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Offshore Breakwater System
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Beach Protection

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

The design memorandum study investigates several alternatives for the preservation of Presque Isle Peninsula and its recreational facilities from natural erosion processes with the least amount of damage to its natural geological and ecological processes. The overall organization of this report consists of a Main Report, a Plate Appendix, a series of Technical Appendices, a Pertinent Correspondence Appendix, and a Public Involvement and Coordination Appendix. The Main Report is written to give both the general and technical reader a clear

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20. ABSTRACT (Cont'd)

understanding of the study, the study results, and the basis for key decisions and conclusions. The Main Report provides a summary of the planning processes carried out for a reformulation Phase I General Design Memorandum investigation. It discusses: the authorizing legislation; the recommended plan for the authorized study and items of local cooperation; the existing cooperative beach erosion control project; historic development of the peninsula and methods of protection implemented for preservation of the peninsula; environmental impacts and concerns; pertinent studies undertaken or to be undertaken and their findings; problems, needs, and concerns; public involvement activities; the alternative concepts being analyzed, subsequent events and changes to the concepts, and plan formulation steps during this investigation; environmental assessments; potential project benefits, costs, and cost allocation; conclusions and recommendations regarding the results and findings of the study, and the advisability for further modification of the cooperative beach erosion control project at Presque Isle Peninsula. The Plate Appendix includes all the plates developed for this report for easy reference. The Technical Appendices provide additional detailed information on the design and costs and benefits of the alternatives investigated and a material survey of construction materials. The Pertinent Correspondence Appendix includes correspondence pertinent to the accomplishment of the project. The Public Involvement and Coordination Appendix contains correspondence documenting public involvement and coordination during this Phase I Design Memorandum investigation.

The plan recommended in the Phase I report would provide for placement of about 500,000 cubic yards of sandfill to build a beach along approximately 6.0 miles of lake frontage and would be protected by a system of 58 offshore breakwater segments.

B

DEPARTMENT OF THE ARMY
OFFICE OF THE CHIEF OF ENGINEERS
WASHINGTON, D.C. 20314

IN REPLY REFER TO

12

DRAFT

DAEN-CWP-A

SUBJECT: Presque Isle Peninsula, Erie, Pennsylvania

THE SECRETARY OF THE ARMY

1. I submit for transmission to Congress my report on Presque Isle Peninsula, Erie, Pennsylvania. It is accompanied by the reports of the Board of Engineers for Rivers and Harbors and the District and Division Engineers. These reports are in response to Section 101(a) of the Water Resources Development Act of 1976 (Public Law 94-587). This Act authorized undertaking the Phase I design memorandum stage of advanced engineering and design of the project for beach erosion control for Presque Isle Peninsula at Erie, Pennsylvania.

2. The District and Division Engineers recommended construction of structures for wave attenuation and beach restoration along approximately 6 miles of shoreline on the lakewood side of Presque Isle Peninsula. The recommended plan provides for:

a. Placement of an estimated 500,000 cubic yards of sandfill beach berm with an average 60-foot width and crest elevation of 10.0 feet above low-water datum.

b. Construction of 58 offshore rubblemound breakwater segments aligned parallel to the shoreline and positioned in a trough between the first and second offshore sandbars.

c. An annual replenishment of approximately 38,000 cubic yards of sandfill, in order to maintain the minimum design beach dimensions.

The estimated cost of the proposed modification, based on October 1980 price levels, is estimated at $22,800,000. The non-Federal portion of the cost is estimated at $7,980,000, which includes a cash contribution by the Commonwealth of Pennsylvania of 5 percent of the project cost. Average annual charges, based on a 50-year period for economic analysis and an interest rate of 7-3/8 percent, are estimated at $2,150,000, including $420,000 for maintenance and periodic nourishment. Average annual benefits are estimated at $4,364,000, and the benefit-cost ratio is estimated at 2.0.

DAEN-CWP-A
SUBJECT: Presque Isle Peninsula, Erie, Pennsylvania

3. The Board of Engineers for Rivers and Harbors, concurring in the views and recommendations of the reporting officers, recommends that the proposed beach erosion control improvements be authorized for construction.

4. I concur in the findings, conclusions, and recommendations of the Board.

J. K. BRATTON
Lieutenant General, USA
Chief of Engineers

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DEPARTMENT OF THE ARMY
BOARD OF ENGINEERS FOR RIVERS AND HARBORS
KINGMAN BUILDING
FORT BELVOIR, VIRGINIA 22060

REPLY TO
ATTENTION OF:

BERH-PLN

29 January 1981

SUBJECT: Presque Isle Peninsula, Erie, Pennsylvania

Chief of Engineers
Department of the Army
Washington, DC 20314

Summary of Board Action

The Board believes that beach erosion control improvements recommended in the Phase I General Design Memorandum for Presque Isle, Erie, Pennsylvania, are economically justified and environmentally acceptable. The Board concurs with the reporting officers' plan consisting of offshore breakwaters and beach replenishment along the lakeward perimeter of Presque Isle Peninsula. The project construction cost is estimated at $22,800,000, of which $7,980,000 is non-Federal. The benefit-cost ratio is 2.0.

Summary of Report Under Review

1. Authority. This report is in response to Section 101(a) of the Water Resources Development Act of 1976 (Public Law 94-587), approved 22 October 1976. The Act authorized the Secretary of the Army, acting through the Chief of Engineers, to undertake Phase I studies for beach erosion control at Presque Isle Peninsula, Pennsylvania. The study authority is quoted in the District Engineer's report.

2. Description of the study area. Presque Isle Peninsula is located near Erie, Pennsylvania, on the south shore of Lake Erie, 78 miles southwest of Buffalo, New York, and 102 miles northeast of Cleveland, Ohio. Presque Isle Peninsula is a curved sandspit that arches lakeward in a generally northeasterly direction from its narrow connection with the mainland just west of the City of Erie. The length of the peninsula is about 6-1/4 miles. The eastern end of the peninsula terminates in several low, flat, curving longshore bars. For about 2 miles from the western root, the peninsula is narrow and has an average width of generally less than 800 feet. Eastward, the peninsula widens abruptly to a width of over 1 mile. Presque Isle Peninsula consists entirely of fine sand. The general ground elevation of the peninsula is relatively

low, averaging about 7 or 8 feet above low-water datum. Four major and several minor sand ridges extend across the peninsula generally in the east-west direction and rise to a maximum elevation of about 20 feet above low-water datum. The higher ground on the peninsula sustains a thick growth of a wide variety of trees and shrubs. Low areas between the sand ridges contain several lagoons and marshes. The lakeward perimeter of Presque Isle Peninsula is about 9 miles long and segmented into 11 beaches of varying width. All bathing beaches have picnic and parking facilities, and four of the beach areas have bathhouse facilities. Encircled between the peninsula and the mainland is Presque Isle Bay, the eastern part of which is Erie Harbor, a Federal deep-draft navigation project. The bay shoreline is characterized by numerous small bays, coves, and inlets.

3. Economic development. Presque Isle is a State recreation area providing facilities for swimming, sunbathing, picnicking, boating, bicycling, sailing, and other recreational activities. From 1972 to 1979, visitation varied between 2.3 million and 4.2 million persons annually. Approximately 70 percent of the visitation originates from the Pittsburgh and Erie metropolitan areas.

4. Existing improvements. Most of the beaches on Presque Isle Peninsula have had a history of serious erosion for over 150 years. Numerous protective works, consisting of groins, revetments, bulkheads, and offshore breakwaters, have been constructed to try to halt erosion. A cooperative (Federal and State) beach erosion control project, authorized by the River and Harbor Act of 1954, provided artificial placement of sandfill and construction of a seawall, bulkhead, and groin system along one section of the lake shoreline of the peninsula. A deep-draft navigation project is maintained for access of general cargo to Erie Harbor and Presque Isle Bay. Small craft facilities are maintained at various locations within the bay.

5. Problems and needs. Since completion of the cooperative beach erosion control project, progressive erosion has continued, seriously affecting beaches along the entire lake shoreline of the peninsula. Periodic nourishment has proved to be an ineffective method for beach stabilization. Experience has shown that sand replenishment requirements have exceeded design estimates and that satisfactory replenishment materials are in limited supply.

6. Improvements desired. State and local interests, concerned about damage to existing beaches and public facilities, desire a stabilized shoreline. They also favor improvements which provide for continued geologic growth at the eastern end of the peninsula.

7. Alternatives considered. In addition to a "no action" alternative, the District Engineer considered structural and

nonstructural plans, including nourishment, breakwaters, sandtrap recirculation, and groins.

8. Plan of improvement. The selected plan of improvement consists of offshore breakwaters and beach replenishment. The plan would provide a beach berm with a minimum width of 60 feet and a crest elevation of 10.0 feet above low-water datum along approximately 6.0 miles of lake frontage. It would be protected by 58 offshore rubblemound breakwater segments aligned parallel to the shoreline and positioned in the trough between the first and second offshore sandbars. Each breakwater segment would be about 150 feet long, spaced about 350 feet apart, and have a top elevation of 10 feet above mean low lake level. Approximately 500,000 cubic yards of sandfill would be required to construct the beach to initial project dimensions. Additionally, the plan would require placement of approximately 38,000 cubic yards of sandfill annually for beach nourishment.

9. Economic evaluation. Based on October 1980 prices, the District Engineer estimates total first cost of the plan of improvement to be $22,800,000, of which $14,820,000 would be Federal and $7,980,000 would be non-Federal. Average annual charges, based on a 50-year period for economic analysis and an interest rate of 7-3/8 percent, are estimated at $2,151,000, including $420,000 for maintenance and periodic nourishment. Average annual benefits are estimated at $4,369,000, and the benefit-cost ratio is estimated at 2.0.

10. Project effects. The proposed project should protect the recreation resources at Presque Isle and should enhance the existing beaches. Offshore breakwaters should reduce erosion and rate of sand transported to the eastern end of the peninsula. A sufficient amount of sand should be bypassed by natural processes to sustain the east end of the peninsula. Long-term effects on aquatic diversity and productivity should be favorable.

11. Recommendation of the reporting officers. The District Engineer recommends authorization for construction of improvements at Presque Isle Peninsula, Erie, Pennsylvania, generally in accordance with the plan described in his report and subject to certain items of local cooperation. The Division Engineer concurs.

Review by the Board of Engineers for Rivers and Harbors

12. General. The scope of the Board's review encompassed the overall technical, economic, social, environmental, and policy aspects involved in the improvements proposed by the District Engineer. The review considered the report's conformance with essential elements of the Water Resources Council's Principles and

Standards for Planning Water and Related Land Resources. The Board also considered the views of local interests, as well as Federal, State, and local agencies.

13. Response to the Division Engineer's public notice. The Division Engineer issued a public notice on 31 July 1980 stating the findings and recommendations of the reporting officers and inviting interested parties to present additional information to the Board. A letter was received from the Pennsylvania Department of Environmental Resources objecting to the 5 percent contribution requirement under the President's proposed 1978 cost-sharing policy. However, the Department indicated that it would fulfill its obligation for the Presque Isle project under the traditional cost-sharing policy for beach erosion control projects.

14. Findings and conclusions. The Board of Engineers for Rivers and Harbors concurs in the views and recommendations of the reporting officers. The improvements are economically justified, are engineeringly and environmentally acceptable, and the requirements of local cooperation are appropriate. The Board believes the District Engineer's proposed plan should enhance and preserve the recreation resources and environmental features of the peninsula and should provide a contribution to the regional economy.

15. The Board finds that the District Engineer has compiled significant data and has undertaken several monitoring programs since authorization of Phase I studies. After the District Engineer's report was completed, these programs were continued in an effort to assess the potential effectiveness of the recommended plan with respect to stabilizing the beach. The Board believes these programs, as defined in the District Engineer's report, should be continued as they will provide valuable information relative to the Presque Isle project, will contribute information having widespread application at other project sites, and should shorten the project completion time. One ongoing program includes a physical model study of the segmented breakwater alternative, which is being conducted by the U.S. Army Corps of Engineers Waterways Experiment Station. The purpose of this study is to refine and to optimize breakwater parameters such as length, height, width of gap, distance offshore, and orientation. It should also provide an indication of interactions between the proposed breakwaters and existing groins, structure effects on littoral processes, and potential for sand transport through the system. Verification tests of the model have been completed, and a design test will be initiated in the immediate future for purposes of obtaining finalized test data.

16. Based on findings of all studies to date, the beach in the recommended plan should be more stable than the existing beach. The

period of time necessary to achieve this stabilized beach condition cannot be determined from available information.

17. Therefore, the Board concurs with the District Engineer that Federal participation in periodic beach replenishment is warranted and should be continued for a period of 50 years in accordance with policies and practices established for this project under Section 101(a) of Public Law 94-587.

18. Recommendation. Accordingly, the Board recommends that improvements for beach erosion control at Presque Isle Peninsula, Erie, Pennsylvania, be authorized for implementation generally in accordance with the plans and recommendations of the District Engineer, and with such modifications thereof as in the discretion of the Chief of Engineers may be advisable and in accordance with the President's proposed 1978 cost-sharing policy. The estimated first cost to the United States is $14,820,000. Estimated annual replenishment costs to the United States are $259,000. This recommendation is made with the provision that, prior to implementation, the Commonwealth of Pennsylvania will, in addition to the general requirements of law for these types of projects, agree to comply with the following requirements:

a. Provide a cash contribution equal to 5 percent of the total first cost of the project;

b. The Commonwealth of Pennsylvania will also:

(1) Provide a cash contribution based on the appropriate percentage of the final construction cost, exclusive of lands, easements, and rights-of-way, the percentage to be in accordance with existing law and based on shore ownership and use existing at the time of implementation; presently estimated at 30 percent;

(2) Provide without cost to the United States all lands, easements, and rights-of-way, including suitable borrow and disposal areas for excavated material determined suitable by the Chief of Engineers and necessary for implementation and for periodic nourishment of the project;

(3) Hold and save the United States free from damages due to construction works, not including damages due to the fault or negligence of the United States or its contractors;

(4) Maintain and operate all works, including breakwaters, after completion in accordance with regulations prescribed by the Secretary of the Army;

(5) Provide periodic beach replenishment and redistribution as needed after completion in accordance with regulations prescribed by the Secretary of the Army;

(6) Pay 30 percent of the cost for annual beach redistribution and replenishment work noted in subparagraph 18b(5); and

(7) Assure continued public ownership and continued public use, without cost to the United States, of appropriate access and facilities, including parking and sanitation, necessary for realization of the public benefits upon which Federal participation is based, and administer and maintain the beach for continued public use during the life of the project.

FOR THE BOARD:

William R. Wray
WILLIAM R. WRAY
Major General, USA
Chairman

NCDED-C (30 Jun 80) 1st Ind
SUBJECT: Presque Isle Peninsula, Erie, PA

18 JUL 1980

DA, North Central Division, Corps of Engineers, 536 South Clark Street, Chicago, Illinois 60605

TO: HQDA (DAEN-CWP-C)
WASH DC 20314

I concur in the analysis and recommendations of the District Engineer and recommend construction authorization for this project in accordance with the President's proposed cost-sharing policy.

Incls
1-18 wd

RICHARD L. HARRIS
Major General, USA
Division Engineer

Copy furnished:
District Engineer, Buffalo

DEPARTMENT OF THE ARMY
BUFFALO DISTRICT, CORPS OF ENGINEERS
1776 NIAGARA STREET
BUFFALO, NEW YORK 14207

NCBED-DC 30 June 1980

SUBJECT: Presque Isle Peninsula, Erie, PA

Division Engineer, North Central
ATTN: NCDED-C

1. Enclosed are 24 copies (Volumes 1 and 2) of the Final Phase I General Design Memorandum (GDM) which contains the Final Environmental Impact Statement (EIS) for the subject project, revised in accordance with comments contained in NCDED-C 1st Indorsement dated 28 March 1980. Twenty copies (#1-#20) are to be forwarded to BERH, one copy (#21) is to be sent to OCE, one copy (#36) is to be sent to CERC, and two copies (#34 and #35) are for retention by NCD. Copies #22 through #33 are being held at Buffalo District until NCD notification to send them to OCE.

2. Also enclosed are: the draft Division Engineer's Public Notice (original and one copy), the map for the Division Engineer's Public Notice (20 copies), 20 copies of the list of parties (mailing list), a sample copy of the letter to be sent to project area Congressmen, the draft NCD 1st Ind to this letter (original), the draft transmittal letter to BERH (original), the draft transmittal letter to OCE (original), the draft Board Report transmittal letter (original), draft OCE Report transmittal letter (original), colored maps (four copies), full size prints (two copies), the draft Record of Decision (original and two copies), the draft Survey Report Summary (original and one copy), and a copy of the Presque Isle talk and slides as presented at the CERB meeting held at NCD (28 April-1 May 1980) for the BERH briefing.

3. The Final EIS and Section 404 (b) Evaluation (enclosed as Exhibit F-29 in Appendix F) discuss and evaluate the effects of the discharge of dredged or fill material into waters of the United States, including consideration of the Section 404 (b)(1) Guidelines. A Public Notice was issued on 9 October 1979 which described the pertinent aspects of the proposed project and informed the public of their right to request a public hearing. No such requests were received and therefore a public hearing was not conducted. The Section 404 (b) evaluation, dated 21 December 1979, was included in the Draft EIS which was coordinated with appropriate agencies. No comments were received which addressed the Section 404 Evaluation or criteria addressed therein.

NCBED-DC
SUBJECT: Presque Isle Peninsula, Erie, PA

4. This completes the action for Milestone No. 30 - Submission of Final Phase I GDM and FEIS to Division.

Lt. Colonel, Corps of Engineers
Deputy District Engineer
for and in the absence of

GEORGE P. JOHNSON
Colonel, Corps of Engineers
District Engineer

18 Incl
1. Final Rpt for BERH (cys #1-#20)
2. Final Rpt for OCE (cy #21)
3. Final Rpt for NCD (cys #34 & #35)
4. Final Rpt for CERC (cy #36)
5. Draft Division Engineer Public Notice (original copy)
6. Map for Division Engineer Public Notice (20 cys)
7. List of Parties (mailing list) (20 cys)
8. Sample letter for Congressmen
9. Draft NCD 1st Ind to this ltr (original copy)
10. Draft transmittal letter to BERH (original copy)
11. Draft transmittal letter to OCE (original copy)
12. Draft Board Report transmittal ltr (original copy)
13. Draft OCE Report transmittal ltr (original copy)
14. Colored Maps (4 cys)
15. Full size prints (2 cys)
16. Draft Record of Decision (original & 2 cys)
17. Draft Survey Report Summary (original & 1 cy)
18. Talk and slide set for BERH briefing (1 cy each)

CF:
NCBED-D
NCBED-DC

PHASE I
GENERAL DESIGN MEMORANDUM
ON
COOPERATIVE BEACH EROSION CONTROL PROJECT
AT
PRESQUE ISLE PENINSULA, ERIE, PENNSYLVANIA

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20	Sand Trap Alternative - Sediment Budget
21	No Federal Action Condition - Sediment Budget

APPENDICES

Designation	Description
A	Plates
B	Economics
C	Detailed Design
D	Construction Materials
E	Pertinent Correspondence
F	Public Involvement and Coordination

ACKNOWLEDGEMENTS

This Phase I General Design Memorandum was prepared through the efforts of many individuals on the Interdisciplinary Team within the Buffalo District of the Corps of Engineers and from other agencies and individuals involved with the Presque Isle Peninsula beach erosion control project. The following are the Corps personnel who were most instrumental in conducting the investigation and preparing the text presented herein:

Richard Gorecki	- Project Manager, Coastal Engineering Section
Joan Pope	- Coastal Geologist
Thomas Bender	- Civil Engineer
Joseph Kurek	- Estimator
Rodger Repp	- Estimator
Michael Pryor	- Geologist
Brian Green	- Geologist
Paul Lang	- Biologist
Robert Klips	- Biologist
Mary Jo Braun	- Political Scientist
Sharon Cooper	- Economist
Jonathan Brown	- Economist
Ronald Guido	- Economist
Jonathan Koszuta	- Survey Technician
David Witmer	- Party Chief, Survey Branch
Andrew Augugliaro	- Party Chief, Survey Branch
Duane Syph	- Party Chief, Survey Branch
Kimberly Hoffman	- Civil Engineer
James Buell	- Civil Engineer
William Worden	- Civil Engineer

Other agencies have contributed to this report through their coordination activities and participation at public meetings. The individuals involved are numerous and not easily identified. Therefore, recognition is provided by the names of their employing agencies as follows:

U. S. Fish and Wildlife Service, State College, PA, Field Office
Pennsylvania Department of Environmental Resources

The report itself was produced through the following who contributed significantly to its preparation:

Roman Bartz and his entire Drafting Section
Freda Soper and her entire Word Processing Center staff
Wilbert Binga and his entire Reproduction Section

The Buffalo District has conducted the investigation under the general supervision of Denton R. Clark, Jr., Chief, Coastal Engineering Section; Joseph A. Foley, Chief, Design Branch; and Donald M. Liddell, Chief, Engineering Division. Colonel George P. Johnson was the Buffalo District Engineer at the time this report was prepared.

Finally, the efforts of other individuals who participated in the study and report preparation, but whose names have not been mentioned above, are gratefully acknowledged.

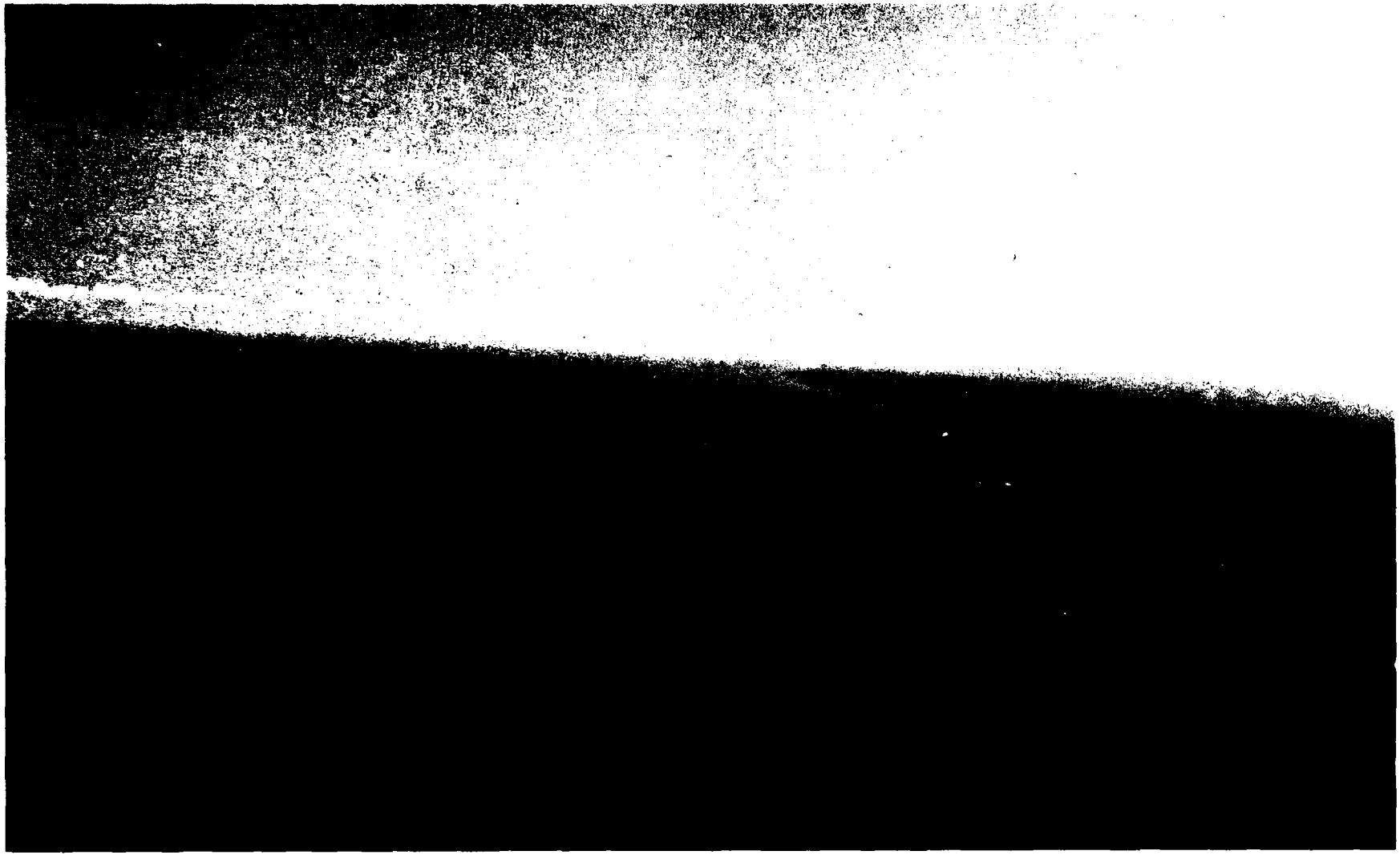


FIGURE 1: AERIAL VIEW OF PRESQUE ISLE PENINSULA AND ERIE HARBOR

(DATE OF PHOTOGRAPH: 19 JULY 1979)

SECTION A
INTRODUCTION

Presque Isle Peninsula is located on the south shore of Lake Erie at Erie, PA, which is about 78 miles southwest of Buffalo, NY, and 102 miles northeast of Cleveland, OH. The peninsula is a compound recurved sand spit projecting in a generally northeasterly direction from its narrow connection with the mainland shore (see Figure 1). The large bay between the peninsula and the mainland provides a spacious harbor which has been improved by the Federal Government under the navigation project for Erie Harbor.

The United States owns two small parcels of land on Presque Isle Peninsula, one near the harbor entrance and the other near the lighthouse, which are occupied by United States Coast Guard facilities. Otherwise, the entire peninsula which contains about 3,200 acres, is owned by the Commonwealth of Pennsylvania and is developed as a State park. Presque Isle State Park is a popular recreational area and provides facilities for bathing, boating, hiking, fishing, bird watching, picnicking, and other recreational opportunities. The public has free and unrestricted access to the park, and the large attendance, averaging nearly 3,800,000 persons annually for the past 10 years, is drawn mostly from western New York, Pennsylvania, and eastern Ohio. Table 1 lists the record of park attendance at Presque Isle as provided by State park personnel for the period from 1956 through 1979.

Presque Isle Peninsula has a lakeward perimeter of about 9 miles and has been segmented into 11 bathing beaches by the Pennsylvania Park Service. Several of these beaches have had a history of serious erosion for at least 150 years. In 1956, the Federal Government, in cooperation with the Commonwealth of Pennsylvania, completed an erosion control project on Presque Isle Peninsula. Since that time, the project has proven to be inadequate, and sand replenishment measures have been required periodically through the 1960's and 1970's, in order to protect the Federal structures and State's park facilities along the neck of the peninsula.

STUDY AUTHORITY

The Committee on Public Works of the United States Senate, on 14 May 1968, authorized the Board of Engineers for Rivers and Harbors to review the report of the Chief of Engineers on Presque Isle Peninsula, Erie, Pennsylvania, published as House Document No. 397, 86th Congress, and other pertinent reports, with a view to determine whether any modifications of the recommendations contained therein are advisable in the interest of beach erosion control at and in the vicinity of Presque Isle Peninsula and the State Park in Erie, Pennsylvania. The District Engineer at Buffalo prepared a Review Report in November 1973 (revised June 1974), on the cooperative beach erosion control project at Presque Isle Peninsula in which a total of 33 solutions to the erosion problem were considered. Many of those solutions were of the same category and were grouped as a general concept. The Review Report recommended a partial breakwater concept as the plan of improvement.

Table 1 - Record of Park Attendance at Presque Isle State Park

Year	Attendance	Year	Attendance	Year	Attendance
1956	2,675,000	1964	3,152,000	1972	3,038,736
1957	2,853,000	1965	3,352,000	1973	3,564,382
1958	2,827,000	1966	3,614,000	1974	3,483,548
1959	3,026,000	1967	3,177,000	1975	3,851,992
1960	3,172,000	1968	3,519,000	1976	3,926,988
1961	3,055,000	1969	3,658,612	1977	4,129,796
1962	3,503,000	1970	4,034,266	1978	4,191,180
1963	3,258,000	1971	3,876,282	1979	3,569,819

Project Authority

Section 101(a) of the Water Resources Development Act of 1976 (Public Law 94-587) approved 22 October 1976, authorized undertaking the Phase I Design Memorandum stage of advanced engineering and design of the project for beach erosion control for Presque Isle Peninsula at Erie, Pennsylvania, in accordance with, and subject to the conditions recommended by the report of the Chief of Engineers dated 8 April 1976 (see Exhibit E-1 in Appendix E), and as set forth in Senate Document No. 85, 95th Congress, 2nd Session. The Water Resources Development Act of 1976 also extended Federal participation in the cost for sand replenishment with authorization that, at the expiration of the authorization provided in Section 57 of the Water Resources Development Act of 1974, allows the Secretary of the Army, acting through the Chief of Engineers, to provide periodic beach nourishment in accordance with the cost-sharing provisions of Section 103(a)(2) of the Act of 23 October 1962.

Description of Recommended Plan for the Authorized Study

The plan of improvement which was recommended in the 1974 Review Report and as recommended in Senate Document No. 95-85 is shown on Plate 1 in Appendix A. The plan provides for construction of five sections of segmented, rubble-mound breakwaters located offshore from susceptible areas of erosion and placement of 1,630,000 cubic yards of sandfill. Three sections of the breakwaters would consist of four segments and two sections would consist of five segments. Each breakwater segment would be 500 feet long and would be separated by a 100-foot gap to permit water circulation. The breakwater segments would be positioned at the 10-foot depth contour and would have a crest height of 8.5 feet above low water datum. The latest approved project cost estimate (Full Funding PB-3 dated October 1979) for the 1976 modification is $31,980,000 (Oct. 1979 Price Levels). The corresponding Federal and non-Federal shares for the 1976 modification are $22,380,000 and $9,600,000, respectively.

Items of Local Cooperation in Authorizing Document

The items of local cooperation at the time of project authorization, as set forth in Senate Document No. 95-85, required that, prior to commencement of construction, local interests agree to:

a. Provide without cost to the United States all lands, easements, and rights-of-way, including suitable borrow and spoil disposal areas as determined by the Chief of Engineers, necessary for the construction of the project;

b. Provide a cash contribution equal to the appropriate percentage of the final construction cost exclusive of lands, easements, and rights-of-way, the percentage to be in accordance with existing law and based on shore ownership and use existing at the time of construction, which contribution is presently estimated at 30 percent;

c. Pay 30 percent of the annual beach redistribution and replenishment costs for the project;

d. Hold and save the United States free from damages due to the construction works;

e. Maintain and operate all the works, including periodic sand replenishment and redistribution as needed, after completion in accordance with regulations prescribed by the Secretary of the Army;

f. Assure continued public ownership or continued public use, without cost to the United States, of appropriate access and facilities, including parking and sanitation, necessary for realization of the public benefits upon which Federal participation is based, and administer and maintain the beach for continued public use during the life of the project; and

g. Control water pollution to the extent necessary to safeguard the health of bathers.

The Existing Cooperative Beach Erosion Control Project

The cooperative beach erosion control project at Presque Isle Peninsula was originally authorized by the 1954 River and Harbor Act (Public Law 83-780) approved 3 September 1954 in accordance with the plans and conditions set forth in House Document No. 231, 83rd Congress, 1st Session. The project provided for construction of a seawall, bulkhead, and a groin system along the neck of the peninsula, removal of a portion of the lighthouse jetty and the bulkhead easterly thereof, the restoration of beaches on the lakeward perimeter of the peninsula by placement of sandfill, and Federal participation in the cost equivalent to one-third of the total first cost. The project plan authorized by the 1954 River and Harbor Act is shown on Plate 2 in Appendix A. The project was constructed in 1955 and 1956 at a total cost of about $2,451,000 of which $817,000 were Federal funds and $1,634,000 was the non-Federal share.

When the cooperative beach erosion control project authorized by the 1954 River and Harbor Act was adopted, it was recognized that periodic replenishment with sandfill would be required to preserve the full protective and recreational function of the project. However, the predominant west-to-east direction of littoral transport continued to remove more sand from the beaches along the peninsula than is supplied by littoral drift along the shore from the west of Presque Isle Peninsula. Sand losses were greater than estimated; therefore, to control the erosion to a point where the Federal shore protection structures and the State's park facilities would not be threatened, a modification of the cooperative beach erosion control project was enacted under the 1960 River and Harbor Act (Public Law 86-645) approved 14 July 1960 in accordance with the recommendations contained in House Document No. 397, 86th Congress, 2nd Session. The 1960 River and Harbor Act authorized Federal participation in beach nourishment to the limits shown on Plate 3 in Appendix A and to the extent of one-third the cost for a period of 10 years following the first major replenishment operation. Later, in accordance with Section 103(a)(2) of the 1962 River and Harbor Act (Public Law 87-874) approved 23 October 1962, the Federal share of subsequent project costs was increased to 70 percent. Sand replenishment operations authorized by the 1960 Act were undertaken in 1960-1961, 1964-1965, 1965-1966, 1968-1969, and 1971 at a total cost of $2,178,000 of which $1,329,000 were Federal funds and $849,000 was the non-Federal cash contribution.

The authorization under the 1960 River and Harbor Act expired in 1971. Subsequently, the cooperative beach erosion control project at Presque Isle Peninsula was further modified under Section 57 of the 1974 Water Resources Development Act (Public Law 93-251) approved 7 March 1974. The 1974 Water Resources Development Act reinstated and extended Federal participation in the cost for sand replenishment, not to exceed $3,500,000 for a period of five years, in accordance with the terms existing immediately prior to the termination of the authorization of the 1960 River and Harbor Act and to the limits shown on Plate 3 in Appendix A. The Water Resources Development Act of 1976 extended Federal participation in the cost for periodic sand replenishment beyond the five years authorized by the 1974 Act. This extension allows for Federal participation in sand replenishment during the preconstruction period for a project which will provide permanent protection to Presque Isle Peninsula. Five years of sand replenishment, as authorized by the 1974 and 1976 Water Resources Development Acts, have been completed, a sixth year of replenishment is presently underway and is scheduled to be completed by July 1980, and another 4 years are scheduled to provide sand replenishment for the period before construction of any improvements can be implemented. Through fiscal year 1980, $6,500,000 have been appropriated under the authority of the 1974 Water Resources Development Act, of which $4,550,000 were Federal funds and $1,950,000 was the non-Federal cash contribution.

The incompleted features of the cooperative beach erosion control project at Presque Isle Peninsula are 4 years of annual beach replenishment which are presently scheduled as authorized by the Water Resources Development Act of 1974 and extended by the Water Resources Development Act of 1976. The estimated cost for these 4 years of sand replenishment is $5,460,000 (from latest approved project cost estimate - Full Funding PB-3 dated October 1979) of which $3,820,000 is the estimated Federal share and $1,640,000 is the estimated non-Federal share. These 4 years of annual beach replenishment will insure protection of existing Federal structures and provide a better recreational beach during the preconstruction period for the permanent project. The continued replenishment should also reduce the initial replenishment required at the time of construction of improvements developed during the study authorized by the Water Resources Development Act of 1976. Also incompleted at this time is the Phase I design memorandum stage of advanced engineering and design, the detailed design, and construction of the improvements for the permanent project. The estimated cost for the incompleted permanent project is $31,980,000 (from latest approved project cost estimate - Full Funding PB-3 dated October 1979) of which $22,380,000 is the estimated Federal share and $9,600,000 is the estimated non-Federal share. The authorized project for Presque Isle will be about 23 percent complete at the end of fiscal year 1980. The estimated total project cost is $48,569,000 (Oct. 1979 P.L.). Estimated Federal (Corps of Engineers) cost is $32,816,000 (Oct. 1979 P.L.) which includes $6,696,000 for completed work. The estimated non-Federal cost is $15,673,000 (Oct. 1979 P.L.) which includes $4,433,000 for completed work. Also included in the total project cost is $80,000 for the U. S. Coast Guard to install navigation lights and aids.

A summary of the Presque Isle project costs is shown below:

	Federal Costs		Non-Federal Costs		Total Project Costs
	Completed Work	Incompleted Work	Completed Work	Incompleted Work	
	$	$	$	$	$
1954 R&H Act	817,000	-	1,634,000	-	2,451,000
1960 R&H Act	1,329,000	-	849,000	-	2,178,000
1974 WRD Act	4,550,000	3,820,000	1,950,000	1,640,000	11,960,000
1976 WRD Act	-	22,380,000	-	9,600,000	31,980,000 1/
Totals	6,696,000	26,200,000	4,433,000	11,240,000	48,569,000

1/ Does not include $1,100,000 for the Phase I General Design Memorandum work effort which is considered as a preauthorization study cost and is not included in the project cost estimate.

$$\% \text{ complete} = \frac{\$11,129,000}{\$48,569,000} = 23\%$$

All items of local cooperation have been fully complied with for the completed project as authorized by the 1954 and 1960 River and Harbor Acts and to date for the work completed as authorized by the 1974 Water Resources Development Act. The Department of Environmental Resources (DER) of the Commonwealth of Pennsylvania acts as the local cooperator and by letter dated 24 July 1974 (see Exhibit E-2 in Appendix E) stated its commitment to the maintenance and development of Presque Isle as a recreational area and also expressed its willingness to sponsor the project. The Pennsylvania Department of Environmental Resources, in letters dated 7 March 1978 and 23 August 1979 (see Exhibits E-3 and E-4 in Appendix E), reiterated its commitment to act as the sponsor for the permanent beach erosion control project on behalf of the Commonwealth of Pennsylvania and stated it will continue to participate in cost-sharing for periodic nourishment prior to construction of the permanent project. The Department of Environmental Resources in their 7 March 1978 and 23 August 1979 letters also stated their intent to meet the terms required for local cooperation in a Local Assurances Agreement for the permanent beach erosion control project. Also, in their 23 August 1979 letter, the Department of Environmental Resources states that they have the legal authority to enter into local cooperation agreements with the Federal Government.

SCOPE OF THE STUDY

The scope of this study is to determine if the partial breakwater concept set forth in Senate Document No. 85, 95th Congress, 2nd Session, or one of the other economically feasible concepts which were investigated during preparation of the Review Report dated November 1973 (revised June 1974), is the best plan

in the interest of beach erosion control at Presque Isle State Park. The geographical area of concern in this investigation is Presque Isle Peninsula and the nearshore area of Lake Erie. Particular attention is given to Gull Point which is located at the eastern end of the peninsula and to the 6-1/4 miles of peninsula shoreline from where the peninsula joins the mainland shore at its western end to its distal eastern end where it turns sharply shoreward.

During preparation of the Review Report, a total of 33 concepts for beach erosion control were suggested by the public. Many of the concepts were of the same category and were grouped into general concepts representative of the most practicable measures for beach erosion control. Six general concepts were determined to be the most viable plans. These six concepts are the full and partial breakwater plans, the sand recirculation and the sand trap recirculation plans, a groin plan, and an annual nourishment plan. The partial offshore breakwater concept appeared to be the most acceptable. However, the Board of Engineers for Rivers and Harbors noted in their report to the Chief of Engineers dated 2 August 1974 (see Exhibit E-5 in Appendix E) that all the economically feasible alternatives warrant further consideration during post authorization studies. In April 1978, the District Engineer at Buffalo prepared a Plan of Study for the project as a basis for undertaking a Reformulation Phase I General Design Memorandum (GDM) investigation. The North Central Division Engineer approved the recommendation for a reformulation type Phase I GDM investigation in May 1978. Therefore, this Phase I advanced engineering and design study consists of a detailed economic, environmental, and technical analysis of those six concepts which are representative of the most viable alternatives for beach erosion control at Presque Isle.

This Phase I General Design Memorandum provides a summary of the planning processes carried out in a reformulation investigation for determining the advisability for further modification of the cooperative beach erosion control project at Presque Isle Peninsula. The investigation, which was accomplished in accordance with the U. S. Army Corps of Engineers regulations contained in the ER 1105-2-200 series, addresses all known water and related land needs in the study area, and discusses procedures to mitigate the problems. The investigation reviewed the Commonwealth of Pennsylvania's comprehensive recreational plans and assessed the existing and planned recreational facilities. An economic base study of northwest Pennsylvania was prepared, a demand schedule for the Presque Isle region was forecasted, and the impact of Presque Isle on regional economy was discussed. This study does not include an investigation of other potential outdoor recreational developments in the region nor regional or local water resource needs other than those directly applicable to Presque Isle Peninsula.

The recommended plan of improvement in this report was developed from reformulation studies discussed and contained in this design memorandum. The selected plan is technically sound, environmentally and socially acceptable, and economically feasible. This Phase I General Design Memorandum serves as the basis for obtaining authorization to proceed with the detailed design and preparation of a Phase II General Design Memorandum.

Current and Planned Surveys and Studies

Previous surveys and studies which were completed will be addressed later in the paragraph entitled "PREVIOUS SURVEYS AND STUDIES" in this section of the report. Those previous surveys and studies contain a considerable amount of data and background information concerning Presque Isle Peninsula. Therefore, it is the intent of this report to summarize or reference pertinent information which was previously documented and only supplement and update those surveys and studies which are applicable to the development of a plan of improvement which will provide adequate protection to the peninsula and sufficient beach area for the recreational users. The following studies were accomplished or are being undertaken to provide information for analyzing alternative plans and development of a plan of improvement which is technically sound, environmentally acceptable, and economically feasible in preserving the beaches along Presque Isle Peninsula:

1. Monitor Shoreline Changes - Vertical aerial photography of Presque Isle Peninsula has been undertaken each April, July, and November since 1976. The aerial photography is scheduled to continue through July 1981. To complement the aerial photography with ground truth data, a contract was awarded to Dr. Dag Nummedal to obtain field survey data which included beach profiles, nearshore bathymetric profiles, and the collection of beach sediment samples. Dr. Nummedal's field surveys were made in April, July, and November of 1978 and coincided with the aerial photography. In addition, historical shoreline change maps were utilized to determine long-term rates of sediment accretion at the east end of the recurved spit. Based on the 1978 survey of beach and offshore profiles at Presque Isle and a review of historical shoreline change maps, Dr. Nummedal has made the following preliminary conclusions:

a. Within the groin field is a distinct seasonal pattern of shoreline erosion and deposition. Data from the 1978 field surveys was representative of only the low energy season (April-November). During this low energy season there was intense erosion downdrift (east) of each groin and slight accretion updrift (west).

b. The estimated total loss of beach material from the groin field between April and November, 1978, is 30,000 m^3 (39,200 cubic yards).

c. Except for localized areas of accretion, the net shoreline trend along the entire shore of Presque Isle west of the lighthouse was one of erosion.

d. The beach line longshore sediment transport rate between the lighthouse and Beach 10 was about 6,600 m^3 (8,600 cubic yards) during the survey period.

e. Evaluation of the historical growth records for the east end of Presque Isle, combined with Erie Harbor dredge records, suggest a total longshore transport rate (associated predominantly with bar migration) of about 200,000 m^3/yr (262,000 cubic yards/year). A further refinement of this figure must be based on studies of bar mobility.

f. Three types of bars are identified along the Presque Isle shoreline: crescentic (in the groin field), longshore (along the central part of the peninsula) and crescent-shaped bars associated with the protuberances along the recurved spit.

g. The crescentic bars are hypothesized as due to the existence of standing subharmonic edge waves between the groins while the multiple longshore bars east of the groin field are ascribed to progressive edge waves of a modal number higher than 1.

h. Bar migration is highly dynamic and believed to be a major factor in influencing longshore transport rates.

The study by Dr. Nummedal continued during April, July, and November in 1979. The 1979 study results indicate that those seasonal trends and the processes of shoreline and offshore evolution which were observed in 1978 continued. In addition, a severe storm which occurred on 5 and 6 April 1979 caused dramatic changes to the outer bar system, as well as to the active beach. Dr. Nummendal made the following preliminary conclusions from the 1979 survey.

a. The western groin field is characterized by a well-developed, stable, crescentic inner bar system and an alongshore outer bar which reflects the position of breaking storm waves. The outer bar increases in amplitude during strong storms and becomes flatter during the summer and fall, as the offshore contributes material to the nearshore inner bar system.

b. The sand placed on the beaches in the western groin field during nourishment operations, quickly retreats to an equilibrium position with the excess beach fill moving onto and along the offshore bar system.

c. By documenting the migration of a beach protuberance east of the lighthouse groin, it was concluded that only 20 percent of the total longshore transport moves along the beach and that 80 percent moves along the offshore bar crests.

d. Sediment transport occurs along the beach as protuberances develop and migrate. They are temporal sediment crops which migrate through the formation of small downdrift recurved spits.

e. The shoreline at Beach 10 has assumed a relatively stable cuspate form in response to the prototype breakwaters.

This monitoring study is being continued during 1980. The 1980 survey is being undertaken in order to test, refine, and expand upon the 1978 and 1979 conclusions and will be incorporated in the detailed design during the Phase II General Design Memorandum stage.

2. Current Pattern Study - A contract was awarded to Dr. Volker Harms whereby observations of the nearshore current system would be made at various locations along Presque Isle Peninsula. The nearshore current system was to

be observed, measured and documented for pattern, width, direction and velocity and an interpretation made which would correlate the wind and wave climate with the nearshore current system. Due to the unusual weather conditions (relatively calm) which prevailed during the Fall of 1978, the Contractor was unable to accomplish the required field observations and therefore the contract was terminated.

Personnel from the Corps of Engineers Coastal Engineering Research Center made field observations of the nearshore current system during October 1979 in the vicinity of the prototype breakwaters at Beach No. 10. The results from that survey are not available for incorporation in this report.

The model study which is presently being undertaken will also provide data on current patterns for incorporation in the detailed design during the Phase II GDM stage.

3. Monitor Prototype Breakwaters - Three breakwaters were constructed offshore from Beach No. 10 during June and July 1978. These breakwaters were constructed as a prototype experiment from which data and information could be obtained and used in analyzing the segmented offshore breakwater alternative in this Phase I design memorandum stage. The breakwaters are of rubblemound construction, 125 feet long, 6 feet in height, aligned parallel to shore, located in about 4 feet of water, and separated by gaps of 300 feet and 200 feet. In addition, 70,000 tons of sand were placed in the lee of the prototype breakwaters. To monitor the effectiveness of these breakwaters as wave attenuators and beach builders, post construction vertical aerial photography of the Beach No. 10 area will be obtained in April, July, and November for the period from 1978 through 1981. In addition, topographic and hydrographic surveys of the Beach No. 10 area will be obtained each April and November to quantify any changes. Sediment samples will be obtained each November and gradation analyses performed. The results obtained to date from the monitoring program are discussed in paragraph C4.b.(2) entitled Existing Breakwaters in Appendix C.

4. Littoral Environment Observation Program (LEO) - A LEO program was enacted in April 1978 at Presque Isle Peninsula to establish a data bank of littoral parameters and provide information on short- and long-term behavior of physical factors in the Presque Isle area. State park personnel obtain information on the climatology of waves and longshore currents, beach response, and nearshore meteorology at two sites (Beach No. 6 and Beach No. 9) on the peninsula. The data obtained from the visual observations by the observers is sent to the Coastal Engineering Research Center (CERC) for analysis. The results from the LEO program along with data from surveys and sand sampling obtained by the Buffalo District will be used in analyses to determine sand transport rates along the peninsula. This program has been underway at Presque Isle for one year (1978) and is scheduled to continue for two more years (1980 and 1981). The results obtained from the 1978 data are discussed in the Summary presented in paragraph C5.c. in Appendix C.

5. Inner Continental Shelf Sediment and Structure Study (ICONS) - The Coastal Engineering Research Center (CERC) performed an ICONS study offshore from Presque Isle during the Summers of 1977 and 1978. The purpose of the

study was to determine locations of sand sources in the offshore area. Geophysical data (bottom and subbottom acoustical energy responses) and cores were obtained to determine sediment characteristics and areal extent of sand suitable for beach restoration and periodic nourishment in the area offshore from Presque Isle. The preliminary results of the study indicate that two areas contain sand that is judged suitable for beach nourishment. The one area (the ridge area) lies in 50 to 65 feet of water and contains fine to medium sand. Volume estimates indicate that there are approximately 48.6 million cubic yards of sand in that area. The second area is located off the Presque Isle Light and calculations indicate that the area contains an estimated volume of 1.9 million cubic yards of sand. The sediment composition of the lake floor in this area appears to be more variable than that of the ridge area. An additional discussion of this study is presented in the paragraph entitled Other Considerations for a Possible Plan of Improvement in Section C of this report.

6. Model Study - A model study of the segmented breakwater alternative was initiated by the Waterways Experiment Station in Vicksburg, MS, during December 1979 and will take 21 months to complete. Correspondence from WES (see Exhibit F-46 in Appendix F) indicates that major changes to the proposed plan of beach protection are not anticipated and that the model is being used as a tool to study, refine, and optimize the breakwater design. The model study will consist of reproducing, at an undistorted scale of 1:50, approximately 9,500 feet of shoreline and modeling underwater contours to about 24 feet below low water datum. The study is discussed in more detail in correspondence presented as Exhibits F-26 and F-27 in Appendix F.

7. Environmental Studies - During the Summer and Fall of 1978, biologists of the Buffalo District Office of the Corps conducted botanical field surveys of the Gull Point area of Presque Isle Peninsula. Consultations with local authorities on bird resources were undertaken to address aspects of avian ecology on the peninsula. A bacteriological study in the vicinity of the prototype breakwaters offshore from Beach No. 10 was accomplished during the Summer of 1979 in order to determine if bacteriological contamination will be a problem in the calm zone in the lee of the breakwaters. The preliminary results from the 1979 study indicate that there is no significant degradation on water quality associated with the prototype breakwaters. The results from the environmental studies undertaken to date are presented in the paragraph entitled Description of the Biological Environment in Section B of this report and also in the ENVIRONMENTAL IMPACT STATEMENT attached as Section H to this report. The bacteriological study is scheduled to continue during the Summer of 1980 in order to verify and expand upon the results from the 1979 study.

8. Topographic and Bathymetric Surveys - During the Summer of 1979, Buffalo District survey personnel obtained topographic and bathymetric survey data along the entire lakeward perimeter of Presque Isle Peninsula. The purpose of the surveys was to establish beach profiles and offshore bottom contours in the study area. This information was required for preparation of estimates for the quantities of beach fill needed for initial replenishment and for the wave refraction analysis. The results of these surveys are also being used to construct the hydraulic model.

9. Wave Refraction Analysis - A wave refraction study was performed to provide an analysis for the shoreward propagation of the design deep water waves at Presque Isle Peninsula. This information was required in order to design the offshore breakwaters for the segmented breakwater plan and will also be used to calibrate the hydraulic model. The results of the wave refraction analysis are presented in paragraph C3.(2) in Appendix C.

STUDYPARTICIPANTS AND COORDINATION

Public Involvement

The Senators and Congressmen representing the Erie, PA, area, in addition to all Federal and State agencies, the local private clubs and associations, and the general public have been involved in the current cooperative beach erosion control study for Presque Isle Peninsula since authorization of the review study in 1968. During preparation of the Review Report, three public meetings and one public workshop were held to keep concerned citizens informed of developments in the study and assess their views and input for incorporation into the planning process. In addition, two coordinating meetings were held between Buffalo District personnel and officials of the Pennsylvania Bureau of State Parks. Four television interviews were also used to transmit information to the public. There was also written correspondence with other Federal, State, and local agencies throughout the study. These activities are recorded in detail in the 1974 Review Report and Final Environmental Statement dated September 1975 which were prepared by the Buffalo District Engineer.

Public involvement activities during this reformulation investigation were initiated by a news release issued on 19 October 1977, informing the public that a study which will recommend a plan of improvement that will reduce sand losses from the beaches at Presque Isle State Park was being initiated (see Exhibit F-1 in Appendix F).

A draft Plan of Study was prepared in March 1978 and copies were provided to the Senators and Congressmen in Erie, PA, to all Federal and State agencies, and to all private clubs and associations on the project mailing list for their review and comment. Copies of the draft Plan of Study were placed on reserve in all Erie city and county libraries and District Libraries in the northern Pennsylvania area to also allow the public an opportunity to review and comment on the report. A letter was sent to each individual on the project mailing list (approximately 400 individuals) to inform them that the draft Plan of Study is available at the libraries. Availability of the draft Plan of Study at the libraries was also announced in the news media. All responses and comments received in coordination of the draft Plan of Study are attached as Exhibits F-2 through F-11 in Appendix F.

On Tuesday, 30 May 1978, an initial public meeting was held at Technical Memorial High School in Erie to inform the public about the alternatives which would be investigated during this Phase I advanced engineering and design study effort and to solicit public response and suggestions for the study. Colonel Daniel D. Ludwig, Buffalo District Engineer, presided over the meeting and six other Corps personnel were in attendance along with 13

interested citizens. The Corps presented seven concepts for controlling beach erosion: the full breakwater plan, the partial breakwater plan, the groin plan, the sand recirculation plan, the recirculation sand trap plan, the annual nourishment plan, and the no-action plan. In addition, the schedule for completion of the project was presented.

The Pennsylvania Department of Environmental Resources (DER) presented a statement at the 30 May 1978 public meeting on the importance of Presque Isle Peninsula to the city of Erie's growth and economy and its value in providing recreational opportunities for picnicking, swimming, and boating, as well as its value to the ecologists and students of nature. The Department of Environmental Resources voiced their opposition to the Board of Engineers for Rivers and Harbors recommendation that the recirculation sand trap alternative warrants further consideration. DER is concerned about serious environmental and maintenance problems with the sand trap alternative. The DER indicated that they favor construction of segmented rubblemound breakwaters and that they are prepared to meet the requirements of local cooperation and work for legislative approval of capital appropriations for the Commonwealth's share of the project.

The strongest environmental concerns were expressed, at the 30 May 1978 public meeting, by a private citizen in attendance who is concerned that the segmented breakwaters would interrupt the view of the lake by bathers lying on the beach, interfere with swimming, and cause debris to collect on the beaches due to the loss of water circulation.

A transcript of the 30 May 1978 public meeting is on file at the Buffalo District Office of the Corps of Engineers. A copy of the public meeting announcement, information packet on the Presque Isle Cooperative Beach Erosion Control Project, and the Department of Environmental Resources statement are included as Exhibits F-12 through F-14 in Appendix F of this report.

The Stage II documentation for this Phase I investigation was prepared in June 1979. Copies of the Stage II document were provided to the U. S. Fish and Wildlife Service, the U. S. Environmental Protection Agency, the Pennsylvania Fish Commission, Pennsylvania Game Commission, the Department of Environmental Resources, and Dr. Dag Nummedal for their review and comment. The responses and comments received in coordination of the Stage II document are attached as Exhibits F-15 through F-18 in Appendix F.

On Wednesday, 26 September 1979, a public meeting was held at the Gannon College Zurn Theater in Erie to review the alternative plans for protection and improvement of Presque Isle Peninsula that were developed during preparation of the State II documentation and to solicit comments and input from the public for final plan selection. Colonel George P. Johnson, Buffalo District Engineer, presided over the meeting and four other Corps personnel were in attendance along with approximately 20 interested citizens. The Corps presented five alternative plans which were developed to provide long-term solutions to the erosion problems and thereby preserve Presque Isle Peninsula and its recreational facilities. The alternative plans presented

were: the segmented breakwater plan, the groin plan, the sand recirculation plan, the sand trap recirculation plan, and an annual nourishment plan. In addition, the no-action plan and schedule for completion of the project were discussed.

The statement presented at the meeting by the Pennsylvania Department of Environmental Resources, as well as comments made by some of the interested citizens, indicated that the segmented offshore breakwater plan is the preferred plan for protection and improvement of Presque Isle Peninsula. In fact, the private citizen who expressed environmental concerns related to offshore breakwaters at the 30 May 1978 public meeting, was now convinced that offshore breakwaters are the way to proceed. That individual's concerns were reversed after having an opportunity to observe the effectiveness of the prototype breakwaters constructed at Beach No. 10 the previous year.

A transcript of the 26 September 1979 public meeting is on file at the Buffalo District Office of the Corps of Engineers. A copy of the public meeting announcement, information packet, and the statement presented by the Department of Environmental Resources are included as Exhibits F-19 through F-21 in Appendix F.

A Section 404 Public Notice for the Cooperative Beach Erosion Control Project at Presque Isle Peninsula in Erie, PA, was issued on 9 October 1979 (see Exhibit F-22 in Appendix F). The purpose of the Public Notice was to provide any person, who has an interest which may be affected by construction of 58 parallel-to-shore breakwater segments and placement of 750,000 cubic yards of sandfill along the entire shoreline of Presque Isle Peninsula, an opportunity to request a public hearing. The Public Notice was sent to all Senators and Congressmen in Erie, PA, to all Federal and State agencies, to all private clubs and associations, and all individuals on the Presque Isle mailing list. The only response received regarding the Public Notice was from the U. S. Fish and Wildlife Service (see Exhibit F-23 in Appendix F) which states that they have no problem with the selected plan.

A draft Phase I General Design Memorandum was prepared in February 1979. Copies of the draft Phase I GDM were provided to the Senators and Congressmen in Erie, PA, to all Federal and State agencies, and to all private clubs and associations on the project mailing list for their review and comment. Copies of the draft Phase I GDM were placed on reserve in all Erie city and county libraries and District libraries in the northern Pennsylvania area to also allow the public an opportunity to review and comment on the report. A letter was sent to each individual on the project mailing list (approximately 400 individuals) to inform them that the draft Phase I GDM is available at the libraries. Availability of the draft Phase I GDM at the libraries was also announced by a press release. A total of 115 copies of the draft Phase I GDM were sent out for coordination with agencies and individuals. A number of reviewers have provided comments to the draft Phase I GDM which was issued in February 1980. Copies of the letters of comment are attached as Exhibits F-34 through F-43 in Appendix F. The reviewer's comments and Buffalo District's responses are addressed in Exhibit F-44 in Appendix F in the order that the letters of comment were received.

As discussed in the preceding paragraphs, the public involvement and coordination activities during this Phase I stage of the Presque Isle beach erosion control study have included two public meetings. The inital public meeting (attended by 13 persons) was held on 30 May 1978 to inform the public about the alternatives which would be investigated during the Phase I GDM study effort. On 26 September 1979, a second public meeting (attended by 19 persons), was held to review the alternatives which were developed during Stage II Planning. At the second public meeting, the selection of the Segmented Breakwater Plan as the plan which will be recommended to Congress for Phase II design study was indicated. A statement presented at the meeting by the Pennsylvania Department of Environmental Resources, as well as comments made by some of the interested citizens, indicated that the segmented offshore breakwater plan is the preferred plan for protection and improvement of Presque Isle Peninsula. Because there was no opposition against the segmented breakwater plan expressed at the 26 September meeting, a Section 404 Public Notice concerning the breakwater plan was issued on 9 October 1979 to nearly 500 agencies, organizations, and individuals on the project mailing list. The only response received regarding the Public Notice was from the U.S. Fish and Wildlife Service. Since it was a foregone conclusion at the 26 September meeting that the segmented breakwater plan was going to be the selected plan and since there had been no objections to the breakwater plan, approval to dispense with the late stage public meeting which was scheduled to be held in May 1980 was requested (See Exhibit F-30 in Appendix F). The North Central Division Engineer agreed that there probably was no need to conduct the late stage public meeting (See Exhibit F-31 in Appendix F); however, it was requested that a press release be issued to inform the appropriate agencies and local citizens that another public meeting is not considered necessary. In concurrence with the NCD request, a press release was issued on 23 May 1980 and information packets describing the most recent plans which were considered in Stage III of the study along with the alternative which was selected as the recommended plan for protection and improvement of the beaches along Presque Isle Peninsula were prepared. The information packet was mailed to all agencies, organizations, and individuals on the project mailing list stating that, due to the lack of opposition to the selected plan at previous public meetings and the general acceptance of the proposed plans to date, it is deemed unnecessary to hold another public meeting. The packet did however give the reviewers the option of requesting a public hearing if they had an interest that may be affected by the segmented breakwater plan. The press release and information packet did not generate any expressions of support for another public meeting, therefore, the late stage public meeting was not held. Copies of the press release and information packet are included as Exhibits F-32 and F-33 in Appendix F.

Coordination with the Commonwealth of Pennsylvania

The Buffalo District Office of the Corps of Engineers has maintained a close working relationship with the Commonwealth of Pennsylvania for development of a project for beach erosion control at Presque Isle Peninsula since authorization of the review study in 1968. The Pennsylvania Department of Environmental Resources (DER), which is the agency committed to act as the sponsor for the project on behalf of the Commonwealth of Pennsylvania, has taken an active role in providing the Commonwealth's ideas and viewpoints

for consideration throughout the study. The DER has participated in each public meeting and has provided comments and suggestions during Stage I Planning (see Exhibit F-5 in Appendix F) and Stage II Planning (see Exhibit F-16 in Appendix F). Copies of the draft Phase I GDM were furnished to the Commonwealth of Pennsylvania, however, there were no comments received concerning the results of Stage III planning as presented in the draft Phase I GDM.

Coordination with the U. S. Fish and Wildlife Service

In accordance with the terms of the Fish and Wildlife Coordination Act of 1959, the Buffalo District Corps of Engineers and the State College Field Office entered into agreement whereby the U. S. Fish and Wildlife Service would review the study progress and provide technical input, particularly on identification of sensitive fish and wildlife concerns and recommendations for future studies and investigations in the project area. The State College Field Office was provided a copy of the draft Plan of Study and the Stage II documentation for review and comment during the planning process. Based on their responses to these reports (see Exhibits F-11 and F-17 in Appendix F), there are no known controversial environmental issues or areas of concern at this time. The U. S. Fish and Wildlife Service has also provided a letter dated 22 October 1979 responding to the Section 404 Public Notice stating that they have no problem with the segmented breakwater plan (see Exhibit F-23 in Appendix F).

Cultural Resource Coordination

During review of the draft Environmental Impact Statement for the Cooperative Beach Erosion Project at Presque Isle Peninsula which was prepared in 1973, the Pennsylvania Historical and Museum Commission of the Commonwealth of Pennsylvania stated that the project would not affect a known archaeological or historical site or historical structure (see Exhibit F-24 in Appendix F). By letter dated 13 April 1979, the Buffalo District of the Corps of Engineers requested that the Pennsylvania Historical Museum Commission review the alternatives being considered during this study and then update their comments on the Presque Isle beach erosion control project. The Pennsylvania Historical and Museum Commission, by letter dated 22 May 1979 (see Exhibit F-25 in Appendix F), reiterated their statement that the proposed work will not have any effect on any known historic or archaeologic resources. Therefore, a Cultural Resources study will not be conducted during this investigation.

Model Study Coordination

A meeting was held at Presque Isle State Park on 21 August 1979 to discuss the feasibility of accomplishing a model study by the Waterways Experiment Station in Vicksburg, MS. Corps of Engineers representatives from the Coastal Engineering Research Center (CERC), Waterways Experiment Station (WES), Office of the Chief of Engineers (OCE), North Central Division (NCD), and Buffalo District (NCB), as well as the Superintendent of Presque Isle State Park and representatives from the Department of Environmental Resources of the Commonwealth of Pennsylvania were in attendance. At the meeting, it

was concluded that a fixed-bed, physical model with tracer material would be a useful tool for the design and arrangement of offshore breakwaters for prevention of erosion of the Presque Isle Peninsula shoreline. The purpose of the model would be to optimize the breakwater parameters such as length, height, orientation, optimum breakwater spacing and distance offshore, the interactions between the proposed breakwaters and the existing groins, the effects of the structures on the littoral processes, and the potential for sand transport through the breakwater system. Correspondence from WES (see Exhibit F-46 in Appendix F) indicates that major changes to the proposed plan of beach protection are not anticipated and that the model is being used as a tool to study, refine, and perfect the breakwater design. The portion of the peninsula shoreline which would be modeled consists of a 1-1/2 or 2-mile reach from Groin No. 8 through Beach No. 8. Also discussed was the possibility of testing conditions at the prototype breakwaters for calibrating the model and extrapolating information for the project. The minutes of the meeting are contained in the Memorandum for the Record (MFR) included as Exhibit F-26 in Appendix F.

The Corps of Engineers Waterways Experiment Station has been requested to perform the model study and has provided the Buffalo District with an estimate of the cost and time schedule to conduct this study. Approval to conduct this study was provided by the Office of the Chief of Engineers by letter dated 30 October 1979. Correspondence relating to this model study is included as Exhibit F-27 in Appendix F.

PREVIOUS SURVEYS AND STUDIES

There have been many studies undertaken and reports written concerning Presque Isle Peninsula. Study reports cover the geological and biological background of the peninsula, the historical significance, plans for protection and improvement of the peninsula, and the environmental impacts of preserving the peninsula and its recreational facilities from natural erosion processes. The reports most pertinent to the cooperative beach erosion control project and the Corps of Engineers investigation are summarized below:

1. House Document No. 231, 83rd Congress, 1st Session - August 1953.

The report contains the results of the investigations undertaken by the Corps of Engineers to develop a plan of protection and improvement for the entire peninsula. The plan of improvement which was considered to be the most suitable consisted of provisions for a continuous sand beach created by placement of artificial fill, the construction of bulkheads to serve as a last line of defense in case of temporary loss of sandfill, and groins to reduce the rate of loss of the sandfill. That plan met the need and desires of local interests since it would provide adequate protection to the highway along the neck of Presque Isle Peninsula and insured its uninterrupted use by elimination of inundation from storm wave action. The plan also would provide sufficient beach area to insure adequate capacity for accommodation of peak-day crowds. The report recommending the plan of improvement was submitted to Congress and authorized for implementation by the 1954 River and Harbor Act.

2. Design Memorandum for Shore Protection Project, Presque Isle Peninsula, Erie, Pennsylvania - prepared by the Corps of Engineers - May 1955.

This report presents the design of the project features for the protection and improvement of the lakeshore of Presque Isle Peninsula. The design memorandum was prepared prior to construction of the cooperative project and contains a discussion on an extensive investigation of sources of beach-fill material to be used in the initial fill operations and subsequent replenishment requirements.

3. Interim Reports on the Cooperative Beach Erosion Control Study.

Topographic and hydrographic surveys were made annually after completion of the initial cooperative project in 1956. Interim reports on the condition of the project were made by the Corps of Engineers in 1958, 1959, and 1963. The 1958 report analyzed rates of movement and losses of beachfill following the completion of the original project. The results of a 1957 survey showed that the movement and losses of sand had been greater during the first year since completion of the project than the predicted losses given in the project design memorandum. There was a total movement of about 1,280,000 cubic yards of sand of which 1,074,000 cubic yards were deposited in the form of an offshore bar located at the toe of the design slope. The 1959 report concluded that approximately 154,000 cubic yards of sand would be required annually during the early life of the project and recommended modification of the cooperative beach erosion control project to provide for Federal participation in periodic replenishment of the sandfill for a period of ten years. The 1963 report provided similar information as contained in the other two interim reports and identified critical areas of erosion in the vicinity of Groin Nos. 4 and 11 and the lighthouse groin.

4. House Document No. 397, 86th Congress, 2nd Session - May 1960.

The report contains the results of the investigations undertaken by the Corps of Engineers to determine the rates of loss and movement of the sandfill, to estimate the nourishment requirements, and to determine the eligibility for Federal participation in the cost of periodic beach nourishment. The content is basically the same as that contained in the 1958 and 1959 interim reports on the cooperative beach erosion control project. This report recommending modification of the original project by providing Federal participation in periodic replenishment of sandfill for a period of ten years was submitted to Congress and authorized for implementation by the 1960 River and Harbor Act.

5. Review Report on Cooperative Beach Erosion Control at Presque Isle Peninsula - prepared by the Corps of Engineers - June 1974.

This report was prepared to determine whether any modifications of the original beach erosion control project completed in 1956 are advisable in the interest of beach erosion control at and in the vicinity of Presque Isle Peninsula. The results of the investigations undertaken by the Corps of Engineers in developing alternative plans for protection and improvement of the peninsula and its recreational beaches are presented. The recommendation

of the report was: that the original project be modified to provide for construction of breakwaters located offshore from areas susceptible to erosion and placement of sandfill subject to provisions that local interests will give certain assurances; that the cooperative agreement between the Federal Government and the Commonwealth of Pennsylvania which provides for Federal participation in beach nourishment be extended beyond the five-year period authorized in Section 57 of the Water Resources Development Act of 1974 to include the preconstruction period and extend through the life of the project; and that a long-term program be set up to monitor changes in Presque Isle which may result from implementation of the project.

6. Final Environmental Statement for the Cooperative Beach Erosion Project at Presque Isle Peninsula - prepared by the Corps of Engineers - September 1975.

The Final Environmental Statement identifies and evaluates the effects which the plan of improvement recommended in the 1974 Review Report will have on the existing environment. A detailed presentation of the environmental setting without the project and the impacts, both favorable and unfavorable, for a number of feasible alternative solutions to the beach erosion problem is included. In addition, a number of reviewers provided comments on the draft Environmental Impact Statement which are attached to the final statement with the Corps responses.

7. Senate Document No. 95-85, 95th Congress, 2nd Session - February 1978.

The report contains the results of the investigations undertaken by the Corps of Engineers in developing the plan of protection and improvement of the peninsula and its recreational beaches. The content is basically the same as that presented in the 1974 Review Report and the Final Environmental Statement which was prepared in 1975. This report recommended modification of the original cooperative beach erosion control project by providing for construction of breakwaters located offshore from areas susceptible to erosion and placement of sandfill. The report of the Board of Engineers for Rivers and Harbors which notes that several alternatives developed during preparation of the 1974 Review Report are economically feasible and warrant further consideration during post-authorization studies is contained in this Senate Document. This report is the document used by Congress to authorize the Phase I general design memorandum stage of advanced engineering and design for the current study.

8. Environmental Assessment for the Prototype Breakwater Project at Presque Isle Peninsula - prepared by the Corps of Engineers - February 1978.

The assessment identifies and evaluates the impacts which construction of the prototype offshore breakwaters at Beach No. 10 would have on the quality of the human and natural environments.

THE REPORT AND STUDY PROCESS

This Phase I design memorandum stage of advanced engineering and design for the authorized Presque Isle Peninsula project involves three stages of planning at increasing levels of detail. Stage I Planning was completed in May 1978 and consisted of preparation of a Plan of Study which presented information about the study area, identified problems, and outlined work efforts to be accomplished during the investigation. Stage II Planning was completed in July 1979 and consisted of preparation of the Stage II documentation in which the alternatives that provide long-term solutions to the erosion problems at Presque Isle were designed, cost estimates prepared, and environmental impacts assessed. Stage III Planning is the final stage of the Phase I study and consists of preparation of the Phase I General Design Memorandum (GDM) Report in which alternatives are further developed and refined and the Environmental Impact Statement incorporated. Stage III is scheduled to be completed in July 1980 with Release of the Division Engineer's Public Notice and the Submisison of the final Phase I General Design Memorandum to the Board of Engineers for Rivers and Harbors (Milestone No. 31).

This Phase I GDM is prepared generally in accordance with the Corps of Engineers guidelines for organization and content of Feasibility Reports as outlined in ER 1105-2-920. The overall organization of this report consists of a Main Report, a Plate Appendix (Appendix A), a series of Technical Appendices (Appendices B through D), a Pertinent Correspondence Appendix (Appendix E), and a Public Involvement and Coordination Appendix (Appendix F). The Main Report is written to give both the general and technical reader a clear understanding of the study, the study results, and the basis for key decisions and conclusions. The Main Report provides a summary of the planning processes carried out for a reformulation Phase I General Design Memorandum investigation. It discusses: the authorizing legislation; the recommended plan for the authorized study and items of local cooperation; the existing cooperative beach erosion control project; historic development of the peninsula and methods of protection implemented for preservation of the peninsula; environmental impacts and concerns; pertinent studies undertaken or to be undertaken and their findings; problems, needs, and concerns; public involvement activities; reviews the alternative concepts being analyzed, subsequent events and changes to the concepts, and plan formulation steps during this investigation; environmental assessments; potential project benefits, costs, and cost allocation; conclusions and recommendations regarding the results and findings of the study, and the advisability for further modification of the cooperative beach erosion control project at Presque Isle Peninsula. The Plate Appendix includes all the plates developed for this report for easy reference. The Technical Appendices provide additional detailed information on the design and costs and benefits of the alternatives investigated and a material survey of construction materials.

The Pertinent Correspondence Appendix includes correspondence pertinent to the accomplishment of the project. The Public Involvement and Coordination Appendix contains correspondence documenting public involvement and coordination during this Phase I Design Memorandum investigation.

SECTION B
PROBLEM IDENTIFICATION

The purpose of this section is to give the reader of this report an understanding of the study area, its historic origin, and the history of protection measures undertaken. It informs the reader of the water and related problems and needs, or lack thereof, in the study area for which this study seeks a solution. This section presents information on the existing physical, biological, and human environment in the study area; discusses the national and planning objectives of the study; reviews the planning constraints under which this study was conducted; and reviews the conditions that would exist if no Federal action was taken.

NATIONAL OBJECTIVES

Current Federal policy, as developed by the President's Water Resources Council, requires that the alternative water and related resource plans be formulated in accordance with two national objectives for planning water resource projects. Therefore, in accordance with the guidance established in Engineering Regulation 1105-2-200, "Multiobjective Planning Framework," dated 10 November 1975, this study will be consistent with the planning requirements of the Water Resources Council Principles and Standards for Planning Water and Related Land Resources (P&S) published in the Federal Register on 14 December 1979. In accomplishing this study, equal consideration will be given to the P&S objectives of National Economic Development (NED) and Environmental Quality (EQ) described below:

National Economic Development (NED) - National Economic Development is achieved by increasing the value of the nation's output of goods and services and improving economic efficiency.

Environmental Quality (EQ) - Environmental Quality is achieved by the management, conservation, preservation, creation, restoration, or improvement of the quality of certain natural and cultural resources and ecological systems.

EXISTING CONDITION (PROFILE)

The purpose of this section is to present the environmental setting without the project in order to assess impacts of the various alternatives on the existing environment. The information presented will provide a data base for impact assessment and evaluation purposes.

Description of Study Area

Presque Isle Peninsula is located at Erie, PA, on the south shore of Lake Erie, 78 miles southwest of Buffalo, NY, and 102 miles northeast of Cleveland, OH. The regional location of Presque Isle Peninsula is shown on the vicinity map in Figure 2 and the locality map in Figure 3. The study area can be found on the Great Lakes Nautical Charts numbered 14820, 14824, and 14835 published by the National Oceanic and Atmospheric Administration (NOAA), the Canadian Nautical Chart numbered 2101, and also on the Erie North, and Swanville, PA, Quadrangles of the USGS maps.

Presque Isle Peninsula is a compound recurved sandspit that arches lakeward in a generally northeasterly direction from its narrow connection with the mainland just west of the city of Erie (see Figure 1). The length of the peninsula from its mainland root to its distal end where it turns sharply shoreward is about 6-1/4 miles. The eastern end of the peninsula terminates in several low, flat, recurving longshore bars. For a distance of about 2 miles from the westerly root, the peninsula is narrow and has an average width of generally less than 800 feet. This narrow section of the peninsula is called the neck. East of this narrow neck, the peninsula widens abruptly to a width of over 1 mile. Presque Isle Peninsula consists entirely of fine sand. The general ground elevation of the peninsula is relatively low, averaging about 7 or 8 feet above low water datum, which for Lake Erie is elevation 568.6 feet above mean water level at Father Point, Quebec, International Great Lakes Datum (IGLD 1955). There are four major and several minor sand ridges which extend across the peninsula generally in an east-west direction and rise to a maximum elevation of about 20 feet above low water datum. The higher ground on the peninsula sustains a thick growth of a wide variety of trees and shrubs. The low areas between the sand ridges are comprised of several lagoons and marshes. The lagoons provide excellent all-weather facilities for rowboats and canoes.

The lakeward perimeter of Presque Isle Peninsula is about 9 miles. The lakeward shoreline has been segmented into 11 bathing beaches by the Pennsylvania State Park Service. These beaches vary in width and, with the exception of Beach No. 11, have had a history of serious erosion for at least 150 years. The bathing beaches are backed by picnic areas, and four major beach areas are provided with bathhouse and parking facilities. Roadside parking provides easy access to intervening beach and picnic areas. Numerous protective works consisting of groins, revetments, bulkheads, and offshore breakwaters have been constructed to halt erosion. The bay shoreline is characterized by numerous small bays, coves, and inlets. Encircled between the peninsula and the mainland is Presque Isle Bay, the easterly part of which has been improved as Erie Harbor, a Federal deep-draft navigation project. The north jetty for the Erie Harbor entrance channel is joined to the distal east end of Presque Isle Peninsula.

Water Levels

Water levels on the Great Lakes vary from year to year and from month to month. Locally, water levels vary from day to day and from hour to hour. The seasonal variations usually consist of high levels in May and June and low levels in January and February. Yearly and seasonal fluctuations are caused by variations in precipitation rates within the Great Lakes Basin. Short-term fluctuations lasting from a few hours to several days are caused by meteorological disturbances. Differences in barometric pressure and winds blowing over the surface of the lake create temporary water level fluctuations which vary locally. Astronomical tides are assumed to have a negligible influence on water levels at the project site.

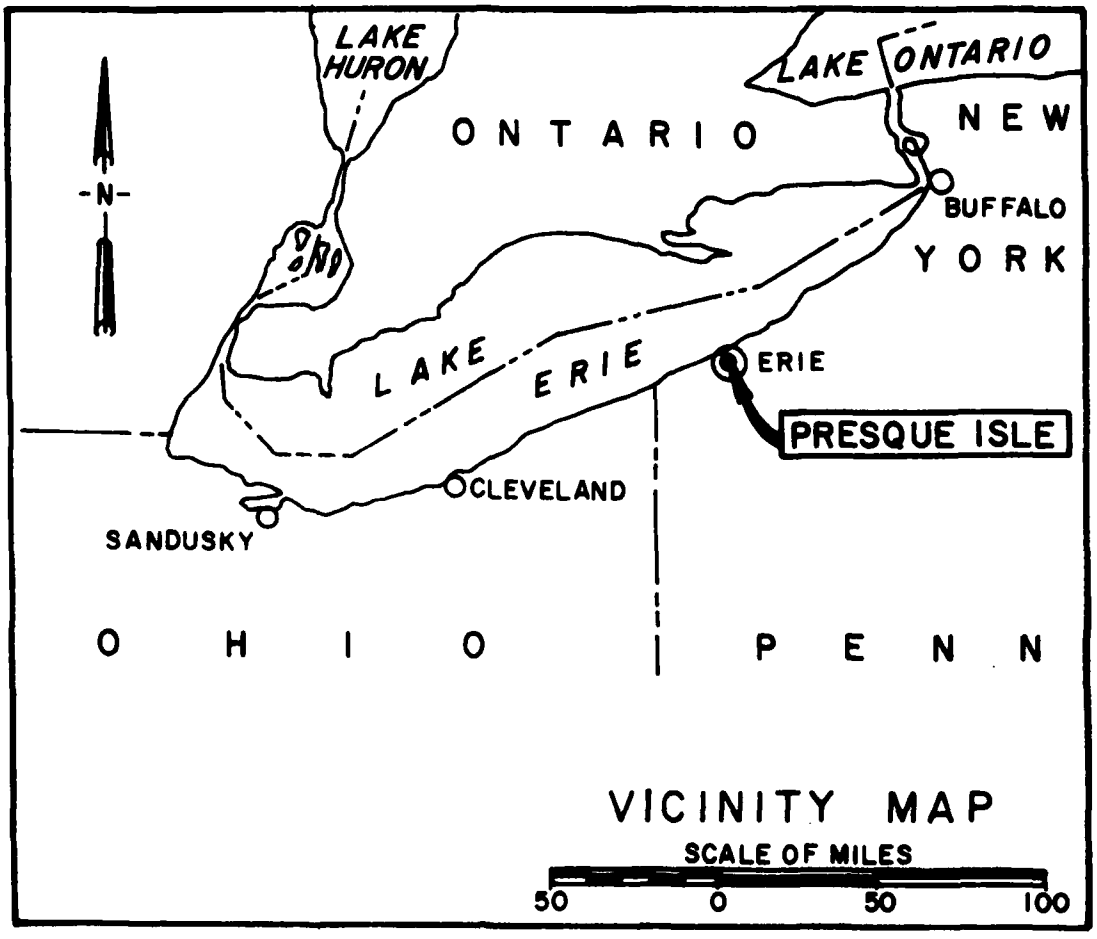

LAKE HURON
LAKE ONTARIO
ONTARIO
NEW
YORK
BUFFALO
-N-
LAKE ERIE
ERIE
PRESQUE ISLE
CLEVELAND
SANDUSKY
OHIO
PENN
VICINITY MAP
SCALE OF MILES
50
0
50
100

FIGURE 2

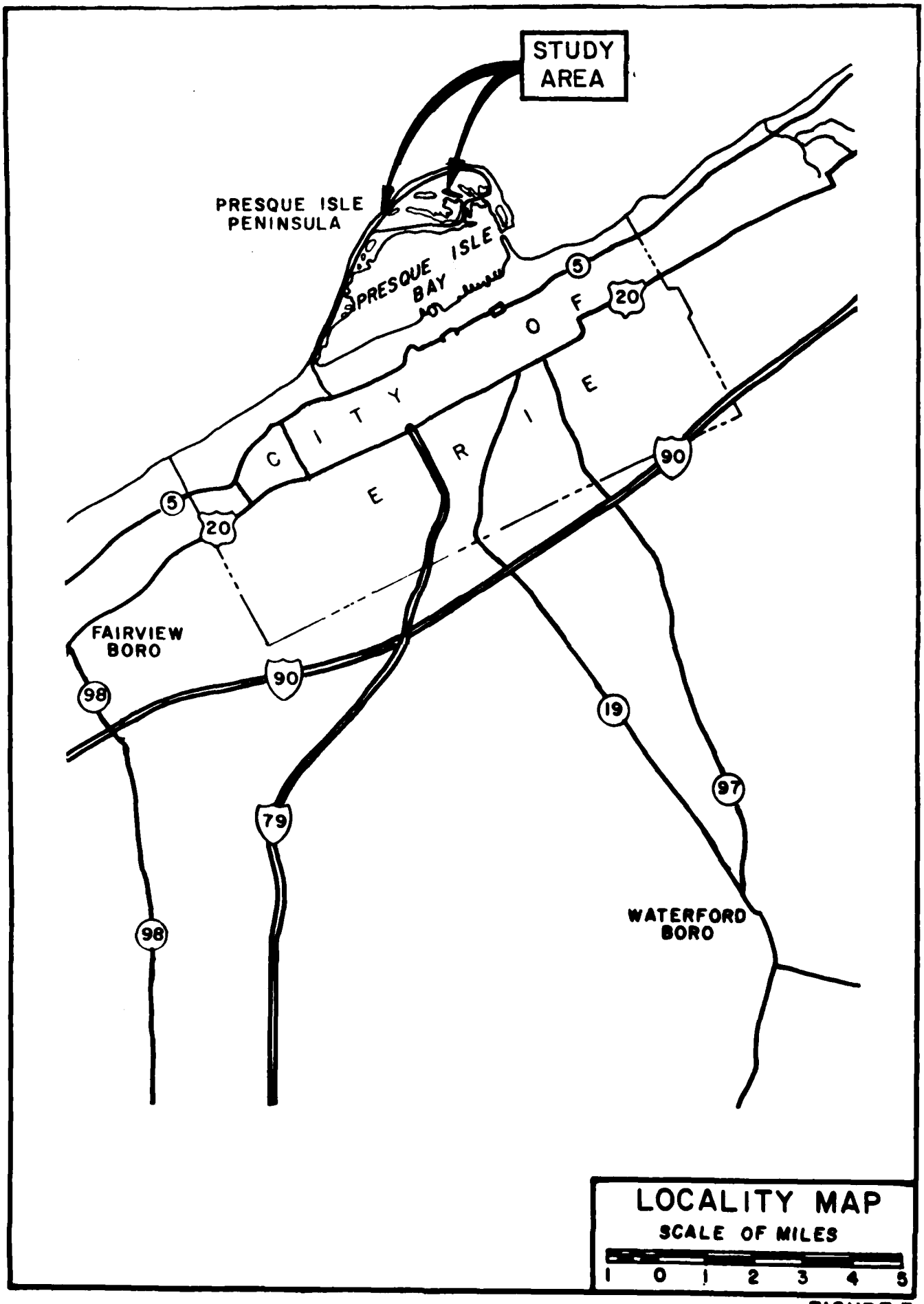

STUDY AREA
PRESQUE ISLE PENINSULA
PRESQUE ISLE BAY
CITY OF ERIE
FAIRVIEW BORO
WATERFORD BORO
5
20
90
98
79
19
97
LOCALITY MAP
SCALE OF MILES
1 0 1 2 3 4 5

FIGURE 3

Water Level Fluctuations and Extremes

Continuous records of water levels in Lake Erie have been monitored at Cleveland, OH, by the Lake Survey Center and National Oceanic and Atmospheric Administration (NOAA) since 1860. The gage at Cleveland serves as the master gage for Lake Erie. Erie, PA, is approximately 90 miles northeast of Cleveland; therefore, the long-term Cleveland records are assumed to be directly applicable to the project site. Table 2 summarizes the average and extreme water levels recorded by the Cleveland water level gage. In the 120 years of record at the Cleveland gage, from 1860 to 1979 inclusive, the level of Lake Erie has fluctuated from a high monthly mean of 573.5 feet in June 1973 to a low monthly mean of 567.5 feet in December 1934 and again in February 1936. The greatest annual fluctuation, as shown by the highest and lowest monthly mean of the year, was 2.75 feet in 1947, and the least annual fluctuation was 0.87 feet in 1895. In the last five years of record, the maximum monthly mean stages have ranged from +4.30 feet in May 1976 to 3.34 feet above low water datum in May 1977. The minimum monthly mean stages have ranged from +3.01 feet in January 1976 to +1.62 feet above low water datum in February 1977. Similar fluctuations are assumed to occur during the life of the project.

Winds

The wind diagram for Erie Harbor on Figure 4 indicates the occurrence of winds of various groups of velocities from all directions based on records of the U. S. Coast Guard at Erie, PA, for the period from 1928 to 1941, inclusive, and 1945 to 1971, inclusive.

The peninsula is exposed to storm winds from the southwest through north to northeast. The wind direction at this locality is generally variable, but winds from one sector have been experienced for more than one full day at a time. Because of the curved form of the peninsula, there exists a leeward section of shoreline for all sectors of exposure. The minimum fetch is from the north, where Long Point lies only 26 miles away. The maximum fetch is from the west-southwest, where the islands offshore from Sandusky, OH, lie about 140 miles away.

Past history of the peninsula indicates that it has been particularly susceptible to damage by storms from the west and southwest. Records indicate that such storms set up strong easterly currents and sometimes raise the water level more than 4 feet above normal. With extreme high water, the greater portion of the neck is submerged, and the remainder is only a few feet above water level. At such time, the highway along the neck becomes impassable and frequently suffers damage from scouring along the shoulder or deposition of sand on the pavement.

Waves

Presque Isle Peninsula can be subjected to waves from the west-southwest through north to east-southeast, however, storms from the west through north to northeast cause the most severe wave action along the peninsula shoreline. The actual fetch distances for winds from the west-southwest, north, and northeast directions are 140, 26, and 78 miles, respectively.

Table 2 - Average and Extreme Water Levels

LAKE ERIE WATER LEVEL DATA
AT
CLEVELAND, OH
PERIOD 1860-1979

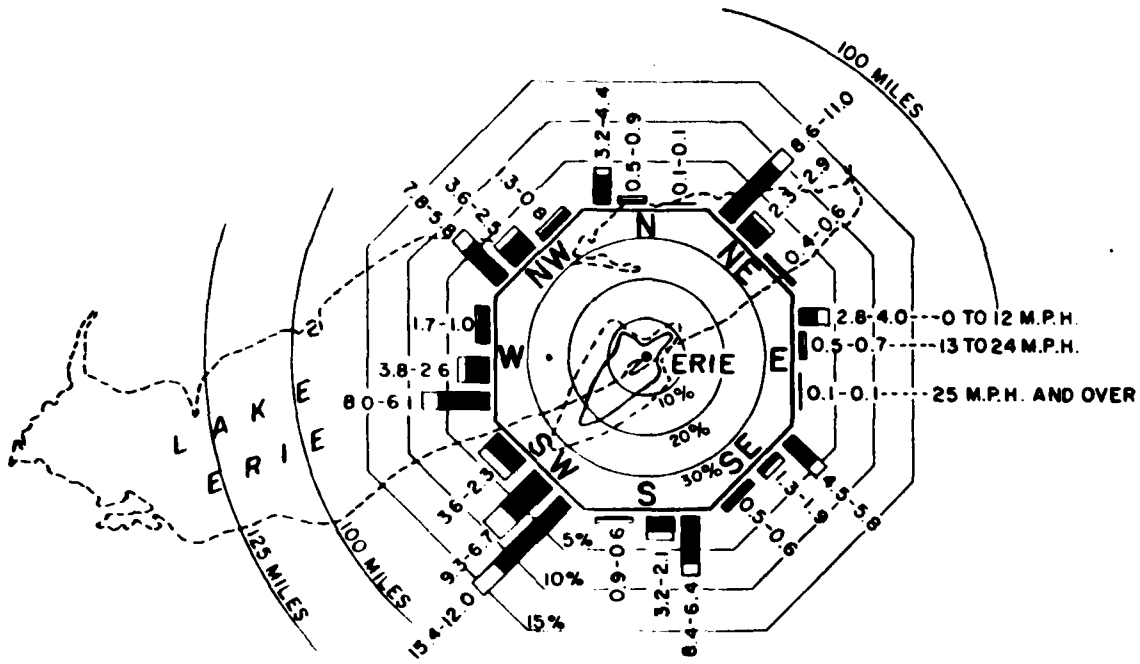
STAGE	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
	1973	1973	1973	1973	1973	1973	1973	1973	1973	1973	1972	1972
HIGH	572.39	572.53	572.88	573.30	573.25	573.51	573.34	573.03	572.51	572.14	572.17	572.35
MEAN	569.96	569.92	570.15	570.68	571.01	571.15	571.11	570.92	570.64	570.31	570.04	569.98
	1935	1936	1934	1934	1934	1934	1934	1934	1934	1934	1934	1934
LOW	567.62	567.49	567.65	568.20	568.43	568.46	568.46	568.36	568.23	567.95	567.60	567.53

CHANGES	Jan-Feb	Feb-Mar	Mar-Apr	Apr-May	May-Jun	Jun-Jul	Jul-Aug	Aug-Sep	Sep-Oct	Oct-Nov	Nov-Dec	Dec-Jan
	1952	1976	1913	1947	1892	1902	1915	1926	1926	1917	1927	1949-50
MAXIMUM RISE	+0.67	+1.12	+1.57	+0.95	+0.76	+0.63	+0.26	+0.13	+0.28	+0.14	+0.52	+0.78
AVERAGE	-0.04	+0.23	+0.53	+0.32	+0.15	-0.04	-0.19	-0.28	-0.33	-0.27	-0.07	-0.03
	1886	1931	1891	1891	1977	1890	1868	1937	1871	1924	1882	1917-18
MAXIMUM FALL	-0.73	-0.31	-0.31	-0.18	-0.24	-0.38	-0.52	-0.57	-0.67	-0.64	-0.51	-0.67

Ave. 1860-1979 570.49
Ave. 1900-1979 570.33

LWD 568.6

January 1979



WIND DIAGRAM FOR ERIE HARBOR, PA.

NOTES

INDICATES DURATION FOR ICE-FREE PERIOD (MAR. TO DEC. INCL.) IN PERCENT OF TOTAL DURATION.

INDICATES DURATION FOR ICE PERIOD (JAN. TO FEB. INCL.) IN PERCENT OF TOTAL DURATION.

INDICATES PERCENT OF TOTAL WIND MOVEMENT OCCURRING DURING ICE-FREE PERIOD.

INDICATES PERCENT OF TOTAL WIND MOVEMENT OCCURRING DURING COMBINED ICE AND ICE-FREE PERIODS.

FIGURES AT ENDS OF BARS INDICATE PERCENT OF TOTAL WIND DURATION FOR ICE FREE PERIOD AND COMBINED ICE-FREE AND ICE PERIODS, RESPECTIVELY.

WIND DATA BASED ON RECORDS OF THE U. S. COAST GUARD AT ERIE HARBOR, PA. FOR PERIOD 1 JAN. 1928 TO 31 DEC. 1941 AND 1 JAN. 1945 TO 31 DEC. 1971.

FIGURE 4

The significant deep water wave heights and associated periods which could be expected at Erie, PA, were determined by Waterways Experiment Station and published in Technical Report H-76-1, "Design Wave Information for the Great Lakes," Report 1, dated March 1976. Table 3 shows the significant deep water wave heights at Erie, PA, for three angle classes and for each season of the year for various recurrence intervals. The three angle classes are defined as viewed by an observer standing on shore and are distinguished below:

a. Angle Class 1 - Mean wave approach angle greater than 30 degrees to the right of a normal to shore;

b. Angle Class 2 - Mean wave approach angle within 30 degrees to either side of a normal to shore;

c. Angle Class 3 - Mean wave approach angle greater than 30 degrees to the left of a normal to shore.

Lake Ice

Generally, ice begins to form along the Lake Erie shore during December, and during the months of January and February, the ice cover usually extends for several miles offshore. Along the lakeward perimeter of Presque Isle Peninsula, ice windrows are frequently formed and grounded offshore in the early winter when onshore winds, blowing across the open water, pile up the shore ice on the beach or offshore bars in mounds 10 to 15 feet high. During March, the ice fields break up and shift with prevailing winds. When open water extends to the lakeward face of the ice mounds described above, there are times when concentrated scour may occur at the face of the ice mounds. The movement and weight of ice can also damage light shore structures. However, the ice cover generally has a net beneficial effect on shore processes at Presque Isle since it prevents erosive wave action during the winter months when some of the most severe storms occur.

Water Quality

Water quality is tested frequently at several points along the perimeter beaches during the bathing season. During 1969 and before, the beach at the extreme east end of the peninsula (Beach No. 11) had been closed on a number of occasions due to high coliform counts. In 1970, the same beach, which is located closest to the city of Erie sewer outfall, was closed for about one week because of pollution. There have been improvements made in the city of Erie's sewer system and, since the 1970 season, there have been no beach closures on the lake side of Presque Isle. Water quality standards for Commonwealth of Pennsylvania beaches requires the following criteria be met:

a. The water in bathing beaches shall be considered contaminated for bathing purposes when one of the following conditions exists:

(1) The fecal coliform density in five samples of said water collected on 5 different days exceeds a geometric mean of 200 per 100 ml.

TABLE 3

SIGNIFICANT DEEP WATER WAVE HEIGHTS AT ERIE, PA.

TABLE OF EXTREMES ESTIMATES
GRID LOCATION 6.18 LAT=42.27 LON=80.17 ERIE PA
SHORELINE GRID POINT 18

WINTER

	ANGLE CLASSES 1	2	3	ALL
5	4.6(0.8)	7.9(0.6)	12.1(0.3)	12.3(0.8)
10	6.6(1.0)	9.5(0.6)	12.8(0.4)	13.1(1.1)
20	8.2(1.3)	10.8(1.0)	13.4(0.5)	14.0(1.3)
50	10.8(1.6)	12.8(1.3)	14.4(0.6)	15.3(1.6)
100	12.8(1.8)	14.4(1.5)	15.1(0.7)	16.4(1.9)

SPRING

	ANGLE CLASSES 1	2	3	ALL
5	3.6(0.6)	2.6(0.5)	7.2(0.4)	7.3(0.6)
10	3.9(0.8)	3.9(0.6)	8.2(0.6)	8.5(0.6)
20	5.6(1.0)	4.9(0.8)	9.2(0.7)	9.6(1.0)
50	7.2(1.2)	6.6(1.0)	10.8(0.9)	11.2(1.2)
100	8.9(1.4)	7.9(1.1)	11.8(1.0)	12.4(1.4)

SUMMER

	ANGLE CLASSES 1	2	3	ALL
5	3.6(0.9)	4.3(0.6)	6.9(0.6)	7.2(0.9)
10	3.9(1.1)	5.2(0.8)	7.5(0.8)	7.8(1.2)
20	4.3(1.4)	5.9(1.1)	8.2(1.0)	8.4(1.5)
50	5.2(1.8)	6.9(1.3)	8.9(1.2)	9.1(1.8)
100	6.2(2.0)	7.5(1.5)	9.5(1.4)	9.7(2.1)

FALL

	ANGLE CLASSES 1	2	3	ALL
5	6.6(0.2)	8.2(0.5)	11.5(0.3)	11.6(0.5)
10	7.5(0.2)	9.2(0.6)	12.1(0.4)	12.3(0.6)
20	7.9(0.3)	10.5(0.8)	12.8(0.5)	13.1(0.8)
50	8.5(0.4)	11.8(0.9)	13.8(0.6)	14.1(1.0)
100	8.5(0.4)	13.1(1.1)	14.4(0.7)	14.9(1.1)

(2) The Department of Health determines that any substance is being discharged or may be discharged into the water and is or may be hazardous to the health of persons using the bathing beach.

b. When the fecal coliform density of any sample collected at a bathing beach exceeds 1,000 per 100 ml, daily samples from the beach area shall be collected by the permittee and analyzed for fecal coliforms for at least 5 consecutive days immediately following the finding. The results of the analyses shall be reported to the Department of Health by the permittee within 5 days of the taking of the last of these five samples.

c. Use of a bathing beach found to be contaminated shall be discontinued until written approval is obtained from the Department of Health. Such approval shall be given by the Department of Health when the Department finds that the waters of such bathing beach are no longer contaminated.

The Department of Health considers the water quality on the lake side of the peninsula to be high enough for water contact sports.

Water quality in Presque Isle Bay is, however, not as high. Relatively poor quality in the bay can be explained by poor circulation of water in a relatively shallow impoundment and a heavy contribution of pollutants from the city of Erie. The Department of Health indicates that, although the coliforms are high in the bay and it is not open to swimming, they do not consider it to be grossly polluted.

Geology

The geology described in this report includes both the historical development and materials comprising the Lake Erie Basin and northwestern Pennsylvania.

Physiography

The major physiographic divisions in this area are the eastern lake section of the Central Lowland Province and the glaciated section of the Appalachian Plateaus Province (Figure 5). The eastern lake section is a 2- to 5-mile wide plain bordering Lake Erie. Some bluffs along the lake are greater than 80 feet high and are composed of glacial and lacustrine deposits. Bedrock is usually found at the base of the bluffs. Sandy ridges, representing former lake levels, cross the area. The topography of the glaciated section of the Appalachian Plateaus Province is that of an eroded plateau with gently rolling hills.

Bedrock

Bedrock exposed in Erie County is predominantly Upper Devonian shales and siltstones of the Conneaut and Canadaway Groups. Figure 6 is a geologic column of exposed rock. Underlying most of Lake Erie are weak, nonresistant Devonian rocks (Hough 1958). In the shallower western portion of Lake Erie are more resistant limestones and siltstones. A generalized geologic map of Lake Erie is given in Figure 7.

Structural Geology

The structural geology in the Presque Isle vicinity is relatively simple and consists of a gently southward dipping homocline. According to a report by Argonne National Laboratory (1978), the Lake Erie Watershed is a tectonically stable area with an inherently low degree of seismicity. On 29 October 1934, an earthquake occurred in Erie, PA with an intensity of V on the Modified Mercalli Scale (Neumann, 1936). No explanation was given for this event.

Surficial Geology

Glacial deposits within the study area consist of till and stratified drift. The till units are variable in texture and found in hilly end moraines and as ground moraine blanketing much of the area. The stratified deposits are in the form of kames and outwash (Figures 8A and 8B). Petrographic analysis of the stratified deposits show them to be composed of hard and tough sandstone, siltstone, limestone, dolomite, quartz, and quartzite particles. Strand deposits of Glacial Lakes Whittlesey and Warren also consist of sand and pebble gravel. These deposits, formed about 12,800 years ago (Schooler, 1974), have not been found to be suitable for use as beachfill because of their high percentage of flat and elongated particles, due to a predominance of shale and siltstone fragments.

Recent deposits consist of alluvium and can be found in most major streams in the area. Other recent deposits making up the Presque Isle Peninsula beaches are discussed in subsequent paragraphs of this report.

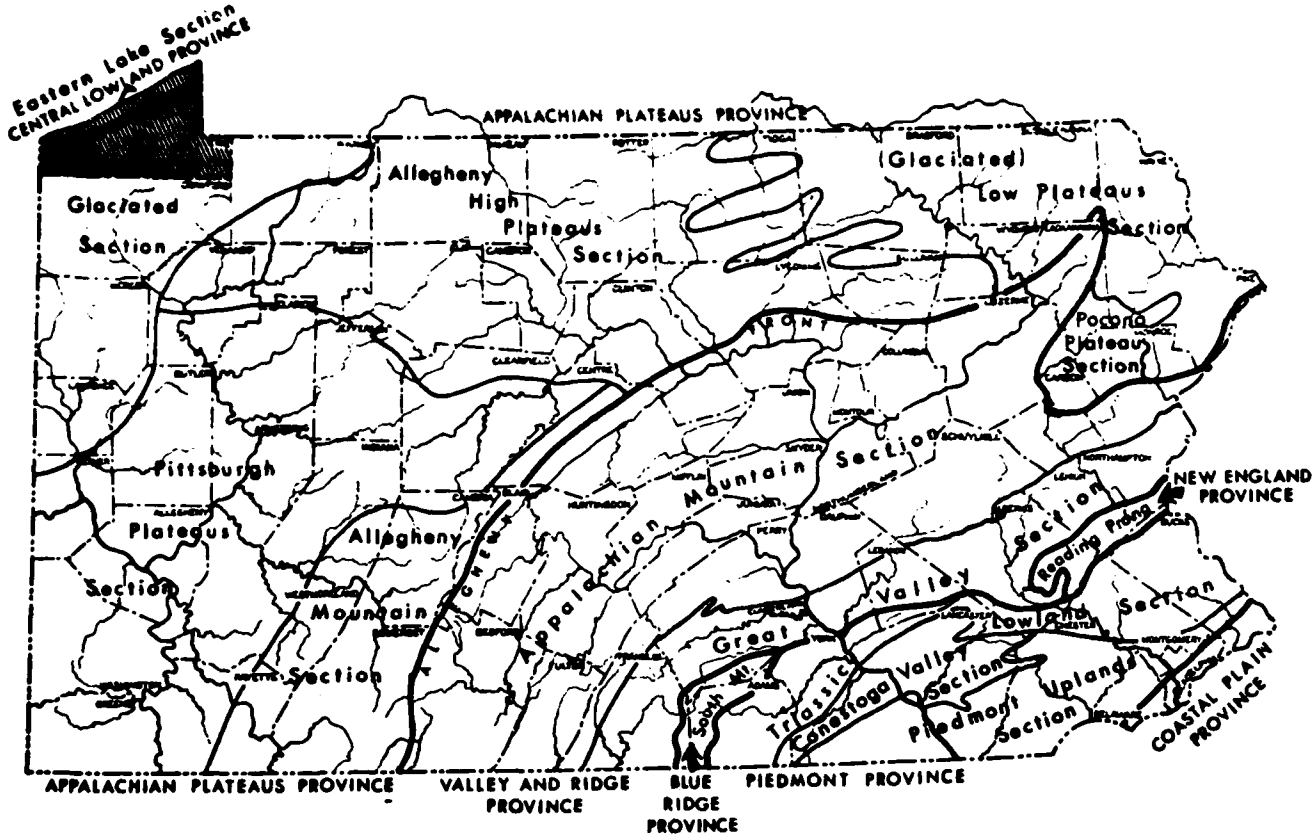
Lake Erie Bottom Deposits

Lake Erie can be divided into three separate subbasins. Presque Isle is located at the eastern end of the central basin. The bathymetry of the lake (Figure 9) is mostly controlled by lithology and dip of bedrock. Superimposed on the bedrock are Pleistocene and recent deposits as shown in Figure 10. The most prominent glacial features in the lake, are three ridges which traverse the lake between Pelee Point and Lorain, Erieau and Cleveland, and Long Point and Erie. These are thought to be end moraines and are composed of clay till veneered with sand or gravel (Lewis, 1967). The Long Point-Erie Moraine, largest of the three, is broad, flat-topped, and about 40 Km (25 miles) wide. Coring studies by the Corps of Engineers (CERC, 1979) indicate that the sand and gravel overlying the moraine on the United States side is as much as 12.7 feet thick and averages about 7.4 feet. Seismic profiling shows the sand to be 15 to 20 feet thick along the ridge surface.

Recent soft, gray mud covers most of the rest of the central basin. In some areas, the mud is 60 to 80 feet thick (Lewis, 1967).

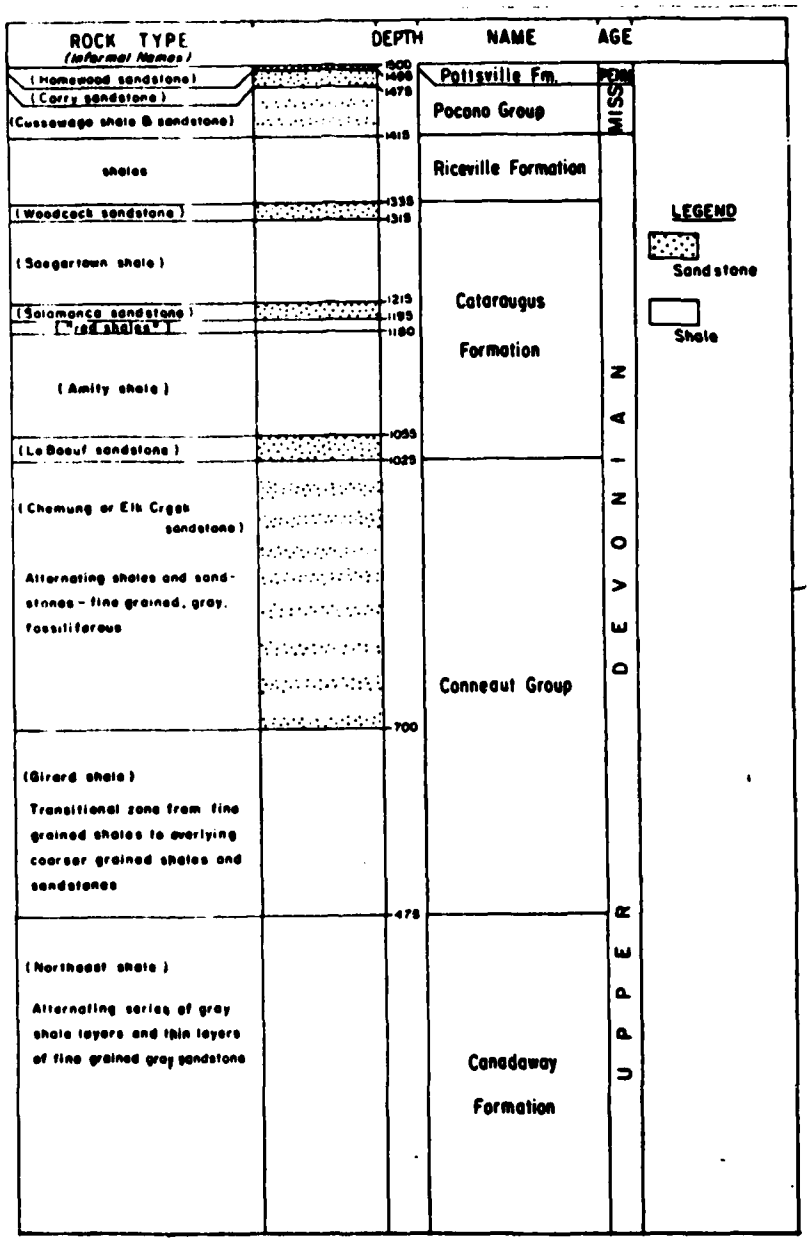
Historical Geology

The development of Lake Erie - Presque Isle geology began during the Paleozoic Era, about 500 million years ago, when the area was covered by a large inland sea. Silt and clay were deposited and later consolidated to



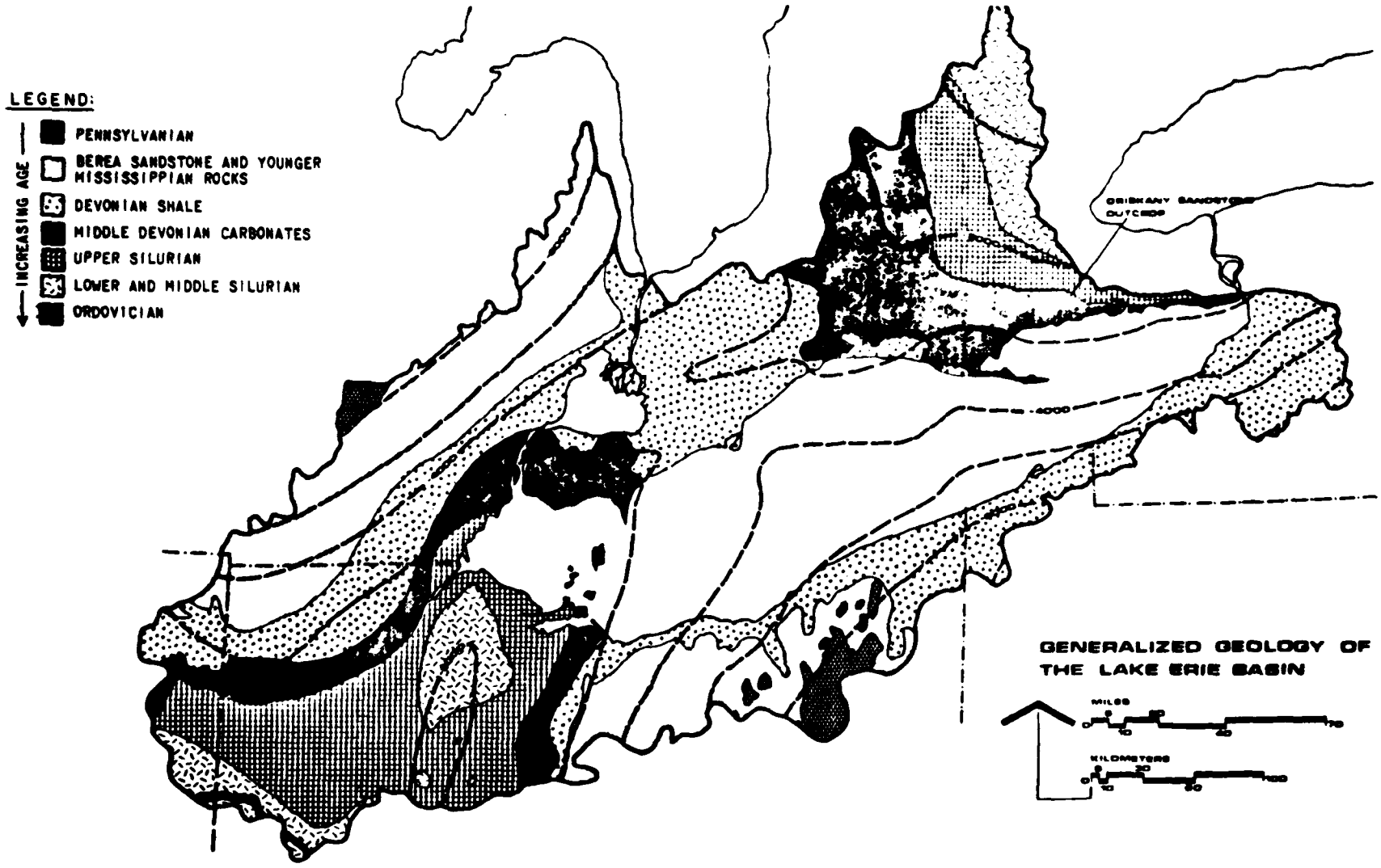
ERIE COUNTY, PENNSYLVANIA'S NORTHWESTERN COUNTY, INCLUDES PARTS OF THE CENTRAL LOWLANDS AND APPALACHIAN PLATEAUS PHYSIOGRAPHIC PROVINCES (TOMIKEL AND SHEPPS, 1967)

FIGURE 6



BEDROCK EXPOSED IN ERIE COUNTY PENNSYLVANIA. ROCKS OF THE CANADAWAY AND CONNEAUT GROUPS OUTCROP IN THE SHORE LINE VICINITY. THE OVERLYING ROCKS CAN BE FOUND FURTHER TO THE SOUTH. (TOMIKEL AND SHEPPS, 1967).

FIGURE 6



GENERALIZED BEDROCK GEOLOGY OF THE LAKE ERIE BASIN. DOTTED LINES REPRESENT STRUCTURAL CONTOUR OVERLAY INDICATING DEPTHS BELOW SEA LEVEL TO THE TOP OF PRECAMBRIAN ROCKS. CONTOUR INTERVALS ARE 305 M (1000 FT.). (ARGONNE NATIONAL LABORATORIES, 1978).

FIGURE 7

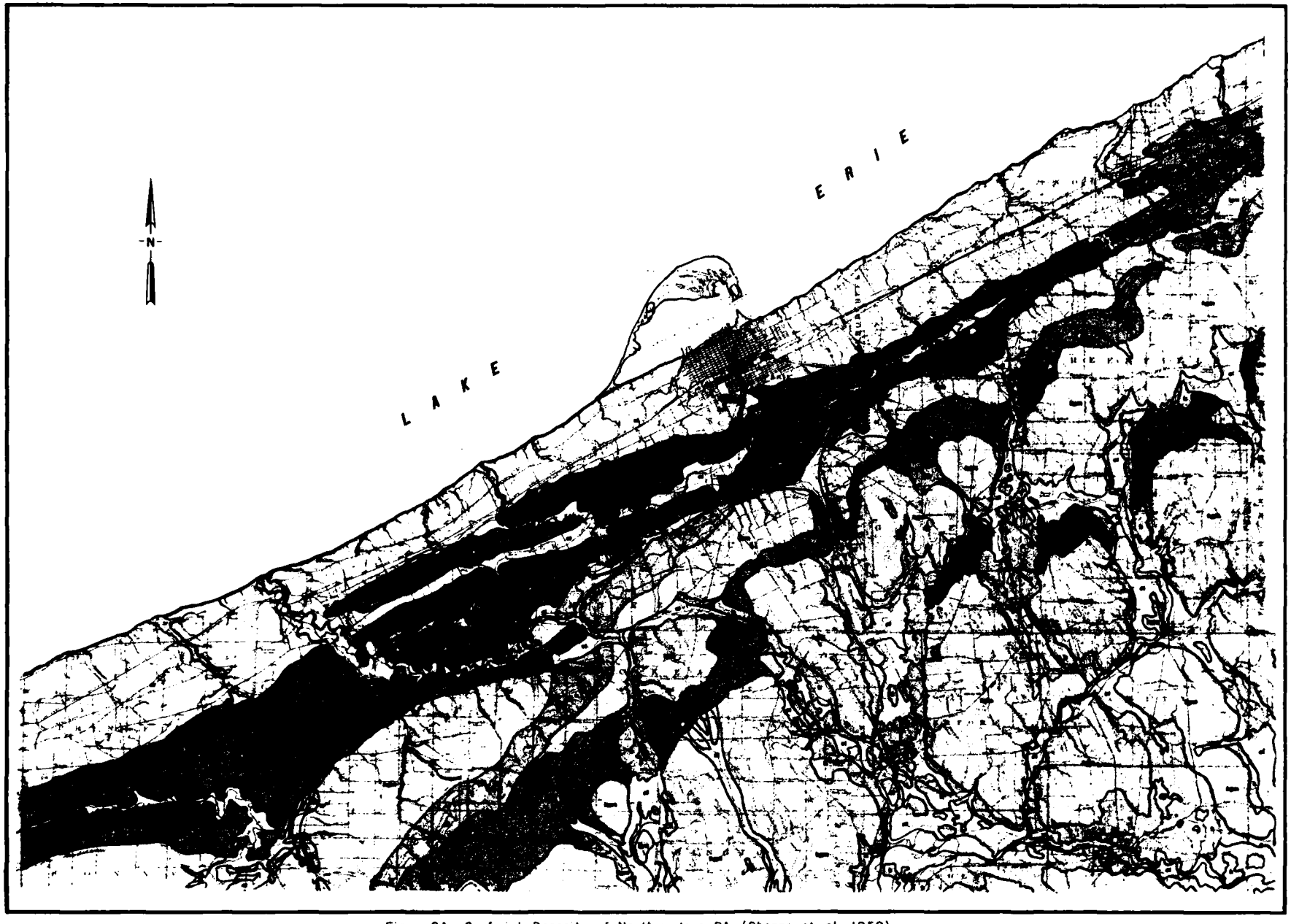


Figure 8A. Surficial Deposits of Northwestern, PA. (Shepps, et. al., 1959)

LEGEND

		Unit		Topographic Features	Character of Material	Topography
PLEISTOCENE	WISCONSIN, CARY	Ashtabula Till		Ashtabula morainic system (end moraines)	Till (silt)	Strongly constructional; knob and kettle topography; numerous undrained depressions
			an *	Ashtabula moraine under thin beach sands		
		Hiram Till		Defiance end moraine	Till (silty clay to clay)	Undulating; locally constructional; scattered undrained depressions; very weak at places
			hgm	ground moraine	Till (silty clay)	Flat to gently undulating; local poorly drained areas
		Lavery Till		Lavery end moraine	Till (silt)	Somewhat undulating; locally constructional; undrained areas rare
			lgm	ground moraine	Till (silt)	Level to gently undulating
		Kent Till	km *	Kent end moraine	Till (sandy loam)	Strongly constructional; knob and kettle topography; numerous undrained depressions
			kfm *	Findley Lake recessional moraine	Till (loam)	
			kcm *	Clymer recessional moraine	Till (loam)	
			kgm	ground moraine	Till (loam becoming sandy loam toward the east and southeast)	Smooth to gently undulating; undrained areas very rare
	ILLINOIAN	Inner phase	ii *	ground (?) moraine	Thin, discontinuous, weathered till blanket	Erosional; similar to non-glaciated area, but less "rugged", rare slightly constructional patches
		Outer phase	io *	ground moraine (?)	Rare patches of thin weathered till over bedrock; scattered erratics	Erosional; similar to non-glaciated area, but slightly less "rugged"
	ILLINOIAN OR WISCONSIN	*Undifferentiated* members of units above	ik	kames, kame terraces, kame moraines, and eskers	*Sand and gravel*	*Distinctly constructional except in* Illinoian areas. Knobby; commonly in the form of ridges, terraces, or isolated mounds; kame moraines intimately mixed with end moraines
		Undifferentiated members of units above	ol	outwash (valley trains), river terraces, lake deposits including beaches of former high levels of Lake Erie	*Bedded sand, silt,* and clay; sand and gravel	*Generally smooth to gently undulating;* commonly nearly level or gently sloping downstream
RECENT OR PRE-PLEISTOCENE		*Undifferentiated*		stream alluvium and bedrock		

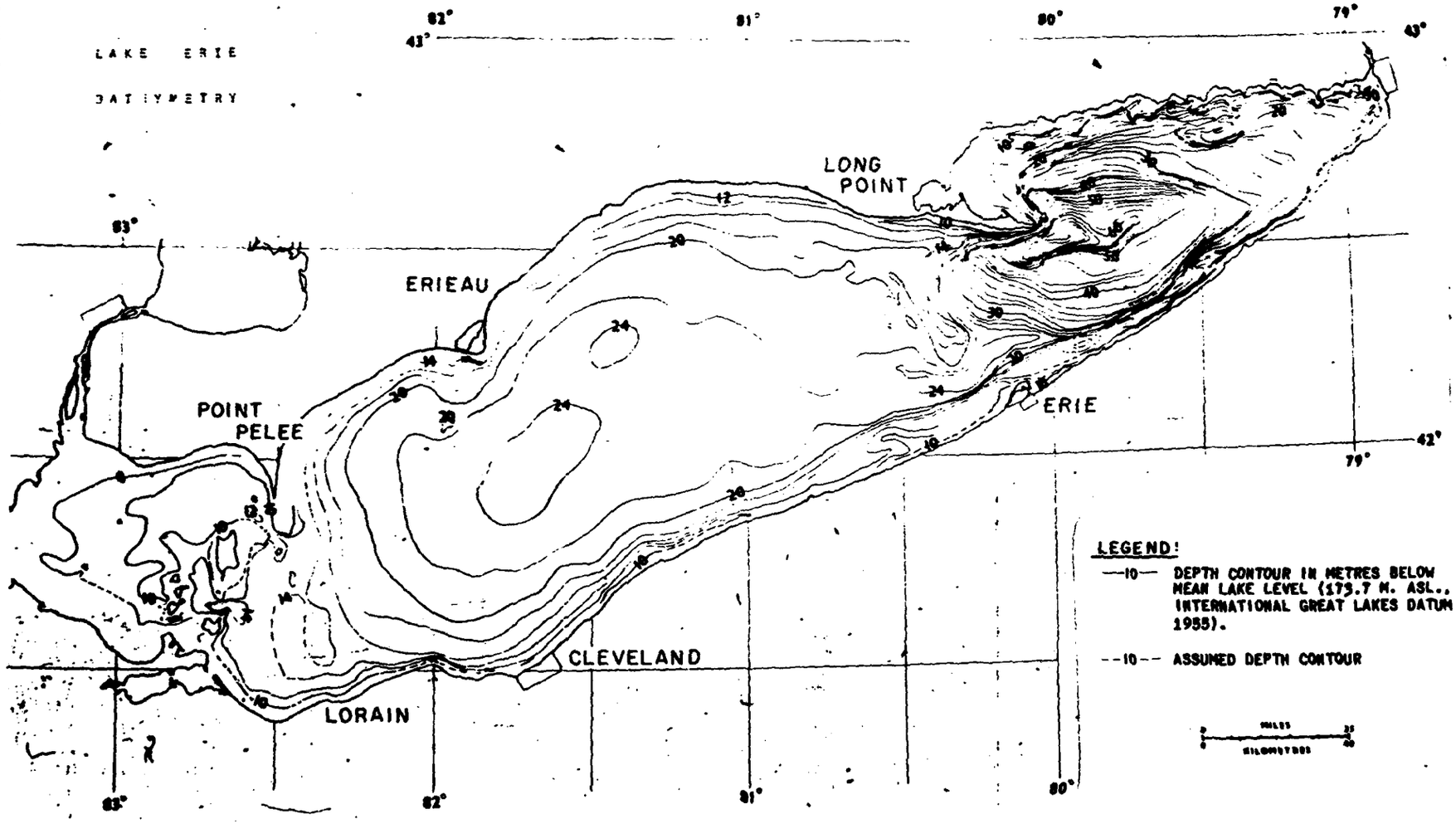
NOTE:

* Not in area of map.

NOTE - The symbols above are normally prefixed by the letter "Q" for Quaternary. The letter has been omitted since all units having symbols are of Quarternary age

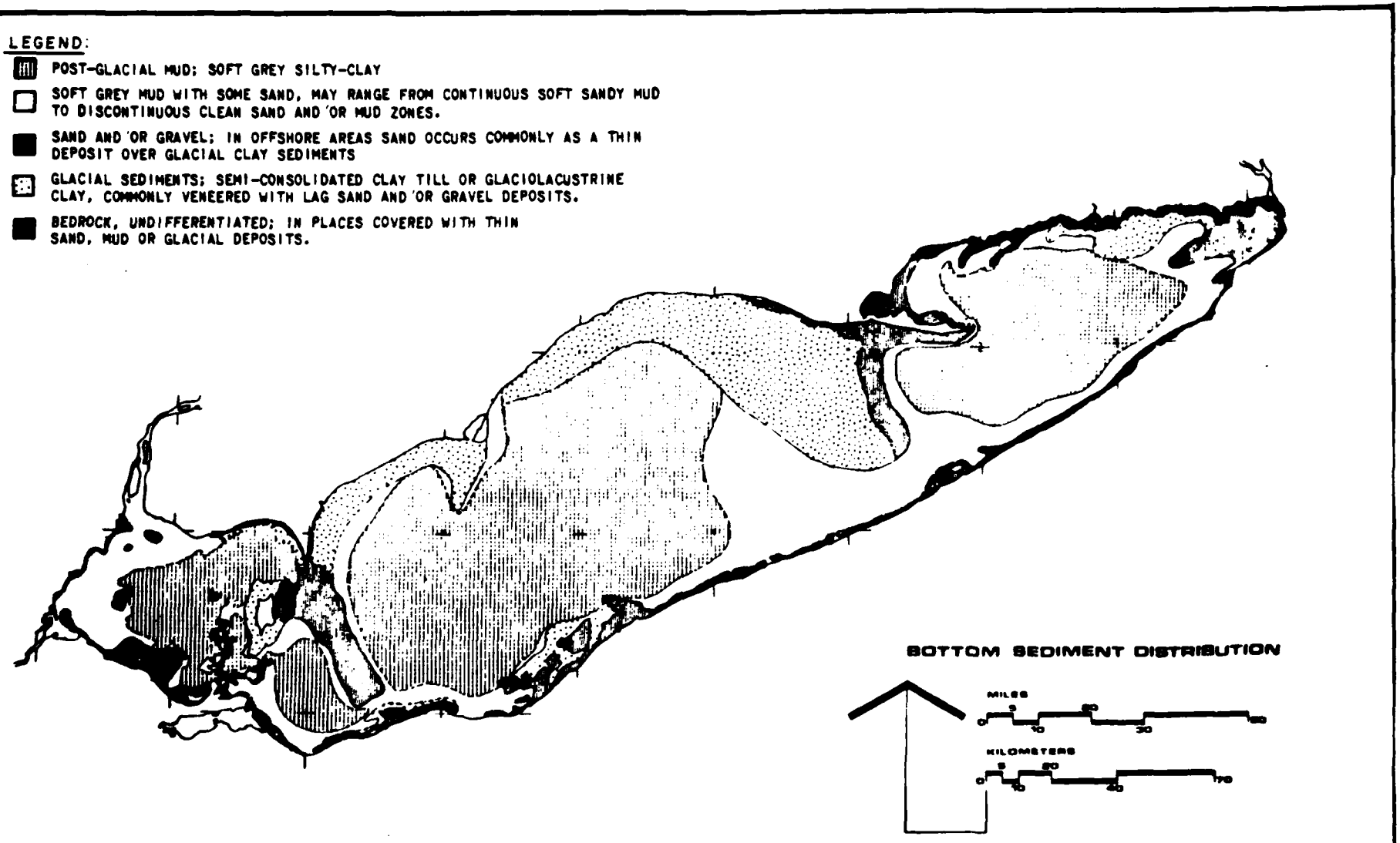
Glaciofluvial deposits outside the glacial border are only partially mapped

Figure 8B



BATHYMETRY OF LAKE ERIE. (LEWIS, 1966)

FIGURE 9



BOTTOM SEDIMENT DISTRIBUTION IN LAKE ERIE. DATA FROM THOMAS ET AL. (1976) (ARGONNE NATIONAL LABORATORY, 1978)

FIGURE 10

form the Devonian shales now exposed along the shoreline. As the Paleozoic Era ended, these rocks were tilted to the south more steeply in what is now the eastern Lake Erie Basin. Stream drainage at this time followed the consequent slope towards the south. A major trunk stream developed to the north along what is now the Erie and Ontario Basins. Piracy, due to headward erosion, captured many of the streams, and reversed their flows to the north.

During the Pleistocene Epoch, which began at least 2,000,000 years ago, a series of glacial advances and retreats modified the landscape and deposited material. The oldest glacial deposit in northwestern Pennsylvania is found in Mercer County. White and others (1969) believe this to be pre-Illinoian which makes it about 500,000 years old.

Most of the glacial material of northwestern Pennsylvania, however, was deposited during the late Wisconsinan Stage. Shepps and others (1959) and White and others (1969) have defined the glacial geology in this area in terms of rock-stratigraphic units.

The earliest event of the late Wisconsinan significantly affecting the project area occurred about 20,000 years B.P. (before present) during the Kent Phase. Deposits of Kent drift include till and stratified drift in the form of kames, crevasse fillings, and outwash. Kent till is bluish-gray, moderately pebbly, calcareous, loam to sandy loam, and weathers to yellow brown. Its average textural composition is 40.6 percent sand, 43.3 percent silt, and 16.1 percent clay. The main characteristic of the Kent Advance is extensive kame deposition. These are found on valley bottoms or perched on valley walls. Most of the sand used for beach replenishment at Presque Isle is derived from these deposits. During the next event, the Lavery Phase, a glacier advanced to a location marked by the Lavery End Moraine shown on Figures 8A and 8B. This occurred about 17,000 years B.P. The Lavery till is light gray, moderately to sparingly pebbly, calcareous, and silty. It contains about 20 percent sand, 40 percent silt, and 20 percent clay (White and others, 1969). The surface expression of this deposit varies from smooth hills and swales to moderately hummocky topography. Shepps and others (1959) have mapped morainal kames in locations where the Lavery moraine crosses valleys. Kames and outwash, deposited in valleys, supply some of the sand used for beach replenishment at Presque Isle.

After the Lavery advance, Fullerton (1971) believes that the ice margin retreated as far northeast as Toronto, Ontario, and he refers to this period as the Lake Erie Interval. During this time, approximately 15,500 years B.P., both Lakes Erie and Ontario drained eastward through the Mohawk Lowland in New York.

A glacial readvance in Port Stanley time (15,000 years B.P.) resulted in the deposition of the Hiram Moraine (Figures 8A and 8B). Hiram till, according to Shepps and others (1959), is gray to bluish gray, sparingly pebbly, calcareous, clay to silty clay, and oxidizes to a drab brown color. Its average composition is 13.6 percent sand, 50.6 percent silt, and 35.8 percent clay. Kames were not as well-developed as during the preceding Kent and Lavery advances. Outwash deposits also are not as extensive.

The last glacial advance into northwestern Pennsylvania, according to Shepps and others (1959), and White and others (1969) was the Ashtabula Advance. Fullerton (1971) shows this to have begun 14,100 years B.P. Its limit is marked by a series of end moraines exhibiting knob and kettle topography. These correspond to the "Lake Escarpment Morainic System" of Leverett (1902), but Shepps and others (1959) prefer the term "Ashtabula Morainic System" for these deposits in Pennsylvania. Kames are more common in the eastern portion of the moraine than in the western portion. Outwash occurs between the ridges. At present, none of these deposits are used as a beach replenishment sand source.

The next major event of the Pleistocene is known as the Cary-Port Huron Interval when the ice margin was probably near Guelph, Ontario (Karrow, 1968). At this time, a series of glacial Great Lakes developed in the Erie Basin. Strand lines of Lakes Maumee I, II, III, and Arkona are fairly well-developed in the western portion of the basin but are faint or absent in the eastern part (Leverett and Taylor, 1915). These lakes drained westward, outletting at Ft. Wayne, IN, through the Wabash River and also through the Huron Basin (Hough, 1958).

At 12,900 years B.P., a major glacial readvance, known as the Port Huron Advance, took place resulting in a rise of water in the Erie Basin to form Glacial Lake Whittlesey (Calkin, 1970). Fullerton (1971) shows that the Wentworth till found in Ontario was deposited at that time and that the Paris Moraine marks the approximate glacial terminus. The Long Point-Erie Moraine of Lake Erie has been correlated with the deposits of the Port Huron Advance by Lewis (1966), Wall (1968), and Fullerton (1971). There is some controversy as to the correlative of the Port Huron Advance in northwestern Pennsylvania. Shepps and others (1959), and White and others (1969), indicate that Port Huron ice did not cross the land; however, Fullerton (1971), considers the Girard Moraine, which begins 14 miles southwest of Erie, as the terminal moraine of this event. He cites as evidence the absence of Maumee and Arkona Beaches east of Girard and suggests that they were obliterated by the Port Huron Advance.

Features of Lake Whittlesey can be found in the vicinity of Presque Isle at an elevation of about 735 feet above mean sea level (MSL). The Whittlesey strand occurs as a 10-foot high wave-cut cliff near the Pennsylvania-Ohio State line. About a mile east, it becomes a 15-foot high, gravelly ridge and then changes to a series of sand dunes south of West Springfield, PA. Across the rest of Erie County, PA, it is a well-defined ridge 15-20 feet high with a steep north slope and gentle south slope. East of Erie, the ridge is replaced by two low, wave-cut cliffs cut in glacial material and bedrock (Schooler, 1974).

Further retreat of the Port Huron glacier resulted in a series of lower lakes. The most important of these is Lake Warren which is evidenced as two ridges occurring at elevations of 725 to 735 feet and 715 to 725 feet. The pebbles and cobbles in the gravel are dominantly shale (Schooler, 1974).

After the ice had retreated north of the Niagara Escarpment, water in the Erie Basin was allowed to drain into the Ontario Basin. Due to crustal

depression caused by the weight of glaciers, the outlet at the escarpment was relatively much lower than the present outlet at Niagara Falls. The lake occupying the Erie Basin at this time was at an elevation of 470 feet MSL, approximately 100 feet lower than today. This stage known as Early Lake Erie existed between 12,370 and 12,790 years B.P. (Lewis and others, 1966). It was during this time that Lewis (1966) and Lewis and others (1966), believe that the sand and gravel overlying the Long Point-Erie Moraine developed. Lewis (1966) gives three explanations for its origin, but prefers to consider it as a former beach deposit. St. Jacques and Rukavina (1973) showing that the sand is much coarser than present-day beach deposits in the same area, believe that the sand on the western flank of the moraine is a lag deposit formed after the selective removal of fine-grained material, and believe that the surface of the deposit is active and migrates eastward during storm periods.

A channel along the southern margin of the moraine is believed to be caused by discharge between the central and eastern basins during the time of Early Lake Erie (Lewis, 1966). This feature is shown on Figure 9.

As the outlet of Early Lake Erie was uplifted by crustal rebound, the elevation of the water surface was raised to its present level. Wave erosion of bluffs along the present shore and streams in addition to the Long Point-Erie Moraine, contributed sand and gravel for the development of beaches and the Presque Isle Spit. The west to east migration of Presque Isle has long been recognized. Figure 11 demonstrates Jenning's (1930) understanding of the development of the peninsula. A more detailed discussion of the development of Presque Isle Peninsula is presented later in this section of the report in the paragraph entitled Historical Origin of Presque Isle.

Lake Erie Water Level Changes

The water levels in the Lake Erie Basin have changed much in post-glacial times. This is due to crustal uplift, climatic changes, and diversion of water. The present outlet, the Niagara River, is controlled by a bedrock threshold at Buffalo, NY. During glacial times, this was blocked by ice, and lake water was diverted through higher outlets such as the Wabash, Grand, and Mohawk Rivers. After glacial retreat, the Niagara outlet was opened, but due to crustal downwarping caused by the weight of glaciers, this outlet was more than 100 feet lower than today. The modern rate of crustal uplift given for the Lake Erie region ranges from 0.09 foot/100 miles/100 years to 1.04 feet/100 miles/100 years (MacLean, 1963). These rates were determined using Gilbert's (1896-1897) method of comparing gage records at opposite ends of the lake to a level surface. MacLean (1963) shows that some of the observed gage differences may have been due to meteorological differences which must be considered in crustal movement calculations.

Early investigators (Leverett and Taylor, 1912, and others) determined the differential uplift in the region by comparing the elevations of southern beaches with northern beaches of the glacial Great Lakes. They found that the beaches are horizontal to a point, known as a hinge line, from which the beaches rise vertically to the north. For example, Lake Whittlesey beaches are at an elevation of 735 feet (MSL) throughout most of Ohio and Pennsylvania, but starting at a point east of Erie, PA, they begin to rise up to an elevation of 910 feet (MSL) in New York State (Leverett and Taylor, 1912).

In another study of water levels, Lewis (1969) compared radiocarbon dates with known lake levels and developed the diagram shown as Figure 12. This shows the rate of change in water level during post-glacial time in the Erie Basin. Lewis prefers to use the curve near the upper envelope. If the lower curve is adopted, it would mean that levels in the eastern basin of the lake would have been lower than the channel along the southern margin of the Long Point-Erie Moraine for more than 1,500 years. Lewis' diagram also shows the steep rise of water from 5,000 to 3,800 years B.P. This rise corresponds to the transfer of the upper Great Lakes drainage from the North Bay outlet to the St. Clair River.

Local Geology

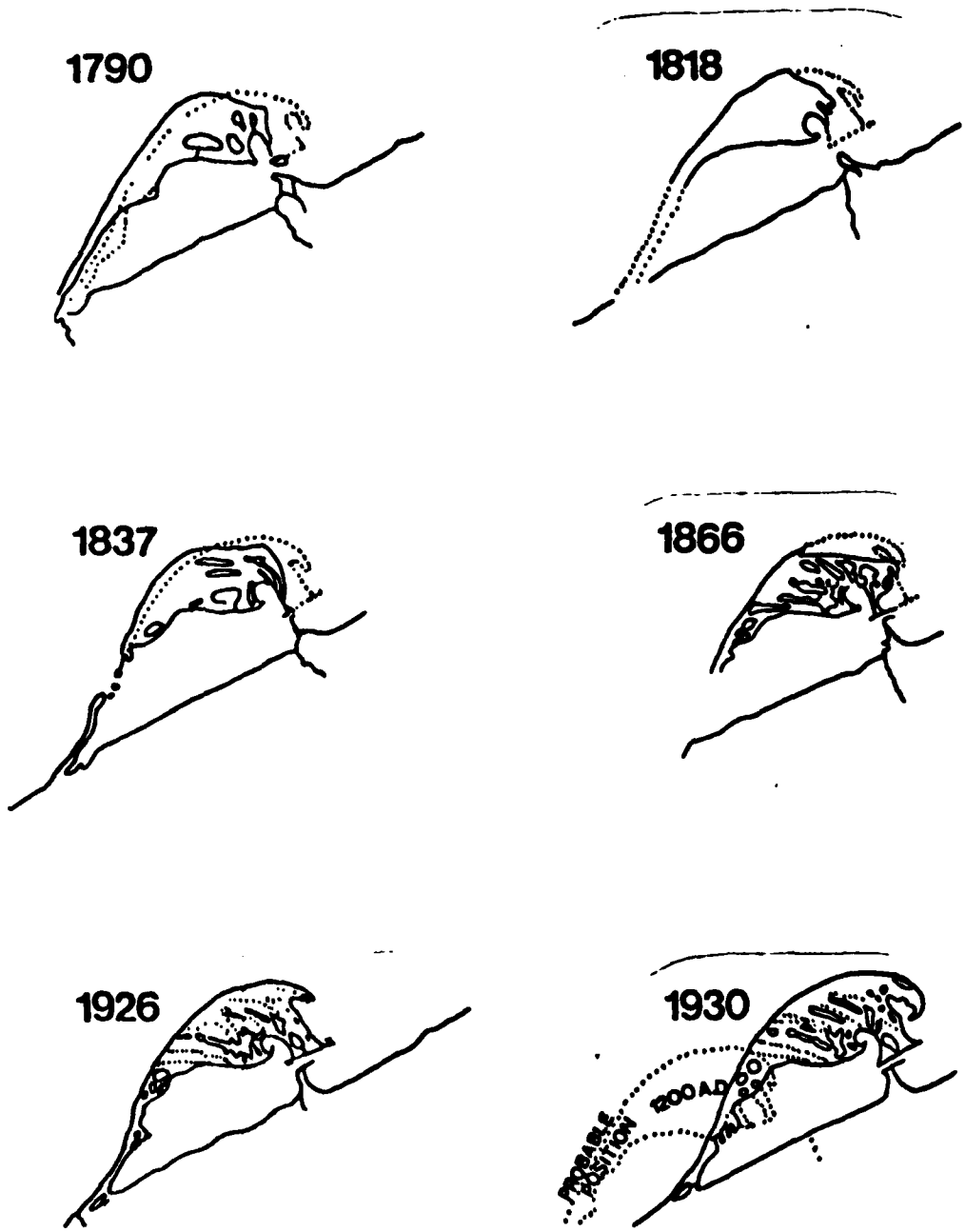
Bedrock - At Presque Isle, there is a lakeward slope of the rock surface with contours parallel to the mainland. At the junction of the neck of the peninsula with the general shore, the bedrock surface is only 2 feet below low water datum. A gas well drilled near the northeast corner of the water works settling basin shows rock to be about 112 feet deep. (USAED, Buffalo, 1951). Borings taken in 1965 by a consulting firm for the State of Pennsylvania extended in a line across the harbor entrance channel and showed that the rock surface sloped lakeward with a 1 on 125 slope with a depth of approximately 60 feet below LWD near Beach No. 11 (Rummel, Klepper & Kahl-Fertig Engineering Company, 1968). The bedrock here is likely to be the gray shale of the Portage Formation.

Surficial Deposits - The shoreline east of Presque Isle is characterized by narrow sandy beaches extending along the base of till and/or sandy bluffs which are 50 to 100 feet above lake level. To the west, beaches are chiefly shingle and coarse gravel backed by till bluffs.

Historical Origin of Presque Isle Peninsula

The observed sediment transport patterns at Presque Isle are the result of a modern wave climate acting on the glacial and post-glacial deposits of the area. Glacial deposits, some reworked during post-glacial lake level fluctuations, serve as the source for the littoral material. Lake level fluctuation and drainage pattern changes have been frequent in post-glacial time (for the past 12,000 years) and are responsible for denudating the glacial topography and producing many of the present, onshore, offshore, and coastal features including Presque Isle Peninsula. However, Presque Isle is a unique feature. It is the only major positive depositional feature along the southern shore of Lake Erie, and any explanation of its existence must be tied to some specific event or feature.

An understanding of the origin and historical development of Presque Isle Peninsula is necessary in order to understand the processes currently at work and to predict the future condition. Thus, the following discussion concerning the post-glacial development of Presque Isle is presented only as a brief overview in order to provide a better understanding of the observed condition. This discussion is hypothetical and, although it fits with the existing information and literature, has not been rigorously tested.



GROWTH AND MIGRATION OF PRESQUE ISLE

(JENNINGS, 1930)

Note: The dotted line on the 1790 through 1866 sketches represents the 1930 position of the peninsula. The dotted line shown on the 1930 sketch documents the eastward migration relative to a 1200 A.D. position as hypothesized by Jennings, 1930.

QUATERNARY OF LAKES HURON AND ERIE

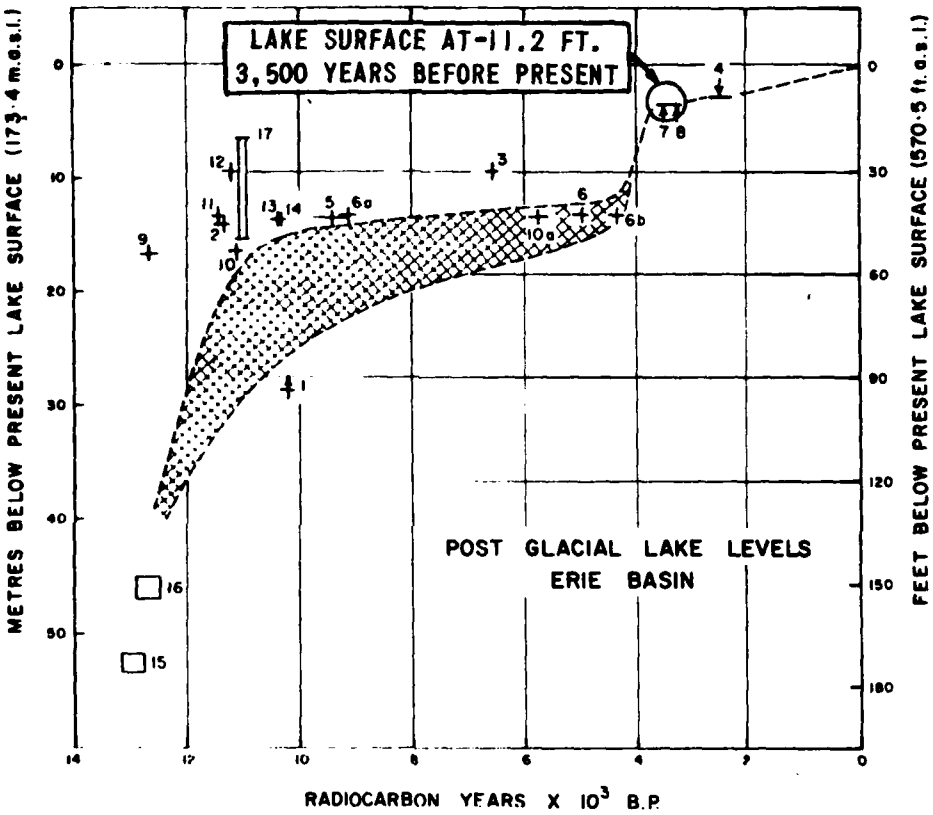


FIG. 12 Post glacial history of Lake Erie water levels. Points are keyed numerically to entries in Table 1.

LEWIS (1969)

FIGURE 12

In order for Presque Isle Peninsula to exist prior to recent lake levels, there must have been a substantial source of sand and a reason for that sand to collect in one area. The existence of the platform to the west of Presque Isle may very well be the key which explains how Presque Isle Peninsula evolved. The platform has a total length of 12 miles of which the eastern five miles is currently covered by the peninsula. Its average width is about 3 to 3-1/2 miles and average depth is 25 to 30' below LWD. Map documentation from the past 150 years shows that the sand of Presque Isle does migrate from west to east across this platform, building a new platform to the east as it moves in that direction. The origin of the platform can be explained as a total sand terrace which has been wave planed by rising lake levels or as a preexisting topographic high (rock or glacial till) which served as the original base for Presque Isle and was added to as the peninsula grew. Data collected by CERC in 1977 and 1978 as part of the ICON Study is currently being evaluated by them and may help identify the stratigraphy of the platform. Preliminary review suggests that the western end of the platform is underlain by till (S. J. Williams, personal communication). For now, let us assume that the original platform is at the western end and was composed of glacial morainal till. The platform is the southern end of the Long Point-Erie ridge (Figure 13) which has been traced to the Post Huron-glacial advance (12,800 $\pm$ 250 years B.P.). Hough describes the moraine as a distinct ridge on the bottom of Lake Erie lying west of the eastern deep basin, emerging on the south side of the lake where it extends eastward into New York as the Lake Escarpment Moraine System (Messenger, 1977). The surface of this moraine, both the ridge and the platform, was probably planed by wave action during lower lake levels, and the silts and clays were carried offshore leaving a lag deposit of sand and gravel. The platform lag deposit was well-sorted by wave action and possibly served as a depositional area for littorally transported material during the Early Lake Erie stage. As lake level rose to approximately 25'below today's lake level, about 4,000 years ago, littoral currents transported the sand on the platform toward the east, remolding it into an elongated sand beach. This historical sequence is described in Table 4 and shown on Figure 12.

Migration caused by waves from the west and rising lake levels caused the sand body to move toward the east side of the morainal root. As sand slumped off of the east side of the moraine, a sand platform was built. The feature we recognize as Presque Isle Peninsula evolved as it migrated onto this sand platform. As the sand platform built, the sand volume available for transport diminished. How much of the platform is till and how much is sand are unknown at this time, but subsurface foundation studies planned for the Phase II General Design Memorandum stage of the project may provide additional information on the platform and Presque Isle Peninsula.

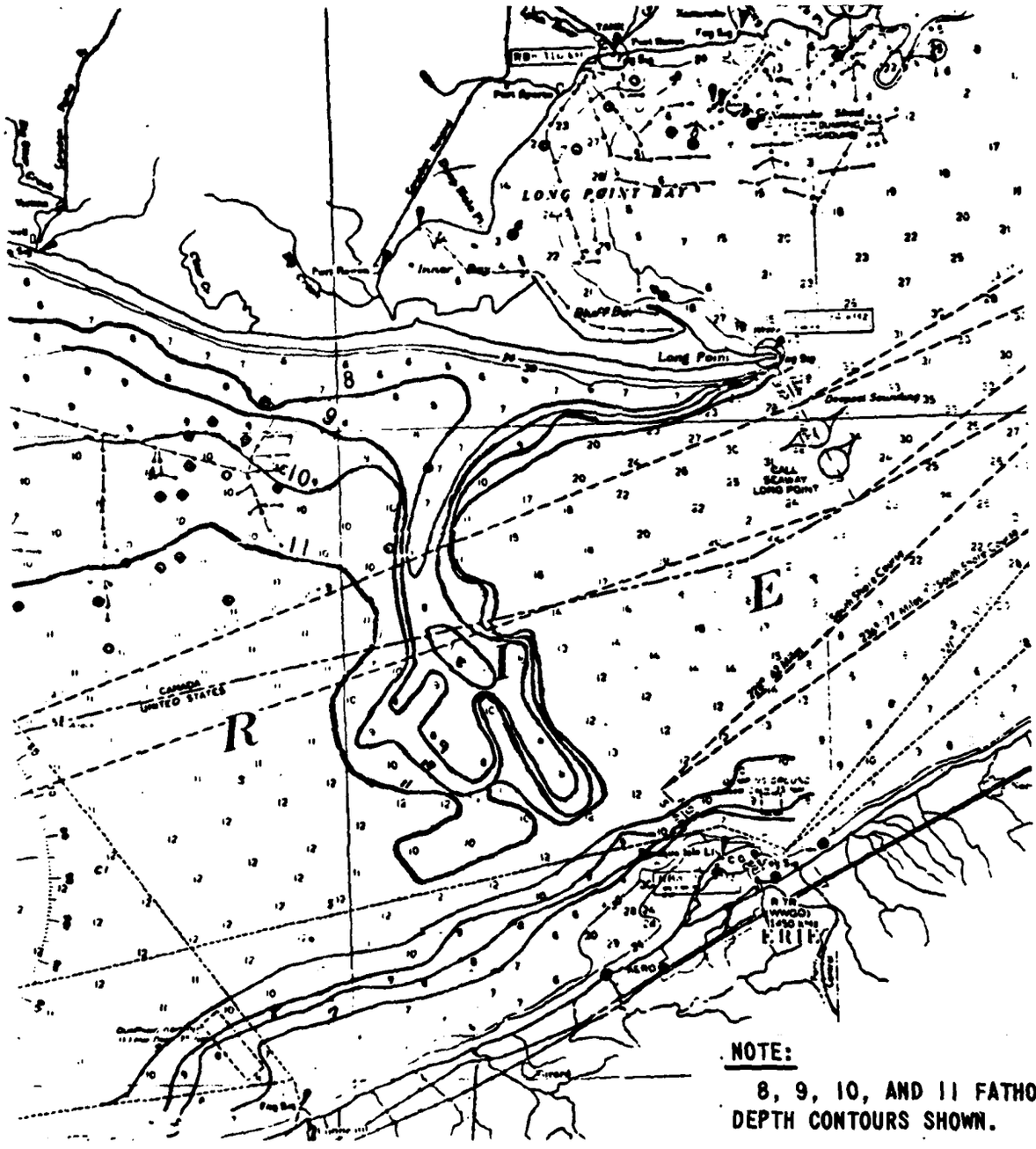
Migration of Presque Isle

Presque Isle Peninsula was originally surveyed in 1819. In 1824, the original Erie Harbor project included action as needed to maintain the integrity of Presque Isle Peninsula in order to assure the harbor's future success. Since then, the migratory character of the peninsula has become very evident as erosion and breaching of the neck has demanded continual attention and as accretion at the east end of the peninsula has required jetty extension and

Table 4 - Hypothetical Chronology of Presque Isle Origin*

Period (Years B.P.)	Event	Discussion
12,900	Port Huron Advance	Long Point-Erie Moraine formed.
12,500-11,500	Early Lake Erie	Rapidly rising lake level from 120' to 60' below current LWD.
11,500-10,000	Early Lake Erie	Slower rising lake level (from 60' to 50' below current LWD). Crest of Long Point-Erie Moraine planed by rising lake level, beach deposits, and dune field develops from lag deposit.
10,000-4,500		Slowly rising lake level (from 50' to 40' below current LWD). Long Point-Erie Morainal ridge inundated.
4,500-3,500		Rapid rise in lake level (from 40' to 10' below current LWD). Platform of Presque Isle (landward extension of the Long Point-Erie Moraine is subjected to wave attack sand and gravel lag deposit from till released as source material for Presque Isle.
3,500 to present	Modern Lake Erie	Lake level rises at approximate rate of 1 foot per 300 years. Modern Presque Isle evolves as it migrates to the east.

*Based on the historical Lake Erie water levels presented in Lewis (1969) and on a hypothetical development sequence for Presque Isle.



LAKE SURVEY CHART NO. 3 ILLUSTRATING THE LONG POINT-ERIE MORAINAL RIDGE.

FIGURE 13

dredging to remove shoal buildup in the entrance channel (see paragraph in this section entitled History of Shore Protection at Presque Isle).

Evidence of long-term migration before Federal involvement with Presque Isle is clearly defined by the morphology of the peninsula's internal features, the platform to the west, and the shoreline of the mainland. A comparison of the sheltered shoreline inside Presque Isle Bay to the open shoreline east and west of Presque Isle Peninsula shows no offset. The bay shore should be a positive shoreline and be characterized by a gently sloping shore if it had experienced long-term sheltering by the peninsula. This is not the case. The shoreline is continuous from the west, through the bay, and to the east. The bay shore is characterized by steep, wave-cut bluffs identical to those outside the bay. The sequence of beach ridges, elongated beach ridge ponds, and fingering distal end ponds is repeated and preserved within the interior of the peninsula, documenting previous stages in Presque Isle's migration. The unknown factor is what has been the change in shape and size as Presque Isle has migrated.

The presence of relict features in Presque Isle Peninsula documents the migration from west to east and a continuation of the same general pattern and process of evolution. Presque Isle Peninsula has probably developed in cycles in order for the specific depositional features to be preserved. We can witness the yearly cycle and the long-term cycles of growth related to annual lake level fluctuations, but Presque Isle Peninsula may also be influenced by longer period climatic patterns about which we have no knowledge. High lake levels increase transport rates causing rapid loss of material from the neck area and rapid growth of the distal east end as sand is fed to the growing eastern platform. During lower lake levels, the distal east end matures as the bars are recurved and become subaerial and new material enters the system at the neck, partially healing the eroded areas and widening the neck (reference Shoreline Changes, Plate 2, U. S. House Document No. 231, 1953).

The beach ridges evolve as the offshore bars migrate onshore and weld onto the shore as a subaerial bar. They probably build in height as they migrate onshore in response to the steeper waves of the surf zone. Sand is deposited in front of the bar; a lagoon is trapped behind it. Cottonwoods and other vegetation take root on the beach ridge, and dunes build on top of the ridge increasing its height to about 20 feet above low water datum. Low areas behind and between the beach ridges are submerged and appear as a series of elongated ponds oriented WNW-ESE. Examples of these ridge ponds are Long Pond, Cranberry Pond, and Ridge Pond (see Plate 4 in Appendix A). The recurving offshore bars at the distal east end form a finger shaped array of ponds which are oriented north-south. These distal ponds include Big Pond, Yellow Bass Pond, and Niagara Pond (see Plate 4 in Appendix A). The Presque Isle system is an eastward migrating system which feeds upon itself as it migrates. Within the system, material is eroded from the neck to the shifting nodal point, which has recently been in the vicinity of Beach 10, and is deposited along the depositional feature which is Gull Point or offshore to create new platform to the east, or landward where it shoals in the harbor entrance channel (see the discussion in Appendix C, Detailed Design, paragraph C5.b.).

Recent rates for this migration are artificial and directly influenced by the large-scale replenishment operations of the late fifties through early seventies. The present migration rate of 289,100 cubic yards per year reflects the replenishment input which has averaged 259,300 cubic yards per year since 1955. Attempts to determine the natural migration rate suffer from a lack of sufficient historical data and the obvious masking influence of the 150-year effort to stabilize the neck. Historical maps extending back to 1819 and aerial photographs extending back to 1939 were used to document the natural drift rate. The results of this evaluation are presented in Appendix C, Detailed Design, paragraph C5.b(1) Gull Point Growth.

Historical maps do suggest that the Gull Point feature is a recent morphological addition to the system. Maps from 1819 through 1907 show a smooth recurved east end to Presque Isle which merges directly with the harbor entrance structures. Since the early 1930's, isolated growth has extended Gull Point as a "Mini Presque Isle" without sufficient recurving to weld this new growth back onto the shore. The original development of Gull Point may be related to a slug of sand which was released to the nearshore processes between 1917 and 1922 by breaching of the neck. The replenishment operations of the 1950's through 1970's continued adding new material to the accretionary end at a rate faster than easterly storms were able to recurve the bars and shoreline onto the Isle.

The incoming quantities of material never really replace the material left behind as the peninsula migrates and as the eastern end of the platform is built up. This continual loss of material plus the effect of a long-term, slowly-rising lake level (post-glacial rise of about 1 foot every 300 years) has probably caused Presque Isle to shrink. As Presque Isle migrates, it becomes smaller and migrates faster. Any attempt to identify the age and migration rate of Presque Isle must consider a measure of the rate of size change, as well as change in the rate of migration. The background data for this sophisticated analysis does not yet exist.

In summary, a few general statements can be made about Presque Isle's natural development trend:

(1) Presque Isle is an old age feature which is migrating with a net annual loss.

(2) Gull Point is a recent feature which has grown at significant rates because of the effects of artificial nourishment.

(3) Presque Isle Peninsula is a fluid feature; any attempt to permanently stagnate its migration will meet with eventual failure, with respect to geologic time, as all such attempts in the past have. An acceptable beach erosion control alternative will retard migration and/or lengthen the peninsula's life by adding new material to the system to replace that which has been used to build the platform and is a net loss to the littoral system.

Description of the Biological Environment

Presque Isle is an exceptional natural area characterized by a wide variety of rich and, in some ways, unique plant and animal communities. Especially noteworthy is the fact that on Presque Isle there is great habitat diversity, with a successional continuity of vegetation types ranging from pioneer vegetation on newly-formed sites, to fairly stable woodland communities on old sites. Also, successionally intermediate sites, including extensive marshland, are well represented and comprise the bulk of the peninsula and include some of the most productive wildlife habitat. This habitat diversity is a result of the size and shape of the landform and also its dynamic nature, since shoreline processes create new areas suitable for colonization by plants. Soil type, too, is an important factor contributing to the nature of the vegetation here. Sand comprises all of the soil parent material, and its presence helps to account for the occurrence of uncommon plant species specially adapted to shores and dunes and also creates, due to rapid percolation, dry conditions on only slightly elevated sites.

There have been several studies of various aspects of the ecology of Presque Isle, addressing botany, birdlife, and the microbial biology of the ponds and lagoons. These references, of value in understanding the baseline environmental conditions, are listed below:

1. Jennings, O. E., 1909, "A Botanical Survey of Presque Isle, Erie City, PA," Annals of the Carnegie Museum 5:289-421.

2. Kormandy, E. J., 1960, "Comparative Ecology of Sandspit Ponds," American Midland Naturalist, 28-61.

3. Todd, W. E. C., 1904, "The Birds of Erie and Presque Isle, Erie City, PA," Annals of the Carnegie Museum, 2:481-596.

Zagorski, S. J., and others, have performed a number of unpublished studies of plankton, bacteria, algae, and water quality in the waters of Presque Isle. Corps planning documents, especially the September 1975, Final Environmental Impact Statement for the Feasibility Study stage of this project, provide background information on many aspects of Presque Isle, including the natural environment.

Plant Ecology - Historically, botanical studies have focused on the process of plant succession: the change in plant communities over time. The earlier studies, and recent reworkings of the same basic studies, have tended to over-emphasize succession and were based on the erroneous belief that plant species occur in association with other species and that these associations, like the species themselves, can be found duplicated on similar sites within a region. Consequently, early work, of which the Jennings (1909) paper "A Botanical Survey of Presque Isle, Erie City, PA" is an example, tended to categorize and classify the observed vegetation in an attempt to establish identity with similar communities elsewhere. In fact, identical communities do not occur because plant species occur in response to environmental factors, which are continuously changing over time and space. Despite these

limitations in interpretation, Jennings' work includes an invaluable compilation of the plant species present and descriptions of the environment and the vegetation. The botanical and environmental descriptions in the following paragraphs were formulated using Jennings' work to aid in interpreting observations made during field visits by a Corps biologist and through examination of aerial photographs.

Presently, the peninsula comprises a variety of general plant community types delineable through aerial photograph examination. These areas and the approximate percentage of the total 3,200-acre land mass (indicated in parentheses) are: Sparsely-vegetated sandy sites (9 percent); open water of ponds and lagoons (13 percent); wetland sites (14 percent); shrubby sites (26 percent); wooded areas (33 percent). The remaining 5 percent is developed and is occupied by roads, parking areas, administration headquarters, the marina, facilities, and the Perry Monument.

Open Sandy Area - Open sandy sites, comprising roughly 9 percent of the land area of Presque Isle, include shoreline and dune sites, as well as some newly-formed sandspit areas embracing ponds on the Gull Point area. Also included is an open, level sand plain area of roughly 37 acres on Gull Point. Except on this latter area, vegetation generally varies from being absent on very newly-formed sites and on those sites exposed to harsh wave action, to scattered and sparse further from shore, associated with dunes and ridges. Sand plain vegetation is composed of continuous fairly dense herbaceous cover with shrubs intermixed.

Due to the severity of wave action, preventing secure rooting, the most exposed beach sands are devoid of vascular plant life. Further toward the mainland, a few plant species with the annual habit of growth are found, occupying a band parallel to shore, reflecting, in some cases, deposition of seeds by water. The plants include Sea Rocket, Clotbur, Russian Thistle, Sea-beach Spurge, and Winged Pigweed. Sites elevated by wind-blown accumulations of sand constitute small dunes, which are occupied and stabilized, by species capable of tolerating hot, dry, sunny conditions combined with substrate instability. Prominent on this habitat is Dune Grass, which, especially on the Gull Point area, is seen capping 2- to 4-foot dunes and ridges; the species' growth is favored by conditions which exclude most other plants, wherein subsurface horizontal stems from which new shoots arise grow more vigorously when partly exposed. Other plants of this sandy dry habitat include Panic Grass, Beach Pea, and Wormwood, and on older, more stable dunes, Sandbar Willow and Cottonwood.

At the eastern end of the peninsula, in the Gull Point area, extending above and beyond the shoreline/dune area, is a quite level, open sandy area of roughly 37 acres. This sand plain is occupied fairly densely by a variety of herbaceous species, and scattered clumps, on slightly elevated hummocks, of bayberry. The more abundant and conspicuous members of this flora include Bluejoint, Panic Grass, and a variety of rushes, Scouring Rush, Cypress Spurge, Lyre-leaved Rock Cress, Goldenrods, Wormwood, Marsh Pink, Gerardia, Ladies Tresses, and roughly 40 other species of lesser importance. Moisture conditions vary considerably on this level area, which, being quite low, receives considerable moisture from a high water table, as evidenced by the

occurrence of some characteristically wet-site species. An elevated sand ridge divides the sand plain. Vegetation on this ridge is like that on nearby dunes.

Wet Sites - Ponds, marshes, and moist shores comprise roughly 27 percent of the area of the peninsula. Ponds, of which there are about 10 (some of them interconnected), have been formed by water-transported sand enclosing areas of open water. This process has been, in part gradual and in part abrupt. Marshes, comprising about half of the wet-site habitat (including open water inland) are best developed adjacent to ponds, and northeast of Ridge Pond. Vegetated shores include the pond shores and the calm margins of Thompson, Misery, and Presque Isle Bays.

Vascular plant life exists in ponds with an abundance and diversity which is related to two factors, mainly. One is the degree of current or wave action, as rougher waters, such as is found in larger ponds or the bays, tend to exclude by mechanical agitation all but a few hardy species such as Tapegrass and Water-milfoil. The other factor is pond age, as the youngest ponds lack both sufficient time for vegetation to have become established and the habitat diversity provided by the existence of plant life. Depth is a factor affecting distribution of plant life within a pond, as the deeper portions of ponds generally lack vegetation since light penetration is slight in deep water. Thus, shallow, calm, older waters tend to have greater abundance and diversity of plant life. Conspicuous, abundant, submerged species include Tapegrass, Water-milfoil, Coontail, and Water-stargrass. Floating-leaved forms include several species of Pondweed, White Water-lily, and Yellow Water-lily.

At pond margins and on the wet meadows of the extensive wetland area northeast of Ridge Pond, a variety of shrubs and herbaceous species occur. Emergent herbs in shallow water are Arrowhead, Water-plantain, and Pickerelweed. In this region, and extending into drier areas as well, are several important wetland plants, distinguishable by their height, abundance, and tendency to occur in large dense stands: the Sedge Threesquare, the grass Phragmites, and Cat-tail. Also, hummocks of Tussuck-forming Sedge (Carex stricta) occur throughout extensive shallow wet areas, with floating-leaved herbs occupying space between the hummocks.

Shrubby Areas - Sites occupied mainly by shrubs occur scattered throughout the peninsula, constituting roughly 26 percent of the area of the peninsula. Mainly these areas are moist sites associated with ponds and lagoons, with which they intergrade. Shrubs bordering and occupying these areas include Willows, Alder, Bayberry, Buttonbush, and Meadow-sweet.

These areas exist both as fairly stable wetland ecosystems, and as transitions to vegetation of a more terrestrial nature. This is related mainly to water level on the site, with extreme fluctuations generally serving to maintain wetland vegetation.

Cottonwood in its juvenile stages is an important component of young pond margins. These areas soon develop into woodland.

Wooded Areas - Mature trees are the dominant vegetation on roughly 33 percent of the area of Presque Isle.

On somewhat dry, fairly old and stable sites, a forest develops which is characterized by a large proportion of Black Oak and Eastern White Pine. This forest was best developed on the area now occupied by the marina, but similar vegetation exists elsewhere on the peninsula. Other tree species on these sites include Red Oak, Basswood, Sassafras, and Eastern Hemlock.

With a higher degree of moisture, other tree species become important. Predominant among these are Red Maple, Black Ash, White Ash, Yellow Poplar, Red Gum, and, formerly, American Elm. Cottonwood is a fast-growing species colonizing young pond margins, which, on these moist sandy sites, develops into a thin forest dominated by this species.

Animal Ecology - Animal associations, of course, directly reflect plant associations and on Presque Isle the birds, mammals, reptiles, and other animals find niches in a diverse matrix of habitats, each situated according to its age and the nature of its origin.

Most of the larger mammals require a wide spectrum of habitat types to survive - forest for cover, brushland, and field for browse. Less mobile species such as small mammals, turtles, or snakes, are more specific to one type of environment. A wide variety of habitats such as are present on Presque Isle can, therefore, support diverse populations of wildlife. There have been no recent published surveys of the mammals of Presque Isle. Most of the mammals and reptiles are year-round residents, whereas many of the bird species are migratory and visit the peninsula only during certain seasons.

The Presque Isle Peninsula is noted for its abundance and diversity of bird life. Its variety of habitats, Great Lakes location, and preservation in a somewhat natural state are contributing factors to its unique richness of avian resources.

The peninsula in its entirety attracts and harbors a wide array of types of birds, with different ones exploiting different areas of the peninsula at various times of the year. Some of these birds are woodland and field species which are generally distributed throughout the western Pennsylvania region, while many others are water-dependent birds which find resting, feeding, and in some cases, breeding sites in the waters associated with Presque Isle. It is mainly this latter group of birds for which Presque Isle is noteworthy; certainly no other site in Pennsylvania is characterized by such a richness of waterfowl, shorebirds, gulls, terns, and marsh birds such as herons, bitterns, and rails. Probably few other sites on the lower Great Lakes approach the peninsula in this richness of bird life.

Presently, the Gull Point area is important to several types of birds. The shorebirds are especially well represented here, with total numbers and numbers of species quite high for inland (not marine-coastal) locality. All are present only as transients except the spotted sandpiper and killdeer, with those being summer residents which are not believed to be breeding here. Typically, in summer, a few thousand nonbreeding ring-billed gulls, mostly

immatures hatched the previous summer, probably of Great Lakes origin, roost and feed along the newly-formed shoreline at Gull Point and on the beaches nearby. Small numbers of herring gulls, Bonaparte's gulls, Caspian terns, and common terns similarly occur, often being found with and near the more abundant ring-billed gulls.

In the ponds and marshes, black terns, snipes, least bitterns, green and great blue herons, sora, and Virginia rails make their nests. The brushlands and old dunes support yellow warblers, song sparrows, and killdeers, and in the forests are redeyed vireos, wood peewees, and various woodpeckers.

The birds which visit and inhabit Presque Isle and the Erie area have been a source of considerable pleasure and study to amateur and professional naturalists alike. The area around Presque Isle is blessed with a wide spectrum of vegetation and habitat types, each providing niches for different assemblages of avian species. In addition to this spatial mosaic, is the temporal variability imposed by changing seasons.

W. E. C. Todd, in his monograph on the bird life of Presque Isle, states: ". . . the locality under consideration is perhaps the most favorable in the entire State of Pennsylvania for the study of water birds." Large expanses of open water provide habitat for diving ducks, while dabbling ducks forage at the marsh edges in shallower water. Native Wild Rice and Wild Celery are abundant in many of the inland ponds and are exploited by wading birds. Shore birds, such as sandpipers, plovers, and rails, are seasonally abundant on the mud flats surrounding ponds and in areas on the bay side of the peninsula.

Periodic fluctuations of the surface level of Lake Erie play an important role in the ecology of the wading and shore birds. As lake levels rise, inundation of low areas and mud flats greatly limits the carrying capacity of the peninsula for these birds. High water is more favorable for ducks, who prefer to be a considerable distance offshore where they are relatively safe from terrestrial predators.

Quite aside from the excellent aquatic bird habitat, is the variety of environments offered by a spectrum of terrestrial plant communities of different successional stages. Sparrows and warblers are common in the more open or brushy areas and thickets. Forests are frequented by owls, while hawks survey their domains perched atop large Oak and Cottonwood snags. Woodpeckers are numerous in the mature forests, as are towhees, oven birds, nuthatches, and creepers.

Fisheries - The aquatic life of Presque Isle is associated with three types of ecosystems: (1) inland ponds, (2) beaches, (3) bays, inlets, and harbors.

The aquatic food chain of inland ponds typifies that of a moderately productive and balanced ecosystem and includes microcrustaceans, insects, forage fish, and predator fish. The peninsula supports a fairly substantial sport fishery, greatly utilized by local and visiting fishermen. It is comprised mainly of largemouth bass, bluegill, sunfish, crappies, bullheads, and catfish. Carp, spotted and longnose gar, and bowfin provide spring and early

summer sport for a number of bow fishermen. Winter brings on some ice fishing activity on the deeper ponds. Catches are mainly of bluegill and yellow perch.

The aquatic community typically associated with the beach environment supports a balanced population of invertebrates and fish, including both forage fish and predators. The beach habitat supports only a narrow diversity of adult species with a moderate population density. However, the peninsula serves as a nursery area for young-of-the-year fish. The diversity of this group is broad and includes both open-lake and beach-associated species.

The fishery can be broken down into three main categories: Rough fish (carp, suckers, etc.), forage fish (lake emerald shiners, spottail shiners, trout-perch, alewife, etc.), and sport fish. The sport fishery includes yellow perch, white bass, freshwater drum, walleye, and the recently introduced salmon species. Yellow perch provide the bulk of fishing sport with coho and chinook salmon exhibiting spring and fall peaks. The beach-associated fishery closely resembles the open-lake fishery.

The peninsula contains numerous aquatic systems falling within the category of bays and inlets. Most are interconnected with the fertile waters of Presque Isle Bay and exhibit dense populations of plankton, benthic (bottom dwelling) organisms, and fish. These areas are used extensively by boat and bank fishermen with good fish catches usually the rule rather than the exception. Ice fishing is a popular sport during the winter months and gives way to bow fishing during the spring months. The sport fishery is composed of the following species: bullheads and catfish, yellow perch, northern pike, largemouth bass, bluegill, crappie, sunfish, and a limited muskellunge fishery.

Presque Isle State Park

Practically the entire peninsula, which contains about 3,200 acres, is owned by the Commonwealth of Pennsylvania and is developed as a park. The United States owns two small parcels of land, one near the harbor entrance, the other at the lighthouse, both of which are occupied by U. S. Coast Guard facilities. The park provides facilities for bathing, boating, hiking, fishing, picnicking, bird-watching, and other recreation opportunities. Extensive acreages are also set aside for botanical and ecological studies.

The prime summertime attraction of Presque Isle State Park is its magnificent sand beaches. These beaches number eleven and stretch the entire shore of the peninsula, Beach 1 being at the lower neck and Beach 11 near Gull Point (see Plate 4 in Appendix A). All of the beaches have parking lots or roadside parking spaces for automobiles and four of the beach areas have developed bathhouse and refreshment facilities. The average beach length is 2,000 feet and the average width of each beach, based on aerial photographs taken in July 1979, ranges from about 50 feet up to about 150 feet. The crest elevation of most of the beaches are relatively low and frequently overtopped during lake storms, causing flooding of the backshore and access onto the peninsula impossible.

Boaters at Presque Isle are fortunate in having one of the finest recreational marinas on the Great Lakes. In 1955, 1961, and 1965, the Corps of Engineers excavated large quantities of sand from an area south of Long Pond. This sand was used to replenish eroding beaches on the Lake Erie side of the peninsula. The excavation created a sizable inland lake about 12 feet in depth, and formed the basis for development of a marina complex which has been built during the last 12 years. The marina is situated in such a fashion that boaters have easy access to the inland waterway of the peninsula, which comprises a complex network of ponds, lagoons, and channels, and offers excellent opportunities for fishing and wildlife watching. Its main entrance provides access to Presque Isle Bay and ultimately to Lake Erie and the other Great Lakes.

Presque Isle State Park presents a very wide spectrum of activities which extend year around. The year-round attractiveness of the park is illustrated in Table 5, which shows seasonal and annual attendance figures provided by Presque Isle State Park personnel for the period from 1935 to 1971. Heaviest use is, of course, in summer. Spring and fall attendance figures typically approximate one-third of the summer attendance and winter attendance about one-fifth. Annual attendance has been steadily increasing from 1,419,102 in 1935 to 2,110,950 in 1950, and 4,191,180 in 1978. In 1979, the annual attendance was 3,569,819, reflecting a decrease of over 600,000 persons from the previous year which can probably be attributed to the increase in gasoline prices and the threat of gasoline shortages.

Table 5 - Seasonal and Annual Attendance at Presque Isle State Park from 1935 to 1978

Year	Annual	Summer 1/	Autumn 2/	Winter 3/	Spring 4/
1935	1,419,101	893,236	186,606	165,807	173,452
1936	1,459,799	951,493	169,371	148,176	190,759
1937	1,417,049	1,013,566	204,867	78,187	120,429
1938	1,761,771	1,147,950	225,508	187,726	200,587
1939	1,787,570	1,102,711	286,353	142,803	255,703
1940	1,937,626	1,170,805	292,189	203,755	270,877
1941	2,116,750	1,309,608	361,989	160,479	284,674
1942	1,542,199	940,414	212,220	146,160	243,405
1943	471,086	221,719	152,577	40,419	56,371
1944	1,019,056	658,350	134,217	89,590	136,899
1945	1,079,053	717,628	193,540	46,138	121,747
1946	1,531,367	956,574	233,604	136,552	204,637
1947	1,486,584	959,661	248,310	99,423	179,190
1948	1,745,126	1,186,299	238,567	135,693	184,567
1949	2,281,751	1,447,875	280,534	203,607	349,735
1950	2,110,950	1,406,160	245,385	178,686	280,719
1951	2,262,495	1,434,622	293,728	217,071	317,074
1952	2,254,728	1,517,211	322,294	160,915	254,308
1953	2,362,440	1,566,405	338,071	169,258	288,706
1954	2,627,522	1,662,547	341,676	251,442	371,857
1955	2,399,593	1,514,394	371,898	221,400	291,901
1956	2,675,132	1,530,130	405,144	277,627	462,231
1957	2,852,797	1,715,418	385,024	336,501	415,854
1958	2,827,011	1,856,362	342,958	236,925	390,766
1959	2,925,790	2,119,711	346,059	204,462	255,558
1960	3,184,064	2,200,459	385,348	236,925	361,332
1961	3,055,004	1,954,885	438,799	289,017	372,303
1962	3,502,826	2,050,245	405,643	551,367	495,571
1963	3,257,746	2,044,516	395,572	304,753	512,905
1964	3,151,988	1,956,123	381,829	299,844	514,192
1965	3,351,554	2,078,545	415,224	306,135	551,650
1966	3,614,173	2,360,556	489,154	256,004	508,459
1967	3,176,667	1,852,371	348,858	384,750	590,688
1968	3,519,198	2,228,805	495,036	271,188	524,169
1969	3,658,612	2,143,989	492,799	411,790	610,034
1970	4,034,266	2,297,435	554,158	491,905	690,768
1971	3,876,282	2,171,358	680,265	408,244	616,415
1972	3,038,736	1,703,321	433,240	351,612	550,563
1973	3,564,382	2,203,216	566,332	317,723	477,111
1974	3,483,548	2,041,760	548,672	416,052	477,064
1975	3,851,992	2,189,280	636,124	449,388	577,200
1976	3,926,988	2,240,868	615,596	365,360	705,164
1977	4,129,796	2,464,848	542,084	347,920	774,944
1978	4,191,180	2,558,583	774,423	179,857	678,317
1979	3,569,819	2,110,119	590,620	366,825	502,255

1/ Start of Memorial Day Weekend through Labor Day Weekend
2/ From end of Labor Day Weekend through 20 December
3/ From 21 December through 20 March
4/ From 21 March through day before Memorial Day Weekend

CONDITIONS IF NO FEDERAL ACTION TAKEN (WITHOUT CONDITION PROFILE)

This section describes the condition that would occur if the Federal Government were to do nothing for beach erosion control along the shoreline of Presque Island Peninsula. This is the "No Action Plan" and represents the base condition for comparing and evaluating improvement alternatives.

The Erosion Problem

The geological forces which have created Presque Isle are also gradually destroying it. Erosion of the lakeshore beaches and breaching of the neck have been counteracted by public and private efforts for a number of decades. A history of the human efforts to retard erosion of the peninsula is lengthy and complex. A summary follows.

History of Shore Protection at Presque Isle

When the project for Erie Harbor was first initiated back in the early 1800's, in addition to the work at the entrance, the project required protection of the shore at the neck of the peninsula of Presque Isle, which by its position, forms the harbor of Erie. The preservation of the peninsula is of vital importance to Erie Harbor, and it is for the purpose of preserving the harbor that protection of the long, narrow neck at the western end of the peninsula has been deemed necessary. The protective works to date have been constructed to prevent breaching through the narrow neck during severe storms from the west. Such a breach would compromise the effectiveness of the harbor. A literature survey of the Chief of Engineers Reports (1867-1978) was undertaken, and the following paragraphs present a documentation on protective works which were implemented for preservation of Presque Isle Peninsula.

The attention of the United States Government was directed to Erie Harbor after the close of the War of 1812 from the fact that it was in Erie that Commodore Perry anchored his fleet after his memorable battle. In 1823, the Board of Engineers presented an elaborate report with a plan for the improvement of the entrance to Erie Harbor. Subsequently, the River and Harbor Act of 26 May 1824 authorized improvement of Erie Harbor and protection of Presque Isle Peninsula.

The first breach recorded appears to have taken place during the Winter of 1828-1829. Its location and extent were not reported, but the entire appropriation of $7,390.25 provided by the River and Harbor Act of 3 March 1829 was used in closing it. During the Winter of 1832-1833, another breach occurred. Nothing was done to close it, and in 1835, it was reported to be nearly 1-mile wide. Plans were developed which provided for partially closing the breach with cribwork and to make a 400-foot wide western entrance to the bay. In 1836, work commenced and 420 feet of cribwork breakwater was completed, strengthened by piling, and partially filled with stone. This

cribwork breakwater was extended 1,920 feet in 1837 for an aggregate length of 2,340 feet. It was reported that the progress in partially closing the breach was very satisfactory, and in 1838 an additional 1,035 feet of cribwork was built. Work continued in 1839 when 990 feet of cribwork was built. There were no appropriations nor work done during the years 1840 through 1843. In 1844, the breach was reported to be about 3,000-feet wide, and the erosion was such that 470 feet of cribwork was built to protect the barracks built for workmen in 1836. Nothing further was done and in 1852, the breach was reported as still existing, and the cribwork protection built in previous years had been almost destroyed. In 1853, efforts were made to prevent further erosion by protecting the shore with brush weighted with stone. The results were very satisfactory, and this mode of closing the breach was continued in 1854 through 1856. Work was suspended in 1857 due to lack of funds, and no further work was done until 1864. In 1864, it was reported that the breach at the west end of the harbor was entirely closed, although about 500 feet of the peninsula was so low that waves would break clear across during high water and heavy gales. This low portion of the peninsula was strengthened in 1865 by placing old tree trunks, brush, saplings, etc., parallel to the shore, making a layer 30-feet wide.

During the years 1871 and 1872, fifty-one thousand three hundred young trees, roots, and slips of silver poplar, American poplar, and willow were planted as an experiment on the west side of the peninsula for protection of the neck. Also, the beach at two exposed points was further protected by anchoring and picketing brush laid in rows and weighted with heavy stone. The Fall and Winter gales of 1873-1874 made alarming attacks on the shore of the peninsula, and in November 1874, the peninsula was once more breached. The breach was closed in 1875 with 400 feet of six-foot high pile and plank fence riprapped on both sides with stone. The protection proved to be successful, and an additional 1,080 feet of pile and plank fence was built at other weak points on the peninsula in 1875. This pile and plank fence was extended 3,056 feet in 1876, another 1,461 feet in 1877, and 550 feet in 1878, making a total length of 6,547 feet. In 1879, the protection fence was badly damaged at various points with the stone washed away, piles broken off, and planks destroyed.

In 1880, eight jetties 200 feet apart were built by driving lines of close piling out to a depth of 6 feet in the lake. A ninth jetty was built about 2 miles from the neck of the peninsula. In addition, about 2,000 feet of brush and stone protection was built along the lakefront to repair the protective fences which had been destroyed during the previous winter. Violent gales during the Winters of 1880-1881 and 1881-1882 destroyed several portions of the protective fencing built during the period from 1875 to 1878. In 1882, three intermediate piles were driven between every two old piles still standing from the protective fencing. About 1,000 feet of this type of protection was built to provide a nearly closed continuous row at a cost of nearly $2,500. This brought the total expenditures for work accomplished on Presque Isle during the period from 1829 through 1883 to approximately $220,000.

There was no work done for protection of Presque Isle Peninsula during the period from 1883 through 1887, and in 1887, it was reported that all the

protection fences and pile jetties built in the previous years were so broken down and rotten that they were considered useless. The River and Harbor Act of 11 August 1888 authorized protection of the neck of the peninsula by construction of a 6,000-foot long timber pile and sheet pile breakwater located about 100 feet offshore. About 4,500 feet of breakwater was built by September 1889 at a cost of about $60,000 when a moderate storm badly wrecked all but 1,300 feet of the structure and work was ordered stopped since it was evident that the protection constructed was not going to prove serviceable. The remaining sheet piling and walings were washed away during a severe storm in October 1892.

No further work was done on protection of the peninsula during the period of 1890 through 1895. Several severe storms occurred during this period whereby waves would wash over the peninsula and into the bay, causing severe erosion along the western portion of the peninsula. In 1896, another experimental tree planting project was undertaken whereby 1,000 Carolina poplars, 200 Wisconsin willows, 200 yellow locusts, 200 Scotch pines, 3 bushels of blue grass, 2 bushels of orchard grass, 1 bushel of crimson clover, 300 willow cuttings, and about 60 native poplar trees were planted on the neck of the peninsula at a cost of $360. The purpose of the plantings was to make a growth that would catch drifting sand and increase the height and width of the neck, increase the resistance of the neck to erosion, and lessen the liability of a possible breach from waves washing over the neck of the peninsula. The trees planted in 1896 grew vigorously during the year and therefore, in 1897, about 2,400 yellow locust trees and 2 bushels of seeds of native shrubs were planted on the neck of the peninsula at a cost of $376. At that time, the plantings were regarded as an important part of the harbor works and further plant growth encouraged since those planted in previous years had thriven very well. Therefore, an additional 2,000 honey-locust trees and 200 willow cuttings were planted in 1898 at a cost of $210.

The River and Harbor Act of 3 March 1899 authorized construction of four protection jetties along the outer edge of Presque Isle Peninsula. The first jetty was built in 1900 and located 5,200 feet west of the Presque Isle Light. The structure cost about $5,390 and was of timber crib construction filled with stone and had a "T" across the outer end. The cribbing was 12-feet wide, 11½-feet deep, and 290-feet long; the "T" was 10-feet wide, 11½-feet deep, and 32-feet long. The second protection jetty was built in 1903 at a cost of $8,560 and located 7,800 feet west of the Presque Isle Light. In 1906, it was determined that the jetties built in 1900 and 1903 were not correcting the beach erosion along the peninsula and therefore, the remaining two jetties authorized by the River and Harbor Act of 1899 were never constructed.

There was no work done for protection of Presque Isle Peninsula during the period from 1904 through 1915. However, in 1916, about $316 was expended for planting 5,000 poplar trees and 2,725 linear feet of willow hedge on the neck of the peninsula to reinforce the existing growth. These trees and hedge grew well during the year and in 1917, an additional 2,310 poplar trees and 2,280 willow cuttings were planted to reinforce the existing growth at a cost of $195.

A severe storm occurred late in October 1917, causing waves to break over the neck of the peninsula and creating a breach about 150-feet wide. Work on closing the breach with a 300-foot timber bulkhead was initiated in mid-November and continued until early December with 270 feet being completed at a cost of $7,000 when another severe storm occurred, uprooting large trees, washing out small growth, destroying the completed portion of the timber bulkhead, and widening the breach to 479 feet. There were no further attempts made to close the breach during 1918, and storms during the Winter of 1918-1919 increased the width of the breach to 1,160 feet. Closure of the breach with sandfill protection was begun in the Fall of 1919 when a 500-foot section of fill protection at the east end of the breach was placed before operations were halted for the winter. When operations resumed in April 1920, the breach was 1,470-feet wide. During 1920, about 3,000 feet of sandfill protection and 1,700 feet of rubblemound protection were placed, and 4,800 small poplar trees were planted on the sandfill protection. In addition, 310 feet of riprap wall was placed on the lakeside of the sandfill protection. The sandfill protection was completed during 1921 with 1,500 feet being placed, and the riprap wall on the lakeside of the sandfill protection was extended 1,465 feet. During the period from October 1920 through November 1921, about 22,700 small poplar and 1,900 small willow trees were planted and 49 bushels of rye and 6 bushels of cowpeas sown to protect the sandfill. In 1922, the riprap stone wall on the lakeside of the sandfill protection was reinforced and extended 1,160 feet, thus completing the work in closing the breach. Approximately $282,000 was expended on work to close the breach.

The River and Harbor Act of 28 November 1922 reconveyed Presque Isle Peninsula to the State of Pennsylvania for park purposes, and its care and protection were no longer to be considered by the United States as part of the project for improvement of Erie Harbor. The State of Pennsylvania built six sand traps in 1927, a series of seven steel sheet pile groins during 1928 and 1929, and about 5,300 feet of steel sheet pile bulkhead in 1929 on the lakeside of the peninsula at various locations from the neck to the lighthouse.

The United States Government again became involved with Presque Isle Peninsula for the protection of Erie Harbor in 1930 and 1931 when 5,646 feet of steel sheet pile bulkhead (including shore returns) with 5,052 feet of stone facing, was constructed along the neck of the peninsula at a cost of about $165,400. The State of Pennsylvania extended this protection along the neck of the peninsula an additional 1,230 feet in 1931 and also built a steel sheet pile groin. In 1932, the State built two more steel sheet pile groins and extended the steel sheet pile bulkhead which they built in 1929 an additional 1,500 feet. This bulkhead was again extended 850 feet by the State in 1937.

In 1943 and 1944, the United States Government repaired shore protection works constructed in previous years and further protected the steel sheet pile bulkheads by construction of a rubblemound facing on the lakeside. In addition, 2,750 feet of rubblemound protection was constructed at the root of the peninsula, and two experimental 300-foot long rubblemound groins were built. The work undertaken in 1943 and 1944 was accomplished at a cost of

about $1,041,700. Further repairs to the protection works along Presque Isle Peninsula were undertaken by the United States Government during the period from 1947 through 1952 at a total cost of $443,100. During the period from 1924 through 1948, it was estimated that the Commonwealth of Pennsylvania had spent approximately $3,500,000 on maintenance of the peninsula.

Severe storms during the early 1950's led to the establishment of the cooperative beach protection program between the Federal Government and the Commonwealth of Pennsylvania as authorized by the River and Harbor Act of 3 September 1954. Work commenced in the Fall of 1955 and was completed in the Summer of 1956, during which time 4,150,000 cubic yards of sand were pumped on the beaches, ten new steel sheet pile groins constructed, two existing groins altered, and a badly damaged bulkhead section near the lighthouse groin was removed. The total cost of the cooperative project was $2,451,270, which includes a stone seawall 3,000-feet long built in 1952 on the neck of the peninsula.

An emergency sand replenishment was accomplished by the Commonwealth of Pennsylvania in the Winter of 1959-1960 at the cost of about $24,000. The cooperative beach protection program between the Federal Government and the Commonwealth of Pennsylvania was modifed by the River and Harbor Act of 14 July 1960 to include participation in periodic nourishment for a period of 10 years following the first major replenishment operation. The emergency protection in 1959-1960 prevented further damage to the project up to the time of the first major replenishment authorized by the 1960 River and Harbor Act. The first major replenishment was undertaken in 1960-1961 during which approximately 681,500 cubic yards of sand were pumped onto the beaches at a cost of $500,000. In 1963-1964, the Commonwealth of Pennsylvania repaired two groins which were built in 1956 by placing heavy stone at a cost of about $54,000. A second major replenishment authorized by the 1960 River and Harbor Act was required in 1964-1965, at which time approximately 402,300 cubic yards of sand were pumped on the beaches at a cost of $355,000. In 1965-1966, a third replenishment was undertaken whereby 45,000 tons of coarse-grained sandfill were placed, and six of the groins built in 1956 were modified by addition of a stone facing. The total cost for accomplishing the work undertaken in the third replenishment was about $166,000. A fourth major beach replenishment was undertaken in 1968-1969, with 102,700 tons of coarse sandfill being placed on the beaches at a cost of $348,000. The fifth and final beach replenishment operation under authorization of the 1960 River and Harbor Act was accomplished in 1971 when a 1,200-foot long barrier consisting of nylon bags filled with sand and grout was built at Beach No. 6, and 152,500 tons of sand were placed on the beaches at a total cost of $535,000. The costs presented in this paragraph for repair and replenishment operations undertaken as authorized by the 1960 River and Harbor Act do not reflect engineering and administrative costs incurred by either the State or Federal Governments nor the costs of annual beach surveys and studies which totaled nearly $250,000. The costs for the replenishment operations discussed in this paragraph are a composite of Federal and Commonwealth of Pennsylvania shares based on the 70%-30%/Federal-Commonwealth cost-sharing agreement.

In 1973, an emergency sand replenishment was undertaken by the Federal Government, whereby 100,000 tons of sand were placed along the neck of the peninsula at a cost of $240,000. Due to the severe erosion problem which still existed, the cooperative beach protection program between the Federal Government and the Commonwealth of Pennsylvania was again modified. The Water Resources Development Act of 1974 authorized the Federal Government to participate in beach nourishment for a five-year period. Actual work under the program was initiated in 1975 with the placement of approximately 187,000 tons of sand and a total expenditure of $1,097,000. A second nourishment was completed in 1976 at a cost of about $1,097,000 for placement of 183,000 tons of sand. In 1977, sand from land sources was used instead of from an offshore borrow area as in the previous two years, and 287,000 tons of sand were placed at a cost of about $1,089,000. The fourth beach nourishment project was completed in 1978 at a cost of $1,074,000 and included construction of three experimental prototype breakwaters offshore from Budny Beach (Beach No. 10) and placement of 173,000 tons of sand. A fifth beach nourishment project was completed in 1979 at a cost of $1,061,000 for placement of 216,000 tons of sand on beaches along the lake shoreline. A sixth beach nourishment project, requiring the placement of 216,000 tons of sand, is currently underway and is scheduled to be completed by July 1980. The costs for the replenishment operations discussed in this paragraph are a composite of Federal and Commonwealth of Pennsylvania shares based on the 70%-30%/FederalCommonwealth cost-sharing agreement.

During the past 25 years, the Commonwealth of Pennsylvania, in addition to contributing approximately $4.4 million to the cooperative beach nourishment program, has expended several million dollars for performing emergency repairs to roadways on the peninsula which were damaged during storms, for undertaking sand replenishment operations, for placement of stone protection at critical locations on the lakeside, as well as the bayside of the peninsula, and for grout-filled nylon bag barriers.

Existing Structures

The structures built for preservation of Presque Isle Peninsula during the 1800's and early 1900's were mainly of timber construction. These structures had a useful life of only a few years before being destroyed. During the period from 1920 through 1978, rubblemound and steel sheet pile construction methods were implemented. These types of construction are more durable and longer lasting. Structures built of these types of construction make up the majority of the protective structures presently in existence along the peninsula. The locations of protective structures presently in existence along Presque Isle Peninsula, the type of construction utilized, the date the structures were built, and who built them are presented on Plate 5 in Appendix A. The types of some of the existing structures and experimental projects implemented at Presque Isle are shown in Photos 1 through 20. The photographs appear in the order in which one would observe the structures if walking along the peninsula shoreline from the west towards the east.

Sediment Budget of the Presque Isle System

Gains. Any influx of sediments into the Presque Isle system must either come from the east, from the west, from offshore sources, or from artificial

PHOTO 1

Experimental groin "A" built by the Federal
Government in 1944
(Rubblemound Construction)
Date of Photo: 2 Nov. 1978

PHOTO 2

Rubblemound revetment built by the
Federal Government in 1920.
Date of Photo: 11 Nov. 1975

PHOTO 3

Cellular steel sheet pile groin (Groin Nos. 1&2) constructed in 1956 as part of the cooperative beach erosion project between the Federal Government and Commonwealth of Pennsylvania.
Date of Photo: 2 Nov. 1978

PHOTO 4

Cantilever steel sheet pile groin (representative of Groin Nos. 3,4,5,6,7,9,10,11) constructed in 1956 as part of the cooperative beach erosion project between the Federal Government and Commonwealth of Pennsylvania. The stone facing was added during the period from 1963 through 1966.
Date of Photo: 2 Nov. 1978

PHOTO 5
Experimental Groin "B" built by the Federal Government in 1944. The concrete cap was added in 1956 as part of the cooperative beach erosion project between the Federal Government and Commonwealth of Pennsylvania. This is presently Groin No. 8 in the groin field along the neck of the peninsula.
Date of Photo: 2 Nov. 1978

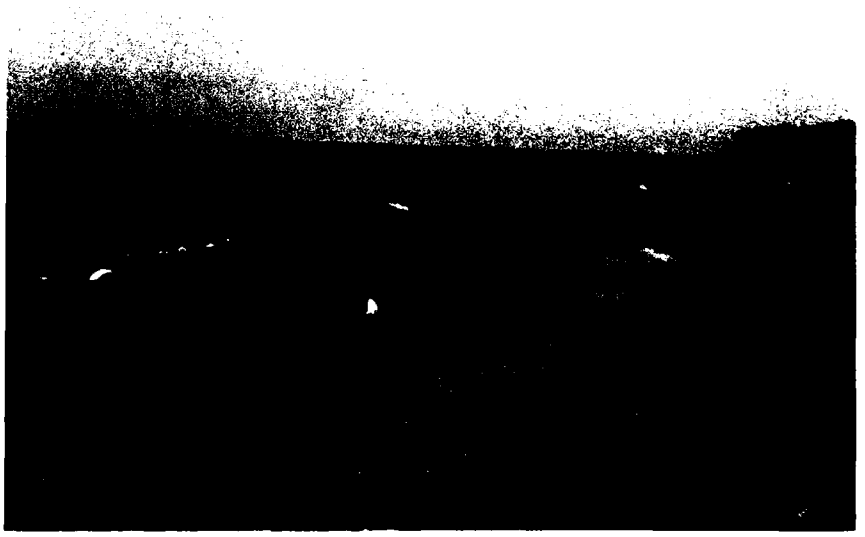


PHOTO 6
Experimental barrier constructed from grout and sand filled nylon bags in 1971 as part of the fifth replenishment operation under authorization of the 1960 modification to the cooperative beach erosion project between the Federal Government and Commonwealth of Pennsylvania.
Date of Photo: 31 Oct. 1978

PHOTO 7

U.S. Jetty #3 (waterworks jetty) built with stone filled timber cribs and topped with a block cap. The structure was built by the Federal Government in 1903.
Date of Photo: 31 Oct. 1978

PHOTO 8

Precast concrete block sand trap built by the Commonwealth of Pennsylvania in 1927.
Date of Photo: 31 Oct. 1978

PHOTO 9

Precast concrete block finger groin system built by the Commonwealth of Pennsylvania during the 1920's or 1930's.
Date of Photo: 31 Oct. 1978

PHOTO 10

Steel sheet pile groin built by the Commonwealth of Pennsylvania in 1928.
Date of Photo: 31 Oct. 1978

PHOTO 11

Precast concrete block sand trap built by the Commonwealth of Pennsylvania in 1929.
Date of Photo: 31 Oct. 1978

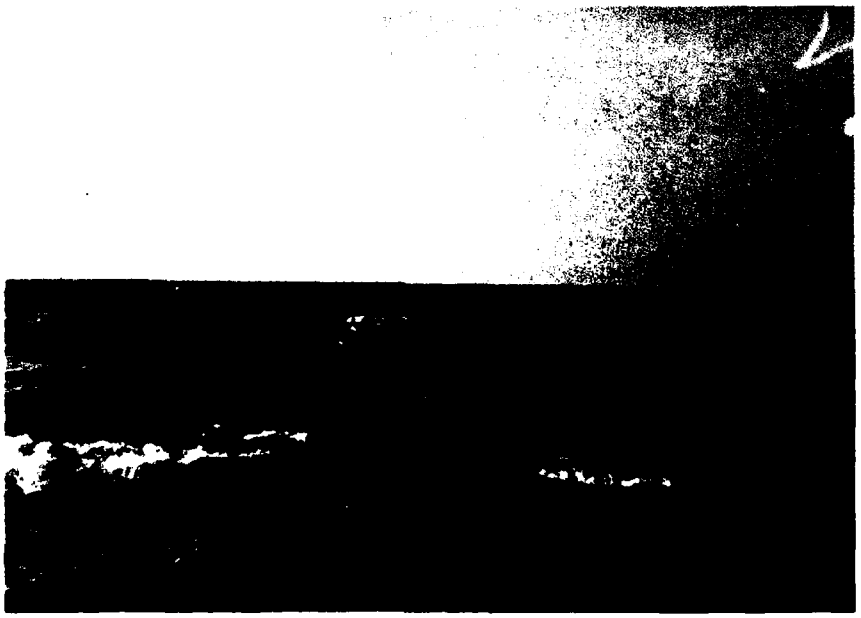


PHOTO 12

U.S. Jetty #2 (Stone Jetty) built with stone filled timber cribs and topped with a stone cap. The structure was built by the Federal Government in 1900.
Date of Photo: 31 Oct. 1978

PHOTO 13

Typical steel sheet pile bulkhead constructed at several locations along the peninsula.
Date of Photo: 31 Oct. 1978

PHOTO 14

Fences built at several locations along the peninsula for catching wind blown sand to create dunes.
Date of Photo: 31 Oct. 1978

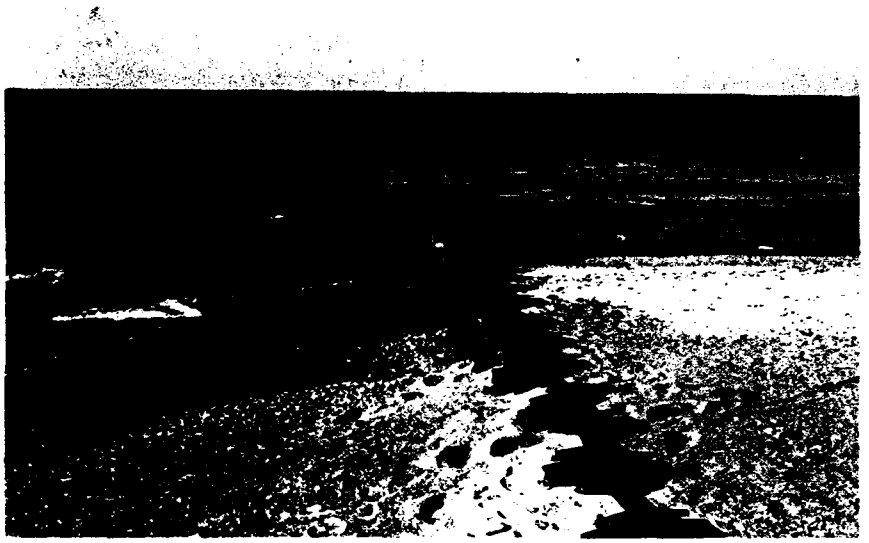


PHOTO 15

Typical cantilever steel sheet pile groin built by the Commonwealth of Pennsylvania during the 1920's or 1930's.
Date of Photo: 31 Oct. 1978

PHOTO 16

U.S. Jetty #1 (Lighthouse Groin) originally built with stone filled timber cribs by the Federal Government in 1885 and since repaired with steel sheet piling.
Date of Photo: 31 Oct. 1978

PHOTO 17

One of three grout-filled nylon bag breakwaters built at Sunset Point by the Commonwealth of Pennsylvania in 1973.
Date of Photo: 31 Oct. 1978

PHOTO 18

Experimental dune stabilization project implemented by the Coastal Engineering Research Center (Corps of Engineers) in cooperation with the Commonwealth of Pennsylvania in 1977 utilizing vegetation to trap wind blown sand. Project was destroyed by severe storm on 5-6 April 1979.
Date of Photo: 31 Oct. 1978

PHOTO 19

Riprap revetment built at Sunset Point in 1977 by the Commonwealth of Pennsylvania.
Date of Photo: 31 Oct. 1978

PHOTO 20

Three experimental prototype stone breakwaters built in 1978 by the Federal Government in cooperation with the Commonwealth of Pennsylvania during the sand nourishment program authorized by the 1974 modification to the cooperative beach erosion project.
Date of Photo: 31 Oct. 1978

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nourishment. Presque Isle Peninsula is probably largely dependent upon influx from the west and artificial nourishment for littoral gains to the system (see Appendix C, Detailed Design, paragraph C5.a. Gains).

Presque Isle is an eastward migrating feature with the Erie Harbor entrance structure and channel blocking any influx of material from the east. In addition, the morphology of Gull Point, plus the known wave energy flux condition for the Erie, PA area (Saville, 1953) further documents the lack of littoral material influx from the east.

Considering the historical development of Presque Isle and the offshore bathymetry, there is little evidence that the offshore is active in supplying a net sediment gain to the Presque Isle system. The platform to the west is below wave base and no longer part of the active Presque Isle system. The offshore is the trailing edge of the migrating feature, and being in deeper water, it does not keep up with the subaerial part of Presque Isle. Thus, there is a continual net offshore loss to the system rather than any gains.

Offshore bars in the nearshore do migrate onshore, but this is simply a redistribution of sand within the system which may result in temporary onshore gains. During lower water periods, the bar system is driven offshore. Further information on the importance of the nearshore bar system in influencing the littoral transport patterns of the Presque Isle system is being accomplished as part of the studies to monitor the shoreline changes to Presque Isle Peninsula.

Thus, all natural *influx to the system must come from the west*. The approximately 20-mile long shoreline between Conneaut, OH, and the root of the Presque Isle Peninsula is generally unbroken by any dominate stick-out features, headlands, or major shoreline inconsistencies. The Federal harbor structures at Conneaut are a very effective block to any littoral material exchange with shores any further to the west. Therefore, this 20-mile section of shore is considered as a single section of shore closed at the west and open at the east where Presque Isle Peninsula serves as the eventual site of deposition for any littoral input. Any littoral sediment input to this section of shore must come from fluvial sources, onshore movement of offshore sands, or bluff recession. The shore to the west is characterized by 20- to 100-feet high eroding till bluffs. The typical section is about 60- to 70-feet high with shale at or just below the waterline, then a coarse-grained till (probably Ashtabula till), followed by a thick clay sequence, and overlain by a thin layer of lacustrine sands (Great Lakes Research Institute, 1975). The recession rate of this sequence ranges from 0.5 ft/year to 2.0 ft/year (Carter, 1977; also see paragraph C5.a.(1) in Appendix C).

Streams in the area, for example Elk Creek and Walnut Creek, flow through steep, shale gorges and have drowned entrance mouths. This combination, plus field data gathered from Elk Creek in support of the proposed Elk Creek Small-Boat Harbor Project, suggest that sand and gravel input from streams is minimal. However, these creeks have such potential for high velocity during periods of discharge (i.e., a steep gradient) that any material which may have collected in the settling basin (the river mouth) could get washed out. A field reconnaissance of the upper river basin would be necessary in order

to ascertain the presence of any significant fluvial contribution to the littoral zone.

The beaches are generally small, pocket beaches on the updrift side of structures or as bay mouth bar complexes at the mouth of each creek. Occasionally, during a period of low water, a narrow beach may collect in front of the bluff areas. The beaches are generally composed of fine to coarse quartz and lithic sands and gravels with shingles of shales and siltstones. Frequently, the beach may appear as a shingle beach.

Little information exists on the offshore area to the west of Presque Isle Peninsula, but it is generally considered to be till or rock surfaced, with little evidence of an offshore sand source except in the area of the Presque Isle platform. The platform area is generally 20 to 30 feet below LWD and, therefore, is considered as below the active wave base. At creek mouths, a delta develops where the bay mouth bars are washed outward during a period of heavy discharge. Some of these delta areas may serve as sites for temporary storage with some minor onshore return from the delta shoals.

Information on the offshore was gathered by the Coastal Engineering Research Center (CERC) as part of the ICON study during 1977 and 1978. Once analyzed by CERC, this data will add to our knowledge of the offshore west of Presque Isle.

In summary, sediment input from the west is dominated by bluff recession rates. There is probably some creek input of a much more minor level, but it is impossible to quantify the level of this contribution at this time. In order to develop a reasonable "ballpark" estimate of littoral transport rates from the west, it is necessary to make the following assumptions:

a. That the drift rate is controlled directly by the amount of material available for transport (This is a high energy shore where the wave energy is capable of transporting all the available littoral material).

b. That the primary source of littoral material is bluff recession.

c. That the major permanent littoral sink for this approximately 20-mile long section of coast is Presque Isle Peninsula. Other losses to the drift regime are limited to temporary storage in fillets associated with stick-out structures and small beaches and to permanent offshore losses. Offshore losses occur, particularly where small creeks divert littorally transported drift offshore into deltas and as material travels around the end of stick-out structures into deeper water. Offshore losses are assumed to be 20 percent.

The annual littoral input due to bluff recession between Conneaut and Presque Isle was calculated from bluff recession rates, bluff heights, reach length, and the stratigraphy presented by Carter (1977) (see Appendix C Detailed Design, paragraph C5.a(1)). Based on these computations, bluff recession contributes approximately 50,000 cubic yards of sands and gravels per year. Considering that 20 percent of this material is lost to the offshore, only

about 40,000 cubic yards of littoral material per year are supplied to Presque Isle from the west.

Artificial nourishment has been a major factor influencing Presque Isle's development for the past 24 years. The need for replenishment reflects the highwater periods of the mid-1950's and the early 1970's which threatened to sever access to the outer peninsula. As shown in Table C6 of Appendix C, over 6,200,000 cubic yards of material have been added to the system since 1955. This input has forestalled breaching of the neck, thus maintaining the neck's position and causing rapid growth at the accretionary east end (Gull Point). Replenishment has caused Presque Isle Peninsula to become elongated and has caused a net gain to the system.

The 4,150,000 cubic yards added in 1955-1956 was fine sand with a median size (50 percent size) of 0.20 mm which was obtained from borrow areas on the bayside of the peninsula. This sand was actually finer than the natural-sized beach material (0.35 mm) and was quickly eroded. The small amount of fill placed in 1965-1966 was medium sand (median size of 0.75 mm) and was considered as successful. As a result of this experience, the sandfill placed in the mid and late 1970's was a medium to coarse sand with a median size to the gradation band of about 1.8 mm. Prior to this period of nourishment, the neck was frequently breached. A major effect of a breach is to cause the neck to migrate eastward through overwash and bayside shoal development. Evaluation of historical maps from the 1800's and early 1900's shows that the accretionary east end (Gull Point) has experienced sporadic growth possibly in response to migration of the neck (reference Table C7 in Appendix C).

Losses. Although Presque Isle Peninsula is a depositional feature, the dominate present activity is erosion. In 1877, the peninsula was described as eroding along the neck and eastward to a point which was 500' west of the lighthouse. A hundred years later, erosion characterizes the shore as far east as the east end of Beach 10. Thus, the nodal point between erosion and accretion has migrated 9,000 feet to the east in 100 years. Part of this nodal point shift is related to the natural migration of the system, and part is related to a net loss of material. The natural migration has been modified over the past 150 years by the many activities which have anchored and built the neck into a well-defined subaerial isthmus. According to Chief of Engineers reports from the early 1800's, the natural "neck" is a low, nominally vegetated, frequently overwashed, 3-1/2-mile long sand spit. Efforts to stabilize the neck have resulted in the whole peninsula system being "stretched." As the distal end migrates, and the neck remains stable, the available littoral load is distributed over a longer shoreline. Thus, the Isle thins, the beaches narrow, and a greater length of shore erodes. This results in an "apparent" loss to the system.

Actual net losses are caused by offshore movement and platform building. Material leaves the system offshore around the total peninsula perimeter and at the distal east end.

Material is lost offshore as a result of bar formation and the migration of the peninsula away from its offshore platform. Typically, the offshore bar system migrates onshore and offshore in response to lake level changes and

severe storms. During this cycle, there is a continual net offshore loss. The offshore bars at Presque Isle have been observed to be both complex and dynamic. Nummedal (1979) has identified four different bar forms and believes that substantial amounts of sediment may move along the bar systems. There are also offshore losses associated with the peninsula migrating eastward away from its western platform. That is, Presque Isle migrates east, leaving its platform behind. There is no present knowledge on the offshore losses from the Presque Isle system, but it has been estimated at 20 percent for use in developing the sediment budget for this Phase I Design Memorandum.

The main area of loss to the Presque Isle system is at the distal east end where the drifting sediment not only builds Gull Point, but also spills over the eastern end of the platform, building a new platform, and is recurved shoreward and landward, shoaling across the Erie Harbor entrance channel. Estimates have been made to summarize the losses at the east end based on historical changes at Gull Point, bathymetric charts, and dredging records for the Erie Harbor entrance channel (see Appendix C, Detailed Design, paragraph C5.b. Losses). Based on these figures, the present condition (with replenishment) is that 146,400 cubic yards of littoral material accumulate in the entrance channel per year, 84,900 cubic yards per year are involved in building Gull Point, and 57,800 cubic yards per year build the new platform at the distal end (Figure 14).

From 1960 to the present, the average annual volume dredged from the entrance channel has been about 225,950 cubic yards. Computations presented in paragraph C5.b.(2) entitled Erie Harbor Channel Dredging in Appendix C indicate that 146,400 cubic yards of the dredged material per year come from Presque Isle and the rest from the mainland to the east or from siltation of suspended sediments. The 1930 to the present dredging record does not identify the amount dredged each year from the entrance channel, but the bulk of the annual dredging probably is material which originated from Presque Isle Peninsula and was deposited in the entrance channel. The 1930-1977 dredging records (reference Table C8 in Appendix C) show that dredging from 1960 to the present has averaged 95,150 cubic yards per year more than the 1930-1959 period. This probably reflects an increased influx of material as a result of the 1956-1971 beach replenishment operations and suggests that there is about a 5 to 6-year lag between replenishment and increased dredging volumes in the entrance channel.

The annual rate of growth of the distal end (Gull Point) varies from a minimum of 18,400 cubic yards per year with shore protection structures, but no replenishment (1875-1950) to 84,900 cubic yards per year with replenishment (1950-1978). The natural growth rate without structures or replenishment appears to be about 43,600 cubic yards per year (1819-1875) (see paragraph C5.b.(1) entitled Gull Point Growth in Appendix C).

Therefore, the natural balance for Presque Isle without replenishment is summarized as a 40,000 cubic yard gain from the west, 51,300 cubic yard permanent loss to the entrance channel, 17,400 cubic yards used to build up the new eastern platform, and 18,400 cubic yards to develop Gull Point. The resultant system, therefore, has a migration rate of 87,100 cubic yards per year (Figure 15). Presently, the volume of Gull Point growth and the net

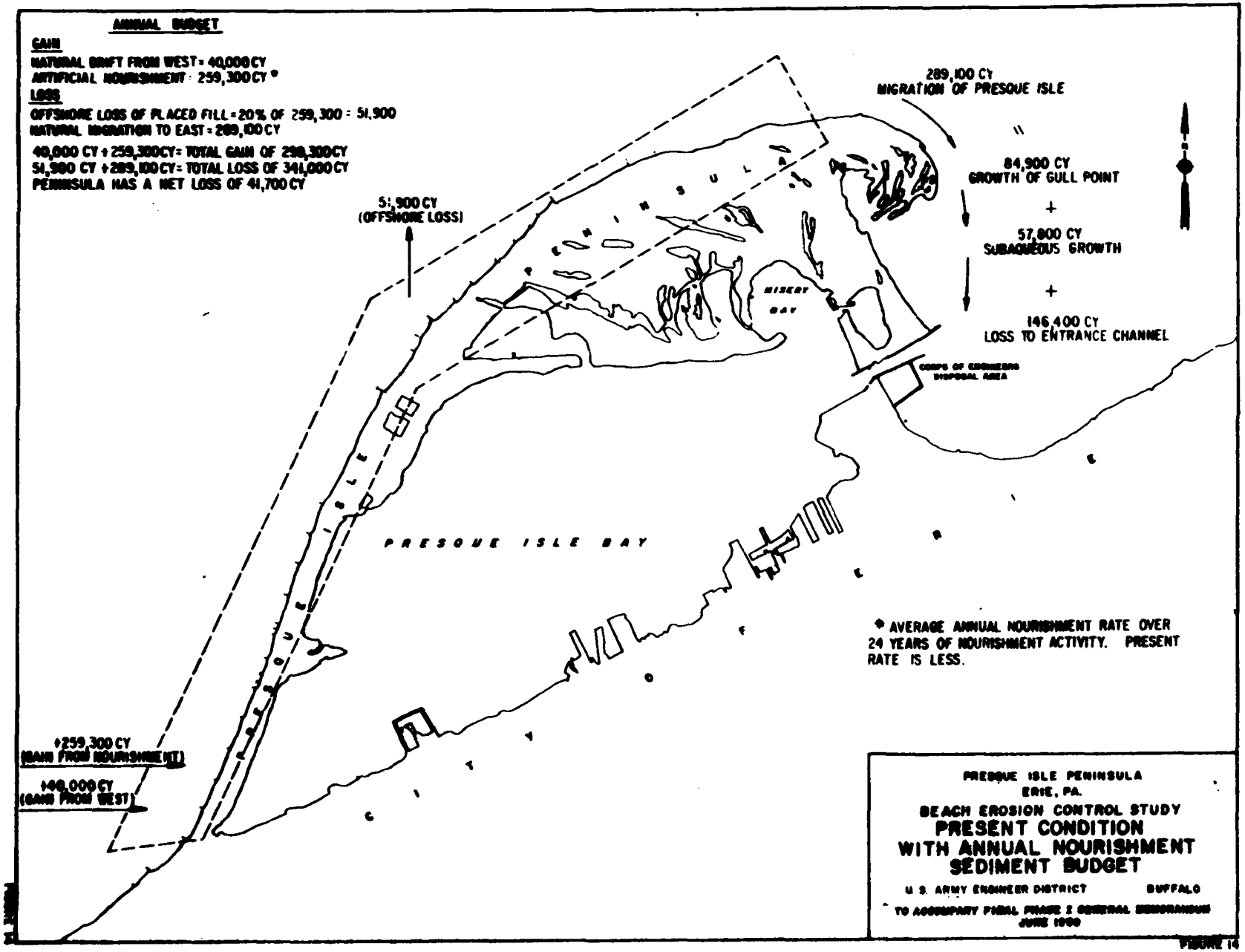
ANNUAL BUDGET
GAIN
NATURAL DRIFT FROM WEST = 40,000 CY
ARTIFICIAL NOURISHMENT : 259,300 CY *
LOSS
OFFSHORE LOSS OF PLACED FILL = 20% OF 259,300 = 51,900
NATURAL MIGRATION TO EAST = 289,100 CY
40,000 CY + 259,300 CY = TOTAL GAIN OF 299,300 CY
51,900 CY + 289,100 CY = TOTAL LOSS OF 341,000 CY
PENINSULA HAS A NET LOSS OF 41,700 CY
51,900 CY
(OFFSHORE LOSS)
289,100 CY
MIGRATION OF PRESQUE ISLE
=
84,900 CY
GROWTH OF GULL POINT
+
57,800 CY
SUBAQUEOUS GROWTH
+
146,400 CY
LOSS TO ENTRANCE CHANNEL
PENINSULA
MISERY BAY
CORPS OF ENGINEERS DISPOSAL AREA
PRESQUE ISLE
PRESQUE ISLE BAY
CITY
* AVERAGE ANNUAL NOURISHMENT RATE OVER 24 YEARS OF NOURISHMENT ACTIVITY. PRESENT RATE IS LESS.
+259,300 CY
(GAIN FROM NOURISHMENT)
+40,000 CY
(GAIN FROM WEST)
PRESQUE ISLE PENINSULA
ERIE, PA.
BEACH EROSION CONTROL STUDY
PRESENT CONDITION
WITH ANNUAL NOURISHMENT
SEDIMENT BUDGET
U. S. ARMY ENGINEER DISTRICT BUFFALO
TO ACCOMPANY FINAL PHASE I GENERAL MEMORANDUM
JUNE 1980

FIGURE 14

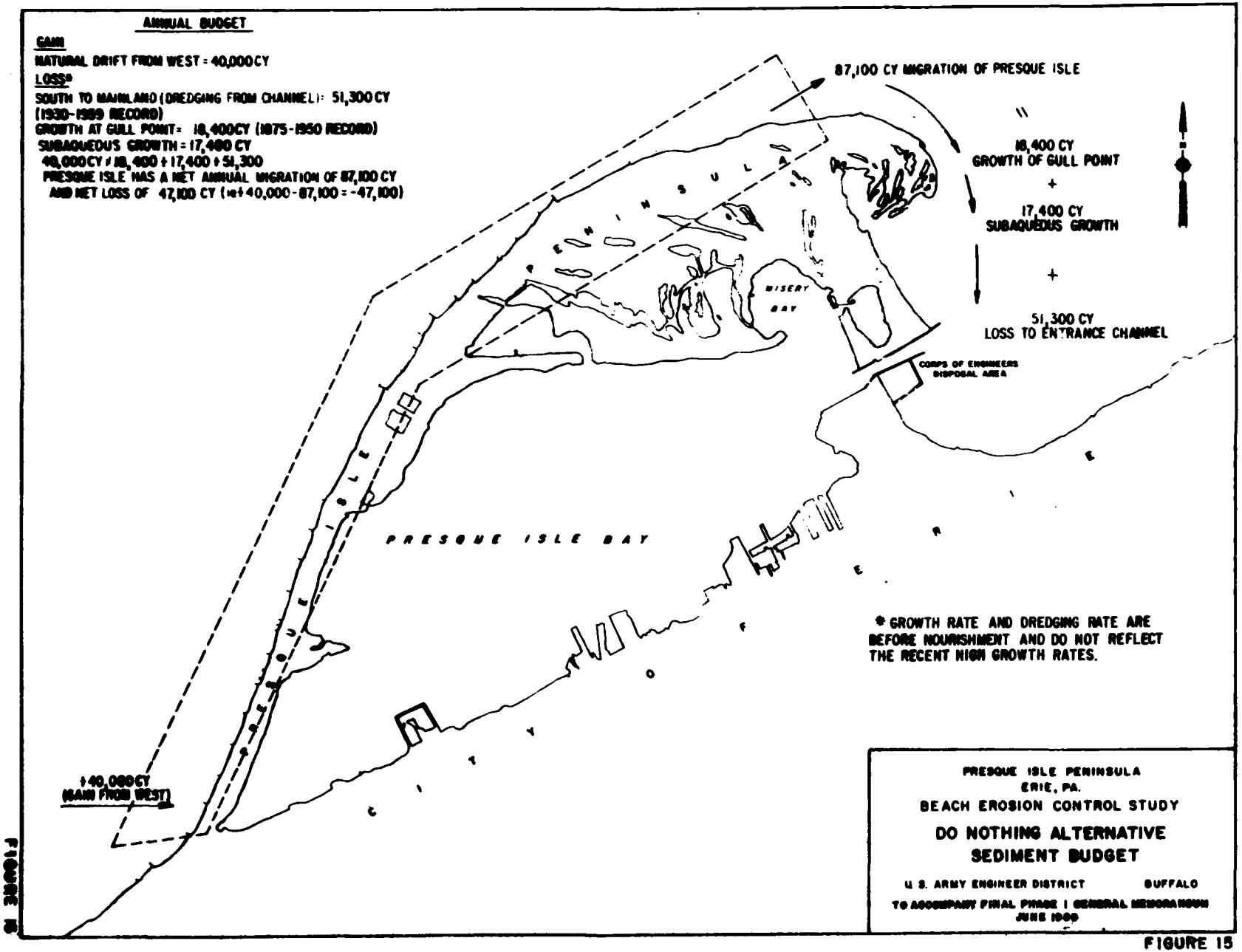
ANNUAL BUDGET
GAIN
NATURAL DRIFT FROM WEST = 40,000 CY
LOSS*
SOUTH TO MAINLAND (DREDGING FROM CHANNEL): 51,300 CY
(1930-1969 RECORD)
GROWTH AT GULL POINT = 18,400 CY (1875-1950 RECORD)
SUBAQUEOUS GROWTH = 17,400 CY
40,000 CY + 18,400 + 17,400 + 51,300
PRESQUE ISLE HAS A NET ANNUAL MIGRATION OF 87,100 CY
AND NET LOSS OF 47,100 CY (ie + 40,000 - 87,100 = -47,100)
87,100 CY MIGRATION OF PRESQUE ISLE
=
18,400 CY
GROWTH OF GULL POINT
+
17,400 CY
SUBAQUEOUS GROWTH
+
51,300 CY
LOSS TO ENTRANCE CHANNEL
PENINSULA
MISERY BAY
CORPS OF ENGINEERS DISPOSAL AREA
PRESQUE ISLE
PRESQUE ISLE BAY
CITY OF ERIE
+40,000 CY
(GAIN FROM WEST)
* GROWTH RATE AND DREDGING RATE ARE BEFORE NOURISHMENT AND DO NOT REFLECT THE RECENT HIGH GROWTH RATES.
PRESQUE ISLE PENINSULA
ERIE, PA.
BEACH EROSION CONTROL STUDY
DO NOTHING ALTERNATIVE
SEDIMENT BUDGET
U. S. ARMY ENGINEER DISTRICT BUFFALO
TO ACCOMPANY FINAL PHASE I GENERAL MEMORANDUM
JUNE 1969

FIGURE 15

loss to the entrance channel are higher (Figure 14), reflecting the additional available sediment load introduced by the replenishment activities.

Summary of "Do-Nothing" Condition

If a "Do-Nothing" plan were carried out, whereby neither the Federal Government nor Commonwealth of Pennsylvania would undertake any protective measures, the natural processes of erosion and deposition would not be interrupted. Likewise, pond and dune genesis and evolution would continue at a slow rate and would revert back to the levels observed prior to the 1950's. The existing shore protection structures will eventually fail allowing the neck to be breached. Once the barrier of the neck has been removed polluted waters of Presque Isle Bay would be diluted by the relatively unpolluted waters of Lake Erie and transported sand would migrate into the bay and reduce bay depth in some areas.

The eastward migration of Presque Isle would continue. Once the neck has been breached, the gap will widen and the west end will be lost as an ecological study area. The old forests and ponds at the west end will be destroyed by Lake Erie, and the released littoral material will build new beaches toward the east. New ponds will be formed, but the peninsula will assume the character of a low offshore shoal-island complex. The inhabitants of the resulting aquatic communities would be representative of those typically associated with existing water quality and habitat conditions. A change in environmental parameters would most probably be reflected by a gradual change in the aquatic species compositions and density. It is impossible to predict in any more than general terms, the rate of migration, the future morphology, or the time required before the natural processes which have created Presque Isle cause its ultimate destruction.

The natural processes, of erosion and deposition would continue as Presque Isle continues to migrate. Destructive natural processes, although necessary in a migrating coastal feature, are considered as aesthetically unacceptable to the majority of individuals who have expressed interest in the problem and have attended the public meetings.

Summary of No Action Condition (Without Condition Profile)

Currently the Federal Government, in cooperation with the Commonwealth of Pennsylvania, participates in an annual nourishment program as an emergency measure to protect and preserve Presque Isle Peninsula. This program was initiated in 1974, approximately 1 year after an emergency sand replenishment (1973) was undertaken to protect the neck of the peninsula. Under the current program, 6 years of annual replenishment have been undertaken during which an annual average of 140,000 cubic yards of sand have been placed on the beaches at a cost of $6,500,000. The program has resulted in an increase of available beach area, from 1,011,000 square feet in May 1972 to 1,865,000 square feet in April 1980. The present beachfill, which is much coarser and less erodible than the native sand, has increased the size of the beach area and has reduced the erosion of the back beach and sand dunes in localized areas, however sufficient quantities of sand cannot be provided under the present program ($1.1 million per year) to maintain a protective beach berm

with adequate dimensions (60 feet wide and +10.0 LWD crest elevation) along the entire lakeshore to preserve the peninsula and its unique environmental ecosystems. To provide the required beach dimensions, an annual replenishment program such as that developed during Stage 2 of this investigation (total annual costs of $2,440,000 at May 1979 P.L.; see Table 6) would have to be implemented. Annual nourishment is not an acceptable solution to the local residents or Commonwealth of Pennsylvania who desire a permanent solution. In fact, the sand provided under an annual nourishment plan, such as the present program, is not conducive to a recreational beach because it must be coarser than the native material in order to withstand the wave climate along an open coast and because of the compactive nature which occurs such as with the fill presently being used. This type of sand reduces the value of the recreational beach.

With a "No-Action Plan," the Federal Government would not participate in the protection or improvement of Presque Isle Peninsula, however, correspondence with the Commonwealth of Pennsylvania (see Exhibit E-2 in Appendix E) indicates that the Department of Environmental Resources is committed, as part of its present and future programs, to the maintenance and development of Presque Isle Peninsula as a public recreational area. Therefore, it is assumed that the Commonwealth of Pennsylvania would undertake measures to protect their previous investments and maintain, although at a lesser degree, the recreational value of the park, even if the Federal Government is not involved in the protection and preservation of Presque Isle Peninsula. These protective measures would probably consist of construction of additional revetments and bulkheads to protect the neck in order to maintain access to the park as well as the relocation of roads and backshore facilities which would otherwise be destroyed over time.

The beach conditions that existed in May 1972 were selected as the base conditions for comparison and evaluation of improvement alternatives because detailed aerial photographs existed to accurately document the extent of beach areas, the beach widths associated with the large-scale replenishment activities were lacking, and all major recreational facilities were in place. This 1972 base condition (1,011,000 square feet) is conservative when compared to the beach condition which existed in 1948 (750,000 square feet) prior to the construction of initial beach erosion control structures and sand replenishment (4,150,000 cubic yards) in 1955 and 1956 and the periodic nourishment of the 1960's, during which about 1,315,000 cubic yards of sand were placed on the beaches. Therefore, the May 1972 beach dimensions are assumed to most accurately represent the instantaneous without condition profile data base. If a no-Federal-action plan were implemented, it is assumed that the Commonwealth of Pennsylvania would do some annual replenishment to maintain the areal extent of the May 1972 beaches which were estimated to be 1,011,000 square feet. It was estimated that the Commonwealth of Pennsylvania would need to place approximately 57,000 cubic yards of sand annually, in order to maintain the 1972 beach condition.

The beaches with the "No Action Plan" (maintenance of a beach size of 1,011,000 square feet by the Commonwealth of Pennsylvania) will be steep, sloping foreshore dominated with a low narrow back beach. The State of Pennsylvania would probably not have the funds available annually to maintain

the back beach at a sufficient crest elevation and berm width to prevent overtopping of the beaches and erosion of the back shore. Therefore, erosion will continue to cause land losses under the without project conditions at an average rate of about 7.0 feet per year across the 21,780 foot length of unprotected lakeward shore. The insufficient beach berm dimensions would also cause wave overtopping to deposit sand and debris on the roads and parking lots and under severe storm conditions would cause damage to the existing shore structures, roads, and other park facilities and back shore ecosystems. Eventually, the "No-Action" option would result in the reduction of the productive ecosystem which is Presque Isle Peninsula. The "No-Action Plan" would also diminish the multirecreational use character of the park into a single use recreational facility as boating, hiking, biking, etc., are lost. The "No-Action Plan" will reduce the value of the area as a recreational beach.

PROBLEMS, NEEDS AND OPPORTUNITIES

General

A stable beach represents a balance between the amount and kinds of source material available and the prevailing natural transporting agents (waves and currents) along the shore. When supplies are abundant, the excess sand is stored on the backshore in dunes; if the supply updrift becomes depleted, the transporting agents erode the foreshore and draw upon the backshore storage to maintain their load of shore drift material, thereby reducing the width of the backshore. In the case of Presque Isle, the apparent post-glacial abundant supply of granular material, which made the peninsula's existence possible, has dwindled. Therefore, the predominant west-to-east littoral movement removes more material from the peninsula beaches than is supplied by littoral drift along the shore from the west.

Previous Projects

A detailed description of the history of shore protection measures at Presque Isle was presented in the paragraph entitled History of Shore Protection at Presque Isle. As described in that paragraph, several of the beaches along the peninsula have had a history of serious erosion for at least 150 years. During the period from the early 1800's through 1920's, the United States Government undertook numerous protection measures for the purpose of preserving Erie Harbor by prevention of breaches through the neck of the peninsula. In 1922, Presque Isle Peninsula was reconveyed to the State of Pennsylvania for park purposes and the care and protection of Presque Isle were shifted to providing recreational beaches. The River and Harbor Act of 1954 initiated the cooperative beach erosion control project between the Federal Government and Commonwealth of Pennsylvania. The project authorized by the 1954 Act provided for construction of a seawall, bulkhead, and a groin system along the neck of the peninsula, removal of a portion of the lighthouse jetty and the bulkhead easterly thereof, and restoration of beaches on the lakeward perimeter of the peninsula by placement of sandfill. When that cooperative project was adopted, it was recognized that periodic replenishment with sandfill would be required to preserve the full protective and recreational functions of the project. However, the sand losses from the beaches were greater than estimated, therefore, the 1960 River and Harbor Act was enacted and authorized the Federal Government to participate in sharing the cost for replenishment operations accomplished by the Commonwealth of Pennsylvania. The authorization under the 1960 Act was for a period of 10 years after which it was felt that the beaches and offshore areas would be stabilized and nourishment requirements would be reduced.

Present Development

The sand replenishment requirements authorized by the 1960 River and Harbor Act were not a complete solution to the erosion problem and far exceeded the estimated requirements. Therefore, the Commonwealth of Pennsylvania, in March 1967, expressed a desire that sand replenishment as a method of protection against beach erosion at Presque Isle be revaluated to determine if a more effective method of protection could be developed (see Exhibit E-6 in Appendix E). In April 1968, the Commonwealth of Pennsylvania requested that the State Congressmen introduce resolutions to the appropriate Congressional Committees to authorize the Corps of Engineers to make a complete restudy of the Presque Isle cooperative beach erosion control project in order to develop a more effective and more permanent solution to the erosion problems. In addition, the residents of the city of Erie are concerned over the high replenishment costs and the recurring threat to established facilities including bathhouses, parking areas, highways, and especially the bathing beaches. The Erie residents have repeatedly requested a "permanent" solution to the erosion problems of the peninsula, thus implying a maintenance-free solution by complete stabilization of the beaches. Another segment of the public is concerned over important changes in the environment and the ecological climate that would occur through elimination of the natural shore processes of the peninsula. Uppermost in their concern is the attenuation of the natural geological growth of the peninsula.

From the earliest stages of this study, there has been intense public and political interest. People in the Erie area desire an immediate solution to the Presque Isle problem, but since the improvement must be functional over a long period, aesthetic and environmental conditions must be carefully scrutinized. Several methods of construction and several types of materials are available that would be functional with the Presque Isle problem. Some, however, would not be aesthetically compatible with the existing features and would interrupt the natural continuity.

By resolution adopted 14 May 1968, the Committee on Public Works authorized the Corps of Engineers to review the cooperative beach erosion control project and determine whether any modification to the existing project would be advisable in the interest of beach erosion control at Presque Isle Peninsula. During a public meeting on 2 June 1972 attended by approximately 500 people, the Corps presented five possible alternatives including: (a) a gapped breakwater extending the full length of the peninsula; (b) a gapped breakwater over portions of the peninsula; (c) an extension of the existing groin field; (d) sand recirculation and (e) a "do-nothing" plan maintaining "status quo." Several plans were submitted by the public including: (f) floating breakwaters; (g) a concept where a structure was designed to slice the waves; (h) wave screens; (i) varied groin plans and (j) varied breakwater plans. Comment sheets were attached to the meeting invitation and rating sheets were handed out during the meeting. Fifty percent of those who responded to these sheets preferred some sort of partial breakwater. The Buffalo District Office of the Corps of Engineers prepared a Review Report in November 1973 (revised June 1974), in which a total of 33 concepts were investigated. The recommendation of the Review Report was that the existing project be modified to provide for construction of the partial breakwater concept (see Plate 1 in Appendix A) as the plan of improvement for beach erosion control. It was that report which was submitted to Congress and serves as the basis for authorization to undertake this study. To control the erosion along the peninsula while the Review Report was being prepared and this present study is undertaken, Congress, through the Water Resources Development Acts of 1974 and 1976, reinstated and extended the terms of the 1960 River and Harbor Act for continuation of beach replenishment operations.

PLANNING OBJECTIVES

When the review study was initiated in 1968, its main objective was to investigate only the existing Federal project in regards to its efficiency and adequacy as a means of shore protection for the beaches of Presque Isle. As the study progressed and public participation in relation to the study evolved, it became evident that new alternatives should be analyzed in order to develop a better and a more acceptable solution to the erosion problem. After preparation of the Review Report in 1973 (revised 1974), several possible solutions were economically feasible and selected for further consideration during post-authorization studies.

The basic objective of this Phase I design memorandum study to develop a plan for the preservation of the peninsula and its recreation facilities from natural erosion processes with the least amount of damage to its natural geological and ecological processes. To guide the formulation of a plan of

improvement, the Buffalo District established planning objectives for the Presque Isle Peninsula beach erosion control project. Planning objectives are the national, State, and local water and related land resource management needs, opportunities, and problems specific to a study area that relate to enhancement of National Economic Development and Environmental Quality. The planning objectives identified by the Buffalo District are as follows:

(1) Provide the required protection for preservation of the peninsula and its recreational facilities.

(2) Preserve and enhance, if possible, the human environment and aesthetic qualities of the shoreline.

(3) Preserve the integrity of the natural environment, especially the sensitive and unique Gull Point portion of the Ecological Reservation on the east end of the peninsula.

(4) Prevent degradation of water quality, especially water stagnation caused by improper water circulation.

(5) Restore, protect, and enhance the beach areas of the peninsula for use by future generations.

(6) Preserve and enhance the natural wildness and beauty of the peninsula.

(7) Prevent or minimize adverse effects on natural shore processes because the peninsula has an area of unique geological formation and botanical history.

(8) Minimize the deposition of sand in the entrance channel to Erie Harbor.

(9) Provide for sand to be bypassed to the east end of the peninsula to provide for continued growth.

(10) Prevent future breaching of the neck of the peninsula.

(11) Insure a protected harbor.

(12) Provide for the public's safety.

(13) Minimize the use of energy.

PLANNING CONSTRAINTS

During this Phase I Design Memorandum investigation, there were no planning constraints identified which impacted on formulation of alternative plans developed to satisfy the water related needs of the study area.

Section 101(a) of the Water Resources Development Act of 1976 authorized undertaking only the Phase I Design Memorandum (GDM) stage of advanced engineering and design of the project for beach erosion control at Presque Isle Peninsula. Therefore, this study is being accomplished under a two-phase authorization whereby at the end of the Phase I study, a recommendation will be made on the project that is considered to be most beneficial to all concerned. This recommendation must then go back to Congress to obtain authorization to proceed with the detailed design and construction. The two-phase authorization process is a planning constraint which has a definite impact on the project implementation since there is an estimated 26-month period between completion of the Phase I General Design Memorandum (Milestone No. 31 - Release of Division Engineer's Public Notice and submission of Phase I report to BERH which is scheduled for July 1980) and the initiation of the detailed design and preparation of the Phase II General Design Memorandum (Milestone 41 - General Design Conference which is scheduled for October 1982). The current project schedule assumes that Congress would take immediate action to authorize the project for construction and approve funding for initiation of the detailed design and preparation of a Phase II GDM in Fiscal Year 1983.

After approval of the Phase II GDM, currently scheduled for February 1984, the Plans and Specifications would be prepared. Construction could be initiated in May 1985 and completed by December 1986.

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SECTION C

FORMULATION OF ALTERNATIVE PLANS

This section presents the plan solution process and outlines the basic criteria used to formulate a plan for responding to the problems and needs discussed in the preceding section of this report. This section provides a brief review of the alternatives investigated during the survey study, subsequent events that necessitated reformulation of the authorized plan of improvement, the formulation methodology used in this investigation, and a discussion of the development of alternative plans.

MANAGEMENT MEASURES

Presque Isle Peninsula is owned almost entirely by the Commonwealth of Pennsylvania and has been developed into a State park containing approximately 3,200 acres. The Department of Environmental Resources of the Commonwealth of Pennsylvania considers Presque Isle State Park as one of the most important and outstanding State parks in the Commonwealth's system. Being a State owned park, the management measures and resources have been and are more likely to continue to be available than if the park were owned and operated at a lower institutional level such as city or county. Therefore, it does not seem practical to consider management measures lower than at the State level. A management measure which can be identified to achieve the planning objectives defined in the previous section of this report is to establish Presque Isle Peninsula as a national park under the jurisdiction of the United States Department of the Interior. However, the measure will not be considered further because the Commonwealth of Pennsylvania has shown that they have the capability and willingness to provide the resources necessary for achieving the planning objectives.

PLAN FORMULATION RATIONALE

Alternatives Considered in the Review Study

During preparation of the Review Report in 1973 (revised 1974), a total of 33 concepts which would provide a solution to the erosion problems at Presque Isle Peninsula were considered. Many of the solutions were of the same category and were grouped as a general concept. The concepts which were considered to provide the most practicable and economical solution to the erosion problem included a full breakwater scheme, a partial breakwater scheme, an annual nourishment plan, a groin plan, a sand recirculation scheme, and a sand trap recirculation scheme. The review study, as reported in Senate Document No. 95-85, considered the partial breakwater scheme as the best plan of improvement for beach erosion control at Presque Isle Peninsula. This plan is shown on Plate 1 in Appendix A and is described in Section A of this report.

Need for Reformulation of Alternatives (Reformulation Phase I General Design Memorandum)

As stated in the preceding paragraph, the partial breakwater scheme was considered to be the best plan of improvement for beach erosion control at Presque Isle Peninsula. However, the Board of Engineers for Rivers and Harbors (BERH) noted in their report to the Chief of Engineers, dated 2 August 1974 (see Exhibit E-5 in Appendix E), that several of the alternatives presented in the Review Report are economically feasible and warrant further consideration during post-authorization studies. Therefore, reformulation of the authorized project is required. Authority to proceed with a Reformulation Phase I AE&D study was recommended in the Phase I AE&D Study Classification Report submitted by Buffalo District on 16 December 1977 (see Exhibit E-7 in Appendix E). Approval to conduct a Reformulation Phase I General Design Memorandum investigation was provided on 8 February 1978 (see Exhibit E-8 in Appendix E).

Stage 3 Reformulation

The basic objective of this Stage 3 investigation is to identify and select the best plan which will preserve Presque Isle Peninsula and its recreational facilities with the least amount of destruction to the environment and which will also allow continued geological growth of the area. The best plan will be selected based on sound engineering, economic, and environmental principles. In this selection process, an iterative procedure that provided for increased levels of refinement in design and critique and evaluation by the principal study participants (i.e., Corps of Engineers; Department of Environmental Resources of the Commonwealth of Pennsylvania; and U. S. Fish and Wildlife Service) was used to narrow the range of alternatives. The procedure also allowed for review and comments by the general public at public meetings.

General Formulation and Evaluation Criteria

Federal policy on multiobjective planning, derived from both legislative and executive authorities, establishes and defines the national objectives for water resource planning, specifies the range of impacts that must be assessed, and sets forth the conditions and criteria which must be applied when evaluating plans. Plans must be formulated to meet the needs of the area with due regard to benefits and costs, both tangible and intangible, and effects on the ecology and social well-being of the community.

The formulation of a plan, including the screening of alternatives, must be within the context of an appropriate planning framework and set of criteria. The objective of the planning framework is to guide planning for the conservation, development, and management of water and related land resources. The planning framework is established in the Water Resource Council's Principles and Standards for Planning Water and Related Land Resources (P&S) which requires the systematic preparation and evaluation of alternative solutions that address problems, needs, concerns, and opportunities under the objectives of National Economic Development (NED) and Environmental Quality (EQ). The formulation process also requires that the impacts of a proposed

action be measured and the results displayed or accounted for in terms of contributions to four accounts: NED, EQ, Regional Development (RD), and Social Well-Being (SWB). This results in information necessary to make effective choices regarding resource management under existing and without projected conditions. The formulation process must be conducted without bias as to structural and nonstructural measures.

Erie Harbor is one of the finest natural harbors on the Great Lakes because of the protection afforded by the peninsula. In the past 2 years, an average of about 1,060,000 short tons of cargo passed through the harbor per year. Several alternatives would insure a protected harbor and continued commerce. If nothing is done, the neck of the peninsula would probably be breached, as it has on several occasions in the past. During such occasions, the efficiency of the harbor would be reduced because of increased wave action, currents, and dredging costs. Implementation of plans in which sand losses are inherent and in which sand is brought in from sources other than the peninsula would also increase dredging costs since more sand would be available for the predominant easterly littoral currents to carry into harbor channels. These factors must be considered in the selection of a plan.

Many of the effects that alternative plans would have on the environment are difficult, if not impossible, to estimate in terms of monetary values. However, the effects on the environment are highly important when choosing the most desirable alternative plan. For instance, any plan that would materially change the natural shore processes would be objectionable to some interests. Since the unique geological formation and botanical history of the easterly growth of the peninsula is of intense interest to ecologists, objections to possible disturbance of the natural shore processes in this area have been received. A plan that would destroy the natural wildness and beauty that attracts so many visitors to the Presque Isle beaches would be objectionable. If the peninsula were left as it is, the natural shore processes would continue, but many of the park facilities would be threatened, and in case the neck of the peninsula is breached, the polluted waters of the bay would have access to the beaches. These and other environmental factors must be evaluated for each alternative plan.

As the population of an area becomes more dense, the well-being of the people becomes an overriding determinant in planning. According to the Great Lakes Basin Framework Study, Planning Subarea 4.4 needed about 9,900 additional acres of recreational land in 1970 and by the year 2020, this need is expected to increase to 72,000 acres. In the 72,000 acres are included 600 acres of recreational beach. Erie County, Pennsylvania, is part of Planning Subarea 4.4 along with Cattaraugus, Chautauqua, Erie, and Niagara Counties, New York. Since approximately 3,800,000 people enjoy the facilities of Presque Isle yearly, the need to preserve it becomes acute. Without protection, the narrow neck would soon begin to erode and eventually break through, making access to the park difficult and expensive. These factors must be carefully weighed as each alternative is considered.

Enhancement of regional development comes about through increases in a region's income, increases in employment and improvement of the economic base, environment, and other specified components of the regional development

objective. The attractiveness of the beaches, which are among the best and most extensive on Lake Erie, has encouraged the development of motels and restaurants in the city of Erie that depend, to a large extent, on visitors that are attracted to the beaches and other park facilities during the summer months. It is estimated by Erie city officials that the millions of park visitors contribute approximately $60,000,000 annually to the Erie area economy. This contribution to the regional economy comes about through increased employment, such as that required for park administration and service-oriented activities; through housing; and through material goods. In the past, shore protection has been expensive. Since 1955, shore protection under the cooperative beach erosion control project has cost approximately $11,129,000.

Within the structure of the overall planning framework, other more specific criteria relative to general policies, technical engineering, economic principles, social and environmental values, and local conditions must be established. The formulation, evaluation, and screening of alternative plans will be done within the context of the planning objectives and technical, economic, environmental, and other criteria described in this portion of the report. The formulation, evaluation, and screening process will determine which of the alternative plans best meet the national planning objectives in order that an NED Plan and an EQ Plan can be designated.

Technical Criteria

a. A basic criteria is that a plan of improvement should provide a solution to the serious erosion problem at Presque Isle Peninsula, thereby preserving the peninsula and its recreational facilities and ensuring the protection of Erie Harbor.

b. Careful consideration must be given to the beach berm elevation. Most storm conditions create higher water levels; therefore, the degree of protection to the backshore is dependent upon the effectiveness of the berm. If the beach berm is too low, the concurrent higher water levels and storm waves may overtop the berm crest and cause ponding and temporary flooding of the backshore. Experience at Presque Isle Peninsula has shown that a beach berm with a crest height of +10.0 feet above low water datum is required to prevent overtopping and flooding on the peninsula.

c. The purpose of this project is to restore the eroded beaches and provide protection to the peninsula and the backshore improvements. In addition, the beach is for recreational activities, therefore, the project must provide a minimum area of 75 square feet per bather. There is insufficient design criteria available for sizing beaches; however, the Shore Protection Manual (SPM) does specify that if the purpose of the fill is to restore an eroded beach to protect backshore improvements from damage by major storms, the width may be determined as the protective width which has been lost during storms of record plus the minimum required to prevent wave action from reaching improvements. The Design Memorandum for the original beach erosion control project at Presque Isle which was built in 1955 and 1956 stated that a 60-foot berm width is the minimum width allowable in terms of protection to the backshore. Therefore, based on experience at Presque Isle and for

engineering reasons, a plan of improvement should provide a minimum 60-foot berm width to restore the beach dimensions of the original project and thereby when readjusted by wave action will adequately protect the backshore. A comparison between the 60-foot berm width, the anticipated realigned shoreline, and the 1866 and 1939 shorelines for the segmented breakwater plan are shown on Plate 19 in Appendix A.

d. The most unique ecological areas on the peninsula depend upon sand deposition. A plan of improvement should provide for sand to be bypassed to the east end of the peninsula for continued growth. It was estimated that approximately 40,000 cubic yards of littoral material are supplied each year to Presque Isle from the shore to the west. Therefore, a requirement was established whereby a minimum of 40,000 cubic yards of material would be bypassed to maintain some degree of continued growth at the east end of the peninsula.

e. Some littoral material, as it moves along the Presque Isle shoreline, is lost to the offshore zones, some is transported and deposited in the entrance channel to Erie Harbor, and some is deposited at the east end of the peninsula. The deposition of sand in the entrance channel to Erie Harbor is increasing the amount of dredging and, thereby, the maintenance costs for Erie Harbor. Therefore, a plan of improvement should allow a minimum amount of sand to be transported and deposited in the entrance channel to Erie Harbor.

Economic Criteria

a. The potential tangible benefits at Presque Isle State Park are those that result from physical damages prevented, costs for emergency erosion control measures avoided, and increased recreational usage. Benefits are measured as the differences in these values under conditions with and without the proposed erosion control measures.

b. Tangible benefits should exceed project economic costs.

c. Recreational benefits are based on user-day values for the experience of visiting Presque Isle State Park.

d. Each plan, as ultimately formulated, should provide the maximum net benefits possible within the formulation framework.

e. The benefits and costs should be in comparable economic terms to the fullest extent possible.

f. A 50-year economic life and 7-3/8 percent interest rate are used for the economic evaluation.

g. The base case for comparison of alternate plans is the "do nothing" (no action) plan.

Socioeconomic and Environmental Criteria

The criteria for socioeconomic and environmental consideration in water resource planning are prescribed by the National Environmental Policy Act of 1969 (PL 91-190) and Section 122 of the River and Harbor Act of 1970 (PL 91-611.) These criteria prescribe that all significant adverse and beneficial economic, social, and environmental effects of planned developments be considered and evaluated during formulation.

Environmental - All plans of improvement should avoid or minimize objectionable or adverse impacts to aquatic or terrestrial habitat, and maximize environmental benefits prior to, during, and following construction. A plan should avoid or minimize water pollution and aesthetically objectionable features. Adherence to these criteria will result in public acceptance and reduce difficulty in obtaining the necessary assurances of local cooperation.

Social Well-Being - Social well-being is the beneficial and adverse social effect that contributes to or detracts from the equitable distribution of real income and employment and other social opportunities. For this

study, social well-being would be enhanced by the continued availability of a unique park, such as Presque Isle, with its exceptional beaches and ecological and botanical interests. Therefore, a plan of improvement should promote the existence of the recreational beaches which attract the most visitors to the park while at the same time minimizes environmental impacts and allows continued geological growth.

Regional Development - Regional development is the relationship of the enhancement of a region with respect to employment and economic stability for each plan of improvement. Therefore, a plan of improvement must enhance regional development through increased regional income, increased employment, and improvement of the economic base.

Public Acceptability - Public acceptability of a plan of improvement is determined by analyzing its acceptance by concerned local interests. A plan is acceptable if it is, or will likely be, supported by a significant segment of the public. However, every attempt must be made to eliminate, to the extent possible, unacceptability to any significant segment of the public.

Other Considerations for A Possible Plan of Improvement

1. Sand Sources for Beach Fill - The costs for placing sand on the beaches at Presque Isle are rising each year, thereby, making the placement of large quantities of sand an increasingly expensive means of controlling erosion. In addition, the availability of sufficient quantities of suitable quality sand from land resources is decreasing each year as the demand continually increases. This decrease may eventually lead to acquisition of higher-priced sand from offshore zones. Therefore, a plan of improvement should require a minimum annual replenishment requirement.

Onshore Sources - A material survey of onshore sources of sand for beach fill was prepared and is included in Appendix D to this report. The survey indicates that the various sand and gravel pits within a 60-mile radius of Presque Isle had sufficient quantities of suitable quality sand available for the year that the survey was prepared (1979), however, it could not be determined whether the land sources would be able to provide the required quantities of sand for the 50-year project life for a plan of improvement.

Offshore Sources - The Buffalo District of the Corps of Engineers has been investigating the possibility of locating and obtaining sand for beach replenishment operations at Presque Isle from offshore areas for several years. Options considered included: (a) direct pumpout from a Corps hopper dredge or a Contractor's dredge into a settling basin then subsequent placement by land earth-moving equipment; and (b) direct pumpout from a dredge onto the beaches.

To locate an area of suitable sand for replenishment operations, a preliminary investigation of the authorized commercial offshore borrow area, which is about 7 miles long and 2 miles wide and located about 6 miles northwest of the peninsula, was made in July 1970. The investigation demonstrated that coarse sand of a suitable grain size was available within the landward 4 square miles of the authorized borrow area. Therefore, on 21-23 August 1974,

a more intensive investigation was made utilizing the Corps Derrickboat TONAWANDA to obtain samples from the authorized borrow area. Analysis of the samples collected on 21-23 August 1974 demonstrated that the sand within the landward 4 square miles of the commercial borrow area is actually a fine to medium grained sand which is totally lacking in a coarse fraction and is finer than the proposed beach fill. Experience has shown that the use of material finer than the existing beach gradation will not form a stable beach. Inspection of the samples, however, showed that there was a trend of finer material to coarser material in the lakeward direction within the authorized borrow area. Therefore, on 6 December 1974, the Corps Derrickboat OHIO was used to gather additional samples from the outer reach of the authorized borrow area. Analysis of the samples showed that the sand in a 1-square mile area in the northwest corner of the commercial borrow area was coarser than the previously sampled inner area, as well as the natural beach sand on Presque Isle Peninsula; however, the deposit extended only to a depth of 6 inches to 2 feet.

On 15 August 1975, the Corps Dredge MARKHAM was utilized in a sand-segregation test to determine if sediment offshore from Presque Isle could be processed by Government plant and placed on the Presque Isle beaches. The dredge sampled the platform area west of Presque Isle which is outside of the commercial borrow area and failed to obtain a concentration of coarse material. The failure of the sand segregation test was attributed more to the lack of suitable sediment than a failure of the processing technique. Therefore, on 17, 18, and 19 September 1975, the Derrickboat TONAWANDA was again utilized in an attempt to locate an offshore coarse sand deposit which could be processed by Government dredge and used as beach sand for replenishment operations on Presque Isle Peninsula. Two areas, one to the northwest and one to the northeast of the authorized borrow area, were sampled. A well-sorted coarse sand-pea gravel deposit was located during the September 1975 sampling operation. Therefore, on 20-21 September 1976, the Dredge MARKHAM was again utilized in a test to dredge coarse sand from deep water (70-foot depth) northwest and northeast of the commercial borrow area. The purpose of this test was to determine if a new draghead and dragarm extension could be efficiently used to exploit deep water coarse sand deposits. The results of the test were inconclusive. Coarse material was dredged, but the operation was not efficient since there were a number of problems with the dredge's drag assembly. Therefore, on 14 December 1976, another test was conducted with the Dredge MARKHAM outside of Cleveland Harbor. The purpose of the test was to determine if the MARKHAM, with the drag assembly having been modified since the September test, could efficiently dredge sand from deep water. The results from this test were also inconclusive since sand deposits could not be located.

Based on the results of the dredge tests and sampling investigations, it can be concluded that:

a. It is unknown whether the Corps Hopper Dredge MARKHAM can efficiently process sand of suitable quality from deep water for placement on the beaches along Presque Isle Peninsula.

b. It is unknown to what areal extent and the maximum volume of the coarse sand deposits in the offshore zone in the Erie, PA, vicinity.

To obtain information in response to conclusion "b" above, the U. S. Army Coastal Engineering Research Center (CERC) performed an Inner Continental Shelf Sediment and Structure Study (ICONS) offshore from Presque Isle Peninsula during the Summers of 1977 and 1978. The purpose of the study was to locate exploitable sand sources in the offshore area. Geophysical data (bottom and subbottom acoustical energy responses) and cores were obtained to determine sediment characteristics and areal extent of sand suitable for beach restoration and periodic nourishment from the area offshore of Presque Isle Peninsula. The preliminary results of the study indicate that two areas contain sand that is judged suitable for beach nourishment. One area, the ridge area, lies in 50 to 65 feet of water and contains fine to medium sand. Volume estimates indicate that there are approximately 48.6 million cubic yards of sand in that area. The second area is located off the Presque Isle Light and calculations indicate that area contains an estimated volume of 1.9 million cubic yards of sand. A more detailed discussion of these possible offshore sand sources for beach replenishment operations is presented in Appendix D, "CONSTRUCTION MATERIALS," of this report.

2. Cost-Sharing - A policy of Federal aid in construction costs for restoring and protecting publicly owned shores was established by Public Law 727, 79th Congress, approved 13 August 1946. Section 103 of the 1962 River and Harbor Act provides that under special conditions, beach erosion protection of State, County, or other publicly owned shore, park, and conservation areas is eligible for Federal costs sharing up to 70 percent of the total project cost, exclusive of land costs. In order for the maximum 70 percent Federal participation to be applied to parks and conservation areas all of the following specified criteria must be met to the satisfaction of the Chief of Engineers:

a. The land must be publicly owned;

b. The park must include a zone extending landward from mean low water line which excludes all permanent human habitation. This excludes summer residences, but does not preclude residences of park personnel or management and administration buildings;

c. The park must include a beach suitable for recreational use, understood to include swimming and similar water contact use;

d. The park must provide for preservation, conservation, and development of the natural resources of the environment;

e. The park or conservation area must extend landward a sufficient distance to include protective dunes, bluffs or other natural features which will absorb and dissipate wave energy and flooding effects of storms; and

f. Full park facilities must be provided for appropriate public use.

It is considered that all these requirements for Federal participation of up to 70 percent are met by the facilities already provided and those planned for complete development of Presque Isle State Park. The apportionment of the project construction cost for the Selected Plan of improvement will be a maximum of 70 percent Federal and 30 percent non-Federal.

President Carter, in his 6 June 1978 water policy message to Congress, proposed several changes in cost-sharing for water resource projects to allow States to participate more actively in project implementation decisions. With respect to the cost-sharing issue, on 16 May 1979, draft legislation for changing cost-sharing for water projects was submitted to Congress. These changes include that benefiting States provide a legally binding commitment that they will contribute a cash contribution of 5 percent of construction (first) costs associated with nonvendible outputs and 10 percent of costs associated with vendible outputs. Vendible outputs being defined as water supply, irrigation, power, and other benefits of projects for which the Federal Government receives revenues from project beneficiaries under present policies. On 31 October 1979, the Commonwealth of Pennsylvania was requested to provide their views on the financial contribution required under the President's proposed revised cost-sharing policy (see Exhibit E-9 in Appendix E). Because this Phase I GDM must go back to Congress for authorization to proceed with the detailed design and construction, the Presque Isle project is subject to the President's proposed cost-sharing legislation and an additional 5 percent cash contribution will be applied to the State's share of the project construction costs. The State's views are contained in their December 1979 letter which is included as Exhibit E-10 in Appendix E.

There are no provisions under existing beach erosion control laws which provide for Federal contributions toward project maintenance of beach erosion control structures. However, Public Law 826, 84th Congress, approved 28 July 1956 provides that Federal participation may be made toward periodic beach nourishment. The 1974 Review Report recommended Federal participation in the costs for annual beach replenishment at a level of 70 percent during the preconstruction period and for 5 years after construction of the "permanent" project. The Secretary of the Pennsylvania Department of Environmental Resources, on behalf of the Governor, objected to the 5-year cutoff date for Federal participation in periodic beach nourishment after construction of the "permanent" project. The Secretary felt that the time period should be extended in view of the uncertainty as to when the new beach will stabilize in light of the experience with the existing project (see Exhibit E-11 in Appendix E). The Chief of Engineers, in his report to the Secretary of the Army, dated 8 April 1976 (Exhibit E-1 in Appendix E), concurred that 5 years may not be an adequate period of time for beach stabilization and recommended Federal participation in periodic beach nourishment, at a level of 70 percent of the nourishment costs, for the life of the project. Therefore, the Commonwealth of Pennsylvania will be responsible for funding 30 percent of the annual beach replenishment costs and 100 percent of the annual maintenance costs for the structural features. The Federal Government will reimburse the Commonwealth of Pennsylvania 70 percent of the cost for annual beach replenishment.

PLANS OF OTHERS

During an alternatives public meeting on 2 June 1972, attended by approximately 500 people, the Corps presented five possible alternatives for controlling erosion at Presque Isle Peninsula. These alternatives were a gapped breakwater extending the full length of the peninsula, a gapped breakwater over portions of the peninsula, an extension of the existing groin field, sand recirculation, and a "do nothing" plan maintaining "status quo." Several plans were submitted by the public including floating breakwaters, a concept where a structure was designed to slice the waves; wave screens; various groin plans; and various breakwater plans. After the alternatives public meeting, there had been a total of 33 concepts suggested. Many of the suggestions were of the same category and could be grouped as a general concept. A listing of the concepts investigated follows:

1. Structural Alternatives

   a. Wave Attenuators
   (1) Full Breakwater
   (2) Partial Breakwater
   (3) Floating Breakwater
   (4) Wave Screen
   (5) Wave Slicer
   (6) Sand Trap Recirculation

   b. Beach Containment
   (1) Groins

2. Nonstructural Alternatives

   a. Nourishment
   (1) Recirculation
   (2) Annual Nourishment
   (3) Feeder Beach

   b. Natural
   (1) Vegetation

3. Other

   a. Do Nothing About Erosion

   b. Do Nothing About Erosion, but Maintain Access Road

During preparation of the Review Report, each alternative was considered and weighed and the comparative effects of implementing the alternatives on the national economic development, environmental quality, social well-being, and regional development were evaluated. The following concepts were determined to provide the most practicable and economical solutions to the erosion problem at Presque Isle Peninsula:

a. Full Breakwater

b. Partial Breakwater

c. Annual Nourishment

d. Groins

e. Recirculation

f. Sand Trap Recirculation

Since preparation of the Review Report, there has not been any specific plans submitted by others which differed significantly from those already considered in the review study. However, suggestions have been received on the type of construction materials which could be used for breakwaters (i.e., concrete units, old naval ships, etc.) and various breakwater-orientation schemes and shapes (i.e. see Exhibit F-36 in Appendix F). Those suggestions will be considered during the detailed design stage of the plan of improvement.

ANALYSIS OF PLANS CONSIDERED IN PRELIMINARY PLANNING (STAGES 1&2)

As stated in Section A, this Phase I design-memorandum stage of advanced engineering and design for the authorized Presque Isle Peninsula project involves three stages of planning at increasing levels of detail. Possible solutions to control erosion are identified and evaluated during this three-stage iterative process in order to address the needs of the study area and the overall planning objectives. Each stage contains essentially the same sequence of tasks (namely: problem identification; formulation of alternatives; impact assessment; and evaluation) but, emphasis was shifted as the process proceeded.

The Review Report, prepared in 1973 (revised 1974), considered 33 alternative measures for beach erosion control. Six of the 33 measures were determined to be viable methods for beach erosion control. From the six viable methods, the segmented breakwater concept was selected as the recommended plan. However, the Board of Engineers for Rivers and Harbors noted that all the viable plans were economically feasible and warrant further consideration during post-authorization studies.

Plans Considered in Stage 1 Planning

Stage 1 Planning was completed in May 1978 and consisted of preparation of a Plan of Study which presented information about the study area, identified problems, and outlined work efforts to be accomplished during the study investigation. The Review Report investigated a wide range of alternatives which were representative of the most practicable measures for beach erosion control, and only six of the concepts investigated were determined to be viable methods for erosion control. Therefore, Stage 1 Planning considered only the four structural and two nonstructural solutions from the Review Report which were determined to be viable methods for erosion control, in addition to the "no action" option.

1. Description of Plans in Stage 1 Planning - The following concepts were the most practicable and economical solutions to the erosion problem at Presque Isle Peninsula and were considered in Stage 1 Planning:

a. Structural Solutions

(1) Full Breakwater - The full breakwater would extend virtually the entire length of the peninsula. To allow circulation of the alongshore water, it would be necessary to gap the structure at regular intervals. The plan consisted of 47 segments, 500 feet long, and separated by 100-foot gaps. The segments would be located at the 12-foot depth contour (approximately 1,000 feet offshore) and have a crest height of 8.5 feet above low water datum. The full breakwater concept would require an initial beach replenishment of 1,630,000 cubic yards of sand, however, annual nourishment would not be required. This plan is shown on Plate 6 in Appendix A.

(2) Partial Breakwater - The partial breakwater plan provided for construction of five sections of segmented, rubblemound breakwaters located offshore from susceptible areas of erosion. Three sections of the breakwaters would consist of four segments and two sections would consist of five segments for a total of 22 segments. Each breakwater segment would be 500 feet long and separated by a 100-foot gap. The segments would be positioned at the 10-foot depth contour and have a crest height of +8.5 feet above low water datum. The partial breakwater concept would require an initial replenishment of 1,630,000 cubic yards of sandfill and an annual recycling of about 126,000 cubic yards of sand to maintain the unprotected areas. Material from an outside source to offset offshore losses and the material bypassed to the distal end would amount to 45,000 cubic yards annually. This concept was the plan recommended for implementation in the Review Report and is shown on Plate 1 in Appendix A.

(3) Groins - Beach No. 6 is one of the areas in which some of the most severe erosion has occurred. This is partially because it is located just downdrift from the existing Federal groin field. Therefore, the groin plan would provide 15 additional groins, seven in the Beach No. 6 area and eight in the Sunset Point area. The groins, 300 feet in length, would consist of steel sheet piling with stone protection on the downdrift side. Spacing between groins would be approximately 700 feet. At their inner end, the groins would be tied to about 12,200 feet of steel sheet pile bulkheads. The groin plan would require an initial replenishment of 1,630,000 cubic yards of sand and an annual nourishment of about 190,000 cubic yards of sandfill. The groin plan is shown on Plate 7 in Appendix A.

(4) Sand Trap Recirculation - The sand trap recirculation plan would include a permanent pipeline, a series of booster stations, and a 2,300-foot long offshore breakwater located about 1,400 feet lakeward of Sunset Point. A sand trap with a 500,000-cubic yard capacity would be excavated in the lee of the breakwater. The breakwater would have a crest height of +14.0 feet above low water datum and would serve as a littoral barrier and provide protection for a hydraulic dredge. The dredge would be used to transfer the sand from the trap to the pipeline. The sand trap plan would require an initial replenishment of 1,630,000 cubic yards of sand (500,000 from the sand trap and the remainder from an outside source) and an annual nourishment requirement of 230,000 cubic yards of sand. The sand trap plan is shown on Plate 8 in Appendix A.

b. Nonstructural Solutions

(1) Recirculation - Sand from the peninsula beaches is moved generally eastward by the predominant easterly drift and is deposited at the tip of the peninsula. A logical method of replenishment would be to recirculate the sand from the outer end of the peninsula to the eroded beaches with a pumping system. The pumping system would consist of a 26-inch diameter permanent pipeline running approximately parallel to the road and a series of six booster stations. Sand would be transferred from the borrow area (Gull Point) to the pumping system with a hydraulic dredge. With this recirculation plan, about 1,630,000 cubic yards of sand would be initially transferred from Gull Point and 230,000 cubic yards of sand each year thereafter. The recirculation plan is shown on Plate 9 in Appendix A.

(2) Annual Nourishment - This plan would require an initial replenishment of about 1,630,000 cubic yards of sand and annual nourishment requirement of 230,000 cubic yards of sand. All sand would come from an outside source.

c. Other

Do Nothing - Some of the public believe the natural processes of the lake will eventually take over Presque Isle and that the users of the park should adapt themselves to these changes. In other words, they believe that nothing should be done to protect the peninsula and that it should be enjoyed as a natural park in whatever form it takes. To do nothing would not burden local interests and the Federal Government with financial costs associated with project development.

2. Comparative Assessment and Evaluation of Plans in Stage 1 Planning - The alternatives considered in Stage 1 Planning were the same as the practicable and economically feasible plans developed during preparation of the Review Report in 1973. The plan formulation appendix in the 1973 Review Report presented a matrix tabulation of the various alternative concepts showing the comparative effects that implementation of the alternatives would have on the national economic development, environmental quality, social well-being, and regional development. That matrix is presented in this report as Figure 16. The plan formulation appendix in the 1973 Review Report also presented a summary matrix highlighting the effects of each concept on the environmental, social, and economic guidelines. That summary matrix has been modified to show only the effects of the alternatives considered in Stage 1 Planning and is presented as Figure 17.

3. Conclusions (Screening) of Stage 1 Plans - With exception to the "do nothing" alternative, each of the alternatives considered in Stage 1 Planning represented a feasible alternative which had potential for implementation as a measure to correct the erosion problems being encountered at Presque Isle Peninsula. They had a ranking by which they could be classified as fair to very good in meeting the objectives of the study. Therefore, further analysis of the alternatives was required during Stage 2 Planning.

Plans Considered in Stage 2 Planning

The basic objective of the Stage 2 investigation was to identify the best plans which would preserve the peninsula and its recreational facilities with the least amount of destruction to the environment and geological growth of the area. The Stage 2 investigation analyzed only those concepts presented in Stage 1 Planning, all of which were found to be a practicable and economically feasible solution to the erosion problem at Presque Isle Peninsula.

1. Description of Plans in Stage 2 Planning - This section provides a summary of the alternatives investigated and discusses the features of the alternative plans developed during Stage 2 reformulation. Each alternative was developed such that comparable permanent protection of the peninsula and its recreational facilities would be provided, as long as the annual replenishment requirements for each alternative were implemented.

CATEGORY	STRUCTURAL ALTERNATIVES							NON STRUCTURAL ALTERNATIVES				OTHER	
FUNCTIONAL DESIGNATION	WAVE ATTENUATORS						BEACH CONTAINMENT	NOURISHMENT			NATURAL		
TYPE	FULL BREAKWATER	PARTIAL BREAKWATER	FLOATING BREAKWATER	WAVE SCREEN	WAVE SLICER	SANDTRAP RECIRCULATION	GROINS	RECIRCULATION	ANNUAL NOURISHMENT	FEEDER BEACH	VEGETATION	DO NOTHING ABOUT EROSION	DO NOTHING BUT MAINTAIN ACCESS BRIDGE
NATIONAL ECONOMIC DEVELOPMENT													
1. EFFECT ON ERIE HARBOR													
a. DREDGING COSTS ($)	2	1	1	-1	1	1	0	1	-1	-2	-2	-3	-3
b. NAVIGATION HAZARDS (CURRENTS, WAVE ACTION)	0	0	0	0	0	0	0	0	0	0	0	-3	-3
c. DAMAGE TO DOCK FACILITIES	0	0	0	0	0	0	0	0	0	0	0	-3	-3
d. ECONOMIC CONTRIBUTION	1	1	1	1	1	1	1	1	1	1	1	-3	-1
TOTAL	3	2	2	0	2	2	1	2	0	-1	-1	-12	-10
RANK	1	2	2	4	2	2	3	2	4	5	5	7	6
ENVIRONMENTAL QUALITY													
1. ECOLOGICAL AND BOTANICAL INTEREST (NATURAL GROWTH OF PENIN)	-3	-1	-1	0	0	-1	0	-3	0	0	0	0	0
2. PARK ATTRACTIVENESS	-3	-1	-2	-3	-1	-1	-2	-1	0	-1	-1	-1	-1
3. BEACH POLLUTION (COLIFORMS PER 100 ML)	-1	0	0	0	0	0	0	0	0	-1	0	-3	-3
4. USEABLE BEACH (REPLENISHMENT)	3	2	1	-1	1	-1	-1	-1	-1	-3	-1	3	3
TOTAL	-4	0	-2	-4	0	-3	-1	-5	-1	-5	-2	-1	-1
RANK	6	2	4	6	2	5	3	7	3	7	4	3	3
SOCIAL WELL - BEING													
1. RECREATIONAL VALUE													
a. PARK (VISITATIONS)	0	0	0	0	0	0	0	-1	0	0	0	-2	0
b. BEACH (VISITATIONS)	2	3	3	-1	3	3	2	3	2	2	-1	-3	-2
2. DAMAGE TO PARK FACILITIES ($)	1	1	1	1	1	1	1	1	1	1	1	-3	-3
3. RECREATIONAL NAVIGATION HAZARDS (CREATED BY STRUCTURES)	-2	-1	-1	0	-2	-1	0	0	0	-1	0	0	0
TOTAL	1	3	3	0	2	3	3	3	3	2	0	-8	-5
RANK	4	2	2	5	3	2	2	2	2	3	5	7	6
REGIONAL DEVELOPMENT													
1. ECONOMIC CONTRIBUTION ($)	1	1	1	1	1	1	1	1	1	1	1	-3	-2
2. JOBS CREATED	1	1	1	1	1	1	1	1	1	1	1	-3	-2
TOTAL	2	2	2	2	2	2	2	2	2	2	2	-6	-4
RANK	1	1	1	1	1	1	1	1	1	1	1	3	2
TECHNICAL CONSIDERATION													
1. EFFECTIVENESS (EROSION CONTROL)	3	2	1	-1	1	3	1	3	3	0	-2	-3	-3
2. STRUCTURAL FEASIBILITY	3	3	-1	3	-2	3	3	3	NA	1	NA	NA	3
TOTAL	6	5	0	2	-1	6	4	6	3	1	-2	-3	0
RANK	1	2	7	5	8	1	3	1	4	6	9	10	7
COST													
FEDERAL *	-3	-2	-1	1	-3	-1	0	-1	-1	-2	2	3	1
RANK	7	6	5	3	7	5	4	5	5	6	2	1	3
SUMMATION OF RANK	20	15	21	24	23	16	16	18	19	28	26	31	27
CLASSIFICATION	F	V.G.	F	P	P	G	G	F	F	P	P	V.P.	P.

* INDICATES RELATIVE RANKING OF EXPECTED COSTS OF EACH ALTERNATIVE CONCEPT. -3 INDICATES HIGHEST COSTS, 3 INDICATES LOWEST COSTS.

NA - NOT APPLICABLE

SUMMATION OF RANK	CLASSIFICATION
15	VERY GOOD (V.G.)
16 - 17	GOOD (G)
18 - 21	FAIR (F)
22 - 28	POOR (P)
29 - 31	VERY POOR (V.P.)

NOTE:

For a discussion on ranking of concept categories, see paragraph 17 in Appendix A of the 1973 Review Report

PRESQUE ISLE, PENINSULA
ERIE, PA.
ALTERNATIVES
EXHIBIT A-1

FIGURE

COMPARATIVE EFFECTS THAT IMPLEMENTATION OF ALTERNATIVES HAVE ON PLANNING OBJECTIVES

PLANNING OBJECTIVE	FULL BREAKWATER	PARTIAL BREAKWATER	GROINS	SANDTRAP RECIRCULATION	RECIRCULATION	ANNUAL NOURISHMENT	DO NOTHING ABOUT EROSION
NATIONAL ECONOMIC DEVELOPMENT	+ 1. REDUCED LONG TERM DREDGING COSTS. 2. NO ADVERSE EFFECTS ON HARBOR FACILITIES.	+ 1. REDUCED LONG TERM DREDGING COSTS. 2. NO ADVERSE EFFECTS ON HARBOR FACILITIES.	0 1. LITTLE CHANGE FROM EXISTING CONDITIONS	+ 1. REDUCED DREDGING COSTS. 2. NO ADVERSE EFFECTS ON HARBOR FACILITIES.	+ 1. REDUCED DREDGING COSTS. 2. NO ADVERSE EFFECTS ON HARBOR FACILITIES.	0 1. SLIGHT INCREASE IN DREDGING COSTS. 2. NO ADVERSE EFFECTS ON HARBOR FACILITIES.	− 1. INCREASED DREDGING COSTS. 2. WITHOUT PROTECTION BREACHED NECK IS POSSIBLE. HARBOR FACILITIES WOULD BE THREATENED.
ENVIRONMENTAL QUALITY	− 1. ADVERSE EFFECT ON ECOLOGICAL INTERESTS, BOTANICAL INTEREST, AND PARK ATTRACTIVENESS. 2. WOULD INCREASE BEACH POLLUTION. 3. LOWEST REPLENISHMENT COSTS.	0 1. SOME REDUCTION IN PENINSULA GROWTH AND PARK ATTRACTIVENESS. 2. LOW REPLENISHMENT COSTS.	0 1. VERY LITTLE CHANGE IN PENINSULA GROWTH. 2. UNATTRACTIVE. 3. REDUCTION IN REPLENISHMENT COSTS.	− 1. LARGE STRUCTURE OFFSHORE FROM SUNSET POINT. WOULD OBSTRUCT VIEW. 2. HIGH REPLENISHMENT COSTS. 3. MASSIVE NOURISHMENT UNDESIRABLE TO FISH AND WILDLIFE SERVICE.	− 1. CRITICALLY ADVERSE EFFECT ON ECOLOGICAL AND BOTANICAL INTERESTS. 2. LITTLE CHANGE IN PARK ATTRACTIVENESS. 3. HIGH REPLENISHMENT COSTS. 4. MASSIVE NOURISHMENT	− 1. CONDITIONS WOULD CONTINUE AS THEY ARE EXCEPT FOR INCREASED EXPENDITURES IN REPLENISHMENT 2. MASSIVE NOURISHMENT UNDESIRABLE TO FISH AND WILDLIFE SERVICE.	+ 1. LITTLE EFFECT ON ECOLOGICAL AND BOTANICAL INTERESTS, PARK ATTRACTIVENESS AND POLLUTION. 2. NO REPLENISHMENT COSTS.
SOCIAL WELL-BEING	0 1. LITTLE EFFECT ON PARK VISITORS. 2. GOOD BEACH ASSURED BUT POLLUTION COULD BE A PROBLEM. 3. HAZARDOUS TO NAVIGATION.	+ 1. LITTLE EFFECT ON PARK VISITORS. 2. GOOD BEACH ASSURED. 3. LESS HAZARDOUS TO NAVIGATION THAN CONCEPT 1.	+ 1. LITTLE EFFECT ON PARK VISITORS. 2. GOOD BEACH BUT STRUCTURES ARE ON BEACH.	+ 1. GOOD BEACH 2. DREDGE AND PUMPING SYSTEM WOULD BE NOISY	0 1. SOME AREAS OF ECOLOGICAL INTEREST WOULD BE DESTROYED. 2. GOOD BEACH	+ 1. LITTLE EFFECT ON PARK VISITORS. 2. GOOD BEACH.	− 1. ACCESS COULD BE DIFFICULT IN TIME. 2. POOR BEACH. 3. PARK FACILITIES COULD BE DESTROYED.
REGIONAL DEVELOPMENT	CONCEPTS WOULD ENHANCE REGIONAL DEVELOPMENT THROUGH INCREASED REGIONAL INCOME, INCREASED EMPLOYEMENT AND IMPROVEMENT OF THE ECONOMIC BASE.						− 1. LOCAL ECONOMY WOULD DECLINE.
TECHNICAL CONSIDERATION	+ 1. VERY EFFECTIVE EROSION CONTROL. 2. STABLE STRUCTURE POSSIBLE WITH ALTERNATIVE TYPES OF CONSTRUCTION.	+ 1. PROTECTS AREAS MOST VULNERABLE TO EROSION. 2. RELIABLE STABLE STRUCTURE. 3. FACILITATES BEACH REPLENISHMENT.	0 1. HAVE NOT REDUCED EROSION TO SATISFACTORY LIMITS. 2. STRUCTURALLY FEASIBLE WITH ALTERNATIVE TYPES.	+ 1. RECIRCULATION FEASIBLE WITH PROVEN TECHNIQUE AND EQUIPMENT. 2. REQUIRES SOME REPLENISHMENT.	+ 1. RECIRCULATION FEASIBLE WITH PROVEN TECHNOLOGY AND EQUIPMENT. 2. REQUIRES SOME REPLENISHMENT.	− 1. REQUIRES SAND FROM OUTSIDE SOURCES THAT HAS COMPETITIVE DEMANDS. 2. HIGH REPLENISHMENT REQUIREMENTS. 3. SOURCES OF SUITABLE SAND LIMITED.	− 1. EROSION DAMAGE WILL INCREASE. 2. BEACHES LIKELY TO OCCUR IN PENINSULA NECK.
TOTAL EFFECT	++ ADVERSE ECOLOGICAL EFFECT.	+++ GOOD BALANCE OF OBJECTIVES.	++ GOOD BALANCE OF OBJECTIVES.	+++ PROVIDES EFFICIENT USE OF SAND	++ PROVIDES NEARLY CLOSED SYSTEM OF REPLENISHMENT BUT DESTROYS ECOLOGICAL GROWTH.	0 GOOD BEACH BUT REQUIRES EXCESSIVE AMOUNT OF REPLENISHMENT	− SEVERE LOSS OF RECREATIONAL CAPACITY AND ACCESS.
CLASSIFICATION	GOOD	VERY GOOD	GOOD	GOOD	GOOD	FAIR	VERY POOR

SUMMARY MATRIX HIGHLIGHTING THE EFFECTS OF EACH CONCEPT.

FIGURE 17

a. Structural Solutions

(1) Segmented Breakwaters - Stage 1 Planning considered two segmented breakwater concepts: the full breakwater and the partial breakwater concepts. During Stage 2 Planning, one segmented breakwater plan which would function as a wave-attenuating and beach-building system was developed. The plan developed was analyzed using existing literature on offshore breakwaters and information obtained by observing the three prototype breakwaters constructed at Beach No. 10 on Presque Isle. To effectively preserve the entire peninsula and its recreational facilities from the natural erosion processes, a segmented breakwater plan was developed consisting of 58 breakwater segments which are 150 feet long and separated by gaps of 350 feet. The breakwater system would extend from the root of the peninsula with the mainland shore eastward through Sunset Point. Each breakwater segment would be positioned approximately 300 to 400 feet offshore at the 3-foot depth contour based on low water datum and have a crest elevation of 8.5 feet above low water datum. This segmented breakwater alternative would require an initial replenishment of 750,000 cubic yards of sandfill and an annual replenishment requirement of 30,000 cubic yards in order to maintain the beaches with a design width of 60 feet and a crest elevation of +10 feet above low water datum. The estimated first cost for the segmented breakwater alternative developed in Stage 2 planning is $15,000,000. The details of the segmented breakwater alternative are shown on Plate 10 in Appendix A. With the segment breakwater alternative, approximately 65,000 cubic yards of sand would be bypassed naturally to the distal end of the peninsula for continued growth.

(2) Groins - The groin concept presented in Stage 1 Planning required construction of 15 300-foot long groins and an annual nourishment of about 190,000 cubic yards of sandfill. The concept was simply an extension of the existing Federal groin field which itself has been inadequate in preserving the peninsula and reducing the erosion. Therefore, during Stage 2 planning, a groin plan was developed which would function more efficiently and reduce the annual sand replenishment requirements. The groin alternative developed consists of construction of 37 new 400-foot long rubblemound groins with a steel sheet pile cutoff to make the groins impermeable. In addition, 10 existing 300-foot long groins would be modified by extending each 100 feet lakeward with steel sheet piling and placement of stone along the entire 400-foot length of the groin. The spacing between the groins in the existing Federal groin field would be reduced from 1,000 feet to 500 feet by construction of an intermediate groin. Eastward of the existing Federal groin field, the spacing between the new groins would be 700 feet. This groin alternative would require an initial replenishment of 1,100,000 cubic yards of sandfill and an annual replenishment of 112,500 cubic yards in order to maintain the beaches with a design width of 60 feet and crest elevation of +10 feet above low water datum. The estimated first cost for the groin alternative developed in Stage 2 Planning is $24,400,000. The details of the groin alternative developed in Stage 2 Planning are shown on Plates 11 and 12 in Appendix A. With the groin alternative 130,000 cubic yards of sand would be bypassed naturally to the distal end of the peninsula for continued growth.

(3) Sand Trap Recirculation - With the sand recirculation alternative presented in Stage 1 Planning, the waterfowl sanctuary that is located at the distal end of the peninsula would eventually be destroyed and the ecological progression of Presque Isle would be virtually stopped. Therefore, the sand trap concept was developed to circumvent the destruction of Gull Point by trapping the littoral material which is moved eastward in a sand trap created offshore from Sunset Point which is about 5,000 feet to the west of Gull Point. The sand trap recirculation alternative was refined and a plan which would function efficiently was developed in Stage 2 planning. The alternative consists of a 2,000-foot long breakwater with a crest elevation of +18.5 feet above low water datum and located about 1,200 feet offshore from Sunset Point at the 10-foot depth contour based on low water datum, excavation of a sand trap with a 270,000-cubic yard capacity in the lee of the breakwater, and a 20-inch diameter permanent pipeline running approximately parallel to the park's lake shore road with a series of three booster pumps located at 8,000-foot intervals. The sand trap recirculation alternative would require an initial replenishment of 750,000 cubic yards of sandfill (270,000 cubic yards from the sand trap and 480,000 cubic yards from an outside source) and an annual replenishment of 305,000 cubic yards in order to maintain the beaches with a design width of 60 feet and crest elevation of +10 feet above low water datum. The 305,000-cubic yards annual replenishment requirement consists of 220,000 cubic yards of sand being pumped from the trap and distributed on the beaches west of the sand trap, a total of 30,000 cubic yards of sand being pumped from the sand trap eastward toward Gull Point, and 55,000 cubic yards of sand from an outside source for distribution along the neck of the peninsula. With the sand trap recirculation alternative, a total of 40,000 cubic yards of sand would bypass to the distal end of the peninsula for continued growth (30,000 cubic yards pumped from the sand trap and 10,000 cubic yards naturally bypassing the sand trap.) The estimated first cost for the sand trap recirculation alternative developed in Stage 2 Planning is $22,200,000. The details of the sand trap recirculation alternative developed in Stage 2 planning are shown on Plate 13 in Appendix A.

b. Nonstructural Solutions

(1) Sand Recirculation - During Stage 2 planning, the same general sand-recirculation concept, as considered in Stage 1 Planning, was analyzed. The sand recirculation alternative developed in Stage 2 planning would require a 20-inch diameter permanent pipeline running approximately parallel to the park's lake shore road and a series of four booster pumps located at 8,000-foot intervals. This sand recirculation alternative would require an initial replenishment of 750,000 cubic yards of sandfill and an annual replenishment of 275,000 cubic yards in order to maintain the beaches with a design width of 60 feet and a crest elevation of +10 feet above low water datum. All material for the replenishment operations would come from the borrow area at Gull Point and would cause an initial loss of 750,000 cubic yards of sand from the distal end and a net annual loss of 15,000 cubic yards of sand over the life of the project. The estimated first cost for the sand recirculation alternative developed herein is $15,600,000. The general plan of the sand recirculation alternative is shown on Plate 14 in Appendix A.

(2) Annual Nourishment - Beach nourishment operations have been undertaken periodically through the 1960's and early 1970's and annually since 1975. The cost for this type of protection is increasing each year. During Stage 2 planning, it was determined that about 750,000 cubic yards of sandfill would be needed to restore the beaches with a design width of 60 feet and crest elevation of +10 feet above low water datum and that an additional 275,000 cubic yards would be required annually to maintain the beach width and crest elevation. With this annual nourishment alternative, about 260,000 cubic yards of sand would bypass naturally to the distal end of the peninsula. However, at present, there is such an increased volume of sand reaching the distal end due the current annual nourishment program, that much of the material is building up in the offshore zones and increasing the shoaling in the entrance channel to Erie Harbor. This volume of sand is reaching the distal end of the peninsula at a faster rate than wave action from the northeast through east is able to recurve the sand spit back on to the beach face. As a result, there is a greater volume of offshore sand losses and lakeward movement of the sand into deeper water including the entrance channel to Erie Harbor. This deposition of sand in the entrance channel to Erie Harbor is increasing the amount of dredging and, thereby, the maintenance costs for Erie Harbor. The estimated first cost for the annual nourishment alternative is $6,200,000. The limits of the annual nourishment alternative would remain the same as the present limits which are shown on Plate 3 in Appendix A.

c. Other

(1) Do Nothing - Some of the public believe the concept of trying to keep the peninsula as it presently exists to be impracticable. They believe the natural processes of the lake will eventually take over Presque Isle and that the users of the park should adapt themselves to these changes. In other words, they believe nothing should be done to protect the peninsula and that it should be enjoyed as a natural park in whatever form it takes.

If this plan were carried out, the natural processes of erosion and deposition would not be interrupted. Likewise, pond and dune genesis and evolution would continue unaltered. The neck would probably be breached and polluted waters of Presque Isle Bay would be diluted by the relatively unpolluted waters of Lake Erie. Transported sand would migrate into the bay and reduce bay depth in some areas.

The eastward migration of Presque Isle would continue. As the neck and west end are gradually breached, these will obviously be lost as ecological study areas. Very old forests and ponds will be enveloped by Lake Erie and some of this material will be reincorporated into the eastern beaches. New ponds will be formed and the peninsula will retain its sandspit nature. The inhabitants of the resulting aquatic communities would be representative of those typically associated with existing water quality and habitat conditions. A change in environmental parameters would most probably be reflected by a gradual change in the aquatic species compositions and density. It is impossible to predict in any more than general terms, the rate of migration, the future morphology of the peninsula or the time required before it is

ultimately destroyed by the same natural forces which created and maintain it.

The natural features and processes, whether they be formation of sandspits or destruction of beaches, would continue. Destructive natural processes may be considered aesthetically pleasing to some or unpleasing to others. This course of action is highly unacceptable to the majority of individuals who have expressed interest in the problem and have attended the public meetings.

2. Comparative Assessment and Evaluation of Plans in Stage 2 Planning - During Stage 2 Planning, the six economically feasible concepts which were considered during Stage 1 Planning were analyzed. The concepts were refined and five alternatives, each capable of providing full protection to the peninsula, provided that the annual replenishment requirements for each alternative are implemented, were developed. These alternatives are: groins, segmented breakwaters, sand recirculation, sand trap recirculation, and annual nourishment. Each of these alternatives are economically feasible, but may have certain technical and environmental advantages and disadvantages. In addition, public opinion may vary as to which alternative will provide the best long-term solution to the erosion problem while at the same time minimize the detrimental impacts on the environment and ecological existence of the peninsula. A comparative summary of alternatives developed in Stage 2 Planning is presented in Table 6.

The groin alternative has the highest first cost but will reduce the annual beach replenishment requirements. The segmented breakwater alternative would provide the most complete protection to the eroding beaches by dissipating a large amount of the incoming wave energy and has the least annual cost but may not be aesthetically acceptable to those who desire a totally uninterrupted view of the sunset over the lake. The annual nourishment has the lowest first cost but one of the the highest annual costs due to the large volume of sand which is needed annually from an outside source. The annual nourishment alternative will also increase the annual maintenance costs of Erie Harbor due to the additional dredging of sand which is transported eastward of Gull Point and deposited in the entrance channel. This annual nourishment alternative would also require the greatest fuel consumption at a time when an energy crisis is imminent. Recirculation of sand from the distal end of the peninsula to the beaches via a pipeline with a series of pumping stations appears to be a technically favorable solution, especially since current hydrographic surveys indicate increased shoaling in the entrance channel to Erie Harbor due to the immense growth rate being observed at the eastern end of the peninsula. However, with this sand recirculation alternative, the waterfowl sanctuary at Gull Point would be destroyed. The sand trap recirculation alternative would eliminate some of the disadvantages of the sand recirculation alternative, however, a 20-inch diameter pipeline would stretch nearly the entire length of the peninsula and may not be aesthetically acceptable.

3. Conclusions (Screening) of Stage 2 Plans - The sand recirculation alternative is environmentally unacceptable since it will cause the destruction of the bird sanctuary located at Gull Point. The annual nourishment alternative

TABLE 6 - COMPARATIVE SUMMARY OF ALTERNATIVES IN STAGE 2 PLANNING

Alternative	Total First Cost $ 1/	Annual Maintenance Cost $ 2/	Total Annual Cost $ 3/	Initial Sand Fill Requirement	Annual Sand Fill Requirement	Sand Quantities Reaching Gull Point Area Annually
Groins	24,400,000	850,000	2,590,000	1,100,000 C.Y. 4/	112,500 C.Y.	+130,000 C.Y.
Segmented Breakwaters	15,000,000	240,000	1,310,000	750,000 C.Y.	30,000 C.Y.	+ 65,000 C.Y.
Sand Recirculation	15,600,000	2,280,000	3,390,000	750,000 C.Y.	275,000 C.Y.	- 15,000 C.Y.
Sand Trap Recirculation	22,200,000	2,500,000	4,080,000	750,000 C.Y.	305,000 C.Y.	+ 40,000 C.Y.
Annual Nourishment	6,200,000	2,000,000	2,440,000	750,000 C.Y.	275,000 C.Y.	260,000 C.Y.
No Action	-	-	-	-	-	124,000 C.Y.

1/ Total First Cost includes the cost for initial sand fill, structures, engineering and design, and supervision and administration.

2/ Annual Maintenance Cost includes the cost for annual sand replenishment and annual maintenance to the structures.

3/ Total Annual Cost includes the annual maintenance cost plus interest and amortization charges on the initial investment.

4/ Additional initial sand fill is required to compensate for sand which will be lost as the fill is reoriented into a stabilized position by wave action.

is technically unacceptable since it will greatly increase the annual maintenance dredging costs of Erie Harbor. Further analysis of the sand recirculation and annual nourishment alternatives does not seem practicable nor justified. However, a Stage 3 investigation is needed and justified to refine and develop the segmented breakwater, groin, and sand trap recirculation alternatives as total plans. These three alternatives are economically and technically feasible and appear to warrant further detailed analysis in order to more accurately evaluate actual environmental impacts and to provide a more positive basis for selection of a recommended plan.

SECTION D
ASSESSMENT AND EVALUATION OF DETAILED PLANS

Preliminary analysis and evaluation of possible conceptual solutions indicated that nonstructural measures, namely annual nourishment and sand recirculation, are not acceptable due to technical and environmental impacts. Therefore, in the final stage (Stage 3) of this investigation, the Buffalo District refined three structural alternatives: the groin alternative, the segmented breakwater alternative, and the sand trap recirculation alternative. This section provides a summary of the engineering design, economic evaluation, and environmental assessment of the three alternative structural plans that the screening process indicated had the greatest potential for meeting the basic objective of preserving Presque Isle Peninsula and its recreational facilities with the least amount of destruction to the environment and geological growth of the area. Appendix C to this report provides the details of the engineering analysis associated with the three structural alternatives which were refined during this Stage 3 investigation in addition to providing the engineering analysis for the nonstructural alternatives developed in Stage 2. Appendix B to this Report provides the details of the economic analysis for the three structural alternatives.

PLAN DESCRIPTION

Description of Plan 1 - Groin Alternative

In the summer of 1979, Buffalo District survey crews performed bathymetric surveys in Lake Erie along the entire shoreline of Presque Isle Peninsula. Based on these surveys, it was determined that the groins for this alternative must be 300 feet in length in order to extend to the zone where a normal storm wave of 4.2 feet would break. Therefore, the groin alternative in this final stage of the Phase I GDM investigation consists of construction of 37 new 300-foot long rubblemound groins with a steel sheet pile cutoff to make the groins impermeable. In addition, eleven existing groins, Groins No. 1 through 7 and 9 through 11 in the existing groin field along the neck of the peninsula and also the Lighthouse Groin, will be modified by placement of stone along the entire 300-foot length of the groin to reduce wave reflection off the structures. The spacing between the groins in the existing groin field along the neck of the peninsula will be reduced from 1,000 feet to 500 feet by construction of an intermediate groin. Eastward of the existing groin field, the spacing between the new groins will be 700 feet. Based on topographic survey data obtained during the summer of 1979, it was estimated that 850,000 cubic yards of sand fill will be required to fill the groin system to its entrapment capacity in order to provide a beach with a design width of 60 feet and crest elevation of +10.0 feet above low water datum. The details of the groin alternative are shown on Plates 15 and 16 which are included in Appendix A.

Description of Plan 2 - Segmented Breakwater Alternative

The segmented breakwater plan requires a total of 58 breakwater segments to protect the entire lake shore perimeter of the peninsula. Each breakwater

segment will be 150 feet long and separated by gaps of 350 feet. The breakwater system will extend from the west end of the peninsula eastward through Sunset Point. The offshore breakwaters would be aligned parallel to the peninsula shoreline and positioned in the trough between the first and second offshore sand bars. Based on bathymetric survey data obtained during the Summer of 1979, it was determined that the trough between the first and second offshore sand bars is located 300 to 400 feet offshore and has a bottom elevation of approximately 563.6 (5.0 feet below low water datum). It has always been the intent to locate the breakwaters at the lowest point in the trough between the offshore bars and surveys show that trough to be 2 feet deeper than had earlier been thought. Therefore, structural changes were implemented during Stage 3 Planning and it was determined that each breakwater segment would be positioned approximately 300 to 400 feet offshore at the 5-foot depth contour based on low water datum and have a crest elevation 578.8 or 10.2 feet above low water datum. Based on topographic survey data obtained during the Summer of 1979, it was determined that the segmented breakwater alternative will require an initial replenishment of 500,000 cubic yards of sand fill in order to provide a beach with a design width of 60 feet and crest elevation of +10.0 feet above low water datum. The details of the segmented breakwater alternative are shown on Plate 17 in Appendix A.

Description of Plan 3 - Sand Trap Recirculation Alternative

The sand trap recirculation alternative consists of a 2,000-foot long offshore breakwater with a crest elevation of +15.5 feet above low water datum and a pumping system which includes a 20-inch diameter permanent pipeline running approximately parallel to the park's lake shore road with a series of three booster pumps located at 8,000-foot intervals. The breakwater would be located about 1,200 feet offshore from Sunset Point at the 10-foot depth contour based on low water datum. A sand trap with a 270,000 cubic yard capacity will be excavated in the lee of the breakwater. This sand trap will collect littoral material that moves along the peninsula shoreline. The littoral material which collects in the trap will be transferred from the trap to the pumping system by a hydraulic dredge and distributed on various beaches along the peninsula. The pipeline would consist of 29,000 feet of permanently installed pipe, 4,000 feet of flexible shoreline pipe, and 2,000 feet of floating pipe. The permanent pipeline is located above ground because the sand slurry, which would be pumped through the pipeline, will abrade the interior of the pipes, such that, they would have to be periodically rotated. Therefore, locating the pipes above ground makes this maintenance less costly than if the pipes were buried and had to be excavated each time in order to rotate. The permanent booster pumps will have a capability of a production rate of between 500 and 800 cubic yards per hour. Based on topographic survey data obtaining during the Summer of 1979, it was determined that the sand trap recirculation alternative will require an initial replenishment of 500,000 cubic yards of sand fill in order to provide a beach with a design width of 60 feet and crest elevation of +10.0 feet above low water datum. About 270,000 cubic yards of sand for the initial replenishment will be pumped from behind the breakwater during excavation of the sand trap. The remaining 230,000 cubic yards will come from an outside source. The details of the sand trap recirculation alternative are shown on Plate 18 in Appendix A.

Plan 4 - The "No Action" Alternative

By this alternative, the no-action alternative, the Corps of Engineers would not participate in protection or improvement of Presque Isle Peninsula. The plan was presented in detail in SECTION B - PROBLEM IDENTIFICATION of this report and represents the base condition for comparing and evaluating other improvement alternatives. This alternative avoids the Federal monetary investment and potential adverse impacts associated with the structural features of the other beach erosion control alternatives; however, it would not satisfy the objectives of preserving Presque Isle Peninsula and its recreational facilities.

Project Considerations and Sediment Budget

Sediment transport along Presque Isle is distributed among multiple transport zones and is active along the offshore bars as well as the shoreline.

Presque Isle is a migrating feature with a continual loss of material. Any project which is designed to stabilize Presque Isle must consider the system as a whole. It is impractical to protect only one portion of the system as the system will continue to migrate and the bars will continue to carry sediment. Each alternative refined during the Stage 3 investigation is discussed herein and its impact on the sediment budget assessed. Figures 18 through 20 summarize the sediment budget which was developed for each structural alternative. A more detailed discussion on the development of the sediment budget is presented in Appendix C.

Figure 15 (included in Section B - Problem Identification) is the expected sediment budget for the "Do-Nothing" condition. Figure 14 (also included in Section B - Problem Identification) documents the existing condition with the present level of artificial nourishment. The present condition characterizes the maximum potential sediment transport rates and was the model used in development of the sediment budgets for the three structural alternatives being considered. The present sediment budget for Presque Isle Penninsula is summarized as a 40,000 cubic yard gain from the west, a 259,000 cubic yard gain from beach replenishment (based on the long-term average rate), a 146,000 cubic yard loss to the entrance channel to Erie Harbor, and a 143,000 cubic yard loss to build the eastern subaqueous platform and subaerial distal east end (Gull Point). Therefore, the maximum average annual rate of longshore transport at Presque Isle as computed in Appendix C is 289,000 cubic yards. The "Do-Nothing" condition represents the long-term conditions existing prior to initiation of the cooperative project in 1954 and is the minimum sediment transport budget model. Due to the lack of a significant source of material, the "Do-Nothing" condition experiences lesser rates of longshore transport (87,000 cubic yards/year), a lesser rate of permanent loss to the entrance channel to Erie Harbor (51,000 cubic yards/year), and a lesser growth rate of the eastern offshore platform and subaerial distal end of the peninsula (36,000 cubic yards/year).

1. Groin Alternative - The sediment budget for the groin alternative is summarized in Figure 18. According to the Shore Protection Manual (SPM), the net longshore transport rate will be reduced because groins will retain littoral material. High groins which extend from mean low water to 4 feet below

mean low water are described in Section 5 of the SPM as being effective in retaining 50 percent of the total annual rate of longshore transport. Therefore, with the groin alternative, about 144,600 cubic yards of littoral material will naturally reach the distal east end of the peninsula each year of which about 50 percent or 73,200 cubic yards of material will be deposited in the entrance channel to Erie Harbor, about 20 percent or 28,900 cubic yards of material will be deposited on the platform offshore from Gull Point as subaqueous growth, and about 30 percent or 42,500 cubic yards of material will maintain subaerial growth at the distal east end (Gull Point). To balance the sediment budget for the groin alternative and maintain the beaches at a design width of 60 feet and a crest elevation of +10.0 feet above low water datum, an average annual replenishment of 130,700 cubic yards of sand fill is required (assuming 20 percent of the placed beach fill is lost to the offshore zones).

2. Segmented Breakwater Alternative - The sediment budget for the segmented breakwater alternative is summarized in Figure 19. The breakwaters will function as a wave attenuator system and thereby reduce the amount of wave energy reaching the shoreline, slow the littoral transport along the shore, and trap littoral material. The total aggregate length of the breakwaters for this plan is 8,700 feet and the length of peninsula shoreline to be protected is 28,650 feet. Therefore, approximately 33 percent of the shoreline is directly protected from wave energy. Because the breakwaters will dissipate wave energy before it reaches the shore, its effectiveness in trapping littoral material from the longshore transport will be greater than that for the groin alternative. Hence, it was assumed that the breakwater system will be 75 percent effective in reducing the total annual rate of longshore transport. Therefore, with the segmented breakwater alternative, about 72,300 cubic yards of littoral material will naturally reach the distal east end of the peninsula each year of which about 50 percent or 36,600 cubic yards of material will be deposited in the entrance channel to Erie Harbor, about 20 percent or 14,500 cubic yards of material will be deposited on the platform offshore from Gull Point as subaqueous growth, and about 30 percent or 21,200 cubic yards of material will maintain subaerial growth at the distal east end of the peninsula (Gull Point). To balance the sediment budget for the segmented breakwater alternative and maintain the beaches at a design width of 60 feet and a crest elevation of +10.0 feet above low water datum, an average annual replenishment of 37,900 cubic yards of sand fill is required (assuming 15 percent of the placed beach fill is lost to the offshore zones).

3. Sand Trap Recirculation Alternative - The sediment budget for the sand trap recirculation alternative is summarized in Figure 20. The 2,000-foot long breakwater in this plan will not function as a complete littoral barrier. However, it is anticipated that the breakwater will be about 90 percent effective in reducing the total annual rate of longshore transport. Therefore, the sand trap which is excavated in the lee of the breakwater will collect about 260,000 cubic yards of littoral material annually. With the sand trap recirculation plan, about 29,000 cubic yards of littoral material will naturally reach the distal east end of the peninsula annually. To balance the sediment budget for the sand trap plan, to provide for the minimum amount of growth at the east end of the peninsula, and to maintain the

beaches at a design width of 60 feet and a crest elevation of +10.0 feet above low water datum, it will be necessary to pump 260,000 cubic yards of sand from the trap annually of which 32,400 cubic yards is pumped to the east and 227,600 is pumped to the west. In addition, 83,600 cubic yards of sand will be brought in from an outside source to replace material lost to offshore zones and the material used to maintain growth at the distal end. Therefore, an average annual replenishment of 343,600 cubic yards of sand fill is required (assuming 20 percent of the recycled and placed beach fill is lost to the offshore zones). With the sand trap plan, about 61,400 cubic yards of littoral material will reach the distal east end of the peninsula each year (29,000 cy naturally and 32,400 cy pumped from the sand trap) of which about 50 percent or 30,700 cubic yards of material will be deposited in the entrance channel to Erie Harbor, about 20 percent or 12,300 cubic yards of material will be deposited on the platform offshore from Gull Point as subaqueous growth, and 18,400 cubic yards of material will maintain subaerial growth at the distal east end of the peninsula (Gull Point).

4. No Action Plan - The sediment budget for the No Action plan is summarized in Figure 21. A sediment budget was developed for the "No Action Plan" based on the assumption that the Commonwealth of Pennsylvania would undertake a minor level of replenishment to maintain the 1972 beach area. It was determined that the Commonwealth of Pennsylvania would have to replenish the beaches with about 57,000 cubic yards of sand annually in order to maintain the 1972 beach area. This level of replenishment results in a sediment budget condition between the condition where there is no replenishment (Figure 15) and the present condition with annual nourishment (Figure 14). The "No Action" sediment budget (see Figure 21 and page 61a of Appendix C) is summarized as a 40,000 cubic yard gain from the west, a 57,000 cubic yard gain from beach replenishment, a 75,000 cubic yard loss to the entrance channel, and a 56,000 cubic yard loss to build the eastern subaqueous platform and subaerial distal east end (Gull Point). This sediment budget results in a 46,000 cubic yard per year loss to the inactive offshore zone which will impact upon the land surface of the peninsula.

IMPACT ASSESSMENT

The basic objective of this Phase I design memorandum study is to develop a plan for the preservation of Presque Isle Peninsula and its recreational facilities from natural erosion processes with the least amount of damage to its natural geological and ecological processes. To develop such a plan, the impacts that will affect the human and natural environments due to implementation and maintenance of the plan must be identified and considered. The following paragraphs discuss the significant impacts associated with the implementation and maintenance of the groin, segmented breakwater, and sand trap recirculation plans developed in this report in addition to the no-action plan. A more detailed discussion of impacts and effects of the plans is presented in the Environmental Impact Statement included as SECTION H of this report.

Groins With Periodic Beach Nourishment

The groin alternative consists of modifying 11 existing groins, construction of 37 new groins, and placement of 850,000 cy of sand fill along approximately 30,000 feet of peninsula shoreline. In addition, an average annual replenishment of 130,700 cy of sand fill is needed to maintain the required beach dimensions. Construction of the groins would be accomplished with land plant consisting of cranes, dump trucks, and front-end loaders whereas placement of sand fill would require land plant consisting of dump trucks, front-end loaders, and bulldozers. Construction of the groin plan would most likely take about 20 months to complete and extend through two construction seasons.

The construction procedure that would probably be followed is to use a pile driver attached to a crane to install the steel sheet pile walls and then randomly place the protective pad and armor stone which would be truck hauled to the site. Placement of the protective pad and armor stone would be accomplished utilizing front-end loaders and cranes equipped with rock grapples. Once the groins are constructed, they can be filled to their capacity with sand that is truck hauled to the site and spread using front-end loaders and bulldozers.

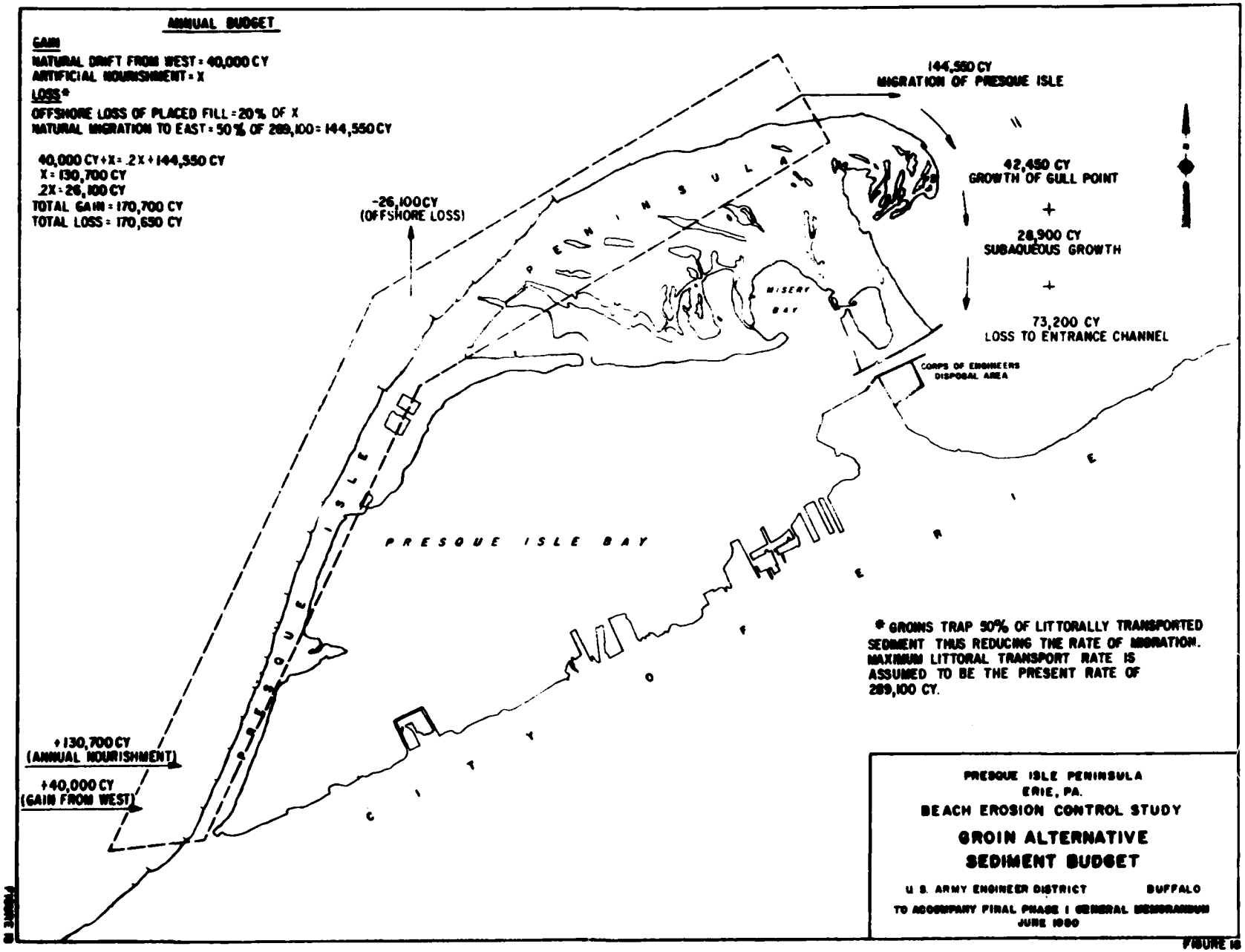
ANNUAL BUDGET
GAIN
NATURAL DRIFT FROM WEST = 40,000 CY
ARTIFICIAL NOURISHMENT = X
LOSS*
OFFSHORE LOSS OF PLACED FILL = 20% OF X
NATURAL MIGRATION TO EAST = 50% OF 289,100 = 144,550 CY
40,000 CY + X = .2X + 144,550 CY
X = 130,700 CY
.2X = 26,100 CY
TOTAL GAIN = 170,700 CY
TOTAL LOSS = 170,650 CY
-26,100 CY
(OFFSHORE LOSS)
144,550 CY
MIGRATION OF PRESQUE ISLE
42,450 CY
GROWTH OF GULL POINT
+
28,900 CY
SUBAQUEOUS GROWTH
+
73,200 CY
LOSS TO ENTRANCE CHANNEL
CORPS OF ENGINEERS
DISPOSAL AREA
PENINSULA
MISERY BAY
PRESQUE ISLE
PRESQUE ISLE BAY
CITY OF ERIE
+130,700 CY
(ANNUAL NOURISHMENT)
+40,000 CY
(GAIN FROM WEST)
* GROINS TRAP 50% OF LITTORALLY TRANSPORTED SEDIMENT THUS REDUCING THE RATE OF MIGRATION. MAXIMUM LITTORAL TRANSPORT RATE IS ASSUMED TO BE THE PRESENT RATE OF 289,100 CY.
PRESQUE ISLE PENINSULA
ERIE, PA.
BEACH EROSION CONTROL STUDY
GROIN ALTERNATIVE
SEDIMENT BUDGET
U. S. ARMY ENGINEER DISTRICT BUFFALO
TO ACCOMPANY FINAL PHASE I GENERAL MEMORANDUM
JUNE 1980

FIGURE 18

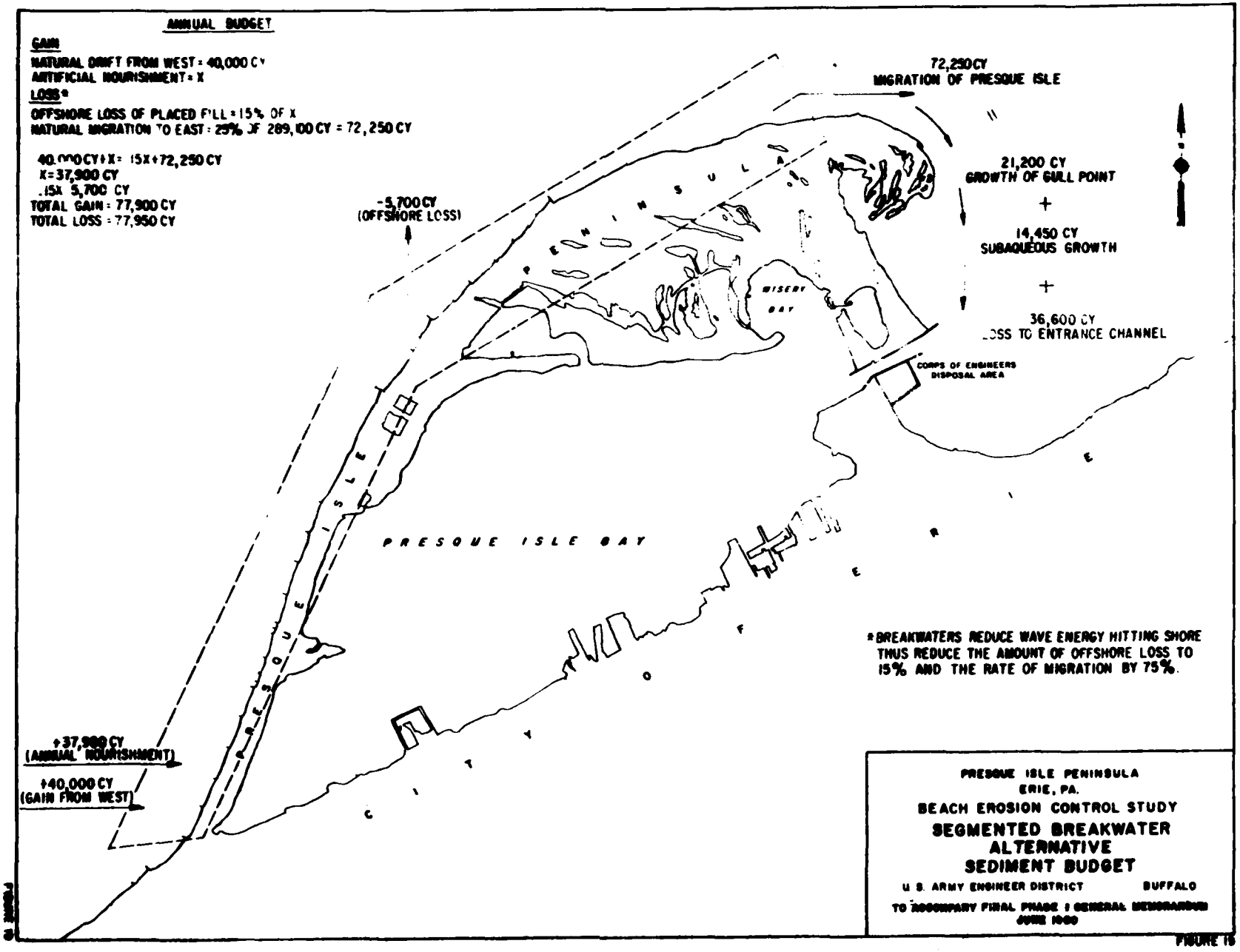
ANNUAL BUDGET
GAIN
NATURAL DRIFT FROM WEST = 40,000 CY
ARTIFICIAL NOURISHMENT = X
LOSS*
OFFSHORE LOSS OF PLACED FILL = 15% OF X
NATURAL MIGRATION TO EAST = 25% OF 289,100 CY = 72,250 CY
40,000 CY + X = .15X + 72,250 CY
X = 37,900 CY
.15X 5,700 CY
TOTAL GAIN = 77,900 CY
TOTAL LOSS = 77,950 CY
-5,700 CY
(OFFSHORE LOSS)
72,250 CY
MIGRATION OF PRESQUE ISLE
21,200 CY
GROWTH OF GULL POINT
+
14,450 CY
SUBAQUEOUS GROWTH
+
36,600 CY
LOSS TO ENTRANCE CHANNEL
PENINSULA
MISERY BAY
CORPS OF ENGINEERS DISPOSAL AREA
PRESQUE ISLE
PRESQUE ISLE BAY
CITY OF ERIE
+37,900 CY
(ANNUAL NOURISHMENT)
+40,000 CY
(GAIN FROM WEST)
*BREAKWATERS REDUCE WAVE ENERGY HITTING SHORE THUS REDUCE THE AMOUNT OF OFFSHORE LOSS TO 15% AND THE RATE OF MIGRATION BY 75%.
PRESQUE ISLE PENINSULA
ERIE, PA.
BEACH EROSION CONTROL STUDY
SEGMENTED BREAKWATER ALTERNATIVE
SEDIMENT BUDGET
U.S. ARMY ENGINEER DISTRICT BUFFALO
TO ACCOMPANY FINAL PHASE I GENERAL MEMORANDUM
JUNE 1980

FIGURE 15

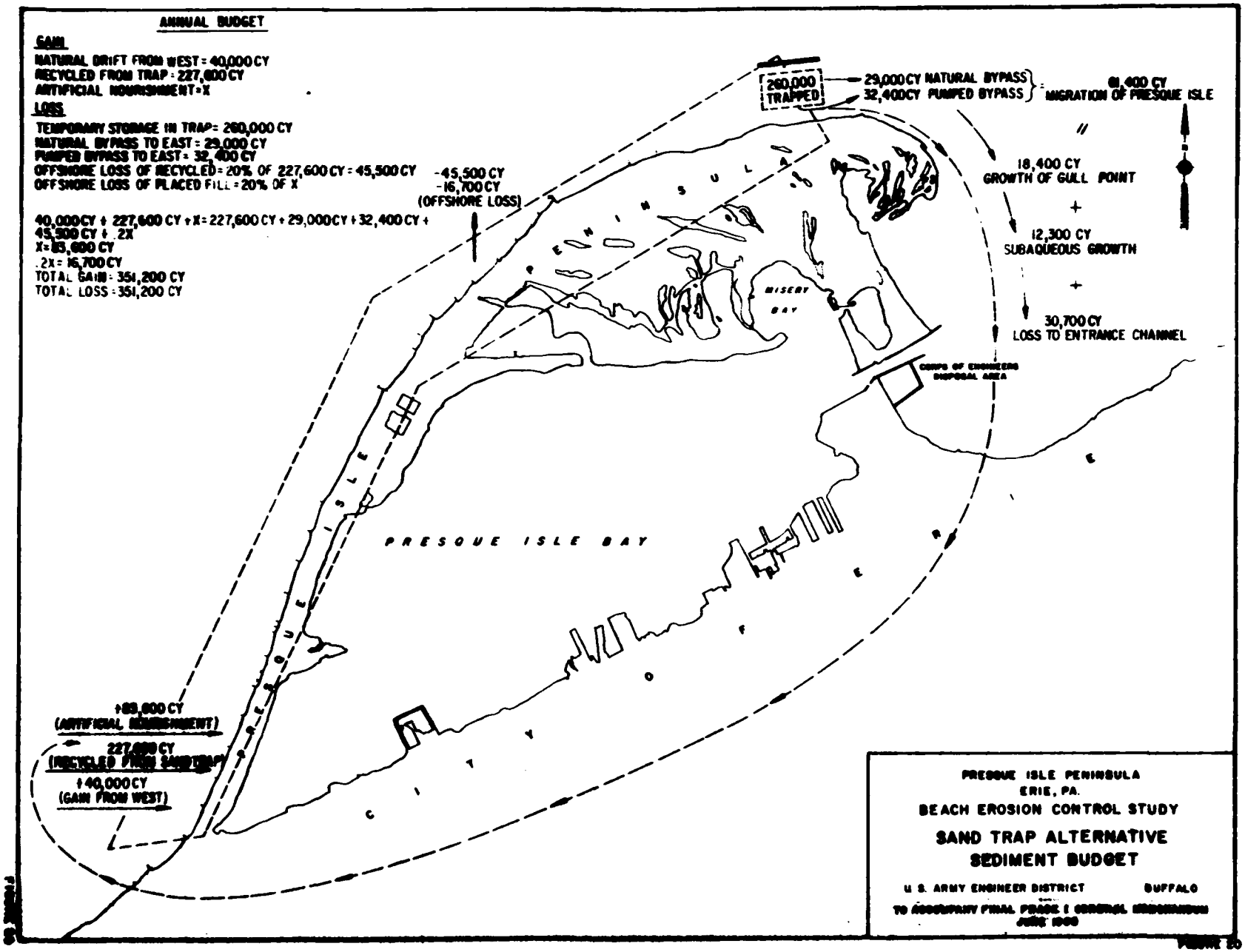
ANNUAL BUDGET
GAIN
NATURAL DRIFT FROM WEST = 40,000 CY
RECYCLED FROM TRAP = 227,600 CY
ARTIFICIAL NOURISHMENT = X
LOSS
TEMPORARY STORAGE IN TRAP = 260,000 CY
NATURAL BYPASS TO EAST = 29,000 CY
PUMPED BYPASS TO EAST = 32,400 CY
OFFSHORE LOSS OF RECYCLED = 20% OF 227,600 CY = 45,500 CY
OFFSHORE LOSS OF PLACED FILL = 20% OF X
40,000 CY + 227,600 CY + X = 227,600 CY + 29,000 CY + 32,400 CY + 45,500 CY + .2X
X = 83,600 CY
.2X = 16,700 CY
TOTAL GAIN = 351,200 CY
TOTAL LOSS = 351,200 CY
-45,500 CY
-16,700 CY
(OFFSHORE LOSS)
260,000 TRAPPED
29,000 CY NATURAL BYPASS
32,400 CY PUMPED BYPASS
61,400 CY
MIGRATION OF PRESQUE ISLE
18,400 CY
GROWTH OF GULL POINT
12,300 CY
SUBAQUEOUS GROWTH
30,700 CY
LOSS TO ENTRANCE CHANNEL
CORPS OF ENGINEERS DISPOSAL AREA
PENINSULA
MISERY BAY
PRESQUE ISLE
PRESQUE ISLE BAY
CITY OF ERIE
+83,600 CY
(ARTIFICIAL NOURISHMENT)
227,600 CY
(RECYCLED FROM SANDTRAP)
+40,000 CY
(GAIN FROM WEST)
PRESQUE ISLE PENINSULA
ERIE, PA.
BEACH EROSION CONTROL STUDY
SAND TRAP ALTERNATIVE
SEDIMENT BUDGET
U. S. ARMY ENGINEER DISTRICT BUFFALO
TO ACCOMPANY FINAL PHASE I GENERAL MEMORANDUM
JUNE 1969

FIGURE 20

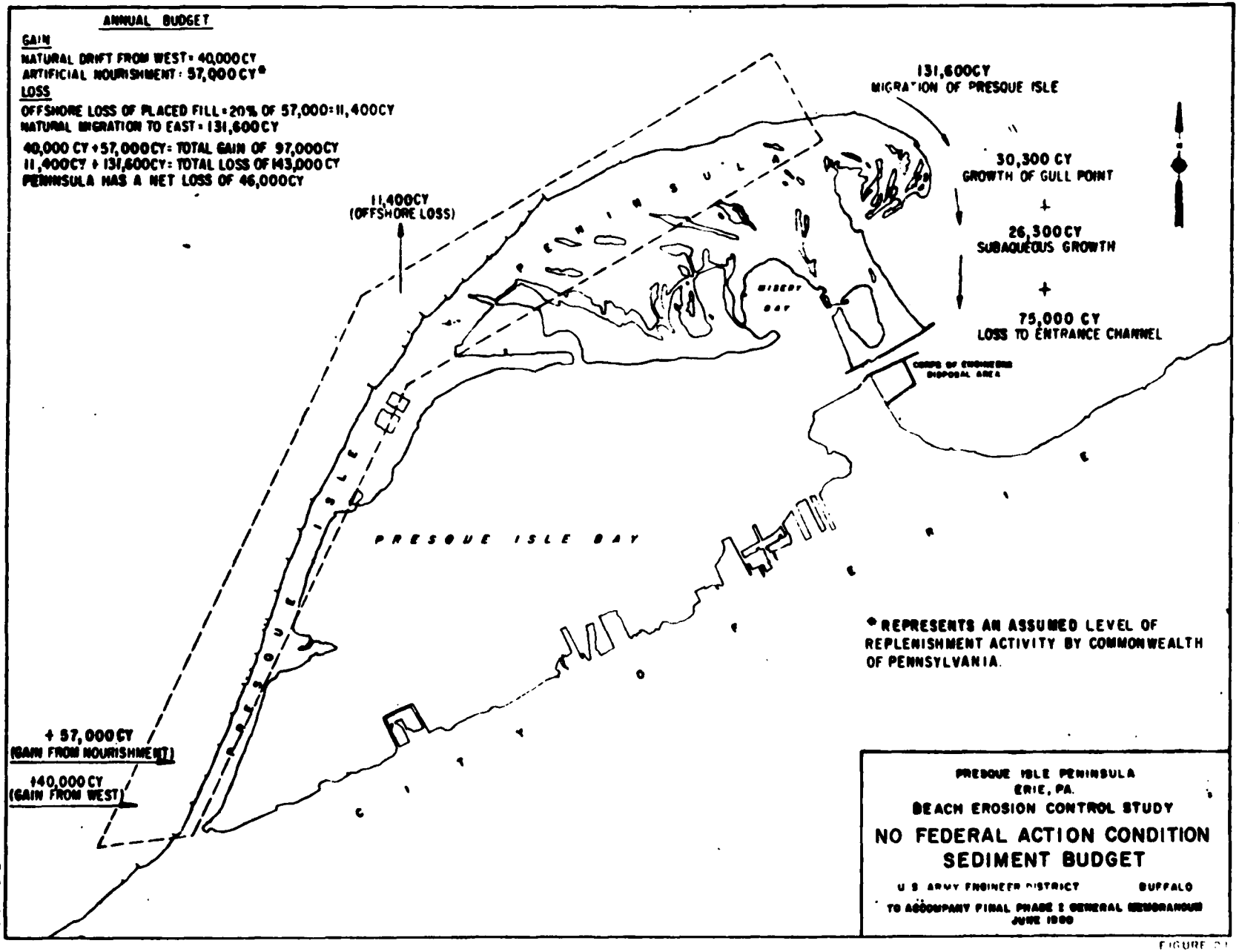

FIGURE 21

FIGURE 21
REVISED NOVEMBER 1980

Since land-based equipment would be utilized in the implementation of the groin plan, construction would cause considerable disruption of terrestrial vegetation. Considerable amounts of turbidity would be unavoidably created during groin construction and beach replenishment operations. Air quality in the project area would be affected by dust, noise, odors, and vehicle emissions from the operation of construction equipment. These water and air quality impacts would be high-magnitude, short-term impacts and would disappear soon after construction and beach replenishment is completed. Construction noise would be especially intense during installation of the steel sheet piling with the pile driver. Once the groin plan is constructed, adequate protection for the recreational resources at Presque Isle State Park would be achieved and the extent and permanence of the existing beaches would be enhanced. The aesthetic effects of the enhanced beaches would be desirable to most people, however, the presence of groins would represent an unsightly departure from an undisturbed beachline. The natural wave action desired by bathers would remain as would an uninterrupted view of the lake. The groins would also provide positive effects upon fish resources as the increased stable surface area and protected niches between pieces of armor stone would support food organisms and comprise protected nesting and spawning areas.

The primary intent of a groin system is to reduce the rate of longshore transport out of an area by compartmentalization of the beach. However, groins tend to increase offshore losses of material and do not diminish incoming wave energy, therefore, about 145,000 cubic yards of littoral material can be expected to be naturally bypassed each year to maintain continued growth at the distal east end of the peninsula. About 73,000 cubic yards of this quantity of littoral material reaching the east end of the peninsula will be deposited in the entrance channel to Erie Harbor while the remaining 72,000 cubic yards is deposited in the Gull Point area to maintain continued growth of the peninsula.

In order for the groin plan to provide adequate protection to the recreational resources at Presque Isle State Park, an average annual beach replenishment requirement of 130,700 cubic yards of sand fill must be incorporated. This annual replenishment operation would be undertaken prior to or immediately after the bathing season. To accomplish this work, land-based earth moving equipment consisting of dump trucks, front-end loaders, and bulldozers would be utilized to haul and spread sand fill on the eroded beaches. Turbidity would be created during placement of the fill in the water and some noise and dust will occur due to the operation of equipment. The impacts caused by the annual nourishment operations would be temporary.

Segmented Breakwaters with Periodic Beach Nourishment

The segmented breakwater alternative consists of constructing 58 rubblemound breakwaters and placement of 500,000 cubic yards of sand fill along approximately 30,000 feet of peninsula shoreline. In addition, an average annual replenishment of 37,900 cubic yards of sand fill is needed to maintain the required beach dimensions. Construction of the segmented breakwaters would be accomplished with marine plant consisting of cranes on barges, scows, and tug boats whereas placement of sand fill would require land plant consisting of dump trucks, front-end loaders, and bulldozers. Construction of the

segmented breakwater plan would most likely take about 20 months to complete and extend through two construction seasons.

The construction procedure that would probably be followed is to use derrick boats to place the bedding stone, underlayer stone, and armor stone which would be transported to the site on scows towed by tug boats. Placement of the bedding stone and underlayer stone would be accomplished utilizing a crane equipped with a clam bucket; placement of the armor stone would be accomplished utilizing a crane equipped with rock grapples. Breakwater construction would start at the east end of the peninsula and proceed towards the west. As the breakwater segments are completed, sand that is truck hauled to the site can be spread in the lee of the structures to provide the design beach dimensions.

Land-based equipment would be utilized during beach replenishment operations and would cause disruption of some terrestrial vegetation, however, the impacts would be minimal. The offshore ecosystem would be affected by the construction of the breakwaters but because the lake bottom in the area where the breakwaters would be constructed is constantly changing due to wave induced currents and littoral transport, the benthic habitat is relatively poor. Therefore, it is likely that direct disruptive effects upon benthic production caused by construction of the breakwaters will be minimal. Considerable amounts of turbidity would be unavoidably created during breakwater construction and beach replenishment operations. Air quality in the project area would be affected by dust, noise, odors, and vehicle emissions from the operation of construction equipment. These water and air quality impacts would be low magnitude, short-term impacts and would disappear soon after construction and beach replenishment is completed.

Once the segmented breakwater plan is constructed, adequate protection for the recreational resources at Presque Isle State Park would be achieved and the extent and permanence of the existing beaches would be enhanced. The aesthetic effects of the enhanced beaches would be desirable to most people, however, the presence of a breakwater system along the shoreline would have some unattractive aspects. The natural wave action of the lake would occur only in the gaps between breakwater segments and the visual appearance of the breakwaters would represent a departure from the natural view of Lake Erie. Preliminary results of a bacteriological study undertaken in the vicinity of the prototype breakwaters at Beach No. 10 indicate that there would be no significant degradation on water quality. The gaps between the breakwater segments would provide sufficient water circulation.

The long-term effects on aquatic diversity and productivity would be favorable. The stone used in construction of the breakwaters would provide a good stable habitat for benthic organisms and forage fish and also good spawning habitat for certain game fish.

The primary effect of the breakwaters would be to dissipate wave energy and reduce the littoral transport along the peninsula thereby retarding erosion and the transport of sand to the eastern end of the peninsula. The effect of the breakwaters on shore processes would be accretion of sand behind the

breakwaters and reduction of peninsula migration. With the segmented breakwater alternative, about 72,000 cubic yards of littoral material can be expected to be naturally bypassed each year to maintain continued growth at the distal east end of the peninsula. About 37,000 cubic yards of this quantity of littoral material reaching the east end of the peninsula will be deposited in the entrance channel to Erie Harbor while the remaining 35,000 cubic yards is deposited in the Gull Point area to maintain continued growth of the peninsula.

In order for the segmented breakwater plan to provide adequate protection to the recreational resources at Presque Isle State Park, an average annual beach replenishment requirement of 38,000 cubic yards of sand fill must be incorporated. This operation would be undertaken prior to or immediately after the bathing season. To accomplish this work, land-based earth moving equipment consisting of dump trucks, front-end loaders, and bulldozers would be utilized to haul and spread sand fill on the eroded beaches. Turbidity would be created during placement of the fill in the water and some noise and dust will occur due to the operation of the equipment. The impacts caused by the annual nourishment operations would be temporary.

Sand Trap Recirculation With Periodic Nourishment

The sand trap recirculation alternative consists of constructing one 2,000-foot long breakwater located offshore from Sunset Point, a 29,000-foot long permanent 20-inch diameter pipeline with three booster stations, and a sand trap with a 270,000 cubic yard capacity. An initial beach replenishment of 500,000 cubic yards of sand fill will be spread along 30,000 feet of shoreline and an additional 344,000 cubic yards of sand fill will be needed each year to maintain the required beach dimensions. Construction of the breakwater would be accomplished with marine plant consisting of cranes on barges, scows, and tug boats. The pipeline and booster stations would be constructed using land plant consisting of cranes, trucks, bulldozers, and front-end loaders. Placement of the sand fill will require a hydraulic dredge to transfer sand from the trap to the pipeline and land plant consisting of dump trucks, front-end loaders, and bulldozers. Construction of the sand trap recirculation plan would probably take about 20 months to complete and extend through two construction seasons.

The construction procedure that would probably be followed is to use derrick boats to place the core stone, underlayer stone, and armor stone which would be transported to the site on scows towed by tug boats. Placement of the core stone and underlayer stone would be accomplished utilizing a crane equipped with a clam bucket; placement of the armor stone would be accomplished utilizing a crane equipped with rock grapples. Construction of the booster stations and pipeline along the road running parallel to the peninsula shoreline would be accomplished concurrently with the construction of the breakwater. Beach replenishment operations would be initiated once the breakwater and pipeline are completed. A hydraulic dredge would be used to excavate the sand trap in the lee of the breakwater and transfer 270,000 cubic yards of sand to the pipeline through which the sand will be pumped to the beaches and spread along the shore. About 230,000 cubic yards of sand

will also be truck hauled to the site and spread along the neck of the peninsula.

Land-based equipment that would be used to construct the pipeline and booster stations and spread the sand during replenishment operations would cause considerable disruption of terrestrial vegetation. The offshore ecosystem would be affected by the construction of the 2,000-foot long breakwater, however, the direct disruptive effects upon benthic production will be minimal due to poor benthic habitat presently existing in the project area. Considerable amounts of turbidity would be unavoidably created during breakwater construction, excavation of the sand trap, and beach replenishment operations. Air quality in the project area would be affected by dust, noise, odors, and vehicle emissions from the operation of construction equipment. These water and air quality impacts would be low magnitude, short-term impacts and would disappear soon after construction and replenishment is completed.

Once the sand trap recirculation plan is implemented, adequate protection for the recreational resources at Presque Isle State Park would be achieved and the extent and permanence of the existing beaches would be enhanced. The aesthetic effects of the enhanced beaches would be desirable to most people, however, the presence of a 2,000-foot long breakwater and a pipeline running along the entire length of the peninsula from Sunset Point to the western end would have some unattractive aspects. The sand trap plan would have a minimal impact on natural currents and circulation of water in the offshore zone. The breakwater offshore from Sunset Point would block the view of the open-lake over a relatively small section of shore and may be aesthetically displeasing to some. The continuous pipeline which would lie directly on the ground would be visible and could be considered as an eyesore by park visitors.

The long-term effects of the sand trap plan on aquatic diversity and productivity would be favorable. The breakwater would contribute to the fisheries resource by providing substrate for food organisms and protected niches for spawning and nesting.

The primary intent of the sand trap breakwater is to act as a littoral barrier which would trap the littoral material that naturally moves eastward towards the distal east end of the peninsula so it can be recirculated to the eroded beaches. The effect of the breakwater on shore processes would be accretion of sand in the trap behind the breakwater and reduction of peninsula migration. With this plan, the features which render the Ecological Reservation at Gull Point environmentally valuable could be threatened. With the sand trap recirculation plan, about 29,000 cubic yards of littoral material can be expected to naturally bypass the sand trap each year and 32,400 cubic yards will be pumped eastward from the trap to maintain continued growth at the distal east end of the peninsula. About 31,000 cubic yards of this quantity of material reaching the east end of the peninsula will be deposited in the entrance channel to Erie Harbor while the remaining 30,000 cubic yards is deposited in the Gull Point area to maintain continued growth of the peninsula.

In order for the sand trap recirculation plan to provide adequate protection to the recreational resources at Presque Isle State Park, an average annual beach replenishment requirement of 312,000 cubic yards of sand fill must be incorporated (228,000 cubic yards pumped from the sand trap onto the beaches to the west of the breakwater and 84,000 cubic yards of sand brought in from an outside source). In addition, 32,000 cubic yards will be pumped from the sand trap towards the east to maintain growth at Gull Point. This annual beach replenishment operation would be undertaken prior to or immediately after the bathing season. To accomplish this work, a hydraulic dredge would be used to transfer the sand from the trap to the pipeline for direct placement on the beaches. The sand from outside sources would be hauled to the site in dump trucks. Land-based equipment consisting of front-end loaders and bulldozers would be used to spread the sand on the eroded beaches. Turbidity would be created during excavation of sand from the trap by the hydraulic dredge, during deposition of the sand slurry from the pipeline onto the beaches, and during placement of truck hauled sand in the water along eroded beaches. Some noise and dust will also occur due to the operation of equipment. The impacts caused by the annual nourishment operations would be temporary.

No Action Plan

With the No Action alternative, no new structural features would be implemented, however, it is assumed that the Commonwealth of Pennsylvania would undertake a minor level of annual beach nourishment to maintain public access to the peninsula and protect the developed park facilities. As a result of this annual maintenance, the area extent of the May 1972 beaches would be preserved. The resulting beaches would be steep, sloping foreshore dominated with a low narrow back beach. It was estimated that approximately 57,000 cubic yards would have to be placed annually to maintain the 1972 beach areas. The annual nourishment quantity would not be sufficient to maintain the crest elevation and width of the back beach to prevent wave overtopping and erosion of the back shore. There would be no additional structures to interrupt the shoreline. The surf would be uninterrupted and a clear view of the open lake would be maintained. Since wave overtopping of the back beach would not be prevented, immediate impacts would be erosion of the backshore and dunes which would cause trees to fall and the loss of ground vegetation resulting in debris littered beaches. The wave overtopping would also cause periodic disruption to park use and access as roads would be frequently closed due to flooding and debris deposits. The continuous pounding of storm waves on the peninsula would cause eventual destruction of existing shore protection structures.

The annual placement of 57,000 cubic yards of sand fill by the Commonwealth of Pennsylvania would be accomplished with land plant consisting of dump trucks, front-end loaders, and bulldozers. The work would most likely take about 2 to 4 weeks to complete and would be accomplished prior to or immediately after the bathing season.

Land-based equipment that would be utilized during beach replenishment operations would cause disruption of some terrestrial vegetation, however, the impacts would be minimal. Considerable amounts of turbidity would be unavoidably created during beach replenishment operations. Air quality in the project area would be affected by dust, noise, odors, and vehicle emissions from the operation of construction equipment. These water and air quality impacts would be low magnitude, short-term impacts, and would disappear soon after beach replenishment is completed.

With the No Action Plan, about 132,000 cubic yards of littoral material can be expected to be naturally bypassed each year to maintain continued growth at the distal east end of the peninsula. About 75,000 cubic yards of this quantity of littoral material reaching the east end of the peninsula will be deposited in the entrance channel to Erie Harbor while the remaining 57,000 cubic yards is deposited in the Gull Point area to maintain continued growth of the peninsula.

IMPLEMENTATION RESPONSIBILITIES

This section presents information on the economic costs attributable to the three refined alternatives for beach erosion control at Presque Isle Peninsula in Erie, PA. Topics to be covered include estimates of first cost, average annual charges, project cost allocations, apportionment of project first costs, and apportionment of annual operation and maintenance costs.

First Costs

Construction costs were based upon quantity computations for the breakwater, groin, and pipeline features of the various alternatives. The quantity

estimates for beach replenishment are based upon computations utilizing the topographic and hydrographic survey data obtained during the summer of 1979. The unit prices are at October 1980 price levels (based on a projected ENR construction cost index of 3,400) and were derived from current and similar construction bid information. An appropriate contingency allowance was applied to the construction cost. Engineering and Design costs were determined by application of the appropriate percentage factor derived from the 11 January 1974 OCE curves relating Government cost to construction costs. The Supervision and Administration costs were determined by application of a percentage factor derived from the actual S&I costs expended through fiscal year 1979 for 5 years of nourishment at Presque Isle Peninsula as authorized by the 1974 Water Resources Development Act, plus the appropriate rates of overhead for engineering and design and construction activities. In accordance with EC 1105-2-83, the cost of the Phase I General Design Memorandum stage of Advanced Engineering and Design for projects under the two-phase authorization shall be 100 percent Federal and shall be excluded from the benefit/cost ratio and cost allocations. Therefore, the estimates of first cost presented in this report do not include $696,000 for engineering and design, $113,000 for supervision and administration, and $241,000 for a model study which are the funds required to complete the Phase I design memorandum study effort. Tables 7 through 9 present the details of the estimates of first cost for the alternatives considered in Stage 3 planning.

Annual Charges

The annual costs are the annual charges on the initial investment plus project operation and maintenance costs. Since the initial construction period is less than 24 months, there is no allowance for interest during construction included in the annual costs. The interest and amortization charges on the initial investment are estimated at the current 7-3/8 percent interest rate and a 50-year project life. The project operation costs consist of the cost for the annual replenishment required to maintain the beaches at a berm width of 60 feet and crest elevation of 10 feet above low water datum. The project maintenance costs include the annual charges for repairing and/or replacing the permanent structural features of the alternatives and are based upon past experience for similar maintenance work done in Buffalo District. The estimated annual charges for the alternatives considered in Stage 3 planning are presented in Table 10.

Cost Allocation and Apportionment of Costs

The objective of the cost allocation is to divide the project costs among the major features of each alternative in order that each feature will carry its separable cost. Tables 11 through 13 present the cost allocation of the project first costs divided among the major features for each alternative.

Apportionment of project costs is the division or sharing of project costs among agencies that will pay for the project. The Commonwealth of Pennsylvania has indicated that the Pennsylvania Department of Environmental Resources will be the agency that will act as the local cooperator for the beach erosion control project at Presque Isle Peninsula. The amount of the local (non-Federal) cooperation involved, both monetary and nonmonetary, is

Table 7 - Estimate of First Cost - Groin Alternative

Item	Estimated Quantity	Unit	Unit Price	Estimated Amount	Total Item Cost
			$	$	$
New Groins (37 each)					
Armor Stone (3.0-7.0 ton)	40,700	Ton	35.00	1,424,500	
Armor Stone (1.0-2.5 ton)	39,100	Ton	38.00	1,485,800	
Prot. Pad Stone (400-1,400 pounds)	22,600	Ton	31.00	700,600	
Prot. Pad Stone (150-500 pounds)	30,800	Ton	34.00	1,047,200	
Filter Cloth	921,300	SF	0.65	598,845	
Steel Sheet Piling (PMA 22)	222,000	SF	12.00	2,664,000	
Excavation	55,500	CY	2.90	160,950	
Contingencies at 15 percent ±				1,218,105	
TOTAL					9,300,000
Modified Groins (11 each)					
Armor Stone (3.0-7.0 ton)	12,100	Ton	35.00	423,500	
Armor Stone (1.0-2.5 ton)	11,600	Ton	38.00	440,800	
Prot. Pad Stone (400-1,400 pounds)	6,700	Ton	31.00	207,700	
Prot. Pad Stone (150-500 pounds)	9,200	Ton	34.00	312,800	
Filter Cloth	273,900	SF	0.65	178,035	
Excavation	15,000	CY	2.90	43,500	
Contingencies at 15 percent ±				293,665	
TOTAL					1,900,000
Beach Replenishment					
Initial Beachfill	1,285,200	Ton	5.00	6,426,000	
Contingencies at 15 percent ±				974,000	
TOTAL					7,400,000
Engineering and Design					850,000
Supervision and Administration					650,000
Total Project First Cost					20,100,000

Table 8 - Estimate of First Cost - Segmented Breakwater Alternative

Item	Estimated Quantity	Unit	Unit Price	Estimated Amount	Total Item Cost
			$	$	$
Breakwaters (58 each)					
Armor Stone (4-10 ton)	221,200	Ton	35.00	7,742,000	
Underlayer Stone (500-2,000 pounds)	136,800	Ton	31.00	4,240,800	
Bedding Stone (5-100 pounds)	97,500	Ton	25.00	2,437,500	
Contingencies at 15 percent ±				2,179,700	
TOTAL					16,600,000
Beach Replenishment					
Initial Beachfill	756,000	Ton	5.00	3,780,000	
Contingencies at 15 percent ±				620,000	
TOTAL					4,400,000
Engineering and Design					1,050,000
Supervision and Administration					750,000
Total Project First Cost					22,800,000

Table 9 - Estimate of First Cost - Sand Trap Recirculation Alternative

Item	Estimated Quantity	Unit	Unit Price	Estimated Amount	Total Item Cost
			$	$	$
Breakwaters					
Armor Stone (11-25 ton)	90,000	Ton	41.00	3,690,000	
Underlayer Stone (0.5-2.5 ton)	20,000	Ton	38.00	760,000	
Core Stone (3-250 pounds)	41,100	Ton	26.00	1,068,600	
Contingencies at 15 percent ±				881,400	
TOTAL					6,400,000
Pipeline and Boosters					
Permanent 20-inch Pipeline with Appurtenances	29,000	LF	190.00	5,510,000	
Permanent Booster Stations	3	EA	765,000	2,295,000	
Booster Station Housing	3	EA	11,800	35,400	
Contingencies at 15 percent ±				1,159,600	
TOTAL					9,000,000
Beach Replenishment					
Initial Beachfill Pumped from Sand Trap	270,000	CY	8.00	2,160,000	
Initial Beachfill Truck Hauled to Site	347,800	Ton	5.00	1,739,000	
Contingencies at 15 percent ±				601,000	
TOTAL					4,500,000
Engineering and Design					1,000,000
Supervision and Administration					700,000
Total Project First Cost					21,600,000

Table 10 - Estimated Annual Charges

Alternative / Type of Cost -	Groins	Segmented Breakwaters	Sand Trap Recirculation	No Action
Economic Investment				
Financial Cost, Initial Construction	20,100,000	22,800,000	21,600,000	-
Interest During Construction		-	-	-
Total Economic Investment	20,100,000	22,800,000	21,600,000	-
Annual Charges				
Interest and Amortization at 7-3/8 Percent	1,526,000	1,731,000	1,640,000	-
Annual Replenishment	1,280,000	370,000	3,515,000	560,000
Annual Maintenance	10,000	50,000	25,000	123,000
Total Annual Charges	2,816,000	2,151,000	5,180,000	683,000

Table 11 - Cost Allocation and Cost Apportionment of Project First Cost - Groin Alternative

Feature	Cost Allocation	Apportionment Based on 70%-30% Traditional Cost-Sharing Policy		Apportionment Based on President Carter's Proposed Revised Cost-Sharing Policy at 65%-35%	
		Federal	Non-Federal	Federal	Non-Federal
	$	$	$	$	$
Groins	11,200,000	7,840,000	3,360,000	7,280,000	3,920,000
Beach Replenishment	7,400,000	5,180,000	2,220,000	4,810,000	2,590,000
Engineering and Design	850,000	595,000	255,000	552,500	297,500
Supervision and Administration	650,000	455,000	195,000	422,500	227,500
Total Project Cost	20,100,000	14,070,000	6,030,000	13,065,000	7,035,000

Table 12 - Cost Allocation and Cost Apportionment of Project First Cost - Segmented Breakwater Alternative

Feature	Cost Allocation	Apportionment Based on 70%-30% Traditional Cost-Sharing Policy		Apportionment Based on President Carter's Proposed Revised Cost-Sharing Policy at 65%-35%	
		Federal	Non-Federal	Federal	Non-Federal
	$	$	$	$	$
Breakwaters	16,600,000	11,620,000	4,980,000	10,790,000	5,810,000
Beach Replenishment	4,400,000	3,080,000	1,320,000	2,860,000	1,540,000
Engineering and Design	1,050,000	735,000	315,000	682,500	367,500
Supervision and Administration	750,000	525,000	225,000	487,500	262,500
Total Project Cost	22,800,000	15,960,000	6,840,000	14,820,000	7,980,000

Table 13 - Cost Allocation and Cost Apportionment of Project First Cost - Sand Trap Recirculation Alternative

Feature	Cost Allocation	Apportionment Based on 70%-30% Traditional Cost-Sharing Policy		Apportionment Based on President Carter's Proposed Revised Cost-Sharing Policy at 65%-35%	
		Federal	Non-Federal	Federal	Non-Federal
	$	$	$	$	$
Breakwaters	6,400,000	4,480,000	1,920,000	4,160,000	2,240,000
Pipeline and Boosters	9,000,000	6,300,000	2,700,000	5,850,000	3,150,000
Beach Replenishment	4,500,000	3,150,000	1,350,000	2,925,000	1,575,000
Engineering and Design	1,000,000	700,000	300,000	650,000	350,000
Supervision and Administration	700,000	490,000	210,000	455,000	245,000
Total Project Cost	21,600,000	15,120,000	6,480,000	14,040,000	7,560,000

dependent upon the nature of the project and the general and specific laws pertinent thereto. As discussed in the cost-sharing topic in the paragraph entitled Other Considerations for a Possible Plan of Improvement in Section C of this report, Presque Isle Peninsula meets all the requirements applicable to parks and conservation areas and qualifies for Federal participation of up to 70 percent of the project first costs. Therefore, the apportionment of project construction costs will be based on the traditional cost-sharing policy for beach erosion control projects which is 70 percent Federal and 30 percent non-Federal. Tables 11 through 13 present the apportionment of the project costs among the major features for each alternative based on traditional cost-sharing (70 percent Federal/30 percent non-Federal).

Also displayed in Tables 11 through 13, as required by EC 1105-2-99, is the apportionment of project first costs based on President Carter's proposed revised cost-sharing legislation which was previously discussed in the cost-sharing topic in the paragraph entitled Other Considerations for a Possible Plan of Improvement in Section C. Based on the President's proposed cost-sharing policy, the Federal share would be 65 percent and the non-Federal share would be 35 percent.

Federal Responsibilities

The Federal Government would be responsible for providing the Federal share of the final construction cost and for carrying out the initial construction activities for the plan of improvement. In addition, the Federal Government will reimburse the Commonwealth of Pennsylvania 70 percent of the cost for annual beach replenishment operations carried out over the 50-year life of the project. With the No Action alternative, the Federal Government would not participate in protection or improvement of Presque Isle. The No Action Plan avoids all Federal monetary investments.

Non-Federal Responsibilities

There are no provisions under existing beach erosion control laws which provide for Federal contributions toward project maintenance of beach erosion control structures. Therefore, the Commonwealth of Pennsylvania, in addition to funding their share of the final construction costs, will be responsible for funding 30 percent of the annual beach replenishment costs and 100 percent of the annual maintenance costs for the structural features. The Commonwealth of Pennsylvania would be responsible for carrying out the actual maintenance and annual beach replenishment activities for the plan of improvement. With the No Action Plan, the Commonwealth of Pennsylvania would be responsible for 100 percent of the annual beach replenishment costs necessary to maintain the 1972 beach area. Table 14 presents the apportionment of the annual costs for beach replenishment and maintenance for each alternative considered.

Table 14 - Apportionment of Annual Operation and Maintenance Costs

Alternative	Federal	Non-Federal	Total Annual O&M Cost
	$	$	$
Groins	896,000	394,000	1,290,000
Segmented Breakwaters	259,000	161,000	420,000
Sand Trap Recirculation	2,460,500	1,079,500	3,540,000
No Action	-	683,000	683,000

EVALUATION AND TRADE-OFF ANALYSIS

In this section of the report, the Buffalo District compares and evaluates the Stage 3 beach erosion control alternatives on the basis of their ability to satisfy the planning objectives established in Section B, the general formulation and evaluation criteria established in Section C, and their potential environmental impact discussed earlier in this section of the report.

Fulfillment of Planning Objectives

Objective 1 - Provide the required protection for preservation of the peninsula and its recreational facilities.

a. The "No Action" plan does not provide for any Federal measures to reduce the severe erosion occurring along the peninsula nor any provisions for restoring the beaches. It is however anticipated that the Commonwealth of Pennsylvania would undertake a minimum level of annual nourishment to maintain public access and protect the developed park facilities. Storm conditions will temporarily disrupt access and park facilities will suffer frequent damage.

b. The structural alternatives were developed such that each plan would restore the eroded beaches and provide permanent protection to the peninsula and its recreational facilities, provided that the annual replenishment requirements for each alternative are implemented. The protection provided by initial construction and annual replenishment would be comparable for each of the three structural plans.

Objective 2 - Preserve and enhance the human environment and aesthetic qualities of the shoreline.

a. The "No Action" plan will result in the gradual destruction of the existing human environment as continuing erosion limits human access, damages the existing recreational facilities, and reduces the size of existing bathing areas to the May 1972 level. Access to the peninsula and use of its recreational facilities may become limited to the summer months as spring and fall storms would frequently overwash the narrow, low relief neck area filling the roads with sand. The constant clearing and maintenance of these roads may not be practical. An indirect effect of the plan will be caused by diminishing peninsula recreational use which will reduce the income of local businesses. The aesthetic appeal of the peninsula and safe use of the beach areas will similarly be compromised as existing relic shore protection works are exposed and battered by wave and ice action, leaving stone, wood, steel sheet pile, and concrete debris in their wake. Although Gull Point will still contain broad beach areas, most of the peninsula shore will experience narrowed beaches and eroding sand bluffs. Mature trees and shrubs will be destroyed and litter the beaches.

b. With each structural plan, there will be a temporary disruption of the human environment due to construction activities. Noise, dust, heavy equipment, and restricted access to the beaches will result from construction of the structures and also during the annual replenishment operations. The breakwater plans (Plans 2 and 3) will involve floating plant construction and thus will not disrupt use of the beach areas as much as Plan 1. Construction activity will effect a slight increase in local business and also create an additional demand on the public service facilities.

c. All structural plans will enhance the extent and permanence of the beaches, thus improving the human and aesthetic environment.

d. Plan 1 (groin alternative) will compartmentalize the beach with rubblemound structures that will interfere with linear beach use. Plan 2 (segmented breakwater alternative) would disrupt the view of the lake and reduce wave action behind the structures. Plan 3 will have the same effect as Plan 2 but only for an isolated area lakeward of Sunset Point. Plan 3, however, would have a permanent, continuous pipeline located parallel to the beach which would have an adverse impact on the human environment.

Objective 3 - Preserve the integrity of the natural environment, especially the sensitive and unique Gull Point portion of the Ecological Reservation on the east end of the peninsula.

a. The "No Action" plan will result in the gradual destruction of the natural environment as erosion rates along the peninsula continue. The Gull Point growth rate will be reduced to a rate which is less than one-half of the present rate. Back beach, dune areas, and beach ridges will disappear as the erosive processes denude them, releasing sand to feed the receding beach line.

b. Some temporary impacts would occur to the wildlife populations and their habitats as a result of construction of the structural plans. These impacts are expected to be of short duration and confined mostly to the immediate project area.

c. Each structural alternative will have some direct negative and positive impacts on the natural environment with various degrees of significance.

(1) The negative impacts include loss of sandy aquatic habitat surface due to construction of the structures and beach replenishment, possible water quality impacts (see Objective 4), and some minor decreases in air quality during construction. The loss of aquatic habitat is primarily due to the sand berm and structures within the active littoral zone. The natural benthic productivity of this area is minimal. Thus, the disruptive effects upon aquatic life caused by construction of Plan 1 or Plan 2 is minor. The sand trap breakwater construction required in Plan 3 is proposed for deeper water which may be beyond the active zone of littoral sand movement where benthic productivity is higher.

(2) Each structural alternative will result in additional aquatic habitat. The rubblemound structures provide stable substrate for increased benthic population and habitat diversity. Plan 2 will create twice as much aquatic habitat as Plan 1 and three times as much as Plan 3. Growth of Gull Point will be greater with Plans 1 and 2 then with the "No Action" plan and Plan 3. The groin and the segmented breakwater alternatives will involve replenishment which will increase the quantity of sand available to continue Gull Point growth. The sand trap breakwater would trap 90 percent of the littoral drift, but Gull Point growth will not be allowed to fall below the "No Action" level as material will be pumped toward the east from the sand trap.

Objective 4 - Prevent degradation of water quality, especially stagnation caused by improper water circulation.

a. Some short-term impacts on water quality would occur during construction of any of the implementable beach erosion plans. There would probably be some unavoidable spilling of fuels, oil, and grease into the water from the operation of both land-based and marine construction and earthmoving equipment. Considerable amounts of turbidity would be unavoidably created during breakwater or groin construction, as well as during the initial and annual beach nourishment operations. This would be a high-magnitude, short-term impact and should disappear soon after construction and/or nourishment is completed.

b. A direct permanent effect on water quality due to implementation of any of the structural alternatives developed in this study would be minimal. Each structural alternative is developed to reduce the alongshore currents to some degree and thus may create localized temporary pockets of calm water. However, the natural wave action and surf-beat will continue to provide sufficient water circulation and flushing action to cause continual exchange of water along the entire peninsula shoreline.

(1) The groin plan will compartmentalize the entire shoreline, however, it does not obstruct the incoming wave action which will generate offshore currents. It is anticipated that a current gyre will develop within each compartment and maintain water circulation such that water quality standards for bathing beaches are not exceeded.

(2) The segmented breakwater plan will reduce one-third of the wave energy reaching the shore. However, as wave approach angle changes, the 350-foot gap between breakwater segments will allow reduced wave action to impinge upon the entire length of the shore. Thus, an alongshore current will be generated in the lee of the breakwater system. In addition, incoming wave energy will create a hydrostatic head behind the breakwater system, thus generating return flows in the gaps between structures and assuring onshore-offshore water exchange. The generation of the alongshore current and return flows will allow sufficient water circulation such that fecal coliform organism density will not exceed the water quality standard for a bathing beach.

(3) The breakwater in the sand trap recirculation plan is located offshore from an area on the peninsula where there is no established recreational beach area. The remaining lake shore perimeter of the peninsula will continue to be subjected to the natural wave action, currents, and surfbeat presently experienced. Therefore, water quality in the beach area would not be any different than what presently exists.

c. Even if the "No Action" plan is implemented, beach nourishment operations by the State will result in short-term impacts on water quality.

d. During extensive calm periods on Lake Erie and with future increased recreational pressure on the beaches, the fecal coliform densities can be expected to increase with each alternative, including "No Action." At those times, water quality will have to be closely monitored and action taken by the Commonwealth of Pennsylvania to safeguard the health of bathers.

Objective 5 - Restore, protect, and enhance the beach areas of the peninsula for use by future generations.

a. The "No Action" plan does not provide for the major recreational needs of the general public for bathing beaches on the Lake Erie side of Presque Isle Peninsula.

b. The three structural alternatives will restore existing beaches to provide recreational beaches with a design berm width of 60 feet extending for about 30,000 feet along the lake shore of the peninsula. These beaches will accommodate present bathing requirements and future recreational usage which is expected to increase.

Objective 6 - Preserve and enhance the natural wildness and beauty of the peninsula.

a. The "No Action" plan will result in the gradual destruction of many of the existing shore protection structures as erosion rates along the peninsula would continue. The minor replenishment activity which the State will find necessary to maintain access and protect the park facilities will still allow the forces of the lake to attack and destroy natural areas of the park. Mature trees, shrubs, and dune environments will be lost. Beaches will be narrow and steep, littered with debris, and dominated by relic shore protective works. The interior environment of the peninsula will continually diminish in size as the shoreline recedes.

b. Each structural alternative would provide beaches with dimensions that are adequate to prevent the forces of the lake from destroying the backshore recreational facilities and forests. There would be some disruption of the wildness of the peninsula during construction of the structures and beaches, as equipment is moved about and some haul roads are built. The disruption would be temporary, and to help mitigate the impacts on soil and vegetation in areas that are disturbed, beautification and restoration measures would be implemented. Disturbed terrain would be planted with herbaceous seed mixtures and/or trees and shrubs adaptable to growing conditions in the area, as needed, to help minimize evidence of construction equipment on disturbed lands.

Objective 7 - Prevent or minimize adverse effects on natural shore processes because the peninsula has a unique geological formation and botanical history.

a. With the "No Action" plan, the natural processes of erosion and deposition would continue, although erosion will progressively dominate more and more of the peninsula. State efforts employed to maintain access to the peninsula will consist of anchoring the neck while the rest of the peninsula

migrates away from its stabilized root. The natural shore processes will be modified as the geomorphic form of the peninsula is stretched into a narrow erosion dominated feature. Beach width would be maintained at the loss of back shore and dunes. The overall peninsula size would decrease through time. Pond and dune genesis and evolution would continue at a slower rate. The eastward migration of Presque Isle would continue at a rate of approximately 131,600 cubic yards per year.

b. The structural plans will preserve Presque Isle Peninsula from the natural erosion processes which would eventually destroy many of the ecological study areas.

(1) The groin plan would compartmentalize the entire shoreline, however, it would not obstruct the incoming wave action and shore processes would continue. The transport of sand to the east end of the peninsula would continue at a rate which is greater than if nothing were to be done.

(2) The segmented breakwater plan will reduce one-third of the wave energy reaching the shore. However, wave energy will pass through the gap between breakwater segments and an alongshore current will be generated in the lee of the breakwater system. Therefore, natural shore processes will continue to transport sand to the east end of the peninsula, in quantities that are only slightly less than if nothing were done.

(3) With the sand trap plan, natural shore processes would continue along the peninsula shoreline from the neck eastward to Sunset Point where the breakwater is located. The breakwater would trap an estimated 90 percent of the littoral material reaching Sunset Point. The remaining 10 percent would continue eastward toward the Gull Point area. The 10 percent which naturally would pass the breakwater is equivalent to about one-third of the quantity that would continue eastward if no action were taken. Therefore, to minimize adverse effects on natural shore processes east of the breakwater, sand would be pumped from the trap in the lee of the breakwater into the littoral system to the east such that continued geological growth would be maintained.

Objective 8 - Minimize the deposition of sand in the entrance channel to Erie Harbor.

a. Beach nourishment operations at Presque Isle have been undertaken periodically through the 1960's and early 1970's and annually since 1975. At present, there is such an increased volume of sand reaching the distal east end of the peninsula due to the current annual nourishment program, that much of the material is building up in the offshore zones and increasing the shoaling in the entrance channel to Erie Harbor. This volume of sand is reaching the distal end of the peninsula at a faster rate than wave action from the northeast through east is able to recurve the sand spit back onto the beach face. As a result, there is a greater volume of offshore sand losses and lakeward movement of the sand into deeper water including the entrance channel to Erie Harbor. Under present conditions, it is estimated that 146,000 cubic yards of sand is lost to the entrance channel each year.

b. Each alternative considered in Stage 3 Planning, including the "No Action" plan, will result in lesser quantities of sand deposition in the

entrance channel to Erie Harbor than what is presently being experienced. The loss of littoral material from Presque Isle to the Erie Harbor entrance channel with the No Action alternative is estimated at 75,000 cubic yards annually.

c. Each of the structural alternatives influence littoral drift rates with a different efficiency.

(1) The Groin alternative would be efficient in retaining 50 percent of the total annual rate of longshore transport and would permit an estimated 73,200 cubic yards of material to be transported around Gull Point and deposited in the entrance channel to Erie Harbor each year.

(2) The segmented breakwaters will dissipate wave energy before it reaches the shore, and it is estimated that the breakwater system will be 75 percent effective in reducing the total annual rate of longshore transport. Therefore, about 36,600 cubic yards of sand will continue around Gull Point and be deposited in the entrance channel to Erie Harbor each year.

(3) It is anticipated that the breakwater in the sand trap plan will be 90 percent effective in reducing the total annual rate of longshore transport. However, to allow continued growth at the distal end of the peninsula, it would be necessary to pump some sand eastward from the trap. The combination of the sand which naturally bypasses the sand trap and that which is pumped eastward, will result in an annual loss of about 30,700 cubic yards to the entrance channel to Erie Harbor.

Objective 9 - Provide for sand to be bypassed to the east end of the peninsula to provide for continued growth.

a. With the "No Action" plan, the natural processes of erosion and deposition would not be interrupted but would be modified due to the minor quantities of sand added to the system by the State. Sand would continue to move along the peninsula shoreline to the east end of the peninsula. An estimated 131,600 cubic yards of littoral material will be transported to the east end of the peninsula each year.

b. The groin and segmented breakwater plans provide sufficient quantities of sand to be bypassed naturally to the east end of the peninsula each year (i.e., 144,500 cubic yards and 72,250 cubic yards, respectively). The sand trap recirculation plan would provide 29,000 cubic yards of littoral material to naturally bypass the sand trap each year. The 29,000 cubic yards would probably not be sufficient to maintain continued geological growth at the east end of the peninsula without having adverse impacts. Therefore, as a mitigative measure, an additional 32,400 cubic yards of littoral material would be bypassed to the east end of the peninsula by pumping sand from the trap.

Objective 10 - Prevent future breaching of the neck of the peninsula.

a. If the "No Action" plan were carried out, the natural processes of erosion and deposition would not be interrupted. The existing shore protection structures will eventually fail but nourishment activity by the State and possibly construction of new shore protective works will prohibit breaching of the neck.

b. The three structural plans were developed such that each plan would restore and maintain the eroded beaches and prevent future breaches provided that the annual replenishment requirements for each alternative are implemented.

Objective 11 - Insure a protected harbor.

a. The position of Presque Isle Peninsula makes Erie Harbor one of the finest natural harbors on the Great Lakes because of the protection afforded by the peninsula. If the "No Action" plan is implemented, the neck of the peninsula would probably be overwashed during severe storms the efficiency of the harbor would be reduced on such occasions because of increased wave action and currents. Dredging costs may increase after those associated with the other alternatives due to a build-up of overwashed sediments in the harbor and as the placed nourishment shoals the entrance channel at a rate higher than that associated with the structural alternatives.

b. The structural alternatives were developed such that each plan would provide permanent protection to the peninsula provided that the annual replenishment requirements for each alternative are implemented. Therefore, providing permanent protection to the peninsula will also insure a protected harbor.

Objective 12 - Provide for the public safety.

a. Public safety concerns are sure to arise during construction. The construction sequence and schedule will be coordinated with officials of Presque Isle State Park to insure isolation of the construction activity from the public. The Contractor will be required to develop a safety program for the contract period.

b. The "No Action" alternative should not cause an immediate adverse impact on public safety. However, as roadways and support facilities are damaged, park use will become more hazardous. Relic shore protection structures will be uncovered and litter the beaches and swimming areas. The general effect of the "No Action" plan will be to decrease public safety.

c. Any structure placed in the water can be hazardous to recreational boaters, particularly those who venture close to shore in unfamiliar waters. Navigation aids would be placed on the breakwater for Plan 3. The structures in Plans 1 and 2 are in shallow water close to shore and out of the normal boating areas. The possibility of navigation aids was coordinated with the U. S. Coast Guard (see Exhibit F-28 in Appendix F).

d. Of the three structural alternatives, both Plans 1 and 2 may have an adverse impact on bathers. The groins (Plan 1) may appeal to some as attractive areas to climb on. However, the public beaches are well supervised which should limit this dangerous activity. The breakwaters in Plan 2 are being placed in deep enough water (approximately 7 feet of water) that only the more adventuresome bathers will be tempted to explore them. Again, park supervision will be an important element in maintaining public safety.

Objective 13 - Minimize the use of energy.

Annual energy use will be required in order to carry on the replenishment and recirculation operations necessary to maintain Plans 1, 2, and 3. The mining of sand, shipment to the peninsula, and placement on the beaches will require petroleum products to operate the necessary equipment. Plan 2 (segmented breakwaters) will require the least annual energy use of the structural alternatives as it involves the lowest annual replenishment quantities. Plan 1 requires the annual placement of over three times as much sand and will therefore require that much more energy. Plan 3 involves the greatest commitment of our national energy reserves in order to replenish the beaches and recycle sand from the trap through a series of pumps. Almost one hundred times as much sand will have to be moved with Plan 3 as with Plan 2.

The "No Action" alternative would require annual energy use as State activities involve beach replenishment activities. In addition the road clearing and facilities maintenance activities will consume large quantities of energy.

Trade-Off Analysis

Three of the four plans considered for in-depth study are structural plans that would provide for the preservation of the peninsula and its recreation facilities from natural erosion. The fourth alternative is the "No Action" alternative which would preserve only selected elements of the peninsula and would not enhance its recreational appeal.

Trade-Off Analysis of "No Action" vs Structural Alternatives

The "No Action" plan would not meet the local and regional demand for recreational use and would result in the continual destruction of a valuable natural resource. It would require a significant, low return, monetary investment by the State, and would result in social and economic losses to the community. Adverse environmental impacts and project induced erosion would not need to be mitigated. The trade-offs for the three structural alternatives would be the converse of those for the "No Action" alternative.

Trade-Offs for the Three Structural Alternatives

Each of the three structural alternatives would provide for a recreational beach, protect the existing facilities, and allow for growth of Gull Point. In devising the three structural plans, primary considerations were project costs, potential adverse environmental impacts, and adverse effects on existing and proposed park facilities.

Plan 1 has the least initial cost but higher annual charges than Plan 2. Plan 3 is the most expensive alternative considering first cost and annual charges, Plan 2 is the least. Plan 1 allows for the highest growth rate for Gull Point and Plan 3 the least. Plan 2 creates the most aquatic habitat while destroying the least. Plan 3 would have a negative aesthetic impact due to the placement of a permanent pipeline whereas Plans 1 and 2 would interrupt the natural contour of the shoreline.

Thus, Plan 2 is the least costly considering the project life and the least environmentally damaging. The social impacts are comparable for each alternative with no significant trade-off involved.

MITIGATION REQUIREMENTS

The proposed cooperative beach erosion control project at Presque Isle is a mitigation project in itself. The incentive for the subject project is due to the pressure of man upon Presque Isle for a stable peninsula with wide beaches. The erosion of Presque Isle has been accelerated by the 150-year effort to anchor the neck, stop migration, and protect the shoreline to the west. As such, the three structural plans incorporate mitigation into the alternative design. The paragraphs entitled Migration of Presque Isle and Sediment Budget of the Presque Isle System in Section B of this report and also paragraph C5 in Appendix C present the concept of Presque Isle as a balanced unit. Any attempt to protect only one portion will cause an imbalance as unprotected areas continue to migrate.

Each of the three structural plans are intended to protect the peninsula from the neck through Beach 10. Gull Point is left unprotected to assume its natural growth pattern. Thus, the main area of mitigative interest is the impact of the alternatives on the natural depositional area, Gull Point. No alternative will maintain the present observed growth rate to Gull Point of 84,900 cubic yards per year (see Figure 14), as this rate is artificially induced by replenishment operations. The do-nothing growth rate is computed at 18,400 cubic yards per year (see Figure 15). Therefore, as long as the alternative maintains a growth rate higher then that expected with the do-nothing alternative, the mitigative purpose of the design is fulfilled. With each alternative, enough artificial fill will be added to the system to maintain a growth rate above 18,400 cubic yards (see Figures 18, 19, and 20). With the Sand Trap Alternative, sediment would actually be pumped to the east to allow a Gull Point growth rate of 18,400 cubic yards per year. The groin alternative is anticipated to allow 42,450 cubic yards of average annual growth while the segmented breakwater alternative would allow 21,200 cubic yards per year. The No Action plan will allow a Gull Point growth rate of 30,300 cubic yards.

An important element of the selected plan will be the operation of a post-construction monitoring program. A major purpose of such a program will be to note the presence of any adverse sediment transport impacts and to document the growth rate of Gull Point. Should adverse impacts arise, the annual replenishment program would be adjusted to provide sand at the immediate east end of Beach No. 10 in order to eliminate, minimize, or ameliorate possible adverse environmental impacts.

PUBLIC VIEWS

The Senators and Congressmen representing the Erie, PA, area, in addition to all Federal and State agencies, the local private clubs and associations, and the general public have been involved in the current cooperative beach erosion control study for Presque Isle Peninsula since authorization of the review study in 1968. As discussed in the public involvement paragraphs in Section A of this report, the Buffalo District Corps of Engineers has kept the public abreast of developments in the study and have provided them with opportunities to express their views and furnish input for incorporation into

the planning process. Responses received from the public are enclosed as Exhibits in Appendix F. The views of the Federal and non-Federal agencies and others are summarized in the following paragraphs.

Views of Federal Agencies

Those Federal agencies whose jurisdiction would extend into implementation of a plan of improvement have been kept informed of developments throughout this study. Several of these agencies acknowledged receipt of project information but offered no comments on any of the plans. The Federal agencies which provided specific comments to any of the potential plans of improvement investigated in this study were the Coastal Engineering Research Center (CERC), the U. S. Fish and Wildlife Service (USF&W), the U.S. Coast Guard, the U.S. Department of Commerce, the U.S. Department of Agriculture, the U.S. Department of the Interior, the Department of Housing and Urban Development (HUD), and the U.S. Environmental Protection Agency (USEPA). CERC provided general comments (see Exhibit F-3 in Appendix F) on the probable effectiveness of each of the viable plans considered. The USF&W, the U.S. Coast Guard, the U.S. Department of Agriculture, the U.S. Department of the Interior, HUD, and the USEPA provided correspondence stating that they have no problem with the selected plan (see Exhibit F-23, F-35, F-39, F-40, F-41, and F-43 in Appendix F). The U.S. Department of Commerce requested to see the comments from the Pennsylvania Coastal Zone Management of the Department of Environmental Resources (Exhibit F-37 in Appendix F) from which there were none received. The U.S. Department of Commerce also suggested construction of a few prototype structures to check the design data and recommended model tests be conducted to develop breakwaters of lesser height (see Exhibit F-38 in Appendix F).

Views of Non-Federal Agencies and Others

The sand replenishment requirements authorized by the 1960 River and Harbor Act were not a complete solution to the erosion problem at Presque Isle Peninsula and far exceeded the estimated requirements. Therefore, the Commonwealth of Pennsylvania expressed a desire that sand replenishment as a method of protection against beach erosion at Presque Isle be revaluated to determine if a more effective method of protection could be developed. In addition, the residents of the city of Erie expressed concern over the high replenishment costs and recurring threat to established facilities including bathhouses, parking areas, highways, and especially the bathing beaches. The Erie residents have repeatedly requested a permanent solution to the erosion problems of the peninsula, thus implying a maintenance-free solution by complete stabilization of the beaches. Another segment of the public is concerned over important changes in the environment and the ecological climate that would occur through elimination of the natural geological growth of the peninsula.

The views of the public have been expressed in coorrespondence and at public meetings. At an alternative's public meeting held during the review stage of this study, the public opinion was overwhelmingly (98 percent) in favor of some sort of project. Fifty percent of those responding were in favor of some type of partial breakwater.

State governmental agencies, namely the Pennsylvania Fish Commission and the Department of Environmental Resources, have both expressed viewpoints whereby they favor the segmented breakwater plan (see Exhibits F-14, F-18, and F-21 in Appendix F). The Pennsylvania Fish Commission feels that the breakwaters would be beneficial toward improving the fish habitat of an area that is now relatively unproductive as a fishery area. The Department of Environmental Resources (DER) feels that the no-action alternative is not an acceptable solution and that installation of the groins along the beaches would be a most objectionable alternative because they are unsightly and would interfere with the safe operation of the beach. The DER opposes the sand trap recirculation plan because they feel that there are serious environmental and maintenance problems involved with that alternative.

SECTION E
COMPARISON OF DETAILED PLANS

Initially a total of 33 concepts were considered as possible solutions for resolving the erosion problem at Presque Isle State Park. Of these, only six were found to be viable methods for controlling erosion and were included in the Stage 1 Planning. Four of these viable methods were structural and two were nonstructural. Upon completion of Stage 2 Planning, these six alternatives were reduced to three structural alternatives primarily because the other three did not meet the national planning objectives to the desired degree of the study. Engineering, economic, and environmental aspects of the three structural plans are discussed in Section D.

COMPARISON OF DETAILED PLANS

A summary of the three structural and one No-Action plan including comparative costs, benefits, economic efficiency, and sediment budgets is presented in Table 15. The results of this table along with Table 16 are incorporated in the selection of the National Economic Development Plan (NED) and the Environmental Quality Plan (EQ) as described in the following sections in order to finally arrive at the Selected Plan.

Table 15 - Comparison of Detailed Plans

Item	Alternatives: Groins	Segmented Breakwaters	Sand Trap Recirculation	No Action
Economic Investment				
First Cost 1/				
	$	$	$	
Federal	13,065,000	14,820,000	14,040,000	-
Non-Federal	7,035,000	7,980,000	7,560,000	-
Total	20,100,000	22,800,000	21,600,000	-
Annual Operation and Maintenance 2/				
Federal	896,000	259,000	2,460,500	-
Non-Federal	394,000	161,000	1,079,500	683,000
Total	1,290,000	420,000	3,540,000	683,000
Total Annual Charges 3/	2,816,000	2,151,000	5,180,000	683,000
Total Annual Benefits	4,256,000	4,319,000	4,329,000	0
Net Annual Benefits 4/	1,440,000	2,168,000	- 851,000	0
B/C Ratio	1.51	2.01	.84	0
Sediment Budget				
Gull Point Growth Rate	42,450 cy/yr	21,200 cy/yr	18,400 cy/yr	30,300 cy/yr
Entrance Channel Collection Rate	73,200 cy/yr	36,600 cy/yr	30,700 cy/yr	75,000 cy/yr
Subaqueous Growth Rate	28,900 cy/yr	14,450 cy/yr	12,300 cy/yr	26,300 cy/yr
Total Peninsula Migration	144,550 cy/yr	72,250 cy/yr	61,400 cy/yr	131,600 cy/yr
Beach Replenishment				
Initial Sandfill Requirement	850,000 cy	500,000 cy	500,000 cy	-
Required Nourishment	130,700 cy	37,900 cy	83,600 cy 5/	57,000

1/ First Cost includes the cost for initial sandfill, structures, engineering and design, and supervision and administration to be shared by Federal and non-Federal interests in the amounts of 65 percent and 35 percent, respectively.

2/ Includes annual replenishment and annual maintenance costs. The Federal share is 70 percent of the replenishment costs. The remaining 30 percent of the annual replenishment costs plus the total maintenance costs for the structures are paid by the non-Federal interests.

3/ Includes interest and amortization on the first cost plus the operation and maintenance costs.

4/ Total Annual Benefits minus Total Annual Charges.

5/ The 83,600 cy/yr is the quantity of sand that must be brought in from an outside source. An additional 260,000 cubic yards of sand per year would be pumped from the sand trap onto the beaches.

RATIONALE FOR DESIGNATION OF NED PLAN

To continue the formulation process, it is necessary to determine which of the alternatives of the Presque Isle beach erosion control project best meets the national planning objectives of the study. This is the purpose of the National Economic Development (NED) Plan which also, most importantly, must maximize net economic benefits.

The three alternative plans listed in Table 16 (System of Accounts) are felt to best meet the planning objectives of the study and are presented by the breakdown of their economic, environmental, and social components. A fourth alternative plan, the No-Action Plan, is also included since this plan is always a possibility even though it does not satisfactorily meet the planning objectives.

Comparison of the benefits of the three structural alternatives shows that they are all very similar since they all provide a major benefit which is restoration of the peninsula beaches and the inherent increase in usage of the park and its facilities. By restoring the peninsula beaches, the alternatives guarantee that one of the finest natural harbors on the Great Lakes will remain functional and maintain its flow of approximately 1,630,000 tons of cargo per year. If the No Action Plan is implemented, the Commonwealth of Pennsylvania would protect their previous investments and somewhat maintain the recreational value of the park however a great deal of economic incentives would undoubtedly be destroyed. The factor that generally determines which alternative will be selected as the NED Plan, depends on what the respective contributions will be to increase the national economic efficiency. The maximation of net benefits (annual benefits minus annual charges) is used to scale the level of development for the National Economic Development (NED) Plan. Using this criteria, it is evident from Table 15 that Plan 2, the Segmented Breakwater Plan, is most inviting with net annual benefits of $2,168,000. This clearly outweighs Plan 1 (Groin Plan) with net annual benefits of $1,440,000, and the Sand Trap Plan with net annual benefits of -$851,000, and the No Action Plan with net annual benefits of $0. An additional benefit that is common to all of the structural plans is that additional employment will be generated for a period of about 2 years.

Based on these findings, it is evident and conclusive that the Segmented Breakwater Plan best satisfies the objectives of the NED Plan. Therefore, the Segmented Breakwater Plan is designated as the NED Plan.

RATIONALE FOR DESIGNATION OF EQ PLAN

Similar to the NED Plan, the EQ Plan (Environmental Quality Plan) must also conform to the planning objectives of the study and at the same time emphasize aesthetic, ecological, and cultural contributions. These contributions can be accomplished by performing activities such as restoration, preservation, maintenance, or enhancement of the natural and social attributes of the study area. The determination of an EQ Plan involves comparing the environmental affects related to the different plans and then the selection of a plan, based on public input, that contributes the most to or is most harmonious with environmental objectives. A plan which makes a net positive contribution to the components of the EQ account may be designated as the EQ Plan.

For the Presque Isle Study, Environmental Quality components include, but are not limited to, those positive or negative components which are itemized as such in Table 16 - System of Accounts. These components are: (1) aquatic habitat provided or lost; (2) maintenance of geological growth necessary for the continuation of unique ecological areas at the distal east end of the peninsula; (3) water quality; (4) wetland destruction; (5) terrestrial habitat destroyed; and (6) air quality. Because environmental quality has both natural and human manifestations, other EQ components, in part, are included in other accounts on Table 16. These other EQ components are: (1) creation and preservation of beach areas; (2) enhancement of health, safety, and community well-being; (3) noise; and (4) aesthetics. The EQ components are reiterated in Table 17 - Comparative Impacts of Alternatives under the following categories: (1) Terrestrial Resources; (2) Recreation Resources; (3) Aesthetics; (4) Aquatic Resources; and (5) Air Resources.

Upon comparing the effects of the structural plans, as displayed in Tables 16 and 17, it is apparent that all plans contain the following positive contributions to the EQ account in varying amounts: (1) preservation of the peninsula and its recreational facilities; (2) maintenance of the ecological integrity of the area, including the portions of the Ecological Reservation which relay upon a continuous supply of littoral transported sand for habitat conditions there; and (3) creation of aquatic habitat on stone surfaces and in protective niches between stones for benthic organisms and free-swimming life. From comparison of the effects of the structural plans, it is apparent that Plan 2, the Segmented Breakwater Plan, provides the greatest value to EQ components which satisfies positive contribution 3 above, and although it does not provide the greatest values to EQ components that satisfy positive contributions 1 and 2 above, its values are very substantial.

Excluding short-term, low magnitude effects, the structural plans contain the following negative effects upon the EQ account: (1) possible degradation of water quality resulting from diminished circulation; and (2) aesthetic disruption caused by structures. Of these negative effects, the significance of the first is not completely known at this time and will be the basis for project design modifications if future bacteriological studies and hydraulic

model studies indicate a likelihood of serious water quality problems consequent to construction of a project. The second negative effect, visual aesthetic disruption of the shoreline and lake, is somewhat subjective in nature and difficult to assess in either quantitative or relative terms. It seems likely, however, that offshore breakwaters would provide less aesthetic disruption, in the opinion of many observers, than would groins. The sand trap recirculation plan would have less serious aesthetic impact along the shore, however, its pipeline would impact seriously on the nearshore inland areas.

Taking the above Environmental Quality considerations into account, it is apparent, despite not being able to place a quantifying value upon some components, that Plan 2, the Segmented Breakwater Plan, fulfills the following aspects: (1) compared to the base or no project condition, it provides net positive contributions to the EQ account; and (2) it provides positive contributions at a higher degree than do the other plans. Plan 2 is also most acceptable to the Pennsylvania Department of Environmental Resources who has the strongest voice for outside concern in plan selection.

As with the NED Plan, it is evident that Plan 2 also be designated as the EQ Plan since it will have minimal overall impact. Therefore, the Segmented Breakwater Plan is designated as the EQ Plan.

RATIONALE FOR SELECTED PLAN

The Segmented Breakwater Plan, Plan 2, is chosen as the Selected Plan since it was determined that it will preserve and restore Presque Isle in the most economical and environmentally pleasing manner. The plan was selected as both the NED and EQ Plans since it fulfilled the objectives of each plan in the most suitable manner. Plan 4, the No-Action Plan was omitted since, even though it had no adverse impacts, it did not satisfactorily meet the planning objectives nor did it provide sufficient benefits.

The social response to acceptability or refusal of the plans can also prove to be very important in whether a favorable plan is actually approved or not. Presently, Plan 2, the Segmented Breakwater Plan, is most desirable since it has received virtually no negative responses from either local interests, private citizens, or involved organizations. The Pennsylvania Department of Environmental Resources (PDER), the local sponsor, is strongly in favor of the Segmented Breakwater Plan. Consequently, PDER is rigidly opposed to the Groin Plan in light of the apparent failures to control erosion with previous groins and to the Sand Trap Plan because of environmental and maintenance reasons. The U. S. Fish and Wildlife Service, the U.S. Coast Guard, the U.S. Department of Commerce, the U.S. Department of Agriculture, the U.S. Department of the Interior, the Department of Housing and Urban Development, and the U.S. Environmental Protection Agency presently have no objections with the Segmented Breakwater Plan (see Exhibits F-23, F-35, F-38, F-39, F-40, F-41, F-42, and F-43 in Appendix F).

Even though it is not possible to precisely determine what the benefits or adverse effects Plan 2 will have on the environment, the actual harm it will cause is felt to be minimal, due primarily to a small reduction in the aquatic habitat. From the aesthetic viewpoint, there is expected to be some reduction in the total beach experience. This will be due to the mere presence of the structures located offshore and the probable reorientation of the beach shoreline, but this again is believed to be of inconsequential concern.

The three experimental breakwaters located at Beach No. 10 have, to date, been the focus of no objection. The beach is still a popular bathing area with the breakwaters having no adverse affects. Should Plan 2 actually be constructed, the breakwaters will be built further offshore and further apart than the prototype structures at Beach No. 10. The additional beach created will also provide more suitable recreational space and add to the environmental value of the park.

From the economic viewpoint, a B/C ratio of 2.01 is very substantial and will absorb future cost increase which might be caused by inflation.

It is believed that all concerned individuals and interests have been contacted and that all valued input has been weighed and incorporated into reaching the decision on the selection of Plan 2, Segmented Breakwaters, as the recommended plan. The lack of substantial opposition made this selection

much less complicated. It is also believed that implementation of Plan 2 would provide for the most efficient use of Federal funds in protection of the park and existing facilities as well as accommodate any new development or new growth that may occur.

SECTION F
CONCLUSIONS

STATEMENT OF FINDINGS

General

I have reviewed and evaluated, in light of the total public interest, the significant reports, studies, and other documents compiling data concerning the proposed action, appended to, summarized in, or referenced in this report, as well as the views of other agencies and the concerned public, relative to various practicable alternatives affecting the balance of values in accomplishing erosion protection at Presque Isle Peninsula. I have studied and analyzed the possible consequences of these alternatives, considering engineering feasibility, environmental effects, economic factors, and social well-being, including regional and national economic development. I have also considered the costs and means of eliminating, minimizing, or ameliorating possible adverse environmental, social, and economic effects including:

a. Water pollution.

b. Destruction or disruption of man-made and natural resources, aesthetic values, community cohesion, and the availability of public facilities and services.

c. Adverse employment effects and tax on property value losses.

d. Injurious displacement of people and businesses.

e. Disruption of desirable community and regional growth.

Wherever adverse effects have been found to be involved, consideration has been given to mitigating measures. In some instances, adverse environmental effects cannot be avoided by following reasonable alternatives which will achieve the intended project purposes. Recognizing that evaluation of the intended project purposes does involve certain adverse consequences which have been explained and analyzed in this GDM, I find that the action leading to such adverse effects is nonetheless justified by other considerations as discussed above.

Coordination in Phase I GDM Study Investigation

Extensive coordination was maintained during this Phase I GDM Study and in development of the Environmental Impact Statement. My staff has participated in several meetings with representatives of public agencies and with the private sector. The Pennsylvania Historical and Museum Commission of the Commonwealth of Pennsylvania were contacted to determine if the proposed work would have any effect on any known historic or archaeologic resources. The

extent of coordination undertaken during this study is indicated in the paragraph entitled STUDY PARTICIPANTS AND COORDINATION in Section A and in correspondence contained in Appendices E and F of this memorandum which includes information on public meetings, distribution of the Plan of Study, Stage 2 Document, and draft Phase I General Design Memorandum, the model study, and views of agencies. Public meetings were held on 30 May 1978 and 26 September 1979. Prior to the public meetings, a news release was sent to various news media announcing the purpose of the meeting and packets containing information to be discussed at the meetings were mailed to each agency and individual on the mailing list. A late stage public meeting was not held due to the lack of opposition to the selected plan. However, an information packet was mailed to all agencies, organizations, and individuals on the project mailing list for the purpose of providing information on the most recent plans which were considered in Stage III and to provide an opportunity to request that a public meeting be held. A Section 404 Public Notice for the cooperative beach erosion control project at Presque Isle Peninsula in Erie, PA, was issued on 9 October 1979. The 404 Public Notice was sent to all Senators and Congressmen in Erie, PA, to all Federal and State agencies, to all private clubs and associations, and all individuals (approximately 400) on the Presque Isle mailing list. The only response received was from the U. S. Fish and Wildlife Service which stated that they have no problem with the selected plan. The draft Plan of Study was sent to various Federal, State, and local interests in April 1978 with a request for comments. The Stage 2 Document was furnished to certain Federal and State agencies in June 1979 for review and comments. Copies of the draft Phase I GDM were made available to all Federal and State agencies, to all private clubs and associations, and to all individuals on the project mailing list in February 1980 for their review and comment. Correspondence received in coordination of the draft Phase I GDM indicates that there are no objections to the selected plan. A close working relationship was maintained with the Pennsylvania Department of Environmental Resources to clearly understand their views, concerns, and recommendations. Views and comments on the study and plans of improvement, as discussed in the paragraph entitled PUBLIC VIEWS in Section D of this report, have been minimal; but those responses received express opposition to the no action plan, groin plan, and sand trap recirculation plan and favoritism for the Segmented Breakwater Plan.

The Selected Plan

The selected plan of improvement, which is the National Economic Development Plan and the Environmental Quality Plan, will preserve Presque Isle Peninsula and its recreational facilities from natural erosion processes with the least amount of damage to its natural geological and ecological processes. The selected plan of improvement is Plan 2, the Segmented Breakwater Plan, and consists of the following:

a. Fifty-eight segmented rubblemound breakwaters in Lake Erie aligned parallel to the shoreline along Presque Isle Peninsula. The base of the structures will be located at El. 563.6 (5.0 feet below low water datum) and have a crest at El. 578.8 (10.2 feet above low water datum). Each breakwater will be 150 feet long with a 350-foot gap between structures; and

b. Placement of 500,000 cubic yards of sandfill along the Peninsula shoreline in the lee of the breakwaters to provide a recreational beach with design dimensions of a 60-foot width and a crest elevation of 10 feet above low water datum.

Departure of the Selected Plan from the Project Document Plan

In the Project Document Plan, it was contemplated that a partial breakwater concept which provides for construction of five sections of segmented rubble-mound breakwaters located offshore from susceptible areas of erosion and placement of 1,630,000 cubic yards of sandfill would be required to provide protection at areas on Presque Isle Peninsula where erosion was determined to be the most serious. Three sections of the breakwaters would consist of four segments and two sections would consist of five segments. Each breakwater segment would be 500 feet long and separated by a 100-foot gap to permit water circulation. The breakwater segments would be positioned at the 10-foot depth contour and have a crest height of 8.5 feet above low water datum.

The project document plan presented in Senate Document No. 95-85 provides protection for only five areas on the Peninsula. Erosion would continue between the sections of breakwater groups. Therefore, the major departure from the project document plan involves development of a plan that effectively preserves the entire Peninsula and its recreational facilities from the natural erosion processes. In general, the departure has resulted in lesser project costs, and a design that is optimum for providing total protection of the Peninsula and recreational facilities.

Other departures from the project document plan are discussed below:

a. The number of breakwaters required increased from 22 to 58, however, the total aggregate length of structure is reduced from 11,000 feet to 8,700 feet. Also, the spacing between breakwater segments was increased from 100 feet to 350 feet. These departures are the result of a refined design based on data obtained from monitoring the three prototype breakwaters at Beach No. 10 on Presque Isle and should provide a plan which will function as a wave attenuating and beach building system;

b. The breakwater segments in the plan developed in this GDM will be positioned closer to shore than those in the project document plan. In the project document plan, the base of the breakwaters would be positioned at the 10-foot depth contour which was about 1,000 feet offshore. During preparation of this GDM, bathymetric survey data was obtained and based on this data, it was decided to position the breakwaters in the trough between the first and second offshore sand bars. This locates the base of the structures at the five-foot depth contour and about 400 feet offshore;

c. The height of the structures in the GDM and project document plan also vary. The project document plan required the structures have a crest elevtion of +8.5 feet above low water datum whereas the structures in this GDM plan need a crest elevation of +10.2 feet above low water datum. The crest elevations are governed by the thickness of the layers of stone required in the structure cross-section; and

d. The quantity of sand required for initial replenishment varies from 1,630,000 cubic yards in the project document plan to 500,000 cubic yards in the GDM plan. The difference is partially attributed to the volume of sand which has been placed on the beaches during annual replenishment operations authorized by the 1974 and 1976 Water Resources Development Act.

Other Alternatives Considered

The following alternatives, displayed in Table 16 of this section, were considered in detail during Stage 3 planning of this Phase I GDM investigation:

1. Plan 1 (Groin Alternative) - This plan included: construction of 37 new 300-foot long rubblemound groins with a steel sheet pile cutoff to make the groins impermeable; modification of 11 existing groins (Groins No. 1 through 7 and 9 through 11 in the existing groin field along the neck of the Peninsula and the lighthouse groin) by placement of stone along the entire 300-foot length of the groin; and placement of 850,000 cubic yards of sand to fill the groin field to its entrapment capacity in order to provide a beach with a design width of 60 feet and crest elevation of +10.0 feet above low water datum. With this plan, the spacing between groins in the existing groin field along the neck of the Peninsula would be reduced from 1,000 feet to 500 feet by construction of an intermediate groin. Eastward of the existing groin field, the spacing between new groins will be 700 feet. Even though this plan has the lowest initial cost ($20,100,000) and greatest growth rate at Gull Point (1.0 acre/year), it was not chosen as the Selected Plan. This plan was not selected for the following reasons:

a. It requires the greatest volume of sand from an outside source for annual replenishment (130,700 cubic yards) and has the second highest annual operation and maintenance cost ($1,290,000);

b. It allows the greatest amount of sand to be deposited in the entrance channel to Erie Harbor (73,200 cubic yards annually) thereby increasing the maintenance cost for Erie Harbor due to increased dredging;

c. The Pennsylvania Department of Environmental Resources considers installation of groins along the beach to be a most objectionable alternative because they are unsightly and interfere with the safe operation of the beach. In addition, they are opposed to this plan in light of apparent failures to control erosion with previous groins; and

d. It increases the recreational beach area the most (55 acres) but also has the highest area of lost aquatic habitat (72 acres).

In summary, it is not as environmentally acceptable, economically efficient, or engineeringly effective as Plan 2 (Segmented Breakwaters).

2. Plan 3 (Sand Trap Recirculation Alternative) - This plan would provide for: construction of a 2,000-foot long breakwater approximately 1,200 feet offshore from Sunset Point; excavation of a sand trap with a 270,000 cubic yard capacity in the lee of the breakwater; installation of about 29,000 feet of 20-inch diameter permanent pipeline running approximately

Table 16 - System of Accounts

	Alternatives			
	Plan 1 Groins	Plan 2 Segmented Breakwaters	Plan 3 Sandtrap-Recirculation	Plan 4 No-Action
A. Plan Description	Construction of 37 new groins, modification of 11 existing groins, initial replenishment, and annual nourishment	Construction of 38 offshore breakwaters, initial replenishment, and annual nourishment	Construction of an offshore breakwater with a sandtrap dredged in its lee and a permanent pipeline which runs parallel with the peninsula for annual sand distribution. Additional sand for annual nourishment will be required from an outside source.	Minor level of annual nourishment by Commonwealth of Pennsylvania
B. Accounts				
1. National Economic Development				
a. Beneficial Impacts				
(1) Required harbor dredging (CY)	73,200	36,600	30,700	75,000
(2) Benefits ($)	$4,256,000	$4,319,000	$4,329,000	0
(3) Harbor facilities	Presque Isle Peninsula will continue to provide protection from wave action for Erie Harbor	Same as Plan 1	Same as Plan 1	Same as Plan 1
(4) Construction employment	Additional employment will be available to the construction field for a period of almost 2 years.	Same as Plan 1	Same as Plan 1	None
b. Adverse Impacts				
(1) First cost ($)	20,100,000	22,800,000	21,600,000	0
(2) Annual charges ($)	2,816,000	2,151,000	5,190,000	663,000
(3) B/C ratio	1.51	2.01	0.84	0
(4) Annual nourishment (CY)	130,700	37,900	83,600 3/	57,000
(5) Maintenance and repairs ($)	10,000	50,000	25,000	123,000 6/
2. Environmental Quality				
a. Beneficial Impacts				
(1) Aquatic habitat provided (acres) 1/	6	15	3	0
(2) Continued ecological growth (acre/yr) 2/	1	.5	.4	.7
b. Adverse Impacts				
(1) Lost aquatic habitat (acres) 3/	72	57	60	0
(2) Water quality	Insufficient data at this time.	Insufficient data at this time.	Insufficient data at this time.	No effect
(3) Wetlands disrupted	None	None	None	None
(4) Terrestrial habitat destroyed	Insignificant	Insignificant	Insignificant	None
(5) Air quality	Minor decrease during construction.	Minor decrease during construction	Minor decrease during construction	Minor decrease during annual nourishment
3. Social Well-Being				
a. Beneficial Impacts				
(1) Recreational beach created (acres)	55	34	34	0
(2) Recreational opportunity	Enhanced	Enhanced	Enhanced	Impaired
(3) Aesthetics	Reduction in the total beach experience due to presence of shore structures.	Same reduction in the total beach experience, but beaches will be unobstructed.	Same as Plan 2	Erosion continues
(4) Enhancement of health, safety, and community well-being	Increased opportunity for both work and and relaxation.	Same as Plan 1	Same as Plan 1	No change
(5) Public and agency acceptability 4/	Plan not acceptable to the public. Strongly opposed by Penn DER.	Plan most desirable to the public. Strongly favored by Penn DER. Several Federal agencies have stated that they have no objection at this time.	Public has shown no interest. Penn DER strongly opposed.	Unacceptable to public. Penn. DER is committed to the protection of Presque Isle.
(6) Educational and cultural opportunities	Ecological studies, nature studies, and hiking will continue.	Same as Plan 1	Same as Plan 1	Same as Plan 1
b. Adverse Impacts				
(1) Noise	Increased during construction.	Increased during construction.	Increased during construction and during pumping operation for annual nourishment.	Increased during annual nourishment
4. Regional Development				
a. Beneficial Impacts				
(1) Regional growth	Enhanced	Enhanced	Enhanced	Impaired
(2) Quality of increased employment	Enhanced	Enhanced	Enhanced	Impaired
(3) Economic contribution	Presently $60,000,000 but would be increased	Same as Plan 1	Same as Plan 1	Presently $60,000,000 but would decrease.
b. Adverse Impacts				
(1) Material consumption	Large volumes of rock, sand, and steel will be used.	Large volumes of rock and sand will be used.	Large volumes of rock, sand, steel or plastic pipe will be used.	Significant volume of sand will be used.
(2) Energy consumption	Increased during construction	Increased during construction	Increased during construction and used during annual nourishment operation.	Increased during annual nourishment operation.

1/ Habitat provided by the voids and stone surfaces of the rubblemound structure.
2/ Continued growth of Gull Point is desirable to insure the ecological growth of Presque Isle.
3/ Includes bottom area covered by structures and sand replacement.
4/ See Appendix F.
5/ The 83,600 cy/yr is the quantity of sand that must be brought in from an outside source. An additional 260,000 cy/yr of sand would be pumped from the sand trap onto the beaches.
6/ The $123,000 is for removal of debris and sand for roads, parking lots and beaches, and repairs to undermined or damaged roads

parallel to the park's lake shore road; construction of three booster stations; and an initial replenishment of 500,000 cubic yards of sandfill in order to provide a beach with a design width of 60 feet and crest elevation of +10.0 feet above low water datum. About 270,000 cubic yards of sand for the initial replenishment will be pumped from behind the breakwater during excavation of the sand trap whereas the remaining 230,000 cubic yards will come from an outside source. The breakwater will have a crest elevation of +15.5 feet above low water datum in order to allow safe operation of a hydraulic dredge behind the structure during all but the most severe weather conditions. This plan has an initial construction cost of $21,600,000 which is slightly less than the cost for Plan 2, however, it was not selected for the following reasons:

a. It is totally unacceptable to the local sponsor due to environmental and maintenance reasons (the exposed pipeline would be an eyesore and high annual maintenance costs);

b. It has the highest annual operation and maintenance cost ($3,540,000) which is 9 times that of Plan 2;

c. The benefits-to-cost ratio of 0.84 does not meet the minimum economic criteria, thereby making the alternative unjustifiable; and

3. Plan 4 (No Action Alternative) - This plan would not satisfy the project purpose of preserving Presque Isle Peninsula and its recreational facilities from natural erosion processes and was not considered further.

Other Considerations of the Selected Plan

In evaluation of the selected and other viable alternatives, the following points were considered pertinent:

a. Environmental Considerations - The proposed project will eliminate some benthic habitat, disturb some, and provide some. The breakwaters will eliminate 23.0 acres of sandy lake bottom benthic habitat but would provide about 15.0 acres of new, rocky, benthic habitat along the submerged portions of the breakwaters. The initial sand replenishment will disturb 34.0 acres of lake bottom habitat. With the proposed project, littoral processes will be disrupted somewhat, however, about 72,250 cubic yards of littoral material will continue to be transported toward Gull Point to continue the natural geological and ecological processes. It is estimated that approximately 1/2 acre of terrestrial habitat will be created at Gull Point each year. Annual beach replenishment will be an integral part of the project plan and will be used, if it becomes necessary to mitigate any significant interruption of the Gull Point area due to changes in the littoral processes that might occur with construction of the breakwaters. Construction of the proposed project will take approximately two construction seasons. Construction operations in the lake will be limited to a scheduled period recommended by the Pennsylvania Department of Environmental Resources in order to minimize the impact on aquatic life. To help mitigate environmental impacts on soil and vegetation in areas that are disturbed during placement of sandfill, beautification, and restoration measures will be implemented. Disturbed terrain will

be planted with herbaceous seed mixture and/or trees and shrubs adaptable to growing conditions in the area, as needed, to help minimize evidence of construction equipment on disturbed lands. The Contractor performing the work will be required to comply with contract specifications for protection of the environment as outlined in the most current "Civil Works Construction Guide Specifications for Environmental Protection."

b. Social Well-Being Considerations - The social well-being will be improved in the area of Presque Isle Peninsula. The proposed project will benefit the social well-being of the general public by protecting the neck of the Peninsula from erosion and thus the existing roadway. The extent and permanence of the beaches would be substantially enhanced upon implementation of the proposed project.

c. Engineering Considerations - Engineering considerations include relative effects of the selected plan and the practicability of its construction. The plan is considered to reflect properly the minimum scope of improvements needed to obtain the desired degree of protection for the Peninsula and its recreational facilities from the natural erosion processes with the least amount of damage to its natural geological and ecological processes. The plan of improvement will ensure the existence of Presque Isle Peninsula and thereby protection of Erie Harbor. The plan is being tested in a hydraulic model in order to optimize the parameters involved in a project of this type.

d. Economic Considerations - An economic analysis of each alternative was made based upon the assumption that economic efficiency of each plan is a measure whereby tangible benefits should exceed project costs. The selected plan has a higher initial cost for construction ($22,800,000) than the groin plan ($20,100,000) and sand trap recirculation plan ($21,600,000) however, the annual operation and maintenance cost for the selected plan ($420,000) is about 1/3 the annual cost for the groin plan ($1,290,000) and 1/9 the annual cost for the sand trap recirculation plan ($3,540,000). Using the benefit-to-cost ratio as a factor in determining the plan which lends itself to the overall national economic efficiency, the selected plan, with a B/C ratio of 2.01, outweighs Plans 1 and 3 and was found to be the most economically feasible since over the 50-year project life is the least costly of all plans investigated.

CONCLUSIONS

I find that the action proposed is based on a thorough analysis and evaluation of various practicable alternative courses of action for achieving the stated objectives. Whatever adverse effects are found to be involved, they cannot be avoided by following reasonable alternative courses of action which would achieve the purposes specified by the Congress. Where the proposed action has an adverse effect, this effect has been minimized through remedial, protective, or mitigation measures wherever possible. The proposed action is consistent with Federal statutes, administrative directives, and national environmental policy. Accordingly, the total public interest will best be served by the implementation of the selected plan of improvement.

SECTION G
RECOMMENDED PLAN

RECOMMENDED PLAN

This section describes the beach erosion improvement plan preferred by the Commonwealth of Pennsylvania's Department of Environmental Resources, the Pennsylvania Fish Commission, and the Buffalo District Corps of Engineers. The U.S. Fish and Wildlife Service, the U.S. Department of Commerce, the U.S. Department of Agriculture, the U.S. Coast Guard, the U.S. Department of the Interior, the Department of Housing and Urban Development, and the U.S. Environmental Protection Agency presently have no objections to the Segmented Breakwater Plan being selected as the recommended plan. There has been no public opposition expressed at the public meetings held to discuss the project nor through other communications.

Description

The recommended plan of improvement provides for construction of a system of 58 rubblemound breakwaters located offshore along the lakeward length of the Presque Isle Peninsula, parallel to the shoreline as shown on the Recommended Plan at the end of this report. The breakwaters are intended to attenuate the wave action to such a degree as to reduce littoral drift by approximately 75 percent, thus reducing erosion and helping to maintain the beach area in the lee of the breakwaters. A comparison between the 60-foot berm width, the anticipated realigned shoreline, and the 1866 and 1939 shorelines for the segmented breakwater alternative is shown on Plate 19 in Appendix A.

The plan consists of the following:

a. Fifty-eight segmented rubblemound breakwaters in Lake Erie are aligned parallel to the shoreline along Presque Isle Penninsula and positioned in a trough between the first and second offshore sand bars. The toe of the structure will be located at approximately elevation 563.6 feet (5.0 feet below low water datum). Each structure has a crest elevation of 578.8 feet (10.2 feet above low water datum) and will be 150 feet long with a 350-foot gap between structures.

b. The placement of 500,000 cubic yards of sand fill along the shoreline in the lee of the breakwaters to provide a recreational beach berm with a width of 60 feet and a crest elevation of +10.0 feet LWD.

Basis of Design

All of the general requirements for design and construction of rubblemound breakwaters were carefully considered in the development of the plan of improvement. The parameters and arrangement of the breakwaters were determined after: reviewing available technical literature on offshore breakwaters; consulting Technical Report H-76-1 Design Wave Information for the Great Lakes-Lake Erie; analyzing existing littoral processes and; from information gained from the prototype structures at Beach No. 10 on Presque Isle. These data and findings are presented in more detail in Appendix C.

For the breakwaters, rubblemound type construction was selected because of its effectiveness, efficiency, and environmental compatability. The length

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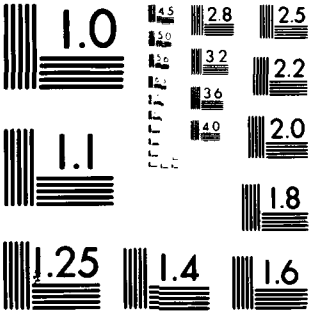

MICROCOPY RESOLUTION TEST CHART

of each breakwater and gap spacing were selected not only to satisfy the intended wave attenuation, but also to minimize interference with the recreational beach activities. Since complete wave attenuation is not a performance requirement of the breakwater plan, overtopping is not a critical factor and is permissible during severe storms. The major factors considered in breakwater crest heights were stability, stone sizes required, and aesthetic considerations. The prototype model located at Beach No. 10 on Presque Isle has shown positive results during its time of operation and has helped in the determination of the selected orientation of the breakwaters.

Concerning the non-Federal work, personnel from the Department of Environmental Resources of the Commonwealth of Pennsylvania have been advised of their responsibility with regards to operation and maintenance of the project and the necessary financial requirements. The position of the Commonwealth of Pennsylvania regarding the recommended improvements is stated in their statement for the 30 May 1978 Public Meeting (see Exhibit F-14). Correspondence with the Pennsylvania Department of Environmental Resources indicates that they have the authority and intent to enter into a Local Cooperation Agreement for this project on behalf of the Commonwealth of Pennsylvania and, thereby, furnish the necessary items of local cooperation. Evaluation by the Pennsylvania Fish Commission approves the segmented breakwater plan and indicates that the structures should be beneficial toward improving the area for fish habitat, since the area is essentially flat, sand covered, and exposed to a constant current. Their letter dated 11 October 1979 is contained in Appendix F as Exhibit F-18. Also an Environmental Impact Statement has been prepared and is attached as Section H of this document.

Construction

Construction of the proposed project will take approximately two construction seasons, which are generally from April to December. During construction, work will occur in one area at a time so that as much beach area as possible is available for recreational use, especially during bathing season.

Environmental Protection and Mitigation

To help mitigate environmental impacts on sand, soil, and vegetation in areas disturbed during construction, beautification and restoration measures will be implemented. Disturbed terrain will be filled, planted with adaptable trees, or graded to meet existing conditions. During construction, the Contractor will be required to minimize temporary environmental impacts such as noise, dust, and water turbidity in accordance with the procedure and regulations outlined in the Civil Works Construction Guide Specification for Environmental Protection (CW 01430 July 1978). The Contractor will be required to prevent or control air pollution, erosion, spillage (including accidental), disposal, turbidity, and maintenance of any pollution control facilities deemed necessary for the duration of construction.

Project Maintenance and Monitoring

Maintenance of the breakwaters will be the responsibility of the Commonwealth of Pennsylvania. Sand replenishment will be a cost-shared responsibility between the Federal Government and the Commonwealth of Pennsylvania based on a 70-30 percent cost-sharing agreement. The Commonwealth of Pennsylvania would be responsible for carrying out the actual maintenance and annual beach replenishment activities. The Federal Government would reimburse the Commonwealth 70 percent of the cost for annual beach replenishment. Annual beach monitoring will be undertaken by the Federal Government to determine replenishment requirements. Examination of aerial photographs, consultation with local experts, and field inspection of the nearshore areas of the Gull Point portion of the Ecological Reservation of the park will be conducted to monitor the biological resources and available habitat. The intent of these studies will be to assess the effects, if any, that the cooperative beach erosion control project will have on the ecological integrity of the area. Emphasis will be placed on evaluation of the nature and extent of the open sandy areas and shallow ponds. The study objective is to make a comparison between observed conditions and those existing prior to project construction as depicted in the Corps biological studies performed during the Summer of 1978 and subsequent studies. It is recommended that this Gull Point monitoring will be performed annually for 5 years following project construction and periodically thereafter for the 50-year life of the project.

Growth of Gull Point is defined as the status quo condition. The condition of growth must be maintained if the ecological integrety of Gull Point is to be preserved. Adverse impacts to Gull Point exist if:

(a) the average annual growth rate of Gull Point falls below the pre-nourishment rate of 18,400 cubic yards per year (Figure 15, Do Nothing Sediment Budget) or 0.4 acre of surface area growth per year, or

(b) the Gull Point area is in danger of being severed from the main body of the peninsula due to severe erosion immediately downdrift of the breakwater system. Physical contact between Gull Point and the peninsula must be maintained if migrating sediment is to reach Gull Point.

Recognition of either of these adverse impacts will initiate a Federal mitigative action through sand replenishment at the easterly end of Beach 10. The level of replenishment will be defined by the historic shoreline at Beach 10 and documented by Plate 19 in Appendix A.

SECTION H

FINAL ENVIRONMENTAL IMPACT STATEMENT

Proposed Plans for the Cooperative Beach Erosion
Control Project at Presque Isle
Peninsula, Erie, Pennsyvlania

The responsible lead agency is the U.S. Army Engineer District, Buffalo, NY.

The responsible cooperating agency is the Department of Environmental Resources of the Commonwealth of Pennsylvania.

Abstract: Presque Isle Peninsula is located on the south shore of Lake Erie at Erie, PA. The Buffalo District has investigated public concerns of the Presque Isle study area related to problems of beach erosion and threatened recreation facilities and environmental study areas on the peninsula. Of the six plans initially considered, four were selected for detailed study, including the No Action Plan. Alternative 1 would consist of 37 new 300-foot long rubblemound groins and modification of 11 existing groins, which would provide adequate protection for the beaches, while still allowing the continued growth of Gull Point. Alternative 2 consists of 58 offshore breakwater segments which are 150 feet long and separated by gaps of 350 feet. The breakwater system would extend from the proximal west end of the peninsula eastward through Sunset Point and would provide adequate protection for the recreational facilities at Presque Isle and also allow continued growth of Gull Point. Alternative 3, Sand Trap Recirculation, consists of a 2,000-foot long breakwater, a sand trap with a 270,000-cubic yard capacity in the lee of the breakwater, and a 20-inch diameter permanent pipeline with a series of three booster pumps located at 8,000-foot intervals. This alternative also would protect the recreational facilities and at the same time nourish Gull Point. Alternative 4, the No Action Plan, would provide no structural features however, the plan assumes that the Commonwealth of Pennsylvania would undertake a minor level of annual nourishment to protect their previous investments and somewhat maintain the recreational value of the park. Alternative 2, the Segmented Breakwater Plan, has been designated as the selected plan based on its performance in addressing the identified public concerns and its net positive contribution to the goals of National Economic Development and Environmental Quality.

SEND YOUR COMMENTS TO THE DISTRICT ENGINEER BY

If you would like further information on this statement please contact:

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Proposed Plans for the Cooperative Beach Erosion Control Project
at Presque Isle Peninsula, Erie, Pennsylvania

FINAL ENVIRONMENTAL IMPACT STATEMENT

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SUMMARY

MAJOR CONCLUSIONS AND FINDINGS

As a first task in the planning process, problems in a study area are identified by eliciting information from the public about water and related land resource management needs. The needs identified for Presque Isle Peninsula include the stabilization of the lakeward side of the peninsula by reducing erosion of the beaches, while at the same time preserving the dynamics of the distal east end or Gull Point area.

As mandated by the Corps planning process, various alternative plans have been formulated to address area needs and planning objectives, and these plans have been addressed and evaluated for economic and environmental impacts. During Stage 2 planning, six economically feasible concepts which were identified during preparation of the 1974 Review Report, were analyzed. The concepts were refined and three alternatives, each capable of providing protection to the peninsula, were developed, in addition to the No Action Plan.

The National Economic Development (NED) Plan is that plan which produces maximum net economic returns. Economic returns are the amount by which annual benefits exceed annual costs. Using this rationale, Alternative 2, Segmented Breakwaters, has been designated as the NED Plan.

Recognizing that environmental quality (EQ) has both natural and human manifestations, an EQ Plan addresses the planning objectives in the way which emphasizes aesthetic, ecological and cultural contributions. Beneficial EQ contributions are made by preserving, maintaining, restoring, or enhancing the significant cultural and natural environmental attributes of the study area. Designating an EQ Plan involves measuring the environmental changes related to different plans and selecting the plan which, based on public input, contributes to, or is most harmonious with, environmental objectives. The fundamental environmental objectives in the Presque Isle study are:

a. Preservation and/or enhancement of the biological resources of the park (natural environment), and;

b. Enhancement of the bathing beaches and human recreation activities (human environment).

Candidate EQ Plans must make net positive contributions to the components of the EQ account. Alternative Plan 2, Segmented Breakwaters, fulfills this criterion to a greater degree than do the other alternatives and has thus been designated as the Environmental Quality (EQ) Plan.

Plan selection, including the designation of NED and EQ Plans, is discussed fully in Section E of this report.

The selected plan is Alternative 2, Segmented Breakwaters. Under this plan, a segmented breakwater, consisting of 58 breakwater segments, would extend from the proximal west end of the peninsula eastward through Sunset Point. The rationale behind selection of this plan is that it is the most economical, most environmentally positive plan, and yet provides protection to the beaches and other recreational resources at Presque Isle State Park.

AREAS OF CONTROVERSY

To date, there are no issues that were the subject of major disagreement among public interests during the course of the study.

UNRESOLVED ISSUES

There are no unresolved major disagreements among study area interests, to date.

RELATIONSHIP TO ENVIRONMENTAL REQUIREMENTS

The Stage 3 plans have been considered in relation to a number of Federal laws and policies, as well as State laws, which have bearing on the issues involved. Project planning has been in full compliance with the following Federal Acts: Water Resources Planning Act of 1965; Fish and Wildlife Coordination Act of 1958; National Historic Preservation Act of 1965; National Environmental Policy Act of 1969; Coastal Zone Management Act of 1972; the Endangered Species Act of 1973; and the Federal Water Pollution Control Act of 1972, as amended by the Clean Water Act of 1977. Also, the following Executive Orders have been complied with: EO 11990 - Protection of Wetlands and EO 11988 - Flood Plain Management.

Section 404 of the Federal Water Pollution Control Act of 1972 (P. L. 92-500) requires that an evaluation of the effects upon water quality be performed for any proposed discharge of dredged or fill materials into waters of the United States. This evaluation has been performed and is included as Exhibit F-29 in Appendix F.

NEED FOR AND OBJECTIVES OF ACTION

INTRODUCTION AND STUDY AUTHORITY

Several of the beaches on Presque Isle Peninsula have had a history of serious erosion for at least 150 years. In an attempt to protect the neck of the peninsula against erosion, the cooperative beach erosion control project at Presque Isle Peninsula was authorized by the 1954 River and Harbor Act. The Federal Government in cooperation with the Commonwealth of Pennsylvania completed the beach erosion control project in 1956. The project provided for construction of a seawall, bulkhead, and groin system along the neck of the peninsula, removal of a portion of the lighthouse jetty and the bulkhead easterly thereof, the restoration of beaches on the lakeward perimeter of the peninsula by placement of about 4,150,000 cubic yards of sand fill, and Federal participation in the cost equivalent to one-third of the total first cost. The total cost for the project was $2,451,270 of which $817,000 were Federal funds.

The completed beach erosion control project was not a complete solution to the erosion problem and the predominant west-to-east littoral movement continued to remove more material from the peninsula beaches than was supplied by littoral drift from the shore to the west. Therefore, to control the erosion to the point where the Federal shore protection structures and the State's park facilities would not be threatened, a modification of the erosion control project was enacted under the 1960 River and Harbor Act. This Act provided for beach replenishment for a period of 10 years with Federal participation equivalent to one-third of the total cost for replenishment. Later, in accordance with the 1962 River and Harbor Act, the Federal share of subsequent project costs was increased to 70 percent. Sand replenishment operations authorized by the 1960 Act were undertaken in 1960-1961, 1964-1965, 1965-1966, 1968-1969, and 1971 during which a total of about 1,315,000 cubic yards of sand were placed on the peninsula beaches at a cost of $2,178,000 of which $1,329,000 were Federal funds.

The cooperative beach erosion control project was further modified by the 1974 Water Resources Development Act which authorized an additional 5-year period of Federal participation to the extent of 70 percent of the cost for sand replenishment. The 1976 Water Resources Development Act extended Federal participation in the cost for periodic sand replenishment beyond the 5 years authorized by the 1974 Act. This extension allows for Federal participation in sand replenishment during the preconstruction period for a project which will provide a more "permanent" solution to the serious erosion problem at Presque Isle. Five years of sand replenishment authorized by the 1974 Act are completed and a sixth year of replenishment is presently underway and will be completed by July 1980.

PUBLIC CONCERNS

The course of study leading up to the General Design Memorandum (GDM) stage dealt mainly with the initial consideration of all possible alternatives, including the No Action Alternative. During this stage, many plans and concerns were submitted to the Corps by the public. The format for this public input was both through statements presented at public meetings and through

written correspondence. The timing and nature of this public input is summarized in the FEIS for the feasibility stage of planning issued in September 1975.

On 30 May 1978, an initial public meeting was held in Erie, PA, to inform the public about the alternatives which would be investigated during the Phase I General Design Memorandum study effort and to solicit public response and suggestions for the study. This meeting consisted of a presentation of the alternatives to be considered during the Phase I study effort and provided an opportunity for concerned parties to make statements. Thirteen persons were in attendance at the meeting of which four were acting as representatives of an organization or agency. Two attendees made statements at the meeting. One of these, a representative of Pennsylvania Department of Environmental Resources: (1) outlined the benefits of Presque Isle Peninsula; (2) recommended a thorough investigation of offshore sand sources; (3) expressed disapproval of the Sand Trap Recirculation Plan because of serious environmental and maintenance problems, and (4) expressed favor toward proposed segmented breakwaters along with willingness to meet the requirements of local cooperation. Another statement, made by an interested private citizen, suggested a modified breakwater design, incorporating curvature into the breakwater segments.

On 26 September 1979, a public meeting was held in Erie, PA, during which the final set of alternatives for the cooperative beach erosion control project were presented. The selection of the Segmented Breakwater Plan as the one which will be recommended to Congress for Phase II design study was indicated. Eighteen persons were in attendance at the meeting, of which six were acting as representatives of an organization or agency. Nine attendees made statements or asked questions. A representative of the Pennsylvania Department of Environmental Resources: (1) outlined the benefits of Presque Isle Peninsula; (2) emphasized the importance of a beach erosion control plan that is energy and economically efficient, meets aesthetic and safety considerations, and allows sand transport to Gull Point, and; (3) expressed favor for the Segmented Breakwater Plan, along with proposals for modifications to improve safety and design of breakwaters. Four attendees suggested modifications or alternative schemes for erosion control. One individual expressed concern that the breakwater could be a safety hazard to bathers by posing as an attraction which could result in the dangerous activities such as swimming to and climbing upon the breakwaters.

Since the initiation of the Phase I GDM stage of planning, there has been written correspondence between the Corps and concerned parties regarding the Presque Isle cooperative beach erosion control project. Fifteen separate pieces of correspondence were received by the Corps between 1 May 1977 and 15 November 1979, of which nine were from State or Federal agencies and six were from concerned individuals (including three letters sent to elected Federal representatives and forwarded to the Corps by these recipients). Topics addressed include: (1) environmental effects of the prototype breakwaters; (2) suggestion of new plans for erosion control; (3) concern about contract specifications for the beach nourishment activities undertaken during the Spring of 1979, and; (4) areas of concern and recommendations for the "permanent" project expressed by the Pennsylvania Department of Environmental Resources.

A total of 115 copies of the draft Phase I General Design Memorandum were sent out for coordination with agencies, organizations, and individuals. The reviewers furnished 10 letters of comment to the Corps within the official 45-day review period, of which seven were from Federal agencies, one was from the Presque Isle State Park Superintendent, one was from the Acquisitions Librarian at Gannan College, and one was from a concerned individual. Six of the letters of comment only acknowledged receipt of the document and indicated that the reviewers had no comments or objections to offer. Other topics included: (1) a suggestion that the breakwaters be sine shaped; (2) a request from a Federal agency to see comments provided by a State agency; (3) a concern that the crest elevation of the 58 proposed breakwaters will greatly interrupt the view of the lake; (4) a suggestion that additional prototype breakwaters be constructed to check the design data; (5) a recommendation that a revision to the project be considered through development of stable structures of lesser height in a model test, and; (6) information regarding the State's proposed public boat launching ramp near Beach No. 1 at Presque Isle.

PLANNING OBJECTIVES

Development of the various alternative shoreline erosion control plans for Presque Isle considered the two national water resource planning objectives (NED and EQ), as defined by the U.S. Water Resources Council, and a number of study area-specific planning objectives developed in relation to public concerns and resource management needs of the project area.

The two national objectives are:

a. To enhance National Economic Development (NED) by increasing the value of the nation's output of goods and services and by increasing national economic efficiency. For a shoreline erosion control project such as the Presque Isle project, the value of the recreational experience at the park shoreline to the beach user, is the measure of NED;

b. to enhance the quality of the environment (EQ) by the management, conservation, preservation, creation, restoration, or improvement of the quality of certain natural and cultural resources and ecological systems.

The planning objectives developed for the Presque Isle Phase I GDM study are as follows:

a. Provide the required protection for preservation of the peninsula and its recreational facilities;

b. Preserve and enhance, if possible, the human environment and aesthetic qualities of the shoreline;

c. Preserve the integrity of the natural environment, especially the sensitive and unique Gull Point portion of the Ecological Reservation on the east end of the peninsula;

d. Prevent degradation of water quality, especially water stagnation caused by improper water circulation;

e. Restore, protect, and enhance the beach areas of the peninsula for use by future generations;

f. Preserve and enhance the natural wildness and beauty of the peninsula;

g. Prevent or minimize adverse effects on natural shore processes because the peninsula has a unique geological formation and botanical history;

h. Minimize the deposition of sand in the entrance channel to Erie Harbor;

i. Provide for sand to be bypassed to the east end of the peninsula to provide for continued growth;

j. Prevent future breaching of the neck of the peninsula;

k. Insure a protected harbor;

l. Provide for the public's safety;

m. Minimize the use of energy.

ALTERNATIVES

PLANS ELIMINATED FROM FURTHER STUDY

Two plans were considered in Stage 2 planning but were not included in the Stage 3 final array of alternatives. These two plans are the Sand Recirculation Alternative and the Annual Nourishment Alternative. In addition to the two plans that were eliminated completely, the Full Breakwater Alternative and the Partial Breakwater Alternative were consolidated to form a new, more economical and more effective Segmented Breakwater Plan.

The Sand Recirculation Alternative developed in Stage 2 planning would consist of a 20-inch diameter permanent pipeline and four booster pumps located at 8,000-foot intervals. The plan would require an initial replenishment of 750,000 cubic yards of sandfill and an annual replenishment of 275,000 cubic yards in order to maintain the beaches with a design width of 60 feet and a crest elevation of +10 feet above Low Water Datum (LWD). All material for the replenishment operations would come from a borrow area at Gull Point and would cause an initial loss of 750,000 cubic yards of sand from the distal east end of the peninsula and a net annual loss of 15,000 cubic yards of sand over the 50-year life of the project. This alternative appears to be a technically favorable solution especially since current hydrographic surveys indicate increased shoaling in the entrance channel to Erie Harbor due to the immense growth rate being observed at the eastern end of the peninsula. However, with the Sand Recirculation Alternative, the wildlife sanctuary at Gull Point would be destroyed. Therefore, the Sand Recirculation Alternative is environmentally unacceptable.

The Annual Nourishment Alternative developed in Stage 2 planning called for about 750,000 cubic yards of sandfill to restore the beaches with a design width of 60 feet and a crest elevation of +10 feet above LWD and an additional 275,000 cubic yards of sandfill placed annually to maintain the beach width and crest elevation. With this alternative, about 260,000 cubic yards of sand would bypass naturally to the distal east end of the peninsula. However, at present, there is such an increased volume of sand reaching the distal east end due to the current annual nourishment program, that much of the material is building up in the offshore zone and increasing the shoaling in the entrance channel to Erie Harbor. This volume of sand is reaching the distal east end of the peninsula at a faster rate than wave action from the northeast-through-east is able to recurve the sand spit back on to the beach face. As a result, there is a greater volume of offshore sand losses and lakeward movement of the sand into deeper water including the Erie Harbor entrance channel. This deposition of sand in the entrance channel is increasing the amount of dredging and, thereby, the maintenance cost for Erie Harbor. The Annual Nourishment Alternative has the lowest first cost but a very high annual cost due to the large volume of sand which is needed annually from an outside source. This alternative is technically unacceptable since it would greatly increase the annual maintenance dredging cost of Erie Harbor. This alternative would also require the greatest fuel consumption at a time when energy conservation is stressed.

During preparation of the Stage 2 report, the Full Breakwater Plan and the Partial Breakwater Plan were consolidated to produce a more economical Segmented Breakwater Plan. With the full breakwater concept, 47 segments, 500 feet long and separated by 100-foot gaps would extend virtually the entire length of the peninsula. The segments would be located at the 12-foot depth contour (approximately 1,000 feet offshore) and have a crest height of 8.5 feet above LWD. The full breakwater concept would require an initial beach replenishment, however annual nourishment would not be required.

The Partial Breakwater Plan provided for construction of five sections of segmented, rubblemound breakwaters located offshore from susceptible areas of erosion and placement of 1,630,000 cubic yards of sandfill. Three sections of the breakwaters would consist of four segments and two sections would consist of five segments for a total of 22 segments. Each breakwater segment would be 500 feet long and separated by a 100-foot gap. The segments would be positioned at the 10-foot depth contour and have a crest height of 8.5 feet above LWD. The partial breakwater concept would require an annual recycling of about 126,000 cubic yards of sand from accreted areas landward of the breakwaters to adjacent, slightly eroded areas. The scallop-shaped beach would therefore be kept at a uniform width.

These two breakwater plans were combined to produce a Segmented Breakwater Plan which would provide maximum stabilization and protection for the beaches, as well as being more economical.

PLANS CONSIDERED IN DETAIL

Alternative 1 - Groins - The Groin Alternative consists of construction of 37 new 300-foot long rubblemound groins with a steel sheetpile cutoff to make the groins impermeable to sand. In addition, 11 existing 300-foot long groins would be modified by placement of stone along the entire length of the groin. The spacing between the groins in the existing Federal groin field along the neck of the peninsula would be reduced from 1,000 feet to 500 feet by construction of intermediate groins. Eastward of the existing Federal groin field, the spacing between the new groins would be 700 feet. This Groin Alternative would require an initial replenishment of 850,000 cubic yards of sandfill and an annual replenishment of 112,500 cubic yards in order to maintain the beaches with a design width of 60 feet and crest elevation of +10 feet above LWD. With the Groin Alternative 130,000 cubic yards of sand would be bypassed naturally to the distal east end of the peninsula resulting in continued growth.

Alternative 2 - Segmented Breakwater - The Segmented Breakwater Plan has been designated as the Selected Plan, the NED Plan, and the EQ plan.

To effectively preserve the entire peninsula and its recreational facilities from the natural erosion processes, a Segmented Breakwater Plan was developed consisting of 58 breakwater segments which are 150 feet long and separated by gaps of 350 feet. The breakwater system would extend from the proximal west end of the peninsula eastward through Sunset Point. Each breakwater segment would be positioned approximately 300 to 400 feet offshore at the 5-foot depth contour and have a crest elevation of 10.2 feet above LWD. This

Segmented Breakwater Alternative would require an initial replenishment of 500,000 cubic yards of sandfill and an annual replenishment requirement of 38,000 cubic yards in order to maintain the beaches with a design width of 60 feet and a crest elevation of +10 feet above LWD. With the Segmented Breakwater Alternative, approximately 65,000 cubic yards of sand would be bypassed naturally to the distal east end of the peninsula for continued growth.

Alternative 3 - Sand Trap Recirculation - This alternative consists of a 2,000-foot long breakwater with a crest elevation of +15.5 feet above LWD and located about 1,200 feet offshore from Sunset Point at the 10-foot depth contour, excavation of a sand trap with a 270,000 cubic yard capacity in the lee of the breakwater, and a 20-inch diameter, 30,000-foot long permanent pipeline extending from Sunset Point to the westernmost end of the peninsula with a series of three booster pumps located at 8,000-foot intervals. The Sand Trap Recirculation Alternative would require an initial replenishment of 500,000 cubic yards of sandfill (270,000 cubic yards from the sand trap and 230,000 cubic yards from an outside source) and an annual replenishment of 305,000 cubic yards in order to maintain the beaches with a design width of 60 feet and a crest elevation of +10 feet above LWD. The 305,000 cubic yard annual replenishment requirement consists of 220,000 cubic yards of sand being pumped from the trap and distributed on the beaches west of the sand trap, a total of 30,000 cubic yards of sand being pumped from the sand trap eastward toward Gull Point and 55,000 cubic yards of sand from an outside source for distribution along the neck of the peninsula. With the Sand Trap Recirculation Alternative, a total of 40,000 cubic yards of sand would bypass to the distal east end of the peninsula resulting in continued growth (30,000 cubic yards from the sand trap and 10,000 cubic yards naturally bypassing the sand trap).

Alternative 4: No Action - By this plan, the Corps of Engineers would not participate in the protection or improvement of Presque Isle Peninsula. Thus it includes none of the structural measures described above, nor beach nourishment as is currently being carried out. For assessment purposes, it is assumed that the Commonwealth of Pennsylvania would act to control erosion or maintain public access to the peninsula and protect the developed park facilities through a program whereby a minor level of annual beach nourishment would be provided.

If this plan were carried out, longshore transport of sand in an easterly direction would occur unabated at the Lake Erie shoreline of the peninsula. At critical points on the shore, net erosion would occur as sand is lost to the east and also to offshore areas outside of the influence of shoreline processes. The critical areas of the shoreline are the sites valued as bathing beaches and on which development in the form of parking lots, roads, and bathhouses has taken place. West of the nodal point between erosion and accretion, which is presently located just easterly of Beach No. 10, erosion would eliminate much of the open, level unvegetated area which now constitutes the lakeshore. These areas would develop into low steep bluffs partly stabilized by the root systems of vegetation (consisting primarily of eastern cottonwood at most lakeshore sites). All sites within the study area are susceptible to erosion, but a prediction of severe erosion cannot be made with regard to its exact locality.

Waterdriven beach material would, at intervals, be deposited by storms onto the road surface, requiring removal and perhaps causing disruption of the use of the park by visitors. The continuous pounding of storm waves on the peninsula would cause the eventual destruction of existing shore protection structures.

Deposition of sand at the distal east end of the peninsula would result in an increase in the area of the Gull Point land mass and would contribute to subsurface sandbar formation in that area. Dune and pond genesis would continue at the ecological reservation and the site would retain its unique plant and animal habitats.

IMPLEMENTATION RESPONSIBILITIES

Federal - The Federal Government would be responsible for providing the Federal share of the final construction cost, for carrying out the initial construction activities outlined under each alternative above, and for reimbursing the Commonwealth of Pennsylvania 70 percent of the cost for annual beach replenishment operations carried out over the 50 year life of the project.

Local - The Commonwealth of Pennsylvania, through the Department of Environmental Resources, has stated it will act as the local sponsor for the "permanent" beach erosion control project and provided a letter dated 23 August 1979 stating their intent to meet the terms required for local cooperation in a Local Assurance Agreement (see Exhibit E-4 in Appendix E). In order for a beach erosion control project to be constructed at Presque Isle, the local cooperator must enter into a written agreement, pursuant to Section 221 of Public Law 91-611, that it will:

a. Provide without cost to the United States all lands, easements, and rights-of-way, including suitable borrow and spoil-disposal areas as determined by the Chief of Engineers, necessary for the construction of the project; the provision of borrow areas shall not include material required for initial beach replenishment;

b. Provide a cash contribution equal to the appropriate percentage of the final construction cost exclusive of lands, easements, and rights-of-way, the percentage to be in accordance with existing law and based on shore ownership and use existing at the time of construction and the President's proposed cost-sharing policy, which contribution is presently estimated at $7,980,000 or 35 percent;

c. Pay 30 percent of annual beach redistribution and replenishment costs for the project;

d. Hold and save the United States free from damages due to the construction works, except for damages caused through the fault or negligence of the United States or its Contractors;

e. Maintain and operate all the works, including periodic sand replenishment and redistribution as needed, after completion, in accordance with regulations prescribed by the Secretary of the Army;

f. Assure continued public ownership or continued public use, without cost to the United States, of appropriate access and facilities, including parking and sanitation, necessary for realization of the public benefits upon which Federal participation is based, and administer and maintain the beach for continued public use during the life of the project;

g. Control water pollution to the extent necessary to safeguard the health of bathers; and

h. Comply with the applicable provisions of the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970 (Public Law 91-646 approved 2 January 1971) in acquiring lands, easements and rights-of-way for construction and subsequent maintenance of the project and inform affected persons of pertinent benefits, policies, and procedures in connection with said Act.

There are no provisions under existing beach erosion control laws which provide for Federal contributions toward project maintenance of beach erosion control structures. Therefore, the Commonwealth of Pennsylvania, in addition to funding their share of the final construction costs, will be responsible for funding 30 percent of the annual beach replenishment costs and 100 percent of the annual maintenance costs for the structural features. The Commonwealth of Pennsylvania would be responsible for carrying out the actual maintenance and annual beach replenishment activities for the plan of improvement.

Table 17 - Comparative Impacts of Alternatives
(Selected Alternative is Alternative 2)

Present Condition and Alternatives	Terrestrial Resources	Recreation Resources	Aesthetics	Aquatic Resources	Air Resources	Plan Economics
Present Condition:	Cultural Resources: No sites in project area on National Register of Historic Places (NRHP) Natural Resources and Wildlife: Available: 70 acres of beach in project area; 132 acres of land area at Gull Point.	Available: adequate public facilities and services and recreation facilities and services.	Available: relatively uninterrupted shoreline; aesthetically pleasing sand beaches.	Available: Lake Erie ecosystem in vicinity of project area; acceptable water quality for water contact recreation.	Available: acceptable quality according to the standards set by the Commonwealth of Pennsylvania.	Not Applicable
Alternative 1: Groins	Cultural Resources: Impact: None Natural Resources and Wildlife: Temporary impacts during construction; +35 acres of terrestrial habitat due to sand placement; +1 acre of terrestrial habitat at Gull Point/year.	Public Facilities and Services: Impact: Short-term benefit during construction. Recreation Facilities and Services: Impact: Provide protection to neck of peninsula and roadway; provide beaches adequate to accommodate future expected park attendance; protect beaches from erosion; would not reduce ice damage to shore.	Impact: Temporary disturbances during construction; enhance extent and permanence of beaches; groins may be unsightly; natural wave action would remain; uninterrupted view of the lake would remain.	Water Quality: Short-term impacts during construction. Aquatic Habitat: -17 acres due to groin construction; +6 acres on submerged groin surfaces; -55 acres due to sand placement.	Impact: Temporary effects during construction - dust, noise, odors, vehicle emissions.	Investment Costs: $20,100,000 Average Annual Costs: $2,816,000 Average Annual Benefits: $4,256,000 Net Benefits: $1,440,000 B/C Ratio: 1.51
Alternative 2: Segmented Breakwaters	Cultural Resources: Impact: None Natural Resources and Wildlife: Temporary impacts during construction; +34 acres of terrestrial habitat due to sand placement; +.3 acres of terrestrial habitat at Gull Point/year.	Public Facilities and Services: Impact: Short-term benefit during construction. Recreation Facilities and Services: Impact: Provide protection to neck of peninsula and roadway; provide beaches adequate to accommodate future expected park attendance; protect beaches from erosion; reduce ice damage to shore.	Impact: Temporary disturbances during construction; enhance extent and permanence of beaches; view of lake would be interrupted; wave action would be interrupted; length of shoreline would be increased; breakwaters may be unsightly.	Water Quality: Short-term impacts during construction; possible degradation of water quality behind breakwaters - results of studies are inconclusive at this time. Aquatic Habitat: -23 acres due to breakwater construction; +15 acres on submerged breakwater surfaces; -34 acres due to sand placement.	Impact: Temporary effects during construction - dust, noise, odors, vehicle emissions.	Investment Costs: $22,000,000 Average Annual Costs: $2,151,000 Average Annual Benefits: $4,319,000 Net Benefits: $2,168,000 B/C Ratio: 2.01
Alternative 3: Sand Trap Recirculation	Cultural Resources: Impact: None Natural Resources and Wildlife: Temporary impacts during construction, +34 acres of terrestrial habitat due to sand placement; 2 acres altered due to placement of pipeline and booster stations; +.5 acre of terrestrial habitat at Gull Point/year.	Public Facilities and Services: Impact: Short-term benefit during construction. Recreation Facilities and Services: Impact: Provide protection to neck of peninsula and roadway; provide beaches adequate to accommodate future expected park attendance; protect beaches from erosion; would not reduce ice damage to shore.	Impact: Temporary disturbances during construction; enhance extent and permanence of beaches; uninterrupted view of lake would remain, except small section behind breakwater; natural wave action would remain; pipeline and breakwater may be unsightly.	Water Quality: Short-term impacts during construction. Aquatic Habitat: -5 acres due to breakwater construction; +3 acres on submerged breakwater surfaces; -34 acres due to sand placement; 21 acres annually altered at sand trap.	Impact: Temporary effects during construction - dust, noise, odors, vehicle emissions.	Investment Costs: $21,600,000 Average Annual Costs: $3,180,000 Average Annual Benefits: $4,329,000 Net Benefits: -$851,000 B/C Ratio: 0.84
Alternative 4: No Action	Cultural Resources: Impact: None Natural Resources and Wildlife: Temporary impacts during annual beach replenishment. 2 acres of terrestrial habitat due to drift of material; +0.7 acre of terrestrial habitat at Gull Point/year.	Public Facilities and Services: Impact: None Recreation Facilities and Services: Impact: No protection of neck of peninsula or roadway; inadequate beaches to accommodate future expected park attendance; no protection of beaches from erosion; would not reduce ice damage to shore.	Impact: Temporary disturbances during annual beach replenishment; no additional structures to interrupt view of lake, wave action, or shoreline; eroded beaches may be unsightly.	Water Quality: No Impact. Aquatic Habitat: 0 acres gained or lost due to structure construction; +2 acres due to drift of material.	Impact: None	Investment Costs: $0 Average Annual Costs: $683,000 2/ Average Annual Benefits: $0 Net Benefits: $0 B/C Ratio: None

Notes: 1. Base Condition Year = 1979.
2. Period of Analysis = 50 years.
3. $123,000 for removal of sand and debris from roads, parking lots and beaches, and for repairs to undermined or damaged roads and structures; $560,000 for annual beach nourishment, all non-Federal costs.

AFFECTED ENVIRONMENT

ENVIRONMENTAL CONDITIONS

Presque Isle is a 6-mile long club-shaped sandspit extending northeastward into Lake Erie from a narrow connection with the mainland at Erie, PA. It is a dynamic landform slowly undergoing continuous change in size, shape, and position as a result of shoreline transport processes. Under natural conditions (i.e., without beach nourishment) the peninsula would slowly shrink in total land area because material would be lost to offshore areas out of the influence of shoreline processes at a greater rate than material would be brought to the peninsula from the west by littoral transport. Erosion characterizes the lakeshore along most of the length of the peninsula with accretion of sand occurring at the distal east end. Numerous ponds and inlets characterize the southeast side of the peninsula bordering Presque Isle Bay.

Presque Isle is an exceptional natural area characterized by a wide variety of rich and, in some ways, unique plant and animal communities. Especially noteworthy is the fact that on Presque Isle, there is great habitat diversity, with a successional continuity of vegetation types ranging from pioneer vegetation on newly-formed sites to fairly stable woodland communities on old sites. Also, successionally intermediate sites, including extensive marshland, are well represented and comprise the bulk of the peninsula and include some of the most productive wildlife habitat. This habitat diversity is a result of the size and shape of the landform and also its dynamic nature, since shoreline processes create new areas suitable for colonization by plants. Soil type too is an important factor contributing to the nature of the vegetation on Presque Isle. Sand comprises all of the parent soil material and its presence helps to account for the occurrence of uncommon plant species specially adapted to shores and dunes and also creates, due to rapid percolation, dry conditions on only slightly elevated sites.

Presently the peninsula comprises a variety of general plant community types. These areas, and the approximate percentage of the total 3,200-acre land mass (indicated in parentheses) are: Sparsely-vegetated sandy sites (9 percent); open water of ponds and lagoons (13 percent); wetland sites (14 percent); shrubby sites (26 percent); wooded areas (33 percent). The remaining 5 percent is developed and is occupied by roads, parking areas, administration headquarters, the marina facilities, and the Perry Monument.

Four hundred and ten species of vascular plants have been observed on Presque Isle, of which several are known to occur nowhere else in Western Pennsylvania; it is noted as an exceptionally rich area botanically. The peninsula is noted also for an outstanding abundance and diversity of bird life; 293 species have been noted of which many are quite rare or uncommon locally, or the numbers in which they occur at Presque Isle is unusual. The shore and water birds are especially well-represented on Presque Isle, occurring primarily as migrants; there are currently no documented shorebird, gull or tern breeding occurrences here, although there have been some in the past. Extensive wetland areas and woodland areas support breeding populations of many species.

The entire peninsula, except for two small tracts owned by the United States and occupied by the Coast Guard Station and Lighthouse, is developed as a State park, and thus, aside from the Coast Guard personnel and the Park Superintendent, there are no permanent residents and only a minimal amount of employment. The State Park is visited by roughly 3,800,000 persons annually, in pursuit of the following activities: swimming, picnicking, boating, fishing, hiking, nature study, and duck hunting. The park is a popular recreational resource, for which a user-value of $2.85 has been calculated. The tourism related business in the Erie area receives an estimated input of $60,000,000 annually from visitors attracted to Presque Isle State Park.

SIGNIFICANT RESOURCES

Each significant resource included in Table 17 - Comparative Impacts of Alternatives is described below, including its location, quantity and quality. Criteria for resource significance are stated in the descriptions, and include the following:

a. resources identified in the laws, regulations, and guidelines or other institutional standards of national, regional and local scope;

b. resources meeting certain study-specific technical criteria for measuring characteristics that may be critical to resource existence;

c. resources specifically identified as a concern by public interests;

d. resources which, if effected by a plan, would violate an institutional standard, meet a study-specific technical criterion, or become the subject of public concern.

Terrestrial Resources: Cultural Resources - The National Register of Historic Places, dated 6 February 1979, and all subsequent revisions through 6 November 1979, were consulted; no significant cultural resources are located in the proposed project area. In addition, the Pennsylvania State Historic Preservation Officer was contacted, and concurred that there are no significant cultural resources in the project area (see Exhibit F-25 in Appendix F).

Terrestrial Resources: Gull Point - The distal east end of the peninsula is an area of sand accumulation of considerable extent. Such sites are very uncommon on the lower Great Lakes and the plant and animal habitats they constitute are unique and interesting, and this specific site is highly regarded by many students of nature. Gull Point constitutes roughly 100 acres and is a portion of the Ecological Reservation at the Park, a status which excludes development or any activities except relatively low intensity, nondestructive ones such as hiking, canoeing, fishing, etc. No structures, roads, or permitted use of motor vehicles occur on the Ecological Reservation, but access is otherwise unlimited at the present time.

Gull Point includes open sandy areas of slightly varied topography, varied moisture conditions, and an overall condition of physical substrate instability. Plant species occurring here number roughly 160, of which several are uniquely adapted to unstable shores and some of which are rare locally.

The site includes open shores of Lake Erie, Presque Isle Bay, and several recently formed sandspit ponds with sparsely vegetated margins. These favorable habitats, combined with the comparative lack of human disturbance, result in making Gull Point the site of significant concentrations of migrating shorebirds - a group which includes a variety of sandpipers, plovers, and related birds. Concern has been expressed that because Gull Point is a depositional feature with a high natural resource value related to its dynamic nature, structures and practices which minimize the forces causing sand accumulation might threaten this resource.

Terrestrial Resources: Western Pennsylvania Conservancy's "Pennsylvania Endangered Plant Survey." - The Western Pennsylvania Conservancy, a private land-trust and education organization, in cooperation with the U.S. Fish and Wildlife Service is currently compiling a list of rare and endangered vascular plant species in Pennsylvania. Eleven species of plants generally restricted to sandy lake shores which occur on the peninsula are included on the list.

Terrestrial Resources: Heritage Conservation and Recreation Service (HCRS) "Natural Landmarks Program." - The Federal Government, through HCRS, has compiled and is continually updating a listing of lands and waters within the U.S. which represent geological or ecological values of national significance. Inclusion of an area on the Registry of Natural Landmarks is accompanied by an understanding between the Secretary of the Interior and the landowner that the purpose of the Registry is to encourage preservation of significant areas and that continuance of Natural Landmark status is contingent upon protection and use of the site for purposes consistent with preservation of its natural integrity. Presque Isle was initially included on the Registry in 1967. The document certifying its eligibility states the following under the heading "Eligibility for Landmark Status:"

a. "Presque Isle is a significant illustration of a geological 'flying spit.' It is unique in the Great Lakes Region because of its size."

b. "There are ecological reserves in the park in which no development other than hiking trails is allowed. These reserves preserve among other things, a complete picture of plant succession, from nothing but sand and water to a permanent climax forest."

c. "The area is a resting place for great concentrations of southward migrating land and water birds. Over two hundred species have been recorded."

Terrestrial Resources (Wildlife): National Audubon Society's "Blue List." - In January 1971, the National Audubon Society inaugurated the maintenance of a list of North American bird species which are of special concern because they seem to be exhibiting a noncyclical decline in numbers in all or parts of their range. This list generally excludes those already proclaimed to be endangered and/or those known to be extreme rarities; it is meant to be an "early warning system" to identify bird species which may be near the threshold of reaching critical levels. The Society hopes that the list will call attention to species in trouble, and will serve to help correct the

situations causing the decline. Several species which are included on the Blue List are observed on the peninsula. Significant occurrences of declining species are of those for which the peninsula presents one or more of the factors related to the species decline. In this regard, the Piping Plover is noteworthy because it has been nearly completely extirpated from the Great Lakes. The peninsula, until fairly recently, supported nesting pairs of this bird. Last known to have bred on the peninsula in the late 1960's, this shorebird nests only on open sandy shores and has suffered greatly from habitat loss and disturbance through development and recreational use of shores. The habitat conditions required by the Piping Plover potentially exist on Presque Isle.

Recreation: Beaches - Presque Isle State Park is known for its extensive excellent quality beaches, of which 11 have been delineated and developed for bathing along the 6-mile Lake Erie shoreline. The beach width varies from about 50 feet up to about 150 feet feet. The crest elevation of most of the beaches are relatively low. The native sand is a fine, clean, light-colored material of fairly uniform texture. Beach nourishment material added in recent years is not of such fine quality, being darker, prone to gully-type erosion and hard-packing, and of an irregular, coarser particle size distribution. Restoration and preservation of the beaches is a primary objective of the cooperative beach erosion control project.

Aesthetics - The visual aspect of the lake, horizon, and sky as seen from Presque Isle's shoreline is impressive and desirable to many people. Also, the relatively undisturbed shoreline, as viewed along the shore is an identified important resource exploited by every beach user. Concern has been expressed that structural beach erosion control measures would be a visual affront which would significantly detract from the quality of the beach user's experience.

Aquatic Resources: Water Quality - The Lake Erie shoreline at Presque Isle is characterized by exceptionally good water quality, relative to many nearby areas, because of the recent improvement in overall quality of the lake water, the geographic situation of the Peninsula (being a projection into the lake, it is thereby distant and separated from shore-based contamination sources), and the rapid replacement of water by wave action. Concern has been expressed that structural plans for beach erosion control might cause a degradation in water quality by diminution of circulation along the shore, resulting in stagnation with an increase in coliform bacteria originating either from the bathers or from outside sources (in the latter instance, exogenous adverse conditions would persist because of diminished water turnover rate).

ENVIRONMENTAL EFFECTS

TERRESTRIAL RESOURCES

Cultural Resources - The State Historic Preservation Office of the Pennsylvania Historical and Museum Commission, in a letter dated 22 May 1979, stated that the proposed work would not have an effect on known historic or archeological resources, under any of the alternatives (see Exhibit F-25 in Appendix F).

Natural Resources and Wildlife - Some temporary impacts would occur to the wildlife populations and their habitat as a result of construction of implementable alternatives. These impacts are expected to be of short duration and confined mostly to the immediate project area. Noise generated by construction equipment and related activity would drive out species which are intolerant of disturbances. There would not be any long-term impacts to endangered birds and/or plants under any of the three implementable alternatives or the No Action Plan.

The implementable structural plans would have a negative impact on the terrestrial vegetation, because they involve activity on land, (i.e., the pipeline and booster stations of the Sand Trap Recirculation Plan) or a terrestrial right-of-way to the beaches (i.e., the beach nourishment phase of the remaining plans). The beach nourishment phase would have negligible impact upon vegetation since the beaches where nourishment material is to be spread are naturally barren of plant life in the lower reaches, and the upland routes to the beaches are well established. The pipeline in the Sand Trap Plan is conceived to carry sand in a slurry from the Sunset Point area of the peninsula to the neck and would have considerable immediate effect on vegetation. The pipeline would be above ground and its installation would disturb the shrubs and smaller plants presently occupying this space. Booster stations similarly would probably be located in semi-open areas where shrubs are likely the dominant life forms.

Each of the three implementable alternatives, as well as the No Action Plan, would have an impact on terrestrial habitat in the form of gain or loss of land area. Under the Groin Alternative, 55 acres of terrestrial habitat would be gained by sand placement during initial replenishment and annual nourishment. Under the Segmented Breakwater Plan, 34 acres of terrestrial habitat would be gained by sand placement. With the Sand Trap Recirculation Plan, 34 acres would be gained by sand placement and 2 acres would be altered due to placement of the pipeline and booster stations along the road. Since the No Action Plan includes a minor level of annual nourishment, no terrestrial habitat would be gained.

Under the Groin Alternative, it is calculated that 144,550 cubic yards of material per year would be transported eastward toward Gull Point. Of this, it is estimated that 73,200 cubic yards would be deposited in the entrance channel to Erie Harbor, 28,900 cubic yards would provide for subaqueous growth, and 42,450 cubic yards would accrete at Gull Point, resulting in approximately 1 acre of terrestrial habitat created each year. Under the Segmented Breakwater Alternative, it is estimated that 72,250 cubic yards of

material per year would be transported eastward toward Gull Point. Of this, it is projected that 36,600 cubic yards would be deposited in the entrance channel to Erie Harbor, 14,450 cubic yards would provide for subaqueous growth, and 21,200 cubic yards would accrete at Gull Point resulting in about 0.5 acre of terrestrial habitat created each year. With the Sand Trap Recirculation Alternative, about 61,400 cubic yards of material per year would be transported eastward toward Gull Point. Of this, approximately 30,700 cubic yards would be deposited in the entrance channel to Erie Harbor, 12,300 cubic yards would provide for subaqueous growth, and 18,400 cubic yards would accrete at Gull Point resulting in about 0.5 acre of terrestrial habitat created each year. Under the No Action Plan, it is expected that 131,600 cubic yards of material per year would be transported eastward toward Gull Point. Of this, it is likely that 75,000 cubic yards would be deposited in the entrance channel to Erie Harbor, 26,300 cubic yards would provide for subaqueous growth, and 30,300 cubic yards would accrete at Gull Point resulting in about 0.7 acre of terrestrial habitat created.

Certain aspects of all the preferred plans, except for the No Action Plan, would require the commitment of natural resources in the form of construction material and energy expended during the construction process. These include: (1) Stone - The alternatives that use the most stone are groins and segmented breakwaters each employing about 173,000 and 456,000 tons, respectively. Sand trap recirculation uses about the same amount of stone as would be used with the groin alternative. The No Action Plan uses no stone; (2) Steel - Steel sheet piling, in the amount of 222,000 square feet, would be used in groin construction. Sand trap recirculation would utilize a 29,000-foot permanent steel pipeline of 20-inch diameter. No steel would be used in either the Segmented Breakwater or No Action Plans; (3) Beach fill - Groins would require an initial replenishment of 850,000 cubic yards of sandfill and an annual replenishment of 130,700 cubic yards. Segmented breakwaters would require initial replenishment of 500,000 cubic yards of sandfill and an annual replenishment of 37,900 cubic yards. The Sand Trap Recirculation Alternative would require an initial replenishment of 500,000 cubic yards of sandfill (270,000 cubic yards from the sand trap and 230,000 cubic yards from outside sources) and an annual replenishment requirement of 311,200 cubic yards (227,600 cubic yards from the sand trap and 83,600 cubic yards from an outside source). The No Action Plan would require an annual replenishment of 57,000 cubic yards; (4) Oil and gasoline would be used by vehicles and machinery in all phases of construction and in annual replenishment under all plans.

RECREATION

Public Facilities and Services - Local business establishments such as restaurants, service and repair shops, motels, and retail stores, may be expected to benefit from the presence of construction workers involved in carrying out all plans except the No Action Plan. This effect would be slight because of the small size of the anticipated work crews (up to 100 persons) compared to the population of Erie. Similarly, demand for public services, in the form of police, rescue, and medical services may rise due to the presence of the workers, with the magnitude of this effect being very slight. Other public services, such as refuse collection, sewage treatment,

Recreational Facilities and Services - All plans, with the exception of the No Action Plan, would provide adequate protection for the recreational resources at Presque Isle State Park. Alternative 1, the Groin Alternative, would provide protection to the neck and thus the existing roadway. The initial nourishment and annual beach replenishment would provide for recreational beaches with a design width of 60 feet and a crest elevation of +10 feet above LWD. This would be sufficient to accommodate future expected attendance. The series of groins, supplemented with the annual nourishment would serve to protect the beaches from erosion as well as the existing picnic, concession, parking, and changing facilities which are adequate to accommodate expected future attendance. The primary intent of the groins is to contain beach material which would otherwise be lost by the longshore transport process. Groins would permit ice to form naturally and would not serve to reduce ice damage to the shore.

Alternative 2, or Segmented Breakwaters, would also protect the neck of the peninsula from erosion and thus the existing roadway, as well as provide beaches with a design width of 60 feet and a crest elevation of +10 feet above LWD. This would be sufficient to accommodate future expected capacity. The beaches and breakwaters would protect the existing picnic, changing, parking and concession facilities, all of which are adequate to accommodate future expected attendance. Ice conditions along the shore would be influenced by the presence of the breakwaters. Windrows of ice, which presently pile up along the beaches would be reduced in size. In fact, there probably would not be any substantial windrow formation except directly on the breakwaters. Reduced wave action behind the breakwaters may hasten the formation of ice in the fall. This would have a positive effect on beach protection because an ice cover substantially protects the beaches from wave action. The breakwaters would prevent severe damage that is often caused by early storms which occur before an ice cover can build up. The spring breakup of the accumulated ice may be delayed slightly by the breakwaters due to physical effects of reduced wave and current energy, thereby providing protection to the beaches from spring storms. Therefore, with the construction of the proposed breakwaters, the extent and permanence of the existing beaches would be enhanced.

Alternative 3, or Sand Trap Recirculation, would also provide, through initial and annual nourishment, protection for the neck, beaches, and existing facilities such as picnic areas, changing facilities, parking lots, and concession stands. These facilities and services are adequate to accommodate future expected attendance. The beaches would be maintained with a design width of 60 feet and a crest elevation of +10 feet above LWD. This would also be adequate to accommodate future expected park attendance. Since the alternative would have a minimal impact on wave and current energy, ice would be permitted to form naturally and ice damage to the shore would not be reduced.

Alternative 4, or No Action, would provide no protection to any of the recreational resources at Presque Isle, including access roadways, parking areas, beaches, picnic and hiking areas, concession stands, and changing facilities. Dynamic forces of wave-induced sand transport would continue

undiminished. Existing shore protection structures would eventually fail and migration of the peninsula would occur causing subsequent reformation further eastward of the neck portion. This would be a gradual process. Immediate impacts would be the loss of most of the recreational resources of Presque Isle, as bathing areas are reduced by storm wave action and land access to the park is rendered impossible due to damage to the road along the neck portion.

AESTHETICS

Construction noises which would occur could be disturbing to visitors in the park if any one of the alternatives is carried out. Probably the most disturbing noises would occur with the Groin Alternative, as that involves work at the shoreline and lakeward along nearly the entire length of the peninsula. The work would involve, in addition to the placement of rock with a crane, the installation of sheet steel plates pounded into the substrate using a pile driver. This would be noise of exceptional intensity and duration. Segmented breakwater construction would be accompanied by the fairly continuous motor noise of cranes moving stone into position; this impact would be less intense than the noise of the Groin Alternative, but like it, would be of long duration. The beach nourishment aspects of the Segmented Breakwater and Groins plans would generate noise during earth-moving operations using trucks and bulldozers, which would be moderate to high in intensity but would be fairly localized, of short duration, and would be onshore where sound is likely to be partly absorbed by adjacent vegetation. The Sand Trap Recirculation Alternative involves construction of a breakwater and the noise generated would be of the same type associated with the segmented breakwaters. The Sand Trap Recirculation Plan includes laying a 3-mile long permanent pipeline which would involve generation of noise of fairly low magnitude but would occur near roads and beaches where the visitor density can be expected to be high. The annual nourishment phases of the No Action alternative would generate noise, during earth-moving operations, using trucks and bulldozers, which would be moderate to high in intensity but would be fairly localized, of short duration, and would be onshore where sound is likely to be partly absorbed by adjacent vegetation.

Climatic conditions of the Lake Erie coast dictate that major construction be accomplished during the spring-fall months which is the period of heaviest use of the park and beaches. Beach nourishment can be performed in spring before most bathers frequent the area. Offshore construction activities would present an obstruction to the natural view of the lake and in some ways detract from the scenic beauty of the shore. Conversely, some visitors to the area might derive pleasure and interest from viewing construction work in progress.

Under Alternative 1, the Groin Alternative, the extent and permanence of the existing beaches would be enhanced. The aesthetic effects of the enhanced beaches would be desirable to most people. In some reaches of the present beach system, erosion has removed virtually all of the beach sand and has progressed landward to claim trees and shrubs whose broken remains litter long reaches of the shore. Prevention of this process would have pleasing aesthetic effects. However, the presence of groins would represent an

unsightly departure from an undisturbed beach. The natural wave action desired by bathers would remain, as would an uninterrupted view of the lake.

Alternative 2, Segmented Breakwaters, would also enhance the extent and permanence of the beaches. This would prove to be more aesthetically pleasing

than an eroded, debris-strewn shoreline. The breakwaters would interrupt a clear view of the lake, which may prove to be aesthetically displeasing to some. The three prototype breakwaters which were constructed in 1978 at Beach No. 10 have a crest elevation of 574.6 which is about 4.0 feet above the long-term average level of Lake Erie. To date, no comments have been received that indicate that the existing prototype breakwaters are aesthetically objectionable. This indicates that the segmented breakwaters of the selected plan, which have a crest elevation of 578.8 or about 8.0 feet above the long-term average level of Lake Erie, might not be aesthetically objectionable to a significant degree. However, the proposed structures would be a visual affront of a greater magnitude than the prototype breakwaters, with many more structures having a crest elevation twice that of the three existing ones. This may prove to be aesthetically objectionable to some. Since the proposed breakwaters will be located at a greater distance offshore and have wider gaps between breakwater segments than the three existing prototype breakwaters, the objectionable aesthetic impacts may be somewhat ameliorated. Also, the natural wave action of the lake would be interrupted for appreciable distances along the shore. Between the breakwaters, however, the surf would remain essentially unchanged and those visitors wishing to witness the action of the waves would be able to do so along substantially long stretches of beach. The alternative would increase the length of the shoreline due to the saw-tooth beaches that would be created.

Alternative 3, Sand Trap Recirculation, would enhance the extent and permanence of the beaches as described under Alternatives 1 and 2. The aesthetic impacts of the Sand Trap Recirculation Plan are quite different from those of either the Groin or Segmented Breakwater Plans. The natural wave action, currents, and surf would not be interrupted. However, a continuous pipeline running along the road parallel to the lake could be considered by visitors to be an eyesore. The pipeline would lie directly on the ground and would probably be hidden by windblown sand and beach vegetation within a few years. The breakwater off Sunset Point, may also be aesthetically displeasing to some, as it would block the view of the open lake from that relatively small section of the shore.

Under Alternative 4, or the No Action Alternative, there would be no additional structures to interrupt the shoreline. The surf would be uninterrupted and a clear view of the open lake would be maintained. The beaches however, would remain unprotected and subject to erosion. This may be aesthetically displeasing to some, or pleasing to those who prefer the effects of the natural shoreline process.

AQUATIC RESOURCES

Water Quality - Some short-term impacts on water quality would occur during construction of any of the implementable beach erosion plans. There would probably be some unavoidable spilling of fuels, oil, and grease into the water from the operation of both land-based and marine construction and earthmoving equipment. Considerable amounts of turbidity would be unavoidably created during breakwater or groin construction, as well as during the annual beach nourishment operations for each of the alternatives, including No Action. This would be a high-magnitude, short-term impact and should disappear soon after construction and/or nourishment is completed.

The presence of structural measures in the form of breakwaters, implemented to control shoreline erosion might cause a degradation in water quality by lessening circulation longshore, resulting in a tendency towards stagnation with a concomitant increase in concentration of coliform bacteria originating either from the bathers or from outside sources. In the latter instance, exogenous adverse conditions would persist because of diminished water turnover rate. The magnitude of this effect cannot be predicted with a high degree of accuracy because it would be influenced by several fairly unpredictable factors, including: the presence or absence of a fecal coliform pollution source; weather (especially wind) conditions at the time of occurrence of high coliform levels, and; the effects of the proposed breakwaters on water turnover rate. Also, the nature of the interaction of these factors is not well understood. Despite inherent limitations to prediction, it is believed that systematic monitoring of the fecal coliform levels in water associated with the prototype breakwaters at beach 10 will significantly contribute to an understanding of the factor interactions which may result in elevated local fecal coliform levels. Toward these ends, the Buffalo District carried out a study in which sampling was performed (twice a week for 3 months during late Summer and Autumn of 1979) and analysis was carried out for fecal coliform levels at the prototype breakwaters, including nearby reference sites. The results of this study are inconclusive, and suggest the need for further, more intensive sampling; nearly all the values were quite low and exhibited no concentration differential between breakwater and reference sampling points, except for two dates which had abnormally high bacterial levels and which seemed also to exhibit a concentration gradient with higher values behind the breakwaters than at nearby reference sites. A more intensive and statistically valuable sampling program is presently being undertaken during 1980 to verify and expand upon the results from the 1979 study.

Neither Alternative 1, the Groin Alternative, or the No Action Plan include construction of breakwaters. Therefore, little or no adverse impact is expected on water quality due to high fecal coliform counts, if either of these plans is implemented. Implementation of Alternative 3, the Sand Trap Recirculation Alternative, may cause negligible degradation of water quality behind the breakwater only.

Aquatic Habitat - Aquatic habitat would be affected under all three of the implementable plans in addition to the No Action Plan. Under the Groin Alternative, 17 acres of existing aquatic habitat would be lost due to groin construction. However, the submerged groin surfaces would provide 6 acres of benthic habitat. This newly created habitat, while less in area than that lost, would likely provide greater diversity and productivity than existing conditions. Fifty-five acres of aquatic habitat would be lost due to initial sand placement and annual nourishment. If the Segmented Breakwater Alternative is implemented, 23 acres of existing aquatic habit would be lost due to breakwater construction. The submerged breakwater surfaces would provide 15 acres of benthic habitat. Sand placement would cause the loss of 34 acres. Under the Sand Trap Recirculation Alternative, 5 acres of existing aquatic habitat would be lost due to breakwater construction, but 3 acres of aquatic habitat would be gained on the breakwater's submerged surfaces. Thirty-four acres would be lost due to sand placement, and 21 acres would be

annually altered due to excavation in the sand trap. Under the No Action Alternative, no aquatic habitat would be gained or lost due to breakwaters or groins. However, 2 acres would be gained each year along the peninsula due to the erosion of beaches and dunes.

AIR RESOURCES

Air Quality - Air quality in the proposed project area would be temporarily affected by dust, noise, odors, and vehicle emissions due to the operation of construction equipment during implementation of any of the plans except the No Action Plan. The construction Contractor would be required to control such emissions and effects where practical.

PLAN ECONOMICS

If the Groin Alternative, Alternative 1, is implemented, initial investment cost would be $20,100,000 and average annual costs would be $2,816,000. Average annual benefits would be $4,256,000, and net benefits (average annual benefits - average annual costs) would be $1,440,000. The benefit/cost ratio (B/C = average annual benefits - average annual costs) for this alternative would be 1.51.

Initial investment cost for the tentatively selected plan, Alternative 2, Segmented Breakwaters, would be $22,800,000, and average annual costs would be $2,151,000. Average annual benefits would be $4,319,000, and net benefits would be $2,168,000. The B/C ratio for this alternative would be 2.01.

The Sand Trap Recirculation Alternative, or Alternative 3, would have an initial investment cost of $21,600,000 and average annual costs of $5,180,000. Average annual benefits would be $4,329,000 and net benefits would be $-851,000. This alternative would have a B/C ratio of 0.84.

The No Action Alternative, Alternative 4, would have an initial investment cost of $0, average annual costs of $683,000, average annual benefits of $0, net benefits of $0, and no B/C ratio.

PUBLIC INVOLVEMENT

Public Involvement Programs - The Senators and Congressmen representing the Erie, PA, area, in addition to all Federal and State agencies, the local private clubs and associations, and the general public have been involved in the current cooperative beach erosion control study for Presque Isle Peninsula since authorization of the review study in 1968. During preparation of the Review Report, three public meetings and one public workshop were held to keep concerned citizens informed of developments in the study and assess their views and input for incorporation into the planning process. In addition, two coordinating meetings were held between Buffalo District personnel and officials of the Pennsylvania Bureau of State Parks. Four television interviews were also used to transmit information to the public. There was also written correspondence with other Federal, State, and local agencies throughout the study. These activities are recorded in detail in the 1974 Review Report and Final Environmental Statement dated September 1975 which were prepared by the Buffalo District Engineer.

Public involvement activities during this reformulation investigation were initated by a news release issued on 19 October 1977 informing the public that a study which would recommend a plan of improvement that would prevent the loss of sand from the beaches at Presque Isle State Park was being initiated (see Exhibit A-1 in Appendix A.)

Copies of the draft Plan of Study were provided to the Senators and Congressmen in Erie, PA, to all Federal and State agencies, and to all private clubs and associations on the mailing list for their review and comment. Copies of the draft Plan of Study were placed on reserve in all Erie City and County libraries, and District Libraries in the northern Pennsylvania area to also allow the public an opportunity to review and comment on the report. A letter was sent to each individual on the mailing list (approximately 400 individuals) to inform them that the draft Plan of Study was available at the libraries. Availability of the draft Plan of Study at the libraries was also announced in the news media.

On Tuesday, 30 May 1978, an initial public meeting was held at Technical Memorial High School in Erie to inform the public about the alternatives which would be investigated during the Phase I General Design Memorandum study effort and to solicit public response and suggestions for the study. Colonel Daniel D. Ludwig, Buffalo District Engineer, presided over the meeting and six other Corps personnel were in attendance along with 13 interested citizens. The Corps presented seven concepts for controlling beach erosion: the Full Breakwater Plan, the Partial Breakwater Plan, the Groin Plan, the Recirculation Plan, the Recirculation Sand Trap Plan, the Annual Nourishment Plan, and the No Action Plan. In addition, the schedule for completion of the project was presented.

The Pennsylvania Department of Environmental Resources (DER) presented comments at the meeting on the importance of Presque Isle Peninsula to the City of Erie's growth and economy and its value in providing recreational opportunities for picnicking, swimming, and boating as well as its value to the ecologists and students of nature. The Department of Environmental Resources

voiced its opposition to the Board of Engineers for Rivers and Harbors recommendation that the Recirculation Sand Trap Alternative warrants further consideration. They are concerned about serious environmental and maintenance problems with the Sand Trap Alternative. The DER indicated that they favor construction of segmented rubblemound breakwaters and that they are prepared to meet the requirements of local cooperation and work for legislative approval of capital appropriations for the Commonwealth's share of the project.

The strongest environmental concerns were expressed by a private citizen in attendance who is concerned that the segmented breakwaters would interrupt the view of lake by bathers lying on the beach, interfere with swimming, and cause debris to collect on the beaches due to the loss of water circulation. A transcript of the 30 May 1978 public meeting is on file at the Buffalo District Office of the Corps of Engineers.

The Stage II documentation for this Phase I investigation was prepared in June 1979. Copies of the Stage II document were provided to the U.S. Fish and Wildlife Service, the U.S. Environmental Protection Agency, the Pennsylvania Fish Commission, Pennsylvania Game Commission, the Department of Environmental Resources, and Dr. Dag Nummedal for their review and comment.

On 26 September 1979 a public meeting was held in Erie, PA, during which the final set of alternatives for the cooperative beach erosion control project was presented, and the selection of the Segmented Breakwater Plan as the plan which will be recommended to Congress for Phase II design study was indicated. Eighteen persons were in attendance at the meeting, of which six were acting as representatives of an organization or agency. Nine attendees made statements or asked questions. A representative of the Pennsylvania Department of Environmental Resources: (1) outlined the benefits of Presque Isle Peninsula; (2) emphasized the importance of a beach erosion control plan that is energy efficient and economically efficient, meets aesthetic and safety considerations, and allows sand transport to Gull Point, and; (3) expressed favor for the Segmented Breakwater Plan along with proposals for modifications to improve safety and design of the breakwaters. Four attendees suggested modifications or alternative schemes for erosion control. One individual expressed concern that the breakwater could be a safety hazard to bathers by posing as an attraction which could result in the dangerous activities such as swimming to and climbing upon the breakwaters.

A Section 404 Public Notice for the Cooperative Beach Erosion Control Project at Presque Isle Peninsula in Erie, PA, was issued on 9 October 1979 (see Exhibit F-22 in Appendix F). The purpose of the Public Notice was to provide any person, who has an interest which may be affected by construction of 58 parallel-to-shore breakwater segments and placement of 750,000 cubic yards of sandfill along the entire shoreline of Presque Isle Peninsula, an opportunity to request a public hearing. The Public Notice was sent to all Senators and Congressmen in Erie, PA, to all Federal and State agencies, to all private clubs and associations, and all individuals on the Presque Isle mailing list. The only response received regarding the Public Notice was from the U.S. Fish and Wildlife Service (see Exhibit F-23 in Appendix F) which states that they have no problem with the selected plan.

A draft Phase I General Deign Memorandum was prepared in February 1979. Copies of the draft Phase I GDM were provided to the Senators and Congressmen in Erie, PA, to all Federal and State agencies, and to all private clubs and associations on the project mailing list for their review and comment. Copies of the draft Phase I GDM were placed on reserve in all Erie city and county libraries and District libraries in the northern Pennsylvania area to also allow the public an opportunity to review and comment on the report. A letter was sent to each individual on the project mailing list (approximately 400 individuals) to inform them that the draft Phase I GDM is available at the libraries. Availaibility of the draft Phase I GDM at the libraries was also announced in the news media.

A total of 115 copies of the draft Phase I General Design Memorandum were sent out for coordination with agencies, organizations, and individuals. The reviewers furnishd 10 letters of comment to the Corps withn the official 45-day review period of which seven were from Federal agencies, one was from the Presque Isle State Park Superintendent, one was from the Acquisitions Librarian at Gannan College, and one was from a concerned individual. Six of the letters of comment only acknowledged receipt of the document and indicated that the reviewers had no comments or objections to offer. Other topics included: (1) a suggestion that the breakwaters be sine shaped; (2) a request from a Federal agency to see comments provided by a State agency; (3) a concern that the crest elevation of the 58 proposed breakwaters will greatly interrupt the view of the lake; (4) a suggestion that additional prototype breakwaters be constructed to check the design data; (5) a recommendation that a revision to the project be considered through development of stable structures of lesser height in a model test; and, (6) information regarding the State's proposed public boat launching ramp near Beach No. 1 at Presque Isle. The full text of comments received and responses to them are attached as exhibits F-34 through F-45 in Appendix F.

As discussed in the preceding paragraphs, the public involvement and coordination activities during the Phase I stage of the Presque Isle beach erosion control study have included two public meetings. The initial public meeting (attended by 13 persons) was held on 30 May 1978 to inform the public about the alternatives which would be investigated during the Phase I GDM study effort. On 26 September 1979, a second public meeting (attended by 19 persons) was held to review the alternatives which were developed during Stage II Planning. At the second public meeting, the selection of the Segmented Breakwater Plan as the plan which will be recommended to Congress for Phase II design study was indicated. A statement presented at the meeting by the Pennsylvania Department of Environmental Resources, as well as comments made by some of the interested citizens, indicated that the segmented offshore breakwater plan is the preferred plan for protection and improvement of Presque Isle Peninsula. Because there was no opposition against the segmented breakwater plan expressed at the 26 September meeting, a Section 404 Public Notice concerning the breakwater plan was issued on 9 October 1979 to nearly 500 agencies, organizations, and individuals on the project mailing list. The only response received regarding the Public Notice was from the U.S. Fish and Wildlife Service. Since it was a foregone conclusion at the 26 September meeting that the segmented breakwater plan was going to be the selected plan and since there had been no objections to the

breakwater plan during coordination of the draft Phase I GDM, approval to dispense with the late stage public meeting which was scheduled to be held in May 1980 was requested. The North Central Division Engineer agreed that there probably was no need to conduct the late stage public meeting; however, it was requested that a press release be issued to inform the appropriate agencies and local citizens that another public meeting is not considered necessary. In accordance with the NCD request, a press release was issued on 23 May 1980 and information packets describing the most recent plans which were considered in Stage III of the study along with the alternative which was selected as the recommended plan for protection and improvement of the beaches along Presque Isle Peninsula were prepared. The information packet was mailed to all agencies, organizations, and individuals on the project mailing list stating that due to the lack of opposition to the selected plan at previous public meetings and the general acceptance of the proposed plans to date, it is deemed unnecessary to hold another public meeting. The packet did however, give the reviewers the option of requesting a public hearing if they had an interest that may be affected by the segmented breakwater plan. The press release and information packet did not generate any expressions of support for another public meeting, therefore, the late stage public meeting was not held.

REQUIRED COORDINATION

Required coordination was accomplished by circulation of the DEIS for review and comment by various individuals, local, State, and Federal agencies as listed below. The DEIS was transmitted to USEPA for filing in the Federal Register on 28 February 1980. Official notice of availability of the DEIS was published in the Federal Register dated 14 March 1980, commencing the official 45-day review period. The official review period ended on 28 April 1980.

Federal

U. S. Department of Historic Preservation
U. S. Department of Agriculture
U. S. Department of Commerce
U. S. Department of Health, Education, and Welfare
U. S. Department of Housing and Urban Development
U. S. Department of the Interior
U. S. Department of Transportation
U. S. Environmental Protection Agency
U. S. Department of Energy

State

Pennsylvania State Clearinghouse
Honorable Richard L. Thornburgh, Governor, Commonwealth of Pennsylvania

Local

Erie County Metropolitan Planning Commission
Mayor Louis J. Tullio, Erie, PA
Erie Morning News
Erie Daily Times
Presque Isle Audubon Society, Erie, PA
Presque Isle State Park, Erie, PA

Legislative

Honorable H. John Heinz, U.S. Senator
Honorable Richard Schweiker, U. S. Senator
Honorable William Clinger, Representative in Congress
Honorable Mark L. Marks, Representative in Congress
Honorable Bernard Dombrowski, State Representative, 1st District
Honorable Italo S. Cappabiance, State Representative, 2nd District
Honorable David C. DiCarlo, State Representative, 3rd District
Honorable Harry E Bowser, State Representative, 4th District
Honorable David S. Hayes, State Representaitve, 5th District

Individuals

Individuals and other interested parties were notified of the availability of the DEIS for review and comment in the local libraries, through a Corps press release and by sending each individual on the project mailing list a letter.

INDEX AND REFERENCES

(Selected Plan is Alternative 2, Segmented Breakwaters)

Subject	STUDY DOCUMENTATION: Environmental Impact Statement (pages)	Main Report (References Incorporated) (pages)	Report Appendices (References Incorporated)
Aesthetics	H18, H22-H23	D5-D10, D20-D22	
Affected Environment	H15-H18	B1-B22, D5-D10, D20-D25	
Air Resources	H25	D5-D10	
Alternatives	H9-H14	C10-C22, D1-D5	A, C
Aquatic Resources	H18, H23-H25	B21-B22, D5-D10	
Areas of Controversy	H4		
Comparative Impacts of Alternatives	H14		
Cover Sheet	H1		
Environmental Effects	H19-H25	D5-D10, E2, F5, Fig. 17	
Implementation Responsibilities	H12-H13	D10-D19	
List of Preparers	H2		
Major Conclusions and Findings	H3-H4	F1-F7	
Need for and Objectives of Action	H5-H8		
Plan Economics	H25	D12-D19, E2, E3, F5	B
Planning Objectives	H7-H8	B37-B38, D20-D27	
Plans Considered in Detail	H10-H12	D1-D5	A, C

INDEX (Cont'd)
(Selected Plan is Alternative 2, Segmented Breakwaters)

Subject	STUDY DOCUMENTATION: Environmental Impact Statement (pages)	Main Report (References Incorporated) (pages)	Report Appendices (References Incorporated)
Plans Eliminated from Further Study	H9-H10	C10-C20	A, C
Public Concerns	H5-H7	B35-B36	
Public Involvement	H26-H29	A11-A14, D28-D30 F1-F2	
Recreation Resources	H18, H20-H22	B22-23	B
Relationship to Environmental Requirements	H4		
Required Coordination	H30	A14-A15, F1-F2	
Section 404 Evaluation	H4, H27	A13	App F, Exhibit F29
Significant Resources	H16-H18, H19-H25	D5-D10	
Statement Recipients	H30		
Study Authority	H5	A1-A4	
Summary	H3-H4		
Terrestrial Resources	H16-H18, H19-H20	B17-B20	
Unresolved Issues	H4		
Without Conditions (No Action)	H11-H12	B25-B35, D2, D3, D10	

SECTION I
RECOMMENDATIONS

RECOMMENDATIONS

It is recommended that the selected plan for control of beach erosion at Presque Isle Peninsula in Erie, PA, described in this report and shown on the Recommended Plan at the end of this report, with such modifications deemed advisable by the Chief of Engineers, be used as a basis for the Phase II General Design Memorandum and construction. The total estimated first cost is $22,800,000, of which the Federal Government and non-Federal interests will cost share. The estimated Federal first costs will be $15,960,000 based on the 70/30 percent traditional cost-sharing policy.

President Carter, in his June 1978 water policy message to Congress, proposed several changes in cost-sharing for water resource projects to allow States to participate more actively in project implementation decisions. These changes include a cash contribution from benefiting States of 5 percent of construction (first) costs associated with nonvendible outputs and 10 percent of costs associated with vendible outputs. Application of this policy to the Presque Isle cooperative beach erosion control project requires a cash contribution from the State of 5 percent of an estimated $22,800,000 (5 percent of $22,800,000 total estimated first costs of construction assigned to nonvendible project purposes, based on October 1980 price levels). This contribution is in addition to other items of local cooperation usually required for shore projects including cost participation based on shore ownership and use. The total non-Federal cost would be $7,980,000, and thus, the Federal share would be $14,820,000. I recommend construction authorization for the Presque Isle project in accordance with the President's proposed cost-sharing policy.

The project recommendation is made with the understanding that prior to construction, non-Federal interest will, pursuant to Section 221 of Public Law 91-611, agree in writing to:

a. Provide without cost to the United States all lands, easements, and rights-of-way, including suitable borrow and spoil disposal areas as determined by the Chief of Engineers, necessary for the construction of the project; the provision of borrow areas shall not include material required for initial beach replenishment;

b. Provide a cash contribution equal to the appropriate percentage of the final construction cost, exclusive of lands, easements, and rights-of-way; the percentage to be in accordance with existing law based on shore ownership and use existing at the time of construction, and the President's proposed cost-sharing policy, which contribution is presently estimated at $7,980,000 or 35 percent;

c. Pay 30 percent of the annual beach redistribution and replenishment costs for the project;

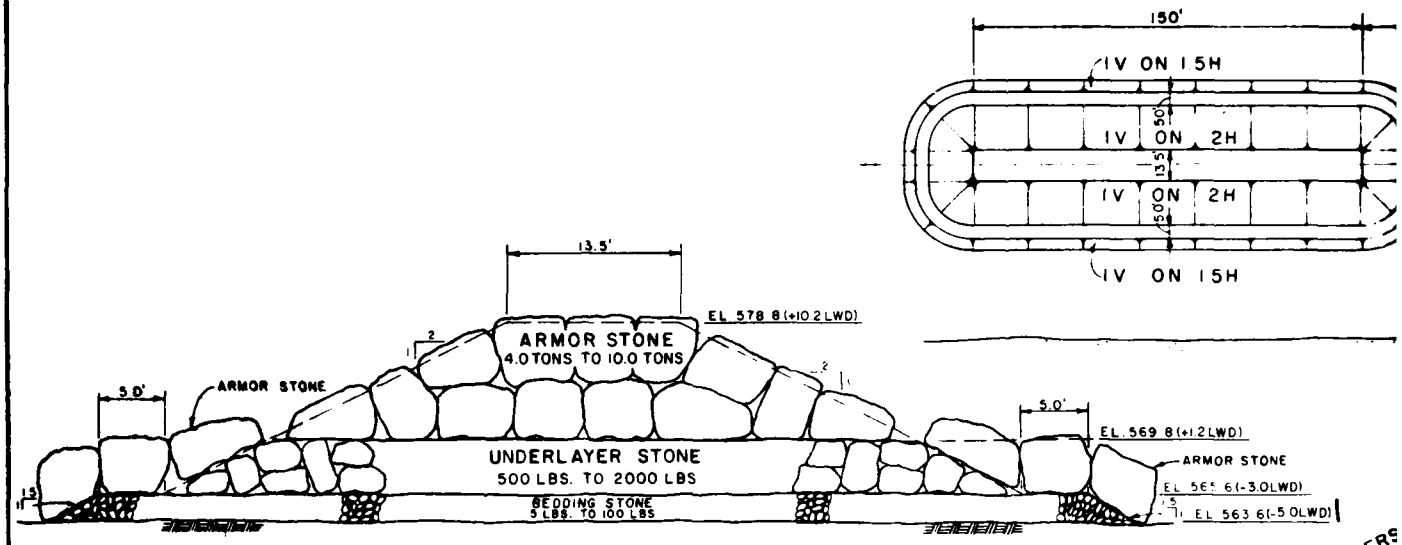
d. Hold and save the United States free from damages due to construction works, except for damages caused through the fault or negligence of the United States or its Contractors;

e. Maintain and operate all the works, including periodic sand replenishment and redistribution as needed, after completion and in accordance with regulations prescribed by the Secretary of the Army;

f. Assure continued public ownership or continued public use, without cost to the United States, of appropriate access and facilities, including parking and sanitation, necessary for realization of the public benefits upon which Federal participation is based, and administer and maintain the beach for continued public use during the life of the project;

g. Control water pollution to the extent necessary to safeguard the health of bathers; and

h. Comply with the applicable provisions of the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970 (Public Law 91-646 approved 2 January 1971) in acquiring land, easements, and rights-of-way for construction and subsequent maintenance of the project and inform affected persons of pertinent benefits, policies, and procedures in connection with said Act.



TYPICAL SECTION

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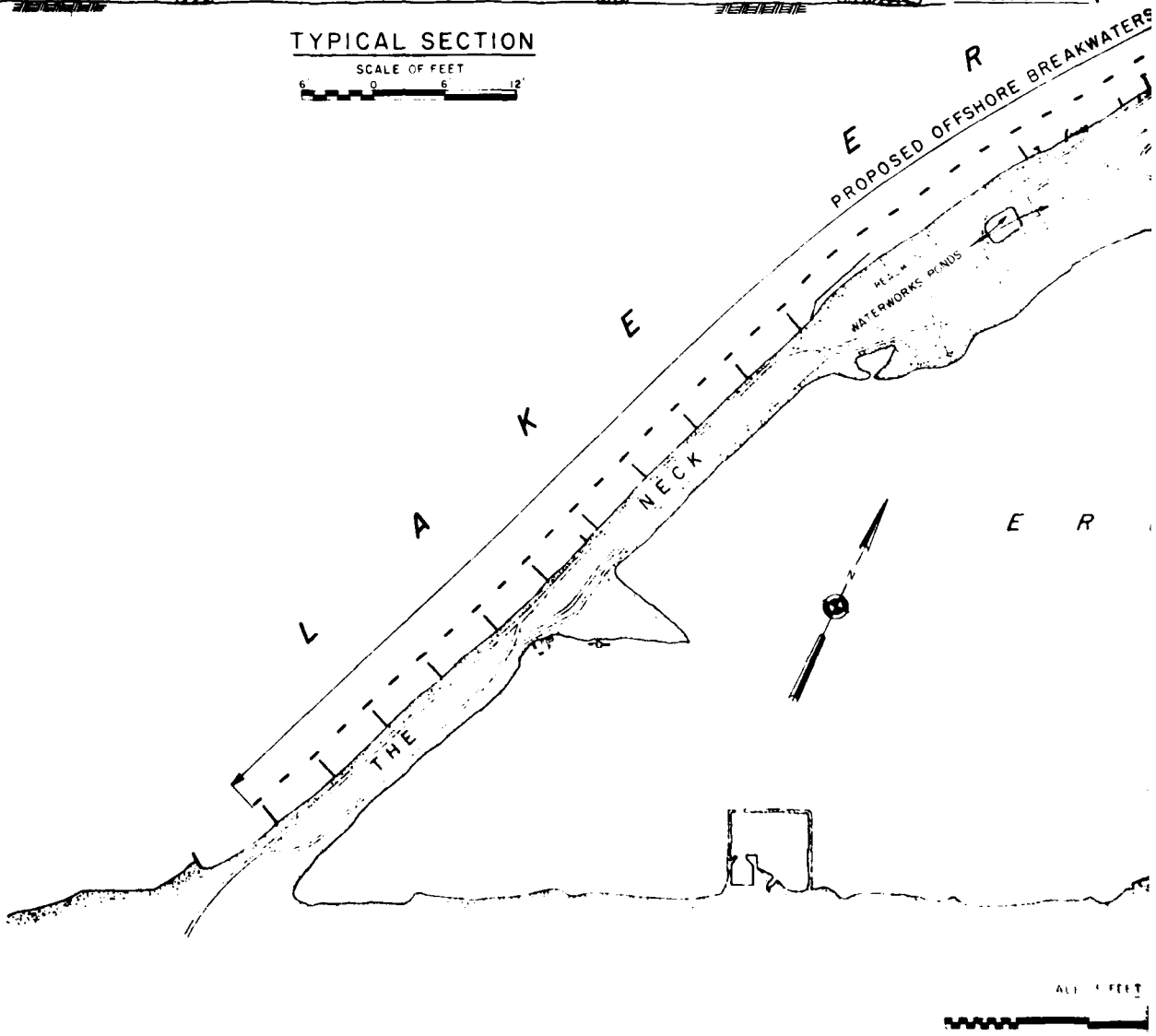

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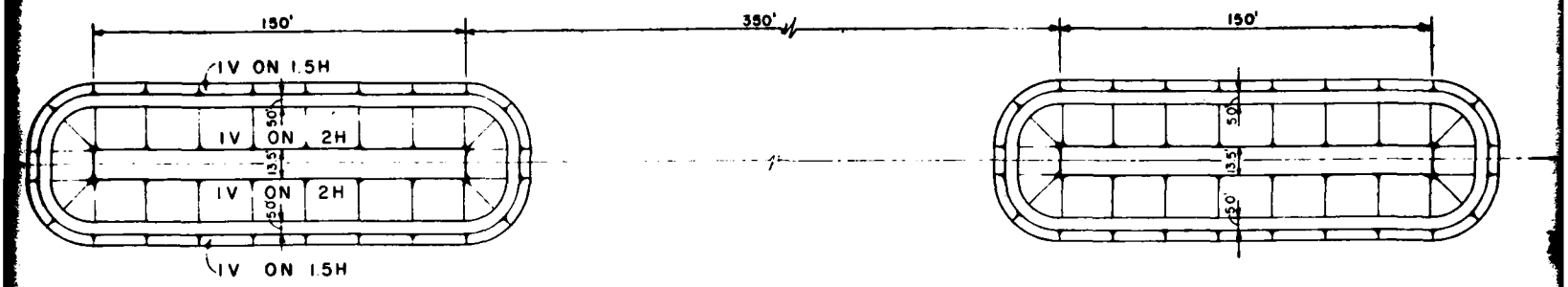

BREAKWATER PLAN

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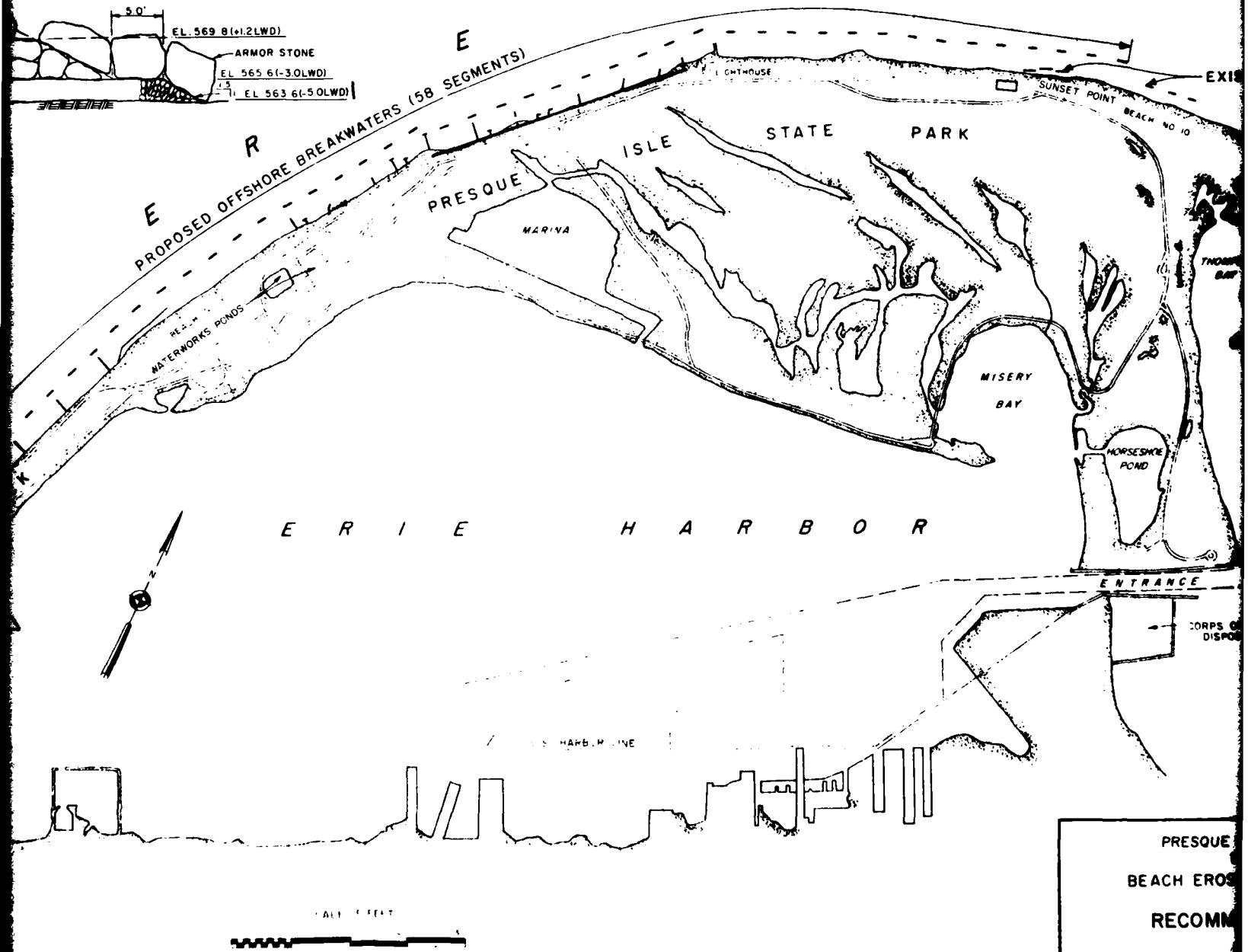

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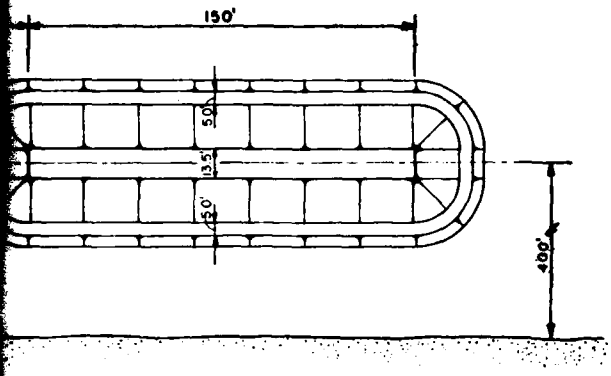

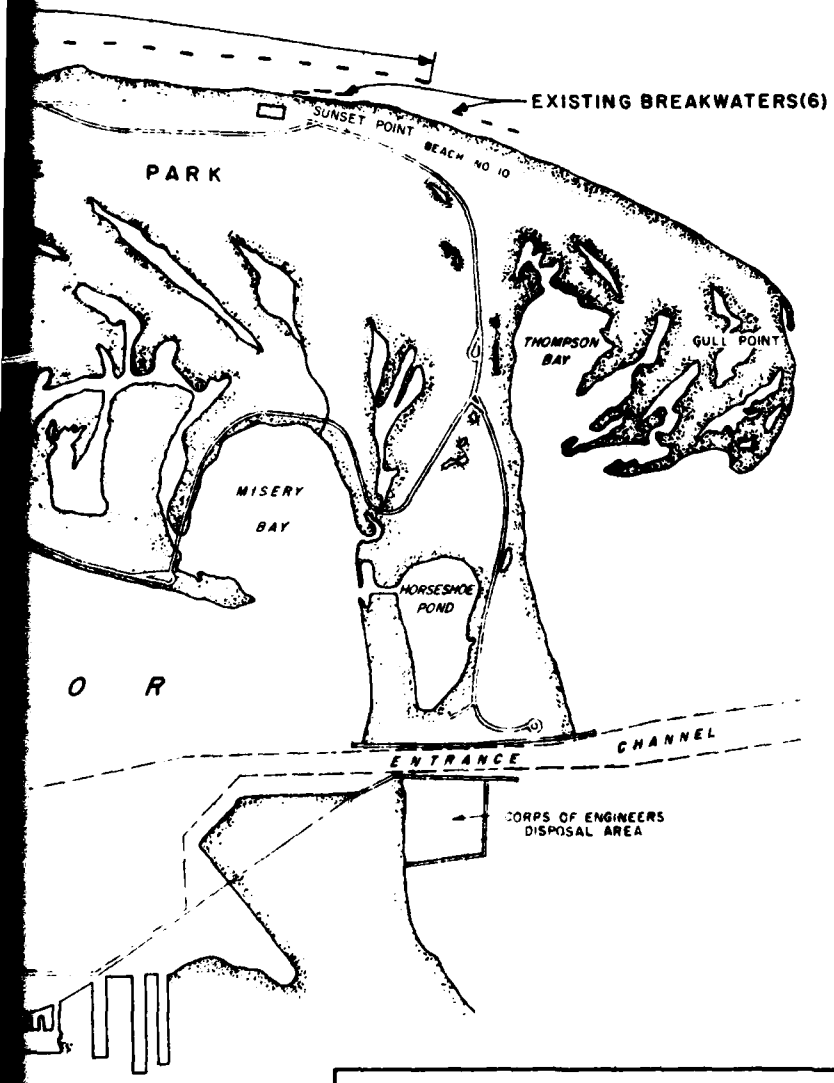

PRESQUE ISLE PENINSULA
ERIE, PA
BEACH EROSION CONTROL STUDY

RECOMMENDED PLAN

U S ARMY ENGINEER DISTRICT BUFFALO
TO ACCOMPANY FINAL PHASE I GENERAL DESIGN MEMORANDUM
JUNE 1980