Beach Basics

Understanding beach nourishment projects from concept to completion to continuing maintenance.

Contents

Purpose Of Brochure

The purpose of this brochure is to give the reader a basic understanding of the how and why of shoreline changes and the design goals of basic shore protection projects

Understanding The Funding Process For A Federal Beach Renourishment Project

Appropriations vs. Authorizations – To fully understand the Corps' process for funding for beach renourishment projects and all civil works projects, one must grasp the differences between appropriations and authorizations. They are not one in the same. An authorization is an act (usually of Congress), which enables the Corps to go ahead with a project. An appropriation is the money needed to finance such projects. Every project must have both before construction can commence.

"The Six Steps to a Civil Works Project"

Funding Process - The funding process for beach renourishment projects works no differently than for other civil works projects in the U.S. Army Corps of Engineers. Listed below are the six steps.

Step 1 - Problem Perception

Local community (i.e., people, businesses) and/or local government perceive or experience water and related land resource problems (i.e., flooding, shore erosion, navigation restrictions, etc.). Problems are beyond local community's / government's capabilities (e.g., jurisdictional boundaries, financial resources, technical expertise, etc.) to alleviate or solve.

Step 2 - Request For Federal Action

a. Local officials talk to Corps about available federal programs. Technical assistance and some small projects can be accomplished without congressional authorization (see Continuing Authorities Program).
b. Local officials contact congressional delegation if study authorization required.
c. Member of Congress requests study authorization through Public Works Committees.
d. Committee resolution adopted if report was previously prepared on water problems in area.
e. Legislation, which may be proposed by the President, is normally required if no corps report exists.

Step 3 - Study Problem and Report Preparation

a. Study is assigned to Corps district office.

b. Funds to complete a 12-18 month reconnaissance study are included in President's budget (see Two-Phase Study Process).

c. Appropriations for reconnaissance provided in annual Energy and Water Development Appropriations Act

d. District conducts reconnaissance study, leading to a reconnaissance report.

e. Because most Corps projects involve cost sharing and environmental issues, local proponents should seek an early consensus for or against a Corps project among the public and private sectors and among diverse interest groups.

f. If study continues beyond reconnaissance phase, local sponsor must agree to share cost of feasibility phase.

g. A life cycle project manager (LCPM) or management team is appointed to coordinate the project through the feasibility study, design and eventual construction. The LCPM serves as the point of contact with the project sponsor and other concerned parties, tracks all the commitments made during the process, and develops a Project Management Plan.

h. Public involvement is an integral part of planning process, including review of draft report and draft environmental impact statement (EIS).

i. Study is conducted under the U.S. Water Resources Council's Economic and Environmental Principles and Guidelines (see Principles and Guidelines) for Water and Related Land Resources Implementation Studies, dated March 10, 1983.

j. Funds are included annually in President's budget; annual appropriations and non-federal monies are needed to continue study.

k. Study results in Feasibility Report and EIS, which are submitted to Corps division (regional office).

Step 4 - Report Review and Approval

a. Division office, which reviews district work during planning process, completes technical review of final district Feasibility Report and EIS.

b. Division engineer submits report to Washington Level Review Center (WLRC) and issues public notice inviting comments. WLRC conducts Washington review.

c. Final EIS is filed with Environmental Protection Agency (EPA) and made available to public.

d. Proposed report of chief of engineers and final EIS are sent to heads of federal agencies and governors of affected states for comment.

e. Board of Engineers for Rivers and Harbors (BERH) or Mississippi River Commission (MRC) submits views and recommendations to Chief of Engineers.

f. Comments from public are fully considered in BERH or MRC action.
g. Chief of Engineers considers comments on proposed report and EIS, prepares final report, and submits it to Secretary of the Army.
h. Assistant Secretary of the Army (Civil Works) reviews the Chief of Engineers' report.
i. Office of Management and Budget (OMB) comments on report as it relates to President's programs.
j. Assistant Secretary of the Army (Civil Works) transmits Chief of Engineers' report to Congress.

Step 5 - Congressional Authorization

a. In most cases, Corps continues pre-construction engineering and design following issuance of Division Engineer's Notice. Funds are included in President's budget and Congress acts on each item in appropriations bill.
b. Chief of Engineers reports (see Step 4) are referred to committee on public works and transportation in House and Committee on Environment and Public Works in Senate.
c. Civil works projects are normally authorized by the Water Resources Development Act (Omnibus Bill) following committee hearings.
d. Occasionally, Corps proposal is authorized by separate legislation or as part of another bill.

Step 6 - Project Implementation

a. New projects are included in President's budget based on national priorities and anticipated completion of design and plans and specifications so that construction contract can be awarded.
b. Budget recommendations are based on evidence of support by state and ability and willingness of non-federal sponsors to provide their share of project cost.
c. Congress appropriates federal share of funds for new starts.
d. Secretary of the Army and appropriate Non-federal sponsors sign formal Local Cooperation Agreement (LCA) once Congress has appropriated funds for project implementation to begin.
e. The LCA obligates non-federal sponsors and the Corps to participate in implementing, operating and maintaining project according to requirements established by Congress and administration.
f. District completes enough engineering and design for developing plans and specifications for initial project implementation.
g. Engineering and design continue during implementation process.
h. Funds are included in President's annual budget for the federal share of the project.
i. Construction is managed by Corps, but done by private contractors.
j. Corps periodically inspects projects, including those for which non-federal sponsors have assumed an operation and maintenance responsibility.

Basic Beach Erosion Science

Shore erosion is affected by the exposure and orientation of the shoreline, offshore water depth, resistance of the beach to wave action, local climatic conditions, and sea level rise. Intrusions, either natural or manmade (seawalls, bulkheads, groins, jetties) into the littoral zone, also affect erosion.

In estuarine systems, currents generated by changing tides are important processes in distributing littoral sediments (sand). The characteristics of a beach are usually described in terms of the average size of the sand particles on the beach, the range and distribution of sizes of those particles, the elevation and width of the berm, the slope or steepness of the foreshore, and the general slope of the inshore zone fronting the beach. Generally, where the rate of littoral material (sand) supplied naturally to the shore is less than the rate at which the natural forces of waves, currents, and winds are removing it from the shore, a beach erodes. Manmade developments greatly influence the rate at which this erosion occurs.

Natural Forces

The intensity of a wave attack is one of the most important factors in shaping the shoreline of Florida's sandy coasts. The wind-generated waves consist of "sea" and "swell." Local waves are generated by local winds. Swells are generated from distant storms.

Sea and swell waves cause littoral transport (sand movement) in the longshore direction (parallel to the beach) and in an offshore-onshore direction (perpendicular to the beach).

The primary agent causing onshore, offshore and alongshore movement of sand is the breaking wave or the "breaker." As a wave moves on to the shore, it finally reaches a depth of water which is so shallow that the wave collapses or "breaks." This depth is equally to about 1.3 times the wave height. This means that a wave 3 feet high will break in a depth of about 4 feet. This breaking action results in a sudden dissipation of energy of the wave, which causes a great turbulence in the water, and stirs up the bottom materials.

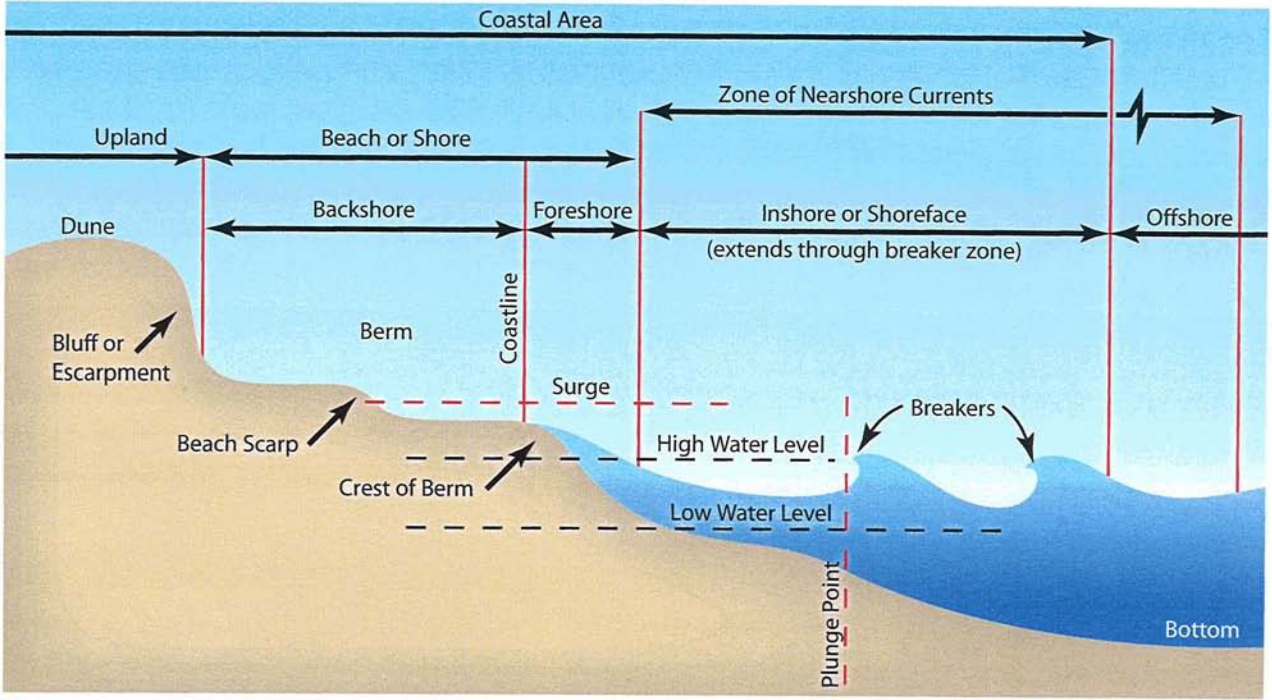


Figure 1- Naturally Occurring Beach Conditions

Breaking Waves

The littoral current is very important in coastal processes because it carries sand which has been stirred into suspension by the turbulence created by the breaking waves. The sand moved in this way is known as "littoral drift." The direction and violence of the wave attack determines the movement and magnitude of the littoral transport at a given time.

Figure 2- Breaking Waves

In the longshore direction, because of the configuration and bearing of the shoreline in the project area, waves approaching from the north and northeast cause a southerly drift; waves from the southeast and south cause a northerly drift. Waves from the east approach the area generally perpendicular to the shoreline and create very little drift in either direction. In the offshore-onshore directions, it should be noted that the long period swell waves tend to build a beach as it moves beach material onshore. Conversely, the period of high wave steepness sea waves (storm condition) tends to move the material offshore. These conditions are depicted in figure 3.

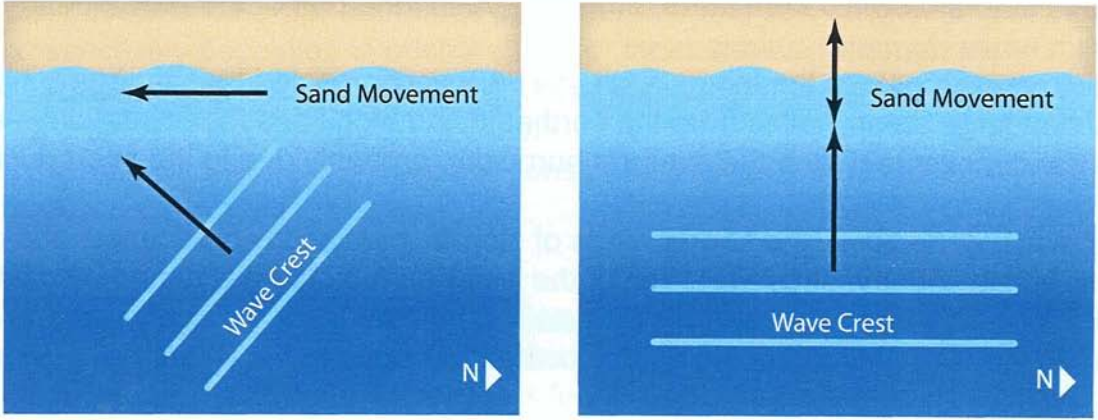


Figure 3- Wave Induced Sand Movement (littoral drift)

Impact Of Storms

Storms considerably aggravate the beach erosion problem in all of Florida. Hurricanes and northeasters are the two main storm types affecting the peninsula.

Both occur with some degree of regularity.

Northeast storms are generally generated by atmospheric disturbances in areas remote from any project area. These storms periodically attack the Florida east coast with heavy swell during the fall and winter months. Northeasters generally cause more erosion of the beaches in 2 or 3 months than is caused by sea and swells from other directions during the rest of the year, and this includes hurricanes.

If the northeasters occur when the moon is full, they are accompanied by abnormally high tides. The combination of large steep waves from the northeast and high tides for several days appears to cause more sand movement than the average hurricane, probably due to the short duration of hurricanes.

In addition to wave generation, the strong winds of storms, particularly hurricanes, can create surface currents which cause a superelevation of the water surface (surge) near the coast. This surge raises the water level and exposes higher parts of the beach not ordinarily vulnerable to waves. Structures inadequately protected and/or located too close to the water, are then subjected to the forces of the waves and are often completely destroyed. Storm surges are particularly damaging if they occur at the same time as high tide.

Tides And Currents

The tides are a rise and fall in the water level caused by the gravitational attraction of the moon and sun. If the water level is to rise and fall in estuarine bays, then water must flow into and out of these areas. Tide-generated currents have important effects on the distribution of littoral materials. Material reaching inlets and harbor entrances by littoral currents can be picked up by ebb or flood currents and respectively deposited in offshore bars or inner shoals. Although some material is subsequently restored to the littoral system, some is always lost from the littoral drift stream and this accelerates the erosion of the downdrift beaches.

In addition to creating currents, the tides are constantly changing the level at which the waves attack the beach.

Sea Level Rise

An important factor affecting the erosion situation along open coast shorelines is the rise in the mean annual level of the ocean. Indications are that we are presently in a warming age which Is causing the polar ice caps to melt. This melting is leading to a rise in sea level estimated at .006

feet per year along the Atlantic coast of the State of Florida. This long-term trend can have serious detrimental effect in flat coastal regions such as the project area. The results of a rise in sea level along a typical beach profile are twofold: first, a direct landward encroachment takes place (shoreline recession) followed by a beach face readjustment by waves to a flatter slope (erosion above the waterline and some accretion offshore).

Effects Of Manmade Developments

With the beginning of the real estate boom in much of coastal Florida, the delicate balance existing between the natural negative and positive forces on the beaches was upset. To accommodate and maximize ocean-front development, many natural dunes were destroyed to make way for hotels, boardwalks, roads, and houses. In many places, dunes were bulldozed away merely to provide picture window views of the ocean. Although natural dunes erode during storms, they are basically a reservoir of sand which absorbs the energy of waves and surges which overtop the berms. Therefore, this unchecked development resulted in the destruction of the last natural line of defense against the waves and surges generated by storms.

The problems associated with dune destruction were at the same time compounded by the practice of erecting bulkheads and seawalls at the mean high waterline and backfilling the wall. The shoreline was thus advanced to the extent that seaward of the line of seawalls, only low tide beach remained.

The introduction of these vertical structures along the active beach zone increased the erosion rate since reflected wave energy emanating from these structures steepened the offshore slopes fronting these structures allowing higher wave energy to reach them.

With reduced beach areas and more erosive forces at work, an attempt was made to stabilize the rapidly developing oceanfront by constructing groins. These steel and timber walls were built out into the longshore currents in the hope of capturing the diminishing precious sand as it moved along the beach. These efforts, however, merely transferred the erosion problem down the beach.

To stabilize ocean entrances along the eastern Florida coast, jetties (longer and more substantial groins) were built and navigation channels deepened to aid larger and more numerous commercial and recreational craft to harbor. In nearly every instance, these harbor structures interrupted the alongshore movement of sand, thus reducing the amount of available material to nourish downdrift beaches.

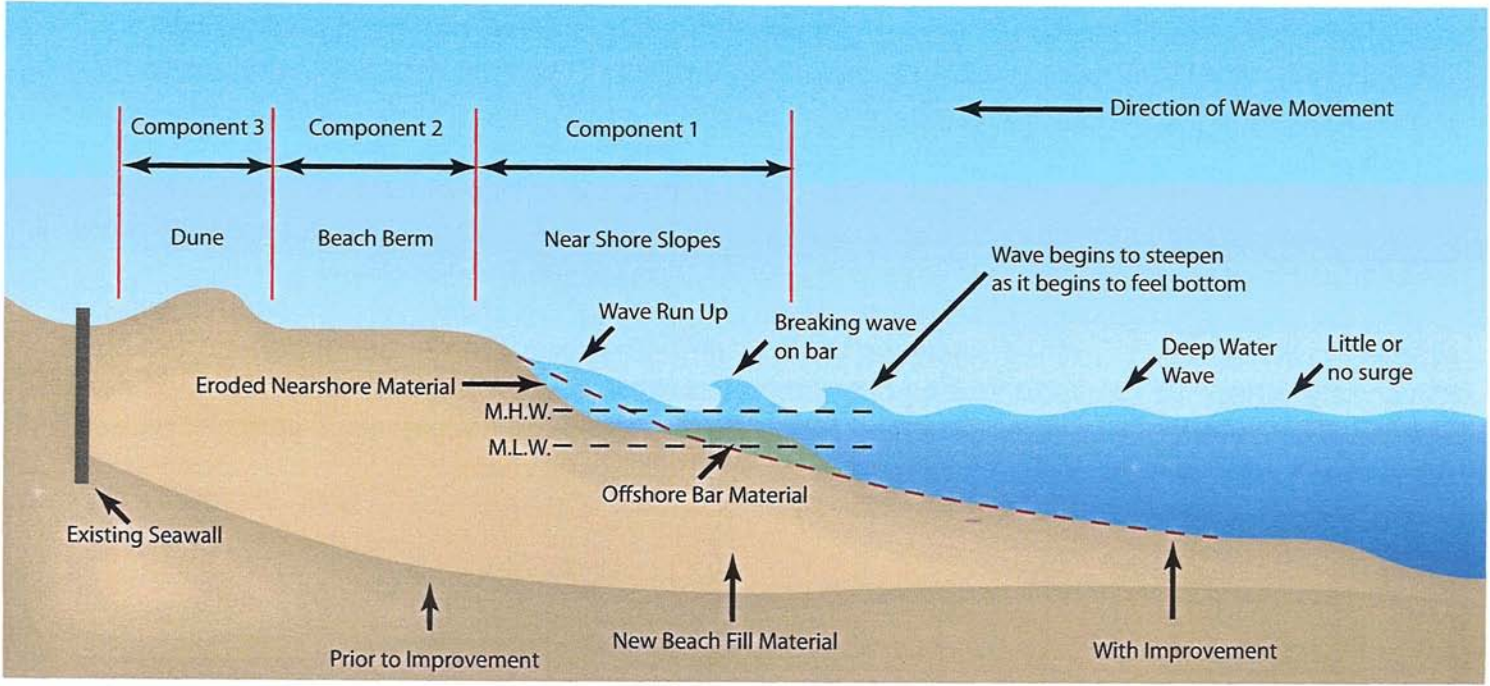
Other manmade actions, which have affected the rate of erosion, include the damming of those rivers and streams which once supplied sand to the Atlantic beaches of the United States.

In the late 1950s and early 1960s, tourists visiting many Florida beach resorts were surprised by the absence of beach area. This was especially evident at high tide.

How A Project Works

Inshore And Foreshore Beach Slopes

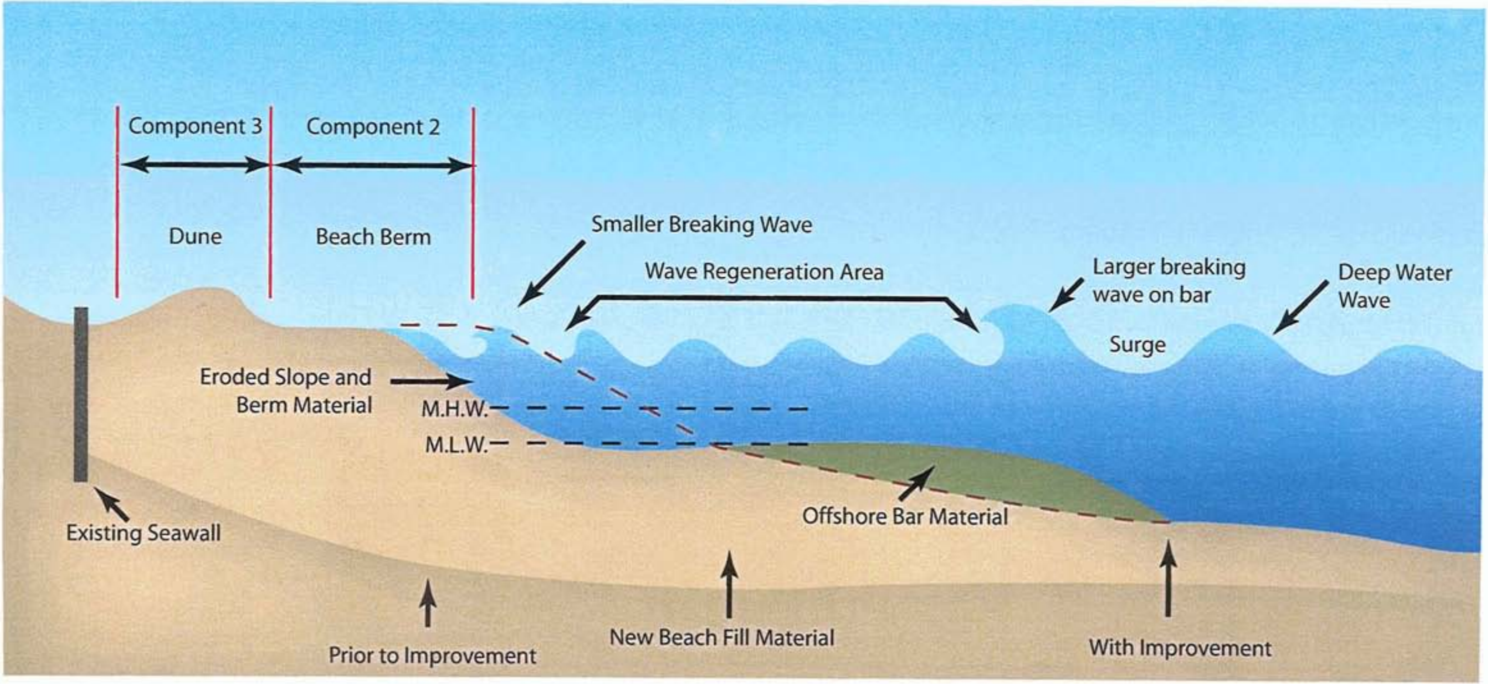
The first defense against normal wave action or that emanating from weak storms is the shallow sloping project foreshore and nearshore slopes. These shallow slopes dissipate the energy or weaken the force of the deepwater waves. The primary agent of littoral transport is the breaking wave. The shallow seaward slopes afforded by the project causes the incoming wave trains to break as they begin to feel bottom. After breaking, the water travels forward as a foaming turbulent mass, expending its remaining energy in a rush up the beach slope. Falling under the influence of the force of gravity, the water then runs back down the beach slope with sediments (sand) which have been placed in suspension during breaking. These sediments are deposited in the calmer and deeper water found a short distance offshore and begin to build an offshore bar. This offshore bar causes subsequent incoming wave trains to break farther offshore where the energy is dissipated and in this way an equilibrium condition is reached and no additional erosion takes place. The material eroded from the foreshore and inshore slope equals the material deposited in the offshore bar as illustrated in the figure.


Direction of Wave Movement
Component 3
Component 2
Component 1
Dune
Beach Berm
Near Shore Slopes
Wave begins to steepen
as it begins to feel bottom
Wave Run Up
Breaking wave
on bar
Deep Water
Wave
Little or
no surge
Eroded Nearshore Material
M.H.W.
M.L.W.
Offshore Bar Material
Existing Seawall
Prior to Improvement
New Beach Fill Material
With Improvement

Beach Berm

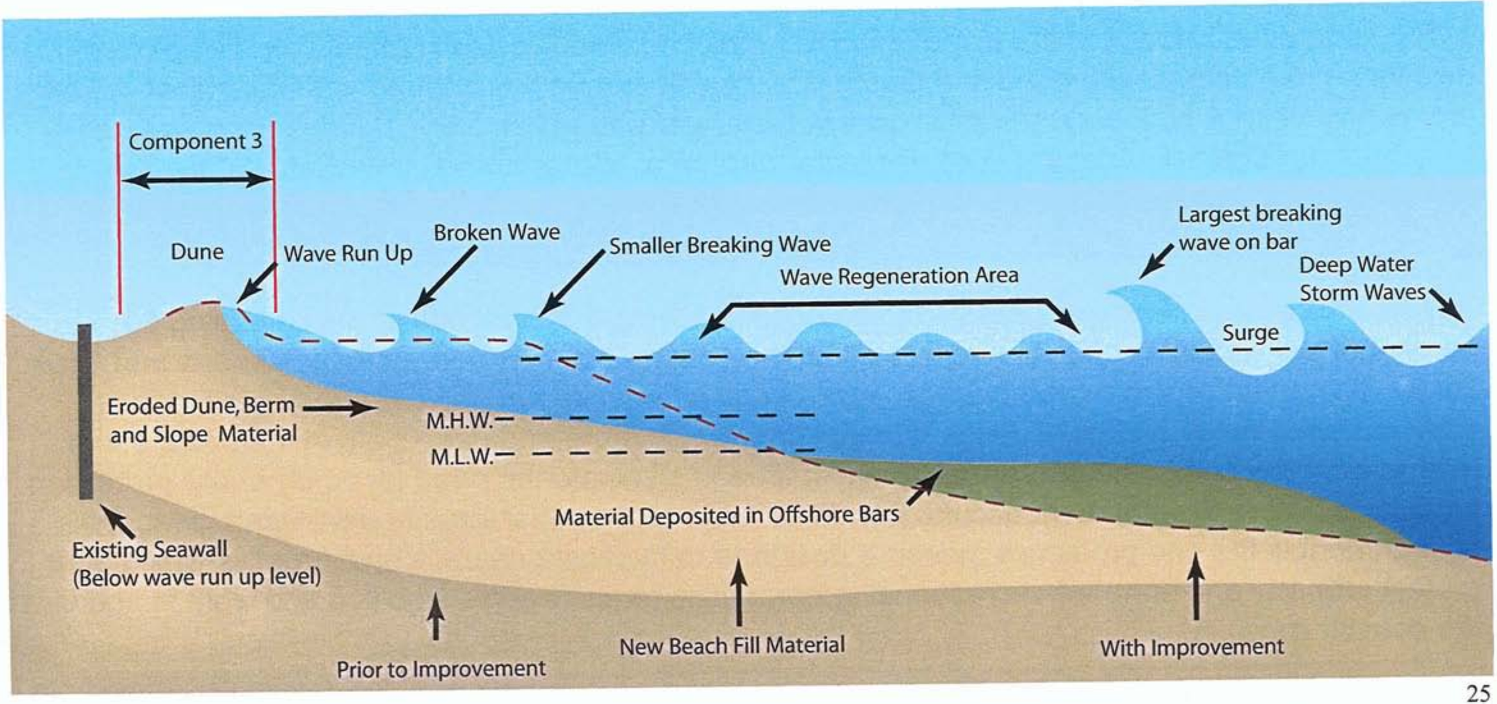
As conditions deteriorate, larger waves approach the shoreline. If the onshore winds are of sufficient magnitude, surges can also be expected to occur. These larger waves when accompanied by surges, tear at the nearshore slopes and beach berm and deposit larger amounts of material in the offshore bars. These large offshore bars trip the subsequent deepwater wave trains. The broken waves reform again in the regeneration area and may break and reform again several times before finally rushing up the foreshore. With each successive break, energy is dissipated until sufficient material is deposited offshore to stabilize the shoreline recession taking place.

After the passage of storms, or the storm season, the majority of material deposited offshore is returned to the beach by normal swell and wave action. The remaining material transported out of the active zone (fines), or transported out of the project area by longshore currents, is replaced during periodic nourishment operations which will be conducted approximately every 5 years or as needed.


Component 3
Component 2
Dune
Beach Berm
Smaller Breaking Wave
Wave Regeneration Area
Larger breaking wave on bar
Deep Water Wave
Surge
Eroded Slope and Berm Material
M.H.W.
M.L.W.
Existing Seawall
Offshore Bar Material
Prior to Improvement
New Beach Fill Material
With Improvement

Hurricane Dune

While the gently sloping beach and the beach berm are the outer line of defense to absorb most of the wave energy and surges affecting the project coastline, the hurricane dune is the last zone of defense in absorbing the energy of the waves and surges that succeed in overtopping the beach berm. The dune provides the large reservoir of sand needed to help build the offshore bar necessary to stabilize the storm induced shoreline recession and acts as a levee to minimize or prevent flooding damages to adjacent developments.


Component 3
Dune
Wave Run Up
Broken Wave
Smaller Breaking Wave
Wave Regeneration Area
Largest breaking wave on bar
Deep Water Storm Waves
Surge
Eroded Dune, Berm and Slope Material
M.H.W.
M.L.W.
Material Deposited in Offshore Bars
Existing Seawall (Below wave run up level)
Prior to Improvement
New Beach Fill Material
With Improvement

Summary

The state of knowledge in the use of sand to protect against the onslaught of the sea has been developed to a point where dune and beach dimensions can be designed to protect against storms of any given intensity. Research has shown that the best protection is afforded by using methods as similar as possible to natural ones. A greater degree of effectiveness is obtained by the type of protection provided by nature, which permits the natural processes to continue unhampered.

Conclusion

Beach nourishment projects have evolved accompanying the affluence of man enabling 50 percent of our Nation's population to live within the coastal counties bordering the oceans and Great Lakes. The need for shore protection projects began when man entered into the narrow strip of land bordering these bodies of water, intending to remain there and participate in the battle of the land against the seas. The appropriate point in time to eliminate the need for costly shore protection projects is before development occurs. For those parts of the coast already developed, beach nourishment is the one protective measure designed to duplicate nature's own process which may protect property and enhance recreational opportunities for our people who live and work in and visit the coastal zone.