NYSGI-W-83-002 C. 2

EROSION OF LONG ISLAND'S SOUTH SHORE: A PRELIMINARY IDENTIFICATION AND ASSESSMENT OF ALTERNATIVE RESPONSES TO THE PROBLEM.

Conveners: J.R. Schubel, Gary A. Zarillo and Henry J. Bokuniewicz

Report of a Workshop held at Westhampton Beach, New York, on 21-22 June 1983.

An Activity of the Marine Sciences Research Center's Coastal Ocean Science and Management Alternatives (COSMA) Program.

Support for the Workshop was Provided by the New York Sea Grant Institute.

Special Report #50

Reference #83-6

Approved for Distribution

J. R. Schubel, Director

INTRODUCTION

The workshop held at Westhampton 21-22 June, 1983 was prompted by severe shore erosion and consequent loss of property at Westhampton Beach, Long Island. During the past winter along a two-mile section of Westhampton was cut back more than 75 feet in some places. Property losses are estimated at more than $1 million.

The goals of the workshop were to identify and assess the full range of plausible management strategies to deal with erosion at Westhampton and, more broadly, to maintain the integrity of Long Island's barrier system as a whole. In order to meet these goals experts in the fields of shore processes, coastal engineering and coastal zone management were invited to participate in the workshop. The résult is a preliminary assessment of the advantages and disadvantages of alternatives and to list knowledge gaps that would have to be filled before rigorous assessments of particular alternatives could be completed. The workshop was an initial step by the Marine Sciences Research Center's shore processes unit to design and conduct a comprehensive research program that will permit rigorous scientific and engineering assessments of management alternatives for dealing with erosion on Long Island's south shore.

The workshop participants are listed in Appendix A. The New York Sea Grant Institute and the Marine Sciences Research Center provided support for the workshop which was an activity of MSRC's Coastal Ocean Sciences and Management Alternatives (COSMA) Program initiated with a grant from the William H. Donner Foundation. Port-O-Kai Hotels generously provided accommodations at reduced rates. We are indebted to Martin Lang, Supervisor of the Town of Southampton for his help in making arrangements that enabled us to hold the workshop at Westhampton.

PROCEDURE

A preliminary list of management alternatives was presented at the beginning of the workshop. Participants were invited to revise the list and a leader was assigned to each alternative. Other workshop members joined the leaders to form a primary working group for each alternative. Each primary working group was given 2 hours to complete an initial assessment of the alternative. Their results were recorded on large sheets of paper and attached to the wall of the meeting room. Once all of the initial assessments had been completed, groups rotated to react to the assessments of the primary working groups. Their responses were recorded on large sheets of paper and placed on the wall beneath the primary assessments. This process was repeated a second time. At that point, groups were dissolved and individuals were invited to respond to any of the assessments or the responses. The additional information was attached to the wall. Leaders of the primary working groups were given the opportunity to review the responses to their initial assessment and to prepare a revised assessment. These were placed on the wall. Once this procedure had been completed, the workshop went into a plenary session. Comments on the revised assessments were invited from the floor.

The list of alternatives considered and an outline of the final assessments are presented in the following section.

I. THE DO NOTHING APPROACH

Alternative: Do nothing - Allow the barrier to reach a state of equilibrium adjusted to existing conditions; occasional repair of breaches when they occur. Implementation includes government buyout of private property.

Advantages:

1. Avoidance of initial investment and subsequent maintenance costs normally associated with structural protection on the beach.
2. Acquisition of private land for public use.
3. Decreased structural interference with littoral drift.
4. Limited interference by man on floral and faunal populations.

Disadvantages:

1. System may not return to equilibrium therefore necessitating management that would include structural solutions.
2. Loss of both public and private property due to natural shoreline changes.
3. Increased likelihood of washovers and breaches leading to increased flooding and sedimentation in the bays.
4. Litigation by private landowners.
5. Cost of buying out landowners.
6. Loss of local business.
7. Loss of tax revenue.

Knowledge Gaps:

1. Cost/benefit analysis.
2. Sources and sinks of littoral material.

II. MODIFICATION OF THE GROIN FIELD

Alternative A: Remove all groins and jetties.

Advantages:

1. Increased littoral sand supply.
2. Low maintenance costs.
3. Restoration of the natural barrier island system.

Disadvantages:

1. Cost of removing structures.
2. Cost to real property; loss of utility of the area to private concerns.
3. Possible closing of the inlets.
4. Possible migration of the inlets and reworking of adjacent barriers.
5. Cost to commercial interests associated with present use of the bays.
6. Possible pollution of the bay areas.

Knowledge Gaps:

1. Assessment of natural barrier islands compared with stabilized barriers as flood protection; is a natural system generally higher and/or wider.
2. Assessment of the ecological benefits/consequences involved.

Alternative B: Remove the groin field (but maintain the inlet jetties).

Advantages:

1. Increased littoral sand supply (but less than in "A")
2. Reduction of commercial economic impacts incurred by alternative "A"; maintains the integrity of the bay systems.

Disadvantages:

1. Less littoral sand accumulation compared with alternative "A".
2. Costs of engineering and costs to real property as listed under alternative "A".

Knowledge Gaps: Similar to alternative "A".

Alternative C: Shorten the existing groins.

Advantages:

1. Maintains a relatively wide beach within the groin field.
2. Increased volume of littoral sand moving downdrift.
3. More favorable economic impacts than "A" or "B".

Disadvantages:

1. Width of the updrift beach may decrease.
2. No guarantee of downdrift effects/benefits.
3. Costs of removing outer ends of groins.

Knowledge Gaps:

1. Is all or part of the groin field filled, and if not, at what rate is it infilling (how long will downdrift erosion continue to be a problem)?

2. How does the length of a groin affect the distribution of the longshore transport of sand?

Alternative D: Shorten existing groins and use the material to extend the present field westward.

Advantages:

1. All advantages listed under alternative "C", plus a better chance of downdrift accretion within the extended field.

Disadvantages:

1. Possible decrease in the width of the updrift beach.
2. Construction costs.

Knowledge Gaps: Same as "C".

Alternative F: Leave the existing groin field and extend it westward.

Advantages:

1. Protection of downdrift areas without risking beach loss in updrift areas.
2. Probably a politically feasible alternative.

Disadvantages:

1. Possible transfer of the erosion problem westward.
2. Construction costs.

Knowledge Gaps: Same as "C".

III. FILL THE GROIN FIELD

Alternative: Fill the groin field with sand (assume the full project includes the downdrift beach).

Advantages:

1. The immediate result would be wide beaches in the groin compartments and a restored downdrift beach.
2. Beach fill is the most politically safe solution because it avoids the issue of shoreline structures.
3. Filling the groins would provide a sand source for downdrift beaches by erosion or bypassing of the fill.
4. A straighter beach after filling may provide for more uniform littoral processes and possibly prevent sand loss to the offshore by rip currents.

Disadvantages:

1. Beach fill is a costly short-term solution (costs range up to $15,000,000).
2. Compatible fill may not be available.
3. Possible adverse effects in the borrow area.
4. Most of the fill might bypass the beach immediately west of the last groin which is the section subject to severest erosion.
5. The groin compartments may already be filled.
6. There may be an offshore sink of sand and additional fill may not bypass the groins.

Knowledge Gaps:

1. Are the groin compartments filled? Assuming a net westward longshore drift of 3×10^5 yd^3 per year, a 19000 foot-long groin

field, a fill width of 200 ft and fill factor of 1 yd^3 per foot, it would take about 13 years to fill the compartments. For a fill width of 400 feet, 25 years is required and the compartments should still be filling.

2. An assessment of groin compartment filling should be made using aerial photos and beach profiles that document patterns and rates of beach change over the past 13 years.

3. An estimate of net littoral drift should be made using aerial photos and beach surveys of the groins during the first five years of the groin field project.

4. A detailed bathymetric survey in the vicinity of the groin field should be made in order to provide the following information:

   i) are there rip-induced offshore deposits (is there an offshore sand sink)?

   ii) present bathymetry can be compared with pre-groin profiles for an estimate of total volumetric accretion.

   iii) is the beach/shoreface profile oversteepened along the groin field.

5. A search for the closest source(s) of compatible fill needs to be made.

IV. MODIFY THE OFFSHORE BATHYMETRY

Alternative: Modification of offshore bathymetry--e.g., by breakwaters, offshore bars, reefs, sea grass, etc. This alternative assumes an adequate sand supply and sand bypassing in the littoral zone.

Advantages:

1. Possible stabilization of eroding shoreline by establishing a quasi-stable crenulate bay shoreline.
2. Offshore breakwaters might be effective in the zone downdrift of the groin field in trapping sand and reducing the impact of wave diffraction around the last groin.
3. Creation of new habitats.

Disadvantages:

1. There may not be an adequate sand supply to maintain bathymetry modifications.
2. Interruption of littoral drift.
3. Breakwaters off the groin field would trap more sand here and further starve the downdrift beach.
4. No documentation that sea grass works.
5. Disruption of nearshore fishing.
6. Capital costs of effective structures is high.

Knowledge Gaps:

1. Detailed survey of the present offshore bathymetry is needed.
2. Measurements of the wave field should be made in combination with detailed bathymetry in order to determine what the role the various

wave-types play in controlling the morphology of the shoreface.

3. What is the role of rip currents in generation of various types of offshore bar morphologies.

V. HARDENING THE SHOREFACE

Alternative: Placing revetments on the seaward face of the dune or bulkheads at the seaward toe of the dune.

Advantages:

1. These structures are not technically limited; they can be effectively designed to work as intended.
2. The structures protect the upland immediately behind them.
3. The structures do not effect the beach except in cases of severe or prolonged erosion.
4. Revetments are more durable and reflect less wave energy than bulkheads.
5. Revetments may have less adverse biological impact and may provide new habitats.
6. Bulkheads are less expensive than revetments.

Disadvantages:

1. These structures do not protect the beach.
2. In the face of severe or prolonged erosion, wave energy reflected from the structures will aggravate beach erosion.
3. The structures hinder access to the shore and are controversial.
4. Because of the potential for erosion flanking the ends of the structure and weakening it, relatively long stretches of the beach must be hardened simultaneously.
5. The structures are expensive. Assuming a typical cost of $1000 per linear foot, it would cost almost $180 million to harden a 30-mile stretch of beach.

6. In the face of shoreline recession due to rising sea level, the beach will eventually disappear in front of the structure.
7. There will be a prolonged commitment to maintaining the structure. As the beach disappears the shoreline will become more and more dependent not only on maintaining the structure, but also on strengthening it to withstand increasingly frequent wave attack until it becomes a sea wall (If the beach is say, 200 feet wide and the recession rate is relatively rapid, say 2 feet/yr, its lifetime in front of a revetment or bulkhead is about 100 years.
8. As the beach disappears and the revetment or bulkhead becomes a sea wall it may interrupt the longshore transport of sand and starve downdrift stretches of beach.
9. Along the barrier island, the structures may reduce overwashing of sand, therefore limiting sediment supply to the bay and leading to bay erosion. If this is the case, loss of bayside marshes may reduce productivity in the bay.
10. Prolonged commitment limits future options.

Knowledge Gaps:

1. What are the sources of sediments?
   i) Will shore hardening structures starve downdrift beaches or is there a sufficient offshore source of sand to maintain them?
   ii) Will dunes or bayside deposits be affected?
   iii) What will be the effect on the neighboring beach of armoring long stretches of the shoreline?
2. What are the erosion effects at the edges of these structures?
3. What are the rates of shoreline recession given the wave climate?

VI. DUNE BUILDING

Alternative: Increasing the height and volume of the dune either directly by dune nourishment or indirectly using sand fences, planting, Christmas trees, etc., to trap wind-blown sand.

Advantages:

1. Low cost and commitment.
2. Adds erosion fodder. In the face of severe or prolonged erosion it increases the lifetime of natural protective features.
3. Reduces traffic on the dunes.
4. Does not limit future options.
5. May improve flood protection by raising the elevation of the dune.

Disadvantages:

1. Does not protect the beach.
2. May reduce sediment supply to the bayside shore of barrier island and, as a result, aggravate bayside shoreline recession and loss of marshland.
3. Fragile structures of uncertain effectiveness.

Knowledge Gaps:

1. What are the erosion rates of dune sands during storms?
2. What are the sources of dune sands?

VII. GIANT BY-PASSING SYSTEM

Alternative: Sand dredged from shipping channels of Lower New York Harbor would be used at the appropriate place (or places) to the east to replenish the littoral drift system.

Advantages:

1. Acknowledges that not all dredged material is spoil, that some is a resource.
2. Replenishes the littoral drift system.
3. Provides a low cost source of sand for beach nourishment.

Disadvantages:

1. Adds to the cost of channel dredging by increasing transportation costs and by prolonging the project.
2. Makes sense only if integrated into a regional dredged material management plan.
3. Cost sharing by appropriate State and County agencies with the U.S. Army Corps of Engineers would be required.

Knowledge Gaps:

1. An economic analysis and development as a component of a regional dredged material management plan would be required.
2. Several scientific questions that need to be addressed include:
   - i) Would the most appropriate use for dredged material be to nourish beaches directly?
   - ii) Should the material be used to replenish the littoral drift system?...construct and offshore?
   - iii) Is the size of material available appropriate?

VIII. ESTABLISH INLET SAND BY-PASSING SYSTEMS

Alternative: Establish and maintain sand by-passing systems which would allow the uninterrupted transport of littoral material across south shore inlets.

Advantages:

1. Enhancement of natural processes that would nourish downdrift beaches and reduce erosion.
2. Maintains or enhances inlet navigation by increasing channel stability and reducing shoaling.
3. Would not involve significant modification of present channels and therefore would not have an adverse impact on bay water quality.
4. Technical, engineering and operational data are available from existing sand by-passing systems that could be applied to the south shore.

Disadvantages:

1. Would not have an immediate effect on areas with severe erosion problems such as Westhampton Beach.
2. Localized temporary degradation of water quality due to turbidity at intake and discharge areas of the by-passing system.
3. Modification of the updrift shoreline might be required to accommodate by-passing facilities.
4. Substantial capital costs are required.
5. Continuous project that must be maintained periodically.

Knowledge Gaps:

1. An effective sand by-passing would have to be designed and engineered specifically for south shore inlets.

2. Data on bathymetry, inlet hydraulics, littoral transport, inlet configuration and historical changes should be compiled from existing monitoring programs and aerial photographs.

3. Studies are needed to determine:

   i) Whether the inlets are naturally by-passing sand and the fate of this material.

   ii) What is the effect of depriving the inlets of sediment?

Additional Alternatives to be Considered:

IX. Taper the groin field from east to west and add an additional groin in the erosion area.

X. Build a short offshore breakwater along the erosion area just west of the groin field.

XI. Use the "Dutch Solution" consisting of a reinforced dike behind the beach and spiles extending from the beach to dissipate wave energy.

CONCLUSIONS

The workshop considered eight major alternatives ranging from the do-nothing approach to hardening the shoreface with shore protection structures. Alternatives that included modification and filling the groin field dealt specifically with erosional problems at Westhampton Beach, but associated advantages and disadvantages are common to groin fields at other locations on Long Island's south shore. Alternatives such as dune building, inlet sand by-passing and hardening of the shoreface approach the problem on a much broader basis and consider the south shore as a system that must be dealt with in its entirety.

Two general categories can be identified from the advantages that were listed for each alternative. Some alternatives such as beach filling and sand by-passing provided for restoration or preservation of beaches. Other alternatives such as shoreface hardening and dune building provided protection for property behind the beach, but are not aimed at protecting the beach itself. This raised the fundamental question of whether shore protection on the south shore should be directed at maintaining the beaches, real estate property or both. The answer to this question depends, in part, on whether Long Island's barrier system is eroding or migrating landward with sea-level rise. The selection of shore protection methods also depends on whether protection of the mainland behind the barrier islands from storm surge remains as the primary goal of the New York District Corps of Engineers or if this has been modified to equally include maintenance of the barriers for their own value. There was general agreement among the workshop participants that this distinction must be more clearly defined before rigorous assessment of any shore protection alternative could be completed.

Among the disadvantages that were listed, the most common one was the substantial cost of almost any alternative selected. For instance, hardening of the shoreface would cost an estimated $1000 per linear foot, which would result in a $180 million price tag to harden a 30-mile stretch of beach. Even costs of the do-nothing approach would be significant, including loss of tax revenue, loss of local business, possible litigation by private land owners and cost of buying out private property. Another disadvantage common to many alternatives was the unpredicted influence of shore protection measures on shore processes, both within protected areas and along adjacent shorelines. In the case of Westhampton Beach, the question was asked whether the groin field is filling and by-passing sand or creating an offshore sink of sand via a mechanism such as rip currents focused on the distal ends of the groins.

Although each alternative assessed had certain merits no single method stood out above all others as the best alternative for managing erosion at Westhampton and other areas of the south shore. This was not the result of disagreement among workshop participants, but due to the complexity of the problem and the prevailing inadequacy of our knowledge concerning the movement of sand on Long Island's south shore. The most important knowledge gaps that remain to be filled include quantitative measurements of wave climate, a more precise estimate of longshore drift rates, mechanisms of on/offshore sand movement, seasonal beach cycles and the effects of storms. Significant contributions have been made in some of these areas by the New York

District U.S. Army Corps of Engineers. Many tasks remain outstanding and should be completed immediately in the face of continuing and accelerating shoreline recession on the south shore of Long Island.

Appendix A

WORKSHOP ATTENDEES

Name	Affiliation
Chester Arnold	Marine Sciences Research Center
Henry Bokuniewicz	Marine Sciences Research Center
Anthony Dalrymple	University of Delaware
Dewitt Davies	Long Island Regional Planning Board
Rhodes Fairbridge	Columbia University/Marine Sciences Research Center
Graham Giese	Marine Sciences Research Center
Gene Gilman	New York State Department of Conservation
John Guldi	Suffolk County Department of Public Works
Joseph Heikoff	State University of New York at Albany
James Kirby	Marine Sciences Research Center
James Liu	Marine Sciences Research Center
Lawrence McCormick	Southampton College
Peter Rosen	Northeastern University
J. R. Schubel	Marine Sciences Research Center
Donald F. Squires	New York Sea Grant Institute
William Swan	Independent
Sara Tangren	Marine Sciences Research Center
Jay Tanski	New York Sea Grant
Hsiao-Hsu Tsien	Marine Sciences Research Center
James Urbelis	New York District - U.S. Army Corps of Engineers
Gary Zarillo	Marine Sciences Research Center
Mindy Zimmerman	Marine Sciences Research Center