COPY

SAND BEACH CONSERVANCY DISTRICT

OTTAWA COUNTY, OHIO

REPORT ON BEACH EROSION

AND

ANALYSIS OF PROTECTIVE MEASURES

MAY 25, 1982

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SAND BEACH CONSERVANCY DISTRICT

OTTAWA COUNTY, OHIO

INTRODUCTION

The Sand Beach Conservancy District is located on Lake Erie in Ottawa County, Ohio, about 1 mile north of State Route 2. It is about 14 miles west of Port Clinton and 20 miles east of Toledo. The boundaries of the Conservancy District include the cooling tower for the Davis-Besse Nuclear Power Station.

Sand Beach has a history of being an excellent recreational area with a good beach. In 1957, the area had about 85 residential structures and a beach about 100 feet wide. The number of residential structures increased to 120 in 1968, and the beach increased in width to about 125 feet.

During the late fall of 1972 and spring of 1973, several violent storms occurred resulting in considerable damage to the area. Several homes sustained structural damage and the beach decreased to about 60 feet. Since 1973, Lake Erie has averaged 1 to 2 feet above its previous level. In addition, several storms have combined with the high lake level to cause additional damage to both the structures and the beach. In 1982, there are about 100 residential structures and the beach has receded to almost zero width throughout the area.

The purpose of this study is to analyze the physical forces exerted on Sand Beach and develop some type of corrective measures that will protect the beach and structures. In addition, the study will analyze possible funding methods for the construction of any improvements.

SUMMARY

(To be added later.)

LAKE ERIE CONDITIONS

The water level of Lake Erie can vary significantly. These changes are caused by a combination of wind direction and speed, and average lake level. The lowest recorded lake level at the Toledo monitoring station was 562.92 feet on January 2, 1941, while the highest level was 578.13 feet on April 14, 1980, for a difference of 15.21 feet. At the Marblehead station, the range is from 565.99 on November 21, 1964 to 576.68 on April 8, 1974. It should be noted that all elevations shown are based on USGS datum.

Average Toledo lake levels have varied from an annual low of 569.74 in 1935 to a high of 574.11 in 1973, and at Marblehead, from 570.37 in 1968 to 574.15 in 1974. It has generally been observed that the lake experiences an 11-year cycle, where a period of high lake level is followed by a period of low lake level. This, however, has not been true during the past 10 years. The average Toledo lake level from 1920 to 1972 was 571.50 feet; while from 1972 to 1982, the average was 573.34. Thus, the lake has been about 2 feet higher during the past 10 years than in previous years.

This high lake level has resulted in higher peaks caused by storms. Prior to November 1972, the maximum lake level at Toledo was 577.09 on April 27, 1966. Since November 1972, there have been at least 6 storm events, with a maximum level above 577.09. The frequency of these storms has resulted in severe erosion along the entire Lake Erie coast.

OTHER SHORE CONTROL PROJECTS

There are currently two similar beach restoration projects in progress along the western Lake Erie shore. The first is restoration of the beach at East Harbor State Park, and the second is construction of the new Maumee Bay State Park. A brief description of each follows:

East Harbor State Park

East Harbor has approximately 1,200 feet of shoreline between the existing East Harbor breakwater and the unfinished West Harbor breakwater. In 1966, when the lake level was about 570, the beach area was 150 feet wide. However, the current high water levels have covered the beach and exposed the beach berm to wear action and serious erosion. A sea wall constructed along the beach berm in the 1950's is being undermined and damaged due to erosion of the berm from the waves.

The project is being undertaken to analyze and construct off-shore breakwaters as a means of mitigating the erosion problems. The study recommended that a series of four breakwaters be constructed immediately to protect the beach. The breakwaters would be about 600 feet off-shore, 150 feet long, and 300 to 400 feet apart, and top elevation would be 576.7. In addition, sand fill will be provided to nourish the existing beach. It is believed that the breakwaters will restrict the sand to the immediate beach area. Ultimately, breakwaters will be constructed along the entire shoreline of the State park.

The initial cost of this project is about $1,500,000; while final overall costs are estimated at $7,750,000. The costs are summarized as follows:

	Initial	Ultimate	Total
Breakwater	$ 520,900	$ 2,192,500	$ 2,713,400
Beach Nourishment	960,000	4,081,300	5,041,300
Total	$ 1,480,900	$ 6,273,800	$ 7,754,700

Maumee Bay State Park

The Ohio Department of Natural Resources is proceeding to develop a 1,855-acre, multi-use recreational complex at Maumee Bay State Park. Erosion of the shoreline fronting the park is the major water resources problem at this site. Therefore, the Ohio Department of Natural Resources and the Corps of Engineers evaluated various control measures to protect the shore.

The following alternatives were evaluated:

1. No Action
2. Protective Beach and Revetment
3. Protective Beach with Detached Breakwaters and Revetment
4. Protective Beach with Groin Field and Revetment

The report concluded that a modification of Alternative No. 3 be pursued. This alternative consists of 8 off-shore breakwaters, 3 jetties, 5,500 feet of protective sand beach, and 6,200 feet of revetment for the wildlife area. The costs are summarized below, while Figures 1, 2, and 3 show details of the plan.

General Site Work	$ 876,800
Beach Fill	2,247,500
Jetties and Revetment	6,698,000
Total	$ 9,822,300

Tests are currently being made to determine if the off-shore sand losses are minimal. Should the losses be minimal, it may be possible to eliminate the off-shore breakwaters and construct an unprotected sand beach.

ANALYSIS OF SAND BEACH

Literature Review

A literature review was conducted in an attempt to develop baseline data for the beach. In addition, Ohio Department of Natural Resources and Corps of Engineers personnel were contacted to obtain additional background data.

Literature reviewed included reports for the two beach projects (Maumee Bay and East Harbor State Parks), the Environment Impact Statement from Davis-Besse, and several Ohio Department of Natural Resources' reports for western Lake Erie. All literature indicated that the entire western Lake Erie shoreline is eroding, with the sand beaches eroding at a more rapid rate. In an unpublished report discussing the Ottawa County shorelines obtained from the Ohio Department of Natural Resources, Dr. Joe Benson stated:

> "erosion is most critical in the highly developed area between range 3 and range 6 (Sand Beach) because of the proximity of homes to the shorelines. Though this area is well protected structurally, these structures have been largely inadequate and past recession has placed the shoreline at or near many of the houses.
>
> The situation is particularly acute east of Brough Creek, where development has occurred on the barrier beach. In 1973, the barrier was less than 100 feet wide in places, and many of the homes present extended lakeward of the natural shoreline. Because of the highly transitory nature of this shore type, future prediction is difficult. Assuming future conditions will be similar to those of the past 34 years, it is felt that up to 50 feet of shoreline recession will occur by the year 2010. This recession will be accompanied by the destruction of most of the present development."

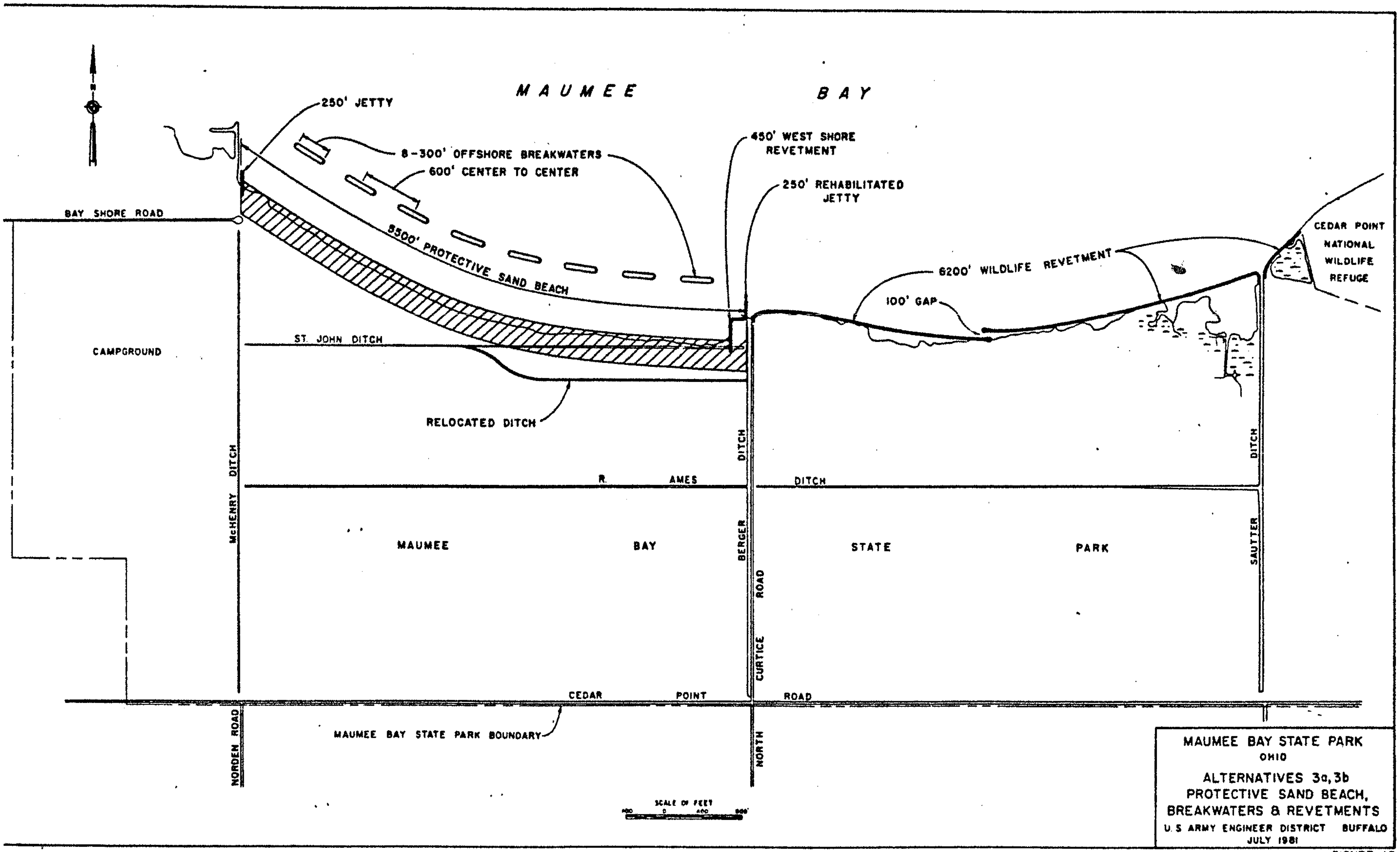
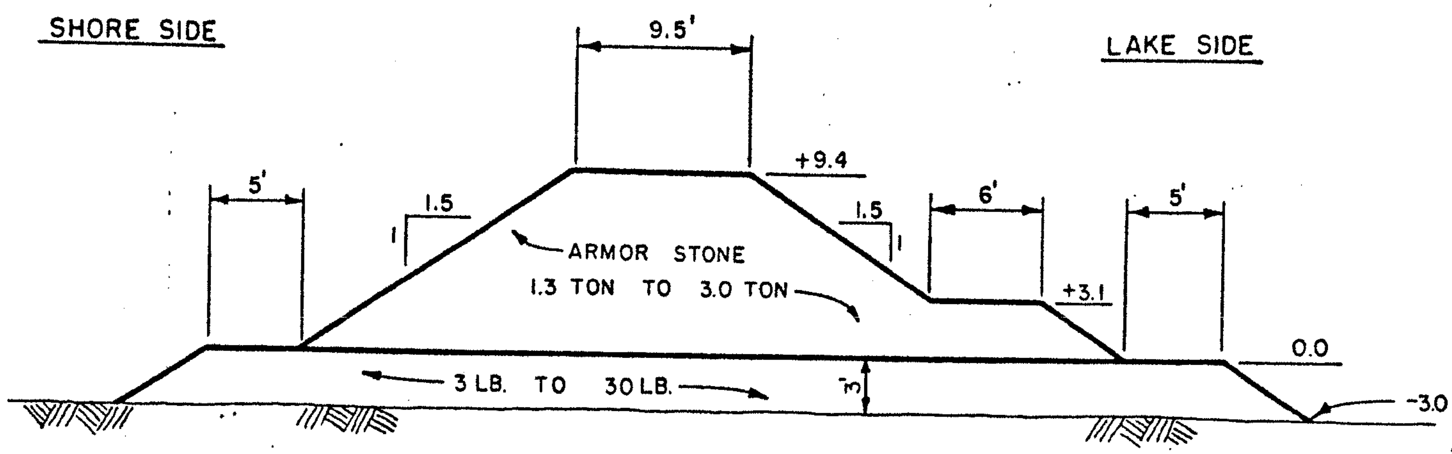


FIGURE 16

FIGURE 1

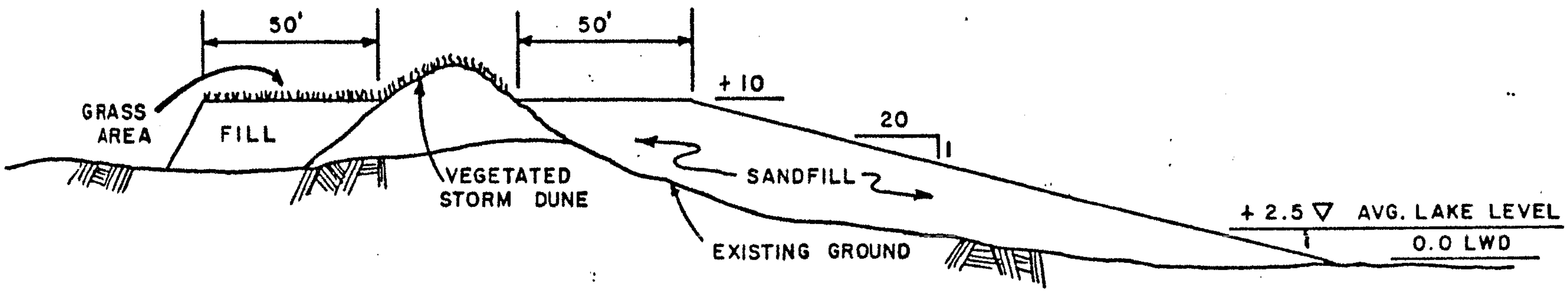


TYPICAL OFFSHORE BREAKWATER CROSS SECTION

SCALE 1" = 10'

MAUMEE BAY STATE PARK, OHIO
TYPICAL OFFSHORE
BREAKWATER SECTION
U.S. ARMY ENGINEER DISTRICT BUFFALO
JULY 1981

FIGURE 2



TYPICAL SAND AND TURF SECTION—ALTERNATIVE 3b

SCALE HORIZ. 1" = 50'
VERT. 1" = 10'

FIGURE 3

MAUMEE BAY STATE PARK, OHIO
ALTERNATIVE 3b
TYPICAL SAND AND TURF BEACH SECTION
U.S. ARMY ENGINEER DISTRICT BUFFALO
JULY 1981

FIGURE 19

This same report summarized beach width for five different years. This data is presented below:

Year	No Beach	Narrow (less than 50 ft)	Medium (50 to 100 ft)
1877	10%	54%	36%
1939	2%	62%	36%
1957	0%	79%	21%
1968	0%	53%	47%
1973	31%	69%	0%

An analysis of the elevation of Lake Erie shows the dramatic effect water elevation has on the beach.

Period	Annual Average	Average of Yearly Peaks
1920-39	571.00	--
1939-57	571.56	575.51
1957-68	571.33	575.25
1968-73	573.10	576.45
1973-Present	573.24	576.95

The data shows that up to 1968, the lake elevaton at Toledo averages about 571.29, with peaks of about 575.5 or less. During this time, the beach grew significantly. Since 1968, the elevation has averaged 573.24, and peaks exceed 576.5. This higher water level has eroded the beach to a dangerously small width.

Sand Transport

Theoretical calculations were made in an attempt to define the physical forces acting on the beach. The calculations were based on the Corps of Engineers Shore Protection Manual. The littoral process can be divided into two general classes; transport parallel to the shore (longshore transport), and transport perpendicular to the shore (onshore-offshore transport). An analysis of each class has been developed in an attempt to define what has happened to the beach.

Longshore Transport

An analysis of longshore transport was developed for five different locations along the shoreline from Camp Perry to Long Beach. This analysis indicated that transport energy southeast of Toussaint River is to the southeast, and transport energy northwest of the River is to the northwest. This tends to indicate that there is a point of zero longshore transport energy near the mouth of Toussaint River.

This fact appears to be constant with actual physical features. Located near the River's mouth are numerous sand deposits that have developed over the years. The sand is not transported due to the fact that this is a zero energy point. Transport along Sand Beach, Long Beach, and Locust Beach is known to be to the west. No physical data could be developed for the beaches along Camp Perry.

The total volume of sand transport cannot be determined due to the lack of historical data. Additional information on the quantity of sand available is necessary to determine the volume.

The groins constructed along the beach have aided in retaining the sand. However, this groin system has stopped most longshore transport and depleted down-drift areas. It appears, however, that the total volume of longshore transport is not extremely great, and this trapping has not created too significant a problem.

Onshore-Offshore Transport

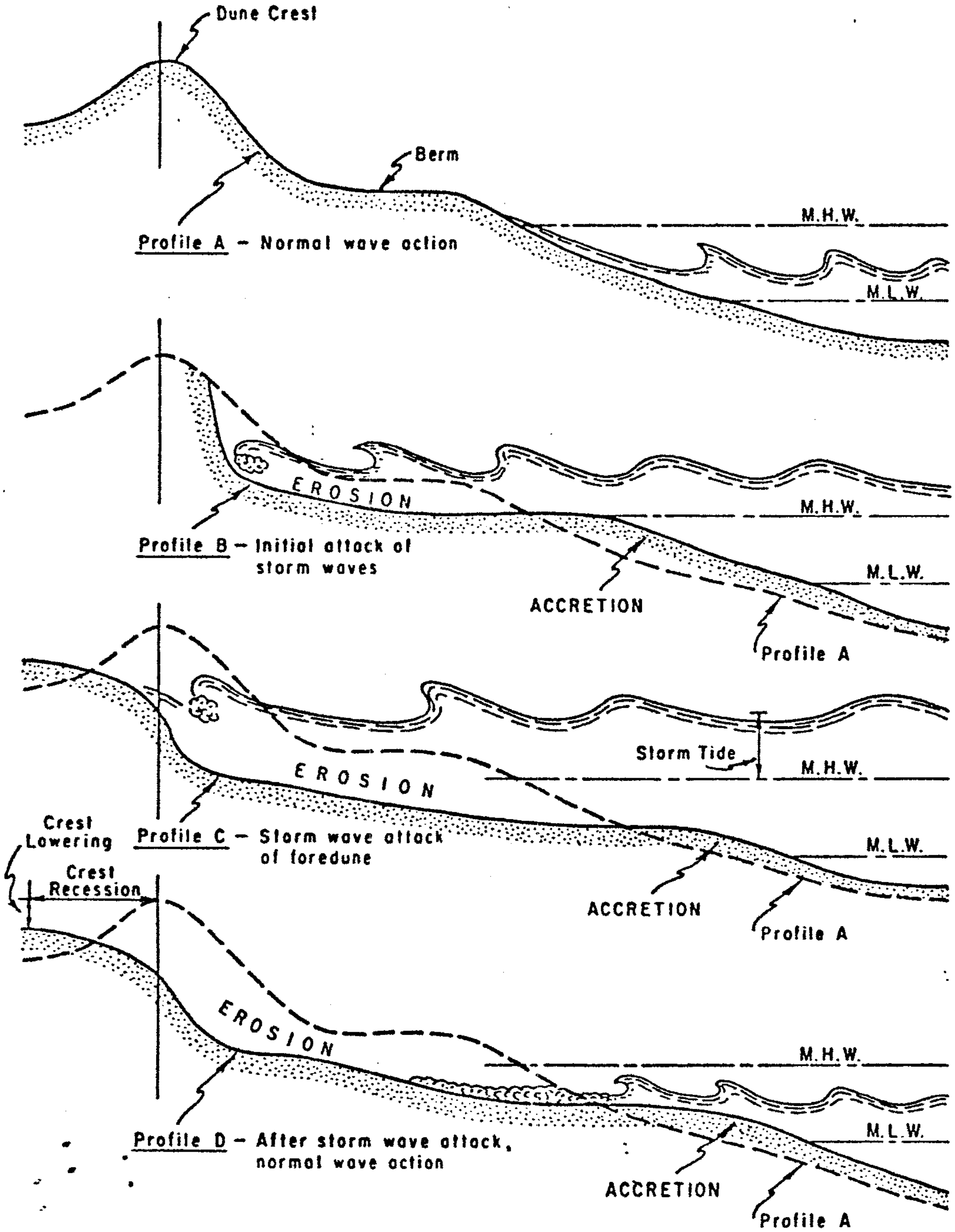
Onshore-offshore transport causes significant beach changes. This is most notable during storms. The part of the beach washed by runup and runback is called the beach face. During normal conditions, the beach face is contained within the foreshore; but during storms, the beach face is moved shoreward by the cutting action of the waves. The waves during a storm are steeper, and the runback of each wave on the beach face carries away more sand than is brought to the beach by the runup of the next wave. Thus, the beach migrates landward, cutting into the berm, as shown in Figure 4.

In moderate storms, the storm surge and accompanying steep waves will subside before the berm has been significantly eroded. In severe storms, or after a series of moderate storms, the backshore may be completely eroded; after which the waves will begin to erode the coastal dune or mainland behind the beach.

Beach recovery occurs through the onshore-offshore processes as follows. The sand is transported landward over the nearly flat, seaward face of sand bars by waves. At the bar crest, the sand fall down the landward face. If this process continues long enough, the bar reaches the landward limit of storm erosion where it is welded into the beach. Further accretion continues by adding layers of sand to the top of the bar which, by then, is part of the beach. This is shown in Figure 5.

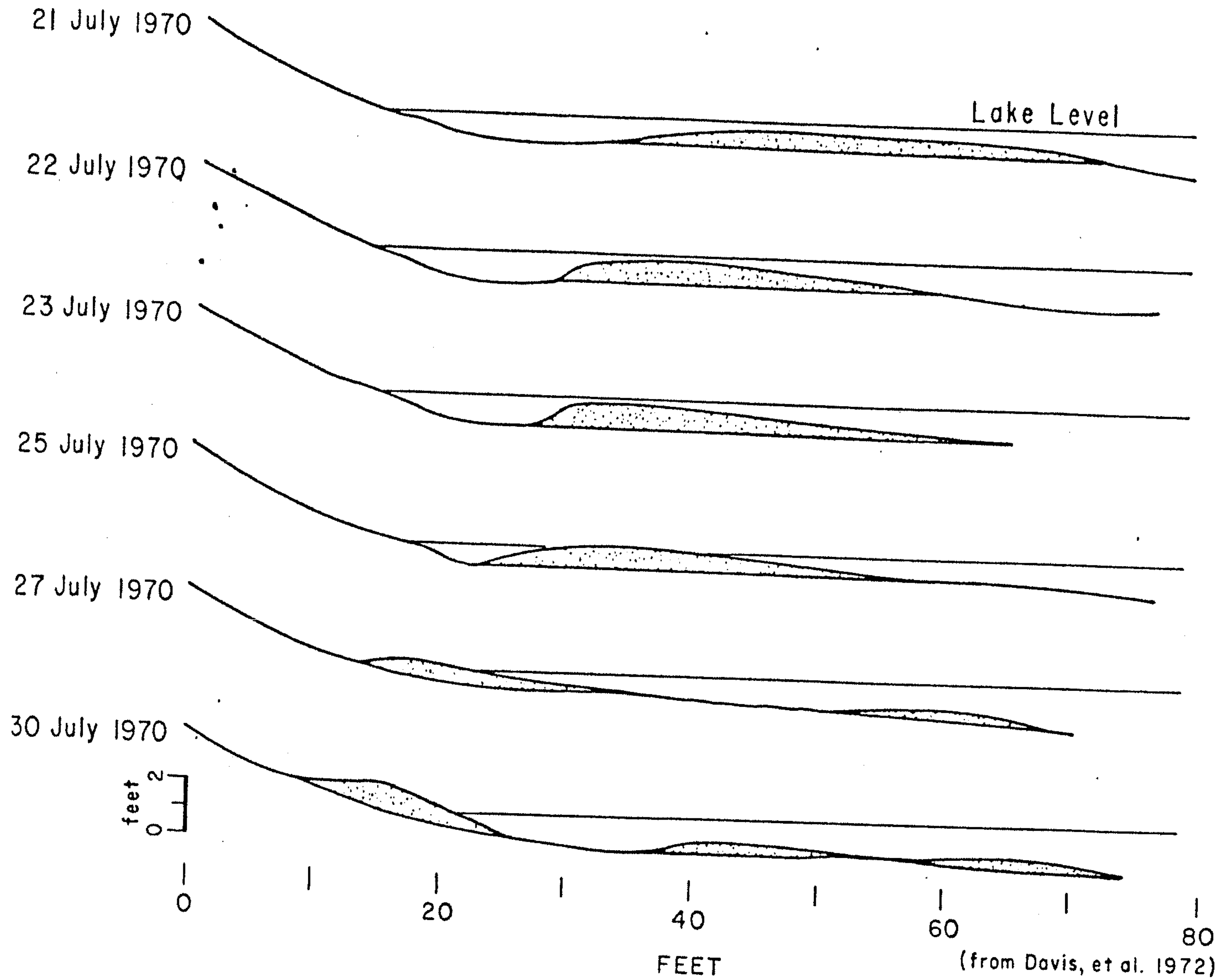
The onshore-offshore transport energy was calculated for the Sand each area. The data indicates that the recent (past 10 years) severe storms have had a significant offshore energy flux. This fact, combined with the high water level and the frequent occurrence of storms, has resulted in recession of the beach. It is thought that a substantial volume of material is located off-shore in the sand bars.

The lack of a substantial beach face and dune (as shown in Figure 4) has also contributed to the problem. As storm waves deplete the beach front, there is no additional beach to dissipate energy. This fact results in waves attacking structures located on the beach. Waves break on the structures causing considerable damage. Also, waves pass through open areas between structures and cause considerable erosion. Because of the irregular feature of the shoreline, the sand transported off shore may not be easily replaced by natural forces, as indicated in Figure 5.



Schematic Diagram of Storm Wave Attack on Beach and Dune

FIGURE 4



Rapid Accretion of Ridge-and-Runnel - Lake Michigan
(Holland, Michigan)

FIGURE 5

An additional factor, not associated with wave action and transport, is the carry-through of sand. The Sand Beach area is extremely flat, with an average elevation of about 576. During storm events when the lake level is at, or above, 576, the sand can be carried off the beach due to the absence of any high structures. In addition, wind erosion can be severe due to flat nature of the area and the absence of any vegetation to hold and/or stop the wind-carried sand. These types of erosion can cause considerable damage to the beach. The sand material will likely be deposited in the marsh behind the development.

DEVELOPMENT OF PROTECTIVE MEASURES

Introduction

The various protective measures available for beaches are summarized below:

Seawalls, Bulkheads, and Revetments

These structures are built at the berm of the beach to prevent additional erosion. Seawalls are the most massive because they resist the full forces of waves. Bulkheads are next and their function is to retain fill. Revetments are the lightest because they are designed to protect shorelines against erosion by currents or light wave actions.

These structures afford protection only to the land immediately behind them. When built on a receding shoreline, the recession will continue and may be accelerated on ajacent shores. Any tendency toward loss of beach material in front of such a structure will be intensified.

Protective Beaches

Protective beaches can be used to dissipate wave energy and protect upland structures. Beach material is deposited along the shore and increases the beach width and height. This process also helps in maintaining a sufficient volume of sand for the transport process.

Material is normally obtained near the site. The optimum location is directly off shore, since the material will likely be the same type of material that is normally found on the beach.

Sand Dunes

Sand dunes bar the movement of storm tides and waves into the area behind the beach. Dunes prevent the flooding of the inland area, are a second line defense against erosion, and can be used as a stockpile to feed the beach. Vegetation must be established on the dunes to stabilize the sand that might be eroded by wind. Dunes can provide protection more effectively at a lower cost than a sea wall.

Groins

Groins are structures extending from a point on land into the water. The purpose of groins is to protect or maintain a protective or recreational beach. This is normally accomplished by trapping the littoral drift, or sabilizing a beach subject to excessive storms.

Groins act as partial dunes that interupts a part of the normal longshore transport. As material accummulates on the updrift side, supply to the downdrift shore is reduced and the downdrift shore recedes.

Breakwaters

Breakwaters are structures designed to protect an area from wave action. Breakwaters are normally constructed of rubble material and are positioned in water significantly deeper than the seaward ends of groins. A breakwater causes littoral drift to deposit on the shore in its lee by dissipating the wave forces that cause littoral transport.

Costs

An initial analysis of protective measures was made for the Sand Beach area. This analysis developed costs for a protective beach with dunes and for off-shore breakwaters. A description of each follows.

Protective Beach

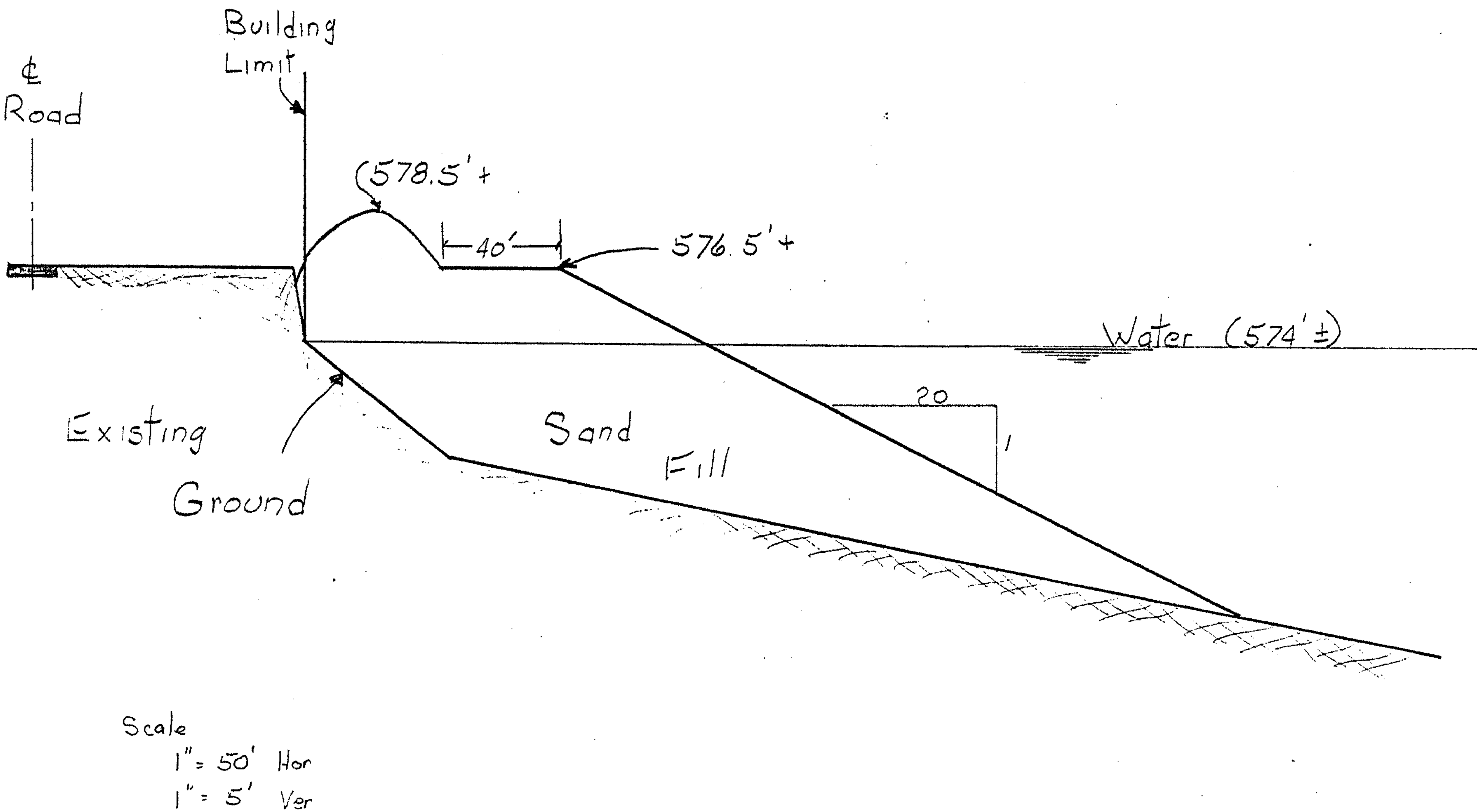
A protective beach with dune was developed for the shore from First Street to Ninth Street. The beach would be similar to that proposed for Maumee Bay State Park. Figure 6 shows the layout.

A total of approximately 100,000 cubic yards of sand are needed for the protective beach, and 20,000 cubic yards are needed for the dune. At an estimated cost of $3.75 per cubic yard, this system will cost about $450,000. This assumes off-shore dredging can be accomplished. If material must be pumped farther, the cost will be significantly higher.

A significant problem with this system is the location of homes on the beach. Since the homes do not form a straight line along the beach, it is estimated that an additional 10,000 cubic yards of fill will be needed behind the dune.

This system has a significant negative environmental factor in that the top of the dune will be at about elevation 578. Many of the homes have first floors at an elevation of 576 to 577. Therefore, on the shore side of the homes, there will be the dune with the crest 1 to 2 feet higher than the floors.

Not included in the above costs are additional groins. Should this alternative be further investigated, several groins will need to be replaced or extended to contain the beach within certain limits. In addition, off-shore breakwaters may be needed if the off-shore transport is creating erosion problems.



Protective Beach

Figure 6

Off-shore Breakwaters

A series of 15 off-shore breakwaters each 150 ft. wide and spaced about 400 ft. apart were estimated. The estimate was based on the East Harbor project.

This system would minimize any future damage, but would not necessarily improve the existing beach. If the beach is to be restored, beach nourishment similar to that described in the previous section is required.

Each of the breakwaters is estimated to cost $125,000, for a total project cost of $1,875,000. If beach nourishment is included, the project will cost about $2,100,000.

Financing

Discussions with ODNR indicated that there is little hope for State funds. ODNR did indicate that there is a funding program for this type of project; however, it is directed toward public places.

The officials stated that while the Conservancy is a public agency, most of the work will be done on private land. Therefore, the possibility for funding is not bright.

ODNR
Ohio Department of Natural Resources
DIVISION OF GEOLOGICAL SURVEY
Lake Erie Section, P.O. Box 650 · Sandusky, Ohio 44870 · (419) 626-4296

January 29, 1982

Mr. John H. Stratman, P.E.
Jones & Henry Engineers, Limited
2000 West Central Avenue
Toledo, Ohio 43606

Dear John:

Enclosed are the pages of the Ottawa County Report I said I would send you. If you do use the material in your report, the following reference would be ok to use:

> Benson, D.J., _____, Unedited manuscript for Ottawa County: Ohio Department of Natural Resources, Division of Geological Survey.

As an afterthought you might want to contact Joe Benson, the author of the report to get his opinion of the Sand Beach area. His address and telephone number are:

> Joe Benson Ph. 1-205-348-5095
> Department of Geology and Geography
> P.O. Box 1945
> University of Alabama
> University, Alabama 35486

If we can be of any further assistance, please contact us.

Sincerely yours,

Charles Carter

Charles H. Carter

CC:mm

1 Enclosure: Ottawa Co. draft pages

Most of the reach has ~~shown~~ a long-term history of recession at ~~from~~ slow to rapid rates. In general, long-term rates indicate recession has been largely natural and unaffected by man. Structures, however, have had a localized effect on recession. Jetties at the mouths of Turtle Creek and Brough Creek in particular, have had a significant impact on recession. While recession rates have been visibly reduced updrift (east) of these structures, beach loss downdrift (Table ~~12~~ 10) has been accompanied by an increase in recession. At the same time the many smaller structures in the area between Turtle Creek and range 6 have had a positive effect in this area by reducing recession rates, but have reduced littoral drift to the west at the expense of the barrier-beach system west of Turtle Creek.

~~E~~ROSION FORECAST - 2010 A.D.

The reach 1 shore~~line~~ has shown a general history of recession over the period of record, and it seems unlikely that this trend will be reversed in the future.

The nature of the barrier beach and sand-covered glaciolacustrine clay-plain shoretypes ~~of reach 1~~ makes the distribution of nearshore sand crucial to stability of the shore~~line.~~ The relatively minor littoral drift in the area further complicates the situation.

Numerous perpendicular structures, such as groins and jetties between Turtle Creek and range 6, have impounded much of the littoral drift. This has had a minor beneficial effect on the developed portions of the reach but a detrimental effect on the more natural areas in the western portion of the reach.

By 1973, the barrier beach west of Turtle Creek had been breached in several places, and the barrier beach remaining was very fragile. It is unlikely that any of this barrier will remain in 2010. ~~Since~~ the entire shoreline west of range 2 is backed by the recently rebuilt Magee Marsh State Wildlife Area dike, and this structure should define the 2010 shoreline (pl.).

The barrier-beach system in the eastern portion of the reach will also undergo some future recession. The problem is not as critical here, however, since the barrier beach is more substantial and is also backed by a dike.

In actuality, erosion is most critical in the highly developed area between range 3 and range 6 because of the proximity of homes to the shoreline. ~~While~~ Though this area is well protected structurally, these structures have been largely inadequate and past recession has placed the shoreline at or near many of the houses.

The situation is particularly acute east of Brough Creek, where development has occurred on the barrier beach. In 1973, the barrier was less than 100 feet wide in places and many of the homes present extended lakeward of the natural shoreline. Because of the highly transitory nature of this shore type, future prediction is difficult. Assuming future conditions will be similar to those of the past 34 years, it is felt that up to 50 feet of shore recession will occur by the year 2010. This recession will be accompanied by the destruction of most of the present development.

material normally increases to establish a steeper than normal slope, the residual accreted material is probably, by selective processes, the coarser fraction of the material that was in transport.

When the accreted slope reaches ultimate steepness for the coarser fraction of available material, impoundment stops, and all littoral drift passes the groin. If the groin is so high that no material passes over it, all transport must be in depths beyond the end of the groin. Because of the nature of transporting currents, the material in transit does not move directly shoreward after passing the groin, and transport characteristics do not become normal for some distance on the downdrift side of the groin. Thus, a system of groins too closely spaced would divert sediment offshore rather than create a widened beach.

The accretion fillet on the updrift side of the groin creates a departure from normal shore alignment, tending toward a stable alignment perpendicular to the resultant of wave attack. The impounding capacity of the groin thus depends on the stability slope and stability alignment of the accretion fillet. These in turn depend upon characteristics of the littoral material and the direction of wave attack.

Figure 5-9 shows the general configuration of the shoreline expected for a system of two or more groins. It assumes a well-established net longshore transport in one direction.

5.66 DIMENSIONS OF GROINS

Groin dimensions depend on wave forces to be withstood, the type of groin, and the construction materials used. The length, profile, spacing of groins in a system, direction of wave approach, and rate of longshore transport are important functional considerations.

The length of a groin is determined by the distance to depths offshore where normal storm waves break, and by how much sand is to be trapped. The groin should be long enough to interrupt enough material to create the desired stabilization of the shoreline or accretion of new beach areas. Damage to downdrift shores must be considered in determining the groin length. For functional design purposes, a groin may be considered in three sections: (a) horizontal shore section, (b) intermediate sloped section, and (c) outer section.

5.661 Horizontal Shore Section. This section extends far enough landward from the desired location of the crest of berm to anchor the groin and prevent flanking. The height of the shore section depends on the degree to which it is desirable for sand to overtop the groin and replenish the downdrift beach. The minimum height for a groin is the height of the desired berm, which is usually the height of maximum high water, plus the height of normal wave uprush. Economic justification for building a groin higher than this is doubtful except for terminal groins. With stone groins, a height about 1 foot above the minimum is sometimes used to reduce passage of sand between large cap stones. The maximum height of a groin to retain all sand reaching the area (a high groin) is the height of maximum high water and maximum wave uprush during all but the most severe storms. This section is horizontal or sloped slightly seaward, paralleling the existing beach profile or the desired slope if a wider beach is desired or a new beach is to be built.

5.662 Intermediate Sloped Section. The intermediate section extends between the shore section and the level outer section. This part should approximately parallel the slope of the foreshore the groin is expected to maintain. The elevation at the lower end of the slope will usually be determined by the construction methods used, the degree to which it is desirable to obstruct the movement of the material, or the requirements of swimmers or boaters.

5.663 Outer Section. The outer section includes all of the groin extending seaward of the intermediate sloped section. With most types of groins, this section is horizontal at as low an elevation as is consistent with economy of construction and safety, since it will be higher than the design updrift bottom slope in any case. The length of the outer section will depend on the design slope of the updrift beach.

5.664 Spacing of Groins. The spacing of groins in a continuous system is a function of the length of the groin and the expected alignment of the accretion fillet. The length and spacing must be so correlated that when the groin is filled to capacity, the fillet of material on the updrift side of each groin will reach to the base of the adjacent updrift groin with a sufficient margin of safety to maintain the minimum beach width desired or to prevent flanking of the updrift groin. Figure 5-10 shows the desirable resultant shoreline if groins are properly spaced. The solid line shows the shoreline as it may develop when erosion is at a maximum at the updrift groin. The erosion shown occurs while the updrift groin is filling. At the time of maximum recession, the solid line is nearly normal to the direction of the resultant of wave approach and the triangle of recession, *a*, is approximately equal to the triangle of accretion, *b*. The dashed line *m n* shows the stabilized shoreline that will obtain after material passes the updrift groin to fill the area between groins and, in turn, commences to pass the downdrift groin. The fillet of sand between groins tends to become and remain perpendicular to the predominant direction of wave attack. This alignment may be quite stable after equilibrium is reached. However, if there is a marked variation in the direction and intensity of wave attack, either seasonally or as a result of prolonged storms, there will be a corresponding variation in the alignment and slope of the shore between groins. Where there is a periodic reversal in the direction of longshore transport, an area of accretion may form on both sides of a groin as shown in Figure 5-11. Between groins, the fillet may actually oscillate from one groin to the other as shown by the dashed lines, or may form a U-shaped beach somewhere in between, depending on the rate of supply of littoral material. With regular reversals in the direction of longshore transport, the maximum line of recession would probably be somewhat as shown by the solid line, with the triangular area *a* plus triangular area *c* about equal to the circular segment *b*. The extent of probable beach recession must be taken into account in establishing the length of the horizontal shore section of groin and in estimating the minimum width of beach that may be built by the groin system. *As a guide to the spacing of groins, the following general rule is suggested: The spacing between groins should equal two to three times the groin length from the berm crest to the seaward end.*

Sand Beach Groins ≅ 60-6
Spacing 150-20
Actual Spacing about 80'

5.665 Length of Groin. To determine the horizontal shore and intermediate sloped section shoreline position adjacent to a groin, it is necessary to predict the ultimate stabilized beach profile on each side of the groin. Total length, including the horizontal outer (seaward) section, is based on projected position of the breaking zone for normal waves. The steps involved for a typical groin are:

(a) Determine the original beach profile in the vicinity of the groin.

(b) Determine the direction of longshore transport. (See Section 4.5, Littoral Transport.)

(c) Determine the shape of the accretion fillet by the shape of the average impounded fillet over a sufficient period of time at an existing structure where the shore has similar orientation and exposure. If no such structure is available, an estimate may be made by plotting a refraction diagram for the mean wave condition, i.e., the wave condition which would produce the greatest rate of longshore transport, and drawing the shoreline or berm crest normal to the orthogonals.

(d) Determine the minimum beach width desired updrift of the groin. This may be a width desired to provide adequate recreational area; adequate protection of the backshore area; or with a groin system, adequate width of beach at the next groin updrift to prevent flanking of this groin by wave action. The last condition is shown at point *m* on Figure 5-10, if line *m n* represents the berm crest of the beach.

(e) The position and alignment of the desired beach relative to the groin under study is indicated by the line *m n*, Figure 5-10, the line being constructed approximately to the orthogonals based on mean wave conditions from *m* to *n*.

(f) Apply the distance *c n* from Figure 5-10 to Figure 5-12; this distance plus enough length landward of *c* to prevent flanking, will represent the length of the horizontal shore section.

(g) The slope of the ground line from the crest of the berm seaward to about the mean low water line will depend on the gradation of the beach material and the character of the wave action. This section of groin, the intermediate sloped section, Figure 5-12, is usually designed parallel to the original beach profile. The ground line will assume the slope of the groin section *n p* or a steeper slope if the material trapped is

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RICHARD P. CROY, JR.
JOSEPH A. HOTZ
ROBERT F. SCHEUERMAN
JOHN W. WOELLER, JR.

Jones & Henry Engineers, Limited

2000 WEST CENTRAL AVENUE, TOLEDO, OHIO 43606 · TEL. 419 / 473-9611

July 24, 1981

Mr. Walter C. Busdiecker
Busdiecker, Inc.
109 Portage
Woodville, Ohio 43469

Subject: Sand Beach Erosion

Dear Mr. Busdiecker:

In accordance with our conversation, we present herein our qualifications for engineering work associated with beach erosion.

We have three partners who have had training and/or experience in beach erosion. Mr. John Jenkins has done considerable engineering work for Beulah Beach and Lake Seneca.

Mr. John Stratman and Mr. Merrill Smith completed a coastal engineering course in 1980.

Our Firm has extensive experience on riprap protection of slopes of upground reservoirs in northwest Ohio, having designed reservoirs for Lima, Archbold, Willard, Delta, and Findlay. We were consultants on The Northwest Ohio Water Plan for the Ohio Department of Natural Resources.

Most of our projects now involve State or Federal grants, and we have assisted our clients in making application and coordinating the grant activities.

We attach hereto general information on our Firm and biographical data on the above-named partners.

We would be pleased to work with your district on the Sand Beach project.

Very truly yours,

JONES & HENRY ENGINEERS, Limited

Harold A. Kelley

Harold A. Kelley

HAK/pk
Attach.

STATEMENT OF SPECIALIZED EXPERIENCE AND QUALIFICATIONS

of

JONES & HENRY ENGINEERS, LIMITED

For

ENGINEERING SERVICES IN CONNECTION WITH BEACH EROSION

Submitted To:

Mr. Walter C. Busdiecker
Busdiecker, Inc.
109 Portage
Woodville, Ohio 43649

JULY 1981

JONES & HENRY ENGINEERS, Limited
2000 West Central Avenue
Toledo, Ohio 43606
419/473-9611

Jones & Henry Engineers, Limited
2000 WEST CENTRAL AVENUE, TOLEDO, OHIO 43606

SPECIALIZED EXPERIENCE AND QUALIFICATIONS OF JONES & HENRY ENGINEERS, Limited

SPECIALIZED EXPERIENCE

Jones & Henry Engineers has worked with the Ohio Department of Natural Resources in the construction of three reservoirs in the State of Ohio. These are the Willard reservoir and two Lima reservoirs. We are presently working with the DNR on an upground reservoir for Delta. We designed another for Archbold that was not constructed.

Similar projects completed by Jones & Henry Engineers are listed below.

Client	Project	Year
Geneva Union Cemetery, Geneva, Ohio	Slide and Soil Erosion Correction Project	1969
Jackson, Ohio	Waterworks Improvement - Earth Dam	1952
	Spillway Protection	1959
	Water Supply Reservoir Spillway Erosion Control	1959
	Hammertown Dam Inspection Report	1975
	Hammertown Dam Repairs	1975
Jackson Iron and Steel, Ohio	Jisco Dam and Reservoir	1952
Lake Seneca Property Owners Association	Earthfill Cofferdam	1974
	Dam Repairs	1975
	Dam Repairs	1978
Sandusky, Ohio	Inner Harbor Dock Repairs	1954
	Mooring Basin, Docks & Boat Storage	1955
Beulah Beach	Beach Protection	
	Roads	
Willard, Ohio	Upground Reservoir Slope Protection	
Lima, Ohio	Upground Reservoir Slope Protection	
Archbold, Ohio	Upground Reservoir Slope Protection	
Findlay, Ohio	Upground Reservoir Slope Protection	

STAFF AND FACILITIES

Jones & Henry Engineers, Limited is staffed and equipped with people and facilities that enable it to perform in a highly professional manner. The following material provides an overview of our staff, organization, and facilities.

STAFF

The eleven managing Members of Jones & Henry are responsible for administration and overall project direction. The Members are all practicing Professional Engineers licensed in at least Ohio and Michigan. The Firm also has six Associates whose abilities and specialized knowledge constitute a technical and managerial resource pool for client projects. The Associates are all Professional Engineers.

The Project Director for each project is a Member of the Firm who, together with the Chairman of the Firm, selects a design team from the technical staff. The team's design activities are directed by the Project Engineer, usually an Associate or Senior Engineer. The team concept permits a multidisciplined approach to a project that results in better designs. This approach allows the more experienced persons of our staff to provide guidance to less experienced persons without stifling innovation.

The technical staff at Jones & Henry is comprised of persons trained in a large number of academic disciplines. These disciplines include: sanitary, environmental, civil, chemical, structural, mechanical, and electrical engineering; planning; hydrogeology; construction services, including field engineers and inspectors; computer applications; and value engineering. Many staff members have obtained advanced degrees in their chosen professions. Jones & Henry encourages employees to take Continuing Education courses and attend seminars and conferences to keep current in their fields. Many engineers are licensed Professional Engineers, and several planners are registered Professional Planners.

The support staff consists of drafters, technicians, accountants, librarian, and word processing specialists.

FACILITIES

Buildings

The offices of Jones & Henry are located at 2000 West Central Avenue in Toledo, Ohio. The main building is a two-story structure with 16,000 feet of usable space. This building houses the administrative offices, the design group facilities, a computer, a chemical laboratory, and a word processing center.

The Firm owns a second building adjacent to the main structure. This building consists of 3,600 square feet of floor space. The Planning Division and our printing operations are located here.

Computer Facilities

Jones & Henry owns a Hewlett-Packard 2100 Series computer. The machine is housed on the premises, with operations directed by a full-time computer applications engineer. Our library of computer programs provides fast, accurate solutions to frequently encountered engineering and planning problems. The facilities are also used for innovative design and other detailed analyses.

Our computer program library includes systems for:

- Water Distribution Analysis
- Modeling Usage Data for Water and Sewer Rate Studies
- Sanitary Sewer Analysis
- Performing Assessments
- Storm Sewer Analysis

The computer system includes a 600 card/minute card reader, a keyboard input with CRT readout, a magnetic tape unit, two disc drives, a 200 line per minute printer, and a central processor with 24K words of core. When a computer with a greater capacity is required, the Firm has arrangements to rent time on Univac 1110 Series or IBM 360 computers.

Laboratory Facilities

Jones & Henry Laboratories, Inc. provides chemical and pollution control laboratory services to municipalities, industries, and consulting engineers. The staff of professional chemists and microbiologists has wet testing and advanced instrumentation laboratory facilities at its disposal. Among these are atomic adsorption spectroscopy; visible, infrared, and ultraviolet light spectroscopy; and gas chromatography. The laboratory and staff are available during design and for bench testing and pilot design and analysis.

Ancillary Facilities

The Jones & Henry library contains over 2,000 manufacturers' catalogs, 10,000 books and government documents, and 200 current journal and newsletter subscriptions. Additional research facilities are available in area public and university libraries. Our information resources are administered by a full-time librarian.

The word processing center contains three Wang CRT word process terminals and two Wang printers. An IBM magnetic tape drive composer is used to set type for reports.

Jones & Henry maintains two offset printing presses, together with auxiliary equipment for making plates, printing, and binding documents.

RESUME OF

JOHN C. JENKINS, P.E.
MEMBER

EDUCATION:

BSCE (Sanitary)	- Case Institute of Technology	- 1954
MSCE	- University of Toledo	- 1971

Advanced coursework in Public Health Engineering and Solid Waste Management

PAPERS/PRESENTATIONS:

"Feasibility of Using a Composed Sewage Sludge as a Soil Conditioner," Ohio Water Pollution Control Conference, Cleveland, June 15, 1978.

PROFESSIONAL HISTORY:

1972-Present Member-Project Manager for solid waste management, wastewater, and large hydraulic structures projects with overall responsibility for major projects.

IMPORTANT PROJECTS:

Washtenaw County Solid Waste Management Study - Project Engineer for the final portions of the work. Evaluated the solid waste management program prepared by others and tested the computer program. This was a resource recovery project.

Northwestern Berrien County Solid Waste Management Study - Project Manager for work including resource recovery and resource market analysis. Program for both interim and final plans incorporating resource recovery. The interim plan is being implemented currently.

Riverview, Michigan - Project Manager for high rise sanitary landfill incorporating a winter sports area.

1968-1972 Associate-Project Engineer - Water, wastewater, storm water management, and solid waste projects.

IMPORTANT PROJECTS:

Lima, Ohio - Preliminary design of advanced waste treatment plant with effluent reuse.

Cleveland Quarries, Inc. - Design of sanitary landfill in an abandoned quarry.

Three Rivers Coordinating Council - Study of the potential solid waste management options, including resource recovery and final disposal.

1963-1968 Project Engineer on water, wastewater, storm drainage, and solid waste projects.

IMPORTANT PROJECTS:

Kalamazoo County, Michigan - Designed industrial waste questionnaire and proposed resource recovery options. This study was cited as a model study by the State of Michigan and the Federal Government.

Oakland County, Michigan - A study of options for solid waste management by incineration. The report addressed co-disposal of wastewater sludges and energy recovery.

Pontiac, Michigan - Design of a large sanitary landfill receiving industrial and municipal waste.

1960-1963 Design Engineer for water, wastewater, and storm water projects.

1957-1960 County Sanitary Engineer - Responsible for County water system and wastewater systems.

PROFESSIONAL AFFILIATIONS:

American Water Works Association
Water Pollution Control Federation
American Public Works Association
Michigan Association of Professions
American Society of Civil Engineers

PAPERS AND AWARDS:

Pumping Station designed with Safety in Mind;
Water & Wastes
Failure of the Sylvania Water Pumping Station;
American Water Works Association
Riverview Land Preserve - A Case Study;
2nd Conference on Waste Disposal at Madison
Wendall La Due Citation;
Water Pollution Control Federation (Ohio Section)
Guest Lecturer in Solid Waste Management;
University of Toledo

RESUME OF

MERRILL G. SMITH, P.E.
MEMBER

EDUCATION:

		Miami University (Ohio)	- 1947-1949
BSCE	-	Purdue University	- 1951

PROFESSIONAL HISTORY:

1969-Present	Partner and overall charge of underground work for Jones & Henry Engineers, including supervision of water line, storm drainage, sanitary sewer, and pump station design, and appurtenances such as siphons, river, and lake crossings. Project Manager for Battle Creek Township, Michigan Sanitary Sewer Facility; estimated cost $37 million. Overall Project Manager for Sanitary Sewers Report and Design for the City of Toledo's Ten Mile Creek Interceptor System; estimated cost $50 million.
1960-1969	Project Engineer on water lines, storm sewers, sanitary sewers, and pump stations; preliminary design, detailed design, and engineering during construction for the Cities of Kalamazoo and Pontiac, Michigan; Defiance, Lorain, Montpelier, Napoleon, Toledo, and Wooster, Ohio. Project Associate on sanitary sewers in Kalamazoo, Pontiac, and Battle Creek, Michigan.
1960	Project Engineer for Harold Hoskins & Associates in Breeley, Colorado; involved in field surveying for major street programs in the City of Casper, Wyoming, and field surveying work for relocation of the Village of Dillon, Colorado. Project involved installation of all utilities, streets, property, etc.
1956-1960	Design Engineer on sanitary sewer and storm water projects for the City of Kalamazoo, Michigan. Design Engineer for a storm drainage study for the City of Lorain, Ohio.
1956	Boeing Airplane Company, Plant Engineering Department; Project Engineer on miscellaneous modifications to existing plant facility.
1954-1956	Assistant Public Works Officer for the Naval Supply Depot in Clearfield, Utah; responsible for the administration, design, construction, maintenance and operation of the Naval Supply Depot in Clearfield, Utah, with 300 civilian employees under my direction including engineering, transportation (rail and motor vehicle), building maintenance, power generation, wastewater treatment, and water supply.

RESUME OF

MERRILL G. SMITH, P.E.
MEMBER
(continued)

1953-1954 U.S. Navy Civil Engineering Corp in Adak, Alaska; Administrative Engineer in the Public Works Department for the U.S. Naval Station in Adak, Alaska; in charge of military personnel in the administrative, planning and estimating, engineering, inspection, and surveying departments.

1951-1953 Installations Engineer for Boeing Airplane Company; design of structural components for installation of electronic components in the Bomarc Guided Missile in Seattle, Washington.

PROFESSIONAL AFFILIATIONS:

American Water Works Association
Water Pollution Control Association
American Society of Civil Engineers
National Society of Professional Engineers
Ohio Association of Consulting Engineers
Past President (1973-1974) of Consulting Engineers of Ohio

PAPERS:

Sanitary Sewer Design Criteria - Water Pollution Control Federation, Ohio Section

RESUME OF

JOHN H. STRATMAN, P.E.
MEMBER

EDUCATION:

BSCE - University of Cincinnati, Ohio (1970)
MSEH - University of Cincinnati, Ohio (1974)
11 Years of Professional Experience

PROFESSIONAL HISTORY:

1981-Present Member - Jones & Henry Engineers, Limited

1979-Present Associate - Jones & Henry Engineers, Limited

1974-1979 Engineer - Jones & Henry Engineers, Limited

1970-1974 Navy Industrial Environmental Health Center, Cincinnati, Ohio - Sanitary Engineer.

SUMMARY OF EXPERIENCE:

Responsible for preparation of various Environmental Engineering and management projects for municipalities and Military installations. Experienced in conducting public acceptance programs.

Specific Experience Relative to the Battle Creek Area Sewer Authority Management Organization

Project engineer responsible for evaluating working conditions to identify potentially hazardous environments for workers. Recommended changes in working conditions and/or work practices to reduce hazards. Brief management on perils and recommendations.

Conducted rate study for Bryan, Ohio water and sewer systems. Work included thorough review of financial records, budgets and bond requirements. Rate adjustment considered projected capital expenses, change in staffing and formation of a reserve fund. Explained the impacts of the rate recommendation to city officials.

Prepared facilities plans for the communities of:

Rochester, Michigan	Port Clinton, Ohio
Hastings, Michigan	Wooster, Ohio
Albion, Michigan	Defiance, Ohio
Battle Creek Metro Area, MI	Montpelier, Ohio

Each of these facilities plans included preparing preliminary budgets, assessing economic and social benefits and review of the existing management system. Each plan required extensive public participation program.

RESUME OF

JOHN H. STRATMAN, P.E.
MEMBER

Responsible for conducting a public acceptance program for Battle Creek Metropolitan Area Facilities Plan. Met with local and county officials to help overcome resistance to a regional sewer program. Met with citizen groups and others to explain the proposed plan and help overcome fears. The success of this program is attested by the lack of discenters speaking at the public hearing and the reality of the Battle Creek Sewer Authority which will operate the regional system.

PROFESSIONAL AFFILIATIONS:

Chi Epsilon
American Society of Civil Engineers
Water Pollution Control Federation

FACT SHEET
FOR
SAND BEACH CONSERVANCY DISTRICT

AUGUST 31, 1981

JONES & HENRY ENGINEERS, LIMITED
ENVIRONMENTAL ENGINEERS/PLANNERS
2000 WEST CENTRAL AVENUE
TOLEDO, OHIO 43606

JONES & HENRY ENGINEERS, Limited

FACT SHEET
PREPARED FOR
SAND BEACH CONSERVANCY DISTRICT

1. The Firm

Jones & Henry is a medium-sized environmental engineering and planning firm specializing in consulting with municipalities and industries. Our staff of over 100 persons uses an extensive library, computers, and laboratory facilities to investigate, design, and provide engineering service during construction to programs for conserving and preserving the environment for human enjoyment.

2. Experience:

   a) Beulah Beach shore protection system on Lake Erie
   b) Erosion control measures and repair of drain for Lake Seneca (Private Association)
   c) Shore protection at Bresler Lake

   Projects include sheet piling, riprap, seawall, and groins.

   We are used to working with property owners' associations and conservancy districts. We are aware of the need for communications between consultant and the client, particularly in communities such as Sand Beach.

3. Project Manager - John Stratman

4. Approach to the Project

   We would like to offer the following services:

   a) Prepare a Master Plan for the Sand Beach Conservancy District covering:

      1. Shore protection and beach restoration
      2. Other services such as parks and improved streets
      3. Prioritize projects and prepare a 5-year plan for implementation
      4. Provide preliminary estimates of cost
      5. Investigate possible funding opportunities

   b) Prepare detailed Plans and Specifications, grant applications, and permits for various projects, as required and directed

   c) Provide engineering services during construction, as required and directed

   d) Appear at meetings from time to time to discuss progress on the plan and on specific projects.

5. Costs

To prepare Master Plan complete	$15,000
To prepare Master Plan covering shore protection and beach restoration only	$12,000
Detailed Plans, Specs, Applications, and Permits	Time & Expense or Lump Sum
Services during construction	Time & Expense

Current average hourly rates for various employee classifications (including overhead and profit) are as follows:

Officer	$122
Manager	$ 73
Member	$ 60
Jr. Member	$ 44
Associates	$ 42
Sr. Engineer/Sr. Resident Engineer/ Planning Director	$ 33
Engineer/Planner/Sr. Technician/ Resident Engineer	$ 26
Jr. Engineer/Assistant Resident Engineer/Chief Inspector	$ 23
Technician/Drafter/Inspector	$ 11

No charge made for secretarial or accounting personnel.
Mileage charge - 20¢/mile.

6. Payment method

a) Invoices issued monthly
b) Payment due in 30 days

7. Financial Assistance Program Possibilities

Ohio Department of Natural Resources (Co-operative Program)
U. S. Army Corps of Engineers