A number of general designs for shore protection works have been presented. These plans should be adapted to the site by a qualified engineer. Please note we have arranged the designs by function: bank protection, beach accretion, wave height reduction, and bluff stabilization. Since this pamphlet is rather general it may not be applicable to unusual problems which may require a different solution.

After selection of a general plan of protection from the information given in this pamphlet, the next step in planning is concerned with the extent of the works. Particular reference to dimensions of the structure, anticipated alignment, and analysis of foundation conditions will be required.

Determination of the design wave height for a given location is critical to the design of any coastal structure subject to wave attack. The wave height is in part regulated by water depths over which the wave is passing. The design wave height is equal to 3/4 the depth of water 50 feet lakeward of the water's edge. The structures described in this pamphlet are located in very shallow water. As a result they are designed for relatively small waves.

Information on the height of the structure above the design water surface and its design specifications are given as a function of the anticipated offshore depth. (The specifications were developed based on wave heights for the various design water depths 50 feet offshore of the proposed structure which are shown so you do not have to actually determine the wave height.) This offshore design depth is made up of three components: The actual measured depth from existing lake level; the difference between the probable maximum lake elevation and the existing lake elevation; and an appropriate storm set-up value.

Upon determining the measured Depth 50 feet offshore the elevation of the lake surface in relation to sea level or low water datum must be determined. This can be done by contacting the Corps District Office in your area.

The District Offices can tell you the approximate elevation of the lake surface at the time you measured the depth 50 feet offshore. Then this can be related to the expected forecasted increase in level. The Great Lakes shoreline map on page 6 shows values of storm set-up for various points on the Great Lakes. Local variations of storm setup can be significant, particularly at the heads of bays. The determination of the design depth for a typical situation is illustrated in the diagram on the right.

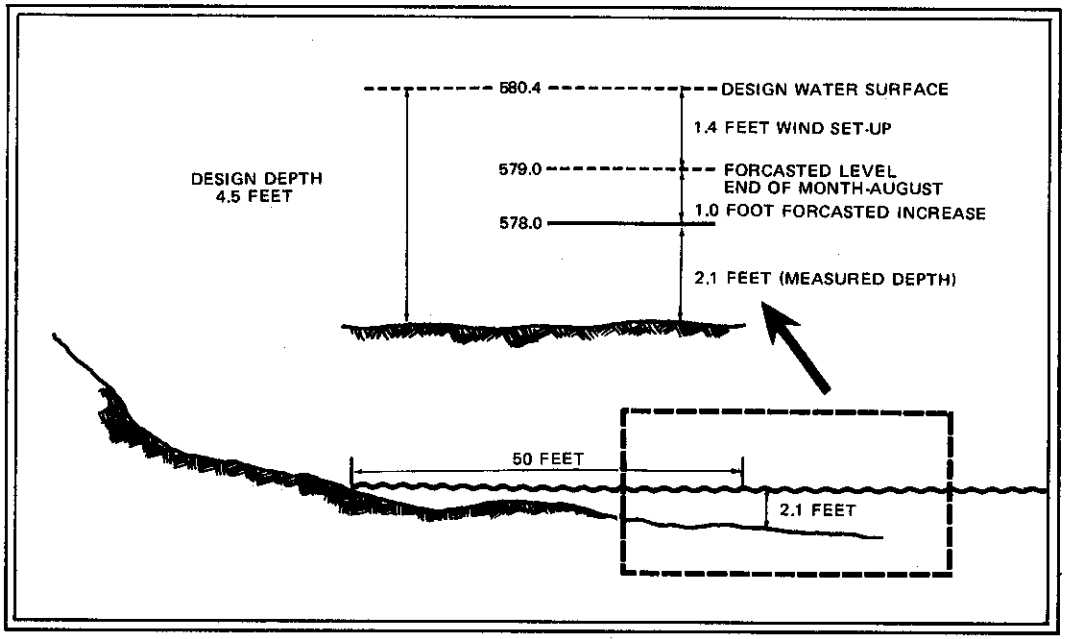
EXAMPLE OF DETERMINING DESIGN DEPTH

The measured depth 50 feet offshore near Port Huron, Michigan is 2.1 feet. Information obtained from Detroit District indicates the lake level on Lake Huron at the time you measured the depth was 578.0 feet above mean sea level. From the table on page 3 the forecasted level for the end of August can be found and is 579. From the map on page 6, the approximate wind set-up value for Lake Huron near Port Huron is found and equals 1.4 feet.

Measured Depth 50 feet offshore	= 2.1 feet
Expected increase in lake levels (579.0 - 578.0)	= 1.0 feet
Storm setup value	= 1.4 feet
Design Depth	= 4.5 feet

The general design of shore protection works and list of materials for various design depths were given in the typical general designs illustrated on pages 8 to 14. These plans show the dimensions and list of materials from a full range of offshore depths and a table of materials that can be used for the elements of shore protection structures.

Structures should also be designed and constructed in stages so that the first stage will become an integral part of more permanent protection. There is always the possibility that the works you decide to build will not function as you had intended. Supplemental construction would then become necessary. The initial works should be designed for the possibility of adding on, so that they can be incorporated into more permanent works.



Protecting the lower portion of the structure is extremely important. Toe protection should be provided to insure the integrity of the structure. This protection should extend below anticipated scour or to bedrock. This can be accomplished by protecting erodible foundation material with heavy stone.

The ends of the structure deserve careful considerations. If possible, structures should terminate at other protective works. Since this is not possible in many locations, the protective works must be returned securely into the bluff or bank. Extra materials are needed to tie into the bank.

Foundation design is another important consideration. If bulkheads are considered, subsurface investigations are needed to insure it is possible to drive the piling and to determine location of slippage planes. On the other hand, the lake bed materials may not have sufficient strength to support the protective works. A filter blanket consisting of small stones or filter cloth is needed for structures to prevent loss of fine material such as sand from beneath the structure.

The next step is the final design and layout of the protective elements. This is beyond the scope of this pamphlet and we again recommend you obtain the services of a qualified engineer; especially where the cost of the features exceed $100 per foot.