looked at the world. The aerial photograph was the first remote sensing tool and was, at the time, a wonder of modern technology. Most people had never seen their homes or towns from the air and had no concept of where they fit on the earth. In the United States, the Fairchild Aerial Camera Company was at the forefront of this revolution and pioneered the use of special cameras, aircraft, and flying techniques to produce ever-more spectacular images of both well-known cities and remote terrain in the United States, Asia, and South America (Fairchild 1922; Campanella 2001). The Eastman Kodak Company developed higher-resolution photographic emulsions, and Zeiss, Bosch and Lomb, and Kodak improved the quality of optical lenses.

The military acknowledged the immense value of aerial surveillance during the First World War, and the U.S. Army Air Corps formed a number of aerial photography surveillance and intelligence squadrons. Some of these were based at Mitchel Field, in Nassau County, Long Island, New York. Long Island was a center of aircraft production and research during the golden years of aviation between the two World Wars, and the squadrons at Mitchel Field pioneered many techniques in long-range aerial photographic reconnaissance (Stoff 2003). The BEB had access to this expertise and appears to have been able to request surveillance flights frequently and at crucial times, such as after major storms.

INVENTORY AND EXAMPLES

The BEB collection consists of aerial photographs, charts, movie films, and documents. We do not know the full extent of the original collections. Many of the original studies based on the photography were not published, and index lists or ledgers are lost. We have not fully inventoried the collection, but Table 1 provides a broad overlook.

Although we have just started sorting and organizing the collection, some historical photographs have already been useful for CHL research. For example, the extensive coverage of the south shore of Long Island, New York, provided evidence to trace the morphological history of Shinnecock Inlet (Morang 1999). Long Island flights near Fire Island Inlet are being used as part of the south shore reformulation studies. We have posted hundreds of Long Island images on a web page: http://chl.wes.army.mil/shore/default.htm. This collection includes flights from

June 1938, and September 24, 1938, only 3 days after the Great New England hurricane crossed Long Island and caused catastrophic damage throughout New England (Figures 1 and 2). The post-storm flights show hundreds of channels and overwash fans on the south shore beaches. Many Long Island images are labeled, "U.S. Army Air Corps, 97th Obs. Sq., Mitchel Field, NY," demonstrating a fruitful cooperation between the Army Air Corps and the BEB.
The barrier island near Ocean City, Maryland, was breached by a hurricane on August 25, 1933. In the 70 years since then, Assateague Island has receded more than 1,000 m, which can be confirmed from the 1933 photograph, where the shores on both side of the new inlet are aligned (Figure 3). The hurricane of record on the New Jersey shore was the September 14, 1944, Category 3 storm that caused over 390 deaths in the Northeast. One day later, the U.S. Navy took a series of high-quality photographs from a blimp to document property damage (Figure 4).

In addition to notable storms, the BEB also documented major coastal infrastructure projects. For example, Figure 5 shows the terminal groin at Rockaway Point on Long Island under construction in 1932. Many federal jetties constructed during the late 1800s and early 1900's were built using a railroad trestle that was erected out into the water. Rail cars brought in the stone, which was placed by crane (Figure 6). Although many inlets were first cut by hurricanes, others, like Manasquan, on the New Jersey shore, were artificially cut in 1930 (Figure 7). Other artificially-cut openings that are now Federal navigation projects include Panama City Inlet, Florida, East Pass, Florida, Duluth Cut, Minnesota, and Aransas Pass, Texas. Only 3 years after the opening of Manasquan, the south fillet was almost full, clear proof of northward longshore littoral transport (Figure 8).

Historical photographs can also reveal unusual sediment conditions. Along the north Texas coast of the Gulf of Mexico, the littoral transport is from northeast to southwest. But, a 1952 photograph of the Bolivar Peninsula, at the mouth of Galveston Bay, Texas, shows that a fillet had not built up on the northeast side of the north jetty (Figure 9). The reason appears to be that the north jetty was so long (7.6 km), it sheltered the Bolivar shore from wave energy, and sediment accumulated further to the northeast. Light color bands in the image indicate some of these shoals. Even now, 5 decades later, a low, marshy zone still separates the fillet from the jetty proper.

One of the most valuable uses of historical vertical air photographs is for shoreline change measurements. Before measurements can be made, images have to be photogrammetrically rectified to remove distortions and create map projections with real coordinates (e.g., latitude-longitude, state plane, etc.). Once the photographs have been transformed, they can be superimposed in mapping or geographic information system (GIS) software, and features can be outlined and measured. Figure 10 is an example of a 1945 photo mosaic from the north shore of Willapa Bay, Washington. This area is said to have some of the most extreme sustained erosion in the United States. Outlines of Graveyard Spit and two islands, traced from a 2000 orthophoto, have been superimposed on the mosaic to show how the shore has retreated. At the spit on the west (left), the shore retreated northward over 1.1 km in 55 years, or about 20 m/year.

The extensive BEB collection is expected to be a valuable resource for understandying regional trends, allowing study of coastal behavior over a more than 60-year span. Such work

will be conducted as part of activities of the Corps of Engineer's Regional Sediment Management Program.

SUMMARY AND PLANS

This paper has provided a brief look at the BEB archives. Our plan is to catalog and organize these photographs, to become part of CHL's spatial data center and be available for use in conjunction with modern aerial flights and other contemporary spatial data. It will be impractical and cost-prohibitive to try to scan all the images. For specific projects, images will be scanned and transferred to digital media, and select dates will be photogrammetrically rectified for use in GIS software. The digital images can be posted on web pages, allowing access by any interested parties.

There are many reasons why these archives are invaluable. There is a critical need for base line information on historic storms (e.g., 1938 New England hurricane, 1962 Ash Wednesday storm) to calibrate models and to trace morphologic changes such as overwash and breaches. With increasing emphasis on regional sediment management, there will be more need to review the historical changes over broad coastal reaches. In particular, historical images can be used to document morphological changes, shoreline change, urban development, wetland loss, dune changes, coastal inlets, beach fills, and wetland vegetation changes. Also, aerial photography is the only data source to use for shoreline mapping of regions where no ground surveys were made. These aerial photographs capture instants of time defining the condition of the U.S. coast.

The archive needs to be organized now, while individuals with corporate memory are still available. It is important to realize that these archives represent a national resource, one that will serve the entire coastal science and engineering and planning community.

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Table 1. Overview of Beach Erosion Board Archive	
I. Paper Print Aerial Photographs	
Type	Most are vertical aerial images from 1930 to about 1960. Many may be unique, unless National Archives or other agencies have copies. We do not know if they were flown exclusively for the BEB. Some are general reconnaissance flights covering many kilometers of the shore. Other groups represent monitoring of specific areas or projects (e.g., exhaustive coverage of Moriches Inlet, Long Island, NY). Some oblique images are of particular interest (e.g., post 1944 hurricane images of New Jersey taken from a blimp; detailed coverage of the 1955 Fire Island Inlet navigation channel relocation).
Coverage	Coastal areas around the United States. Coverage is particularly good for Long Island, New Jersey, California, and Florida. The USA is not fully covered.
Media	Most images are contact prints on single-weight or double-weight fiber-based paper. Some are toned sepia or selenium. Some flights have been skillfully mosaiced onto cardboard backing (specifically flights of Long Island). For some mosaics, individual frames are also available. Note: for most flights, the original negatives are lost.
Size	1930s: 7 x 9.25 inch. 1940s and later: 9 x 9 or 9.25 x 9.25 inch. 1960s: Occasional 9 x 18 inch (specifically post-1962 Ash Wednesday Storm coverage).
Quantity	Estimate > 20,000 frames
II. Film Cans	
Quantity:	> 100 cans of 9.25-inch film stock. Some cans are labeled, but most are unidentified.
Condition and coverage	Unknown.
III. T-sheets and H-sheets	
100s of tightly rolled copies of U.S. Coast and Geodetic Survey T-sheets and H-sheets.	
IV. 16 mm Movie Film	
Quantity:	> 100 cans.
Subject matter	Unknown. A few reels in one box are labeled 1962 storm.
V. Project Files	
Subject matter	Various bathymetry maps, structure diagrams, historical shoreline and bathymetric contour change maps from the late 1800s to 1950s, etc., are in map cases. Most are blueline copies, so presumably the originals are filed at the U.S. Army Corps of Engineers Districts within whose jurisdiction the projects are located. But, many Districts have had to clean out their files, so the BEB copies may be unique now. Some show harbor and marine structures and designs from the 1920s and earlier.
VI. Strip Charts	
Many boxes of unknown measurements. 100s of filmstrips contain weather maps, used for the USACE Wave Information Studies.	
VII. 35 mm Slides	
Miscellaneous topics. Some boxes are thoroughly labeled, and look like documentation of flume or wave tank tests. Kodachrome emulsions are in good condition. Overall value unknown.	
VIII. Field Notebooks and Other Materials	
Unknown value. Many may be from damage-inspection field trips after the 1962 Ash Wednesday storm.	

Figure 1. Shinnecock Bay, Long Island, New York, June 30, 1938. Photograph taken before the Great New England Hurricane of September 21, cut the barrier island in several locations. The present Shinnecock Inlet was cut where a channel crosses from the bay to the road. The channel may be a remnant of an artificial cut dug by the Shinnecock and Peconic Canal Company in 1896. Shoal areas in the bay near the barrier attest to former inlets that had been open long enough to form flood shoals. North is to the top, the water body in the center of the image is Shinnecock Bay, and the Atlantic Ocean is on the bottom (Mosaic prepared by the Beach Erosion Board).

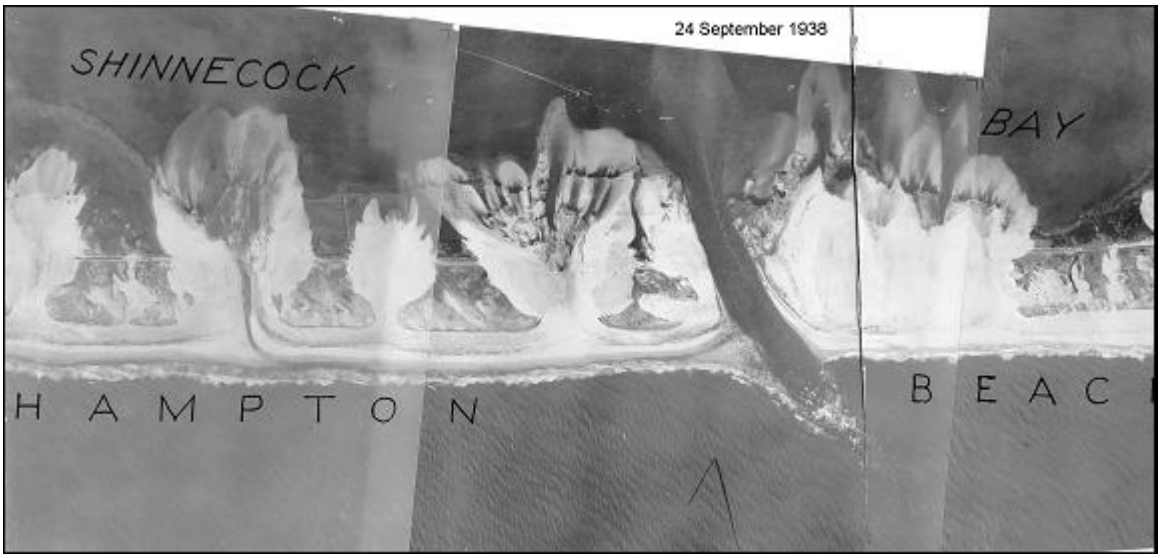

Figure 2. Shinnecock Inlet, Long Island, New York, September 24, 1938. Taken 3 days after Great New England Hurricane breached the barrier, this image shows the new Shinnecock Inlet and many overwash fans along the adjacent shore. Immediately after the storm, all the breaches along this stretch of the coast trended left of shore-perpendicular (Mosaic made at the Beach Erosion Board, original photographs from U.S. Army Air Corps, Mitchel Field).

Figure 3. Ocean City Inlet, Maryland, September 1933. Ocean City is on Fenwick Island in the top center of the image, the Atlantic Ocean is to the right, and Assateague Island is on the bottom. This photograph was taken only 1 month after a hurricane breached the barrier island. Note waves breaking at the edge of a small ebb shoal.

Figure 4. Atlantic City, New Jersey, at the mouth of Absecon Inlet, September 15, 1944. This is one of a series of images taken after the hurricane of September 14, a Category 3 storm that caused 390 deaths in the northeast U.S. This photograph illustrates the degree of urban development along this coast. Photograph taken from a blimp from the U.S. Naval Air Station, Lakehurst, New Jersey (Official U.S. Navy Photograph).

Figure 5. Construction of the jetty on the east side of Rockaway Inlet, Long Island, New York, July 12, 1932. The urban area on the opposite side of the inlet is the east end of Coney Island, and Jamaica Bay is in the distance. In 7 decades, the fillet has filled with sand to approximately the end of the jetty seen in this image.

Figure 6. Construction of the Fire Island jetty on Democrat Point, at the west end of Fire Island, Long Island, New York, January 3, 1940. Many early USACE jetties were built from the land moving seaward using materials brought in by train.

Figure 7. Construction of Manasquan Inlet jetties, New Jersey, October 2, 1930, view looking north. Material for the jetties was supplied via an elevated roadway that extended out to sea from the land. Note that sand is already accumulating on the south (lower) side of the south jetty. The shoreline is continuous, and at this site the inlet was dredged after the jetties were completed.

Figure 8. The recently opened Manasquan inlet, January 23, 1933. The south fillet has almost filled with sand, and developers have built a road seaward of the seaward-most row of cottages in Figure 7.

Figure 9. Bolivar Peninsula, near the mouth of Galveston Bay, Texas, January 1952. The line extending to the lower right is the Galveston north jetty. A fillet has not built up against the jetty, but shoals have accumulated further to the northeast.

Figure 10. North Willapa Bay, Washington State. This mosaic consists of six frames flown on September 19, 1945. These have been photogrammetrically rectified to create a map projection. The three islands (hatched polygons) were traced from an October 12, 2000, orthophoto. The shoreline retreat at the spit in the center of the map was 1,100 m, or 20 m/year. (Original photographs, BEB archives, mosaic courtesy of Washington State Department of Ecology).