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Fact Sheet 020

Beaches are shore protection

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Almost everyone recognizes the value of a beach for recreational purposes. But how many people know that a beach is one of the best natural shore protection features a shoreline property owner can have? Beaches are, in fact, part of the first line of defense against excessive shore erosion. Let's briefly explore the nature of beaches and why they help reduce erosion along the coastline.

Beaches are temporary geologic features found where land and water meet. They are composed of an accumulation of rock fragments, ranging in size from fine sand to large boulders. Because this accumulation can be moved by ordinary wave action, beaches have a dynamic quality. They are always in motion! Movement of beach material may be parallel to land, away from land or toward land.

Berms and bars are important features of the coastline (Figure 1). The flat, above-the-water section between the bluff and the water is called the berm. It is the part of the beach we usually walk on. Sometimes, offshore and underwater, there are ridges of sand that roughly parallel the shore. These ridges are called bars. The presence of these two features affects a beach's ability to dissipate wave energy and protect against erosion.

Waves which are generated by the wind are responsible for much shoreline erosion (see Fact Sheet 019, *Lake Erie shore erosion*). The amount of energy in a wave is dependent on the speed of the wind, the wind's duration and the fetch—the unobstructed distance over the water the wind blows. The greater the speed, duration and fetch of the wind, the larger the wave that is generated. Large waves contain more energy and thus have a greater ability to erode shoreline materials than smaller waves. Steep near shore bottom slopes allow large waves to break on the beach with greater force than do shallow near shore bottom slopes.

Not only do the berm, bars and the steepness of the near shore slope affect the height of an incoming wave, their presence can affect erosion rates. Large waves will break on a near shore bar or in shallow water and dissipate a great amount of energy. Waves that do reach the shore will break on the berm of the beach and dissipate their energy before reaching the base of the bluff. But a narrow berm, a steep near shore slope and lack of bars will allow large waves to break directly against the base of the bluff. This will result in a greatly increased rate of bluff erosion. A good beach, with a wide berm, a shallow near shore slope and near shore bars will protect the shoreline by absorbing and dissipating wave energy.

Where does the material to form a beach come from? The primary source of sand and gravel for beaches in northeast Ohio comes from the erosion of shoreline bluffs. Approximately 20 percent of the material eroded from the bluffs is sand and gravel which is available for beach nourishment. The remainder is fine silt and clay which is carried out into the deeper portions of the lake. Rivers draining into Lake Erie carry appreciable amounts of fine silt and clay but very little sand.

Littoral transport

Littoral transport is the movement of material in the near shore zone by waves and currents. Littoral drift is the material that is being moved. This movement may be parallel to shore or onshore-offshore. Littoral transport is the mechanism that moves beaches.

Dr. Willard Bascom refers to the littoral transport mechanism as the "littoral conveyor belt" in his book *Waves and Beaches*. Bascom points out that Professor J. Munch-Petersen, who studied the Danish coast intensively for nearly forty years, drew the following analogy:

> *"One can get a good picture of the material movement if one looks on the waves as an excavating machine and the wave current as a conveyor belt that moves the material the machine has loosened. Each wave machine lifts the sand and impels it in a more or less oblique direction, adding it to the conveyor."*

It is the littoral transport mechanism that causes problems by removing material from where we would like to have it—on our beach—and placing it where we do not want it—in the harbor channel entrance.

Waves and the currents they generate are the primary agents of littoral transport. It is the energy of the waves that picks up the sand and moves it along. Breaking waves carry sand onshore and offshore. Most waves strike the shore at an angle and thus set up a longshore current. This moves the sand on the beach in a series of zig-zag patterns as successive waves strike the shoreline (Figure 2). Downdrift is the term that refers to the predominant direction of the littoral transport.

The general direction of littoral transport in northeast Ohio is from west to east. This is because most waves are generated by winds coming from the southwest. Storms which come from the northeast can and do move large amounts of material from east to west, but over the long term more material is carried to the east by the more constant, southwesterly generated waves. The amount of material

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moved and the distance it is moved in a single day is highly variable. Most movement of material occurs underwater and goes unnoticed. Often shore property owners notice changes in their beach only after large storms or over a long period of time.

To determine the direction of the littoral transport system along a specific beach, look at a jetty or groin perpendicular to the shore. Notice which side of the structure appears to be accumulating sand. Sand will accumulate on the updrift side of the structure—the side facing into the nearshore current, and it is removed or deficient on the downdrift side (Figure 3).

An understanding of the importance of beaches as natural shore protection and the littoral transport process is basic to understanding the lakeshore erosion problem. This understanding in turn can help coastal property owners to avoid costly mistakes in protecting their property.

FIGURE 1. An idealized beach.

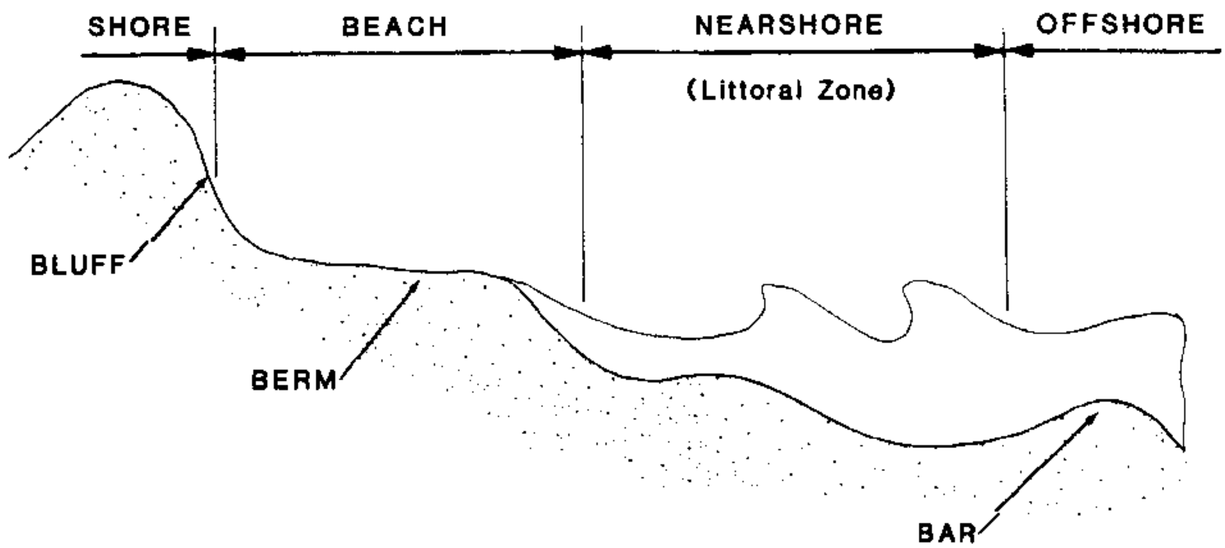


FIGURE 2. Zig-zag movement of sand responding to runup and return waves.

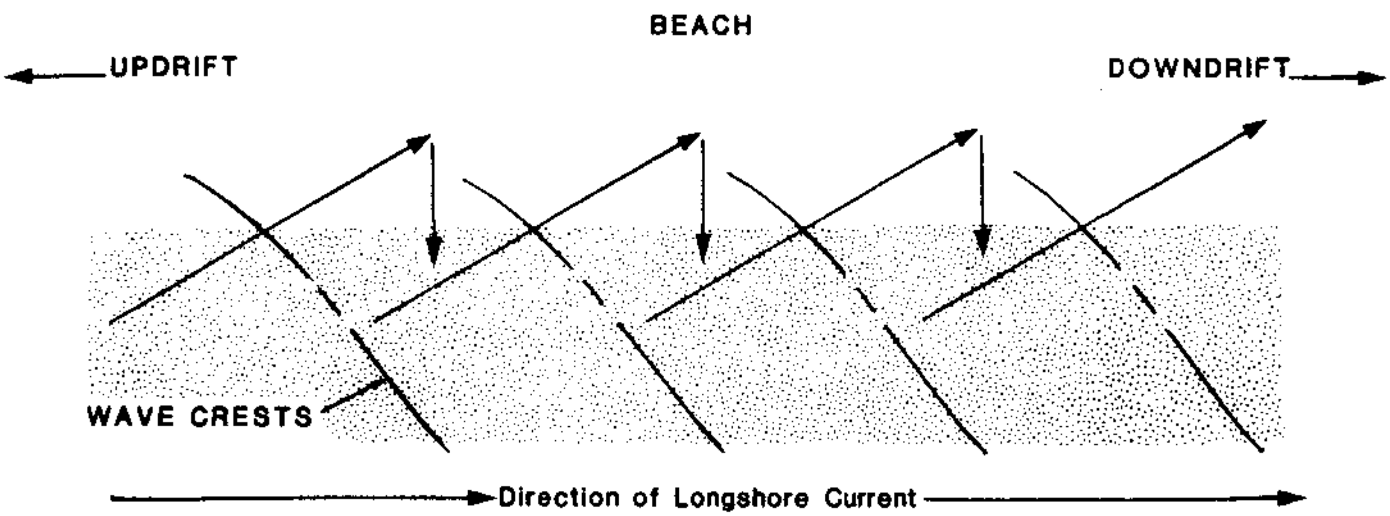
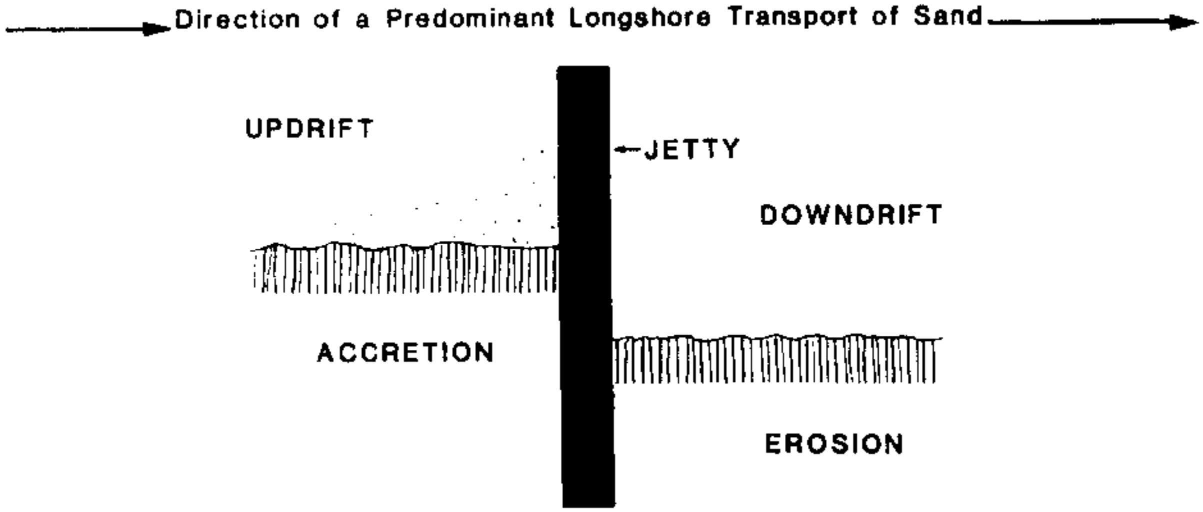


FIGURE 3. **Idealized effect of a jetty on the longshore transport of sand.**



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