

NORTHERN MILWAUKEE COUNTY SHORELINE EROSION MANAGEMENT PLAN SUMMARY

OVERVIEW

The shoreline of northern Milwaukee County, always under wave attack, has been severely eroded by relatively high Lake Michigan water levels in the 1970's and 1980's—levels which peaked to record highs in 1986. Two factors above all characterize the condition of the shoreline:

- First, there has been a loss of private and public land owing to the limited effectiveness of those shore protection structures that are not designed for high water levels, and that often are not properly maintained.
- Second, current governmental policies and institutional mechanisms need to be improved to more effectively help lakefront property owners protect their shoreline.

In short, the shoreline is largely protected by structures installed on a piecemeal basis by property owners facing a crisis situation with few alternatives to choose from. While progress continues in protecting many shoreline properties, looming ahead are potential complex, long-term problems, including truck and heavy equipment traffic problems, increased erosion of shoreline areas updrift and downdrift of new structures, increased erosion of the offshore sediments, and the interruption of offshore sediment transport.

Responding to the need for information and for guidelines and procedures to help lakefront property owners, the local shoreline communities in the northern half of Milwaukee County retained the Southeastern Wisconsin Regional Planning Commission to conduct a shore erosion and bluff recession management study. The study was funded in part by the local communities and in part by a grant from the State. The study was carried out under the guidance of an Advisory Committee composed of representatives of the Villages of Fox Point, Shorewood, and Whitefish Bay; the City of Milwaukee; Milwaukee County; the Wisconsin Department of Natural Resources; the University of Wisconsin Sea Grant Institute; the University of Wisconsin-Milwaukee; and concerned and know-

ledgeable citizens. Assisting the Regional Planning Commission staff in the conduct of the study were consultants from the University of Wisconsin-Madison; University of Wisconsin-Milwaukee; Warzyn Engineering, Inc., Milwaukee, Wisconsin; W. F. Baird & Associates, Ltd., of Ottawa, Canada; and Johnson, Johnson & Roy, Inc., of Ann Arbor, Michigan. The 7.3-mile northern Milwaukee County study area shoreline extends from the Linnwood Avenue water treatment plant in the City of Milwaukee northward through the Villages of Shorewood, Whitefish Bay, and Fox Point to Doctors Park.

INVENTORY FINDINGS

About 80 percent of the total shoreline was being eroded by wave action in 1986, when record high lake levels were recorded. Shoreline and bluff recession rates range up to 1.6 feet per year. This recession results in the annual loss of nearly 8,000 square feet of land surface and nearly 600,000 cubic feet of shore material.

Field surveys were conducted to evaluate existing beach characteristics, assess the degree of bluff toe erosion, and determine the adequacy of existing shore protection structures. About 61 percent of the shoreline was found to be protected by revetments, groins, bulkheads, or breakwaters. A 1986 inventory of all 80 shore protection structures in the study area indicated that 76 percent of the structures were in need of substantial repair. The types of structure failure identified included overtopping, where the waves exceeded the top of, and often eroded material behind, the structure; flanking, or erosion at the sides of the structure; material failure; and undercutting. Few structures were found to be properly maintained.

Bluff characteristics and the stability of the bluff slopes were also evaluated. The bluff materials and groundwater conditions were determined by field surveys, soil borings, and electrical resistivity analyses. The bluffs are largely composed of relatively impermeable glacial tills. Sandwiched between these tills, however, are permeable lake sediments—mostly sand and silt. Groundwater

seepage within these lake sediments (which discharges from the face of the bluffs) as well as bluff toe erosion by wave action are major causes of slope failure.

Approximately 70 percent of the northern Milwaukee County bluffs exhibited a potential for bluff slope failure in 1986. The stability of the bluff slopes was evaluated by use of mathematical slope stability models. The stability analyses, which were conducted at 44 profile sites, helped quantify the risk of slope failure based on the geometry of the slope, the bluff materials, the strength characteristics of those materials, and the elevation of the groundwater. These analyses also identified those portions of the bluff that were most likely to fail, and helped identify the measures needed to stabilize the slope, such as regrading the slope, or draining groundwater.

THE RECOMMENDED PLAN

A recommended shoreline erosion management plan was prepared to provide guidance to the local communities and lakefront property owners on how to effectively protect the shoreline without adversely affecting other shoreline areas, or the coastal environment. The recommended plan, graphically summarized on Map 1, attempts both to fully stabilize the bluff slopes and to protect the shoreline from wave and ice erosion on a long-term basis. The plan seeks to identify those shore protection measures for individual sections of shoreline which would effectively abate the erosion problems; which recognize the preferences and priorities of the local communities and lakefront property owners; which are economically feasible and implementable; and which would provide—where practicable—a usable shoreline.

To stabilize the bluff slopes, the plan recommends that bluff slopes be regraded—either by filling or by cutting back the top of the bluff—along 29 percent of the shoreline. The plan recommends that groundwater drainage systems be considered for about 15 percent of the shoreline, and surface water control for about 4 percent. Revegetating the bluff slope is recommended for about 18 percent of the shoreline. Bluff slope stabilization may be expected to cost up to \$150 per lineal foot of shoreline.

Three alternative means of protecting the bluff toe from wave action were considered: riprap revetments; nourished gravel beaches; and offshore breakwaters, peninsulas, and islands.

Riprap revetments represent the lowest cost alternative, the revetments being relatively easy to construct and maintain. Revetments, however, may result in wave energy which in some areas may erode offshore sand deposits, creating steeper offshore slopes. They do not generally provide a shoreline suitable for most recreational activities. Revetments may be expected to cost from \$250 to \$350 per lineal foot of shoreline in most areas.

Nourished gravel beaches, which could be contained by rock groins extending out into the lake perpendicular to the shoreline, would provide a more usable shoreline, offering access and recreational opportunities. By resulting in less wave energy than revetments or bulkheads, beaches would cause less scouring and thereby help retain offshore sand deposits. Nourished beaches are generally more costly than revetments and would require periodic renourishment. Nourished gravel beaches may be expected to cost from \$300 to \$450 per lineal foot of shoreline.

Offshore breakwaters, peninsulas, and islands would create new public lakeshore parkland, provide protected water areas, and minimize the need for shore protection measures along the existing shoreline. When combined with onshore beach systems, offshore structures can reduce the maintenance requirements of the beaches. Offshore structures, however, have a high cost and require a large amount of material for construction. Offshore structures may be expected to cost from \$1,000 to \$2,000 per lineal foot of shoreline.

The recommended plan integrates the best components of the alternative plans considered. The plan envisions large sand beaches contained by offshore breakwaters at Atwater Park, Klode Park, and Doctors Park; about 19,000 feet of nourished gravel beaches contained by rock groins; nearly 17,000 feet of riprap revetments; and bluff slope stabilization measures. The offshore breakwaters were proposed only for public parks where sand beaches for swimming are desired. Revetments were recommended to protect existing and proposed bluff fill projects, high wave energy environments, and certain locations where revetments were already in place, or under construction. Nourished gravel beaches, which provide a usable shoreline and result in less wave energy, were recommended for essentially all remaining shoreline areas. Beaches were also recommended for some shoreline areas now protected by other structures—such as revetments or bulkheads—where

it was concluded that the beaches would have fewer harmful effects on adjacent shoreline areas or on the offshore coastal environment.

The recommended plan would entail a capital cost of about \$17.8 million, and an annual maintenance cost of about \$1.2 million in 1988 dollars. About 28 percent of the total cost would be financed by the public sector to protect public shoreline property, while the remaining 72 percent of the total cost would be financed by private property owners.

The scope of the recommended plan extends beyond the selection of individual shore protection measures. Coastal processes and the anticipated impacts of the various types of shore protection measures were thoroughly investigated. The plan recognizes that environmental trade-offs must at times be made—particularly when shore protection is not undertaken until a severe erosion problem has developed and real property is threatened. The plan attempts to minimize these environmental trade-offs, as well as potential adverse impacts on adjacent shoreline areas, by trying to foresee problems and by carefully selecting those protection measures which are needed and most appropriate for different coastal environments within the study area. The plan also seeks to ensure that the recommended measures would not have long-term harmful effects on the overall coastal environment—including the offshore bathymetry, sediments, and ecosystem.

PLAN IMPLEMENTATION

The recommended plan must be implemented within entire portions of shoreline, referred to as implementation segments. Eighteen implementation segments, each containing from one to 44 property owners, were identified, as also shown on Map 1. The provision of nine proposed permanent access areas would help centralize and thereby reduce the areawide impacts—including traffic problems—of the movement of trucks and heavy equipment during construction and maintenance operations.

Several alternative methods of implementing the plan were considered: having Milwaukee County coordinate the implementation activities, creating a new lakeshore management district, and placing primary responsibility for implementing the plan with the municipalities.

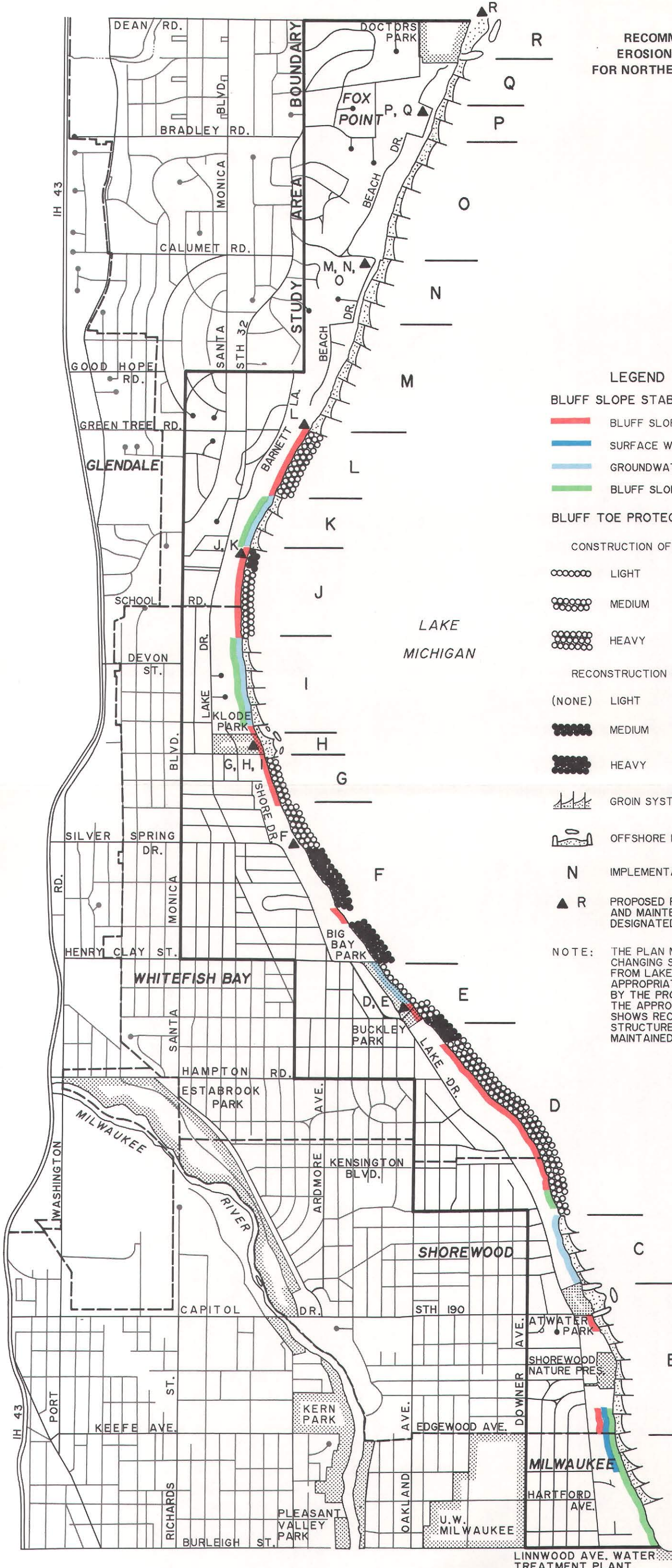
The cooperation, coordination, and local support needed to successfully implement projects within entire implementation segments can best be provided by the four municipalities concerned: the City of Milwaukee and the Villages of Fox Point, Shorewood, and Whitefish Bay. Thus, it is recommended that the municipalities assume primary responsibility for carrying out the plan.

To enhance the efficiency and coordination of the functions needed to carry out the plan, it is recommended that, once the municipalities formally adopt the plan, they jointly form a cooperative contract commission under the provisions of Section 66.30 of the Wisconsin Statutes. Such a commission could efficiently promote plan implementation, although it could not levy taxes or special assessments and could not condemn property without the approval of the individual municipalities concerned. Examples of commissions created under Section 66.30 include the North Shore Water Commission and the North Shore Library Cooperative.

The specific duties to be carried out by the proposed commission would have to be agreed upon by the local elected officials concerned. These duties could include compiling and distributing information on shoreline erosion; reviewing and issuing permits formerly issued by Milwaukee County and the U. S. Army Corps of Engineers; administering shore protection projects; entering into contracts to construct and maintain shore protection structures; and monitoring compliance with the plan. Individual municipal ordinances would remain in effect with respect to zoning, and the regulation of filling, hauling, and other construction activities.

The process for obtaining permits to construct new shore protection measures would be simplified and designed to maximize local control. Under the plan recommendations, permits would no longer be required from Milwaukee County, and permits from the U. S. Army Corps of Engineers and the Wisconsin Department of Natural Resources would be routinely granted for projects in conformance with the plan once these agencies act to approve the plan. Permits for new work may be required only from the newly created commission and the local municipality concerned, thereby assuring both local control and compliance with the recommended plan. The successful implementation of the plan, which requires a stable, long-range commitment to the plan, would provide a high-quality, well-managed coastal environment for northern Milwaukee County.

RECOMMENDED SHORELINE
EROSION MANAGEMENT PLAN
FOR NORTHERN MILWAUKEE COUNTY



LEGEND

BLUFF SLOPE STABILIZATION PLAN ELEMENT

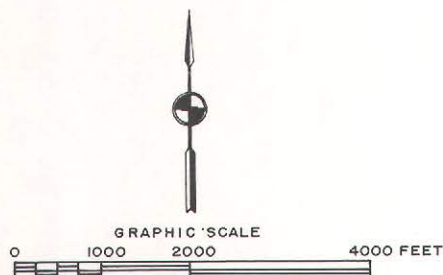
- BLUFF SLOPE REGRADING
- SURFACE WATER RUNOFF CONTROL
- GROUNDWATER DRAINAGE
- BLUFF SLOPE REVEGETATION

BLUFF TOE PROTECTION PLAN ELEMENT

- CONSTRUCTION OF A NEW REVETMENT
 - LIGHT
 - MEDIUM
 - HEAVY
- RECONSTRUCTION OF EXISTING REVETMENT
 - (NONE) LIGHT
 - MEDIUM
 - HEAVY
- GROIN SYSTEM WITH NOURISHED GRAVEL BEACH
- OFFSHORE BREAKWATERS WITH NOURISHED SAND BEACH

- N IMPLEMENTATION SEGMENTS
- ▲ R PROPOSED PERMANENT ACCESS SITES FOR CONSTRUCTION AND MAINTENANCE OF SHORE PROTECTION MEASURES IN DESIGNATED IMPLEMENTATION SEGMENTS

NOTE: THE PLAN MAY BE REVISED OVER TIME TO REFLECT CHANGING SHORELINE CONDITIONS. UPON A REQUEST FROM LAKEFRONT PROPERTY OWNERS AND THE SUBMITTAL OF APPROPRIATE INFORMATION, THE PLAN COULD BE AMENDED BY THE PROPOSED COOPERATIVE CONTRACT COMMISSION WITH THE APPROVAL OF THE MUNICIPALITIES. THIS MAP SHOWS RECOMMENDED FUTURE SHORE PROTECTION STRUCTURES; EXISTING STRUCTURES MAY CONTINUE TO BE MAINTAINED.



This map prepared by the Southeastern Wisconsin Regional Planning Commission; P. O. Box 1607; Waukesha, Wisconsin 53187-1607 Telephone number (414) 547-6721

LINNWOOD AVE. WATER TREATMENT PLANT ▲ A, B, C

QUESTIONS AND ANSWERS ABOUT THE NORTHERN MILWAUKEE COUNTY SHORELINE EROSION MANAGEMENT PLAN

1. Q. WHAT PROMPTED THE STUDY?

A. In the early 1980's, local citizens expressed significant concern about the current piecemeal approach to shore protection. These concerns, which included the type and design of shore protection measures installed, the construction and maintenance of these measures, the appearance of the measures, impacts on adjacent shoreline areas, disturbance by truck and heavy equipment operators, and the control and management of these projects by the units of government involved, were raised publicly at hearings and meetings held to discuss certain shore protection projects initiated in the early 1980's. In response to these citizen concerns, the local units of government formed a committee to discuss the problem. In 1984, the shoreline communities of the northern half of Milwaukee County subsequently retained the Regional Planning Commission to undertake a study of the problems and the best means of their resolution.

2. Q. WHO CONDUCTED THE STUDY?

A. The study was primarily conducted by the staff of the Regional Planning Commission, with assistance from consultants, under the guidance of an advisory committee. The advisory committee consisted of representatives of the Villages of Fox Point, Shorewood, and Whitefish Bay, the City of Milwaukee, Milwaukee County, the Wisconsin Department of Natural Resources, the University of Wisconsin Sea Grant Institute, the University of Wisconsin-Milwaukee, and concerned citizens.

3. Q. WHAT ARE THE RESULTS OF THE STUDY?

A. The results of the study are summarized in the accompanying overview and map. Key questions and answers about the study results follow.

4. Q. WOULD RECENTLY COMPLETED WORK BE REDONE UNDER THE PLAN?

A. No additional work would be undertaken until a majority of the property owners within a proposed project area agreed that protection was desirable. Additional shore protection measures are recommended in some areas where the existing shore protection measures provide an inadequate level of protection against wave action, or where existing measures have an adverse impact on adjacent shoreline areas or on the offshore coastal environment.

5. Q. WHY ARE NOURISHED GRAVEL BEACHES RECOMMENDED FOR SOME SHORELINE AREAS NOW PROTECTED BY OTHER TYPES OF STRUCTURES?

A. In the long term, the beaches should provide a more desirable shoreline for the property owners. The nourished gravel beaches reduce wave reflection, thereby preventing steepening of the offshore slopes and the associated increased wave damage potential. To a limited extent, the beaches feed the offshore sediment transport system, thereby reducing adverse impacts on the near-shore environment.

6. Q. HOW FLEXIBLE IS THE PLAN?

A. The plan is flexible in terms of both how and when projects would proceed. Projects would be undertaken only upon an appropriate petition of a majority of the property owners within a proposed project area, or implementation segment. Upon request and the submittal of appropriate information, the implementing agencies—your municipality and the cooperative contract commission jointly formed by the communities of the northern half of Milwaukee County—could amend the plan recommendations as the need arises.

7. Q. DO PRIVATE PROPERTY OWNERS GIVE UP THEIR RIPARIAN RIGHTS BY IMPLEMENTING THE PLAN?

A. No. All existing private property would remain in private ownership. Any new beaches created above the ordinary high water marks become the property of the riparian property owners, for their exclusive use.

8. Q. COULD PRIVATE PROPERTY OWNERS BE REQUIRED TO COMPLY WITH THE PLAN?

A. If an appropriate petition is submitted by the majority of the property owners in a project area and approved, a property owner may be required to comply with the plan. Upon a request from a majority of the property owners within a project area, your municipality may use its special assessment authority to assist in financing shore protection projects at favorable interest rates.

9. Q. HOW WOULD THE PLAN SIMPLIFY THE PERMIT PROCESS?

A. Under existing conditions, permits for shore protection projects are issued by the U. S. Army Corps of Engineers, the Wisconsin Department of Natural Resources, Milwaukee County, and the municipalities. Under the recommended plan, your municipality would continue to issue permits for filling and hauling. The cooperative contract commission created by the municipalities would likely also issue permits for shore protection structures formerly issued by Milwaukee County and the U. S. Army Corps of Engineers. Milwaukee County would no longer issue permits for shore protection projects.

10. Q. WHO WILL PAY FOR THE IMPLEMENTATION OF THE PLAN ON PRIVATE PROPERTY?

A. Lakefront property owners would continue to pay for shore protection measures for their property. The municipalities may assist the property owners in distributing the costs over time by financing the projects and then levying taxes or special assessments to the benefiting parties.

**ADVISORY COMMITTEE FOR THE NORTHERN MILWAUKEE COUNTY
SHORELINE EROSION MANAGEMENT STUDY**

- Lucia Petrie, Chairman Trustee, Village of Shorewood
- Michael C. Harrigan, Vice-Chairman Village Manager, Village of Whitefish Bay
- Kurt W. Bauer, Secretary Executive Director, Southeastern
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