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PRESQUE ISLE PENINSULA, FRIE, PENNSYLVANIA. VOLUME II. APPENDIC--ETC(U)
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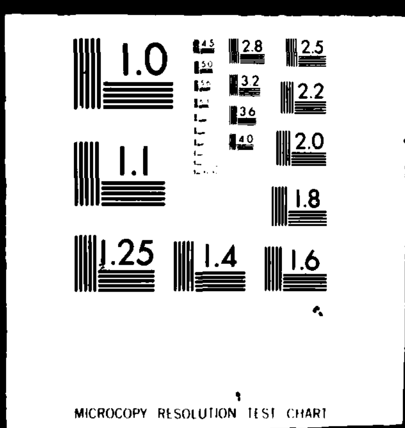

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19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Beach Erosion Control
Beach Restoration
Offshore Breakwater System
Rubblemound Breakwaters
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.

PRESQUE ISLE PENINSULA
ERIE, PENNSYLVANIA

PHASE I
GENERAL DESIGN MEMORANDUM

APPENDIX A

PLATES

APPENDIX A
PLATES

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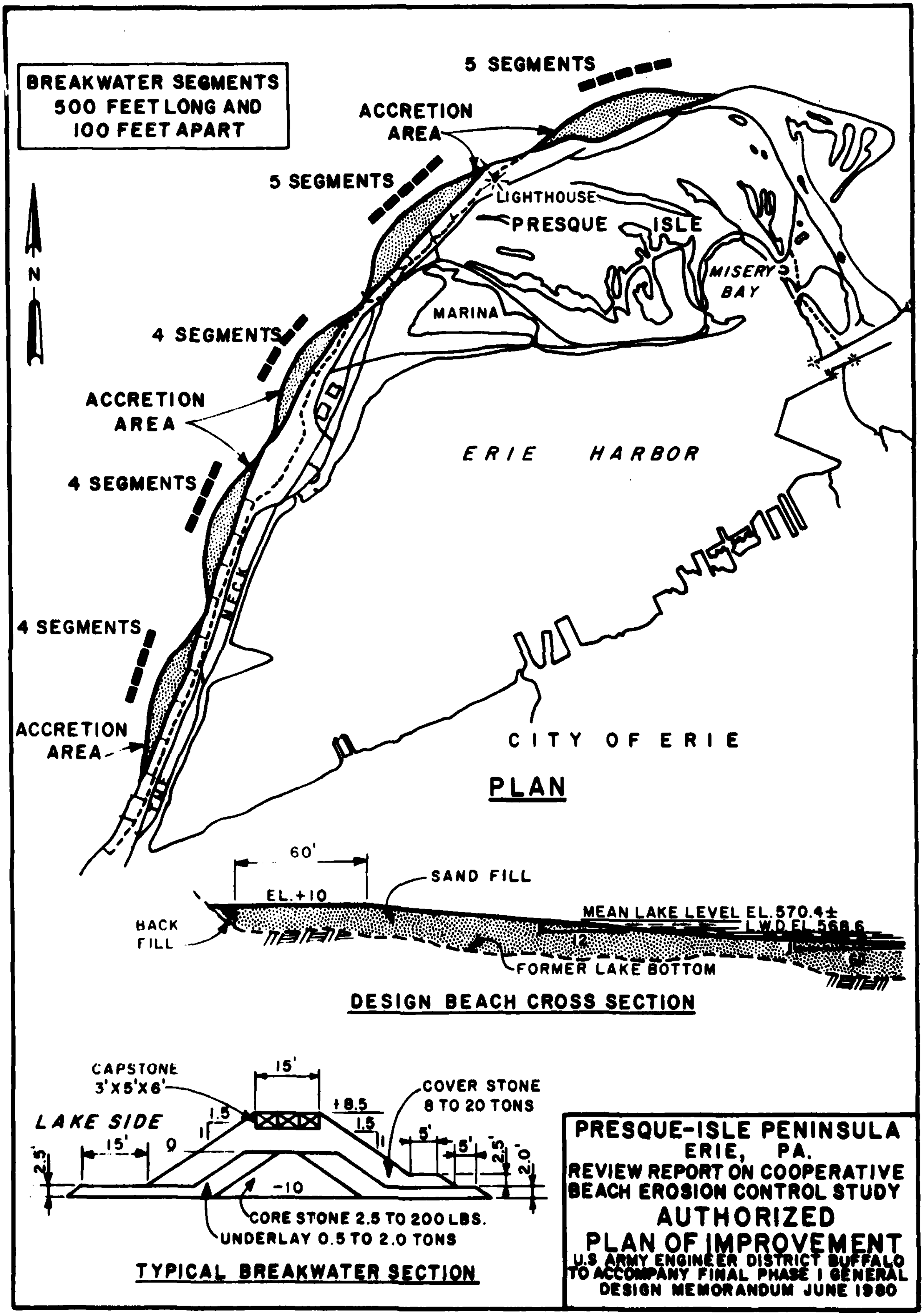
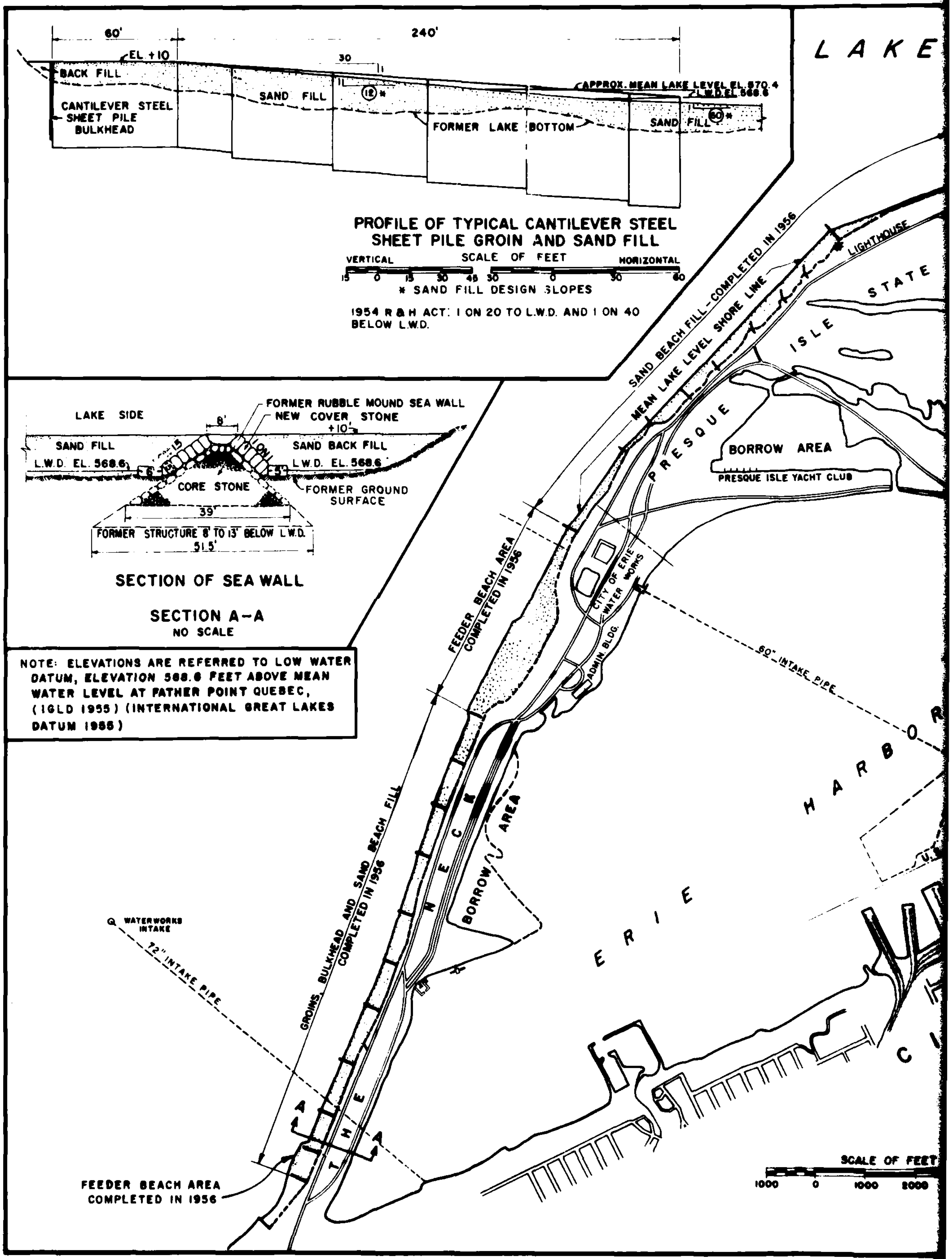
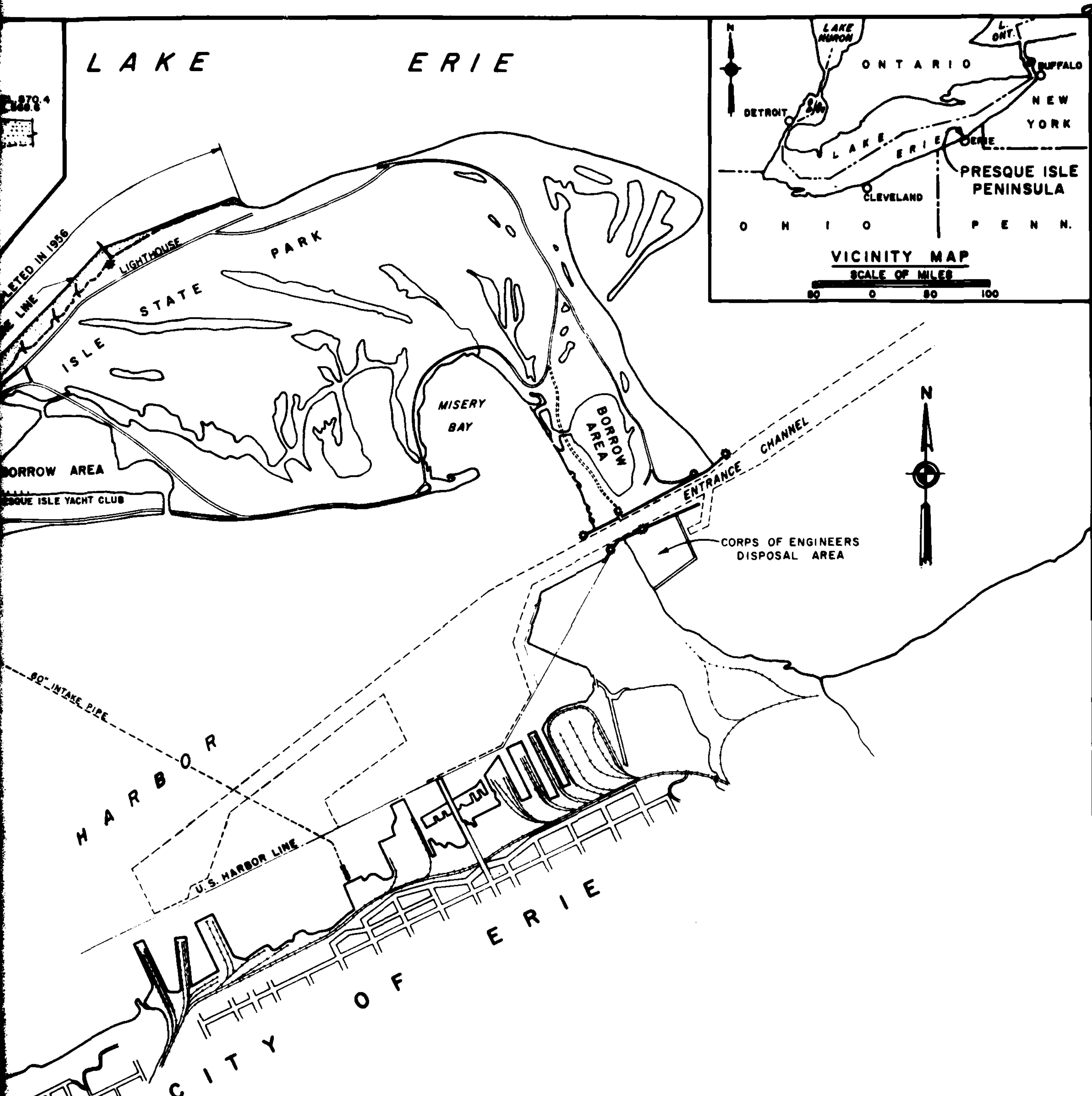


BREAKWATER SEGMENTS 500 FEET LONG AND 100 FEET APART
5 SEGMENTS
ACCRETION AREA
5 SEGMENTS
LIGHTHOUSE
PRESQUE ISLE
N
MISERY BAY
MARINA
4 SEGMENTS
ACCRETION AREA
ERIE HARBOR
4 SEGMENTS
NECK
4 SEGMENTS
ACCRETION AREA
CITY OF ERIE
PLAN
60'
SAND FILL
EL.+10
MEAN LAKE LEVEL EL.570.4±
L.W.D. EL.568.6
BACK FILL
12
FORMER LAKE BOTTOM
DESIGN BEACH CROSS SECTION
CAPSTONE 3'X5'X6'
15'
COVER STONE 8 TO 20 TONS
LAKE SIDE
+8.5
1.5
1
15'
9
5'
5'
2.5'
2.5'
2.0'
-10
CORE STONE 2.5 TO 200 LBS.
UNDERLAY 0.5 TO 2.0 TONS
TYPICAL BREAKWATER SECTION
PRESQUE-ISLE PENINSULA
ERIE, PA.
REVIEW REPORT ON COOPERATIVE BEACH EROSION CONTROL STUDY
AUTHORIZED PLAN OF IMPROVEMENT
U.S ARMY ENGINEER DISTRICT BUFFALO
TO ACCOMPANY FINAL PHASE I GENERAL DESIGN MEMORANDUM JUNE 1980

PLATE I



60'
240'
EL +10
30
BACK FILL
CANTILEVER STEEL SHEET PILE BULKHEAD
SAND FILL
APPROX. MEAN LAKE LEVEL EL. 570.4
L.W.D. EL. 568.6
FORMER LAKE BOTTOM
SAND FILL
PROFILE OF TYPICAL CANTILEVER STEEL SHEET PILE GROIN AND SAND FILL
VERTICAL SCALE OF FEET HORIZONTAL
* SAND FILL DESIGN SLOPES
1954 R & H ACT: 1 ON 20 TO L.W.D. AND 1 ON 40 BELOW L.W.D.
LAKE SIDE
FORMER RUBBLE MOUND SEA WALL
NEW COVER STONE
8'
+10'
SAND FILL
SAND BACK FILL
L.W.D. EL. 568.6
L.W.D. EL. 568.6
CORE STONE
FORMER GROUND SURFACE
39'
FORMER STRUCTURE 8' TO 13' BELOW L.W.D.
51.5'
SECTION OF SEA WALL
SECTION A-A
NO SCALE
NOTE: ELEVATIONS ARE REFERRED TO LOW WATER DATUM, ELEVATION 568.6 FEET ABOVE MEAN WATER LEVEL AT FATHER POINT QUEBEC, (IGLD 1955) (INTERNATIONAL GREAT LAKES DATUM 1955)
LAKE
SAND BEACH FILL-COMPLETED IN 1956
MEAN LAKE LEVEL SHORE LINE
LIGHTHOUSE
PRESQUE ISLE STATE
BORROW AREA
PRESQUE ISLE YACHT CLUB
FEEDER BEACH AREA COMPLETED IN 1956
CITY OF ERIE WATER WORKS
ADMIN. BLDG.
60" INTAKE PIPE
HARBOR
NECK
BORROW AREA
GROINS, BULKHEAD AND SAND BEACH FILL COMPLETED IN 1956
WATERWORKS INTAKE
72" INTAKE PIPE
ERIE
A
A
THE
FEEDER BEACH AREA COMPLETED IN 1956
SCALE OF FEET
1000 0 1000 2000

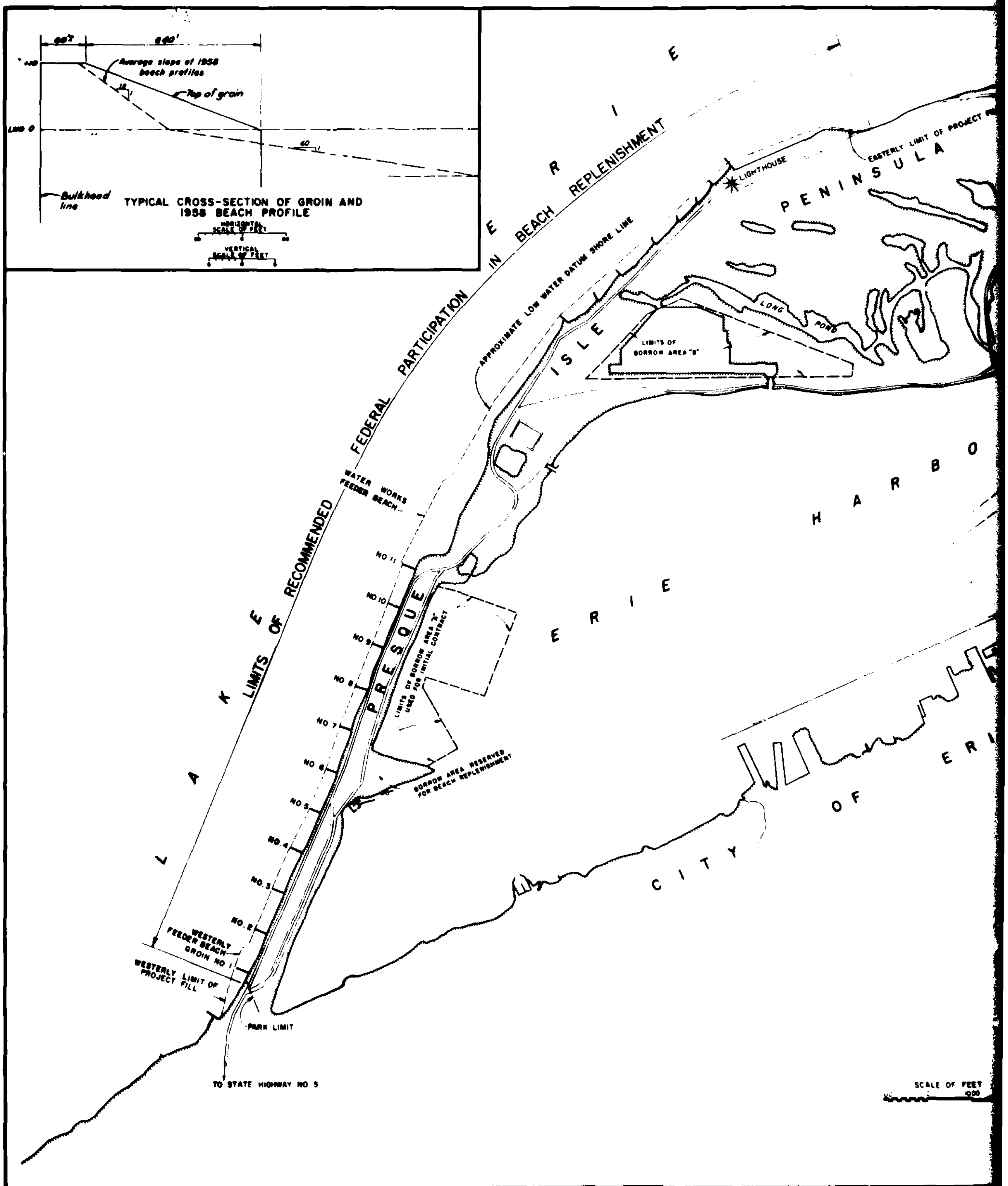


PRESQUE ISLE PENINSULA
ERIE, PA.
BEACH EROSION CONTROL STUDY

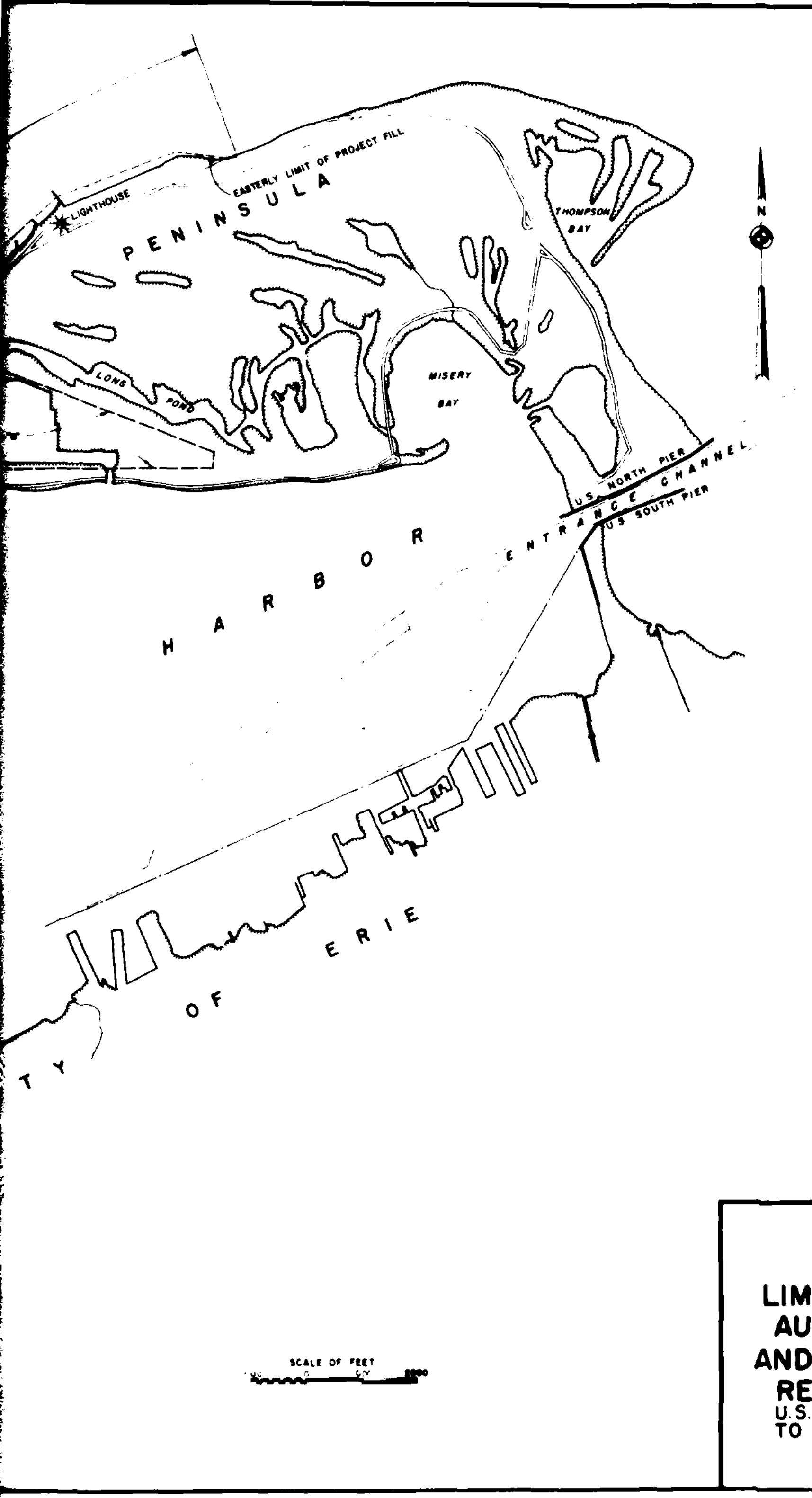
IMPROVEMENTS AUTHORIZED BY THE 1954 RIVER AND HARBOR ACT

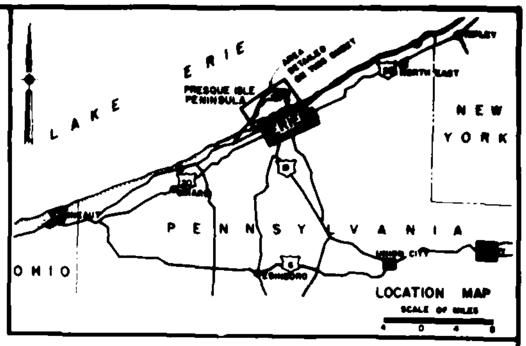
U.S. ARMY ENGINEER DISTRICT BUFFALO
TO ACCOMPANY FINAL PHASE I GENERAL DESIGN MEMORANDUM
JUNE 1980

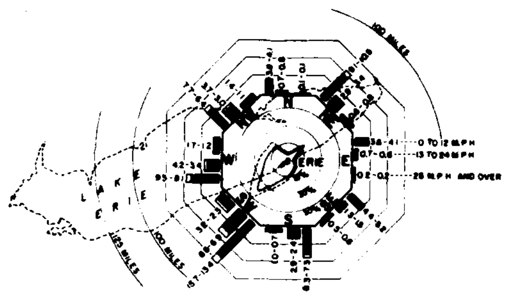
PLATE 2



TYPICAL CROSS-SECTION OF GROIN AND
1958 BEACH PROFILE
Average slope of 1958 beach profiles
Top of groin
Bulkhead line
HORIZONTAL SCALE OF FEET
VERTICAL SCALE OF FEET
L A K E   E R I E
LIMITS OF RECOMMENDED FEDERAL PARTICIPATION IN BEACH REPLENISHMENT
APPROXIMATE LOW WATER DATUM SHORE LINE
LIGHTHOUSE
EASTERLY LIMIT OF PROJECT FILL
P E N I N S U L A
LONG POND
LIMITS OF BORROW AREA "B"
I S L E
P R E S Q U E
WATER WORKS FEEDER BEACH
NO 11
NO 10
NO 9
NO 8
NO 7
NO 6
NO 5
NO 4
NO 3
NO 2
WESTERLY FEEDER BEACH GROIN NO 1
WESTERLY LIMIT OF PROJECT FILL
LIMITS OF BORROW AREA "A" USED FOR INITIAL CONTRACT
BORROW AREA RESERVED FOR BEACH REPLENISHMENT
PARK LIMIT
TO STATE HIGHWAY NO 5
H A R B O
E R I E
C I T Y   O F   E R I
SCALE OF FEET







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.

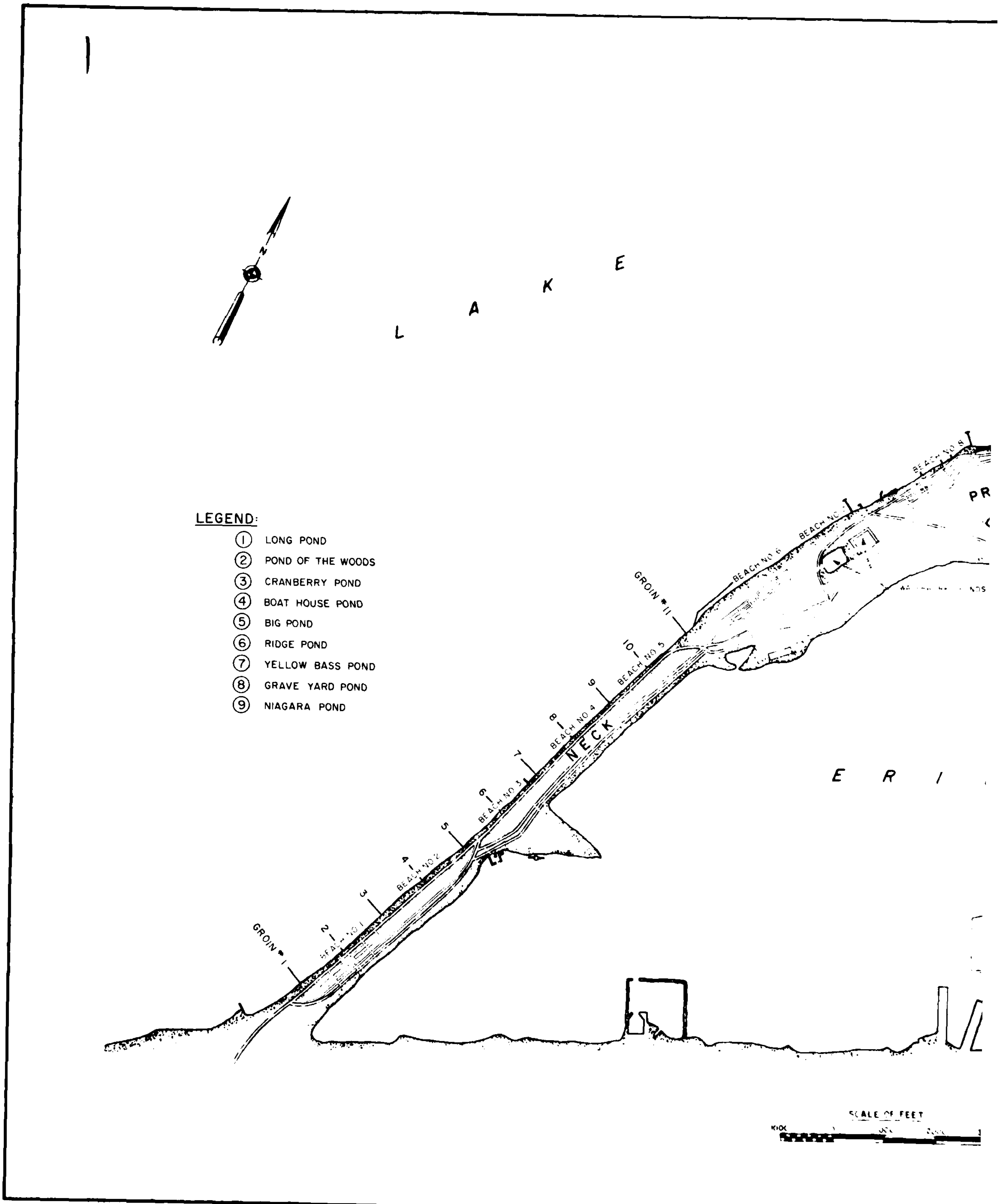
WIND DATA BASED ON RECORDS OF THE U. S. COAST GUARD AT ERIE HARBOR, PA. FOR PERIOD 1 JAN 1928 TO 31 DEC 1941 AND 1 JAN 1945 TO 31 DEC. 1953.

PRESQUE ISLE PENINSULA
ERIE, PA.
BEACH EROSION CONTROL STUDY

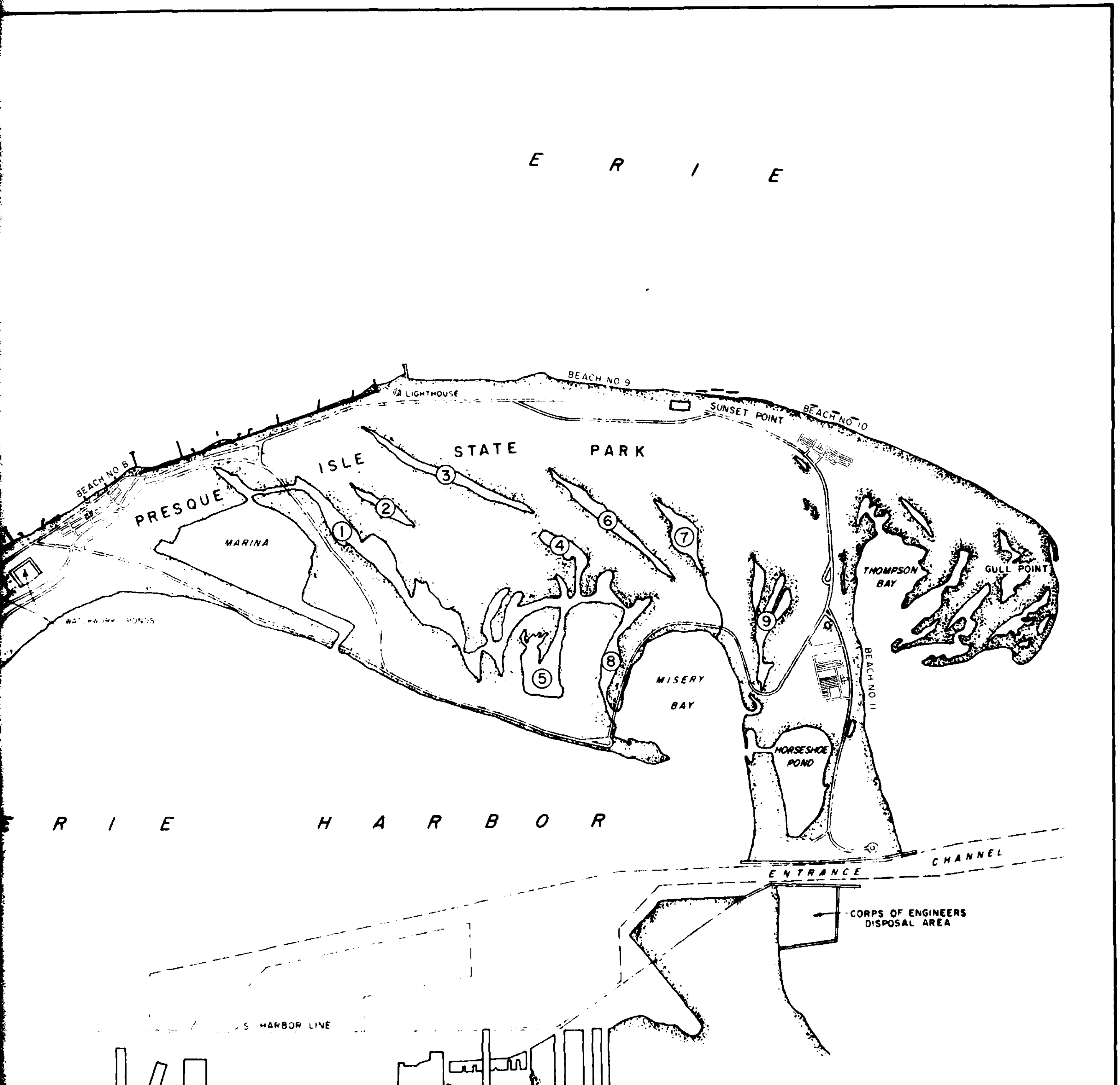
LIMITS OF FEDERAL PARTICIPATION AUTHORIZED BY THE 1960 RIVER AND HARBOR ACT AND 1974 WATER RESOURCES DEVELOPMENT ACT

U.S. ARMY ENGINEER DISTRICT, BUFFALO
TO ACCOMPANY FINAL PHASE I GENERAL DESIGN MEMORANDUM
JUNE 1980

PLATE 3


LAKE
ERI
PR
LEGEND:
1 LONG POND
2 POND OF THE WOODS
3 CRANBERRY POND
4 BOAT HOUSE POND
5 BIG POND
6 RIDGE POND
7 YELLOW BASS POND
8 GRAVE YARD POND
9 NIAGARA POND
NECK
GROIN # 1
GROIN # 11
BEACH NO 1
BEACH NO 2
BEACH NO 3
BEACH NO 4
BEACH NO 5
BEACH NO 6
BEACH NO 8
2
3
4
5
6
7
8
9
10
SCALE OF FEET

1 2

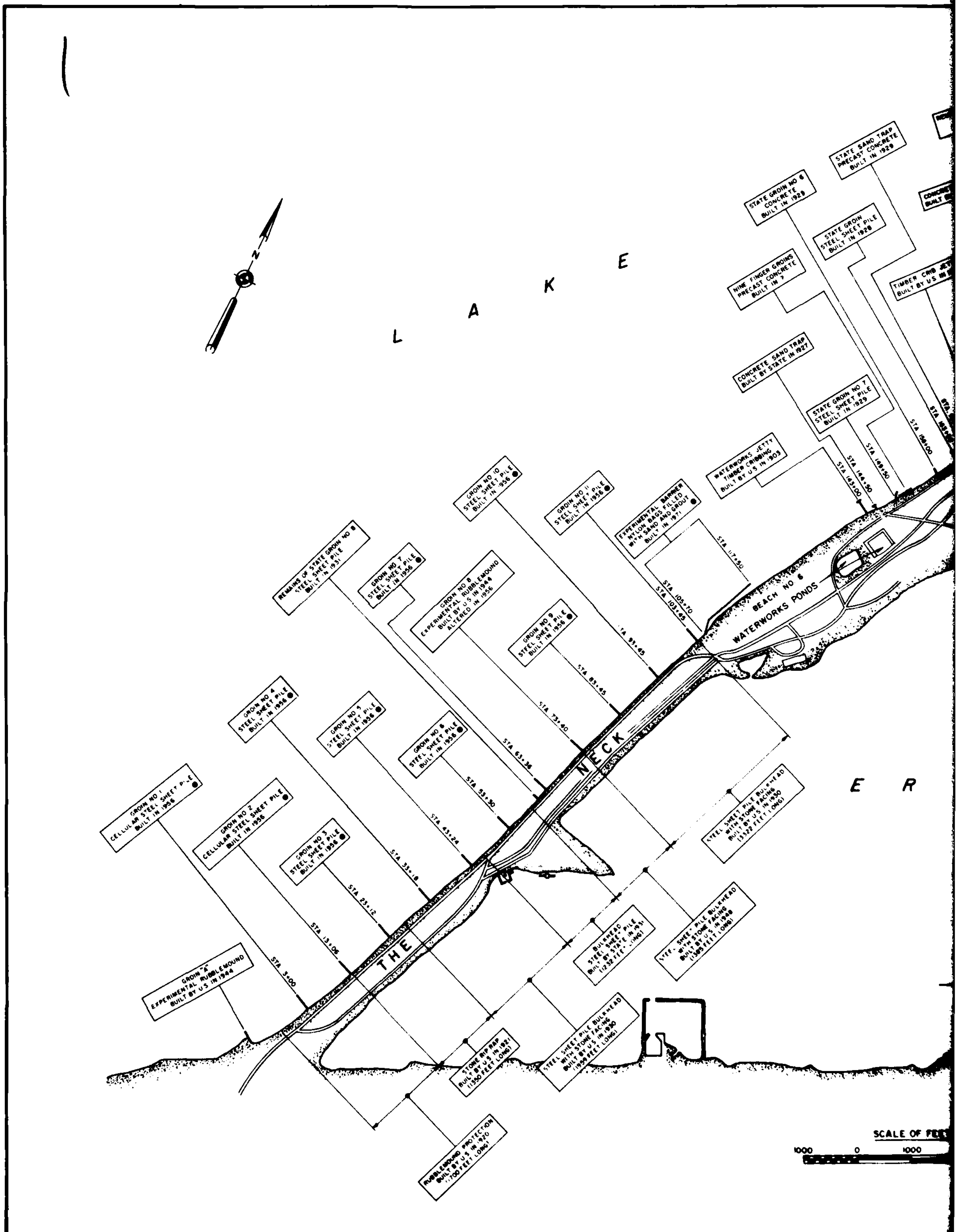


PRESQUE ISLE PENINSULA
ERIE, PA.
BEACH EROSION CONTROL STUDY

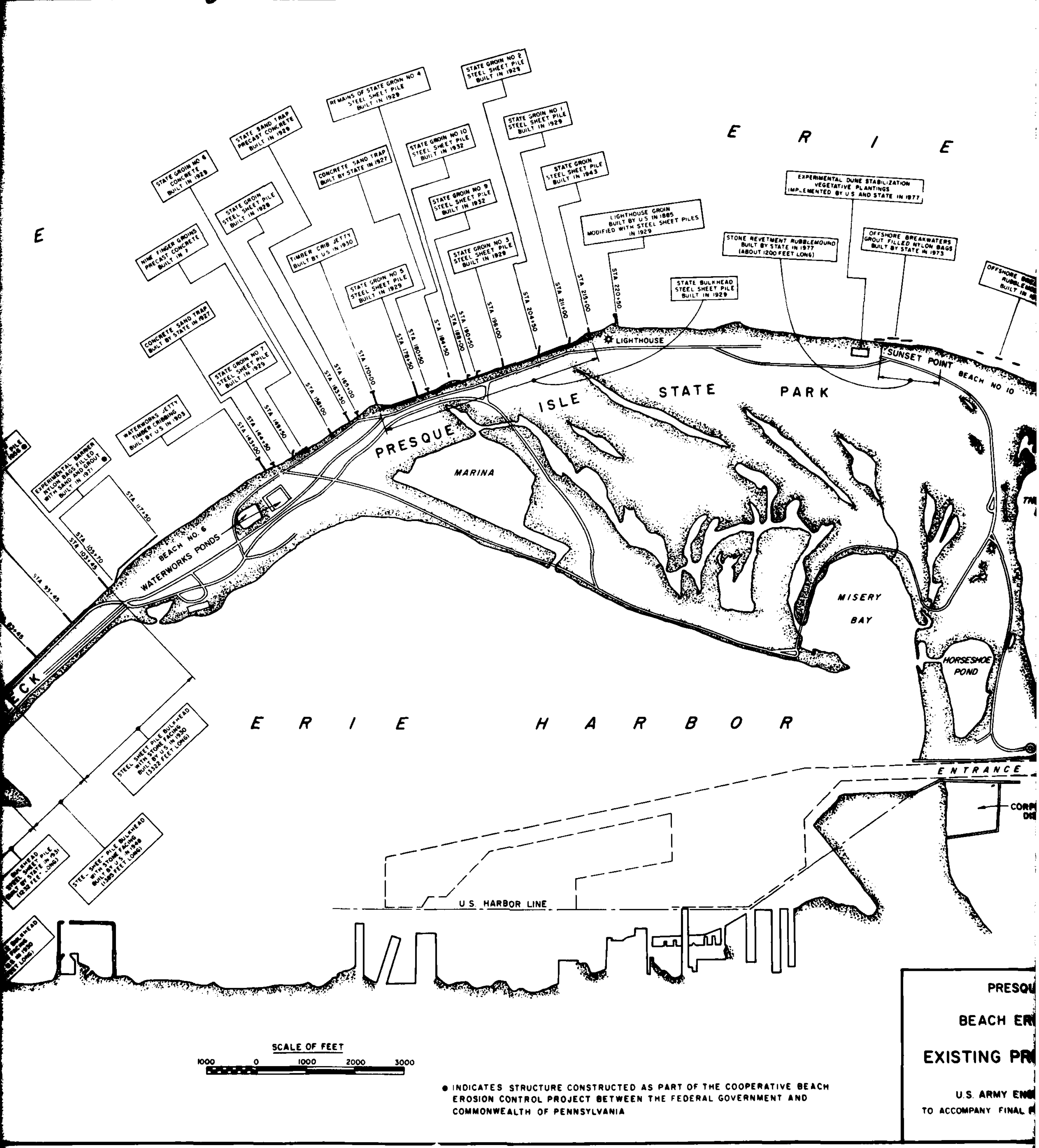
LOCATION OF BEACHES AND PONDS ON PRESQUE ISLE PENINSULA

U S ARMY ENGINEER DISTRICT BUFFALO
TO ACCOMPANY FINAL PHASE I GENERAL DESIGN MEMORANDUM
JUNE 1980

PLATE 4

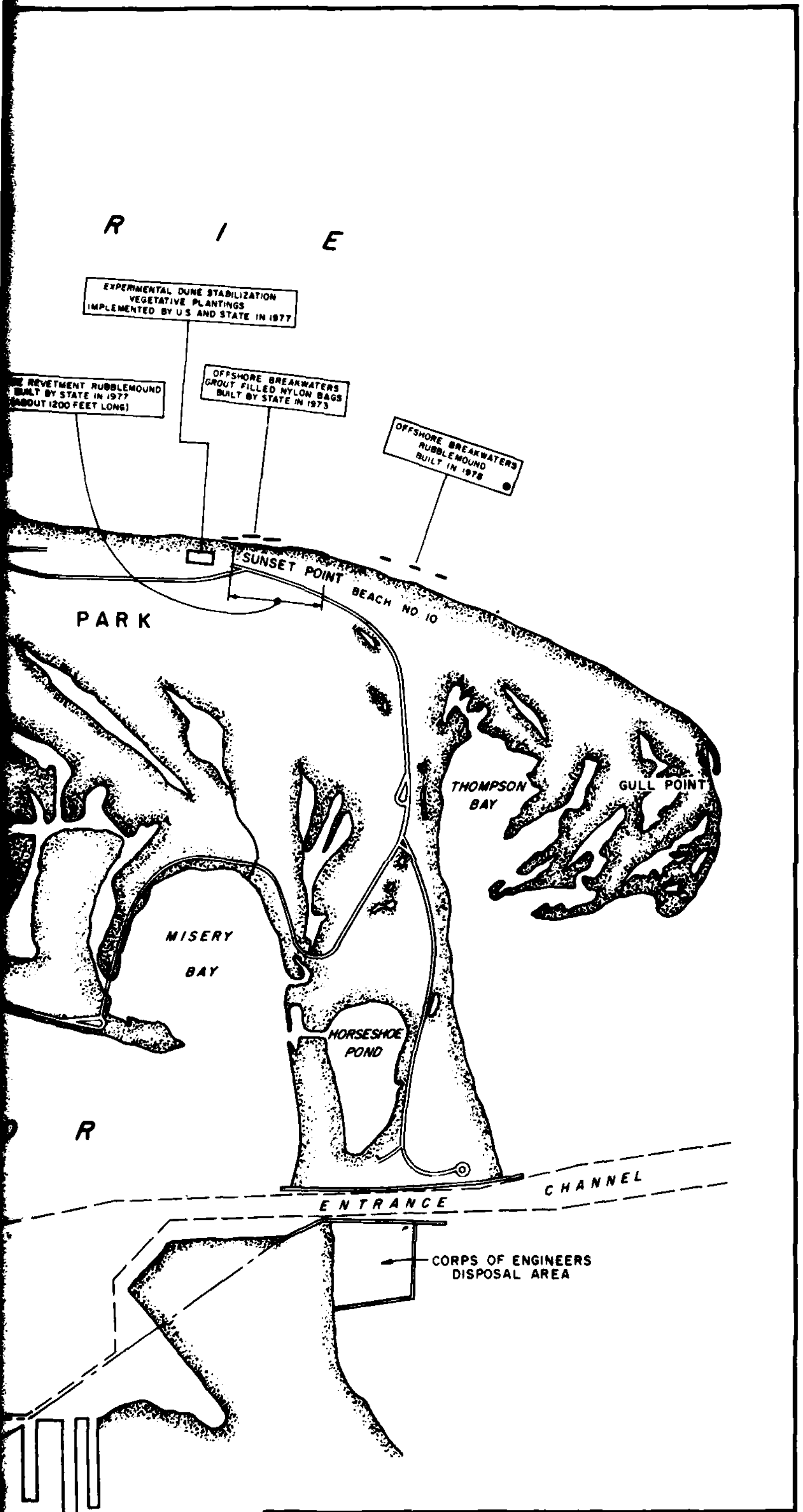

N
LAKE
ER
THE NECK
BEACH NO 6
WATERWORKS PONDS
GROIN "A" EXPERIMENTAL RUBBLEMOUND BUILT BY U.S. IN 1944
GROIN NO 1 CELLULAR STEEL SHEET PILE BUILT IN 1956
GROIN NO 2 CELLULAR STEEL SHEET PILE BUILT IN 1956
GROIN NO 3 STEEL SHEET PILE BUILT IN 1956
GROIN NO 4 STEEL SHEET PILE BUILT IN 1956
GROIN NO 5 STEEL SHEET PILE BUILT IN 1956
GROIN NO 6 STEEL SHEET PILE BUILT IN 1956
GROIN NO 7 STEEL SHEET PILE BUILT IN 1956
GROIN NO 8 EXPERIMENTAL RUBBLEMOUND BUILT BY U.S. IN 1944 ALTERED IN 1956
GROIN NO 9 STEEL SHEET PILE BUILT IN 1956
GROIN NO 10 STEEL SHEET PILE BUILT IN 1956
GROIN NO 11 STEEL SHEET PILE BUILT IN 1956
REMAINS OF STATE GROIN NO 8 STEEL SHEET PILE BUILT IN 1931
EXPERIMENTAL BARRIER NYLON BAGS FILLED WITH SAND AND GROUT BUILT IN 1971
WATERWORKS JETTY TIMBER CRIBBING BUILT BY U.S. IN 1903
CONCRETE SAND TRAP BUILT BY STATE IN 1927
STATE GROIN NO 7 STEEL SHEET PILE BUILT IN 1929
NINE FINGER GROINS PRECAST CONCRETE BUILT IN ?
STATE GROIN NO 6 CONCRETE BUILT IN 1928
STATE GROIN STEEL SHEET PILE BUILT IN 1928
STATE SAND TRAP PRECAST CONCRETE BUILT IN 1929
TIMBER CRIB JETTY BUILT BY U.S. IN
STA 3+00
STA 13+06
STA 23+12
STA 33+18
STA 43+24
STA 53+30
STA 63+36
STA 73+40
STA 83+45
STA 93+45
STA 103+45
STA 105+70
STA 117+50
STA 143+00
STA 144+50
STA 149+50
STA 158+00
RUBBLEMOUND PROTECTION BUILT BY U.S. IN 1920 (700 FEET LONG)
STONE RIP RAP BUILT BY U.S. IN 1921 (1350 FEET LONG)
STEEL SHEET PILE BULKHEAD WITH STONE FACING BUILT BY U.S. IN 1930 (1959 FEET LONG)
BULKHEAD STEEL SHEET PILE BUILT BY STATE IN 1931 (1232 FEET LONG)
STEEL SHEET PILE BULKHEAD WITH STONE FACING BUILT BY U.S. IN 1949 (1359 FEET LONG)
STEEL SHEET PILE BULKHEAD WITH STONE FACING BUILT BY U.S. IN 1930 (3522 FEET LONG)
SCALE OF FEET
1000 0 1000

2



E R I E
E
STATE GROIN NO 2
STEEL SHEET PILE
BUILT IN 1929
REMAINS OF STATE GROIN NO 4
STEEL SHEET PILE
BUILT IN 1929
STATE GROIN NO 1
STEEL SHEET PILE
BUILT IN 1929
STATE SAND TRAP
PRECAST CONCRETE
BUILT IN 1929
STATE GROIN NO 10
STEEL SHEET PILE
BUILT IN 1932
CONCRETE SAND TRAP
BUILT BY STATE IN 1927
STATE GROIN
STEEL SHEET PILE
BUILT IN 1943
STATE GROIN NO 6
CONCRETE
BUILT IN 1929
STATE GROIN NO 9
STEEL SHEET PILE
BUILT IN 1932
STATE GROIN
STEEL SHEET PILE
BUILT IN 1929
LIGHTHOUSE GROIN
BUILT BY U.S. IN 1885
MODIFIED WITH STEEL SHEET PILES
IN 1929
EXPERIMENTAL DUNE STABILIZATION
VEGETATIVE PLANTINGS
IMPLEMENTED BY U.S. AND STATE IN 1977
NINE FINGER GROINS
PRECAST CONCRETE
BUILT IN ?
TIMBER CRIB JETTY
BUILT BY U.S. IN 1930
STATE GROIN NO 3
STEEL SHEET PILE
BUILT IN 1929
STONE REVETMENT RUBBLEMOUND
BUILT BY STATE IN 1977
(ABOUT 1200 FEET LONG)
OFFSHORE BREAKWATERS
GROUT FILLED NYLON BAGS
BUILT BY STATE IN 1973
STATE GROIN NO 5
STEEL SHEET PILE
BUILT IN 1929
STATE BULKHEAD
STEEL SHEET PILE
BUILT IN 1929
CONCRETE SAND TRAP
BUILT BY STATE IN 1927
STATE GROIN NO 7
STEEL SHEET PILE
BUILT IN 1929
WATERWORKS JETTY
TIMBER CRIBBING
BUILT BY U.S. IN 1903
EXPERIMENTAL BARRIER
NYLON BAGS FILLED
WITH SAND AND GROUT
BUILT IN 1971
STA 220+50
STA 215+00
STA 211+00
STA 204+50
STA 196+00
STA 190+50
STA 188+00
STA 184+50
STA 180+50
STA 178+50
STA 170+00
STA 165+00
STA 163+50
STA 158+00
STA 149+00
STA 144+50
STA 143+00
STA 117+50
STA 105+70
STA 103+45
STA 93+45
LIGHTHOUSE
SUNSET POINT
BEACH NO 10
PRESQUE ISLE STATE PARK
MARINA
BEACH NO. 6
WATERWORKS PONDS
MISERY BAY
HORSESHOE POND
ERIE HARBOR
ENTRANCE
U.S. HARBOR LINE
STEEL SHEET PILE BULKHEAD
WITH STONE FACING
BUILT BY U.S. IN 1930
(3322 FEET LONG)
STEEL SHEET PILE BULKHEAD
WITH STONE FACING
BUILT BY U.S. IN 1928
(1585 FEET LONG)
SCALE OF FEET
1000 0 1000 2000 3000
● INDICATES STRUCTURE CONSTRUCTED AS PART OF THE COOPERATIVE BEACH
EROSION CONTROL PROJECT BETWEEN THE FEDERAL GOVERNMENT AND
COMMONWEALTH OF PENNSYLVANIA
PRESQU
BEACH ER
EXISTING PR
U.S. ARMY EN
TO ACCOMPANY FINAL

3



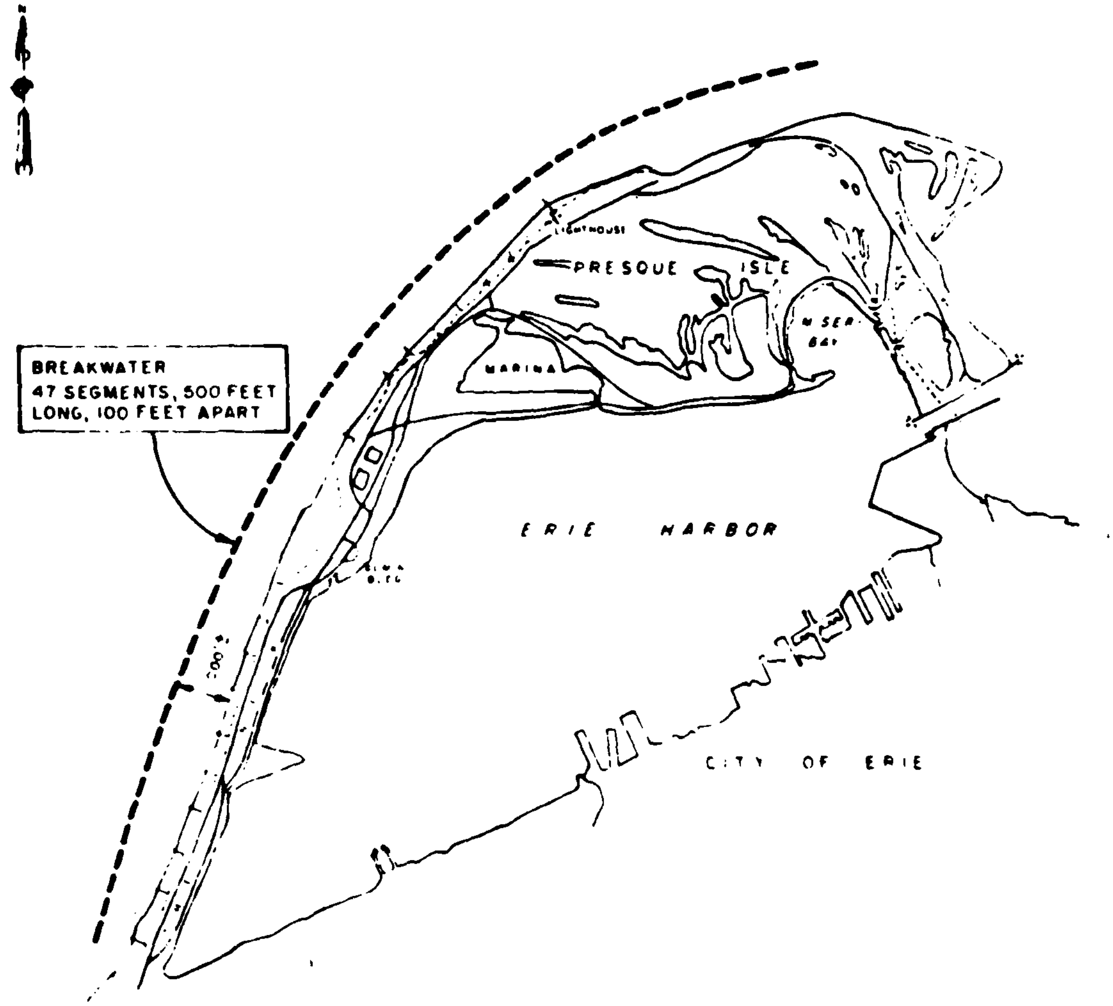
OPERATIVE BEACH
ERNMENT AND

PRESQUE ISLE PENINSULA
ERIE, PA.
BEACH EROSION CONTROL STUDY

EXISTING PROTECTION STRUCTURES

U.S. ARMY ENGINEER DISTRICT BUFFALO
TO ACCOMPANY FINAL PHASE I GENERAL DESIGN MEMORANDUM
JUNE 1980

PLATE 5



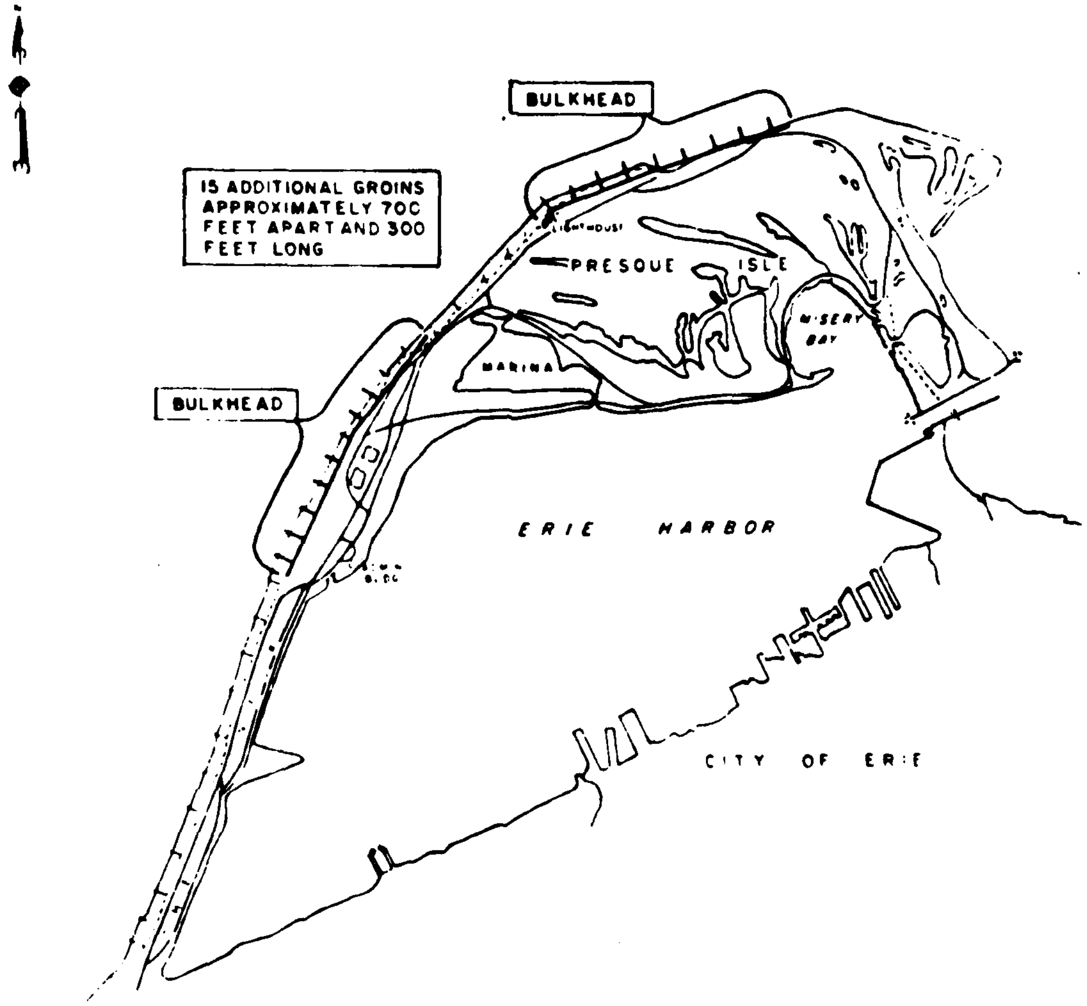
FULL BREAKWATER CONCEPT

PRESQUE ISLE PENINSULA
ERIE, PA.
BEACH EROSION CONTROL STUDY

ALTERNATIVE CONCEPT

U.S. ARMY ENGINEER DISTRICT, BUFFALO
TO ACCOMPANY PLAN OF STUDY
APRIL 1978

PLATE 6



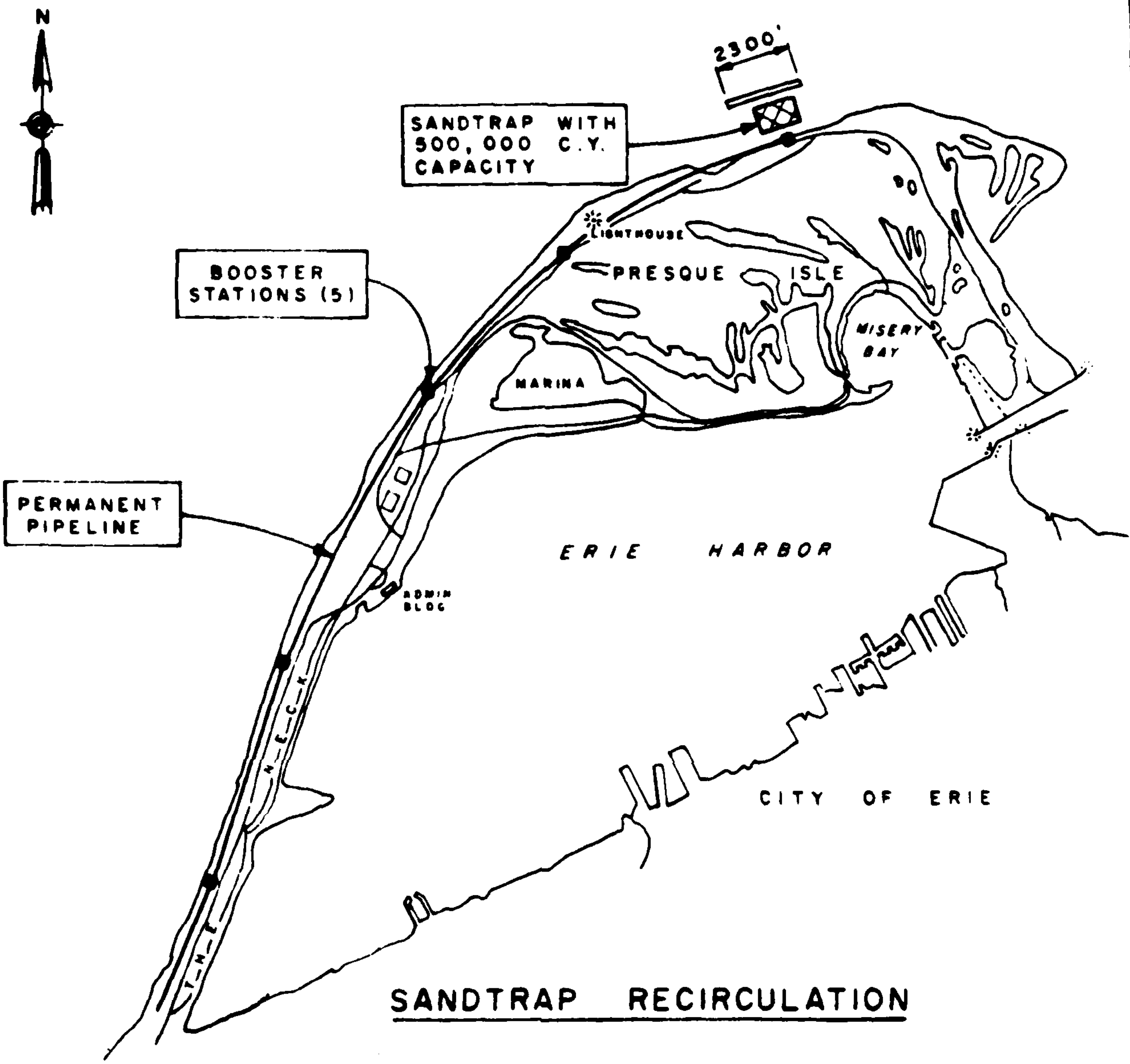
GROIN CONCEPT

PRESQUE ISLE PENINSULA
ERIE, PA.
BEACH EROSION CONTROL STUDY

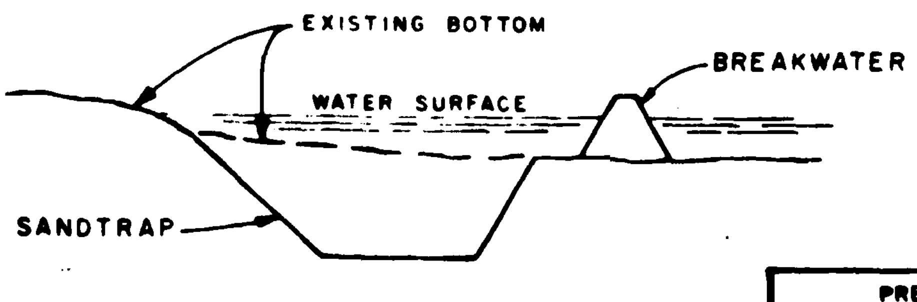
ALTERNATIVE CONCEPT

U.S. ARMY ENGINEER DISTRICT, BUFFALO
TO ACCOMPANY PLAN OF STUDY
APRIL 1978

PLATE 7



SANDTRAP RECIRCULATION



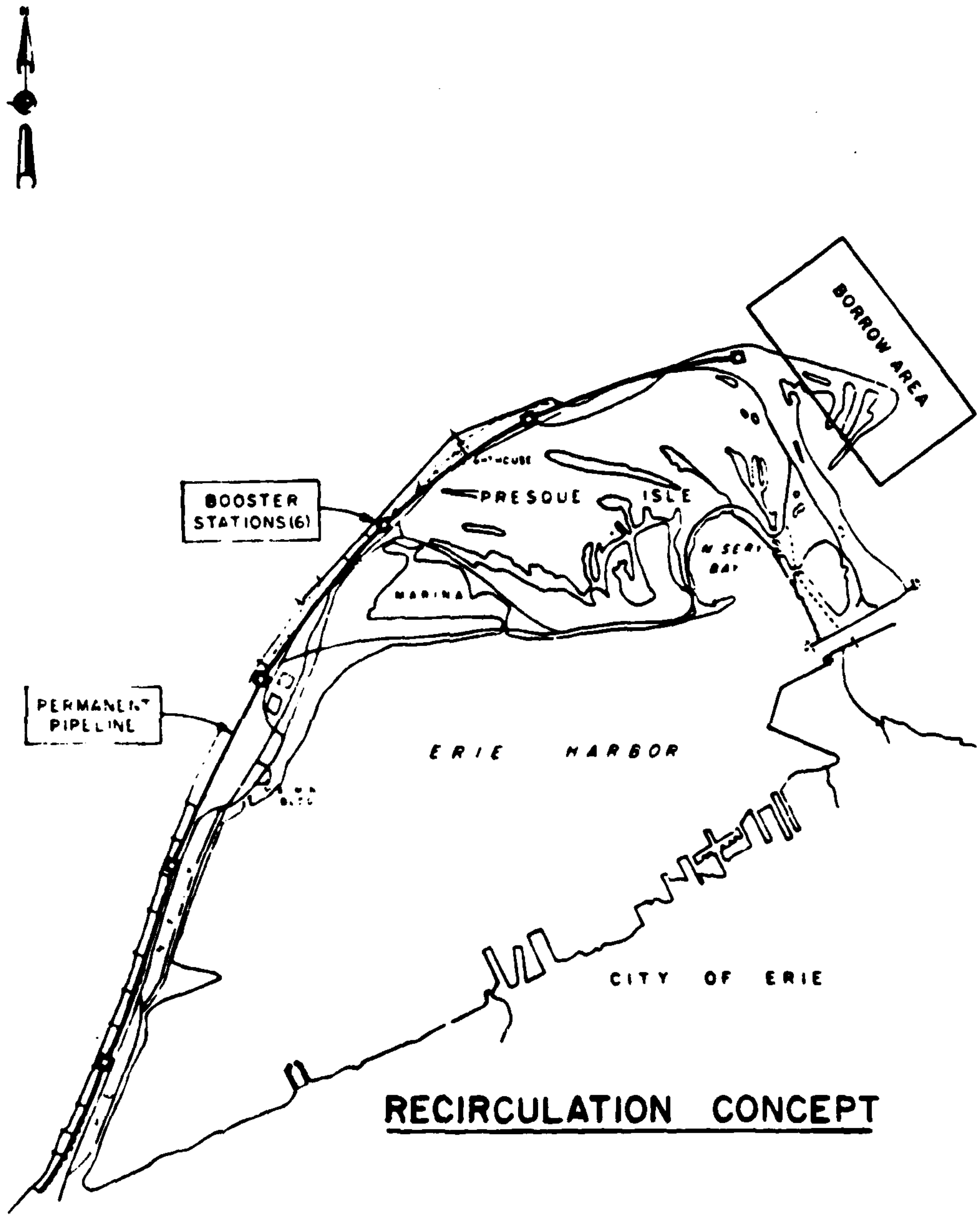
SANDTRAP SECTION
(N.T.S.)

PRESQUE ISLE PENINSULA
ERIE, PA.
BEACH EROSION CONTROL STUDY

ALTERNATIVE CONCEPT

U.S. ARMY ENGINEER DISTRICT, BUFFALO
TO ACCOMPANY PLAN OF STUDY
APRIL 1978

PLATE 8



RECIRCULATION CONCEPT

PRESQUE ISLE PENINSULA
ERIE, PA.
BEACH EROSION CONTROL STUDY

ALTERNATIVE CONCEPT

U.S. ARMY ENGINEER DISTRICT, BUFFALO
TO ACCOMPANY PLAN OF STUDY
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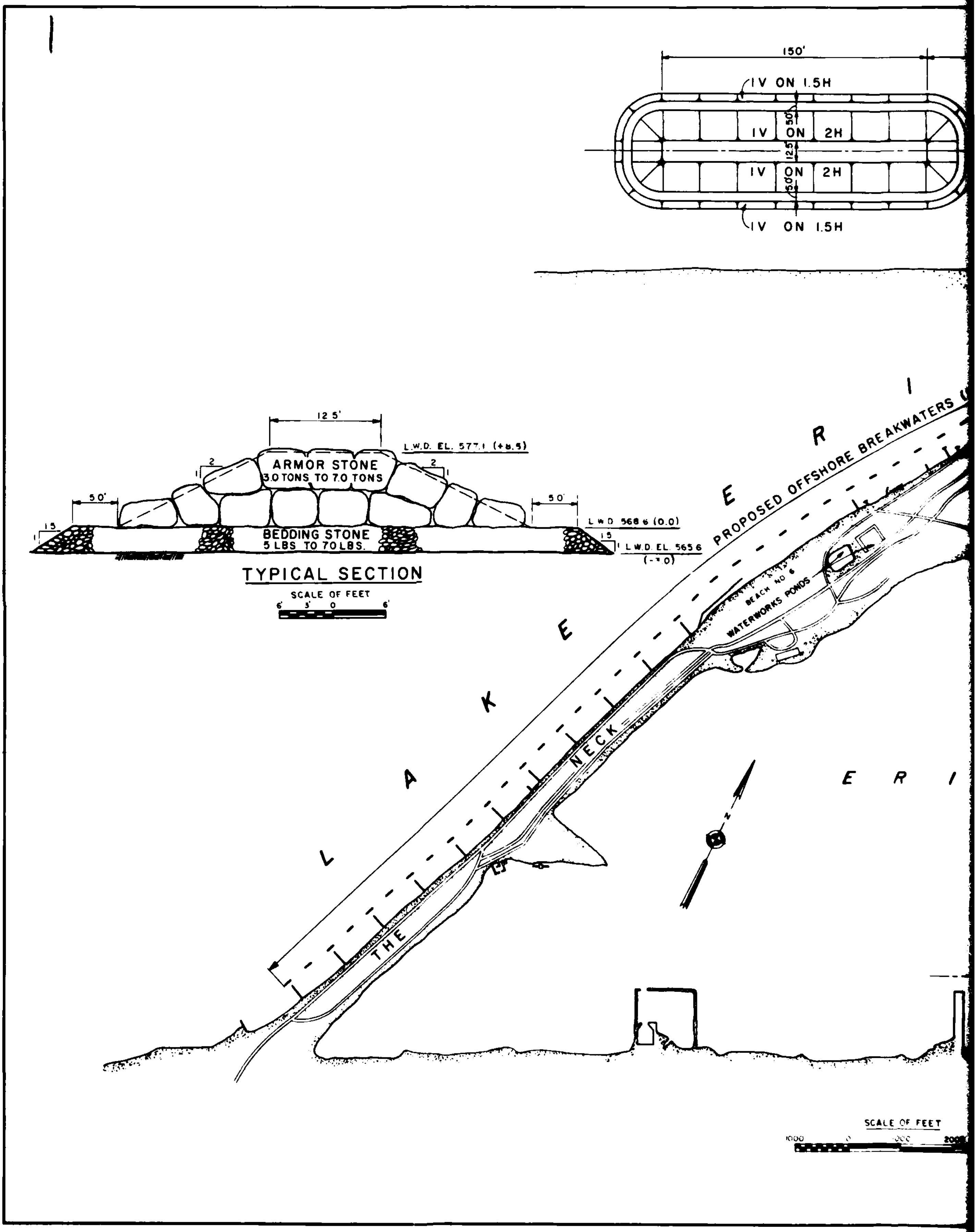
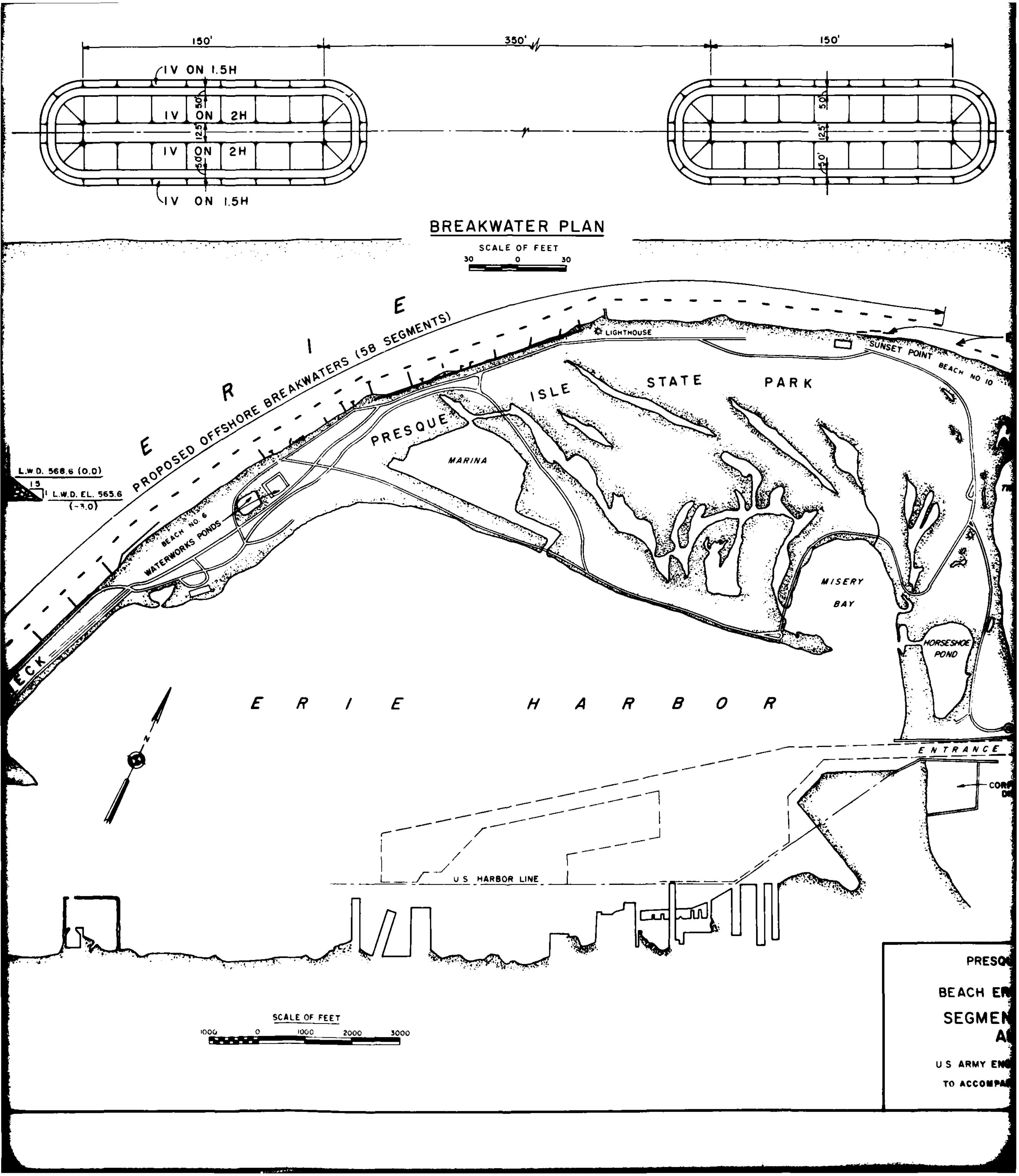
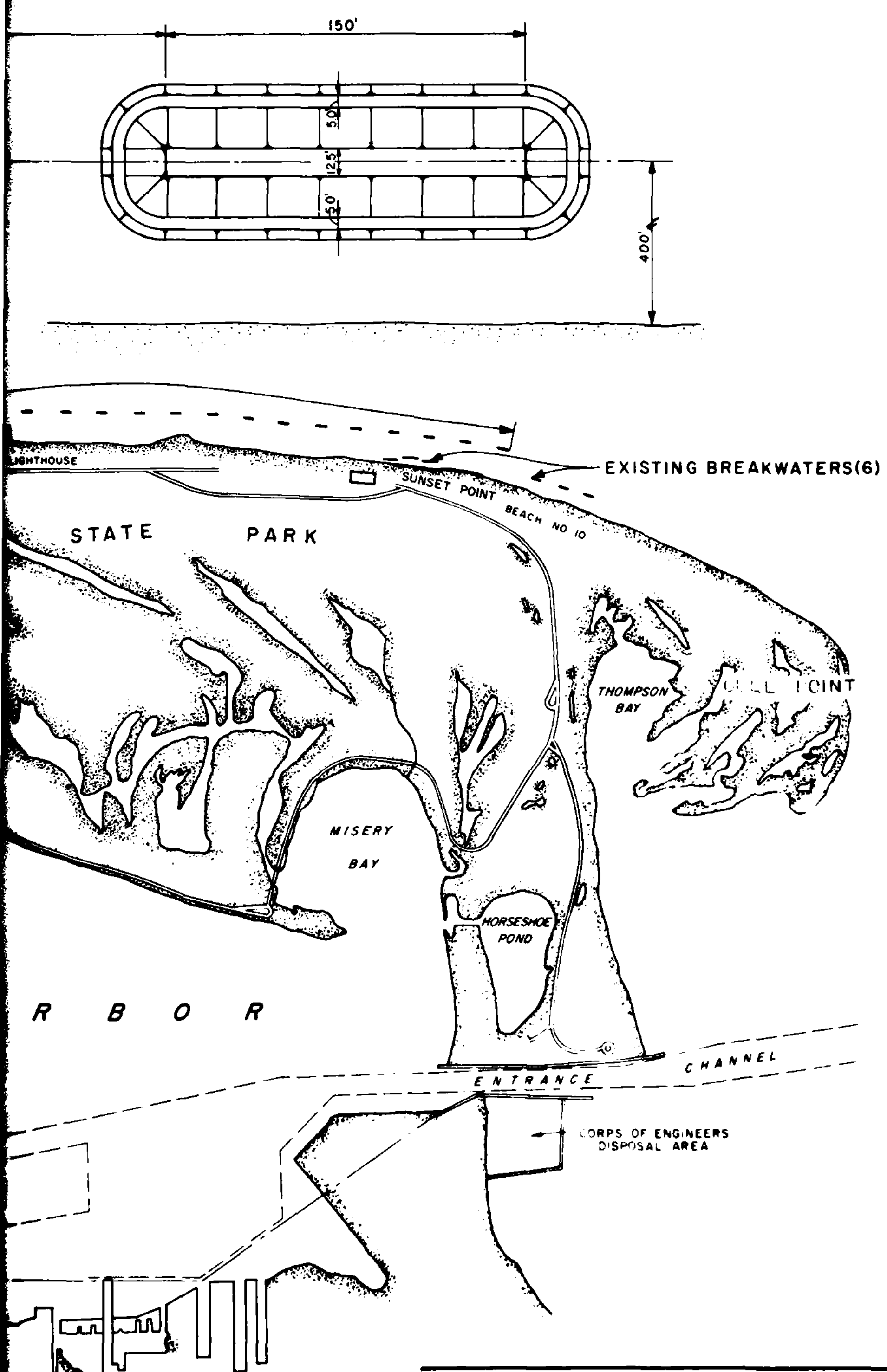
PLATE 9



150'
1V ON 1.5H
1V ON 2H
12.5'
1V ON 2H
1V ON 1.5H
12.5'
L.W.D. EL. 577.1 (+8.5)
2
1
ARMOR STONE
3.0 TONS TO 7.0 TONS
5.0'
5.0'
L.W.D. 568.6 (0.0)
1.5
BEDDING STONE
5 LBS TO 70 LBS.
L.W.D. EL. 565.6
(-3.0)
TYPICAL SECTION
SCALE OF FEET
L A K E E R I
PROPOSED OFFSHORE BREAKWATERS
BEACH NO 6
WATERWORKS PONDS
THE NECK
E R I
SCALE OF FEET



150'
350'
150'
IV ON 1.5H
IV ON 2H
IV ON 2H
IV ON 1.5H
5.0'
12.5'
5.0'
BREAKWATER PLAN
SCALE OF FEET
30 0 30
E R I E
PROPOSED OFFSHORE BREAKWATERS (58 SEGMENTS)
LIGHTHOUSE
SUNSET POINT BEACH NO 10
PRESQUE ISLE STATE PARK
MARINA
MISERY BAY
HORSESHOE POND
BEACH NO. 6
WATERWORKS PONDS
L.W.D. 568.6 (0.0)
15
1
L.W.D. EL. 565.6 (-3.0)
ECK
ERIE HARBOR
N
ENTRANCE
U S HARBOR LINE
SCALE OF FEET
1000 0 1000 2000 3000
PRESQ
BEACH ER
SEGMEN
A
U S ARMY EN
TO ACCOMPA



PRESQUE ISLE PENINSULA
ERIE, PA
BEACH EROSION CONTROL STUDY

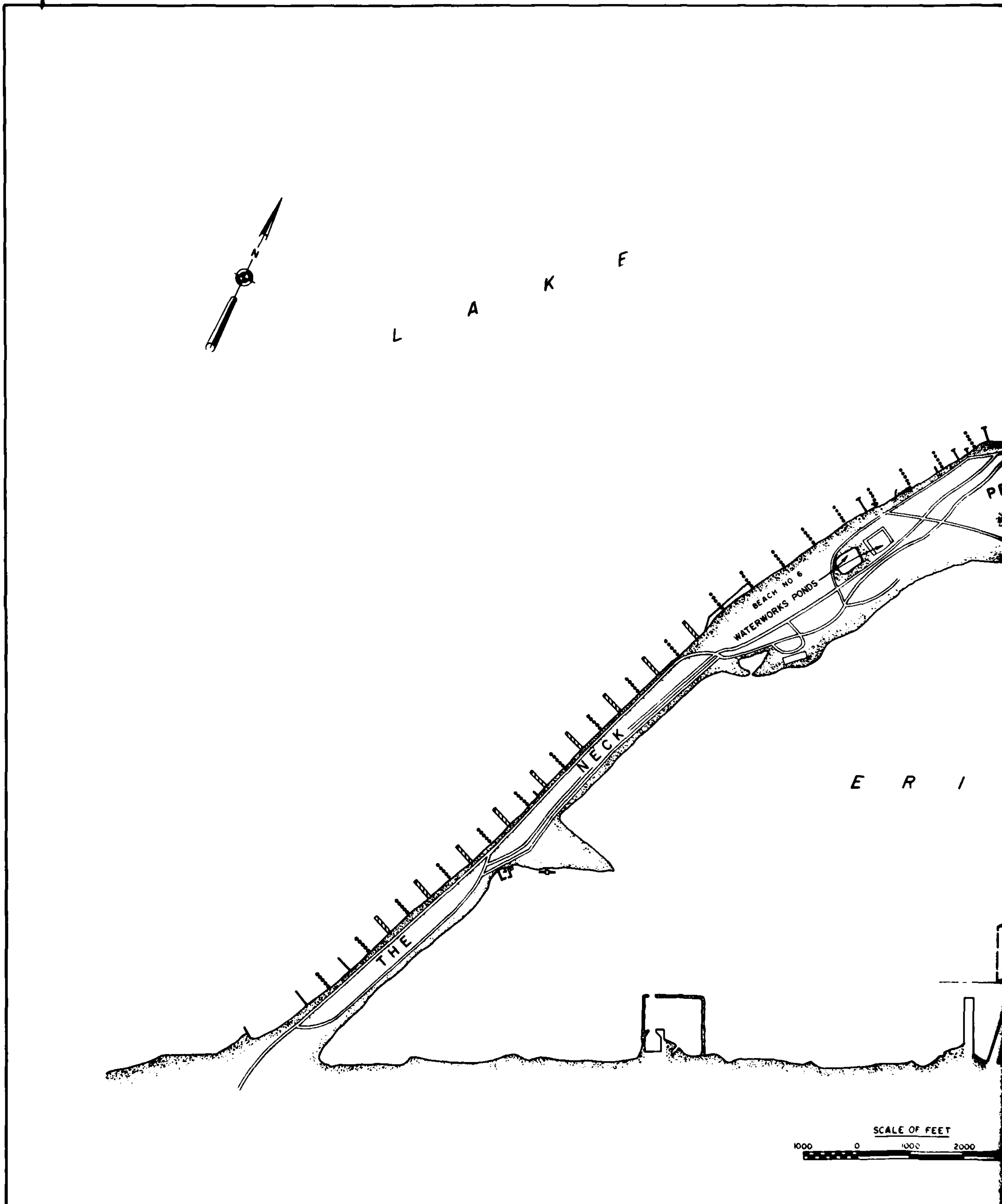
SEGMENTED BREAKWATER ALTERNATIVE

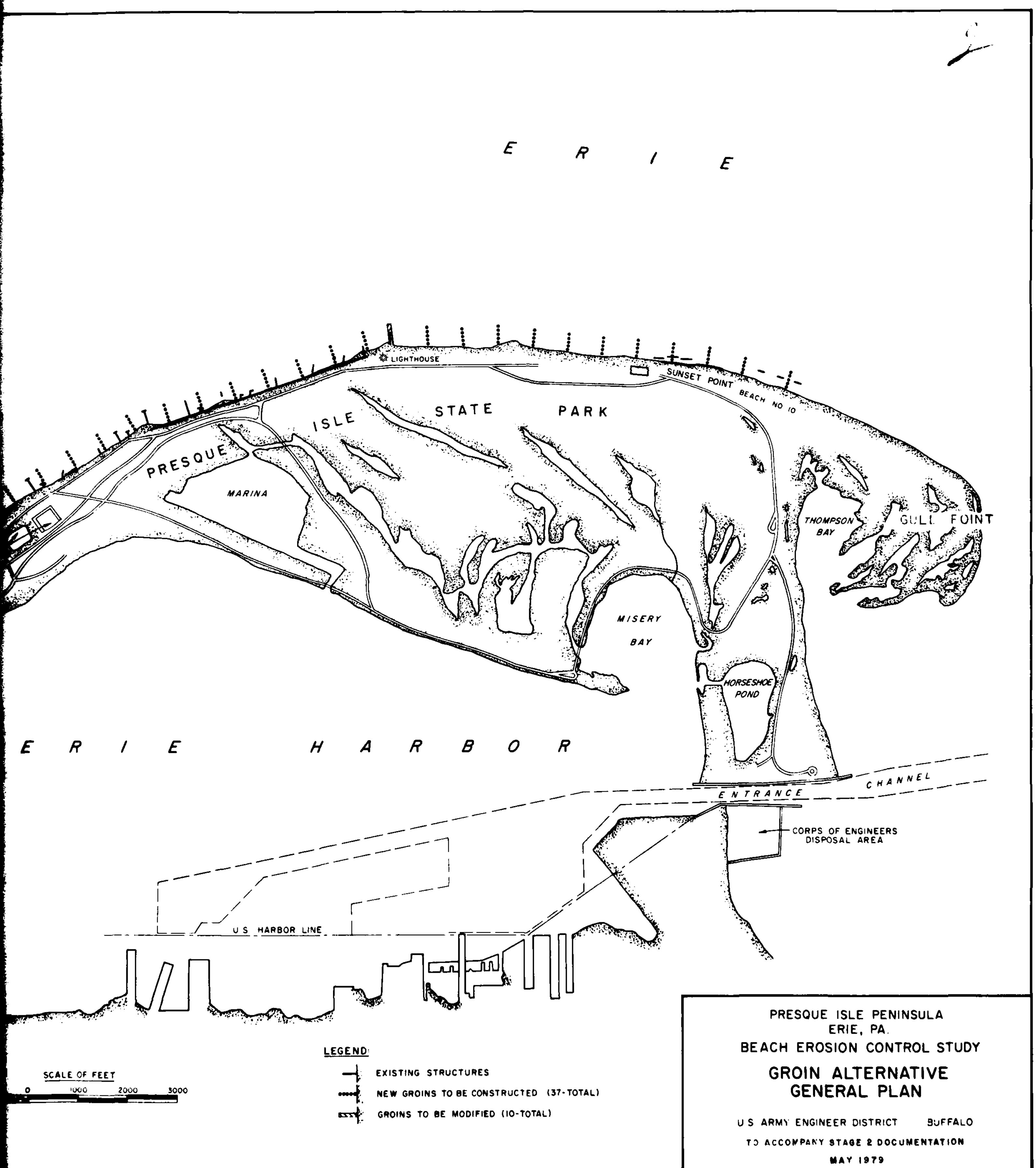
U S ARMY ENGINEER DISTRICT BUFFALO

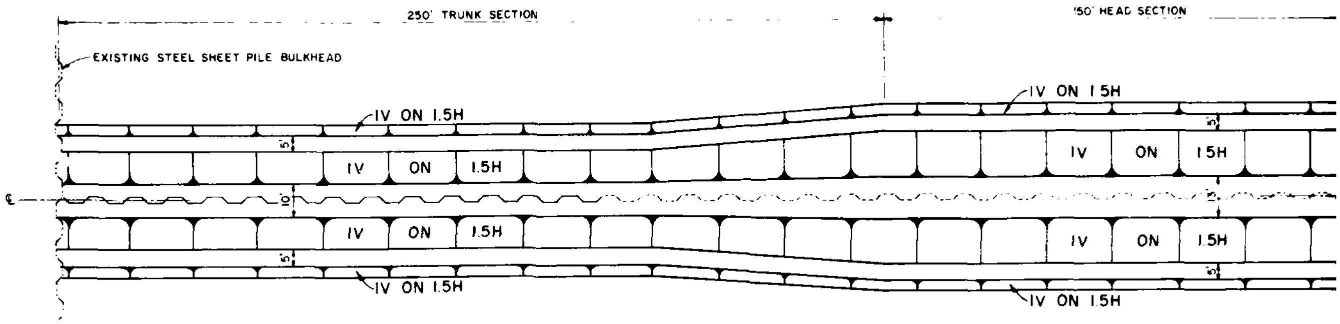
TO ACCOMPANY STAGE 2 DOCUMENTATION

MAY 1979

PLATE 10


N
L A K E
E R I
THE NECK
BEACH NO 6
WATERWORKS PONDS
SCALE OF FEET
1000 0 1000 2000

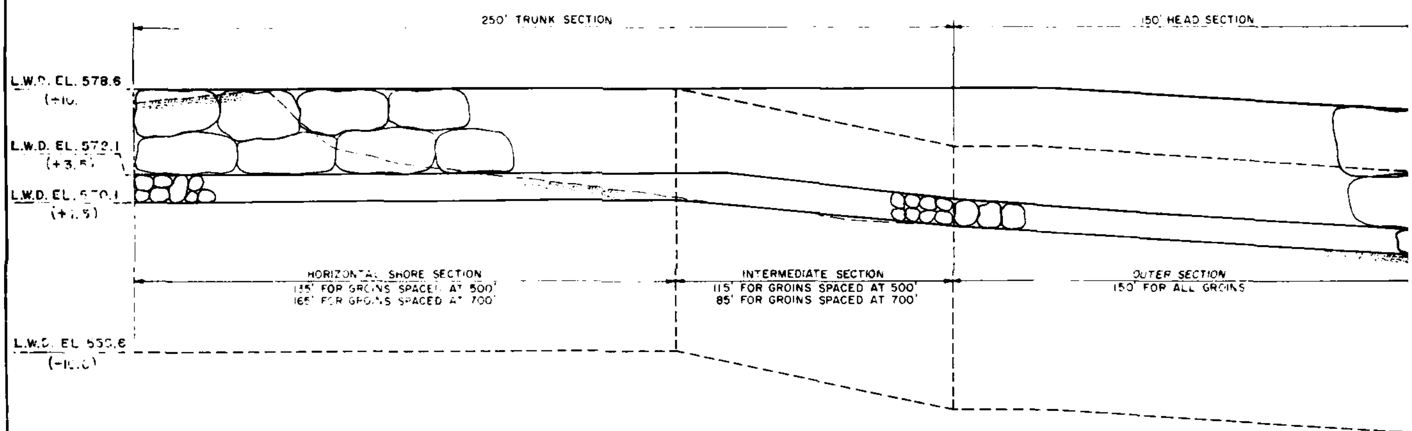

E R I E
LIGHTHOUSE
SUNSET POINT BEACH NO 10
PRESQUE ISLE STATE PARK
MARINA
THOMPSON BAY
GULL POINT
MISERY BAY
HORSESHOE POND
E R I E H A R B O R
ENTRANCE CHANNEL
CORPS OF ENGINEERS DISPOSAL AREA
U S HARBOR LINE
LEGEND
EXISTING STRUCTURES
NEW GROINS TO BE CONSTRUCTED (37-TOTAL)
GROINS TO BE MODIFIED (10-TOTAL)
SCALE OF FEET
0 1000 2000 3000
PRESQUE ISLE PENINSULA
ERIE, PA.
BEACH EROSION CONTROL STUDY
GROIN ALTERNATIVE
GENERAL PLAN
U S ARMY ENGINEER DISTRICT BUFFALO
TO ACCOMPANY STAGE 2 DOCUMENTATION
MAY 1979



PLAN OF NEW GROINS

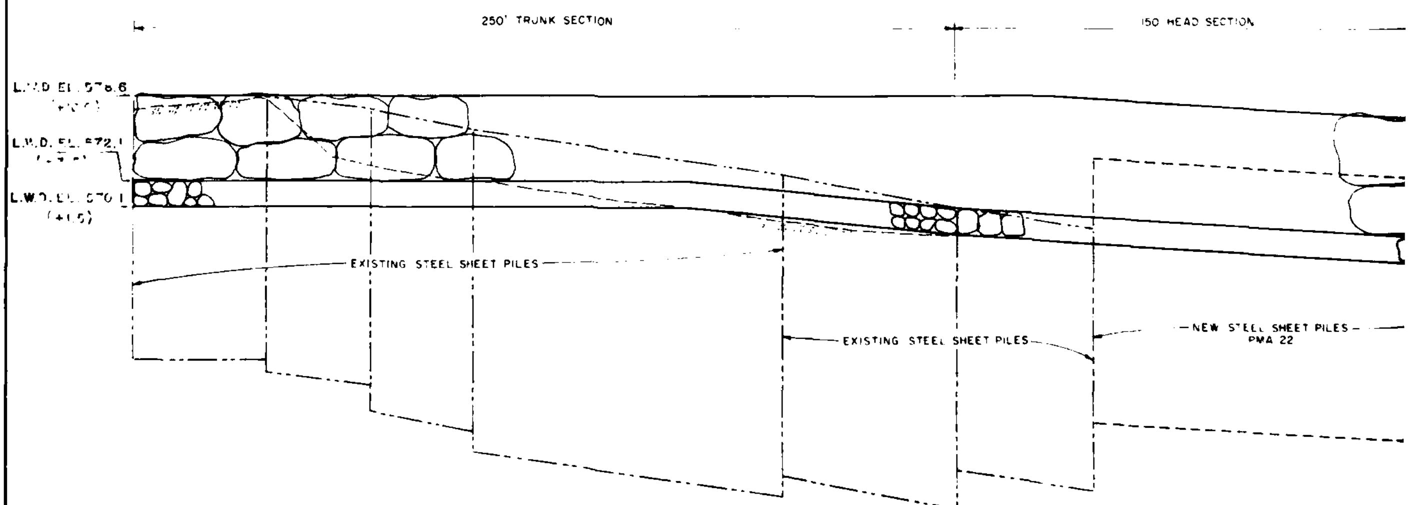
SCALE OF FEET

20 0 20 40



PROFILE OF NEW GROINS

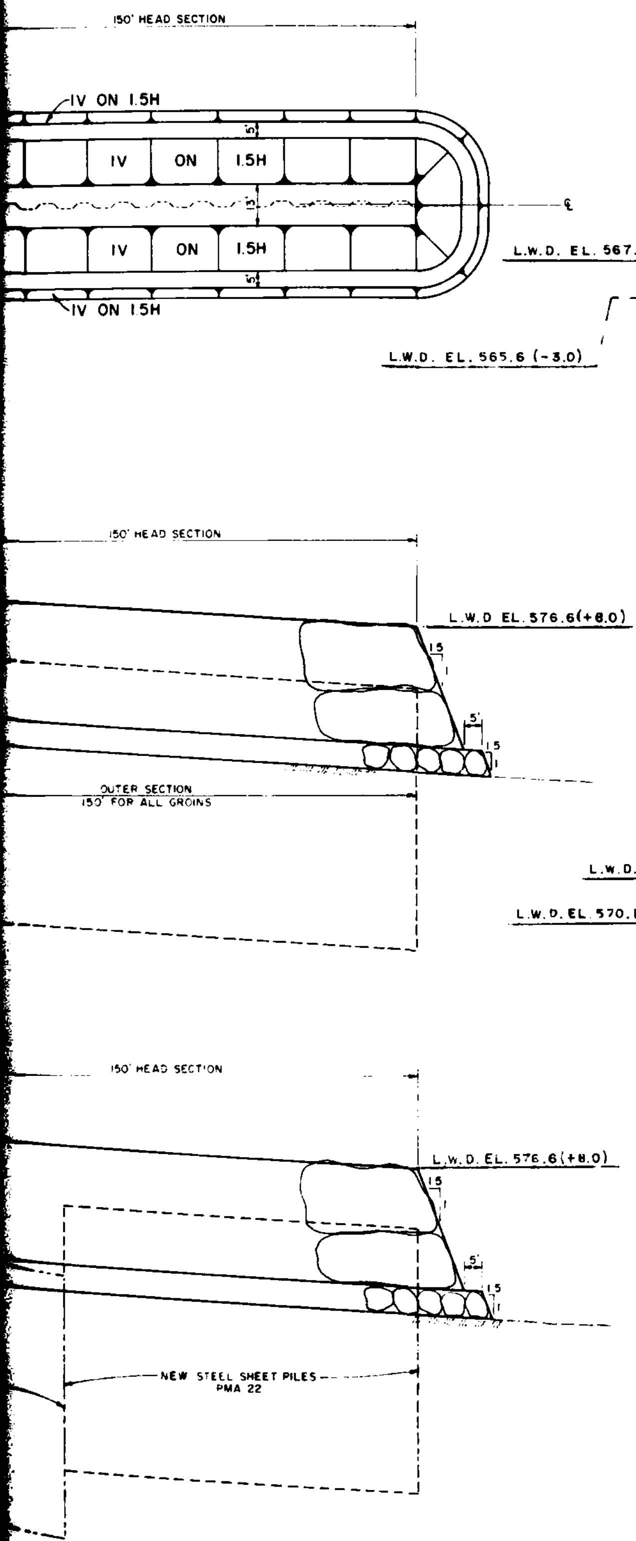
SCALE OF FEET 1" = 20' HORIZONTAL
1" = 5' VERTICAL

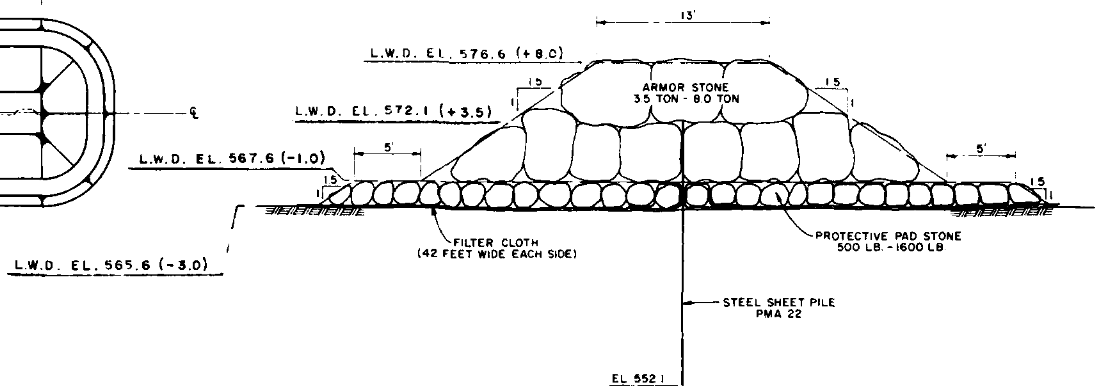


PROFILE OF GROINS TO BE MODIFIED

SCALE OF FEET 1" = 20' HORIZONTAL
1" = 5' VERTICAL

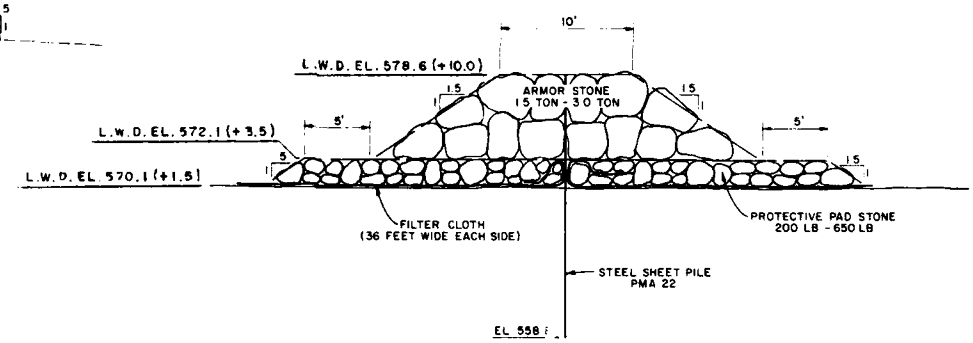
1 2





TYPICAL HEAD SECTION

SCALE OF FEET



TYPICAL TRUNK SECTION

SCALE OF FEET 1"=5'

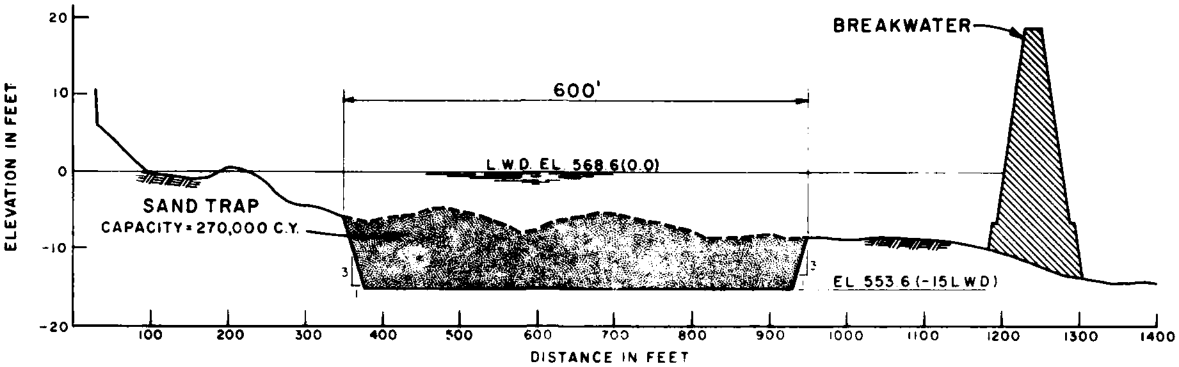
PRESQUE ISLE PENINSULA
ERIE, PA.

BEACH EROSION CONTROL STUDY

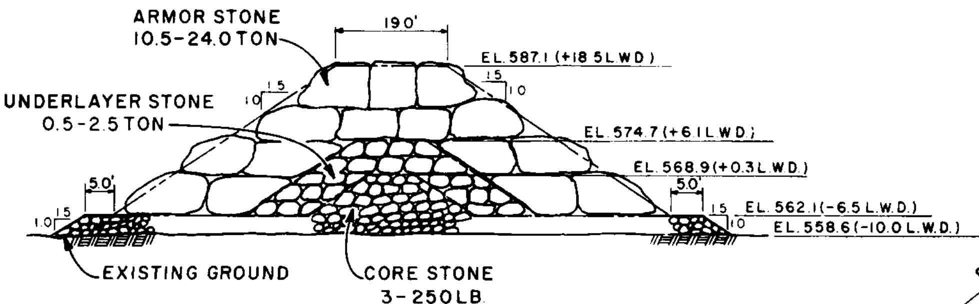
GROIN ALTERNATIVE
PLAN, SECTIONS AND PROFILES

U S ARMY ENGINEER DISTRICT BUFFALO
TO ACCOMPANY STAGE 2 DOCUMENTATION
MAY 1979

PLATE 12

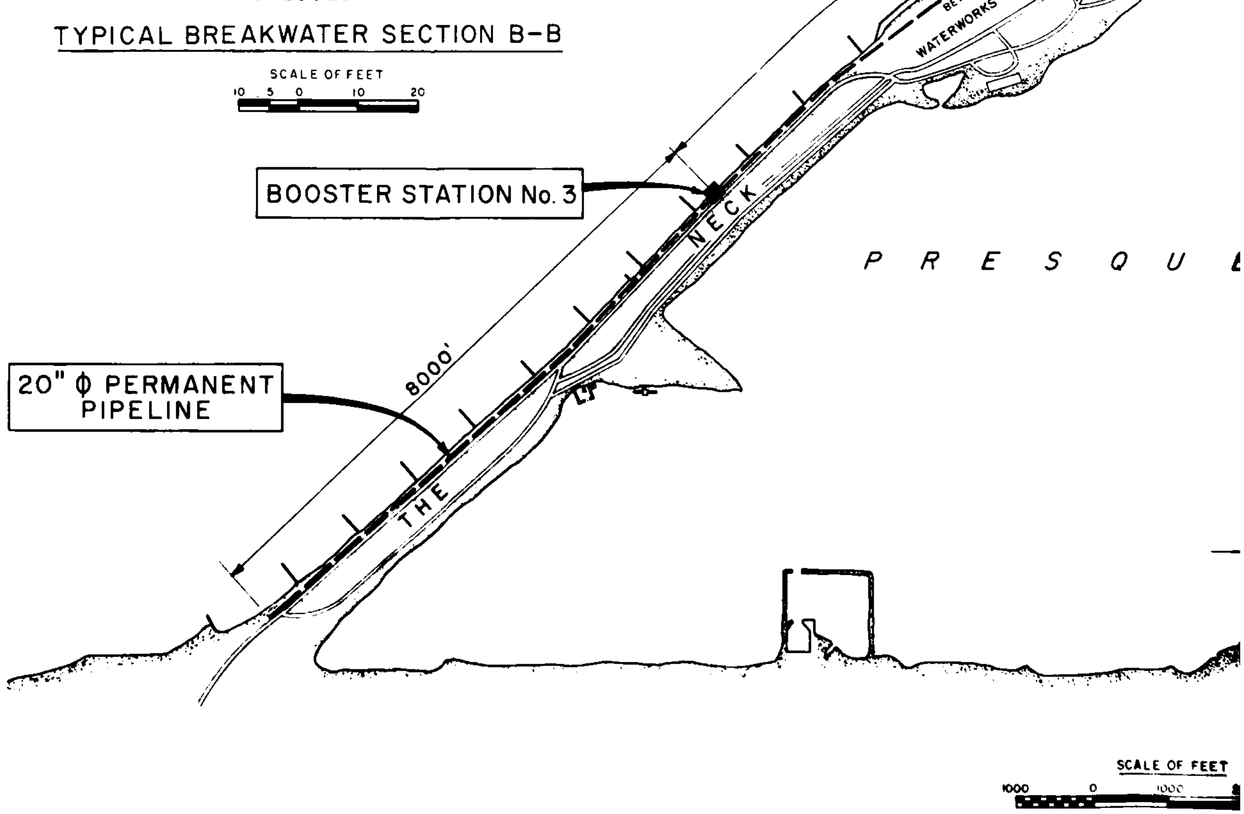


PROFILE SECTION A-A



TYPICAL BREAKWATER SECTION B-B

SCALE OF FEET



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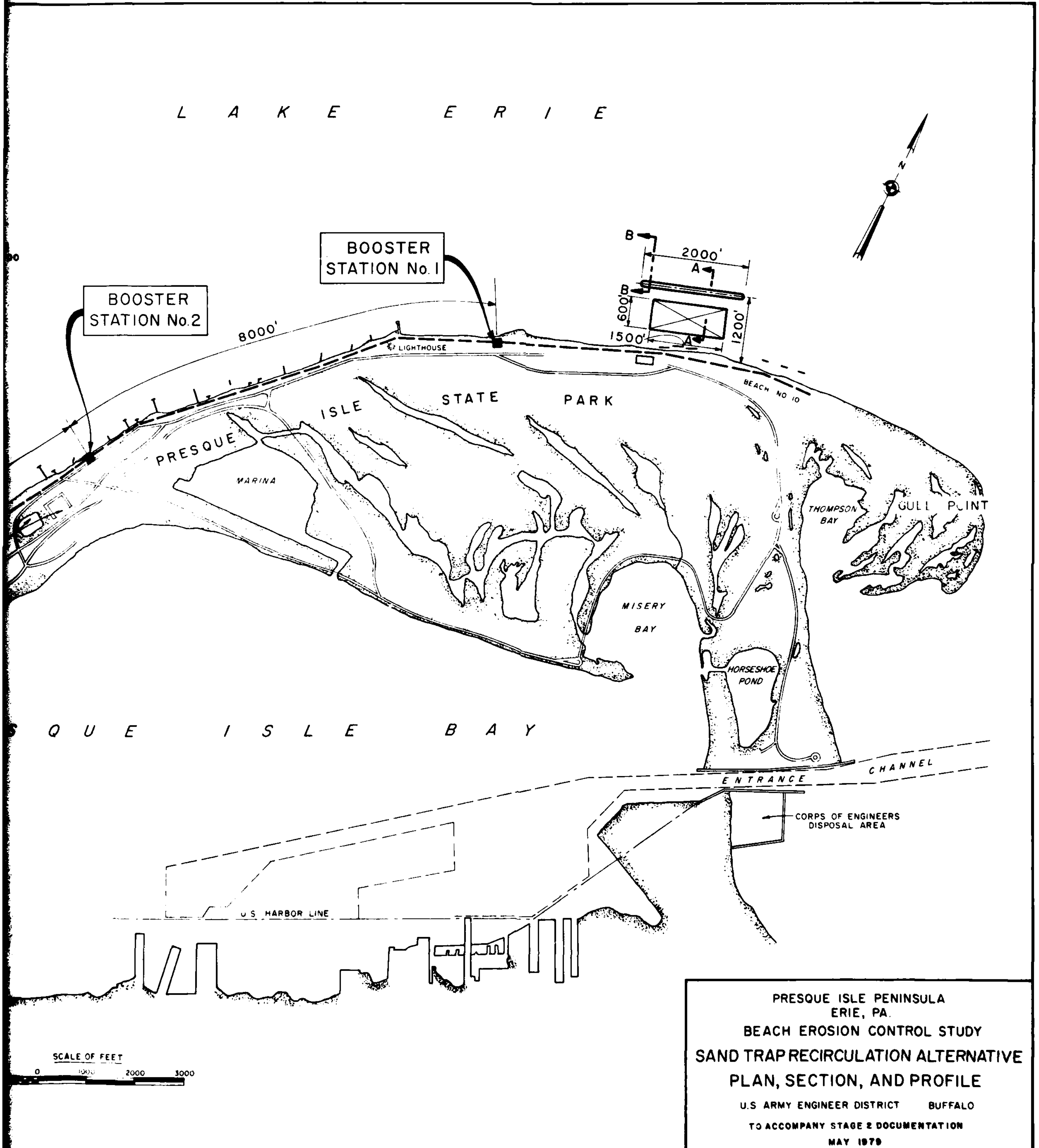


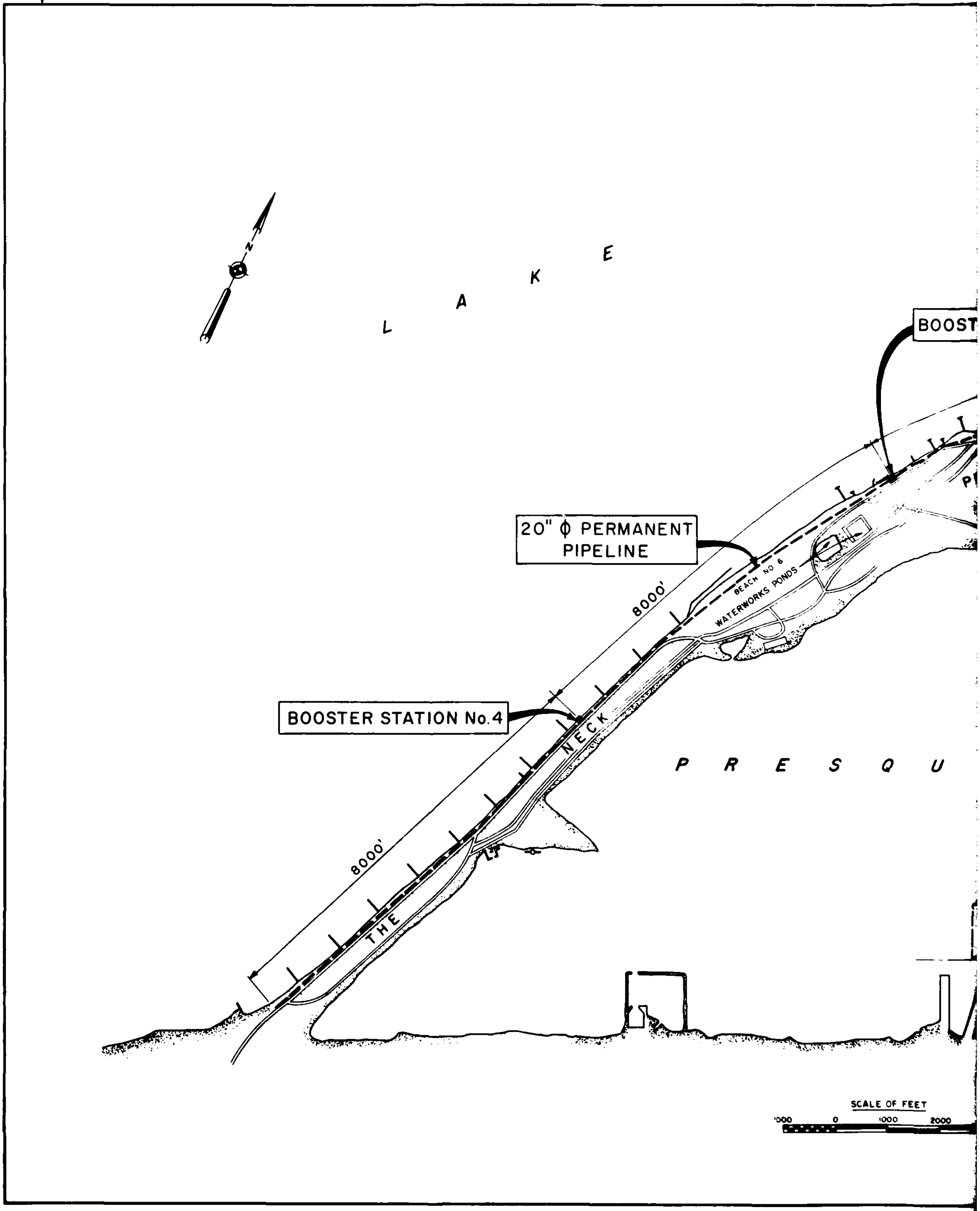
PRESQUE ISLE PENINSULA
ERIE, PA.
BEACH EROSION CONTROL STUDY

SAND TRAP RECIRCULATION ALTERNATIVE
PLAN, SECTION, AND PROFILE

U.S ARMY ENGINEER DISTRICT BUFFALO

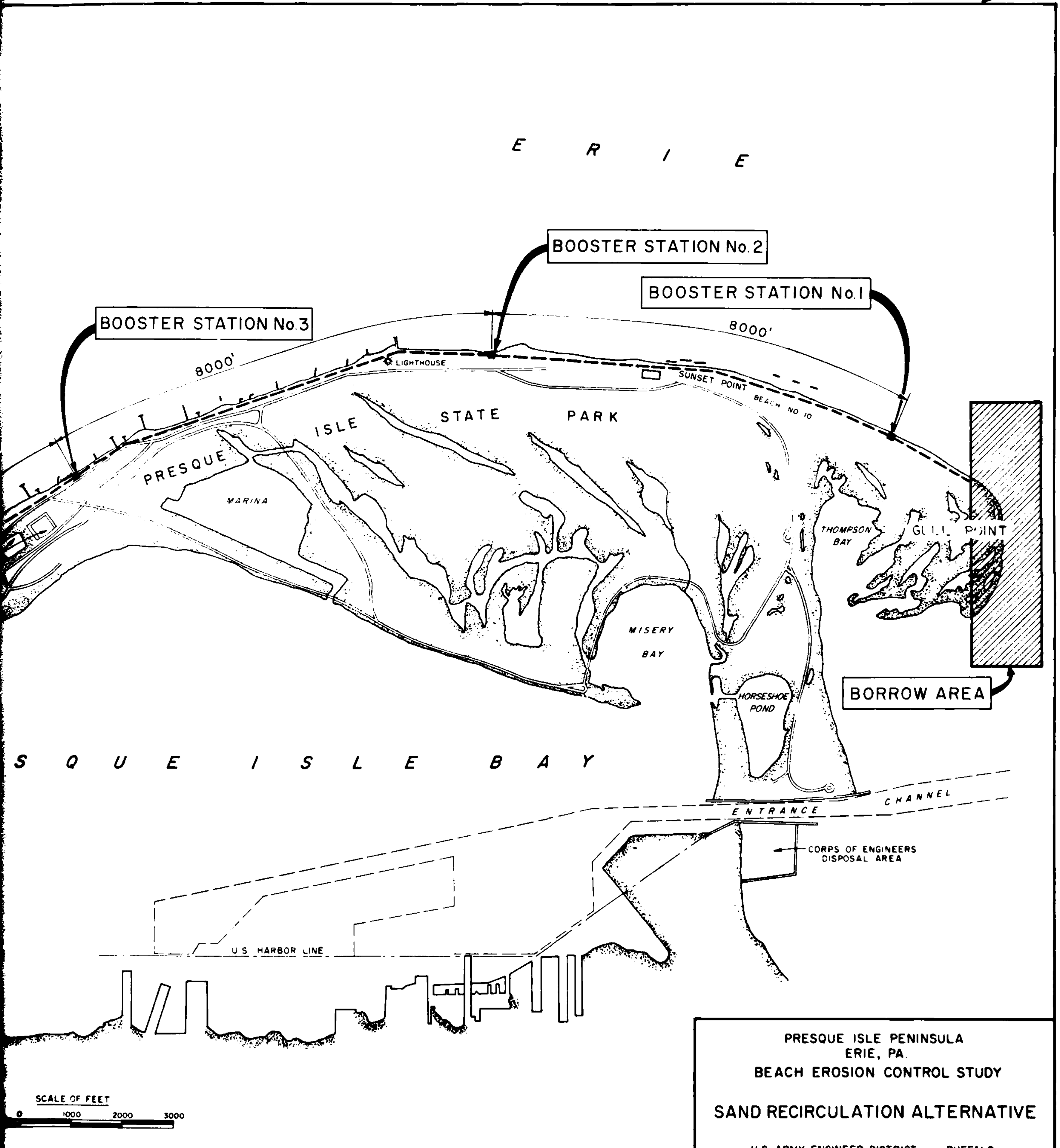
TO ACCOMPANY STAGE 2 DOCUMENTATION
MAY 1979

PLATE 13



N
L A K E
BOOST
20" Φ PERMANENT
PIPELINE
BEACH NO 6
WATERWORKS PONDS
8000'
BOOSTER STATION No. 4
THE NECK
8000'
P R E S Q U
SCALE OF FEET
1000 0 1000 2000

2

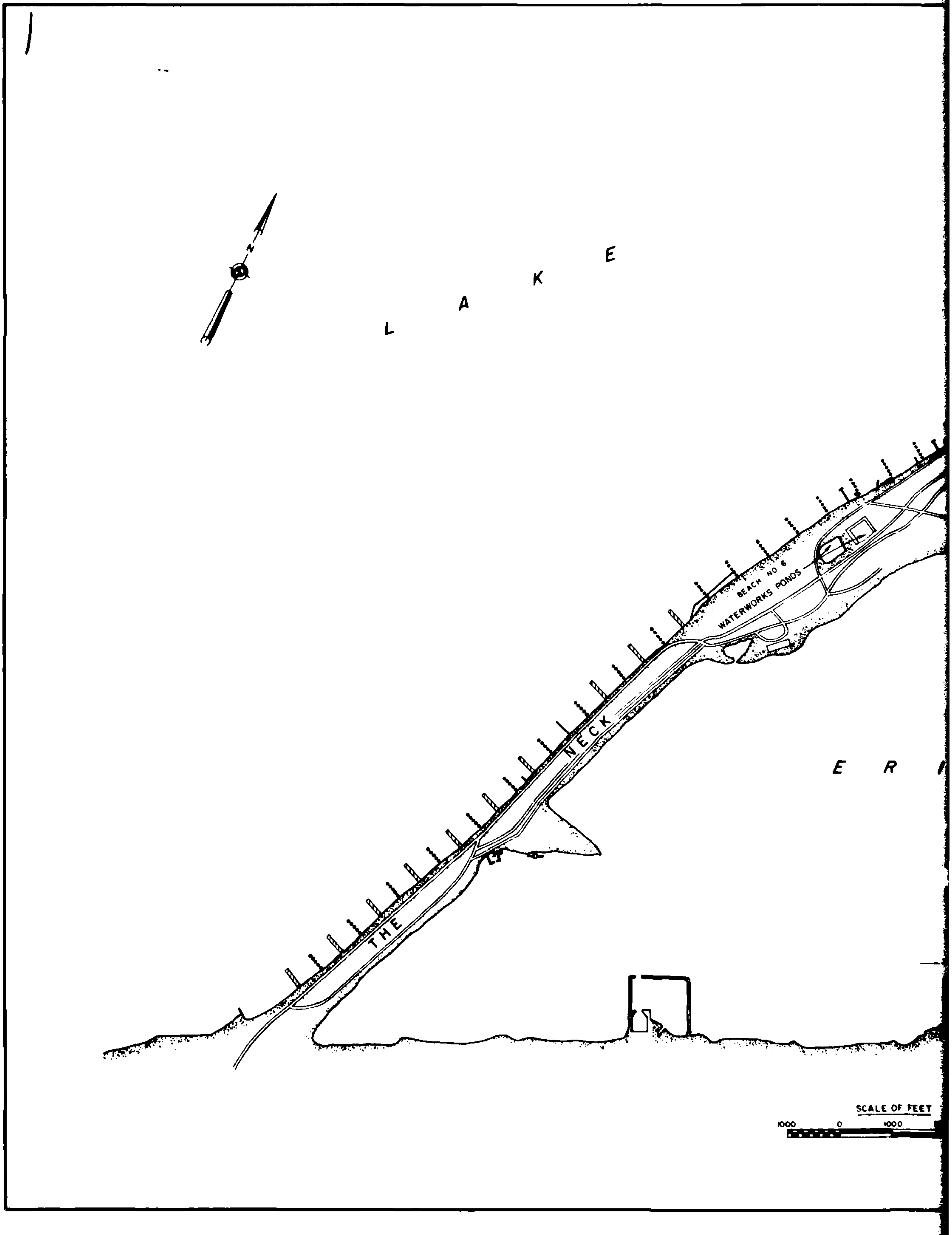


PRESQUE ISLE PENINSULA
ERIE, PA.
BEACH EROSION CONTROL STUDY

SAND RECIRCULATION ALTERNATIVE

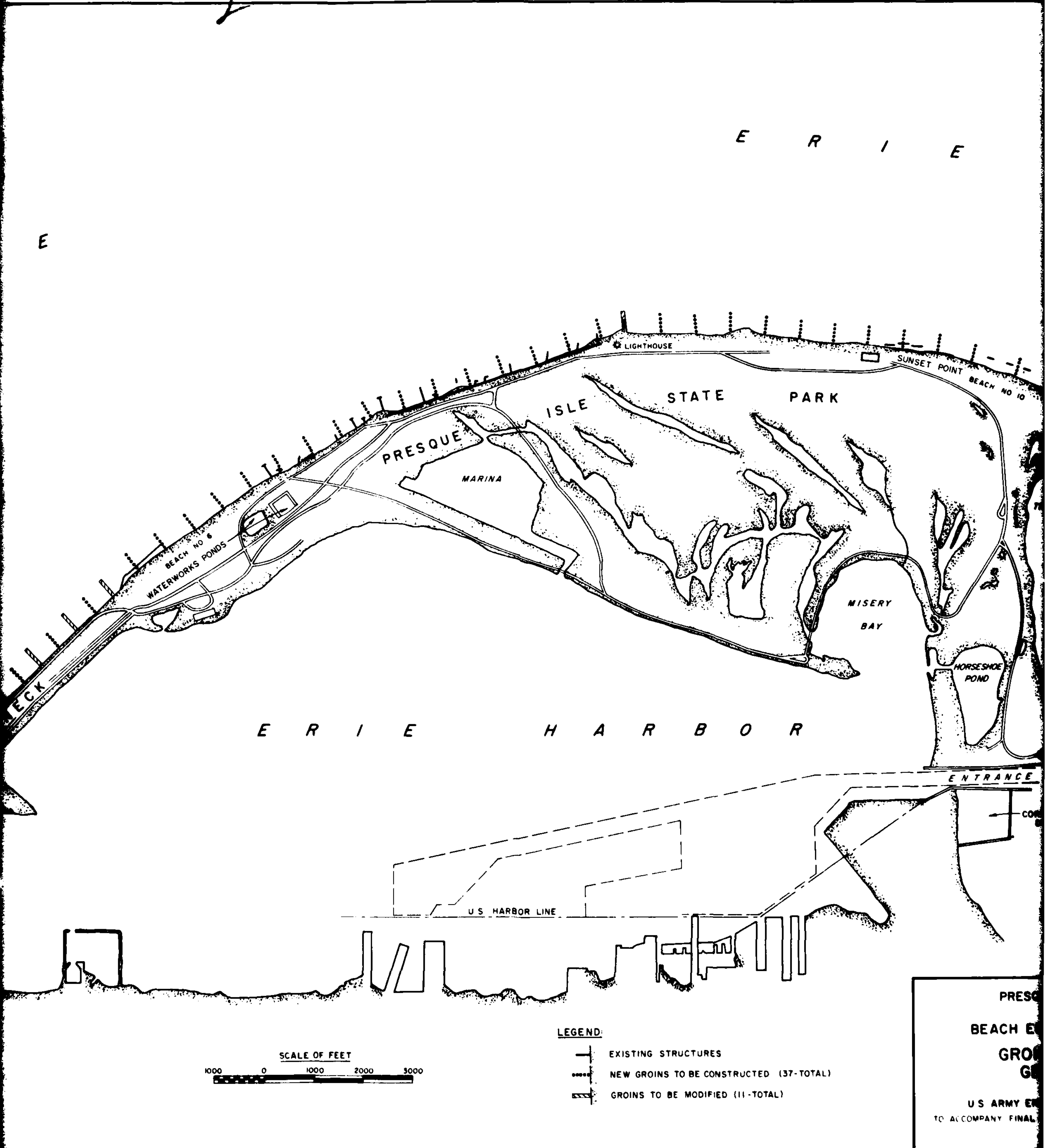
U.S. ARMY ENGINEER DISTRICT BUFFALO
TO ACCOMPANY STAGE 2 DOCUMENTATION
MAY 1979

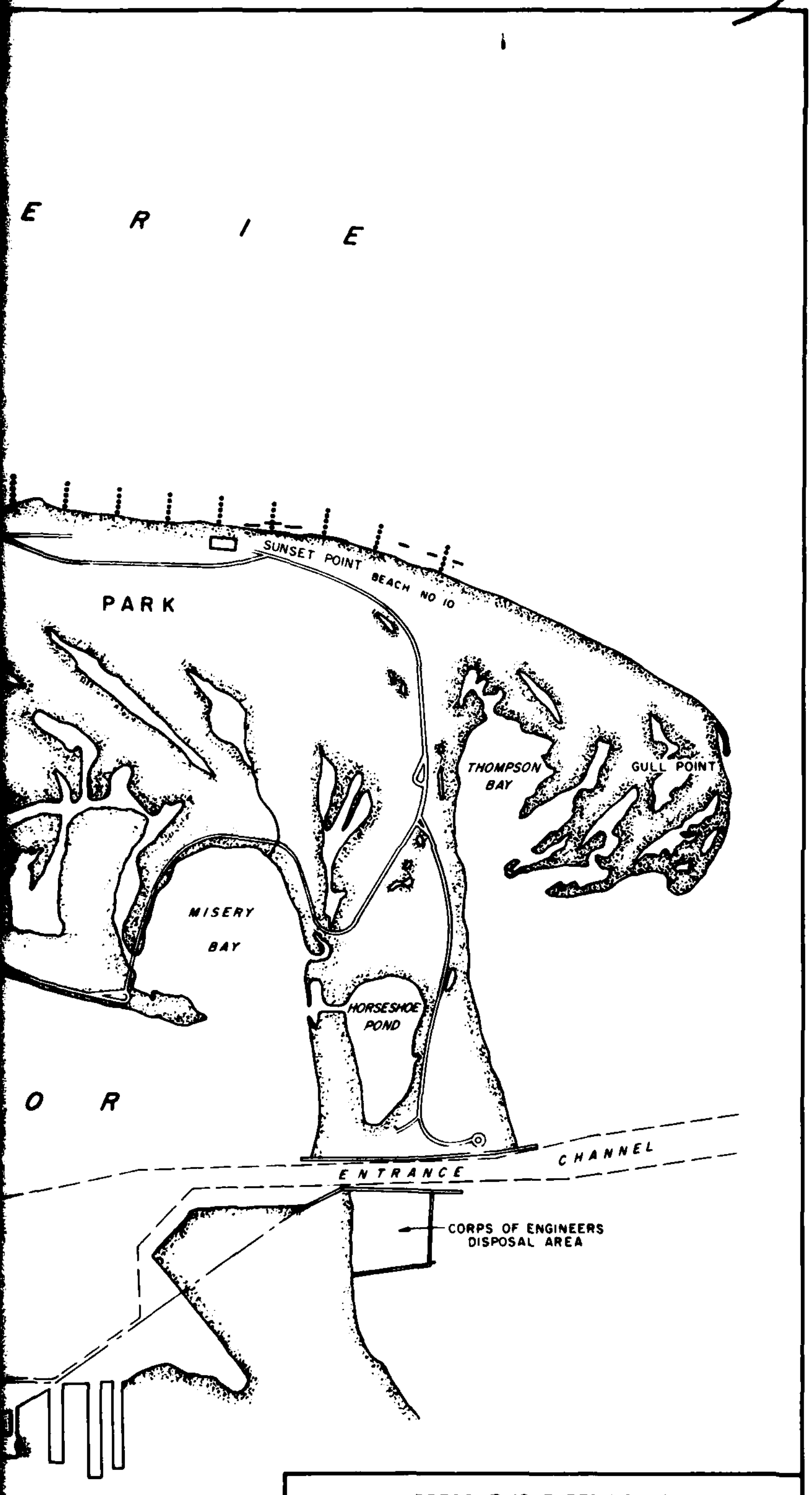
PLATE 14



1
L A K E
BEACH NO 6
WATERWORKS PONDS
THE NECK
E R I
SCALE OF FEET
1000 0 1000

2

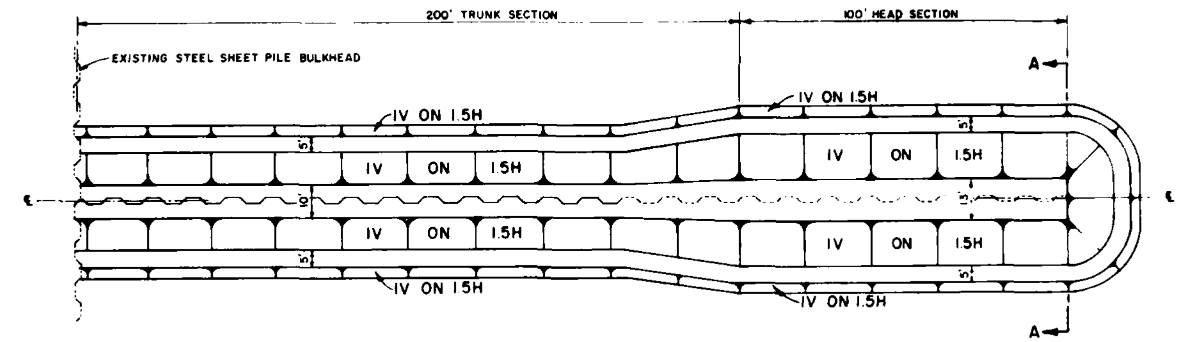

E R I E
E
ECK
LIGHTHOUSE
SUNSET POINT
BEACH NO 10
PRESQUE ISLE STATE PARK
MARINA
BEACH NO 6
WATERWORKS PONDS
MISERY BAY
HORSESHOE POND
E R I E H A R B O R
ENTRANCE
U S HARBOR LINE
PRESQ
BEACH E
GRO
G
U S ARMY E
TO ACCOMPANY FINAL
LEGEND:
EXISTING STRUCTURES
NEW GROINS TO BE CONSTRUCTED (37-TOTAL)
GROINS TO BE MODIFIED (11-TOTAL)
SCALE OF FEET
1000 0 1000 2000 3000



PRESQUE ISLE PENINSULA
ERIE, PA.
BEACH EROSION CONTROL STUDY

GROIN ALTERNATIVE
GENERAL PLAN

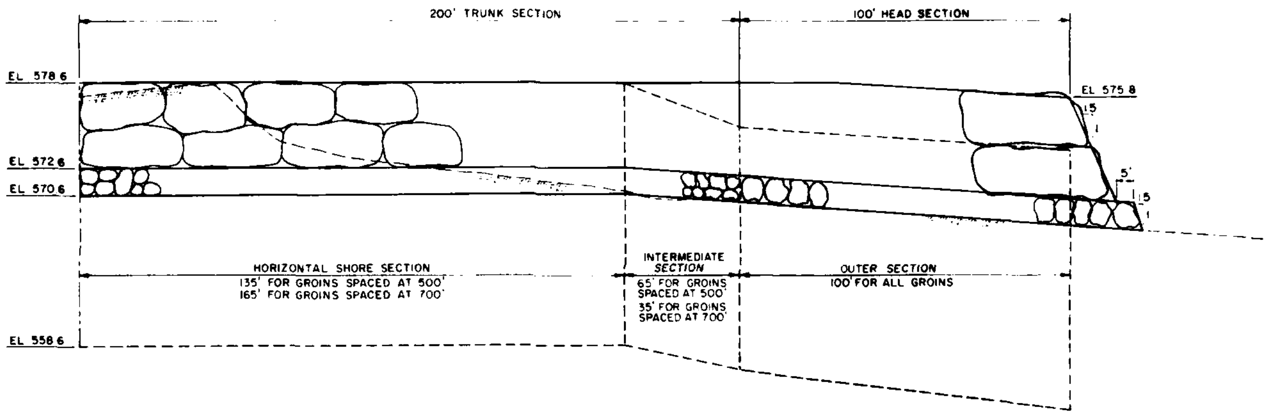
U S ARMY ENGINEER DISTRICT BUFFALO
TO ACCOMPANY FINAL PHASE I GENERAL DESIGN MEMORANDUM
JUNE 1980



PLAN OF NEW GROINS

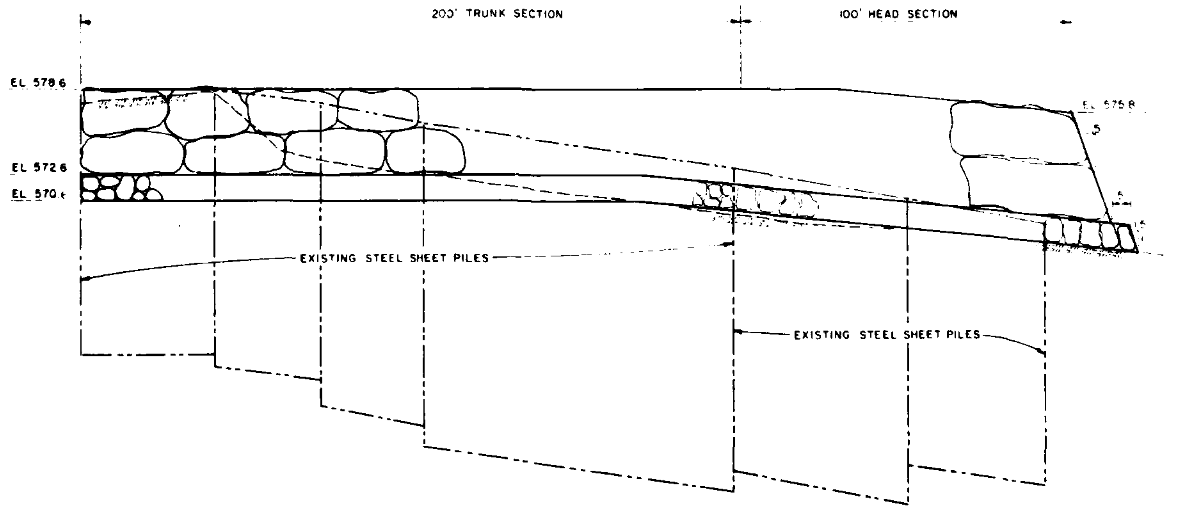
SCALE OF FEET

20 0 20 40



PROFILE OF NEW GROINS

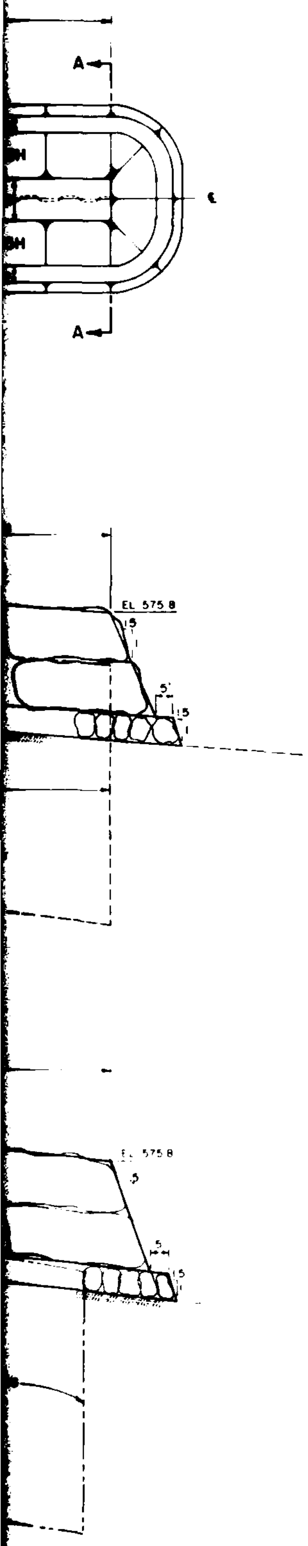
SCALE OF FEET 1" = 20' HORIZONTAL
1" = 5' VERTICAL

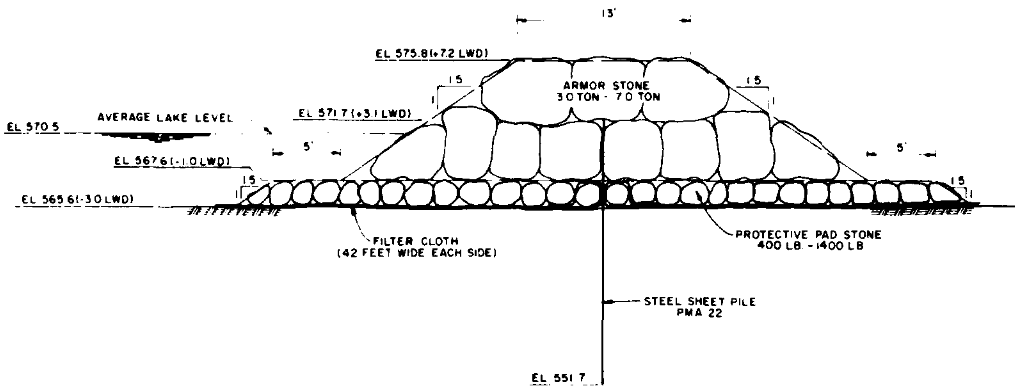


PROFILE OF GROINS TO BE MODIFIED

SCALE OF FEET 1" = 20' HORIZONTAL
1" = 5' VERTICAL

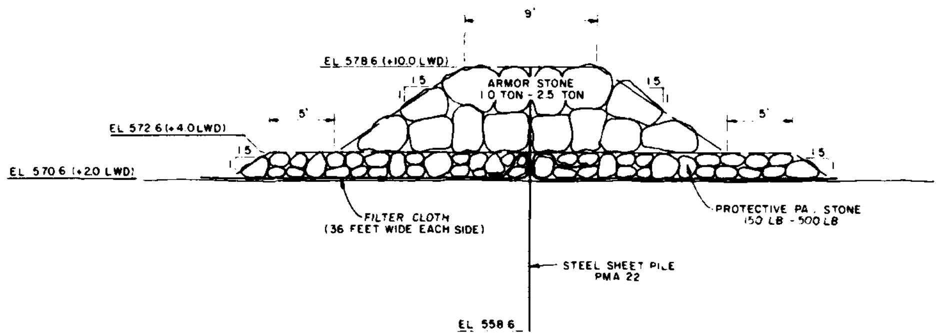
2





TYPICAL HEAD SECTION A-A

SCALE OF FEET
5 0 5 10



TYPICAL TRUNK SECTION

SCALE OF FEET 1"=5'

PRESQUE ISLE PENINSULA
ERIE, PA

BEACH EROSION CONTROL STUDY

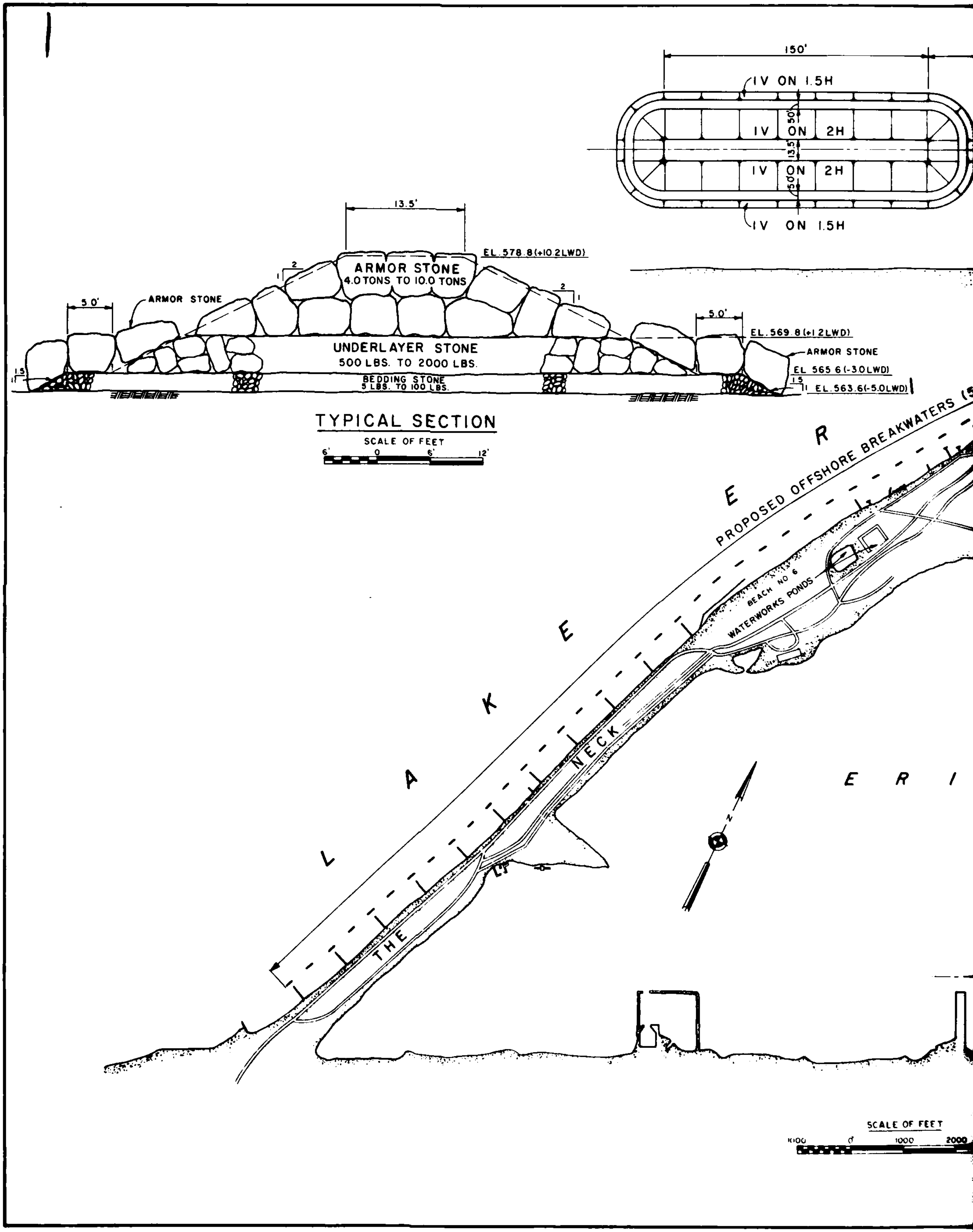
GROIN ALTERNATIVE
PLAN, SECTIONS AND PROFILES

U S ARMY ENGINEER DISTRICT BUFFALO

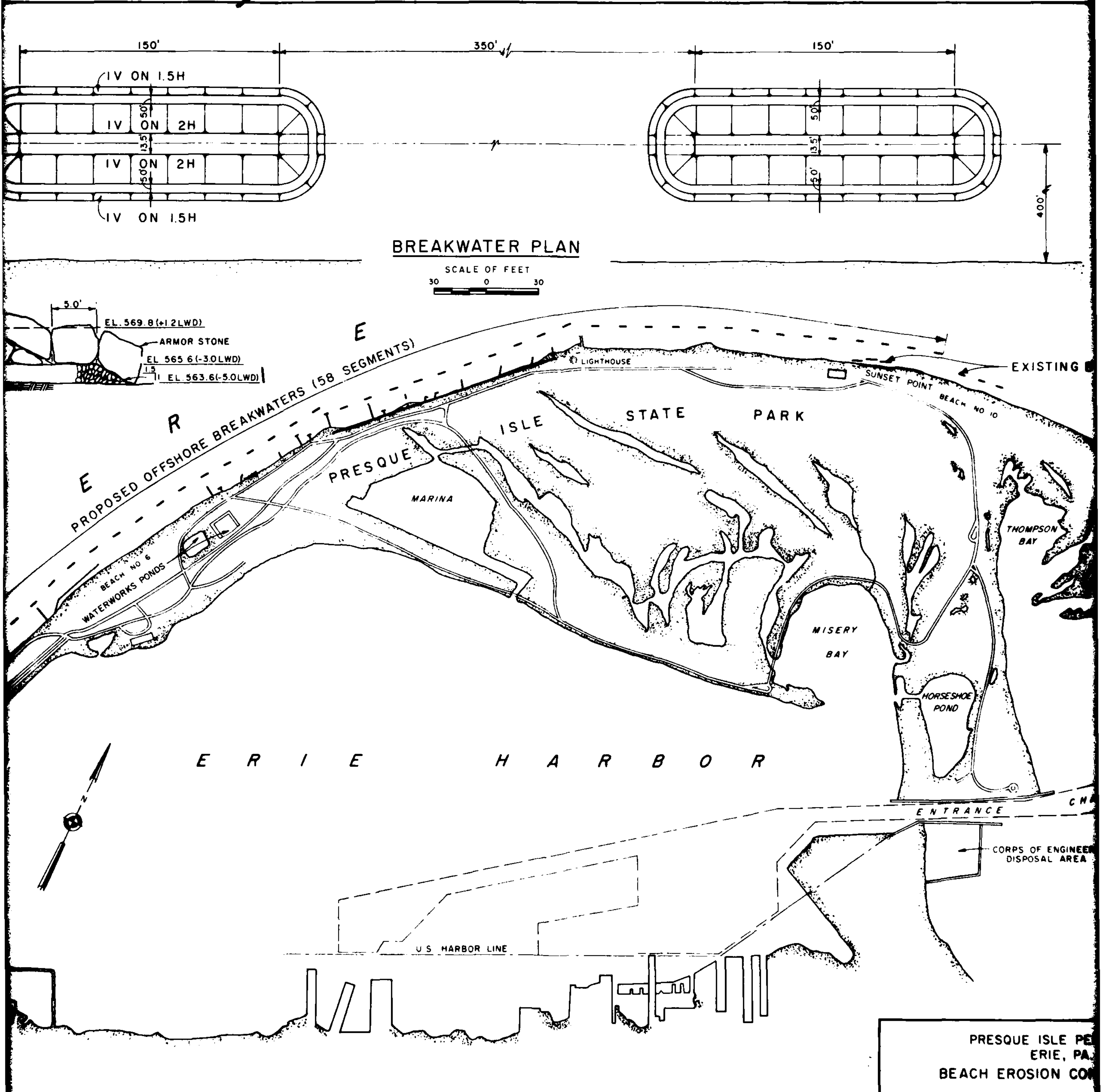
TO ACCOMPANY FINAL PHASE I GENERAL DESIGN MEMORANDUM

JUNE 1980

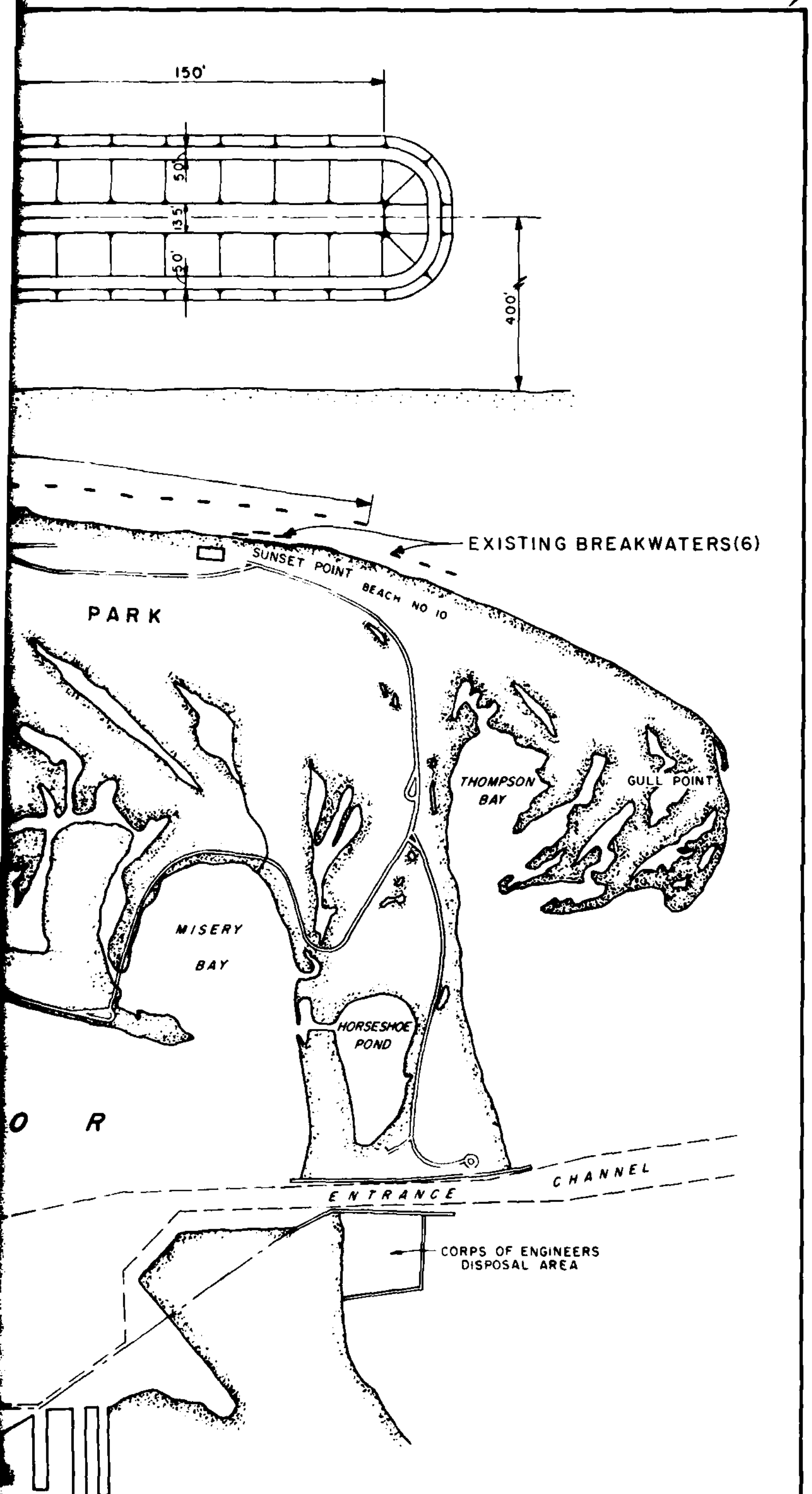
PLATE 16


1
150'
1V ON 1.5H
1V ON 2H
5.0'
13.5'
1V ON 2H
5.0'
1V ON 1.5H
13.5'
EL. 578.8(+10.2LWD)
ARMOR STONE
4.0 TONS TO 10.0 TONS
2
1
ARMOR STONE
5.0'
UNDERLAYER STONE
500 LBS. TO 2000 LBS.
BEDDING STONE
5 LBS. TO 100 LBS.
1.5
1
EL. 569.8(+1.2LWD)
ARMOR STONE
EL. 565.6(-3.0LWD)
EL. 563.6(-5.0LWD)
TYPICAL SECTION
SCALE OF FEET
6' 0 6' 12'
PROPOSED OFFSHORE BREAKWATERS (5
L A K E E R
E R I
BEACH NO. 6
WATERWORKS PONDS
THE NECK
LT
N
SCALE OF FEET
1000 0 1000 2000

2 1



PRESQUE ISLE PE
ERIE, PA.
BEACH EROSION CO
SEGMENTED BR
ALTERNATI
U.S. ARMY ENGINEER DISTRI
TO ACCOMPANY FINAL PHASE I GEN
JUNE 1980

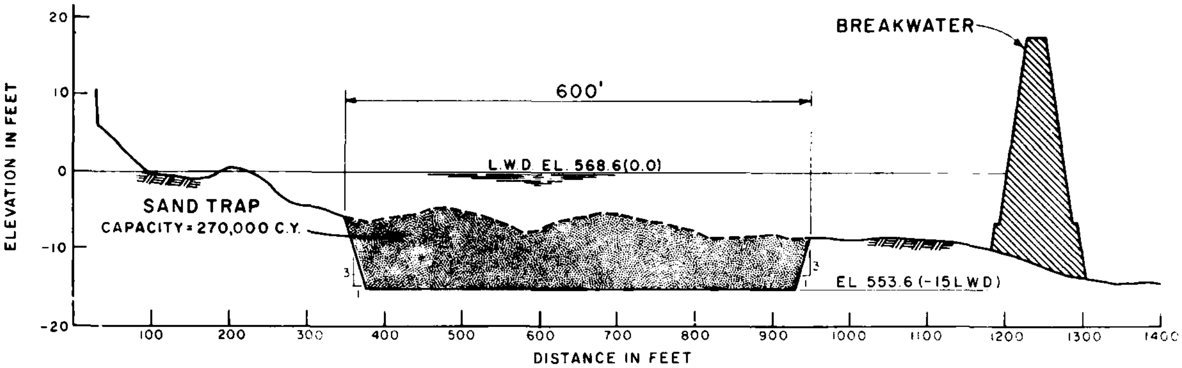


PRESQUE ISLE PENINSULA
ERIE, PA.
BEACH EROSION CONTROL STUDY

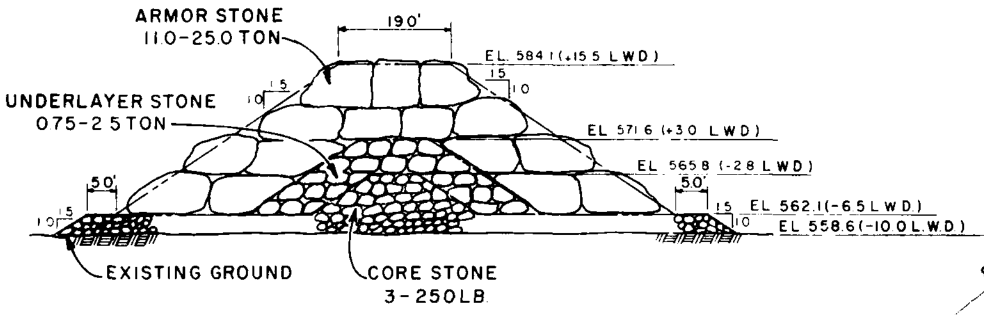
SEGMENTED BREAKWATER ALTERNATIVE

U S ARMY ENGINEER DISTRICT BUFFALO
TO ACCOMPANY FINAL PHASE I GENERAL DESIGN MEMORANDUM
JUNE 1980

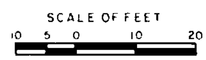
PLATE 17

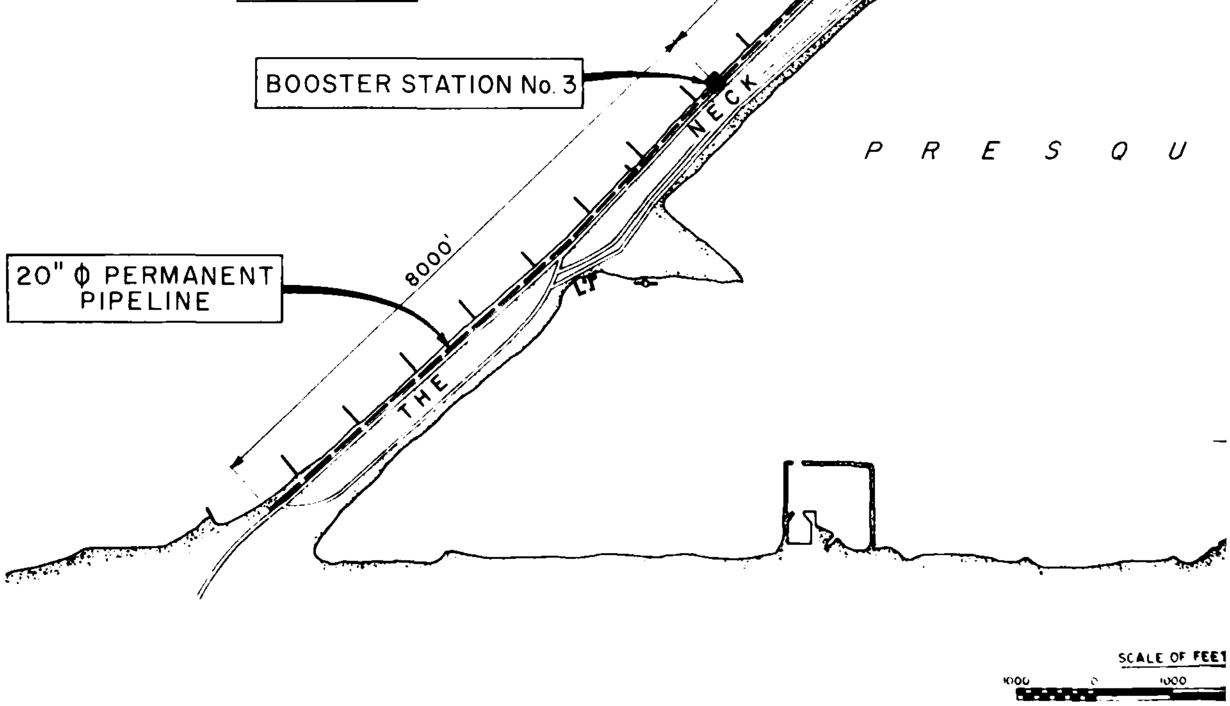


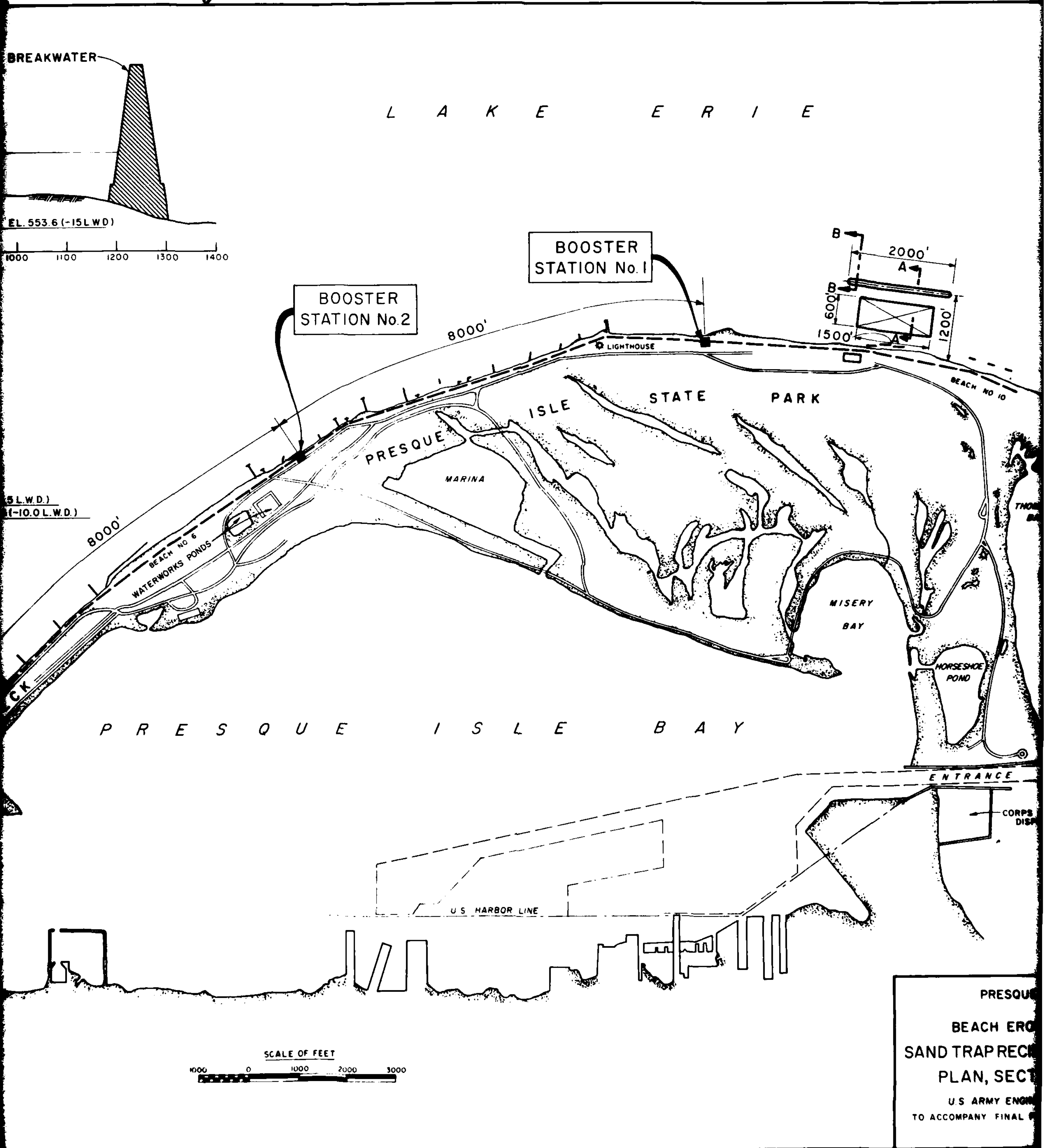
PROFILE SECTION A-A



TYPICAL BREAKWATER SECTION B-B

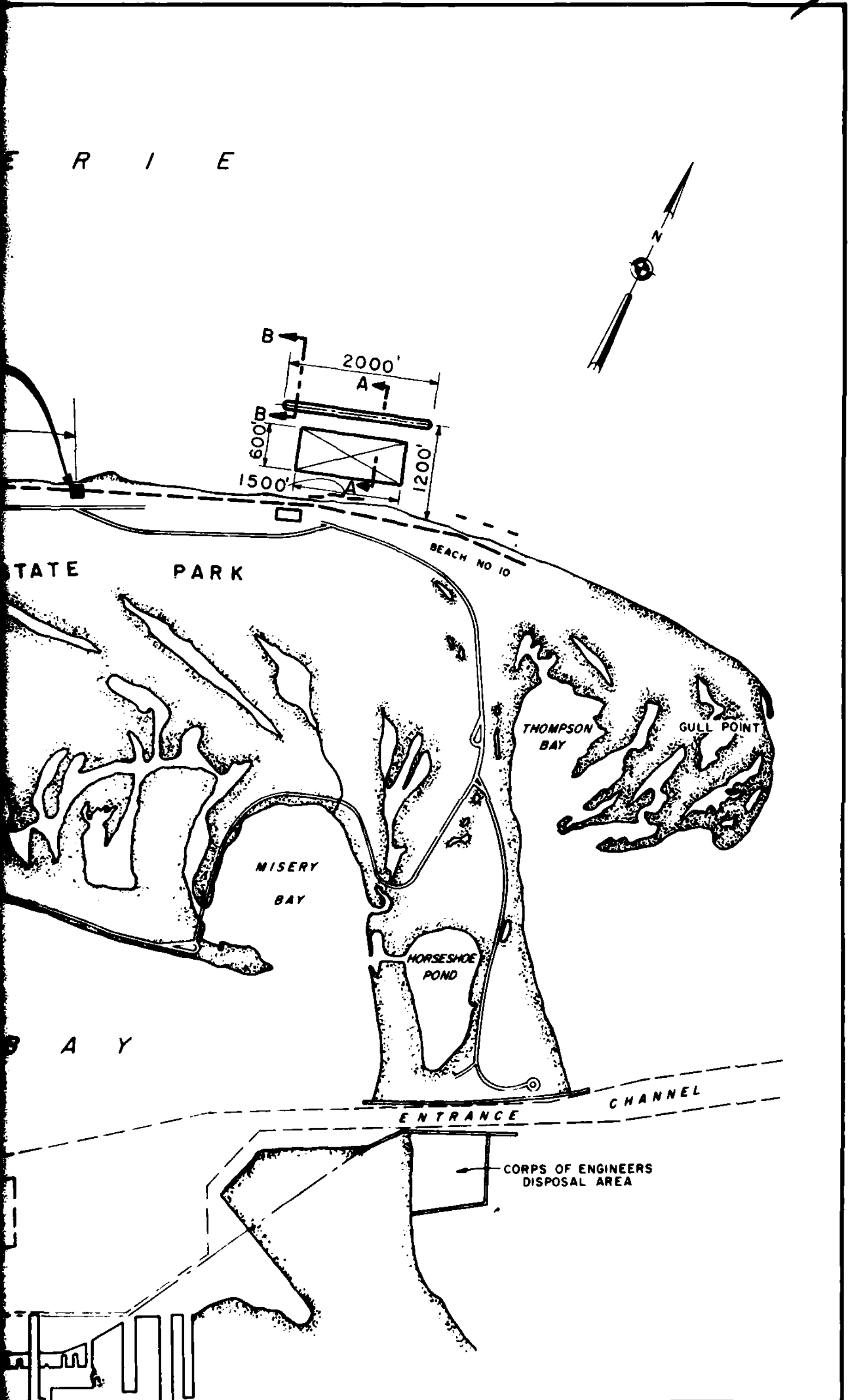




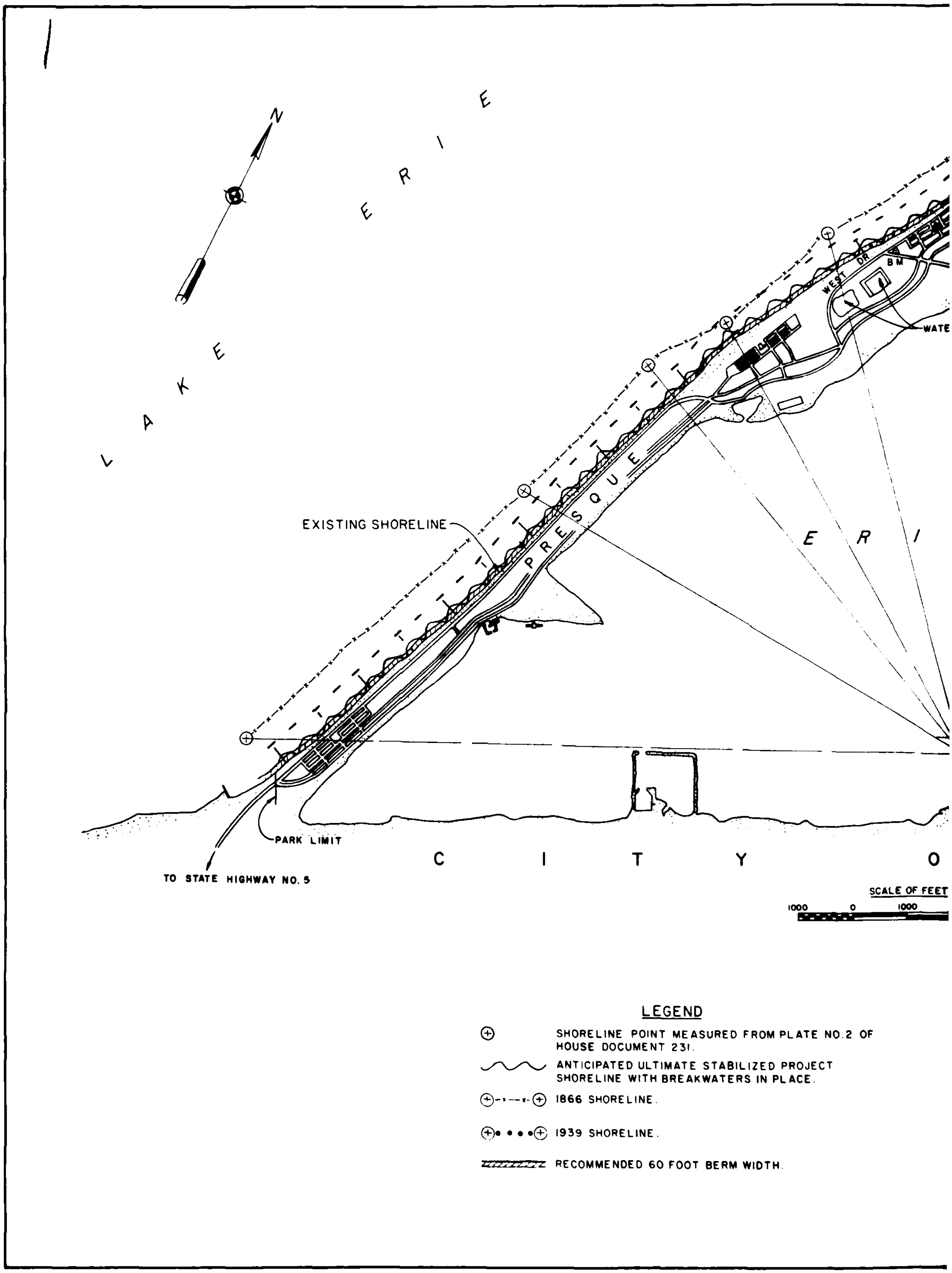


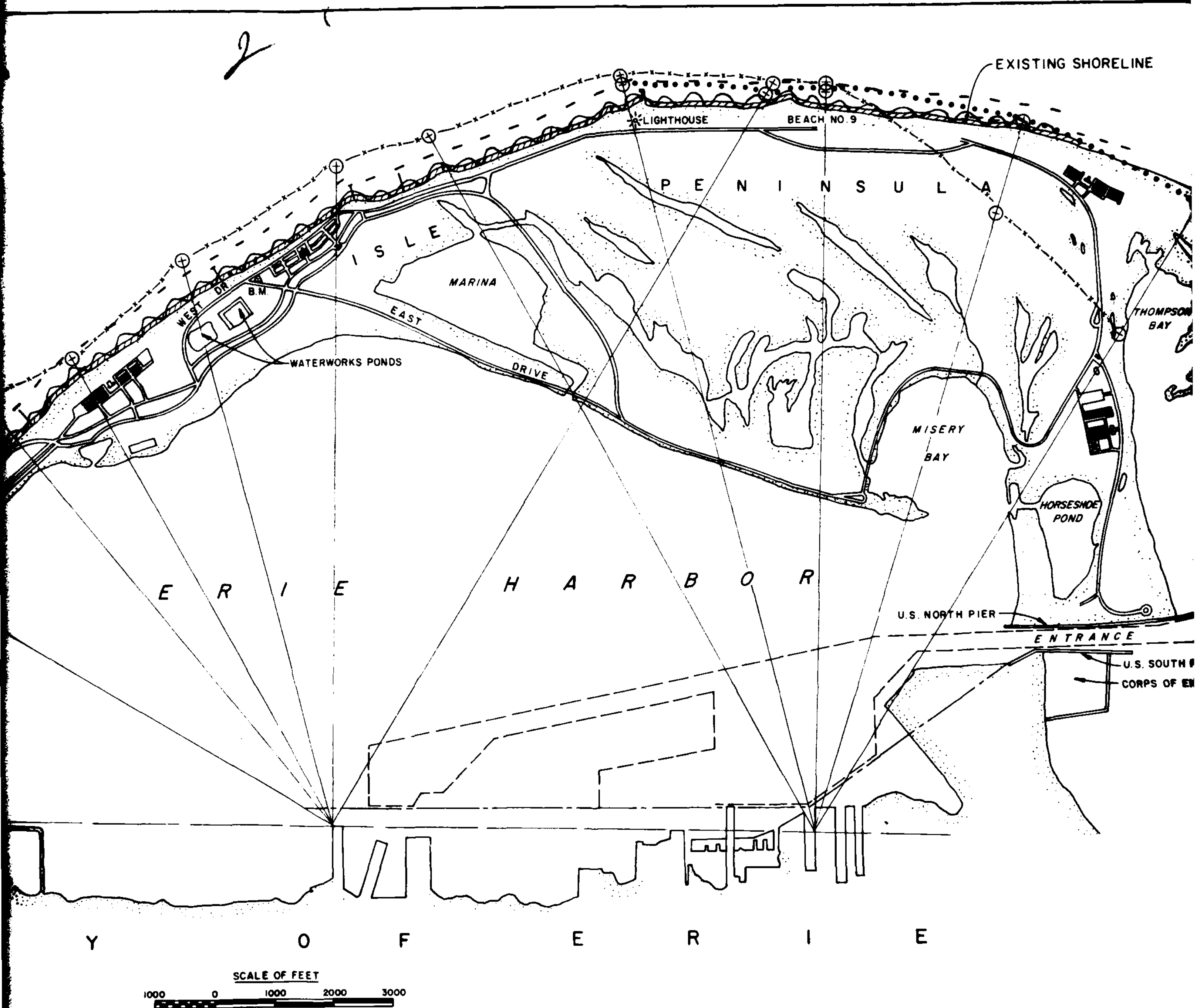
2 1
BREAKWATER
EL. 553.6 (-15 L.W.D.)
1000
1100
1200
1300
1400
LAKE ERIE
BOOSTER STATION No. 1
BOOSTER STATION No. 2
B
2000'
A
600'
1200'
1500'
8000'
LIGHTHOUSE
BEACH NO 10
PRESQUE ISLE STATE PARK
MARINA
5 L.W.D.)
(-10.0 L.W.D.)
8000'
BEACH NO 6
WATERWORKS PONDS
MISERY BAY
HORSESHOE POND
CK
PRESQUE ISLE BAY
ENTRANCE
CORPS
DISP
U.S. HARBOR LINE
SCALE OF FEET
1000
0
1000
2000
3000
PRESQU
BEACH ERO
SAND TRAP REC
PLAN, SECT
U.S. ARMY ENGI
TO ACCOMPANY FINAL

3



PRESQUE ISLE PENINSULA
ERIE, PA.
BEACH EROSION CONTROL STUDY
SAND TRAP RECIRCULATION ALTERNATIVE
PLAN, SECTION, AND PROFILE
U.S. ARMY ENGINEER DISTRICT BUFFALO
TO ACCOMPANY FINAL PHASE I GENERAL DESIGN MEMORANDUM
JUNE 1980


N
LAKE ERIE
EXISTING SHORELINE
PRESQUE
WEST DR
BM
WATE
E R I
PARK LIMIT
TO STATE HIGHWAY NO. 5
C I T Y O
SCALE OF FEET
1000 0 1000
LEGEND
SHORELINE POINT MEASURED FROM PLATE NO. 2 OF HOUSE DOCUMENT 231.
ANTICIPATED ULTIMATE STABILIZED PROJECT SHORELINE WITH BREAKWATERS IN PLACE.
1866 SHORELINE.
1939 SHORELINE.
RECOMMENDED 60 FOOT BERM WIDTH.



END

MEASURED FROM PLATE NO. 2 OF
231.

ATE STABILIZED PROJECT
REAKWATERS IN PLACE.

FOOT BERM WIDTH.

NOTES:

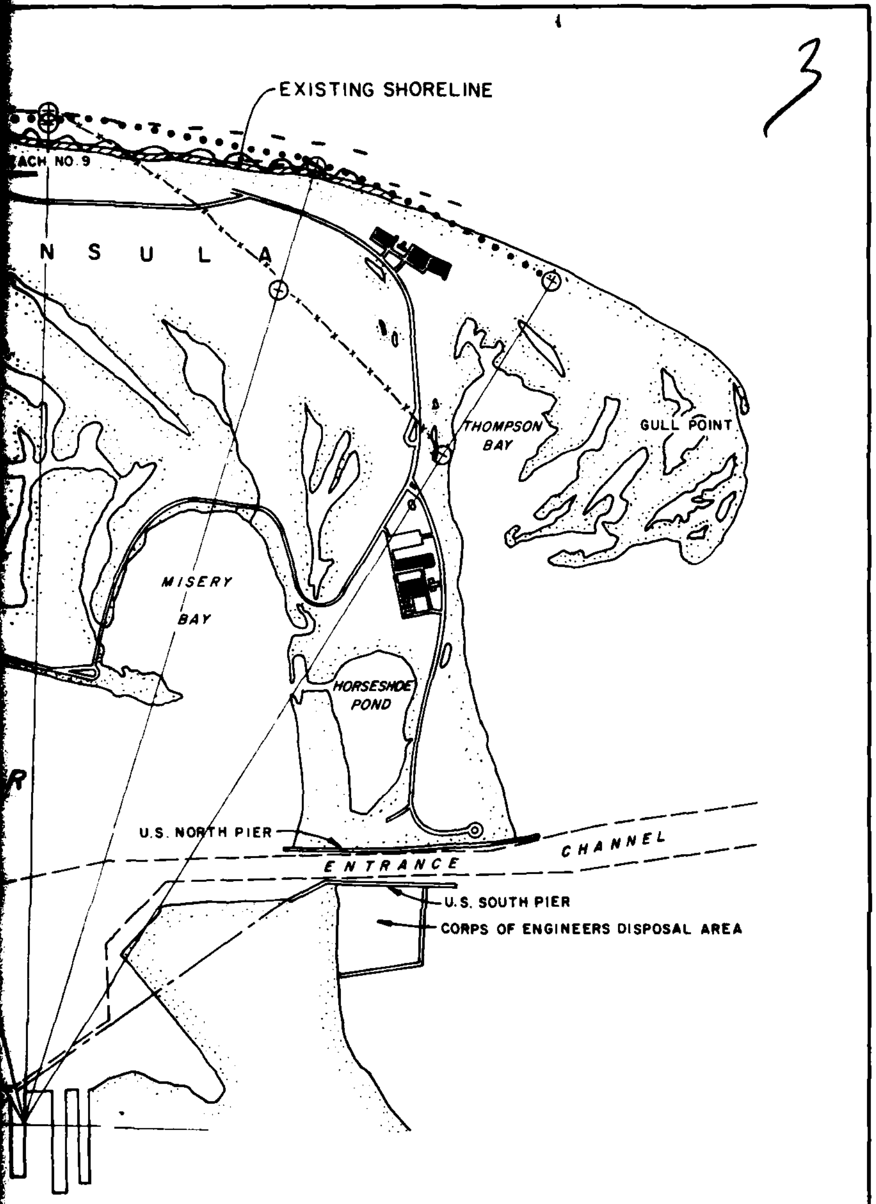
1. THE 1866 SHORELINE WAS SELECTED TO REPRESENT THE SHORELINE FROM THE LANDWARD CONNECTION OF THE NECK THROUGH TO BEACH NO. 9.
2. THE 1939 SHORELINE WAS SELECTED TO REPRESENT THE SHORELINE FROM BEACH NO. 9 THROUGH TO GULL POINT.
3. IT WAS NECESSARY TO SELECT TWO HISTORICAL SHORELINES IN ORDER TO DOCUMENT THE NATURAL MIGRATION OF THE PENINSULA.

PRESQU

BEACH ERO

COMPARISO
SHORELINE
S

U.S. ARMY ENG
TO ACCOMPANY FINAL



RESENT THE
ON OF THE NECK

EPRESENT THE
GULL POINT.

RICAL SHORELINES
RATION OF THE

PRESQUE ISLE PENINSULA
ERIE, PA.

BEACH EROSION CONTROL STUDY

COMPARISON OF ANTICIPATED SHORELINE TO 1866 AND 1939 SHORELINES

U S ARMY ENGINEER DISTRICT BUFFALO

TO ACCOMPANY FINAL PHASE I GENERAL DESIGN MEMORANDUM

JUNE 1980

PLATE 19
REVISED NOVEMBER 1980

PRESQUE ISLE BEACH EROSION CONTROL PROJECT
STAGE 3 DOCUMENTATION
PRESQUE ISLE PENINSULA
ERIE, PA

APPENDIX B

Buffalo District
Economics Section
Sharon L. Cooper
Jonathan W. Brown
Ronald J. Guido
Rev. Nov. 1980
pgs. 29-56

PRESQUE ISLE PENINSULA
ERIE, PA

APPENDIX B
ECONOMICS

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TABLE OF CONTENTS (Cont'd)

TABLES (Cont'd)

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TABLES (Cont'd)

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APPENDIX B

ECONOMICS

B1. SHORELAND DESCRIPTION

B1.1 Presque Isle is located on the Great Lakes Shoreline in Pennsylvania. The Great Lakes Shoreline in Pennsylvania is 48.3 miles long and consists of high erodible bluffs fronted by sand and gravel beaches. Presque Isle Peninsula which encloses Erie Harbor is a large sand spit developed as a park by the Commonwealth of Pennsylvania. The major urban center is Erie.

B1.2 The shoreline of Pennsylvania is divided 21.2 miles residential, 3.6 miles industrial and commercial, 11.6 miles public recreation, and 11.9 miles agricultural and undeveloped. Shoreline ownership is classified 11.6 miles non-Federal public and 36.7 miles private. The entire shoreline is subject to significant erosion except where protective works have been constructed. About 36.1 miles of shoreline are subject to noncritical erosion and 6.3 miles are protected. Six miles of shore on the Presque Isle Peninsula are subject to critical erosion.

B1.3 Erie County, PA, which has a shore frontage of 48.3 miles, is the only Pennsylvania frontage on Lake Erie. It lies between Ashtabula County, OH, and Chautauqua County, NY. The shore bluffs are generally 50 feet to 75 feet high and rise to 100 feet high in a few places. Between the Ohio-Pennsylvania line and Erie, which includes the westerly half of the shore, the bluffs are entirely silt, clay, and granular material, with shale bedrock at about water level. To the east of Erie Harbor, the shale bedrock is frequently from 15 to 35 feet above the lake level, and the upper part of the bluff is composed of silt, clay, and granular material. Sand and gravel beaches up to 150 feet wide extend along the toe of the bluffs. Table B1 illustrates shoreline uses, ownership, and problem areas for this shoreline reach.

B1.4 The westerly 8 miles of the shore, from the Ohio-Pennsylvania line to the mouth of Elk Creek, are thinly populated. In the first 2 miles, where a highway closely follows the lakeshore, a single row of residences and summer homes borders the lakeshore. The next 3 miles are mostly occupied by organizational camps, and the 2 miles of shoreline west of Elk Creek are undeveloped and quite heavily wooded. Between Elk Creek and Erie Harbor, the shore development increases. Many of the shore properties in this reach are high value permanent homes.

B1.5 The first mile of shore east of Erie Harbor is occupied by a steel mill and a paper mill. The next 8 miles, to the mouth of Twelvemile Creek, are developed with residences and a golf course. The next 4 miles, to near Sixteenmile Creek, are generally undeveloped. The shore from there to the Pennsylvania-New York line is being developed for residential use. The westerly half of the mainland shore in the city of Erie within Presque Isle Bay is residential. The easterly half is commercial and industrial.

Table B1 - Shoreline of the Great Lakes - Erie County, PA

Shoreland Use Category	Existing Shoreland Use			Miles of Shoreline			Problem Identification, Miles of Shoreline				
	Miles of Shoreline	Percent of Total	Number of Sites	Public: Federal	Public: Non-Federal	Private	Subject to Erosion: Critical	Subject to Erosion: Noncritical	Protected	Subject to Flooding	Not Subject to Erosion or Flooding
Economic Uses											
Residential	21.2	43.8		0	0	21.2	0	20.5	0.7	0	0
Industrial and Commercial	3.6	7.4		0	0	3.6	0	3.1	0.5	0	0
Agricultural and Undeveloped	11.9	24.8		0	0	11.9	0	11.9	0	0	0
Commercial Harbors			1								
Electric Power Sites			1								
Public Buildings and Related Lands	0	0		0	0	0	0	0	0	0	0
Recreational Uses											
Parks	11.6	24.0		0	11.6	0	6.0	0.5	5.1	0	0
Recreational Boat Harbors			4								
Beach Zone	(48.3)	(100.0)		(0)	(11.6)	(36.7)					
Environmental Uses											
Wildlife Preserves and Game Lands	0	0		0	0	0	0	0	0	0	0
Fish and Wildlife Wetlands (Offshore)	(0)	0					0	0	0	0	0
Forest	0	0					0	0	0	0	0
Total	48.3	100.0		0	11.6	36.7	6.0	36.0	6.3	0	0

Source: Great Lakes Basin Commission

Presque Isle Peninsula, which encloses Erie Harbor, is a large sand spit developed as a State park. The distribution of shoreline use and ownership is shown in Figure B1.

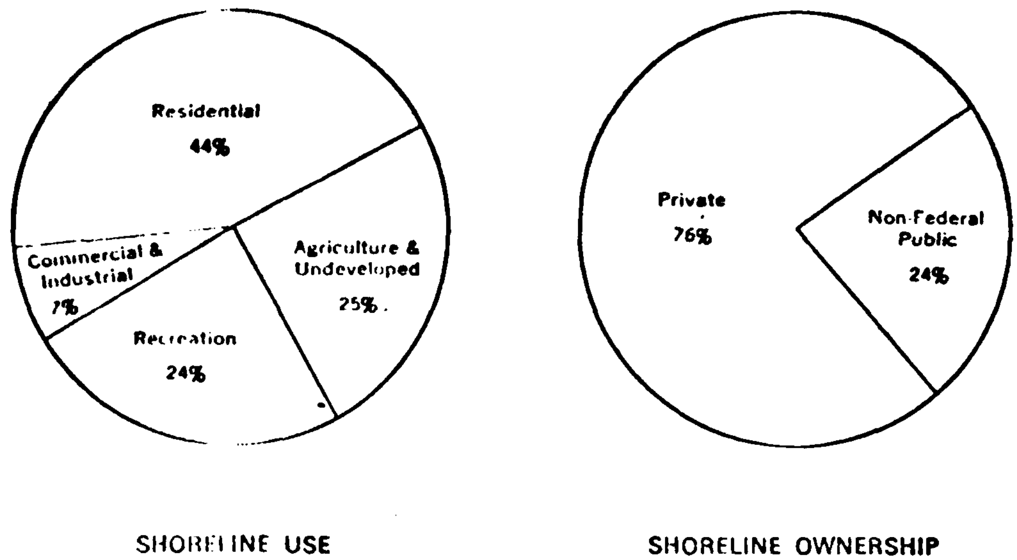


Figure B1 Distribution of Shoreline Use and Ownership, Erie County, Pennsylvania.

B1.6 Presque Isle State Park has the most expansive public beach on the south shore of Lake Erie. It has a total shoreline of over 7 miles on its lakewood edge and almost as much on the bay side of the peninsula. Its unique formation and development are of considerable ecological and botanical interest. Perry's Monument on the peninsula is of historical interest as a memorial to Commodore Perry, whose fleet defeated the British at Put-in-Bay in 1813.

B1.7 In addition to this 3,200-acre park, the Commonwealth owns lake frontage at the mouth of Walnut Creek and at the Borough of Northeast, about 2 miles west of the New York State line. These areas are managed by the Pennsylvania Fish Commission. There is a local community park in the Borough of Lake City located near the mouth of Elk Creek. For its future recreational needs, Erie County has proposed six new lakefront park developments. These would be located at the mouths of the following tributary streams: Raccoon Creek, Crooked Creek, Elk Creek, Eightmile Creek, Sixteenmile Creek, and Twentymile Creek. In addition, Erie County would like to preserve the tributary valleys as natural areas for hiking trails and fishing.

B1.8 There is a Federal deep-draft navigation project at Erie Harbor. A Federal small-boat harbor has been authorized at Elk Creek, where there are private marina facilities. And a study is underway for a new Federal small-boat harbor at Northeast, PA, about 2 miles from the Pennsylvania-New York line. The Commonwealth has completed improvements at the mouth of Walnut Creek to accommodate small boats now using its public launching ramp. There is a large marina operated by the Commonwealth in Presque Isle State Park. There are also private marina facilities and a yacht club in Presque Isle Bay.

B1.9 Presque Isle Peninsula is located in the city of Erie, PA, on the south shore of Lake Erie, about 78 miles southwest of Buffalo, 102 miles northeast of Cleveland, and 135 miles north of Pittsburgh. The city of Erie, PA, is located in Erie County, the Erie SMSA, and the 24th Congressional District.

a. Presque Isle Bay

B1.10 Presque Isle Bay contains the Harbor of Erie. It is bounded on three sides by Presque Isle Peninsula and on the south side by the city of Erie. The city of Erie, population 129,231 (1970 census) is located on a bluff rising 50 feet or more from the shore. Harbor development, another man-made resource, has been concentrated near the entrance. Receipts of iron ore and shipments of coal ceased during the period since World War II, and docks have been converted to other uses or abandoned. East of State Street, a dock has been reconstructed for general cargo and a shipyard (Litton Industries) has been established. Other docks are used for receipt of stone and sand. Small craft, used for commercial or sport fishing, or recreation, are based at several points. Much of the western bay frontage is undeveloped. Beach development has been concentrated on the lake side of the peninsula, where water quality is higher.

b. The Port of Erie

B1.11 Water is one of the most economical means of commercial transportation. By water, the Port of Erie lies 78 miles from Buffalo and 102 miles from Cleveland. With the advent of the St. Lawrence Seaway, Erie has become available to the world market. Most of Erie's foreign trade is with the United Kingdom and Europe. However, connections to the Orient, Australia, South America, and African ports are considerable.

B1.12 The average annual commercial traffic at Erie for the years 1972 to 1977 amounted to 1,146,205 short tons. About 1,100 vessels annually call at the Port of Erie. Products in well over 100 different classifications are made in the Erie area and sold throughout the world. Some of the items that are shipped from Erie include oil, heavy machinery, pig iron, and lumber. Cargo that is received includes limestone, sand, petroleum, and newsprint. The harbor is also used extensively by pleasure craft.

c. Waterfront Facilities

B1.13 Waterfront facilities include fenced and lighted storage areas. In addition, internal concrete storage area is available with office facilities, transit sheds, and bonded storage cages. Two high capacity cranes handle port needs with a maximum capacity of 60 long tons in the hold and 80 long tons in the deck. A tailgate-high loading platform enables quicker, easier cargo transfer direct from the warehouse to rail cars and vehicles.

Ramps are also built-in for jitney servicing and the Penn-Central has a reciprocal switching agreement with the Bessemer & Lake Erie Railroad and the Norfolk-Western Railroad. A moderate concrete two-lane highway provides direct access to and from port facilities. A high weigh-in scale is also located near the main port entrance and provides exact truckload weight. In addition to the Port of Erie's facilities, the bayfront has large storage areas for coal, iron ore, grain, and bulk petroleum.

B1.14 The Erie Shipyards, now owned by the Litton Company, have been the site of construction of the 1,000-foot long bulk cargo carrier Stewart J. Court and the barge Presque Isle. The draft of these carriers in the 1,000-foot class is 28.5 feet. The Erie Shipyards built a tug, for maneuvering the 1,000-foot barge, which has a draft of 26.5 feet. The Erie Sand Steamship Company uses vessels with a draft of 21 feet to bring sand and gravel into the Erie Harbor.

d. Presque Isle State Park Marina

B1.15 During the period from 1955 to 1965, the Corps of Engineers excavated large quantities of sand from an area south of Long Pond for use in replenishing eroded beaches on the Lake Erie side of the peninsula. This 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 past 14 years (see Plate B1). The marina has facilities for 498 boats up to 45 feet in length. Onshore installations include boat launches, winter storage facilities, and parking lots. There is a proposal to expand the Presque Isle Marina to meet increasing demand in small craft recreation.

B2. ERIE COUNTY ECONOMIC PROFILE

a. County Location and Description

B2.1 Erie County's geographic location has largely been responsible for its past relatively rapid growth. Located at the hub of the three aforementioned metropolitan centers, Erie County is served by the entire array of transportation facilities. Historically, the Erie area has taken advantage of its regional location as a lake port and is part of the water route between the midwest and the Atlantic seaboard. This water route has become important in recent years as the corridor for population concentration and economic activity and is expected to assume even greater importance in the future. Past trends support the claim that the rate of growth of Erie County will increase significantly in coming decades. Erie's location as a link in the population/economic bond stretching between the Atlantic seaboard and the lower Great Lakes area will help increase its attractiveness as an economic center. See Plate B2 for the regional location of Erie County.

B2.2 Erie County is situated within the eastern megalopolis - a growth pattern which, in the immediate regional area, stretches from Cleveland through Youngstown to Pittsburgh and from Buffalo to Cleveland, and on as far west as Detroit and as far east as New York City and the Atlantic seaboard. The significance of the close relationship between Erie, Buffalo, Cleveland, and Pittsburgh cannot be overstressed. In many respects, the close link with these three major urban areas has contributed to the growth of Erie County; and, in other respects, particularly since all three areas are economically strong, their competition has had a direct effect upon Erie as well.

B2.3 Erie County is made up of 40 individual municipalities. These separate Governments include two cities - the city of Erie on Lake Erie in North Central County which is the third largest city in the State (population: 129,231) and the city of Corry on the southeastern border of the county. There are 16 boroughs and 22 townships. The total population (1970 census) is 263,654, placing Erie County as the 12th largest county in the State.

B2.4 Erie County is not only a recognized manufacturing area, but also a significant agricultural area concentrating on dairy and fruit growing, particularly grape production, placing Erie County consistently in the top eight in farm production (cash receipts) of the 67 counties in the Commonwealth. Erie County is also a noted recreational center due in part to the 3,200 acre peninsula (a unique natural area) known as Presque Isle State Park and the 48.3 miles of lakeshore, both of which afford this resort area all the amenities associated with water, beach, and fishing activities. This economic diversity provides for similar beneficial diversity in terms of the population make up and resulting use of the land throughout the county. However, such differences also cause divergent and sometimes conflicting priorities in land use decision making.

(1) Land Use

B2.5 Since 1969, the Erie County Metropolitan Planning Commission (ECMPC) has entered into a work program which periodically includes a complete update of existing land use, the formulation of a systematic procedure for an annual update of land use utilizing electronic data processing, and a thorough land use analysis which would culminate in a county land use plan. The existing land use for Erie County during the years 1959-1976 is presented in tabular form in Table B2. The information contained in the table indicates a decided trend toward urban uses. The trend would not include agriculture, open or State lands.

b. Population Characteristics

(1) Regional Growth

B2.6 The boundary delineation of the Northwest Pennsylvania Economic Region was stated in the Overall Economic Development Program (OEDP, 1977) of the Northwest Pennsylvania Regional Planning and Development Commission and is defined as the eight counties of Clarion, Crawford, Erie, Forest, Lawrence, Mercer, Venango, and Warren. The northwest Pennsylvania region's population is unequally distributed and a sharp distinction between the rural-urban sectors is readily apparent. According to the United States Bureau of Census definitions of urban and rural, the region has a large (46.3) percent rural population which is almost double the corresponding figures found for the Commonwealth or the United States. Generally the population in the eastern half of the region exceeds that in the western half.

B2.7 The total population of the Northwest Pennsylvania region was 751,552 in 1975; by 1980, projections found in the OEDP estimated the Northwest Region's population to be 753,902. During the period between 1940 and 1975, the Northwest Region had an increase in population of about 25 percent compared to an increase of 19.6 percent for the Commonwealth and an increase of 61 percent for the United States.

B2.8 The average population density of the Northwest Region in 1975 was 134 persons per square mile. The average density of the Commonwealth of Pennsylvania is somewhat higher being about 262 persons per square mile. The Northwest Region contains 6.2 percent of the State's population located on 12 percent of its total land area.

(2) Erie County

B2.9 The total number of persons residing in the Erie Standard Metropolitan Statistical Area (SMSA includes the whole of Erie County) according to the 1970 Bureau of the Census is 263,654. In 1976, approximately 70 percent of the total Erie County populus resided in the Erie Urbanized Area. The city of Erie, which is the focal point of the urbanized area, accounts for 49 percent of the total county population.

Table B2 - Erie County Land Use Comparisons
1959-1976

Land Use Category	1959		1963		1971		1976	
	Acres	Percent	Acres	Percent	Acres	Percent	Acres	Percent
Residential	10,300	2.0	19,850	3.9	28,417	5.6	30,004	5.9
Commercial	1,840	.4	1,900	.4	3,086	.6	3,942	.8
Industrial	2,280	.5	2,250	.4	1,643	.3	2,395	.5
Public and Institutional	N.A.	-	3,800	.8	4,933	1.0	6,368	1.3
Recreation	3,247	.6	N.A.	-	5,152	1.0	7,440	1.5
Agriculture	321,610	63.7	447,550	88.6	235,211	46.6	225,437	44.6
Open	165,873	32.8	N.A.	-	195,824	38.8	197,087	39.0
Railroads and Airports	N.A.	-	4,700	.9	3,716	.7	4,275	.8
Roads	N.A.	-	16,100	3.2	17,999	3.6	17,837	3.5
State Game Lands	N.A.	-	9,000	1.8	9,169	1.8	10,365	2.1
TOTALS	505,150	100.0	505,150	100.0	505,150	100.0	505,150	100.0

(3) Population Growth (Historical)

B2.10 Historically, population has grown steadily in Erie County with dramatic increases occurring in the 20th century. The accompanying Table B3 traces Erie County's population from 1850 to 1970 and relates this growth to that of the region, Pennsylvania, and the United States. Throughout the first half of the 20th century, Erie County's population growth per decennium exceeded both National and State growth. It should be noted that since the turn of the century, Erie County's population increased by 168 percent, that of the United States 98.3 percent, and 87 percent for Pennsylvania.

B2.11 According to the U.S. Bureau of Census Population Trends, the total population of Erie is expected to reach 350,000 by 1985. Excluding the city, Erie County is expected to represent 49 percent of the total county population in 1985 as compared to the 1960 percentage of 54 percent and its 1930 percentage of 66.2.

(4) Projected Population Densities

B2.12 Population densities for the city and county of Erie, PA, are presented in Table B4 for the years 1950, 1960, 1970, 1980, and 1985. The county of Erie shows a more rapid increase of population density than the city of Erie, which was more developed at an earlier date. The major reason for stabilized population growth rates is the moderate employment growth predicted for the area. The cities in the area are also experiencing a decline in total population.

(5) Population Pyramid

B2.13 Figure B2, the population pyramid of Erie County, PA, for the years 1960 and 1970, presents a graphic picture of age-sex breakdown for Erie County, PA. The population in the area is becoming relatively older. The age group over 65 is expected to expand, while the under 20 age group will shrink relative to total population. The distribution of population by age as shown by the population pyramid in Figure B2 will tend, over time, to assume a smooth triangular shape.

c. Employment

B2.14 In 1971, the 496 industrial plants located in Erie County employed 44,609 workers. The extensive complex of hotels, motels, cottages, and restaurants can accommodate over 10,000 people and furnish employment in service-oriented activities. Erie is served by 35 trucking companies which also provide 13,000 persons with employment.

d. Labor Force

B2.15 The Erie area has traditionally been a labor market oriented toward industrial employment. Over the last 20 years, some 40-50 percent of the civilian labor force has been employed in the manufacturing fields. In terms of job numbers this has meant over 40,000 jobs are generated by manufacturing, the durable goods sector accounts for 75 percent of the 40,000 figure.

Table B3 - Population: 1850 to 1979
Number and Percent Change from Previous Decade

	1850	1860	1870	1880	1890	1900	1910
Clarion	23,565	24,988	26,537	40,328	36,802	34,283	36,638
		6.0	6.2	52.0	-8.7	-6.8	6.9
Crawford	37,849	48,755	63,832	68,607	65,324	63,643	61,565
		28.8	30.9	7.5	-4.8	-2.6	-3.3
Erie	38,742	49,432	65,973	74,688	86,074	98,473	115,517
		27.6	33.5	13.2	15.2	14.4	17.3
Forest	0	898	4,010	4,385	8,482	11,039	9,435
			346.5	9.4	93.4	30.1	-14.5
Lawrence	21,079	22,999	27,298	33,312	37,517	57,042	70,032
		9.1	18.7	22.0	12.6	52.0	22.8
Mercer	33,172	36,856	49,977	56,161	55,744	57,387	77,699
		11.1	35.6	12.4	-.7	2.9	35.4
Venango	18,310	25,043	47,925	43,670	46,640	49,648	56,359
		36.8	91.4	-8.9	6.8	6.4	13.5
Warren	13,671	19,190	23,897	27,981	37,585	38,946	39,573
		40.4	24.5	17.1	34.3	3.6	1.6
Region	186,388	228,161	309,449	349,132	374,168	410,461	466,818
		22.4	35.6	12.8	7.2	9.7	13.7
PA	2,311,786	2,906,215	3,521,951	4,282,891	5,258,113	6,302,115	7,665,111
		25.7	21.2	21.6	22.8	19.9	21.6
U.S.	23,191,876	31,443,321	38,558,371	50,189,209	62,979,766	76,212,168	92,228,496
		35.6	22.6	30.2	25.5	21.0	21.0

Table B3 - Population: 1850 to 1979 (Cont'd)
Number and Percent Change from Previous Decade

	1910	1920	1930	1940	1950	1960	1970
Clarion	36,638	36,170	34,531	38,410	38,344	37,408	38,414
		-1.3	-4.5	11.2	-.2	-2.4	2.7
Crawford	61,565	60,667	62,980	71,644	78,948	77,956	81,342
		-1.5	3.8	13.8	10.2	-1.3	4.3
Erie	115,517	153,536	175,277	180,889	219,388	250,682	263,654
		32.9	14.2	3.2	21.3	14.3	5.2
Forest	9,435	7,477	5,180	5,791	4,944	4,485	4,926
		-20.8	-30.7	11.8	-14.6	-9.3	9.8
Lawrence	70,032	85,545	97,258	96,877	105,120	112,965	107,374
		22.2	13.7	-.4	8.5	7.5	-4.9
Mercer	77,699	93,788	99,246	101,039	111,954	127,519	127,225
		20.7	5.8	1.8	10.8	13.9	-.2
Venango	56,359	59,184	63,226	63,958	65,328	65,295	62,353
		5.0	6.8	1.2	2.1	-0.1	-4.5
Warren	39,573	40,024	41,453	42,789	42,698	45,482	47,682
		1.1	3.6	3.2	-.2	6.5	4.8
Region	466,818	536,391	579,151	601,397	666,724	721,892	732,970
		14.9	8.0	3.8	10.9	8.3	1.5
PA	7,665,111	8,720,017	9,631,350	9,900,180	10,498,012	11,319,366	11,793,909
		13.8	10.5	2.8	6.0	7.8	4.2
U.S.	92,228,496	106,021,537	123,202,624	132,164,569	151,325,798	179,323,175	203,211,926
		15.0	16.2	7.3	14.5	18.5	13.3

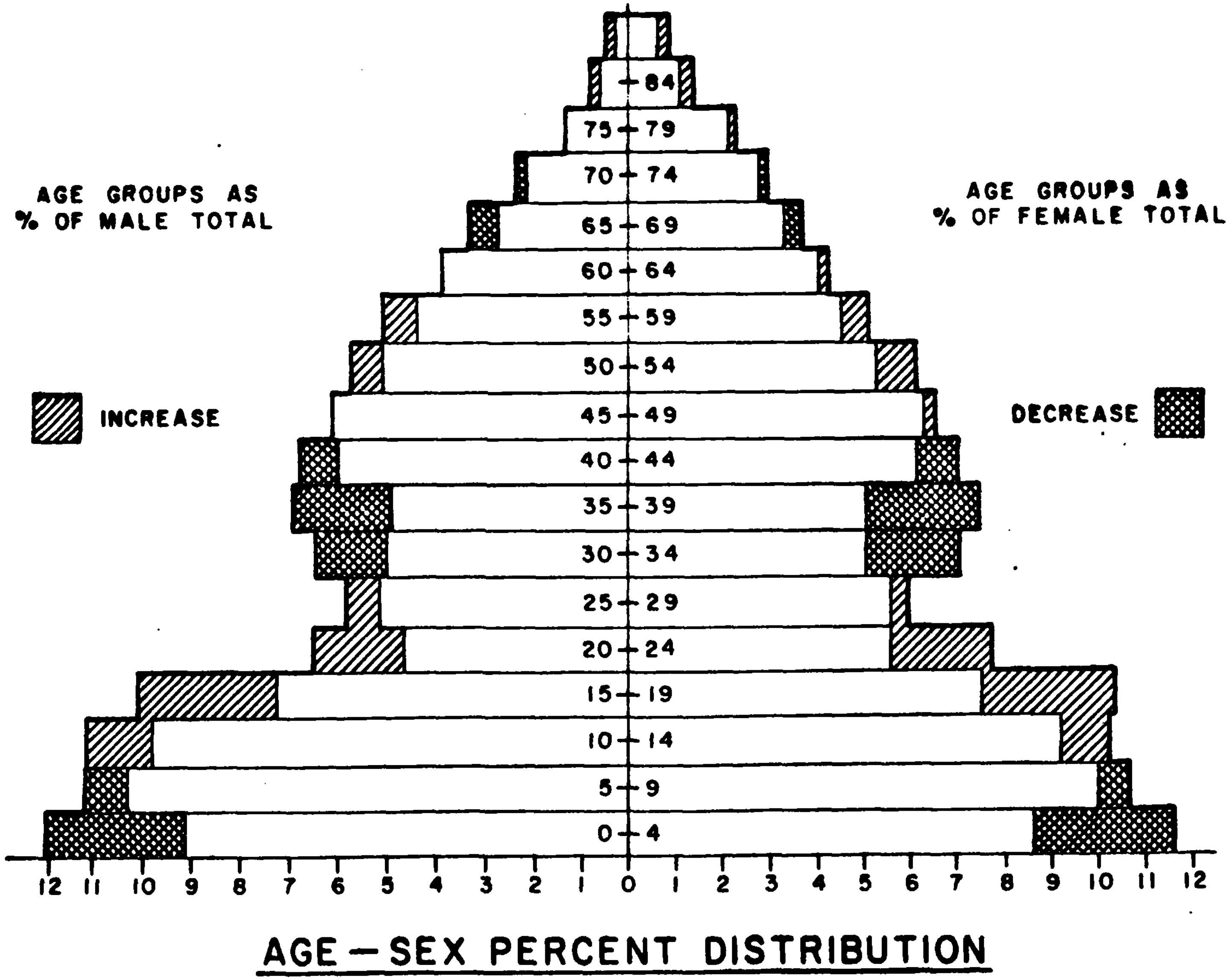
Source: County Data: PA Abstracts 1968, 1975
U.S. & PA Data: U.S. No. of Inhabitants 1970 Census

Table B4 - Municipality Population Densities of Erie County, 1940, 1960, 1985

Municipality	Area (Acres)	1940 Pop. Density (Persons/ Acre)	1950 Pop. Density (Persons/ Acre)	1960 Pop. Density (Persons/ Acre)	1970 Pop. Density (Persons/ Acre)	1980 Pop.* Density (Persons/ Acre)	1985 Pop.* Density (Persons/ Acre)
City of Erie	13,440	8.70	9.73	10.10	10.60	12.11	12.74
County of Erie	522,268	0.35	0.42	0.48	0.52	0.61	0.67

NOTE: *Estimated densities (based on median population estimates).

Source: U.S. Bureau of Census Population Trends.



PRESQUE ISLE PENINSULA
ERIE, PA.

POPULATION PYRAMID
OF ERIE COUNTY
1960—1970

U.S. ARMY ENGINEER DISTRICT, BUFFALO
DATED 1979

FIGURE B2

e. Public Facilities and Services

(1) Transportation

B2.16 In addition to the traffic in Erie Harbor, several transportation modes serve the Erie, PA, area. Major interstate routes include the I-90, in an east-west direction on the southeastern edge of the urbanized area, and the I-79 running north and south and connecting Erie to Pittsburgh. Other highways leading to Erie are U.S. Routes 5 and 20, and State Routes 8, 19, 97, and 99. Major rail systems also traverse the county in both the north/south and east/west directions. Four major railroad companies, the Norfolk and Western Conrail, the Bessemer and the Lake Erie Railroads, and one short haul line provide rail service which also includes Amtrak passenger service. The four larger companies own tracks and other facilities connecting the trunk lines to the harbor area. Finally, Port of Erie International Airport, located to the southwest of Presque Isle Peninsula, provides both air passenger and freight service.

(2) Health Facilities

B2.17 Eight hospitals in Erie County provide approximately 1,700 beds. They have all undergone modernization, expansion, and improvement in recent years. There are also several private nursing and convalescent homes serving the needs of Erie County's residents. The major hospitals are equipped with the latest medical care equipment and techniques.

(3) Communication

B2.18 The Erie area is served by the General Telephone Company of Pennsylvania. The Erie area is served by the entire array of news media communications. The Erie-Times News, with daily morning and evening editions, is the major newspaper in the area. In addition, four television stations and nine radio stations operate within Erie County.

(4) Fire Protection

B2.19 Half the population of Erie County, residing in the city of Erie, is served by a full-time salaried fire department consisting of 216 men, 12 engineer companies, three hook and ladder companies, and 25 pieces of equipment. The remaining area of the county is protected by 31 volunteer fire companies, generally located in the more populous suburbs, cities, and boroughs.

(5) Police Protection

B2.20 Similarly, the citizens of Erie City have a full-time police force of 211 officers and men, including specialized divisions for crime detection, criminal investigation, and juvenile supervision, as well as traffic control and general patrol work. Millcreek has the next largest police department of 40 men. Corry, Edinboro, Fairview, Girard, Lake City, Lawrence Park, North East, Union City, and Wesleyville all employ a small full-time force for general patrol work and security. The State Police, who patrol all of the State Routes in Erie County, supplement the limited police supply in the outlying areas of the county. The County Sheriff also maintains a force of professional law enforcement officers.

f. Recreation

B2.21 The major outdoor recreation area in Erie County is Presque Isle State Park. This facility attracts many local and regional visitors each year, who enjoy swimming, boating, picnicking, and the many other complementary facilities that this 3,200-acre natural preserve offers.

B2.22 In addition to Presque Isle, the Erie County Parks and Recreation Department maintains and operates several county parks. The larger recreational facilities include Eaton Reservoir, 750 acres, Shades Beach Park, 337 acres, and Sixmile Creek Park, 250 acres.

B2.23 The Erie area also has the entire array of private recreation facilities. Among those facilities are the following: a year-round ice rink, horseback riding, YMCA, and YWCA, snowmobiling, summer camps, bowling, roller skating, an amusement park, tennis courts, and many others. There are 11 golf courses within Erie County and eight major snow-ski centers located in close proximity. For the Erie residents' cultural needs, there are many outdoor and indoor theaters in addition to a community Playhouse. The Erie Philharmonic Orchestra schedules programs each season.

g. Education

B2.24 Erie County has 13 public school districts of which there are approximately 66 elementary schools and 23 secondary schools and nine high schools, principally in the urbanized area. Twelve private schools providing various kinds of training and skills also operate in the Erie Area. Presently, the Opportunities Industrialization Center is providing training to many unskilled and unemployed individuals in the county.

h. Tourism

B2.25 The Northwest Pennsylvania Region offers a wide range of recreation facilities, historic and scenic areas, and public open space which serve as basic tourist attractions. The varied physical characteristics of the region offer countless opportunities to provide additional attractions.

B2.26 Tourism is a sizable industry throughout the Northwest Region of Pennsylvania at the present time. Furthermore, this industry shows great growth potential. According to a study completed for the Northwest Pennsylvania Regional Planning and Development Commission in 1973 by Allegheny College, an estimated $92 million dollars was spent that year by visiting tourists. According to the Northwest Pennsylvania Tourist Association, this figure has and is expected to grow. One indicator of growth is based on the attendance at State and National Parks from 1965 to 1977 which has increased at an average rate of 8 percent per year.

B2.27 Though local tourism economy can be termed Erie County's second largest industry, it is not a specific employment category. This sector is derived from a portion of most of the other categories, especially from selected services, retail trade, and municipal, county, and State Government (public parks). Activities important to tourism (and which the tourism economy helps to support) are hotel/motel and other lodging accommodations (cottages and vacation homes), auto service and repair, outdoor amusement and recreation services, selected personal services, restaurants, and other eating establishments, grocery and drug stores, and proprietory shops. As can be seen on Chart B1, this sector generated in new business $76.9 million in 1975.

B2.28 It is apparent that tourism plays a prominent role in the local economy with Erie County ranking 13th out of the 67 counties in Pennsylvania in travel-generated business for 1975.

Chart B1 - The Economic Impact of Travel in Erie County, 1975

Expenditures by All Travelers		Total Sales in Travel Business		Owners & Workers in Travel Business	Active Firms in Travel Business
Amount in $1,000	Percent Retail Business	Amount in $1,000	Percent Retail Business		
$76,916	8.4	$172,491	18.8	8,059	1,371

Source: Tourist & Convention Bureau of Erie County

B2.29 The general attraction of Erie County arises from the various sportsman land uses such as: Hunting - State game lands and major portions of the escarpment and upland plateau agricultural region of the county; fishing - the Pennsylvania Fish Commission stock numerous stream mouths and inland waterways and lakes with game fish every year; and recreation land uses such as: local municipal and county Government-maintained parks in the lake plain area, as well as semi-public and private camping/recreation areas (and private cottages and summer homes) immediately along the lake shore.

B2.30 However, the primary mainstay of the Erie County tourism economy centers in and around Presque Isle State Park (Presque Isle Peninsula and Bay), the bulk of which is located offshore north of the Erie Metropolitan Area. This significant natural/recreational area covers over 3,000 acres. Within its boundaries, this area possesses various fragile ecosystems containing many unique plant and animal species, both land and water varieties. At the same time, the area provides over seven miles of beaches, numerous boating facilities, etc. for recreational use which attract several million visitors a year to Erie County. There is a sizable number of motels, hotels, and other tourist facilities concentrated in the immediate townships surrounding Presque Isle State Park. Any improvements to the park can be expected to substantially increase the contribution of tourism to the Erie County economy.

1. Manufacturing

B2.31 Manufacturing statistics for Erie County during 1976 indicated that 41,466 persons were employed by industries, which was 3,525 (7.8 percent) fewer jobs than a year ago. Industry groups were about evenly divided between losses and gains. However, the industries experiencing losses were more severe than the modest gains for the other industries, indicating that industry in Erie County during 1976 had not fully experienced the effects of the 1974-75 national recession in 1975 which it had resisted in 1974.

B2.32 From the following tabulation it will be noted that over the past decade industrial employment, and wages and salaries, have maintained a fairly constant ratio between durable goods and manufacturers and nondurable goods manufacturers; whereas, the ratio between the two for number of establishments and value of production has varied somewhat. The information is conveyed by Table B5.

Table B5 - Comparison Durable and Nondurable Goods

	Durable Goods			Nondurable Goods		
	Percent of County Total			Percent of County Total		
	1976	1967	Change	1976	1967	Change
Establishments	70.1	66.5	+3.6	29.9	33.5	-3.6
Employment	79.7	78.5	+1.2	20.3	21.5	-1.2
Wages & Salaries	79.8	79.7	+0.1	20.2	20.3	-0.1
Value of Production	76.4	78.2	-1.8	23.6	21.8	+1.8

Source: Pennsylvania County Industry Report, Erie County, Dept. of Commerce 1977.

B2.33 It is evident that the durable goods industry is the dominant factor in the county economy, with six of the seven largest employing groups falling within this category. Actually, this is only in the aggregate, as no single industrial group, as defined by SIC listings, dominates the picture. The seven leading employing groups in 1976, who each contributed 5 percent or more of total employment, were ranked as follows on Table B6.

Table B6 - Ranking of Industries by Employment

Code	Industry Group	Employment	Percent
	County total	41,666	100.0
37	Transportation equipment	8,200	19.7
34	Fabricated metal products	7,884	18.9
35	Machinery, except electrical	4,910	11.8
36	Electrical and electronic machinery equipment, and supplies	4,897	11.8
30	Rubber and miscellaneous plastic products	2,977	7.1
38	Measuring, analyzing and controlling instruments; photographic, medical, and optical goods	2,915	7.0
33	Primary metal products	2,145	5.1

Source: Pennsylvania County Industry Report, Erie County, Dept. of Commerce 1977.

B3. ALLEGHENY COUNTY ECONOMIC PROFILE

a. County Location and Description

B3.1 Because Allegheny County contributes heavily to attendance at Presque Isle State Park, even though it is not an adjoining county, a detailed analysis of the county was necessary.

B3.2 Allegheny County, located in the southwestern part of the State, lies in the Allegheny Plateaus Province. See Plate B3 for the regional location of Allegheny County.

B3.3 Long before the formation of the county in 1788, the territory contributed much to the history of the Commonwealth. The "Point," where the Allegheny and Monongahela Rivers join to form the Ohio River, was recognized early by both the French and English for its strategic location. As a result, much military activity was directed toward control of the area during the early colonial period by both the French and English and later by the Americans, as the struggle for dominance of North America developed. On conclusion of the struggle, development was comparatively slow until after the 1800's. With the increase of river commerce on the Ohio and Mississippi, aided by the introduction of the steamboat into the area, the discovery of bituminous coal, iron ore and petroleum, the advent of the canal and later the railroad, all have made Allegheny County the greatest iron and steel producing area in the world.

B3.4 Although iron ore is now obtained from sources outside the county, bituminous coal is still mined quite extensively. "Soft" coal production, about 4.1 million tons in 1975, employed an average of 1,806 persons daily, ranking the county ninth in the State. About 62 percent of the total tonnage was obtained from underground mines. Estimated recoverable reserves, in 1975, were listed as one billion tons. In 1975, the county ranked eighth for crude petroleum. Production in the oil fields, over the past decade, has declined slowly, with 54 more operating wells (342) producing only 59 percent of the 1966 volume. In size the county is above average, in density, ranks second in the State, and with less than 10 percent of its area in crop and pasture land, has a limited agricultural activity. A census on 31 December 1973 showed 510 farms producing annual cash receipts of $9.5 million, of which $4.4 million was derived from horticultural specialties, consisting mainly of cut flowers and greenhouse products. Manufacturing, highly diversified, is the leading industry; and in 1974, based on employment and value of production, ranked second in the State and exported goods and products from 234 establishments valued at about $411.8 million. Also contributing to the economy of the county were sales realized from wholesale trade, retail trade, and selected services outlets, which in 1972 amounted to $7.1 billion, $3.4 billion, and $1.0 billion, respectively.

B3.5 In spite of being densely populated, about 18 percent of its area is in forest land.

b. Population

B3.6 Based on the 1970 U.S. Census figures, Allegheny County ranks second in the State in population. The 1970 U.S. Census of Housing reported 533,520 housing units located in the county of which 533,196 were year-round housing. Sixty-two percent were owner occupied and valued at a median figure of $16,000. See Table B7 for general demographic information. Although the total population in Allegheny County has been projected to decrease, the Pittsburgh SMSA region has been projected to grow for the project life (1987-2037). The attachment analysis contains a set of population projections for the Pittsburgh SMSA.

Table B7 - Allegheny County - Land Area - 727.9 Sq. Mi. - Ranks 30th

	1960	1970	1980 Estimate	1990	2000
Population	1,628,587	1,605,133	1,473,911	1,513,470	1,516,044
Density	2,237.4	2,205.1	2,024.8	2,079.2	2,082.7
Rank	2nd	2nd	2nd	2nd	2nd
Percent Urban	93.2	94.8	N.A.	N.A.	N.A.
Percent Rural	6.8	5.2	N.A.	N.A.	N.A.

c. Transportation

B3.7 The Pennsylvania Turnpike traverses the county from the east-central part to the northwest corner and Interstate Highway 79, now completed, passes through the county from north to south; with proposed Interstate 279, a freeway, to be constructed through the city of Pittsburgh. Interstate 76 connects 79 to the Pennsylvania Turnpike in the Pittsburgh-Wilkinsburg area.

B4. DESCRIPTION OF PRESQUE ISLE STATE PARK

a. General

B4.1 Presque Isle State Park is located on a long compound recurved sandspit, 6-1.4 miles long, that projects into Lake Erie in a generally northeasterly direction from its narrow connection with the mainland. The predominant littoral drift is from west to east, causing sand to be eroded from the western end of the peninsula and be deposited near the eastern tip. The proposed project is designed to slow this drifting process and result in the expansion of beach area on the western end of the peninsula. The large bay between the peninsula and mainland provides the spacious Erie harbor, the easterly part of which is available for deep-draft navigation.

B4.2 The peninsula has a lakeward perimeter of about 9 miles and contains about 3,200 acres, practically all of which 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 swimming, sunbathing, picnicking, boating, bicycling, sailing, and canoeing and other recreational activities. These facilities include 17,700 square feet of beach area, 800 picnic tables, 9 miles of hiking/nature trails, seven boat launch areas, a 498 plus boat marina, ice fishing, and cross country skiing. In addition, approximately 500 acres of Presque Isle Bay are essentially open for waterfowl hunting.

B4.3 Presque Isle is environmentally unique and is included in the Natural Register of Natural Landmarks. In 1921, it was designated by the Legislature of the Commonwealth of Pennsylvania as a historical memorial and public park to preserve its features. The natural and ecological significance of Presque Isle is caused by two factors. First, the predominant eastward littoral drift acting on glacial sands has produced a recurving sandspit formation and through its migratory growth pattern extends the peninsula and locks water in the interior. Second, the resulting series of ponds and terrestrial habitats, combined with the area's location in the western portion of the Atlantic Waterfowl Flyway, has produced a unique habitat for a wide variety of wildlife species. Many environmentalists and students come to observe the flora and fauna at the eastern portion of the isle which serves as a widely known outdoor classroom for observation of the process of ecological succession. This unique outdoor laboratory allows the process of primary plant and animal succession to be studied in ecosystems varying in age from one to several hundred years within a distance of 3 miles. The park is also a wildlife refuge that visitors can enjoy by using the many hiking trails. The presence of the wildlife reservation encourages such activities as hunting, fishing, and birdwatching. Future plans envision a museum and restaurant complex near the Perry Monument on Misery Bay. Heaviest use of the park is, of course, during the 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 1,103,746 in 1935 to 1,641,850 in 1950 and 4,191,180 in 1978 (Table B8). 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 B8 - Attendance Data
Data Taken by Car Counter
Visitor Attendance Based on 3.5 Occupants Per Car
Presque Isle State Park
Erie, Pennsylvania

Year	Annual	Summer 1/	Autumn 2/	Winter 3/	Spring 4/
1935	1,103,745	694,739	145,138	128,961	134,907
1936	1,135,329	739,980	131,733	115,248	148,368
1937	1,102,149	788,329	159,341	60,812	93,667
1938	1,370,032	892,850	175,161	146,009	156,012
1939	1,390,332	857,664	222,719	111,069	198,880
1940	1,507,042	910,626	227,258	158,476	210,682
1941	1,646,361	1,018,584	281,547	124,817	221,413
1942	1,199,488	731,433	165,060	113,680	189,315
1943	366,396	172,448	118,671	31,433	43,844
1944	792,599	512,050	104,391	69,681	106,477
1945	839,263	558,155	150,531	35,885	94,692
1946	1,191,063	744,002	181,692	106,207	159,162
1947	1,156,232	746,403	193,130	77,329	139,370
1948	1,357,317	922,677	185,549	105,539	143,552
1949	1,774,695	1,126,125	218,193	158,361	272,016
1950	1,641,850	1,093,680	190,855	138,978	218,337
1951	1,759,718	1,115,817	228,455	168,833	246,613
1952	1,753,677	1,180,053	250,673	125,156	197,795
1953	1,837,453	1,218,315	262,944	131,645	224,549
1954	2,043,628	1,293,092	265,748	195,566	289,222
1955	1,866,350	1,177,862	289,254	172,200	227,034
1956	2,080,658	1,190,101	315,112	215,932	359,513
1957	2,229,342	1,334,214	309,963	261,723	323,442

Table B8 (Cont'd)

Year	Annual	Summer 1/	Autumn 2/	Winter 3/	Spring 4/
1958	2,198,800	1,443,851	266,745	184,275	303,929
1959	2,353,392	1,648,664	269,157	159,026	276,545
1960	2,467,348	1,711,468	299,715	175,129	281,036
1961	2,376,114	1,520,466	341,288	224,791	289,569
1962	2,724,420	1,594,635	315,500	428,841	385,444
1963	2,533,802	1,590,179	307,667	237,030	398,926
1964	2,451,546	1,521,429	296,978	233,212	399,927
1965	2,606,764	1,616,646	322,952	238,105	429,061
1966	2,811,024	1,835,988	380,453	199,115	395,468
1967	2,470,741	1,440,733	271,334	299,250	459,424
1968	2,737,154	1,733,515	385,028	210,924	407,687
1969	2,845,583	1,667,547	383,288	320,281	474,467
1970	3,137,753	1,786,893	431,011	382,592	537,257
1971	3,014,885	1,688,834	529,095	317,523	479,433
1972	2,363,458	1,324,802	336,966	269,871	431,819
1973	3,135,306	1,927,814	496,709	261,649	449,134
1974	3,048,083	1,786,540	482,265	361,868	417,410
1975	3,373,999	1,915,626	559,587	390,236	508,550
1976	3,436,114	1,960,759	542,458	321,048	611,849
1977	3,613,571	2,156,742	475,174	303,579	678,076
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 start of Memorial Day weekend

b. Erosion and Flooding History of Presque Isle

B4.4 Erosion of the Pennsylvania shoreline is generally noncritical, since sand and gravel beaches provide good protection. Beaches in some of the highly developed residential and camp areas between the Ohio-Pennsylvania line and Erie have been improved by construction of groins. Erosion of the frontage east of Erie Harbor is further slowed by the shale in the lower part of the bluffs. In general, the development is well back from the bluff face and, except in a few isolated cases, there has been no critical erosion damage, apart from the lakeward edge of Presque Isle Peninsula.

B4.5 Presque Isle Peninsula has a history of serious and continuous erosion. It consists entirely of fine sand, with a surface elevation averaging about 7 feet above low water datum. Parts of the peninsula are low marshes, which are flooded during extreme high lake stages. Its principal problem, however, is erosion of its lakeward edge. Due to littoral forces, the peninsula tends to move in an easterly direction, and several wide breaks have occurred in the narrow neck in the past 150 years. The average annual recession rate of beach due to erosion along the neck from the mainland shore to the lighthouse is about 7.0 feet per year for the period 1875-1947 (72 years). During periods of high water (i.e. 1875-1888), recession rates averaged about 15-20 feet per year. Between 1872 and the present time, much of the peninsula has been progressively protected by groins, bulkheads, and sandfill. This work has been done by the city of Erie, the Commonwealth, and the Federal Government. The latest Federal project, in cooperation with the Commonwealth, provided for construction of groins along the neck of the peninsula and placement and replenishment of sandfill where needed along the entire lakeward edge.

c. Solutions to Erosion Damages

B4.6 The cooperative beach erosion project at Presque Isle was originally authorized by the 1954 River and Harbor Act (Public Law 83-780), in accordance with the plans and conditions published in House Document No. 231, 83rd Congress, 1st Session. The project provided for the placement of 4,200,000 cubic yards of sandfill and the construction of 11 groins. A later report, published in House Document No. 397, 86th Congress, 2nd Session, recommended Federal participation in the cost for beach replenishment for the original project. Replenishment requirements have been greater than originally estimated, and a review study is now underway to find means of reducing those requirements. The rate of natural accretion is obviously not enough to maintain the extensive park beaches. Cost of the cooperative project to date has been a little over $11 million. An additional $5.5 million will be required for additional groins or other project changes and replenishment of beachfill in order to maintain the project until permanent protective measures can be implemented. The rate of littoral drift, particularly west of Presque Isle, is sufficient that groins have successfully protected long lengths of privately-owned shore. A summary of beach protection and nourishment expenditures (1955-1979) is shown in Table B9.

B4.7 Other than further participation in the Presque Isle project, there are no other critical erosion or flooding problems along the Lake Erie

Table B9 - Summary of Beach Protection and Nourishment Expenditure
Presque Isle State Park, Erie, PA

Item	Year	Total Cost $	State Share $	Federal Share $
1. Storm Damage Repairs	1955	100,000	100,000	
2. Beach Restoration	1956	1,879,126	1,250,751	628,375
3. Groin Protection	1956	2,451,000	1,634,000	817,000
4. Beach Nourishment (Emergency)	1959-1960	24,046	24,046	
5. Beach Nourishment	1960-1961	500,000	350,000	150,000
6. Groin Repairs (No. 4 & No. 11)	1963-1964	54,103	54,103	
7. Beach Nourishment	1964-1965	355,002	106,500	248,502
8. Groin Protection (No. 3 to No. 10)	1966	165,915	49,774	116,141
9. Beach Nourishment	1968-1969	348,018	104,405	243,613
10. Erosion Control	1971	534,127	160,000	374,127
11. Emergency Work (Sunset Point)	1972	40,000	40,000	
12. Erosion Control	1972	391,021	391,021	
13. Emergency Work (Sunset Point)	1973	25,000	25,000	
14. Emergency Work Under P.L. 99	1973	240,000		240,000
15. Erosion Control	1973	662,956	662,956	
16. Beach Nourishment	1974	108,000	108,000	
17. Erosion Control	1974	638,292	638,292	
18. Beach Nourishment	1975	1,097,000	310,000	787,000
19. Beach Nourishment	1976	1,097,326	350,000	747,326
20. Beach Nourishment	1977	1,089,000	325,000	764,000
21. Erosion Control	1977	308,295	308,295	
22. Erosion Control and Beach Nourishment	1978	1,074,000	321,000	753,000
23. Erosion Control and Beach Nourishment	1979	1,060,000	310,000	750,000
TOTALS		14,242,227	7,623,143	6,619,084

shore of Pennsylvania under investigation by the Federal Government at this time.

d. Commitment

B4.8 Review of the Commonwealth of Pennsylvania Recreation Policies.

Introduction: The purpose of this section is to review the Comprehensive Recreation Policies and Policy Guidelines of the Commonwealth of Pennsylvania as they would relate to an evaluation of any proposed development of the Presque Isle State Park area.

In general: During the first half of the present century, Pennsylvania's urban centers were developing in the eastern and western portions of the State. During that period, and in contrast to the bi-polar east-west urbanization trend, most park development and recreation efforts were concentrated in the central counties of the State away from the centers of population. By the 1950's, the State had recognized that its "supply" of outdoor recreational facilities was located far from its principal demand areas. Most State parks located in close proximity to the larger cities were severely overused. Therefore, the following recreational policies were declared to redefine State recreational development:

a. Identification of unusual natural areas of Statewide significance and determination of procedures for their acquisition and protection; and

b. In keeping with the present policy of providing the greatest benefits to the greatest number of citizens, emphasize the development of high density State parks close to major urban centers and actively promote their accessibility.

B4.9 Pennsylvania established its planning concept for the Erie-New Castle-Warren area which contains the Presque Isle State Park in its 1970 "State Wide Comprehensive Outdoor Recreation Plan (SCORP)." The SCORP report estimated an additional 26,840 State park acres were needed beyond the presently existing 17,102 acres to meet future demand. Of this, Presque Isle State Park contributes approximately 3,200 acres. The Pennsylvania Department of Environmental Resources (DER), in a letter dated 23 August 1979 (Exhibit 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 DER also stated its intent to meet the terms required for local cooperation in a local assurance agreement for the "permanent" beach erosion control project.

B4.10 This commitment must be tempered with the findings of the Commonwealth's 1975 "State Wide Comprehensive Outdoor Recreation Plan" which evaluated the kind of recreation facilities needed in the particular State planning regions by magnitude of need. Statewide, of the the most needed recreational facilities, natural swimming areas came in last. For Planning Region 9, which includes the eight counties surrounding Presque Isle (accounting for approximately 55 percent of users), and the neighboring nine counties in Planning Region 10 (accounting for 31 percent of users), development of natural swimming areas did not rank in the top 10. The nearest Planning Region (Number 8) which has a top-10 priority (7th) need for natural swimming areas is approximately 65 plus miles distant. However Region 8's seven counties provide less than 1 percent of the users of Presque Isle based on data from the Commonwealth of Pennsylvania Department of Environmental Resources "1977 Statewide Summer Recreation Survey Park Summary Report."

B4.11 This apparent low priority on natural swimming needs will be reflected in the development of this type of recreational facility through Pennsylvania's 1975 SCORP section on "Policies which Pertain to Planning." This section states "It is commonwealth policy to plan comprehensively...to meet the needs of Pennsylvanians..." Another section on "Policies Which Pertain to Physical Resources" states, "The selection and diversity of location and type of facility are determined on the basis of need." Therefore, it appears from these policy statements and the results of survey data that any improvements to Presque Isle State Park do not accrue from any increased value as a natural swimming recreation area under present conditions.

e. Presque Isle Beaches

B4.12 Presque Isle State Park is a recreational area with its main attraction being its bathing beaches - those being the most expansive recreational beaches of any area along the south shore of Lake Erie. These magnificient sand beaches number 11 and stretch the entire northern shore of the peninsula, Beach I being at the lower neck and Beach II near Gull Point. See Plate A4 in Appendix A. The approximate lineal length of supervised beach is 2,000 feet with an average width of 20 feet, each beach having about 400,000 square feet in surface area. Unofficial (unsupervised) beaches are also quite heavily utilized on days where overcapacity pressure on official beaches creates spillover situations. Actual beach areas (supervised and unsupervised) will run the entire length of the peninsula when expected results from the project are attained. With an estimated space requirement of 100 square feet per user, Presque Isle beaches in 1972 could handle a design load capacity of 10,110 people. See Table B10.

f. Presque Isle Parking Facilities

B4.13 Presque Isle State Park has the capability of handling 1,100 cars at each of its 11 beaches. This means that there are parking facilities for a maximum of 12,100 vehicles at any given time. Applying a 3.5 AOC (average occupants per car), the beach parking facilities are adequate for 42,350 beach users. The 3.5 average occupants per car has been determined to be appropriate in accordance with the Statewide standards set by the Department of Environmental Resources of the Commonwealth of Pennsylvania.

Table B10 - Presque Isle Beaches

Beach Number	Length 1/	Width 2/ 1972	Width 2/ Post Project	Area 1972	Area Post Project	1972 Carrying Capacity	Post Project Carrying Capacity
1	2,000	60	140	120,000	280,000	1,200	2,800
2	2,000	25	140	50,000	280,000	500	2,800
3	2,000	25	140	50,000	280,000	500	2,800
4	2,000	30	140	60,000	280,000	600	2,800
5	2,000	20	140	40,000	280,000	400	2,800
6	2,200	100	140	220,000	308,000	2,200	3,080
7	1,800	60	140	108,000	252,000	1,080	2,520
8	2,000	40	140	80,000	280,000	800	2,800
9	5,280	25	140	132,000	739,200	1,320	7,392
10	500	110	140	55,000	70,000	550	700
11	1,600	60	140	96,000	224,000	960	2,240
	23,380			1,011,000	3,273,200	10,110	32,732

1/ Source: Pennsylvania Department of Environmental Resources

2/ Approx. from treeline back berm to water's edge

B5. DEMAND SCHEDULE

a. Demand Forecast.

B5.1 The future summer season attendance at Presque Isle State Park was projected on the basis of future population and the historical participation rates presented in Table B11 - Historical Participation Rates. The participation rate is the ratio of the summer season to the population of each demand origin zone. The future population for each of the demand origin zones was determined for the period (1987-2037), and is shown in Table B12 - Population Projections. The demand origin zones and their distances from Presque Isle are defined as follows:

(1)	Zone 1	Erie SMSA	15 miles
(2)	Zone 2	Pittsburgh SMSA	115 miles
(3)	Zone 3	Pennsylvania	150 miles
(4)	Zone 4	New York	175 miles
(5)	Zone 5	Ohio	175 miles
(6)	Zone 6	Virginia	250 miles
(7)	Zone 7	United States	475 miles.

B5.2 The summer season attendance at Presque Isle State Park was estimated for 1987 and 2037 by the travel cost method. The origin zone distance zones of 0-75, 76-150, 151-225, 226-300, 301-375, 376-450, and 451-525 were used to determine demand. The participation rates reflect historical participation from these zones as shown in Table B11. For example, the distance 0-75 miles has a participation rate of 3.5. This is the participation rate for the Erie SMSA visitors who live 15 miles away from Presque Isle. The participation rates for zones 301-375 miles and 376-450 miles, .002 and .001 respectively, dummy variables used in the travel cost analysis as prescribed in Principles and Standards. The (aggregated) historical data base did not include these distance zones. Therefore, for analytical purposes they were estimated. As shown on Tables B13 and B14, population shown is - for these distance zones in the first iteration. Subsequent iterations would be strongly biased if the dummy participation rates were not employed. The participation rates for the Pittsburgh SMSA and Pennsylvania were calibrated to arrive at .08 for distance 76-150 miles. The next step in the travel cost method is to determine the quantity demanded, given small incremental increases in the price of participation and the change in quantity demanded with the change in price. This is the equivalent of moving the project farther and farther from the potential users. The simulated incremental distance used for this study is 75 miles. The distance is increased until the potential demand at Presque Isle State Park is reduced to 0. This is the point at which the dummy participation rates become significant. The farthest distance people will travel to Presque Isle is 475 miles. The actual park attendance for 1987 is determined by multiplying the population of each incremental 75-mile distance by the participation rate for the distance shown. The total park attendance derived at 0 miles for 1987 is 2,731,594. Beach-use demand is 80 percent of total park attendance, or 2,185,275 beach users. The simulated distance increase of 75 miles will increase the distance traveled and reduce participation from the same areas. The 76-150 miles participation rate of .08 is applied to the population

Table B11 - Historical Participation Rates

Origin 1975 Zones	Population (X)	Attendance Percent)1/	Summer Season (Y)	Participation Rate Per 10,000 (Y ÷ X)	
1. Erie SMSA	273,000	.50	957,813	3.5	(3.50847)
2. Pittsburg SMSA	2,322,000	.20	383,125	.16	(.164997)
3. Pennsylvania	9,265,000	.18	344,813	.04	(.037216)
4. New York	18,076,000	.02	38,313	.002	(.002119)
5. Ohio	10,735,000	.05	95,781	.009	(.008922)
6. Virginia	4,981,000	.01	19,156	.004	(.003845)
7. United States	167,380,000	.04	76,625	.0005	(.000457)
		100	1,915,626		

1/ Origin of Park Users from 1977 Park Survey

Table B12 - Population Projections

Zones	1987	1997	2007	2017	2027	2037
1. Erie SMSA 1/	322,160	349,400	375,416	393,158	411,143	426,714
2. Pittsburgh SMSA 2/	2,495,260	2,530,360	2,564,865	2,601,815	3,597,500	3,733,750
3. Pennsylvania	12,899,200	13,820,660	14,382,590	14,937,290	12,951,000	13,441,500
4. New York 4/	20,457,980	21,990,560	23,411,400	24,801,400	28,780,000	29,870,000
5. Ohio 5/	12,316,120	13,150,360	13,866,800	14,561,380	15,988,889	16,594,444
6. Virginia 6/	5,873,820	6,588,110	7,238,035	7,889,085	8,738,634	9,748,890
7. United States 7/	239,125,980	258,492,700	276,106,600	292,412,600	312,173,470	334,726,960

1/ Source: OBERS Projections, Vol. 5, Series E (1972) p. 76
2/ Source: OBERS Projections, Vol. 5, Series E (1972) p. 180
3/ Source: Statistical Abstract of the U. S. 1977 Series I-E, U. S. Dept. of Commerce p. 15
4/ Source: OBERS Projections, Vol. 4, Series E (1972) p. 100
5/ Source: OBERS Projections, Vol. 4, Series E (1972) p. 109
6/ Source: OBERS Projections, Vol. 4, Series E (1972) p. 142
7/ Source: OBERS Projections, Vol. 5, Series E (1972) p. 7

Table B13 - Recreational Demand 1987

	Distance	Participation Rate	Population	Park Attendance
	0- 75	3.50	322,160	1,127,560
	76-150	.08	15,394,460	1,231,557
	151-225	.007	32,774,100	229,419
	226-300	.004	5,873,820	23,495
	301-375	.002	-	-
	376-450	.001	-	-
	451-525	.0005	239,125,980	119,563
Total				2,731,594
	Simulated Distance (Actual + 75)			
	76-150	.08	322,160	25,773
	151-225	.007	15,394,460	107,761
	226-300	.004	32,774,100	131,096
	301-375	.002	5,873,820	11,748
	376-450	.001	-	-
	451-525	.0005	-	-
Total				276,378
	Simulated Distance (Actual + 150)			
	151-225	.007	322,160	2,255
	226-300	.004	15,394,460	61,578
	301-375	.002	32,774,100	65,548
	376-450	.001	5,873,820	64,612
	451-525	.0005	-	-
Total				193,993

Table B13 - Recreational Demand 1987 (Cont'd)

	Simulated Distance (Actual + 225)	Participation Rate	Population	Park Attendance
	226-300	.004	322,160	1,289
	301-375	.002	15,394,460	30,789
	376-450	.001	32,774,100	32,774
	451-525	.0005	5,873,820	2,937
Total				67,789
	Simulated Distance (Actual + 300)			
	301-375	.002	322,160	644
	376-450	.001	15,394,460	15,394
	451-525	.0005	32,774,100	16,387
Total				32,425
	Simulated Distance (Actual + 375)			
	376-450	.001	322,160	322
	451-525	.0005	15,394,460	7,697
Total				8,019
	Simulated Distance (Actual + 450)			
	451-525	.0005	322,160	161

Table B14 - Recreational Demand 2037

	Distance	Participation Rate	Population	Park Attendance
	0- 75	3.5	426,714	1,493,500
	76-150	.08	17,175,250	1,374,018
	151-225	.007	46,464,444	325,251
	226-300	.004	9,748,890	38,996
	301-375	.002	-	-
	376-425	.001	-	-
	426-500	.0005	334,726,960	167,363
Total				3,399,128
	Simulated Distance (Actual + 75)			
	76-150	.08	426,714	34,137
	151-225	.007	17,175,250	120,227
	226-300	.004	46,464,444	185,858
	301-375	.002	9,748,890	19,498
	376-425	.001	-	-
	426-500	.0005	-	-
Total				359,720
	Simulated Distance (Actual + 150)			
	151-225	.007	426,714	2,987
	226-300	.004	17,175,250	68,701
	301-375	.002	46,464,444	92,929
	376-450	.001	9,748,890	9,749
	451-525	.0005	-	-
Total				174,366

Table B14 - Recreational Demand 2037 (Cont'd)

	Simulated Distance	Participation Rate	Population	Park Attendance
	(Actual + 225)			
	226-300	.004	426,714	1,707
	301-375	.002	17,175,250	34,350
	376-450	.001	46,464,444	46,464
	451-525	.0005	9,748,890	4,874
Total				87,395
	Simulated Distance (Actual + 300)			
	301-375	.002	426,714	853
	376-450	.001	17,175,250	17,175
	451-525	.0005	46,464,444	23,232
Total				41,260
	Simulated Distance (Actual + 375)			
	376-450	.001	426,714	427
	451-525	.0005	17,175,250	8,588
Total				9,015
	Simulated Distance (Actual + 425)			
	451-525	.0005	426,714	213

residing 0-75 miles from Presque Isle. This reduces total beach attendance for the 75-mile simulated distance. Total park attendance is 176,374 for that distance. The same methodology is used to determine the recreational demand for 2037 as shown on Table B14.

b. Method of Determining Peak and Nonpeak Days.

B5.3 The number of peak and nonpeak days was determined from the 1979 Presque Isle State Park attendance records. The recreational season for beach activities was determined to span a period of about 14 weeks, extending from the Memorial Day Weekend through the Labor Day Weekend; an average length of 101 days. A peak good weather day with respect to beach activities consists of daylight temperatures of at least 70°F, with sunny weather and no rain. A peak day includes Saturdays, Sundays, and holidays. An examination of the 1979 attendance records shows that there were 19 peak good weather days having an average attendance of 31,807. The total 1979 attendance divided by the average peak day good weather attendance yields the percentage of total summer season park attendance that would attend the park on a given peak day. The peak day good weather factor is .01511 or 31,807 ÷ 2,104,491 as shown on Table B15 - Summer Season Attendance 1979. Using the factor in the demand analysis for 1987 and 2037 will yield the expected peak day good weather attendance. As shown on Table B16 - 1987 Recreational Demand, multiplying the beach use demand by the peak day good weather factor for incremental distances shown will give the total demand for peak day good weather, or 33,020 for the 0 incremental distance, and 2,345 for the 150 incremental distance.

B5.4 The peak bad weather days are Saturdays, Sundays, and holidays that do not meet the good weather criteria of 70°F and no rain. There were 13 peak bad weather days in the 1979 summer season according to actual park weather observations. The average peak bad weather attendance was 22,981, yielding a peak bad weather percentage factor of .0109, which is the average peak bad day weather attendance, divided by the total summer park attendance, or 22,981 ÷ 2,104,570. The determination of nonpeak good weather days includes all weekdays having air temperatures of at least 70°F and no rain. There were 46 nonpeak good weather days in the 1979 season at Presque Isle. The average attendance on nonpeak good weather days was 19,196 yielding a nonpeak good weather day factor of .0091 or the ratio of 19,196 ÷ 2,104,570. The nonpeak bad weather days totalled 23 and had an average attendance of 13,843 yielding a factor of .0066. Total recreational demand for 1987 and 2037 is shown in Tables B16 and B17.

c. Derivation of the Travel Demand Curve.

B5.5 The travel demand curve is derived for peak good weather, peak bad weather, nonpeak good weather, and nonpeak bad weather. Each simulated distance shown on Tables B16 and B17 is a point on the demand curve. The peak good weather demand curve is shown on Figure B3 - Travel Demand Peak Day Good Weather 1987. Multiplying the beach use demand at 0 distance for 1987, 2,185,275 by the peak day good weather factor percentage yields the total peak day attendance of 33,020. Thus, the demand for the average peak good weather day for the 1987 summer season at 0 incremental distance is 33,020.

Table B15 - Summer Season Attendance 1979

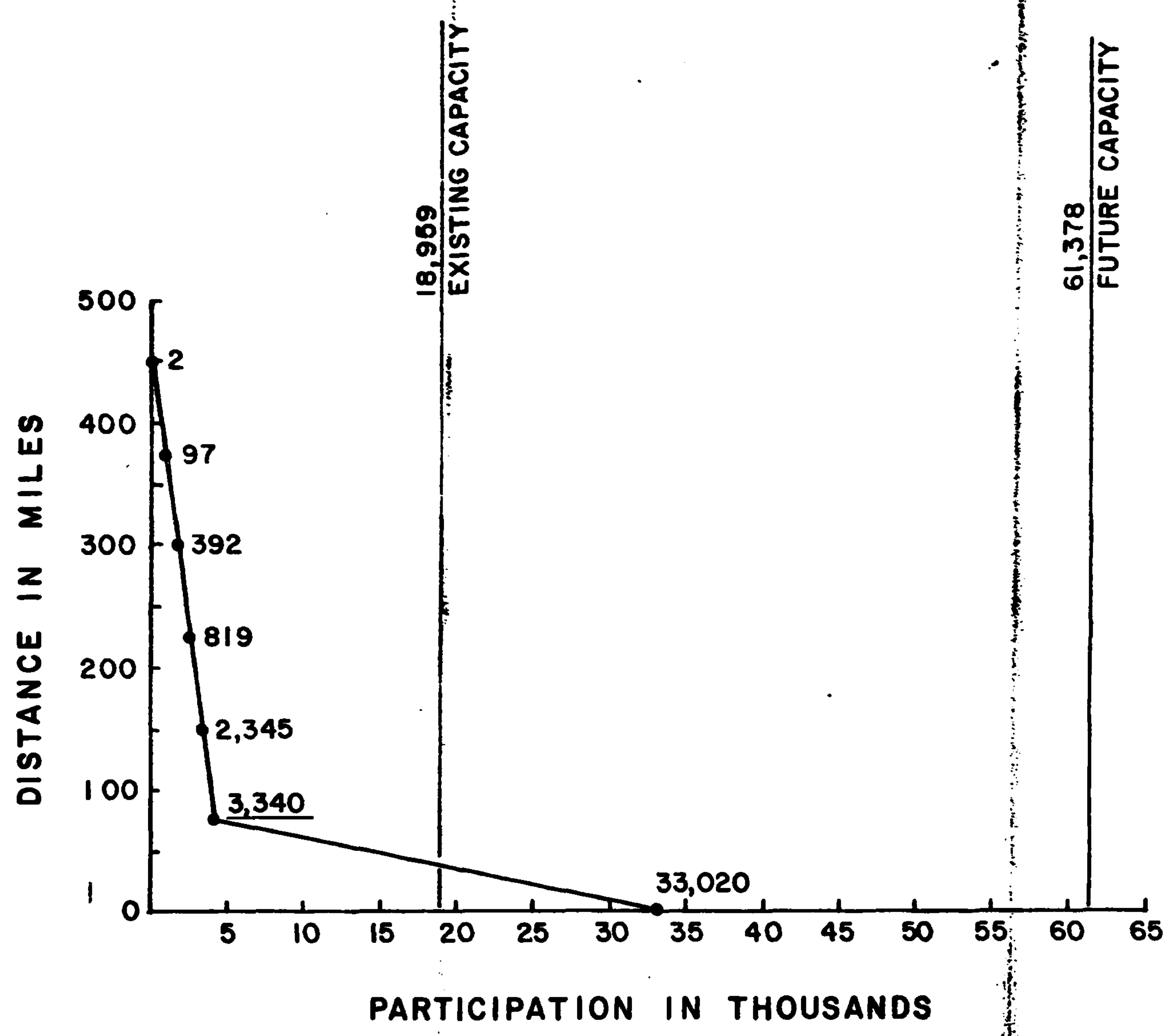
Days	Average Attendance	Number of Days	Total Attendance	Park Attendance on any Given Day (Percent Total)
Peak Good Weather	31,807	19	604,333	.0151
Peak Bad Weather	22,981	13	298,753	.0109
Nonpeak Good Weather	19,196	46	883,016	.0091
Nonpeak Bad Weather	13,843	23	318,389	.0066
Total Summer Season Attendance		101	2,104,491	

Table B16 - 1987 Recreational Demand

Simulated Distance	Beach Use Demand	Peak Day Good Weather (.0151)	Peak Day Bad Weather (.0109)	Nonpeak Day Good Weather (.0091)	Nonpeak Day Bad Weather (.0066)
0	2,185,275	33,020	23,819	19,886	14,423
75	221,102	3,341	2,410	2,012	1,459
150	155,194	2,345	1,692	1,412	1,024
225	54,231	819	591	493	358
300	25,940	392	283	236	171
375	6,415	97	70	58	42
450	129	2	1	1	1

Table B17 - 2087 Recreational Demand

Simulated Distance	Beach Use Demand	Peak Day Good Weather (.0151)	Peak Day Bad Weather (.0109)	Nonpeak Day Good Weather (.0091)	Nonpeak Day Bad Weather (.0066)
0	2,719,302	41,089	29,640	24,756	17,947
75	287,777	4,345	3,137	2,619	1,899
150	139,493	2,106	1,520	1,269	921
225	69,916	1,056	762	636	461
300	33,008	498	360	300	218
375	7,212	109	79	65	48
450	170	3	2	2	1



TRAVEL DEMAND CURVE PEAK DAY GOOD WEATHER 1987

FIGURE B3

The simulated distance of 75 miles yields the demand which is the second point on the travel demand curve shown on Figure B3. As shown on Table B16, the beach-use demand at 75 miles incremental distance is 221,102. Multiplying the beach-use demand by the peak day good weather factor of .0151 yields the demand for the average peak day of 3,341 participants. This is the second point on the demand curve. This procedure is followed for each 75-mile incremental distance until the demand on peak day good weather is reduced to 0.

B5.6 The demand curves for 1987 and 2037 for peak day good weather and bad weather, and nonpeak good weather and bad weather are derived in the same manner.

d. Value of a Recreational Unit.

B5.7 The dollar value for participants at Presque Isle State Park is the summation of the out-of-pocket travel cost; the opportunity cost of time for the beach experience and the actual travel time.

(1) Travel Cost

B5.8 The travel cost per vehicle mile is determined as an average variable cost per mile. The Cost of Owning and Operating Automobiles and Vans, 1979, Pamphlet, published by the U.S. Department of Transportation was utilized to determine the average variable cost per mile. The variable costs of maintenance, accessories, parts, and tires, gasoline and oil, and taxes on gas, oil, and tires for standard, compact, and subcompact cars were used to derive an average variable cost per mile. The mid-1979 prive levels were updated to mid-1980 price levels by use of consumer indexes of transportation, private, and fuels and related products, gas fuels. An average weighted cost of 14.5 cents per mile was determined as the cost per vehicle mile. Table B18 - Average Variable Costs in Cents Per Mile, shows the derivation of the 14.5 cents per mile vehicle cost. The automobile cost for traveling to Presque Isle is 14.5 cents per mile.

(2) Determination of the Opportunity Cost of Time.

B5.9 The opportunity cost of time is the monetary value of work or alternative leisure activities foregone to travel and to recreate at the site. The individual who recreates at Presque Isle may work or participate in a leisure activity which has a higher personal monetary value than the Presque Isle beach experience. The opportunity cost for a person whose work time is variable is measured as the income lost during the recreation visit and associated travel time. Increasing distances also decreases use because of the additional time required to travel greater distances. The exclusion of the time factor would introduce a bias in the derived demand curve, shifting the entire demand curve as shown on Figure B3 to the left. This would result in an underestimation of project benefits.

B5.10 The majority of beach visitors come from the State of Pennsylvania. Therefore, the average hourly wage rate for Pennsylvania was used as the basis for determining the opportunity cost of time.

Table B18 - Average Variable Costs in Cents Per Mile, to Operate an Automobile

1979 Variable Cost	Standard	Compact	Subcompact	Average (¢)
Maintenance, Accessories, Parts and Tires	5.5	4.8	4.1	4.8
Gasoline and Oil	5.5	4.9	4.1	4.8
Taxes on Gas, Oil, Tires	1.6	1.3	1.1	1.3
				10.9
1980 Variable Cost				
Maintenance, Accessories, 1/ Parts and Tires	6.5	5.6	4.8	5.6
Gasoline and Oil 2/	7.9	7.1	5.9	7.0
Taxes on Gas, Oil, Tires 2/	2.3	1.9	1.6	1.9
				14.5

1/ Use transportation, private — June 1979-June 1980 212.3 - 249.7 1.176

2/ Use fuels and related products, gas fuels — June 1979-June 1980 522.3 - 750.1 1.44

SOURCE: Cost of Owning and Operating Automobiles and Vans 1979, U.S. Department of Transportation, Office of Highway Planning, updated form 1979 price levels.

The opportunity cost of time is valued as one-third of the average hourly wage rate for adults and one-twelfth of the adult wage rate for children. The 1980 average hourly wage rate of $5.77 was derived from the 1976 Department of Commerce Pennsylvania Industrial Census Series Release No. M-5-75 1976, prepared by the Bureau of Statistics Research and Planning. Using the formula shown in the 14 December 1979 Principles and Standards, the adult opportunity cost of time is $1.92 and the children's opportunity cost of time is .48 cents or one-twelfth of the adult hourly wage rate. The average occupancy per car is 3.5, the standard set by the Department of Environmental Resources for the Commonwealth of Pennsylvania. Assuming 2 adults and 1.5 children per car would result in total attendance of 57 percent adults and 43 percent children. The weighted opportunity cost of time for the average park participant is $1.30 and is derived as follows:

($.57 X $1.92) + ($.43 X $.48) = $1.30

B.6 BENEFIT COMPUTATIONS.

a. Supply Contraints

B6.1 The Department of Environmental Resources conducted a summer recreation survey in 1977 to determine the origin of visitors to Presque Isle State Park. Table B19 - 1977 Park Survey shows the percentage and origin of visitors in 1977. The percentage was assumed to remain constant throughout the project life (1987-2037). The percentage of visitors from origin zones 1-7 shown on Table B20 reflects the percentage of visitors that will come from various distances from Presque Isle. The origin zones on Table B20 are the incremental distances of 75, 150, 225, 300, 375, and 450 miles. The beaches will accommodate different capacities from each demand origin zone. As shown on Table B20 - Existing Beach Capacity, visitors from demand origin Zone 1 will utilize 50 percent of the existing beach of 1,011,000 square feet or 505,500 square feet. The minimum acceptable space for beach users was determined to be 100 square feet. The instantaneous capacity for the beaches is determined by dividing the beach area by zone by the minimum 100 square feet space standard.

Table B19 - 1977 Park Survey

Origin Zone	Percentage of Visitors
Erie SMSA	.50
Pittsburgh SMSA	.20
Pennsylvania	.18
Ohio	.02
New York	.05
Virginia	.01
United States	.04
	1.00

SOURCE: 1975 and 1977 Summer Recreation Survey of Pennsylvania State Parks and State Forests, Commonwealth of Pennsylvania Bureau of Resources Programming, June 1979

B6.2 The daily beach attendance supply constraint is determined by multiplying the demand origin zones instantaneous attendance by the turnover rate. The turnover rate for Zone 1, which is the Erie SMSA is 2.0. This was considered to be appropriate because it reflects the turnover rate for day-use activities in the New York State Comprehensive Outdoor Recreation Plan. The turnover rate is interpolated for areas 2-6, and reflects a longer visitation period as distances traveled increase. The fall in the turnover rate

Table B20 - Existing Beach Capacity

Origin Zone	Visitation by Zone (1) (Percent)	Total Beach Supply (2)	Beach Area by Zone (3) (1) X (2)
1	50	1,011,000	505,500
2	37	1,011,000	374,100
3	7	1,011,000	71,000
4	1	1,011,000	10,000
5	1	1,011,000	10,000
6	4	1,011,000	40,400

Origin Zone	Beach Area by Zone (1)	Square (2) Feet/Person	Instantaneous Visitors From Each Zone (3) (1) ÷ (2)
1	505,500	100	5,055
2	374,100	100	3,741
3	71,000	100	710
4	10,000	100	100
5	10,000	100	100
6	40.400	100	404

Origin Zone	Instantaneous (1) Number Visitors From Each Zone	Turnover (2) Rate by Zone	Daily (3) Attendance by Zone (1) X (2)
1	5,055	2.0	10,110
2	3,741	1.84	6,883
3	710	1.68	1,193
4	100	1.52	152
5	100	1.36	136
6	404	1.20	485
			18,959

from 2.0 to 1.2 reflects the assumption that people will be unwilling to travel 375-450 miles for a 4-hour beach visit. The incentive for longer recreational participation periods is increased as distances traveled increase. The average beach time for individuals from Zone 6 or distances of 451-525 miles is 6.7 hours. The beaches can accommodate 18,959 beach users on any given day under existing conditions or a total supply area of 1,011,000 square feet. The supply of visitors from each zone is shown in Table B20. The derivation of the future daily attendance supply constraint is shown in Table B21 - Improved Beach Capacity. The future supply constraint is 61,378 beach users.

b. Benefits to Beach Users.

B6.3 The benefits to 1987 and 2037 beach users is determined for peak day good weather, peak day bad weather, and nonpeak day good weather. Benefits will not accrue to nonpeak bad weather days. As shown on Table B17, the demand will reach 17,947 by 2037, which is less than the existing supply constraint of 18,959 beach users. Project benefits are accrued only when the demand exceeds 18,959 beach users since area supplied in excess of this is the result of the improved beach capacity and thus yields benefits to the project. The benefits to peak day good weather beach users for any given day is the area under the demand curve shown in Figure B3. The benefits to the project are benefits to demand for beach users in excess of the 18,959 beach constraint. All benefits to increasing demand lie within the 0 and 75-mile incremental distances as shown on Figure B4 - Schematic of Peak Day Good Weather. The benefits to the project are represented by area B of Figure B4. In order to determine the travel cost, the average distance traveled must be determined. The theory of similar triangles is utilized to determine the height of area B. The ratio of the adjusted demand, 18,619 beach users - 3,340 beach users to 33,020 beach users - 3,340 beach users is 53 percent. The height of triangle B is determined by multiplying 75 miles by 47 percent. The average miles traveled for peak day good weather is 35.25 miles. The total vehicle cost of this travel distance is $10.22, determined by multiplying the average distance traveled by a round-trip adjustment factor and the average variable cost of 14.5 cents per mile. Since there are 3.5 average occupants per car for Presque Isle beach visitation, the total vehicle cost is $2.92 for peak day good weather visitors in 1987.

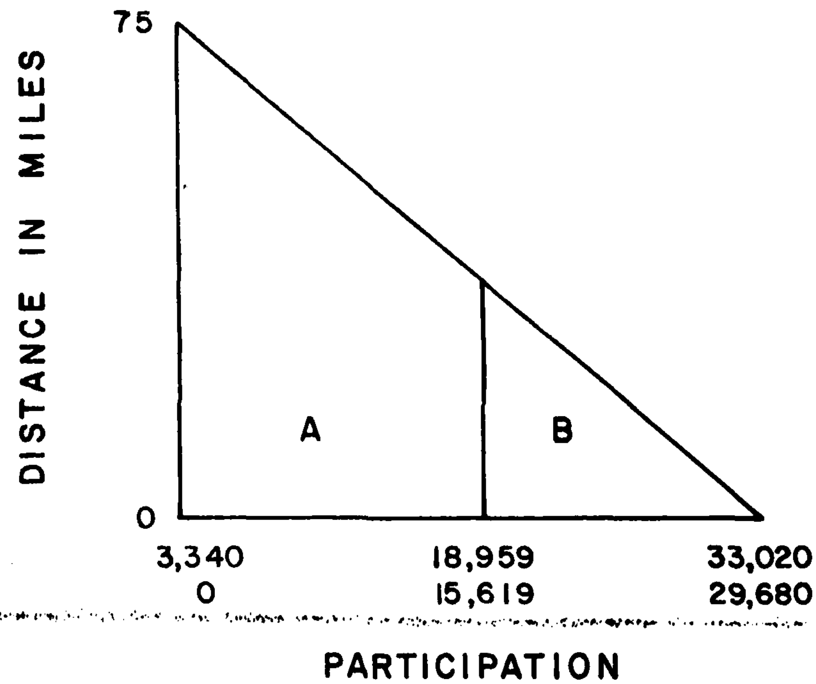
B6.4 The total recreational value for beach participants in 1987 is the sum of the beach and travel opportunity cost of time and vehicle cost. The opportunity cost of 4 hours of beach time given a $1.30 opportunity cost per hour is $5.20 as shown on Figure B5 - Schematic of Peak Day Good Weather Benefits 1987. The travel opportunity cost of time is $1.67 for the average distance traveled of 35.25 miles. At an average speed of 55 mph and an opportunity cost of $1.30 per hour, the travel time opportunity cost is $1.67 for each recreationist. The total recreational value for the peak day good weather recreationist is $9.77. The components are summarized on Table B22 - Travel Cost Peak Good Weather 1987. Figure B5 shows the total benefits for a peak good weather day in 1987. The total peak good day weather demand for 1987 is 33,020 for any given day. The benefits to the project is the total demand in excess of the existing supply constraint of 18,959 beach users.

Table B21 - Improved Beach Capacity

Origin Zone	Visitation by Zone (1) (Percent)	Total Beach Supply (2)	Beach Area by Zone (3) (1) X (2)
1	50	3,273,200	1,636,600
2	37	3,273,200	1,211,084
3	7	3,273,200	229,124
4	1	3,273,200	32,732
5	1	3,273,200	32,732
6	4	3,273,200	130,928

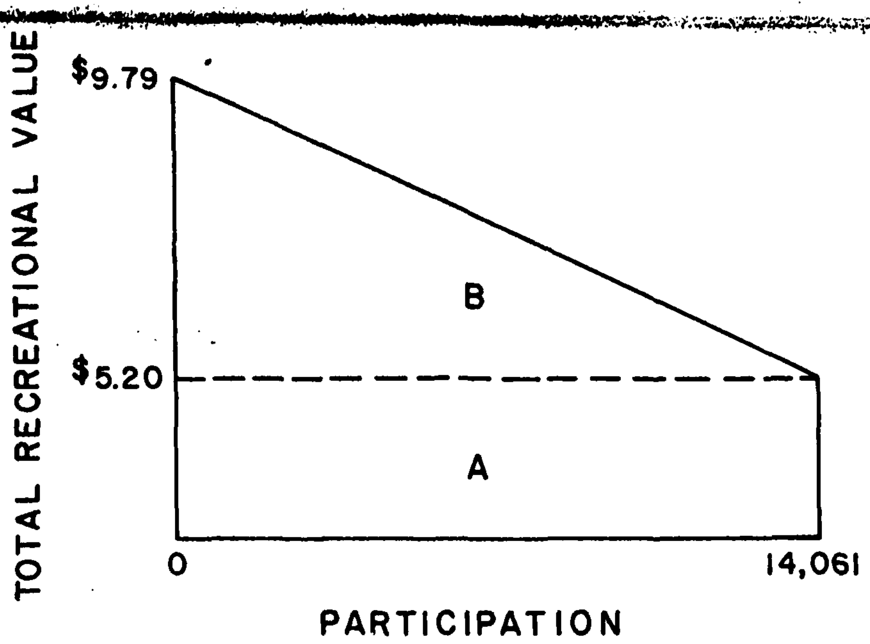
Origin Zone	Beach Area by Zone (1)	Square (2) Feet/Person	Instantaneous Visitors From Each Zone (3) (1) ÷ (2)
1	1,636,600	100	16,366
2	1,211,084	100	12,110
3	229,124	100	2,291
4	32,732	100	327
5	32,732	100	327
6	130,928	100	1,309

Origin Zone	Instantaneous (1) Number Visitors From Each Zone	Turnover (2) Rate by Zone	Daily (3) Attendance by Zone (1) X (2)
1	16,366	2.0	32,732
2	12,110	1.84	22,284
3	2,291	1.68	3,849
4	327	1.52	497
5	327	1.36	445
6	1,309	1.20	1,571
			61,378



SCHEMATIC OF PEAK DAY GOOD WEATHER BENEFITS 1987

FIGURE B4



SCHEMATIC OF PEAK DAY GOOD WEATHER BENEFITS 1987

FIGURE B5

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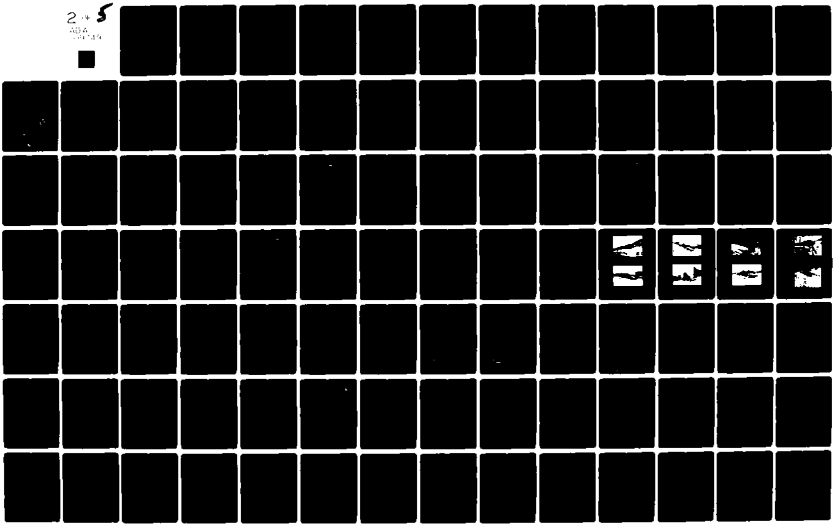

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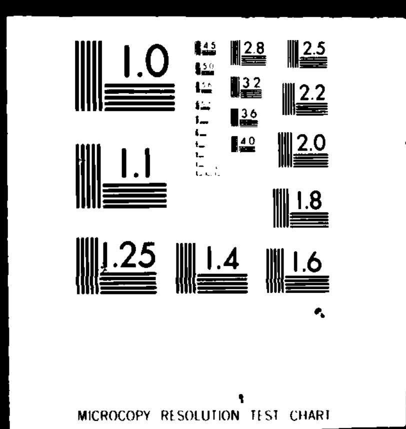


Peak day good weather benefits accrue to 14,061 beach users. Area A in Figure B5, a rectangle represents the total beach opportunity cost of time to 14,061 beach users, or total benefits of $72,117. Area B, a triangle, gives the travel cost and opportunity cost of travel time for 14,061 beach users or $32,270 in benefits. The computation of benefits is as follows:

Area A = lw		
= $5.20 X 14,061 beach users	=	$ 73,117
Area B = 1/2 bh		
= 1/2 (4.59) X 14,061 beach users	=	32,270
		$105,387

Table B22 - Travel Cost Peak Good Weather 1987

Type Cost	Derivation	Total Costs
		$
Beach Time	$1.30 Opportunity Cost X 4 Hours	5.20
Travel Time	$1.30 Opportunity Cost X 35.25 Miles ÷ 55 mph X 2	1.67
Travel Cost	$.145 Average Cost/Mile X 35.25 Miles ÷ 3.5 AOC1/	2.92
		9.79

1/ Average occupant per car.

There are 19 peak good weather days yielding benefits of $2,002,353 in 1987 as shown in Table B23. The benefits for peak good weather days in 2037 are $3,397,390, as given in Table B23 - Recreational Benefits Peak Days and Nonpeak Days. Peak day good weather benefits for 2037 are determined using the same methodology as used to determine 1987 peak day good weather benefits. The total recreational value is $11.06 for the peak good weather recreationist in 2037. The average distance traveled is 45 miles. The increased visitation for 2037 is 22,130 which is 41,089 less 18,959 beach users. The total value of beach time is $115,076 and $64,841 is the total value of the travel time. The growth in benefits for the period 1987-2037 is $1,416,070. The net discounted stream of benefits is the present value of benefits to the project. Given a 7-3/8 percent interest rate, a 50-year project life and 50 years of straight-line growth, the average annual equivalent is .2619. Multiplying the change in benefits for the period (1987-2037) by the average annual equivalent factor yields total project benefits of $370,869 for 2037. The 1987 project benefits are $2,002,353 as shown in Table B23. Total discounted project benefits for peak good weather days are $2,373,222, as shown on Table B24 - Discounted Recreational Benefits.

B6.5 The same methodology applies to the peak day bad weather days and nonpeak good weather days. Benefits for 13 peak bad weather days are $396,448 for 1987. The benefits for peak bad weather days are $993,486 for project year 50. There are 46 nonpeak good weather days yielding $232,162 in benefits for 1987. The nonpeak good weather days yield $1,725,276 in benefits for 2037.

Table B23 - Recreational Benefits Peak Days and Nonpeak Days

Benefit Category	(1) Average Distance Traveled (Miles)	(2) Opportunity Cost, Travel Time, Beach Time Plus Travel Cost Per Person ($)	(3) Increased Visitation	(4) Total Value Beach Time 1/ ($)	(5) Total Value Travel Time 2/ ($)	(6) Total Value Recreation Experience/Day (4) + (5) ($)	(7) Number of Days	(8) Total Benefits (6) X (7)
1987-Peak Good Weather	32.25	9.79	14,061	73,117	32,270	105,387	19	2,002,353
2037-Peak Good Weather	45.0	11.06	22,130	115,076	64,841	179,917	19	3,397,390
1987-Peak Bad Weather	16.5	7.35	4,860	25,272	5,224	30,496	13	396,448
2037-Peak Bad Weather	30.0	7.11	10,681	55,541	20,881	76,422	13	993,486
1987-Nonpeak Good Weather	3.75	5.69	927	4,820	227	5,047	46	232,162
2037-Nonpeak Good Weather	19.5	7.74	5,797	30,144	7,362	37,506	46	1,725,276

1/ Total Value is area of rectangle where length is increased visitation and width is opportunity cost of beach time.

2/ Total Value is area of triangle where base is increased visitation and height is total recreational value per person less opportunity cost of beach time.

Table B24 - Discounted Recreational Benefits

Benefit Category	Net Dollar Increase ($)	Average Annual Equivalent	Growth Discounted ($)	Discounted Average Annual Benefits ($)
1987-Peak Good Weather	-	-	-	2,002,353
2037-Peak Good Weather	1,416,070	.2619	370,869	370,869
Peak Good Weather	-	-	-	2,373,222
1987-Peak Bad Weather	-	-	-	396,448
2037-Peak Bad Weather	597,038	.2619	156,364	156,364
Peak Bad Weather	-	-	-	552,812
1987-Nonpeak Good Weather	-	-	-	232,162
2037-Nonpeak Good Weather	1,493,114	.2619	391,046	391,046
Nonpeak Good Weather	-	-	-	623,208
Total Recreational Benefits	-	-	-	3,549,242

Given 7-3/8 percent interest rate, 50-year project life.

B6.6 Discounted recreational benefits are shown in Table B24. Project benefits for peak good weather days in the base year 1987 are $2,002,353. The benefits for 2037, annualized over the 50-year project life are $370,869. Total project benefits are $2,373,222 for peak good weather days. There are fewer benefits accruing to peak bad weather days. Benefits for the base year, 1987, are $396,448. Benefits for 2037 are $156,364. As shown in Table B24, the growth in benefits from 1987 to 2037 is $597,038. Applying the average annual equivalent factor for a 50-year project life, 50 years straight line growth at 7-3/8 percent project interest rate yields discounted benefits of $156,364. There are 46 nonpeak good weather days per summer season yielding $232,162 in project benefits for 1987. Discounted benefits for nonpeak good weather days in 2037 are $391,046, which is the growth in benefits from 1987-2037, $1,493,114, multiplied by the average annual equivalent of .2619. Total discounted project benefits are $623,208 for nonpeak peak good weather days. Benefits will not accrue to nonpeak bad weather days since the demand will reach 17,947 by 2037. This is less than the existing supply constraint of 18,959 beach users.

B6.7 The total discounted recreational benefits are $3,549,242. These are the total benefits that accrue to peak good and bad weather days and nonpeak good weather days. Recreational benefits are summarized in Table B25.

Table B25 - Summary of Recreational Benefits

Peak	
Good Weather	2,373,222
Bad Weather	552,812
Nonpeak	
Good Weather	623,208
Total	3,549,242

c. Decreased Dredging Costs.

B6.8 Because Erie Harbor is an important commercial navigation channel, it must be periodically dredged to insure movement of an annual average of 1,146,205 short tons of cargo to pass in and out of Presque Isle Bay. Since beach nourishment was provided in 1973, the number of cubic yards required to be dredged to clear the harbor rose to an annual average of 268,000, up from a prenourishment period of 130,000 cubic yards, an annual difference of 138,000 cubic yards. Erosion control will not stop the continuously ongoing, natural process of sand movement along Lake Erie which contributes sand to the entrance channel, nor will erosion control reduce the amount of sand being dredged from the inner harbor channels. The cost per cubic yard of dredging is $1.71 for Erie Harbor. The method of disposal for Erie Harbor dredging is open-lake dumping.

The basis-of-comparison for the computation of dredging cost savings is the without-project condition utilizing the historical record for the average annual dredging removal of littoral drift from the west. A total amount of 75,000 cubic yards of fill will end up in the Erie Harbor Entrance Channel. The average annual cost of dredging littoral drift from the west for the without-project condition is $128,250. The annual dredging costs for each alternative was determined and compared to the dredging costs for the without-project condition. The groins plan would result in 73,200 cubic yards of dredging annually yielding a savings of $3,000. The segmented breakwaters alternative would require dredging an annual amount of 36,600 cubic yards. The annual savings for the plan would be $66,000. The sand trap alternative would require annual dredging of 30,700 cubic yards at a cost savings of $76,000.

d. Decreased Road Maintenance Costs.

B6.9 An average of $123,000 in reduced road maintenance costs will be realized annually under with-project conditions. The energy of damaging waves would be more effectively dissipated by the postproject structures eliminating the need for removal of sand and debris from roads and parking lots, and repairs to undermined or damaged roads. A detailed breakdown of these costs as supplied by the Presque Isle State Park Superintendent's Office are shown in Table B26.

Table B26 - Road Maintenance Costs Avoided[1/]

Manpower Costs			
(1)	(2)	(3)	(4)
Number of Men	Cost/Day	Number of Days Annually	Total Manpower Costs
	$		(1) X (2) X (3)
6	44.10	85	22,491.00
Equipment Costs			
(1)	(2)	(3)	(4)
Pieces of Equipment	Cost/Day	Number of Days Annually	Total Equipment Costs
5	235.36	85	100,028.00

1/ October 1980 Price Levels based on projected ENR Index of 3,400.

e. Decreased Damages to Structures.

B6.10 The reduction in the energy of damaging waves under with-project conditions will eliminate damages to buildings estimated at a cost of $1,200 annually by the Presque Isle State Park Superintendent's Office. With-project conditions will also halt the ongoing erosion process across a 21,780-foot length of the lakeward shore and thereby eliminate the necessity of relocation of telephone poles. The relocation of telephone poles was estimated at a cost of $3,500 annually. The total decreased damages to structures under with-project conditions is $5,000.

f. Land Loss Costs.

B6.11 Presque Isle has a history of serious and continuous erosion. It consists of fine sand, with a surface elevation averaging about 7 feet above low water datum. Due to littoral forces, the peninsula continues to move in an easterly direction and several wide breaks have occurred in the narrow neck in the past 150 years. Under without-project conditions, the inward recession of land averaging approximately 7.0 feet per year across a 21,780-foot lenth of the lakeward shore is expected to continue. The with-project conditions will stop the natural loss of land due to erosion and result in land loss savings. Total loss eliminated annually under with-project conditions is 3.5 acres. Due to Presque Isle uniqueness, land is valued at the prevailing maximum rate of $4,700 per acre. Total land loss savings are $16,450 annually under with-project conditions.

g. Decreased Beach Maintenance Costs.

B6.12 The basis for the computation of benefits is the without-project condition. The without-project conditions indicate that in order to maintain a beach size of 1,011,000 square feet, the Commonwealth of Pennsylvania will have to place 57,000 cubic yards of sand each year. The cost of nourishment is measured as a unit cost of tons/yard. A cubic yard of sand weighs approximately 1.512 tons. Thus 86,184 tons of sand will have to be placed each year, in order to maintain the 1972 beach area size. The cost per ton of sand is $5.00 in October 1980 price levels, yielding an annual cost of $430,920 for minimal nourishment requirements. There are also fees for contingencies, engineering and design, and supervision and inspection which yields additional annual costs of $127,700. Total decreased maintenance costs are $560,000 for the without-project conditions.

B6.13 The benefits to the project is the difference in maintenance costs under the without-project conditions. The net benefit for reduced beach nourishment cost for the segmented breakwaters alternative is $190,000 given $560,000 costs for without-project conditions and $370,000 for with-project conditions. However, the annual replenishment costs for with-project condition are displayed on the cost side to yield a more accurate portrayal of actual costs to maintain the project. Therefore, the full cost of nourishment under without-project conditions is shown as a benefit to the segmented breakwaters and other alternatives for accounting purposes.

h. Site Attraction Factors.

B6.14 Presque Isle State Park is a unique environment also offering a variety of recreational activities. Many visitors are attracted to the site because of the variation in outdoor recreational activities. For example, an individual might want to spend half a day swimming and half a day hiking. There is a loss of benefits to both swimming and hiking activities under without-project conditions. The beach supply under with-project conditions would result in additional benefits to the other activities the beach participant will enjoy while visiting Presque Isle. Presque Isle offers boating, fishing, and other launching facilities. The benefits for site attraction factors have not been evaluated because the percentage of visitors to Presque Isle who will participate in two or more activities has not been determined by an onsite survey. There is a loss of benefits to both swimming and hiking activities. The unconstrained beach supply would result in additional benefits to other activities as well as the swimming activities. Although a dollar value has not been placed on these benefits, they are still important and should not be ignored.

i. Summary of Benefits.

B9.15 The summary of benefits is displayed in Table B27 on an alternative-by alternative basis. The total benefits for each plan are as follows: $4,256,000 for groins, $4,319,000 for segmented breakwaters, and $4,329,000 for sand trap recirculation.

Table B27 - Summary of Benefits

Benefits	Groins	Segmented Breakwaters	Sand Trap Recirculation
	$	$	$
Recreation			
Peak Good Weather	2,373,000	2,373,000	2,373,000
Peak Bad Weather	553,000	553,000	553,000
Nonpeak Good Weather	623,000	623,000	623,000
Decreased Dredging	3,000	66,000	76,000
Decreased Road Maintenance	123,000	123,000	123,000
Decreased Damages to Structures	5,000	5,000	5,000
Land Loss	16,000	16,000	16,000
Decreased Beach Maintenance	560,000	560,000	560,000
Total	4,256,000	4,319,000	4,329,000

B7. PROJECT COSTS

a. Total Annual Charges.

B7.1 The total annual charges for each alternative is portrayed in Table B28. The first costs of investment are $20,100,000 for groins, $22,800,000 for segmented breakwaters, and $21,600,000 for sand trap recirculation. The total annual maintenance costs for each alternative are also shown in Table B28.

b. Interest Costs During Construction.

B7.2 Although project construction initiation begins in 1985, actual benefits are not expected to occur until 1987. However, although a 24-month gap intervenes, it was determined that actual construction will take place for two periods only during the warm season. Therefore, because the length of the actual construction period is less than 24 months, no interest costs during construction are anticipated. With each alternative, there will be an initial placement of fill. The initial fill placement will take place during the construction period. Any fill placed thereafter will be placed on an annual basis, the costs incurred being covered by the annual replenishment fee.

Table B28 - Total Annual Charges

Alternative Type of Cost	Groins	Segmented Breakwaters	Sand Trap Recirculation
	$	$	
Economic Investment			
Total First Cost	20,100,000	22,800,000	21,600,000
Interest During Construction1/	-	-	-
Total Investment Cost	20,100,000	22,800,000	21,600,000
Annual Charges			
Interest and Amortization2/	1,526,000	1,731,000	1,640,000
Annual Replenishment	1,280,000	370,000	3,515,000
Annual Maintenance	10,000	50,000	25,000
Total Annual Charges	2,816,000	2,151,000	5,180,000

1/ No interest during construction because project will be completed in less than 24 months.

2/ Using 7-3/8 percent interest rate and 50-year project life.

B8. ECONOMIC EFFICIENCY

B8.1 Four measures of economic efficiency were developed for the proposed plans of improvement. They are: the B/C ratio, net discounted benefits, the payback period, and the internal rate of return as shown on Table B29.

B8.2 The net benefits are the excess of average annual benefits over average annual costs. The total net benefits for each alternative are as follows: $1,440,000 for groins, $2,168,000 for segmented breakwaters, and -$851,000 for sand trap recirculation. The benefit-cost ratio for each alternative is as follows: 1.51 for groins, 2.01 for segmented breakwaters, and .84 for sand trap recirculation.

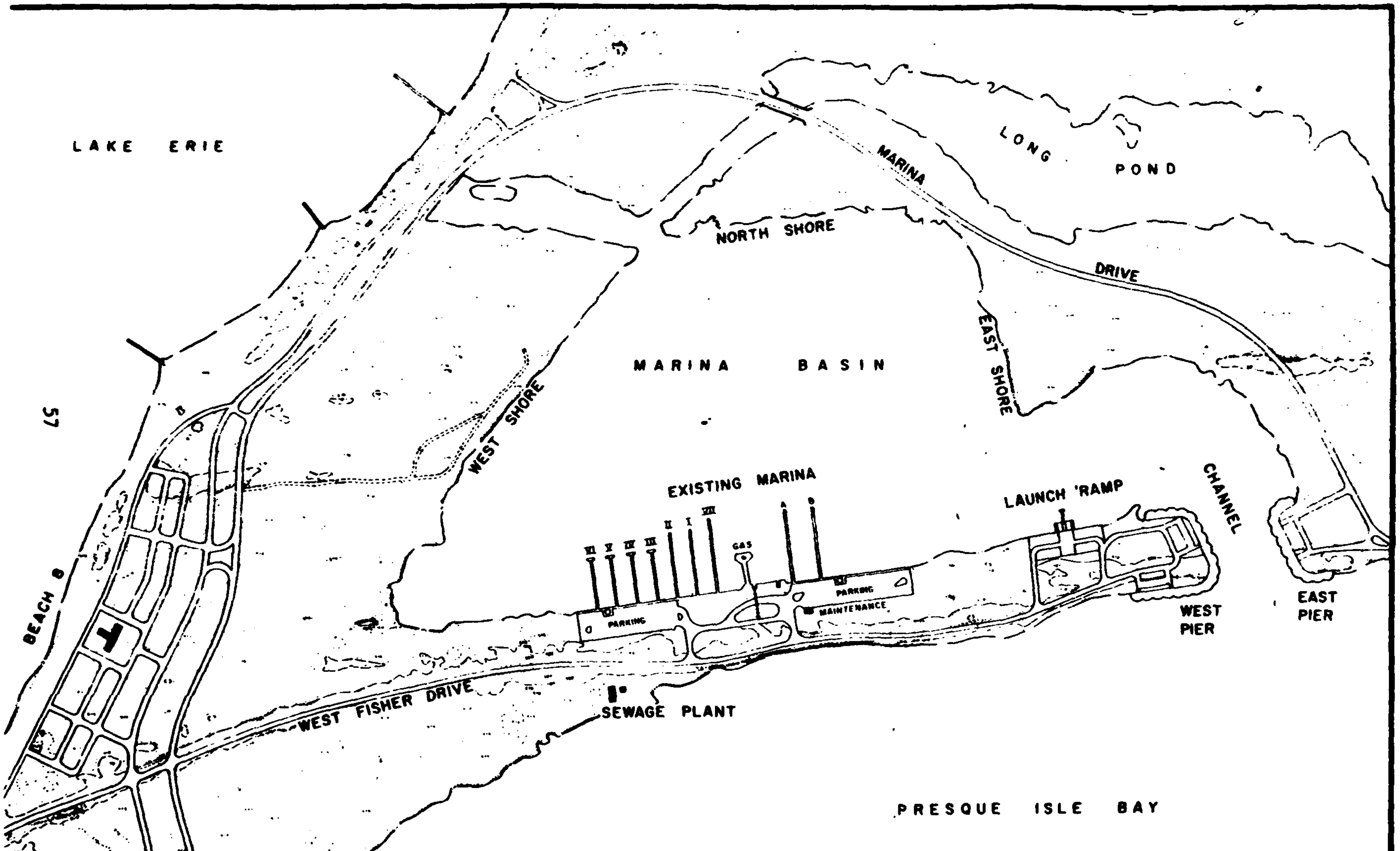
B8.3 The project payback period is the amount of time it takes for undiscounted annual benefits to equal the project costs. The project payback period is 8 years for groins, 9 years for segmented breakwaters, and 9 years for sand trap recirculation. The internal rate of return indicates the return on investment resulting from project implementation. The internal rate of return for each alternative is shown on Table B29.

B8.4 This economic analysis was based on future population trends and a recreation demand schedule for existing and improved beach conditions. Both the groins and segmented breakwaters plans are economically justifiable on the basis of the analysis. The segmented breakwaters plan is the favored plan due to net benefit maximization and the largest benefit-cost ratio. This plan offers a more permanent solution to the erosion problem than the present annual nourishment program. The segmented breakwaters plan is the recommended plan based on the economic analysis.

Table B29 - Economic Efficiency

Alternatives	Investment Cost	Average Annual Benefits	Average Annual Costs	Net Discounted Benefits	B/C Ratio	Payback	Internal Rate of Return (Percent)
	$	$	$	$			
a. Groins 1/	20,100,000	4,256,000	2,816,000	1,440,000	1.51	8 Years	7.55
b. Segmented Breakwaters	22,800,000	4,319,000	2,151,000	2,168,000	2.01	9 Years	9.38
c. Sand Trap Recirculation	21,600,000	4,329,000	5,180,000	-851,000	.84	9 Years	3.63

1/ There are no interest costs during construction.



PREPARED
REVISIONS
LEGEND

PLATE H 1

EXISTING MARINA

PRESQUE ISLE MARINA STUDY

FIGURE 2

9 PAGE

REGIONAL LOCATION

MAP 1

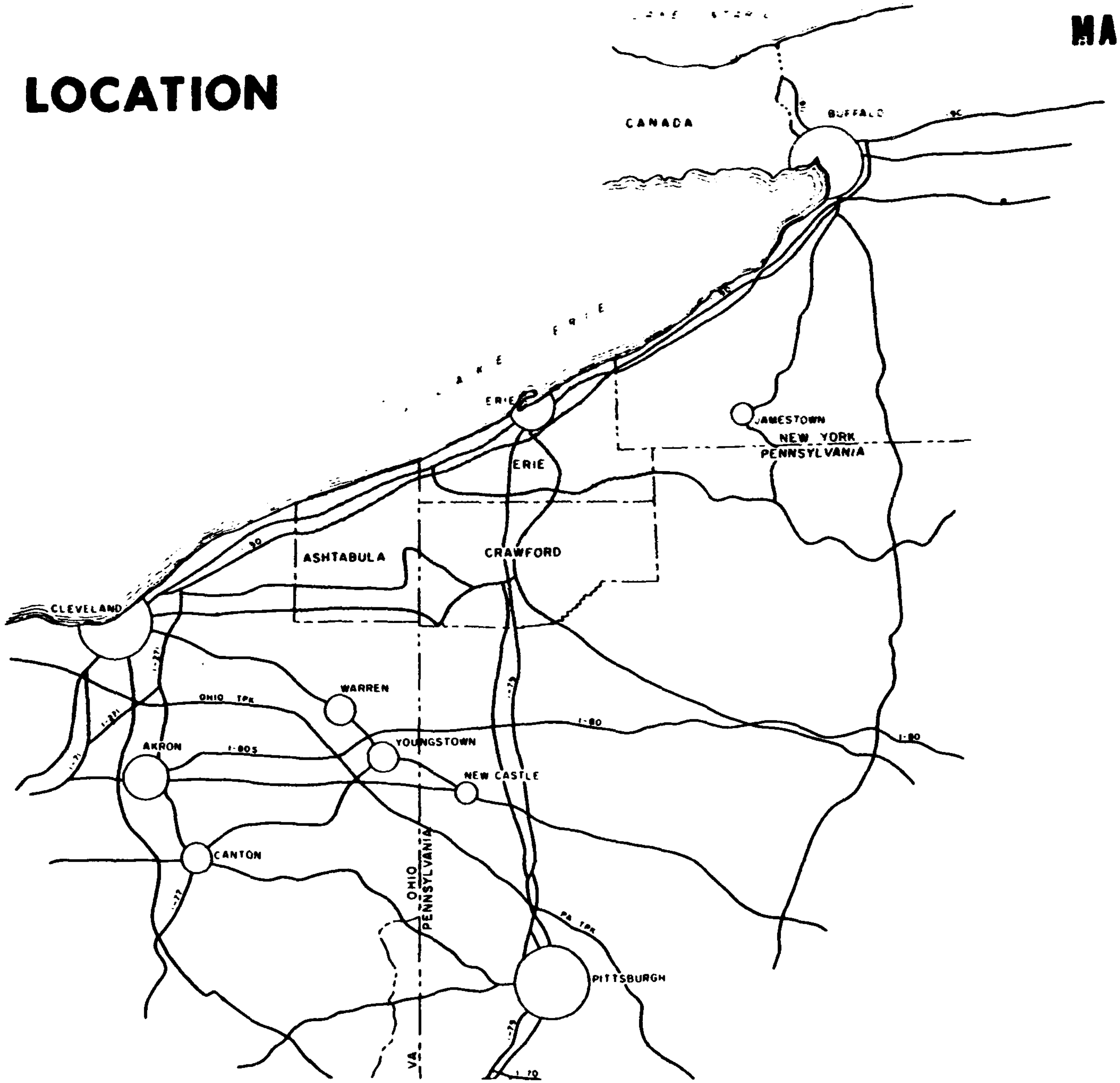
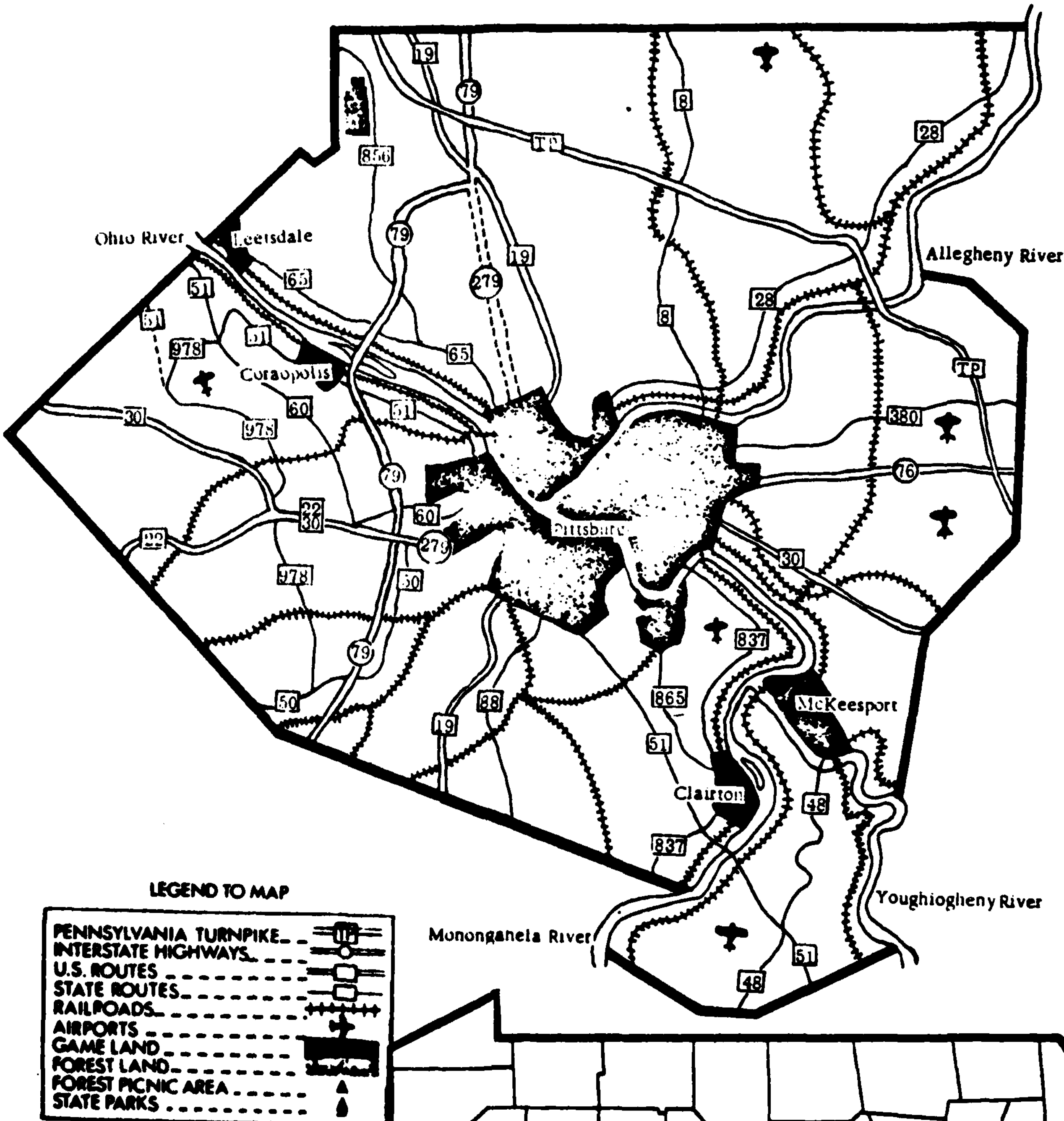


PLATE B2

Allegheny County



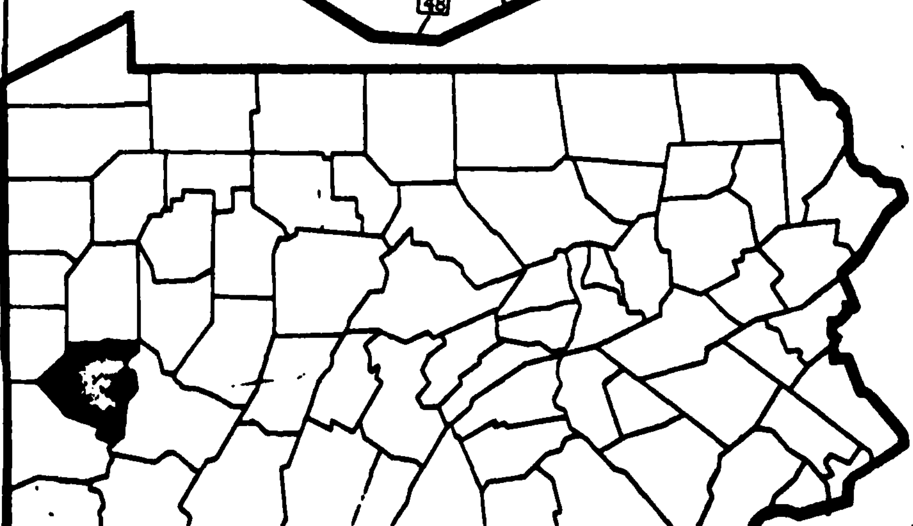


PLATE B3

PRESQUE ISLE PENINSULA
ERIE, PENNSYLVANIA

PHASE I
GENERAL DESIGN MEMORANDUM

APPENDIX C

DETAILED DESIGN

APPENDIX C
DETAILED DESIGN

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TABLES

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FIGURES

APPENDIX C
DETAILED DESIGN

C1. INTRODUCTION

This Appendix presents the design criteria, assumptions, sediment budget, and detailed design of the groin, offshore breakwater, annual nourishment, and sand recirculation alternatives for the beach erosion control project at Presque Isle Peninsula in Erie, PA. The groin alternative consists of a single groin field extending from the root of the peninsula with the mainland shore eastward through Beach No. 10 and includes construction of new rubblemound groins and modification of existing groins. There are two breakwater alternatives: the first consists of a series of segmented breakwaters located offshore from the peninsula shoreline and would extend from the neck of the peninsula through Beach No. 10; the second consists of a single breakwater located offshore from Sunset Point and will serve as a sand trap from which sand would be recirculated to the beaches along the peninsula. The annual nourishment alternative would be an expanded version of the present replenishment program. There are two recirculation alternatives: the first involves construction of a breakwater offshore from Sunset Point as previously mentioned and pumping the sand which collects behind it onto the beaches with a hydraulic dredge and a series of booster pumps; the second involves pumping sand from a borrow area at Gull Point to the beaches along the peninsula with a hydraulic dredge and a series of booster pumps.

C2. DESIGN WATER LEVEL

The design water level (DWL) or still water level (SWL) is a combination of the joint occurrence of long-term average lake level with a short-term rise due to a storm setup. The 20-year recurrence water level will be used in this design and is determined by combination of a 20-year lake level with a 1-year short-term rise. The recording gage at Cleveland serves as the master gage for Lake Erie, therefore, the long-term Cleveland records are assumed to be directly applicable to the Presque Isle project site. The maximum annual events stage-frequency curve for Lake Erie is shown in Figure C1 and indicates that a maximum monthly mean level of approximately 572.4 occurs once in 20 years. Erie, PA, is midway between Buffalo, NY, and Cleveland, OH, therefore, a 1-year short-term rise at Erie can be determined by averaging records at Buffalo (4.8 feet) and Cleveland (1.4 feet) to obtain 3.1 feet fluctuation each year. Combining a maximum monthly mean level of 572.4 which has a 20-year recurrence with a 3.1 foot short-term fluctuation that has a 1-year recurrence, yields a 20-year recurrence design lake level of 575.5 or +6.9 feet above low water datum.

C3. DESIGN WAVES

a. Design 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.

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 C1 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:

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

(2) Angle Class 2 - Mean wave approach angle within 30 degrees to either side of a normal to shore (north to west-northwest);

(3) Angle Class 3 - Mean wave approach angle greater than 30 degrees to the left of a normal to shore (west-northwest to southwest).

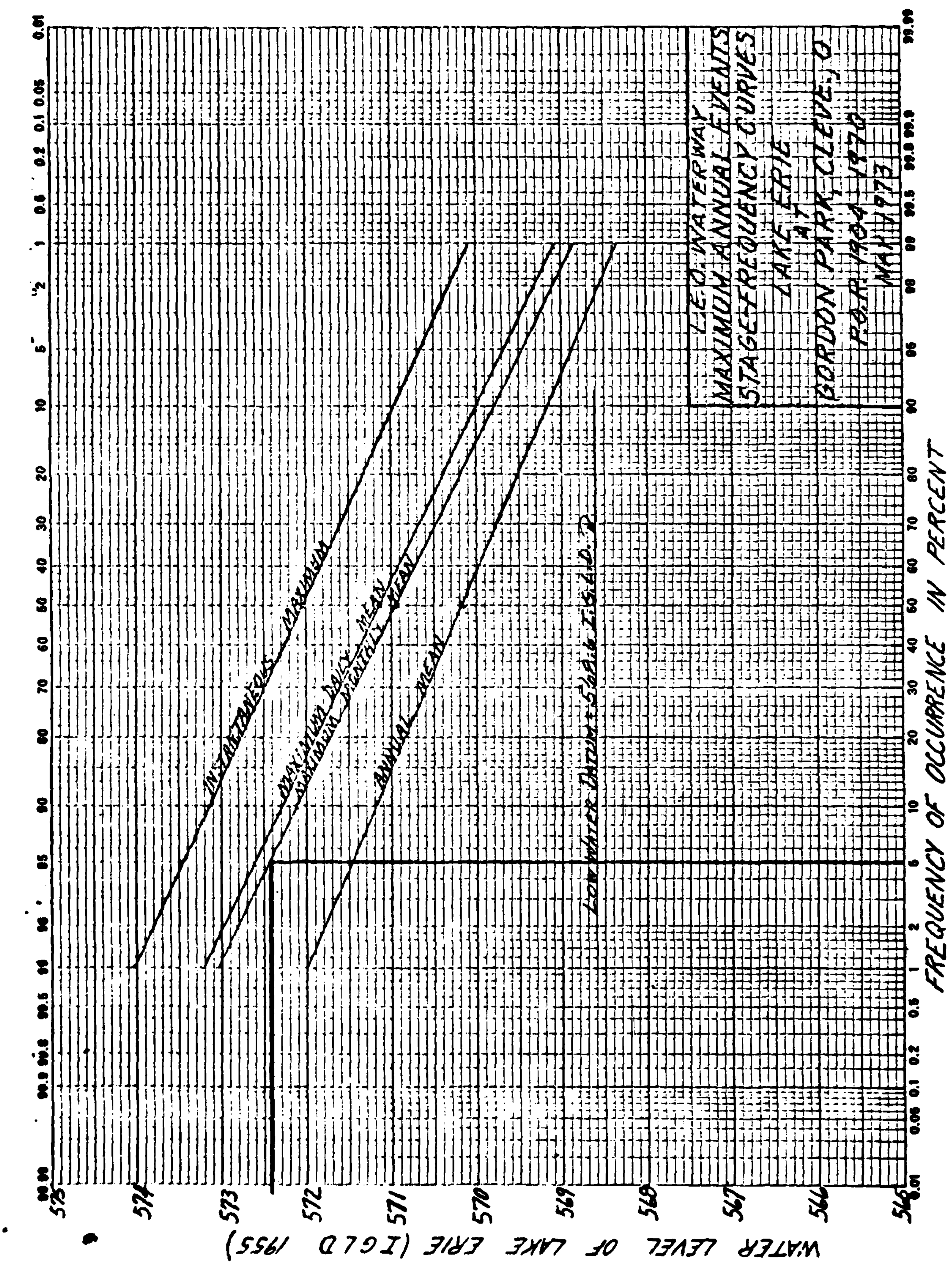
Table C2 gives the wave period associated with each wave height at Erie, PA, as a function of wave direction and wave height as presented in Technical Report H-76-1.

In accordance with a 4 May 1976 Guidance letter provided by NCDED-H for use of WES Technical Report H-76-1, for coastal projects having a 50-year design economic lifetime, a combined lake level and deep water wave corresponding to a 200-year recurrence event is recommended. Therefore, a 10-year wave recurrence interval can be used with a 20-year recurrence design lake level to obtain a 200-year recurrence event. Table C1 indicates that the largest significant deep water wave heights with a 10-year recurrence interval occur from the west and north directions during the winter season and from the northeast during the fall season. These significant deep water wave heights and associated wave periods are presented in Table C3 below:

Table C3 - Significant Deep Water Wave Heights with 10-Year Recurrence Interval and Associated Wave Period

Direction	Wave Height	Wave Period
West	12.8 feet	9.0 seconds
Northwest	9.5 feet	7.0 seconds
North	9.5 feet	7.0 seconds
Northeast	7.5 feet	6.4 seconds

b. Wave Refraction Analysis - A refraction analysis was conducted using a computer model developed by R. S. Dobson (Waterways Experiment Station) for his M. S. Thesis at Stanford University. The water wave refraction program was used to solve the governing equations that describe the propagation of



L.E.O. WATERWAY
MAXIMUM ANNUAL EVENTS
STAGE-FREQUENCY CURVES
LAKE ERIE
AT
GORDON PARK, CLEVE., O
P.O.R. 1904-1970
MAY 1973
INSTANTANEOUS MAXIMUM
MAXIMUM DAILY MEAN
MAXIMUM MONTHLY MEAN
ANNUAL MEAN
LOW WATER DATUM = 568.6 I.G.L.D.
FREQUENCY OF OCCURRENCE IN PERCENT
WATER LEVEL OF LAKE ERIE (IGLD 1955)

FIGURE C1

TABLE C-1

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(0.8)	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(0.8)
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)

TABLE C-2

SIGNIFICANT DEEP WATER WAVE PERIODS AT ERIE, PA.

GRID LOCATION 6,18 LAT=42.27 LON=80.17 ERIE PA

GRID POINT NUMBER 18

SIGNIFICANT PERIOD BY ANGLE CLASS AND WAVE HEIGHT

WAVE HEIGHT (FT)	ANGLE CLASS		
	1	2	3
1	2.3	2.3	2.4
2	3.6	3.5	3.7
3	4.5	4.4	4.7
4	5.2	5.1	5.4
5	5.7	5.6	6.0
6	6.0	5.9	6.4
7	6.2	6.2	6.8
8	6.5	6.5	7.1
9	6.8	6.8	7.5
10	7.1	7.1	7.9
11	7.3	7.3	8.3
12	7.6	7.6	8.7
13	7.9	7.9	9.0
14	8.1	8.2	9.4
15	8.4	8.5	9.8
16	8.7	8.8	10.2
17	8.9	9.1	10.6
18	9.2	9.4	10.9
19	9.5	9.7	11.3
20	9.8	10.0	11.7
21	10.0	10.2	12.1
22	10.3	10.5	12.5
23	10.6	10.8	12.8
24	10.8	11.1	13.2
25	11.1	11.4	13.6

the design waves from deep water into shallow water. To analyze the waves at Presque Isle, the peninsula was divided into two reaches: Reach 1 extends from Groin No. 1 northeastwardly through Beach No. 8 (see Plate 4 in Appendix A); Reach 2 extends from Beach No. 8 eastward through Beach No. 10. Refraction diagrams for deep water waves from the west, northwest, and north directions in Reach 1 are shown in Figures C2, C3, and C4, respectively, whereas refraction diagrams for deep water waves from the west-northwest, northwest, north, and northeast directions in Reach 2 are shown in Figures C5, C6, C7, and C8, respectively (see Table C3 for wave height and period relative to specific direction). The refraction diagrams represent the wave conditions along the peninsula at a design water level of 575.5 or +6.9 feet above low water datum.

C4. DESIGN CRITERIA AND ASSUMPTIONS

The primary purpose of the beach erosion control project for Presque Isle Peninsula is to develop a publicly acceptable and technically feasible plan to improve and preserve the peninsula and its recreational facilities with the least amount of destruction to the environment and geological growth of the area. During preparation of the 1974 Review Report on the cooperative beach erosion control project, several concepts for solution of the erosion problems were investigated. Those which were determined to provide the most practicable and economical solution to the erosion problem include a full breakwater concept, a partial breakwater concept, an annual nourishment plan, a groin plan, a sand recirculation concept, and a sand trap recirculation concept.

A recent draft (presently awaiting final publication) of the Coastal Engineering Technical Aid (CETA) entitled "Estimating Nearshore Conditions for Irregular Waves," dated 9 July 1979, presented methods developed by Goda (Coastal Engineering in Japan, Vol. 18, 1975 - Irregular Wave Deformation in the Surf Zone, Yoshimi Goda) for predicting nearshore irregular wave conditions. Curves for nearshore significant wave heights (H_{sig}) or the maximum wave heights (H_{max}) can be used to obtain incident waves for the design of coastal structures in shallow water. Comparison of incident wave heights computed using the H_{sig} and H_{max} curves indicate that an incident wave reduction by as much as 50 percent can be obtained by using H_{sig} instead of H_{max}. Wave reductions of this amount could reduce the stone size of an offshore structure to a degree that structural stability becomes questionable. Since Presque Isle is in a severe ice climate and a critical wave climate, the Buffalo District elected to use H_{max} in the design of the groin, segmented breakwater, and sand trap plans. This H_{max} wave is conservative and corresponds to approximately the H_b wave determined using Table 7-4 of the Shore Protection Manual. A two-dimensional stability test will be conducted by the Corps Waterways Experiment Station and will indicate the optimal stone size for the selected alternative.

An average refraction coefficient was applied to the significant deep water waves in Table C3 to determine the incident wave height that is used in calculation of the armor stone requirements for the groin and segmented breakwater alternatives. The results from the wave refraction analysis for waves from the west in Reach 1 (see paragraph C3b. entitled Wave Refraction

Analysis) were used to determine the average refraction coefficient which would be applied. The wave from the west in Reach 1 was used because it is the largest design deep water wave that can impinge on probably the most critical portion of the peninsula. An average coefficient of 0.85 was determined for design of the head and trunk section of the groins which are located in design water depths of 9.9 feet and 7.0 feet, respectively. For the segmented breakwater alternative, an average refraction coefficient of 0.86 was determined for the 11.9-foot design water depth. In the detailed design stage during preparation of the Phase II GDM, the peninsula will be divided into several design reaches for either of these alternatives (groin or segmented breakwaters) in order to obtain a more precise design. For the sand trap alternative, the results from the refraction analysis for waves from the west-northwest in Reach 2 at Sunset Point were used in calculation of the armor stone requirements for the breakwater. The wave from the west-northwest direction was used because it is the largest design deep water wave that could propagate into the area of the sand trap breakwater. A refraction coefficient of 0.97 was determined for design of the sand trap breakwater which is located in a design water depth of 16.9 feet.

The segmented breakwater and the sand trap recirculation concepts are designed in this report as rubblemound structures. The use of dolosse armor units or other concrete units for these concepts will be considered in the final design during preparation of the Phase II GDM. Paragraph C5 presents a detailed discussion of the sediment budget assumptions and computations used in the development of each alternative.

A review of available foundation literature and the geologic development of Presque Isle was made to evaluate the expected foundation conditions for the erosion control structures. Bedrock topography is high (-2.0 LWD) at the westernmost end of the peninsula where it joins the mainland shore and drops to below -100 LWD in the vicinity of the waterworks ponds. The entire peninsula is underlain by a thick deposit of modern stratified fine sands and silty sands with the possibility of a deep lacustrine mud layer. Settlement and bearing capacity problems are not anticipated, therefore, it was assumed in this phase of the study, that foundation conditions are adequate for support of the erosion control structures. Evaluation of the results from the Inner Continental Shelf Sediment and Structure Study (ICONS) and a complete subsurface investigation, including a boring program, testing program, and stability analysis, will be undertaken during the detailed design and preparation of the Phase II GDM to verify the assumption made at this time.

The following paragraphs will present a discussion of the design criteria and assumptions used for refining the design of each of these alternatives.

a. Groin Alternative

(1) General - A groin is a shore protection structure designed to act as a barrier to sand moving in the littoral zone between its seaward end and the limit of wave uprush. Groins may be used: to build a beach or retard erosion of an existing or restored beach by trapping littoral drift; to stabilize a beach subjected to excessive storms by reducing the rate of loss;

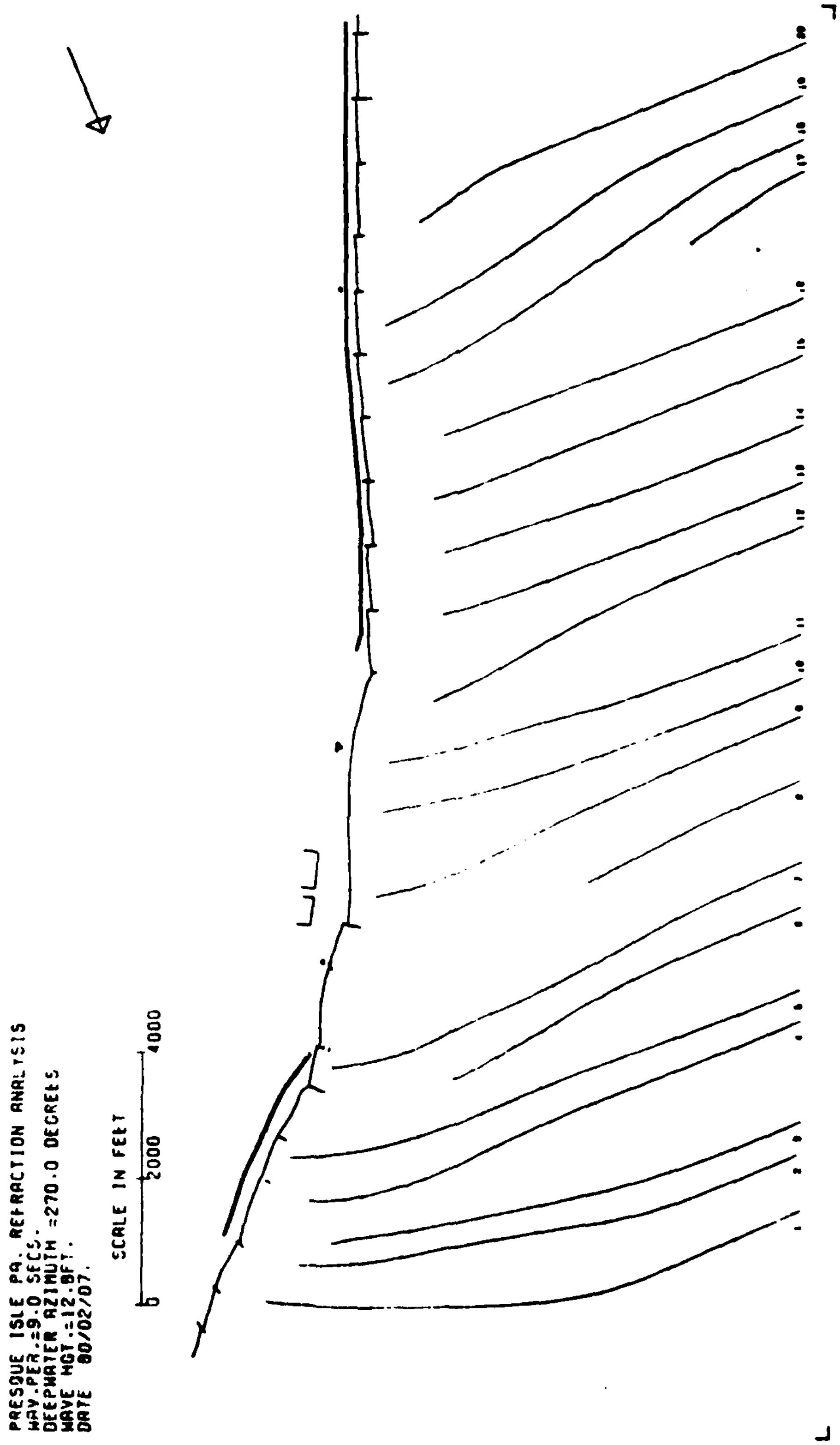


Figure C7 Refraction Diagram for 10-year Deep Water Wave from the West Direction in Reach 1

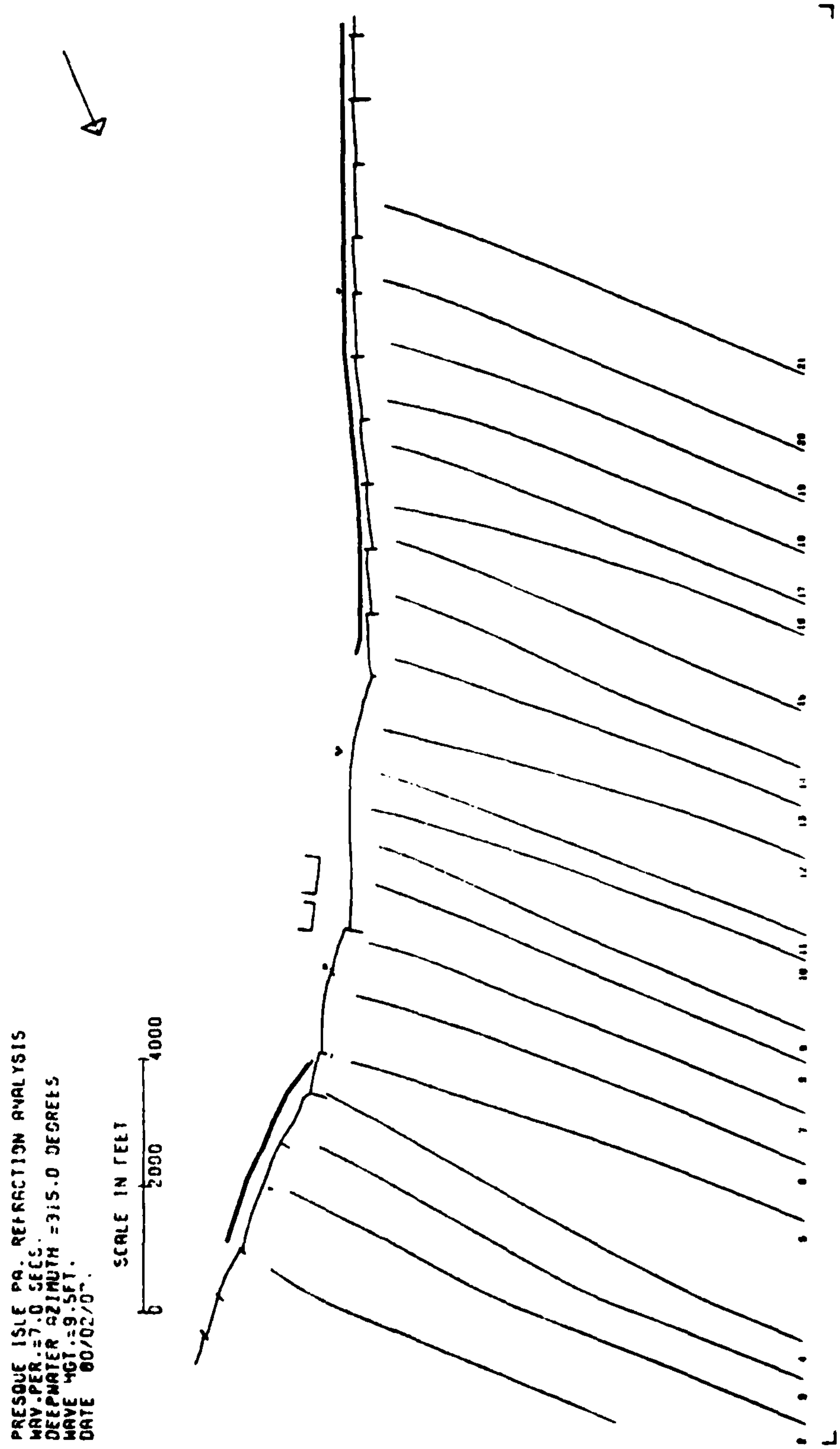


Figure C3 - Refraction Diagram for 10-year Deep Water Wave from the Northwest Direction in Reach 1

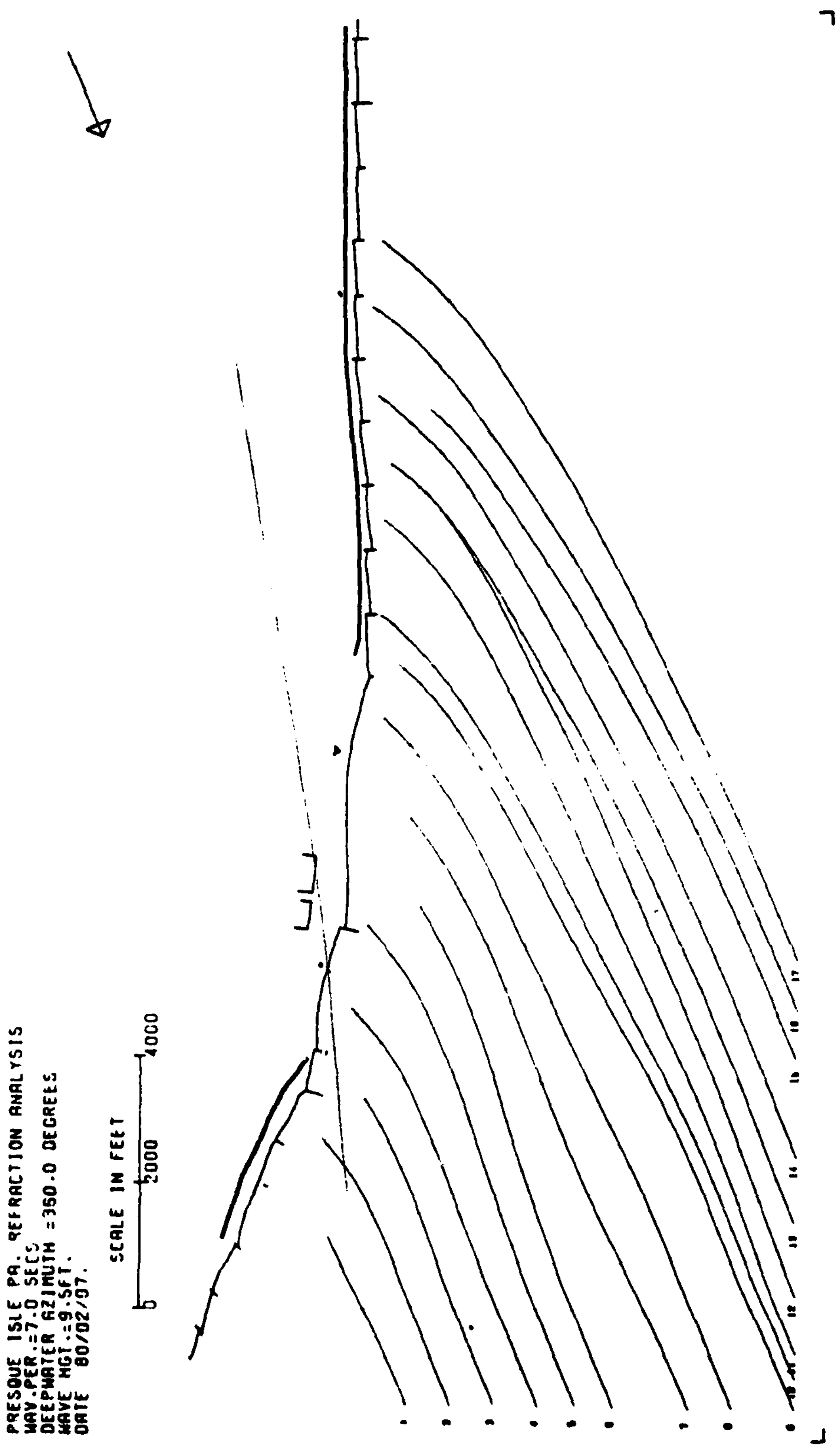


Figure C4 - Refraction Diagram for 10-year Deep Water Wave from the North Direction in Reach 1

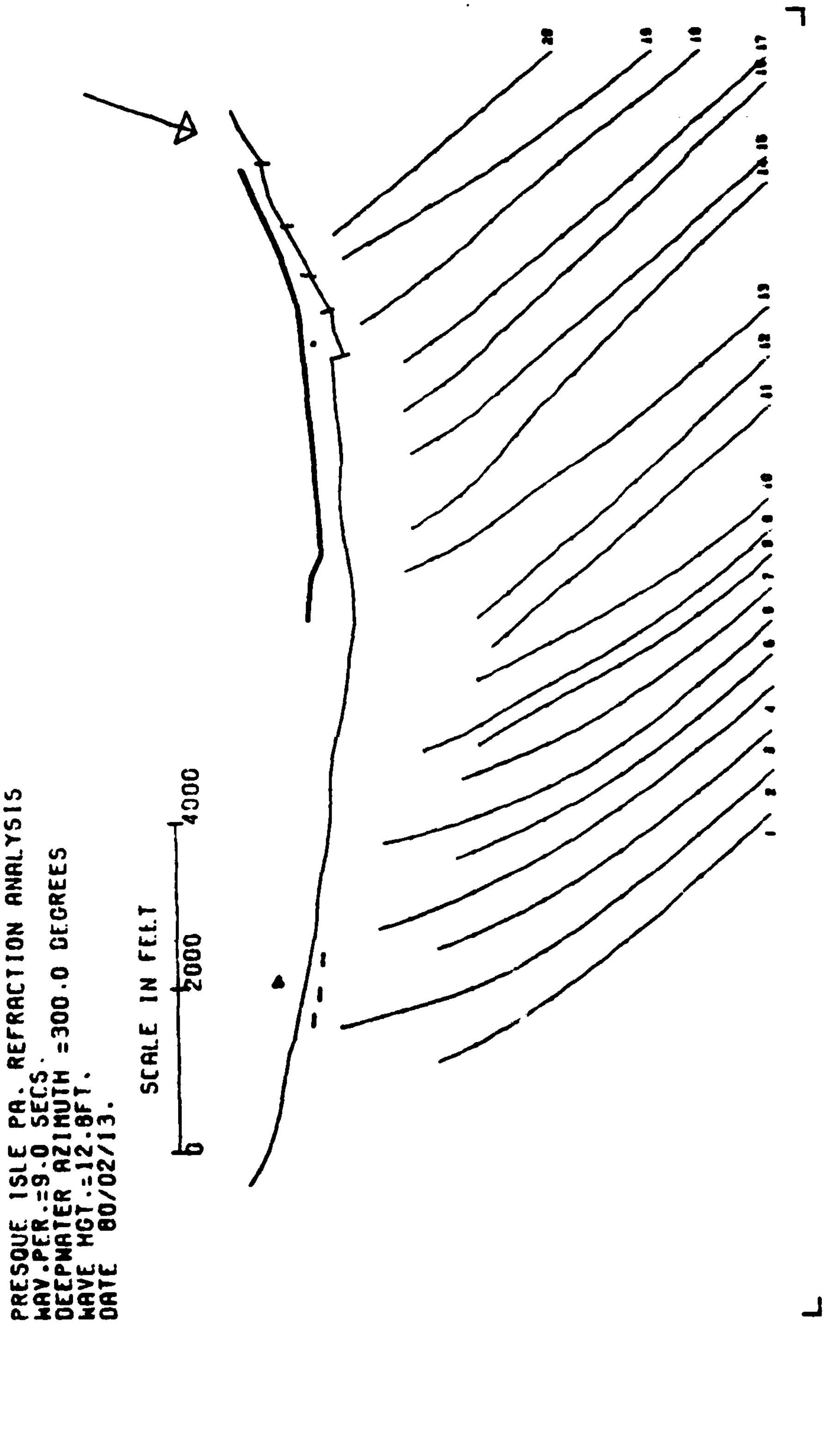


Figure C5 - Refraction Diagram for 10-year Deep Water Wave from the West-Northwest Direction in Reach 2

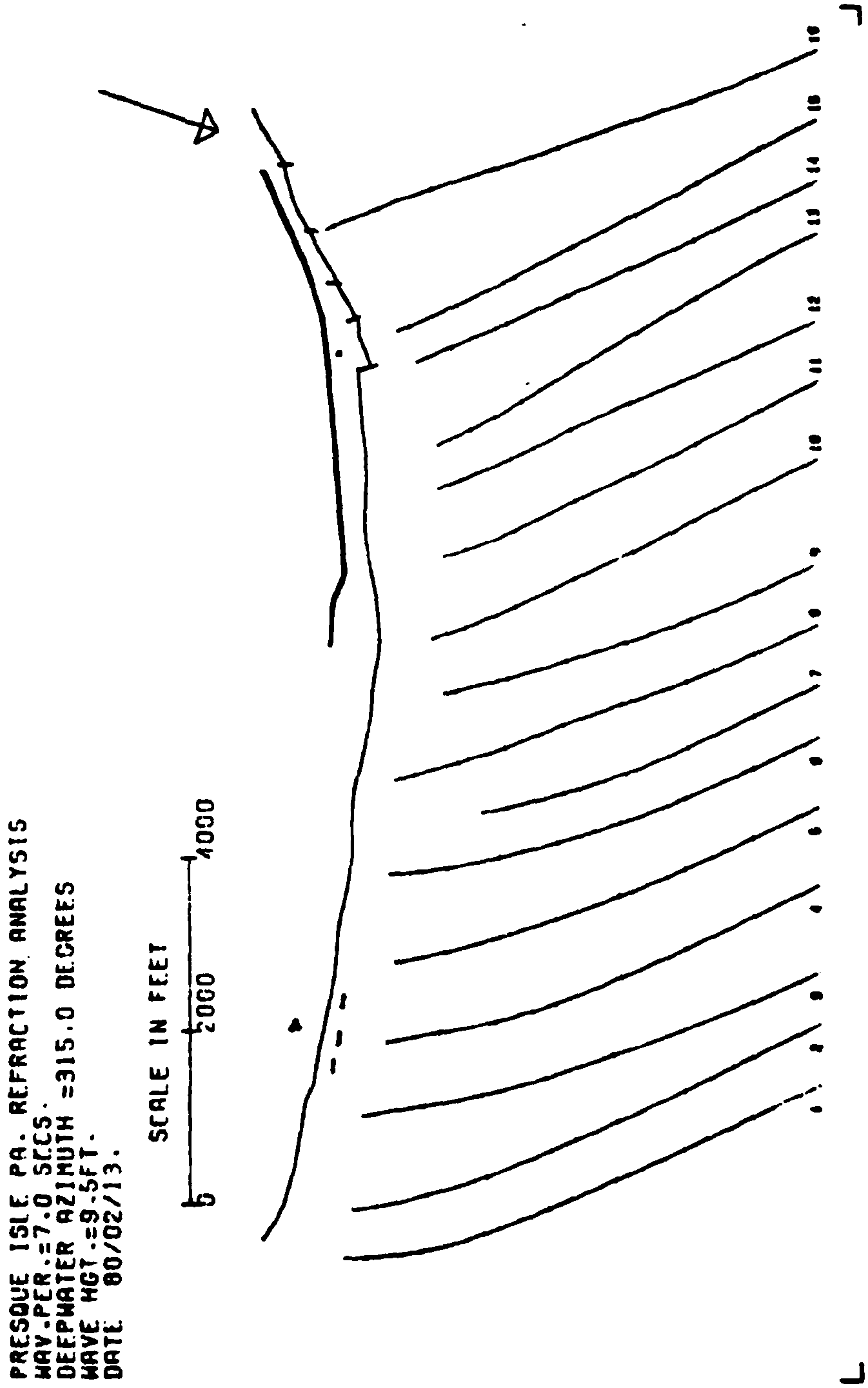


Figure C6 - Refraction Diagram for 10-year Deep Water Wave from the Northwest Direction in Reach 2

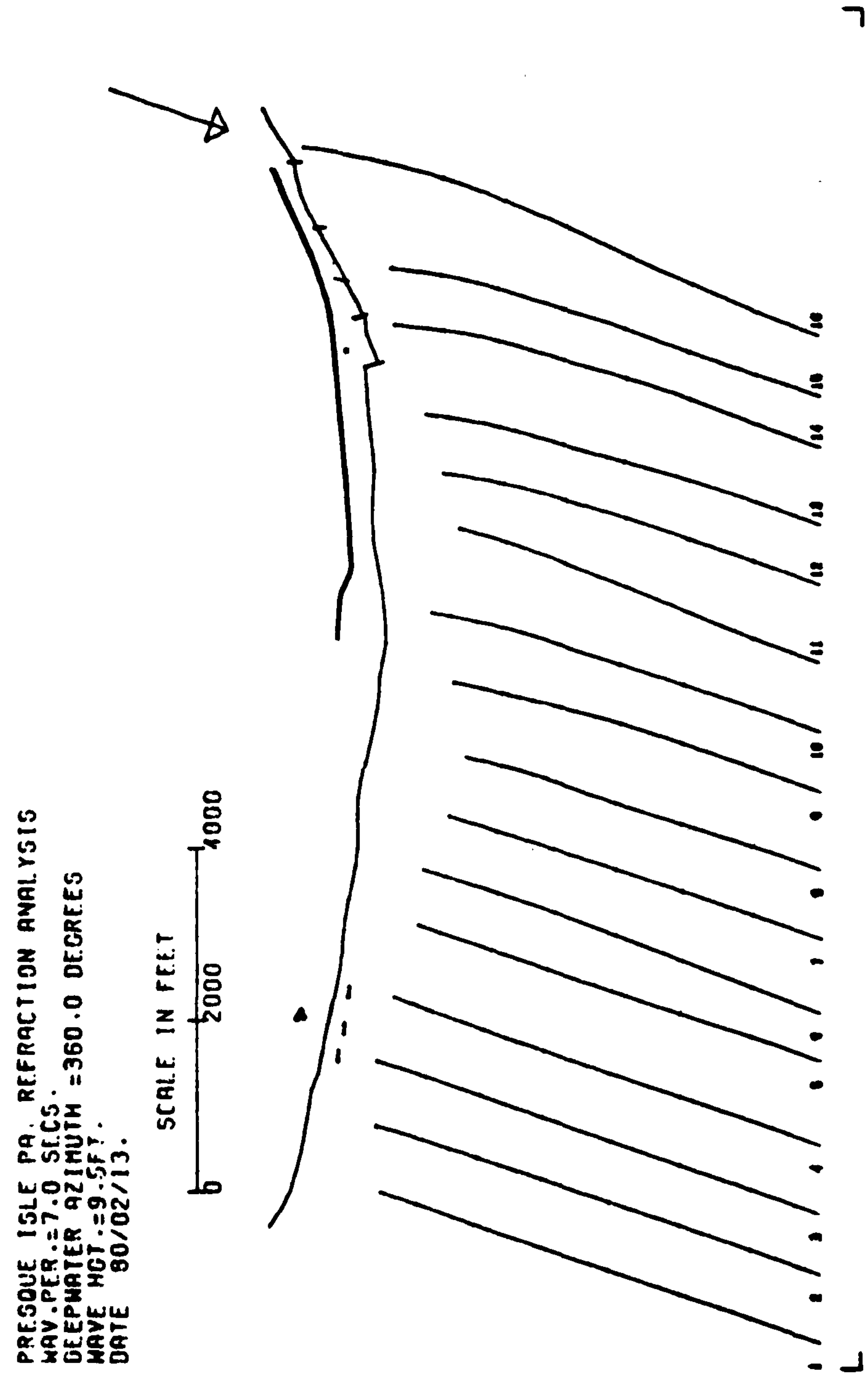


Figure C7 - Refraction Diagram for 10-year Deep Water Wave from the North Direction in Reach 2

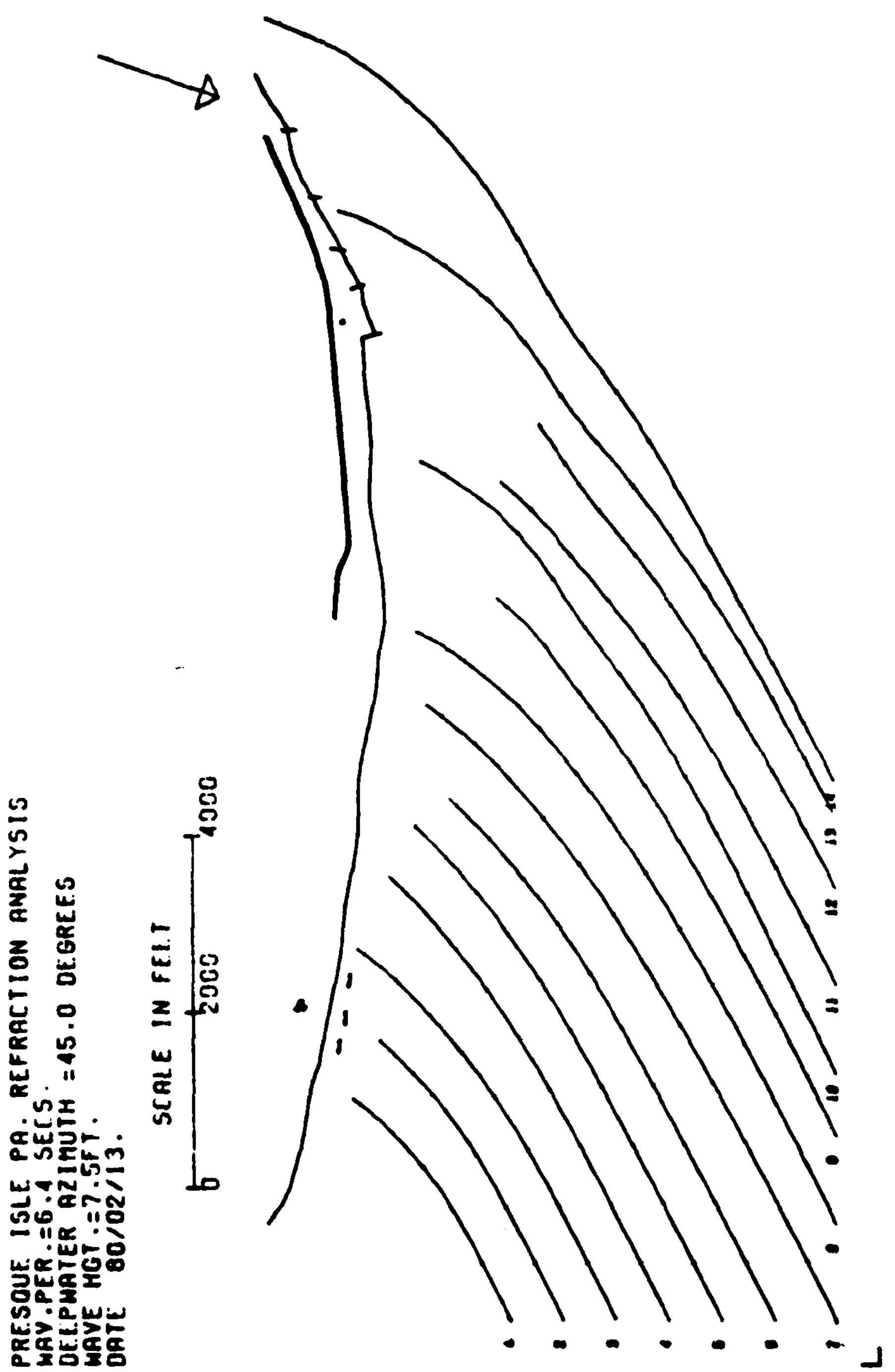


Figure C8 - Refraction Diagram for 10-year Deep Water Wave from the Northeast Direction in Reach 2

to reduce the rate of longshore transport out of an area by reorienting a section of the shoreline to an alignment more nearly perpendicular to the predominant wave direction; and to reduce losses of material out of an area by compartmentalization of the beach. Trapping of sand by a groin is done at the expense of the adjacent downdrift shore unless the groin or groin system is artificially filled with sand to its entrapment capacity from other sources, thereby insuring a more or less uninterrupted passage of sand to downdrift shores.

(2) Existing Groins - There are presently two existing groin fields on Presque Isle Peninsula. The first, located along the neck of the peninsula, was built in 1956 and consists of a system of eleven groins. These groins are 300-feet long and spaced about 1,000 feet apart. The length of each groin is comprised of a 60-foot horizontal shore section with a top elevation of +10 feet above low water datum and a 240-foot long sloped intermediate section which terminates at an elevation of 568.6 (0.0 LWD). The second existing groin field is located just east of the water works (see Plate 5 in Appendix A) and was constructed over a period of years during the 1920's and 1930's. This groin system consists of 13 groins and three sand traps. The groins in this system vary in length from about 80 to 300 feet and in spacing from about 600 to 1,000 feet.

Both of the existing groin fields on Presque Isle Peninsula have proven to be ineffective in trapping sufficient littoral material. Extensive beach replenishment measures have been undertaken periodically since 1960, and the existing groins have not functioned adequately in retarding erosion of the restored beaches by reducing the rate of sand losses. Therefore, the functional design of a groin system which consists of spacing, length, height, and orientation with the shoreline was analyzed to develop a groin system which should be effective in retarding erosion of the beaches by reducing sand losses.

(3) Groin Design - Groin dimensions depend on wave forces to be opposed, the type of groin, and the construction materials used. The length of the groin is determined by the distance to depths offshore where normal storm waves break and by how much sand is to be trapped. Using Thorndike Saville's data presented in Technical Memorandum No. 37, the normal storm wave at Erie, PA, was found to be 4.2 feet with a wave period of 3.8 seconds (see computations on pages 8 through 11 of this Appendix). The method in Section 7.121 of the Shore Protection Manual was used to determine that the breaking depth for the 4.2-foot normal storm wave ranges from elevation 564.1 to 565.6 (see computations on page 8). From surveys obtained during the Summer of 1979, it was determined that the groins for this alternative must be 300 feet in length in order to extend to the zone where the normal storm waves break. Due to the inadequate functioning of the existing steel sheet pile groins at Presque Isle, it was decided to use stone as the construction material for this groin alternative and, thereby, reduce wave reflection from the structures. A steel sheet pile wall will be driven along the center line of the groin and will extend for the entire length of the groin to make the structures impermeable. The groin alternative will consist of modifying 10 of the existing 300-foot long groins in the groin field along the neck of the peninsula by placement of 100 feet of 3.0 to 7.0 ton armor stone adjacent to

COMPUTATION SHEET	DATE March 1979	PAGE OF	FILE NUMBER
NAME OF OFFICE NCBED-DC	COMPUTATION Normal Storm Waves		
SUBJECT Presque Isle Peninsula	[redacted] for Groin Design.		
COMPUTED BY RJG	CHECKED BY TJB	APPROVED BY	

The normal storm wave was determined using Thorndike Saville's data presented in Table C-4 of Technical Memorandum No. 37 (see page 9 of This Appendix). Assuming a normal distribution (see pages 10 and 11), the normal storm wave was found to be 4.2 feet with a wave period of 3.8 seconds.

Depth where normal storm wave breaks:

Assume an average bottom slope of 0.015 and $k_R = 1.0$ *

$H_o = 4.2$ feet ; $H_o' = H_o k_R = (4.2)(1.0) = 4.2$ feet ; $T = 3.8$ seconds

$$\frac{H_o'}{gT^2} = \frac{4.2}{(32.2)(3.8)^2} = 0.0090$$

$$\frac{H_b}{H_o'} = 0.95 \quad \text{(from Fig 7-3 of SPM)}$$

$$H_b = 0.95(H_o') = (0.95)(4.2) = 4.0 \text{ feet}$$

$$\frac{H_b}{gT^2} = \frac{4.0}{(32.2)(3.8)^2} = 0.0086$$

$$\beta = \left(\frac{d_b}{H_b}\right)_{min} = 1.22$$

$$d_{b_{min}} = 1.22 H_b = (1.22)(4.0) = 4.9 \text{ feet}$$

$$\alpha = \left(\frac{d_b}{H_b}\right)_{max} = 1.61$$

$$d_{b_{max}} = 1.61 H_b = (1.61)(4.0) = 6.4 \text{ feet}$$

Therefore, based on a long term average lake level of 570.5, the groins must extend offshore to a lake bottom elevation in the range of 565.6 to 564.1.

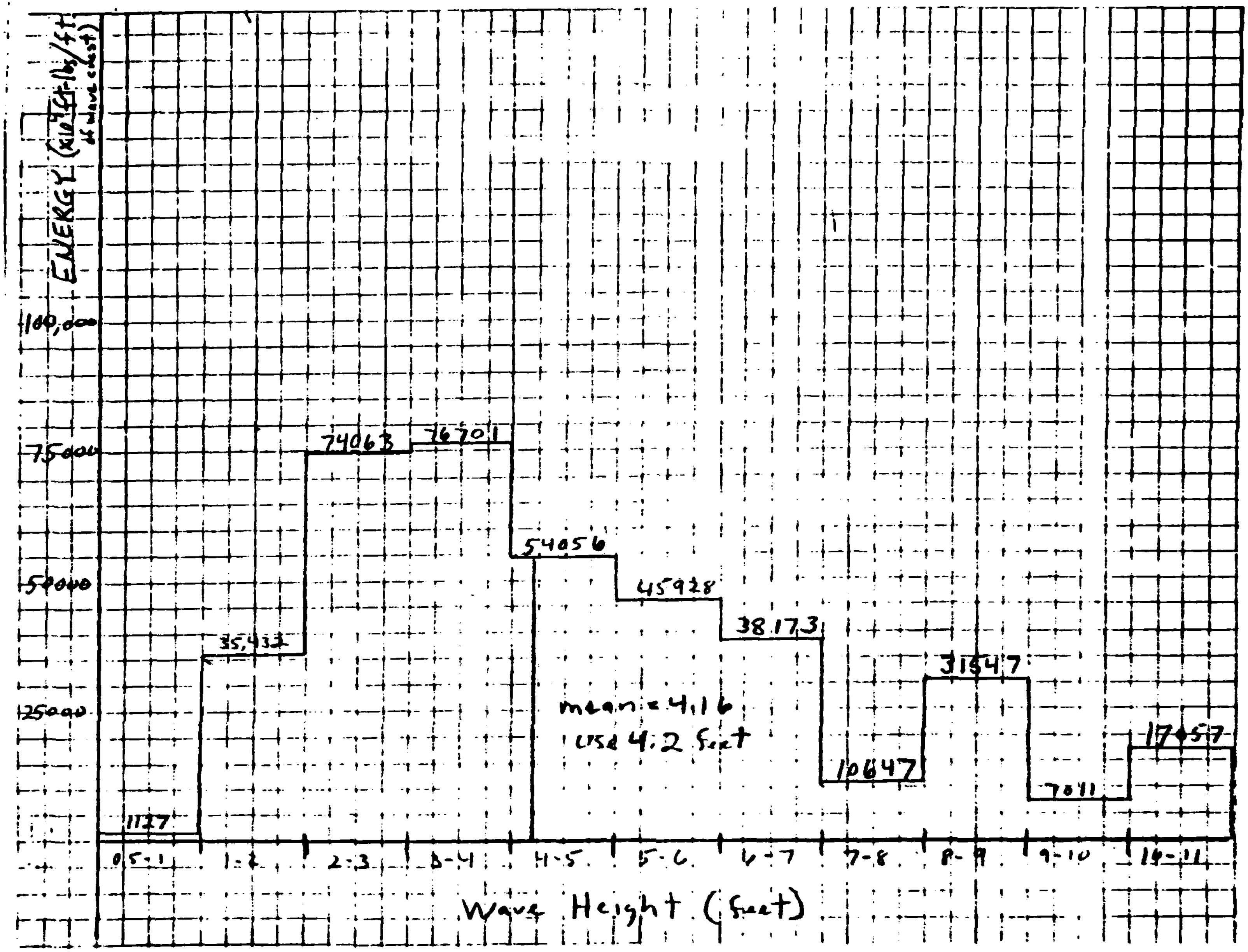
* Surveys and refraction analysis will be done during the Phase II GDM stage

TABLE C-4

STATISTICAL ENERGY DATA FOR LAKE ERIE STATION C, ERIE, PA
ICE-FREE PERIOD (1 APRIL - 30 NOV.)

Energy given in foot-pounds per foot of crest per year x 10^{-6}. Height and period groupings include lower value but not the upper

Height (feet)	Period / Dir.	1-2 Seconds	2-3 Seconds	3-4 Seconds	4-5 Seconds	5-6 Seconds	6-7 Seconds	1-7 Seconds
	WSW	71	40					111
	W	71	40	28				139
	WNW	71	20					91
.5-1	NW	95	40					135
	NNW	83	61					144
	N	59	61					120
	NNE	155	121					276
	NE	71	40					111
	Total	676	423	28				1127
	WSW	44	2162	1243				3449
	W		3,443	1243	146			4832
	WNW	133	2,162	565				2860
	NW	178	4724	226				5128
1-2	NNW	133	5285	452				5870
	N	267	3843	113				4223
	NNE		4724	452				5176
	NE	89	2562	1,243				3894
	Total	844	28905	5,537	146			35,452
	WSW		2,835	937	404			4,176
	W		2,852	7,496	2825			18,173
	WNW		1,745	3,748				5,493
	NW		2,617	12,493				15,110
2-3	NNW		3,708	6,246				9,954
	N		2,617	3,186				5,803
	NNE		3,053	5,622				8,675
	NE		1,745	5,934				7,679
	Total		26,172	44,662	3229			74,063
	WSW		415	4,860	1,578			6,853
	W		1,244	18,833	2,366			22,443
	WNW		1,244	9,113	789			11,146
3-4	NW			2,113				2,113
	NNW		415	6,075				6,490
	N			2,430				2,430
	NNE			13,366				13,366
	NE			4,860				4,860
	Total		3,318	68,650	4,733			76,701
	WSW			1,988	1,299			3,287
	W			6,959	5,196			12,155
	WNW			3,977				3,977
4-5	NW			12,924	3,897			16,821
	NNW			5,965				5,965
	NNE			3,977				3,977
	NE			3,977	3,897			7,874
	Total			39,767	14,289			54,056
	WSW					2379		2,379
	W			1,466	7,727	2,379		11,572
	WNW				5,795			5,795
	NW			1,466	5,795			7,261
5-6	NNW			2,932				2,932
	N			1,466				1,466
	NNE			2,932	1,932			4,864
	NE				2,659			2,659
	Total			10,262	30,908	4,758		45,928
	W			8,003	13,415	6,630		28,108
	WNW			2,016	2,683			4,699
6-7	NW				2,683			2,683
	NE				2,683			2,683
	Total			10,079	21,464	6,630		38,173
	W				3,549			3,549
7-8	WNW				2,549			2,549
	NW				2,549			2,549
	Total				10,647			10,647
	WSW						6,707	6,707
8-9	W				3,048	5,634		14,682
	WNW				4,524	5,634		10,158
	Total				13,572	11,268	6,707	31,547
9-10	W					2,011		2,011
10-11	WSW					12,057		12,057
TOTAL		1520	28810	178985	98900	46,224	6,707	391,742



Subject: Presque Isle Peninsula

Computation of Mean Wave Height from Saville (TM No 37, pg C-15)

Computed by RJG 3/79 Checked by TJB Date 11/79

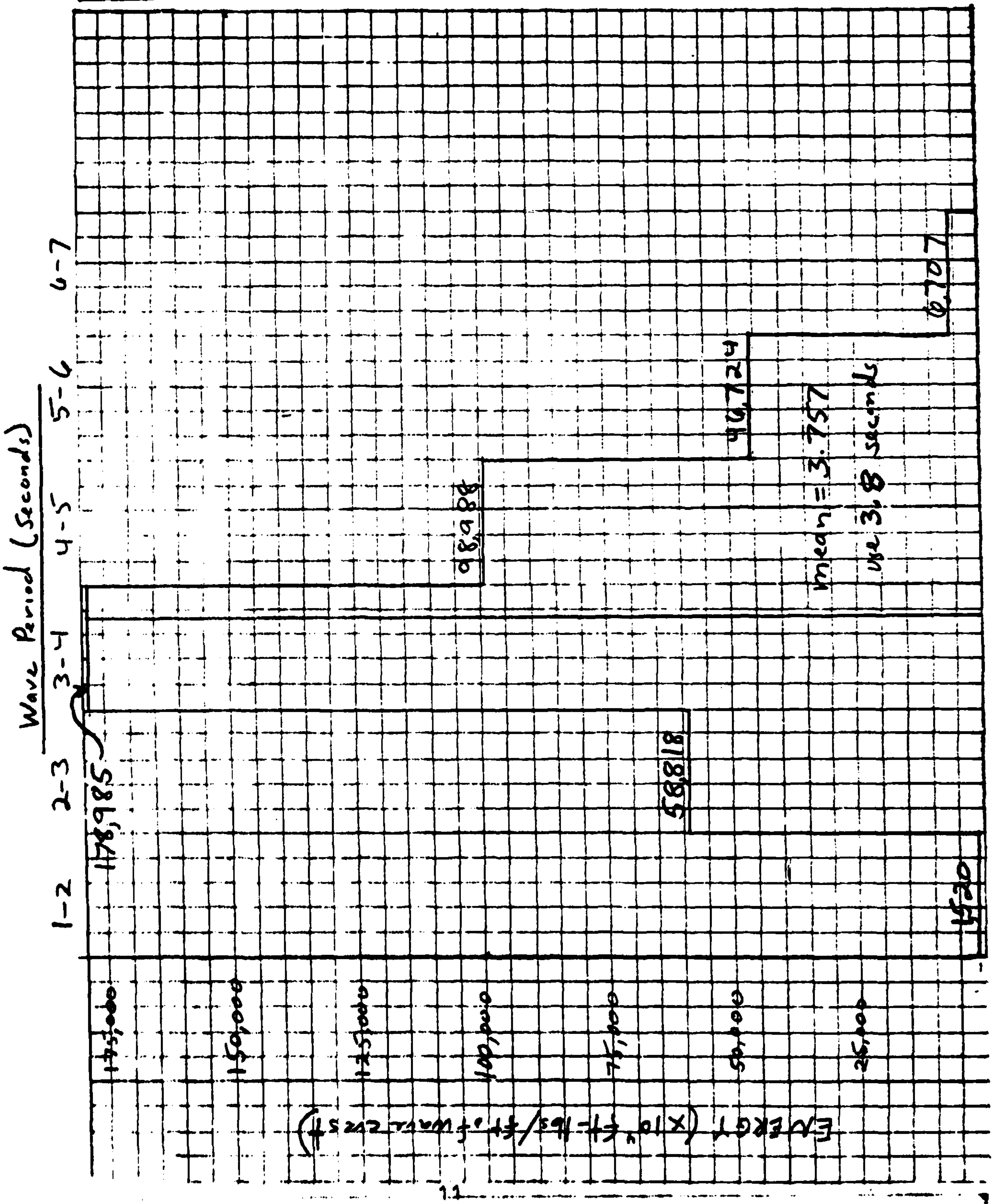
Page __ of __ pages.

Page ___ of ___ pages.

Subject *Presque Isle Peninsula*

Computation of *Mean wave Period from Saville (TM No. 37; pg C-15)*

Computed by *RJG 3/79* Checked by *TJR* Date *12/79*



the piling along the outer end of the groin, and placement of 1.0 to 2.5 ton armor stone along the remaining 200 feet of the groin. In addition, 10 new 300-foot long groins will be constructed in the existing groin field to reduce spacing from the existing 1,000 feet to 500 feet. Easterly of the groin field along the neck, the groin alternative will consist of construction of 27 new 300-foot long groins at a 700-foot spacing and modification of the lighthouse groin. The groin alternative will also require an initial beach replenishment of approximately 850,000 cubic yards of sandfill to fill the groin system to its entrapment capacity in order to provide a beach which has a width of 60 feet and crest elevation of +10 feet above low water datum. The sandfill will be distributed along about 30,000 feet of peninsula shoreline. In addition to this initial beach replenishment, an annual nourishment of about 130,700 cubic yards of sand would be required to offset losses from the beaches. This annual nourishment rate is based on the assumption that the groins will be 50 percent effective in reducing the rate of longshore transport which is presently estimated at 289,100 cubic yards annually and includes 40,000 cubic yards which move to the peninsula from the west. This transport volume is consistent with the past 5-year nourishment experience at Presque Isle. Offshore losses are estimated to be 20 percent of the annual nourishment rate or 26,100 cubic yards. Approximately 42,450 cubic yards of sand will cause peninsula growth at the distal end. The calculations for the groin alternative are presented on pages 13 through 22 of this Appendix. The plan for the groin alternative is shown on Plate 15 and the details of the groins on Plate 16, both of which are included in Appendix A.

b. Offshore Breakwater Alternatives

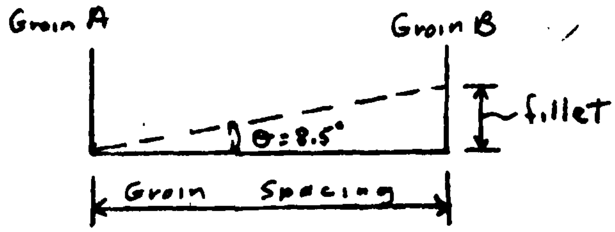
(1) General - An offshore breakwater is a structure designed to protect the area located behind it from wave action. Offshore breakwaters, which are used as shore protection structures, will serve as wave attenuators and as a trap for littoral drift. They are one of the most effective means of intercepting the movement of littoral material. Because longshore transport is the direct result of wave action, the extent to which the offshore breakwater intercepts the movement of littoral drift is directly proportional to the extent of wave attenuation by the breakwater. An offshore breakwaters initially causes sand to be deposited on the shore in its lee by dissipating the wave energy responsible for transport. As the sand is deposited, a shore salient is formed in the still water behind the breakwater. This projecting shore alignment acts as a groin which causes the updrift shoreline to advance. As this projection enlarges and the zone of littoral transport moves closer to the breakwater, the salient becomes increasingly efficient as a littoral barrier. If the breakwater is of sufficient length and height, in relation to its distance from the shore, to act as a complete littoral barrier, the sand deposition may continue until a tombolo is formed with the breakwater at its point of culmination.

(2) Existing Breakwaters - There are presently six breakwaters constructed offshore from Presque Isle Peninsula for the purpose of serving as wave attenuators and beach builders. Three segmented breakwaters constructed with grout-filled nylon bags were built by the Commonwealth of Pennsylvania at Sunset Point in 1973 (see Plate 5 in Appendix A and Photo No. 17 in Section B of the Main Report). These structures are 210-feet long,

COMPUTATION SHEET	DATE March 1979	PAGE OF	FILE NUMBER
NAME OF OFFICE NCBED-DC		COMPUTATION Groin Length-Horizontal Shore Section	
SUBJECT Presque Isle Peninsula			
COMPUTED BY RJG	CHECKED BY TJB	APPROVED BY	

Length of horizontal shore section:

The method outlined in Section 5.665 of SPM will be used to design the horizontal shore section. Experience at Presque Isle has shown that the orientation of the impounded fillet between groins has an average angle of approximately 8.5°. It is assumed that this 8.5° angle will be representative of the typical natural orientation of the beach. The minimum beach width desired updrift of the groin is 60 feet. Therefore, the length of the horizontal shore section can be determined as follows:



$$\tan\theta = \text{Fillet}/\text{Groin Spacing}$$

$$\text{Fillet} = \text{Groin Spacing} \cdot \tan\theta$$

for groin spacing = 500 feet

$$\text{Fillet} = (500\text{ ft})(\tan\theta) = (500)(0.15) = 75\text{ feet}$$

for groin spacing = 700 feet

$$\text{Fillet} = (700\text{ ft})(\tan\theta) = (700)(0.15) = 105\text{ feet}$$

Length of horizontal shore section = Fillet + minimum beach width

$\therefore L = 75\text{ ft} + 60\text{ ft} = 135\text{ feet}$ for 500 ft spacings

$L = 105\text{ ft} + 60\text{ ft} = 165\text{ feet}$ for 700 ft spacings

The height of the horizontal shore section will be equivalent to the height of the existing beach berm which is +10.0 feet above low water datum. Experience with past replenishment projects at Presque Isle have shown that a berm height of 10 feet will limit overtopping.

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SUBJECT PRESQUE ISLE		SOURCE DATA	
COMPUTED BY TJB	CHECKED BY RJG	APPROVED BY	

STONE DESIGN

The outer section of the groin will extend to the zone of the normal breaking waves. The limit where the minimum water depth in which normal storm waves will break was found to be at a lake bottom elevation of 565.6. Therefore the stone for the outer section of the groin will be designed using the maximum wave which can occur.

a) Determine H_{max} for the head section using the most recent draft of the Coastal Engineering Technical Aid entitled "Estimating Nearshore Conditions for Irregular Waves", dated 9 July 1979.

$H_o = 12.8$ ft. - maximum deepwater significant wave from the west (see Table C-3)

slope = 0.015

T = 9.0 secs.

$L_o = 5.12 T^2 = 5.12(9.0)^2 = 414.72$ ft.

d = design lake level - 565.6 = 575.5 - 565.6 = 9.9 ft.

$K_R = .85$ - from refraction analysis

$H_o' = H_o K_R$

$H_o' = (12.8)(.85) = 10.88$ ft.

$d_B / H_o' = 9.9/10.88 = 0.91$

COMPUTATION SHEET	DATE OCTOBER 79	PAGE OF	FILE NUMBER 2
NAME OF OFFICE NCBED-DC		COMPUTATION STONE DESIGN FOR GROINS	
SUBJECT PRESQUE ISLE		SOURCE DATA	
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$H_o'/L_o = \frac{10.88}{415.0} = 0.026$

$\frac{H_{MAX}}{H_o'} = 0.78$ - from curves in Coastal Engineering Technical Aid

$H_{MAX} = (0.78)(H_o') = (0.78)(10.88) = 8.5$ ft. ∴ Use 8.5 ft. breaking wave

b.) Armor Layer Stone Weight (Head Section)

$W = \frac{(w_r) H^3}{K_\Delta (S_r - 1)^3 \cot\theta}$

Where $w_r = 155$ lb/ft.^{3}
$K_\Delta = 2.9$
$S_r = \frac{155}{62.4} = 2.48$
$\cot\theta = 1.5$

$W = \frac{(155)(8.5)^3}{(2.9)(2.48-1)^3(1.5)}$

$W = 6750$ lbs.

$W_{MAX} = 2.0\,W = (2.0)(6750) = 13,500$ lbs $= 6.75$ tons
$W_{MIN} = 0.9\,W = (0.9)(6750) = 6075$ lbs $= 3.04$ tons

∴ Use 3.0 tons to 7.0 tons

1) Thickness of Armor Layer

$r = n k_\Delta \left(\frac{W}{w_r}\right)^{1/3}$

Where $n = 2$
$k_\Delta = 1.15$
$w_r = 155$ lb/ft.^{3}
$W = 6750$ lbs.

COMPUTATION SHEET	DATE OCTOBER 79	PAGE OF	FILE NUMBER 2
NAME OF OFFICE NCBED-DC	COMPUTATION Stone Design for Groins		
SUBJECT PRESQUE ISLE	SOURCE DATA		
COMPUTED BY TJB	CHECKED BY RJG	APPROVED BY	

$$r = (2.0)(1.15)\left(\frac{6750}{155}\right)^{1/3} =$$

$r = 8.09$ ft. $\therefore$ Use $r = 8.1$ ft.

2.) Crest Width of Armor Layer

$$B = n k_\Delta \left(\frac{W}{W_r}\right)^{1/3}$$ Where $n = 3$, $k_\Delta = 1.15$, $W_r = 155$ lb/ft.^{3}, $W = 6750$ lbs

$$B = (3)(1.15)\left(\frac{6750}{155}\right)^{1/3}$$

$B = 12.14$ ft. $\therefore$ Use 13.0 ft.

C.) Protective Pad Stone (Head Section)

$$W_{MAX} = \frac{2.0W}{10} = (0.2)(6750) = 1350 \text{ lbs}$$

$$W_{MIN} = \frac{0.9W}{15} = (0.06)(6750) = 405 \text{ lbs}$$

$\therefore$ Use 400 lbs. to 1400 lbs.

1.) Thickness of Protective Pad

$$r = n k_\Delta \left(\frac{W}{W_r}\right)^{1/3}$$ Where $n = 1$, $k_\Delta = 1.15$, $W_r = 155$ lb/ft.^{3}, $W = \frac{W}{10} = \frac{6750}{10} = 675$ lbs.

COMPUTATION SHEET	DATE OCTOBER 79	PAGE OF	FILE NUMBER 4
NAME OF OFFICE NCBED-DC		COMPUTATION STONE DESIGN FOR GROINS	
SUBJECT PRESQUE ISLE		SOURCE DATA	
COMPUTED BY TJB	CHECKED BY RJG	APPROVED BY	

$r = (1)(1.15)\left(\frac{695}{155}\right)^{1/3} = 1.88$ ft. $\therefore$ Use $r = 2.0$ ft.

d.) Determine H_{max} for the trunk section using the Coastal Engineering Technical Aid entitled "Estimating Nearshore Conditions for Irregular Waves," dated 9 July 1979.

$H_o = 12.8$ ft. – maximum deepwater significant wave height from the west

slope = 0.015

T = 9.0 secs

$L_o = 5.12T^2 = 5.12(9)^2 = 414.72$ ft.

d = avg. water depth for this section under design conditions
use d = 7.0 ft.

$K_R = 0.85$ - from refraction analysis

$H_o' = H_o K_R$

$H_o' = (12.8)(.85) = 10.88$ ft.

$d_s/H_o' = 7.0/10.88 = 0.643$

$H_o'/L_o = 10.88/415.0 = 0.26$

$\frac{H_{max}}{H_o'} = 0.64$ - from curves in Coastal Engineering Technical Aid

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COMPUTATION SHEET	DATE OCTOBER 79	PAGE OF	FILE NUMBER 5
NAME OF OFFICE NCBED-DC		COMPUTATION STONE DESIGN FOR GROINS	
SUBJECT PRESQUE ISLE		SOURCE DATA	
COMPUTED BY TJB	CHECKED BY RJG	APPROVED BY	

$H_{max} = (0.64)(H_o) = (0.64)(10.88) = 6.4$ ft. $\therefore$ Use $H_{max} = 6.4$ ft. breaking wave

e.) Armor Layer Stone (Trunk Section)

$$W = \frac{w_r H^3}{k_D (S_r - 1)^3 \cot\theta}$$

Where
$w_r = 155$ lbs/ft.^{3}
$k_D = 3.5$
$S_r = 2.48$
$\cot\theta = 1.5$
$H = 6.4$ ft

$$W = \frac{(155)(6.4)^3}{3.5(2.48-1)^3(1.5)}$$

$W = 2{,}387$ lbs.

$W_{max} = 2.0\,W = (2.0)(2387) = 4{,}774$ lbs $= 2.38$ tons

$W_{min} = 0.9\,W = (0.9)(2387) = 2{,}148$ lbs. $= 1.07$ tons

$\therefore$ Use 1.0 ton to 2.5 ton

1) Thickness of Armor Layer

$$r = n k_\Delta \left(\frac{W}{w_r}\right)^{1/3}$$

where:
$n = 2$
$k_\Delta = 1.15$
$w_r = 155$ lb/ft.^{3}
$W = 2387$

$$r = (2)(1.15)\left(\frac{2387}{155}\right)^{1/3}$$

$r = 5.72$ ft. $\therefore$ Use $r = 6.0$ ft.

COMPUTATION SHEET	DATE OCTOBER 1979	PAGE OF	FILE NUMBER 6

NAME OF OFFICE NCBED-DC	COMPUTATION STONE DESIGN FOR GROINS
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COMPUTED BY TJB	CHECKED BY RJG	APPROVED BY

2.) Crest Width of Armor Layer

$B = nk_\Delta\left(\frac{W}{W_r}\right)^{1/3}$ Where $n = 3$, $k_\Delta = 1.15$, $W = 2387$, $W_r = 155\ Lbs/ft^3$

$B = nk_\Delta\left(\frac{2387}{155}\right)^{1/3}$

$B = 8.58$ ft. $\therefore$ Use $B = 9.0$ ft.

f.) Protective Pad Stone (Trunk Section)

$W_{max} = \frac{2.0W}{10} = (0.2)(2,387) = 478$ lbs

$W_{MIN} = \frac{0.9W}{15} = (0.06)(2387) = 143$ lbs

$\therefore$ Use 150 lbs to 500 lbs

1.) Thickness of Protective Pad

$r = nk_\Delta\left(\frac{W}{W_r}\right)^{1/3}$ Where $n = 1$, $k_\Delta = 1.15$, $W_r = 155\ lbs/ft^3$, $W = W/10 = 2387/10 = 238.7$ lbs.

$r = (1)(1.15)\left(\frac{238.7}{155}\right)^{1/3}$

$r = 1.32$ ft. $\therefore$ Use $r = 2.0$ ft.

Note: The protective pad stone is placed immediately on top of the filter cloth and acts only as a pad to prevent rupture of the filter cloth during placement of the armor stone.

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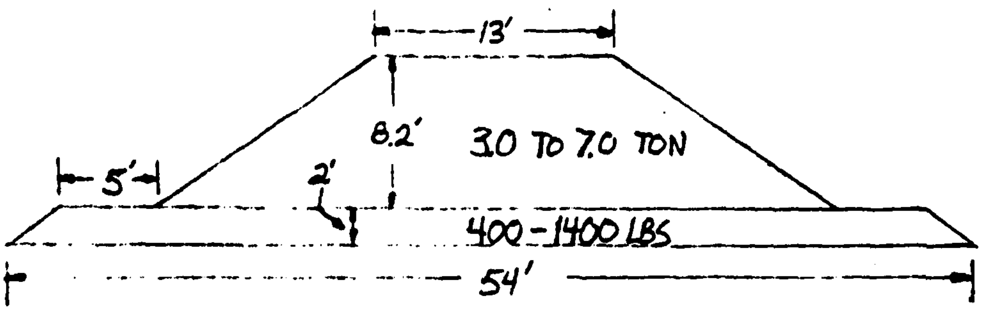
NAME OF OFFICE NCBED-DC	COMPUTATION STONE DESIGN FOR GROINS		
SUBJECT PRESQUE ISLE	SOURCE DATA		
COMPUTED BY TJB	CHECKED BY RJG	APPROVED BY	

9.) L-Shaped Groins

Consideration was given to modifying the groin alternative by the addition of a 50 ft. extension at right angles to the proposed groins. The extensions would extend from the lakeward end of the groins towards the updrift direction in order to be more effective in trapping littoral sediment.

The cross-sectional dimensions and stone sizes of the extensions would be the same as those of the proposed groin head sections. A cross-section and plan view of the extensions are shown below in sketches #1 and #2.



Cross-sectional view

Sketch #1

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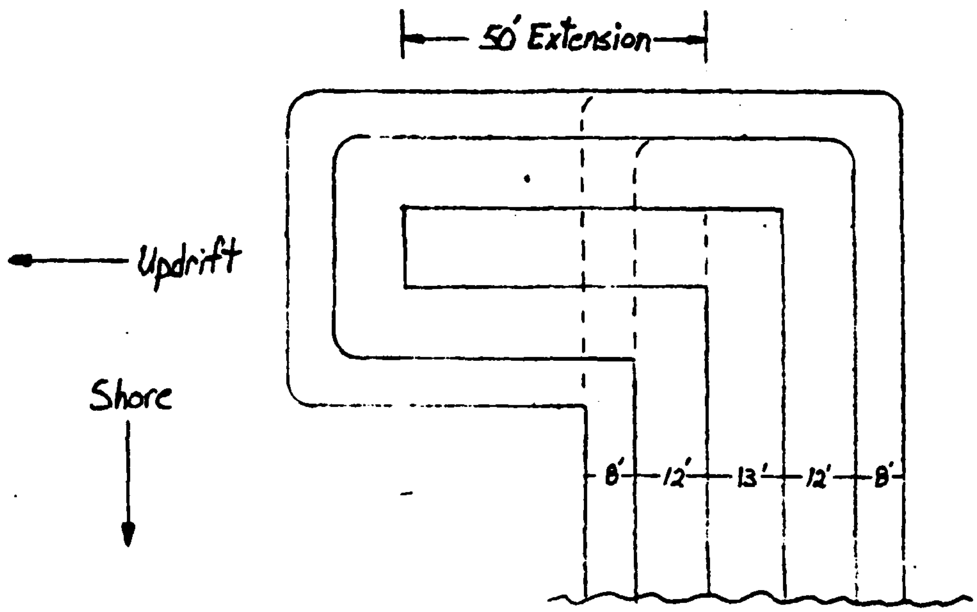
NAME OF OFFICE NCBED-DC		COMPUTATION STONE DESIGN FOR GROINS	
SUBJECT PRESQUE ISLE		SOURCE DATA	
COMPUTED BY TJB	CHECKED BY RJG	APPROVED BY	



Plan View

Sketch #2

It was determined that an additional 38,850 tons of stone would be required to build the L-shaped extensions and thereby increase the cost of the groin alternative by approximately $1,430,000 including all E&D and S&A expenses. It is believed that an additional expenditure of that amount could not be justified due to the fact that this type of modification has had limited success in proving to be more efficient in trapping sediment. As described in section 5.67 - Alignment of Groins, SPM(1977) recession on the downdrift side of "T" and L-shaped groins is not always

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NAME OF OFFICE NCBED - DC		COMPUTATION STONE DESIGN FOR GROINS	
SUBJECT PRESQUE ISLE		SOURCE DATA	
COMPUTED BY TJB	CHECKED BY RJG	APPROVED BY	

reduced but just shifted to a location further downdrift of the groin. Scour is also normally increased due to the additional amount of structure built normal to the direction of wave attack.

Due to these uncertainties and to the lack of sufficient sediment movement along Presque Isle it is believed that the additional cost of modifying the groins would not be justifiable. This modification concept was therefore not studied in any more detail.

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separated by a 40-foot wide gap, have a crest elevation of 574.0, and are positioned 70 to 150 feet offshore. Another series of three breakwaters (see Plate 5 in Appendix A and Photo No. 20 in Section B of the Main Report) is located offshore from Beach No. 10 (commonly called Budny Beach). These breakwaters are of rubblemound construction and were built as part of the beach nourishment program during the Summer of 1978 by the Federal Government in cooperation with the Commonwealth of Pennsylvania. The three rubblemound structures were constructed as an experimental prototype program to obtain data which can be used in analyzing the segmented offshore breakwater alternative for this study. The experimental prototype breakwaters are 125-feet long and separated by a 200-foot and a 300-foot gap. The structures are aligned parallel to the shoreline and positioned with the toe of the structure at elevation 567.6 (1.0 feet below low water datum). The breakwaters are built with 1.5 ton to 3.5 ton armor stone placed on a 3-foot thick layer of bedding stone ranging in size from 5 pounds to 70 pounds. The bedding layer was excavated 2 feet into the lake bottom. The structures have a crest elevation of 574.6 (+6.0 feet above low water datum), a crest width of 9.0 feet, and side slopes of one vertical on two horizontal.

The three grout-filled nylon bag breakwaters at Sunset Point have proven to be ineffective in trapping sand and functioning as a system. Only the westernmost bag breakwater appears to be functioning as a beach builder, whereas apparent settlement of the middle and easternmost bag breakwaters has probably contributed to the ineffectiveness of the nylon bag breakwaters as a system.

Although the prototype breakwaters offshore from Beach No. 10 have been in place for only 2 years, they have proven to be very effective in attenuating waves and functioning as beach builders. During the period from July 1978 through November 1978, the surveying program, which was established to monitor these experimental breakwaters, indicates that approximately 1,000 cubic yards of littoral material have accreted in the lee of the structures over a 4-month period. A third survey under the established monitoring program was completed in April 1979, and the results indicated that about 400 cubic yards of littoral material have accreted in the lee of the structures over the 5-month period from November 1978 through April 1979. A fourth survey was completed in November 1979, and the results indicate that there was a loss of over 3,100 cubic yards of littoral material in the lee of the breakwaters over the 7-month period from April 1979 through November 1979. These results are inconclusive since field observations and aerial photographs obtained during this period indicated that tombolos existed behind the western and center breakwaters and that one had almost formed behind the eastern breakwater; thereby making the November 1979 survey results questionable. A fifth survey was recently completed in April 1980 and may show that the November 1979 survey is erroneous. The results from the April 1980 survey are being compared to the April 1979 and November 1979 surveys, however, the evaluation is not available at this time.

Field inspections were made following a severe storm which occurred on 6 April 1979, when winds gusting to 62 knots drove the water level to elevation 575.9 (+7.3 feet above low water datum) and caused waves, estimated by State Park personnel to be 8 to 10 feet. The field inspections indicated that although there had been major changes along the peninsula shoreline, the experimental breakwaters performed as designed with shore salients now existing in the lee of each of the three breakwaters. Therefore, a design for a segmented breakwater system which will function as a wave attenuator and beach builder will be developed and analyzed based on existing literature and information obtained by observing the experimental prototype breakwaters. Also, a single breakwater, located offshore from Sunset Point, which will function as a trap for littoral material that can then be pumped onto the beaches will be investigated.

(3) Segmented Offshore Breakwater Design - The design of an offshore breakwater system which will function as a wave attenuator and beach builder is dependent upon relationships among breakwater parameters such as crest height, crest width, length, width of the gap between breakwater segments, the distance that the breakwater is located offshore, and the shape and type of structures. These parameters, in addition to wave properties, relate to the development of erosion and accretion patterns behind the offshore breakwaters. To effectively protect the entire lakeward perimeter of Presque Isle Peninsula, a combination of the partial/full breakwater concepts presented in the 1974 Review Report would be required. 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). Therefore, the toe of the structures would be located at a bottom elevation of approximately 563.6 (5.0 feet below low water datum). The breakwaters are designed using a 20-year recurrence design lake level of elevation 575.5 (+6.9 feet above low water datum) and to be stable against the forces of breaking waves with a height of 9.9 feet as determined using the Coastal Engineering Technical Aid entitled "Estimating Nearshore Conditions for Irregular Waves," dated 9 July 1979. A design side slope of one vertical on two horizontal was selected for the breakwaters and was used on both the lake and land sides of the structure. The rubblemound structures were designed utilizing a three-layer section. The stone size was calculated by application of Hudson's formula. A stability coefficient of 2.5 was selected for breakwaters comprising two layers of angular quarry stone randomly placed and subjected to breaking waves. A stone gradation of 4.0 tons minimum and 10.0 ton maximum was determined to be the stone size required for the outer/armor layer of the breakwaters. The integrity of the rubblemound breakwaters is largely dependent upon the stability of the stone placement. To enhance stability and provide support at the bottom of the armor layer, a second layer/underlayer is required. A stone gradation of 500 pounds minimum and 2,000 pounds maximum was determined to be the stone size required for the underlayer of the breakwaters. In addition, a third layer of stone consisting of 2 feet of gravel or crushed stone (5 pounds to 100 pounds) will be placed beneath the breakwaters to prevent the sand from leaching through the structures causing them to become unstable and/or settle. Since the breakwaters would be located in shallow water, the underlayer and bedding layer will be subjected to severe wave action. In order to protect these layers from wave scour, a single layer of armor stone will be placed over the toe of the structures.

One of the factors which determine the effectiveness of an offshore breakwater as a sand trap is its height in relation to the wave action at the site. The breakwaters will be positioned approximately 400 feet offshore where the bottom elevation is at 563.6 and with an armor stone layer about 9.0-feet thick placed on a 4.2-foot underlayer and a 2.0-foot bedding stone layer will yield a crest elevation of 578.8 or 10.2 feet above low water datum. It is believed that a structure with a crest elevation of 578.2 will be effective as a wave attenuator and beach builder and will be low enough in order not to interrupt the view of the horizon. The crest width of the breakwaters was designed in accordance with the method presented in the Shore Protection Manual and was determined to be 13.5 feet. The length of each breakwater will be 150 feet and separated by a 350-foot gap between structures. The length and gap width dimensions were selected after observing the functional operation of the experimental prototype breakwaters which were constructed at Beach No. 10 in 1978 for the purpose of obtaining information and data which could be used in analyzing this alternative. Photographs C-1 through C-8 depict the development of beach salients in the lee of the breakwaters from May 1978 through April 1980. Field inspections in the Summer of 1979 identified three discrete salients behind the breakwaters. Since the sand fill which was placed behind the breakwaters has been only slightly redistributed by the wave energy entering through the gaps, it is felt that a wider gap can be incorporated and still be effective in "holding" a beach while allowing swimming between the breakwaters. Therefore, a 350-foot gap is proposed instead of the 200- or 300-foot gaps used with the prototype structures. Because the proposed breakwaters will be positioned further offshore than the prototype structures, the length of the breakwaters was increased from 125 feet to 150 feet. Based on the breakwater parameters presented above, a total of 58 breakwaters would be required to protect the entire lake shore perimeter of the peninsula. If the segmented breakwater alternative is selected as the recommended plan, a model study will be undertaken to verify or increase the size of the gaps and length of the structures.

The segmented breakwater alternative will require an initial beach replenishment of approximately 500,000 cubic yards of sandfill distributed along the shoreline in the lee of the breakwaters to provide a beach with a width of 60 feet and crest elevation of +10 feet above low water datum. In addition to this initial beach replenishment, an annual nourishment of about 37,900 cubic yards of sand would be required annually to offset losses from the beaches. This annual nourishment rate is based on an assumption that the breakwaters will be 75 percent effective in reducing the rate of longshore transport which is presently estimated at 289,100 cubic yards annually and includes 40,000 cubic yards which move to the peninsula from the west. Offshore losses are estimated to be 15 percent of the annual nourishment rate or 5,700 cubic yards. Approximately 21,200 cubic yards of sand will cause peninsula growth at the distal end. The calculations for the segmented breakwater alternative are presented on pages 26 through 29 of this Appendix. The plan and detailed section of the segmented breakwater alternative is shown on Plate 17 in Appendix A.

(4) Sand Trap Breakwater Design - One of the factors which determine the effectiveness of an offshore breakwater as a sand trap is its crest

COMPUTATION SHEET	DATE OCTOBER 1979	PAGE OF	FILE NUMBER 1
NAME OF OFFICE NCBED-DC		COMPUTATION STONE DESIGN FOR SEGMENTED BREAKWATERS	
SUBJECT PRESQUE ISLE		SOURCE DATA	
COMPUTED BY TJB	CHECKED BY RJG	APPROVED BY	

STONE DESIGN

a) Determine H_{max} using the Coastal Engineering Technical Aid "Estimating Nearshore Conditions for Irregular Waves" dated 9 July 1979.

$H_o = 12.8$ ft = maximum deepwater significant wave from the west (see Table C-3)

slope = 0.015

T = 9.0 secs.

$L_o = 5.12\,T^2 = 5.12(9.0)^2 = 414.72$ ft.

d = design lake level − 563.6 = 575.5 − 563.6 = 11.9 ft.

$K_R = 0.86$ - from refraction analysis

$H_o' = H_o K_R$

$H_o' = (12.8)(0.86) = 11.0$ ft.

$$\frac{H_o'}{L_o} = \frac{11.0}{415} = 0.026$$

$$\frac{d_s}{H_o'} = \frac{11.9}{415} = 1.08$$

$\frac{H_{MAX}}{H_o'} = 0.90$ from curves in Coastal Engineering Technical Aid

$H_{MAX} = 0.90(11.80) = 9.90$ ft.

∴ use 9.90 ft. breaking wave.

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PHOTO C-1

Beach No. 10 area on 19 May 1978 prior to construction of three experimental prototype breakwaters and placement of sand fill.

PHOTO C-2

Beach No. 10 area on 12 July 1978 immediately after construction of three experimental prototype breakwaters and placement of 70,000 tons of sand fill.

PHOTO C-3

Beach No. 10 area on 2 September 1978

PHOTO C-4

Beach No. 10 area on 9 November 1978

PHOTO C-5

Beach No. 10 area on 18 April 1979.

PHOTO C-6

Beach No. 10 area on 16 July 1979

PHOTO C-7

Beach No. 10 area on 16 November 1979

PHOTO C-8

Beach No. 10 area on 17 April 1980

COMPUTATION SHEET	DATE OCTOBER 79	PAGE OF	FILE NUMBER 2
NAME OF OFFICE NCBED- DC	COMPUTATION STONE DESIGN FOR SEGMENTED BREAKWATERS		
SUBJECT PRESQUE ISLE	SOURCE DATA		
COMPUTED BY TJB	CHECKED BY RJG	APPROVED BY	

b.) Armor Layer Stone Weight

$$W = \frac{w_r H^3}{K_d (S_r - 1)^3 \cot\theta}$$

Where $W_r = 155$ lb/ft³
$K_d = 2.5$
$S_r = \frac{155}{62.4} = 2.48$
$\cot\theta = 2.0$
$H = 9.9$

$$W = \frac{(155)(9.9)^3}{(2.5)(2.48-1)^3(2.0)}$$

W = 9,279 lbs.

$W_{MAX} = 2.0\,W = (2)(9,279) = 18,558$ lbs = 9.28 tons

$W_{MIN} = 0.9\,W = (.9)(9279) = 8351$ lbs = 4.18 tons

∴ Use 4.0 ton to 10.0 ton armor stone

1.) Thickness of Armor Layer

$$r = n k_\Delta \left(\frac{W}{W_r}\right)^{1/3}$$

Where $n = 2$
$k_\Delta = 1.15$
$W = 9,279$ lbs.
$W_r = 155$ lbs/ft³

$$r = (2)(1.15)\left(\frac{9,279}{155}\right)^{1/3}$$

r = 9.0 ft. ∴ Use r = 9.0 ft.

2.) Crest width of armor layer

$$B = n k_\Delta \left(\frac{W}{W_r}\right)^{1/3}$$

Where $n = 3$ $W = 9,279$ lbs
$k_\Delta = 1.15$ $W_r = 155$ lbs/ft³

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NAME OF OFFICE NCBED-DC	COMPUTATION STONE DESIGN FOR SEGMENTED BREAKWATERS		
SUBJECT PRESQUE ISLE	SOURCE DATA		
COMPUTED BY TJB	CHECKED BY RJG	APPROVED BY	

$$B = (3)(1.15)\left(\frac{9279}{155}\right)^{1/3}$$

$B = 13.5$ ft. $\therefore$ Use 13.5 ft.

c.) Underlayer Stone Weight

For the most practicle gradation which is compatible with the cover stone gradation use 0.2 W to 0.06 W

$0.2W = 0.2(9{,}279) = 1{,}855.8$ lbs. $= 0.928$ tons

$0.06W = 0.06(9{,}279) = 556.7$ lbs. $= 0.278$ tons

$\therefore$ Use 500 lbs. to 2000 lbs.

1.) Underlayer Thickness

$$r = n k_\Delta \left(\frac{W}{W_r}\right)^{1/3}$$

Where
$n = 2$
$k_\Delta = 1.15$
$w = W/10 = \frac{9279}{10} = 927.9$ lbs.
$W_r = 155$ lbs/ft³

$$r = (2)(1.15)\left(\frac{927.9}{155}\right)^{1/3}$$

$r = 4.17$ ft. $\therefore$ Use $r = 4.2$ ft.

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COMPUTATION SHEET	DATE OCTOBER 79	PAGE OF	FILE NUMBER 4
NAME OF OFFICE NCBED	COMPUTATION STONE DESIGN FOR SEGMENTED BREAKWATERS		
SUBJECT PRESQUE ISLE	SOURCE DATA		
COMPUTED BY TJB	CHECKED BY RJG	APPROVED BY	

d.) Bedding Stone Weight and Layer Thickness

$$W_{MAX} = 0.01W = (0.01)(9279) = 92.79 \text{ lbs.}$$

$$W_{MIN.} = 0.000125W = (0.000125)(9279) = 1.16 \text{ lbs.}$$

$\therefore$ Use 5 lbs. to 100 lbs.

Use a 2.0 ft. thick layer of bedding stone

e.) Toe Protection Stone

The underlayer and bedding layer of the breakwaters will be subject to severe wave action since the breakwaters are located in shallow water. In order to protect these layers from wave scour a single layer of armor stone will be placed over their exposed surfaces.

height in relation to wave action at the site. A structure which completely eliminates wave action in its lee will function as a complete littoral barrier. Therefore, the most efficient type of offshore breakwater is one where the crest height permits no significant overtopping by waves. However, the construction and maintenance cost for high breakwaters are great. Therefore, the breakwater for this alternative will be designed to permit overtopping. The crest elevation for this breakwater will be designed to allow overtopping of the structure by design waves which would regenerate a maximum 3-foot wave in the lee of the structure. This 3-foot transmitted wave limitation would allow a hydraulic dredge to operate behind the breakwater and pump sand onto the beaches along the peninsula under all but the most severe weather conditions.

The sand trap breakwater will be 2,000-feet long, aligned parallel to the peninsula shoreline, and be located about 1,200 feet offshore from Sunset Point at the 10-foot depth contour (based on low water datum). The breakwater is designed using a 20-year recurrence design lake level of elevation 575.5 (+6.9 feet above low water datum) and to be stable against the forces of breaking waves with a height of 13.1 feet as determined using the Coastal Engineering Technical Aid entitled "Estimating Nearshore Conditions for Irregular Waves," dated 9 July 1979. A design side slope of 1.0 vertical on 1.5 horizontal was selected for the breakwater and was used on both the lake and land sides of the structure. The stone sizes were calculated by application of Hudson's formula. A stability coefficient of 2.9 was selected for a breakwater comprising two layers of angular quarry stone randomly placed and subjected to breaking waves. The breakwater will have a protective armor stone outer layer with stones ranging in size from 11.0 tons to 25.0 tons, an underlayer of smaller size stone ranging from 0.75 ton to 2.5 tons, and a core with 3-pound to 250-pound stones. The integrity of the breakwater is largely dependent upon the stability of the stone placement and foundation. Therefore, a 3.5-feet thick layer of core stone will be placed on the lake bottom to prevent the large armor stones from sinking into the bottom and thereby losing their usefulness.

Whether overtopping will occur depends on the height of the crest of the structure relative to wave runup which depends on wave characteristics, structure slope, porosity, and roughness of the cover layer. The wave runup on the sand trap breakwater was determined by using the method in Section 7.2 of the Shore Protection Manual. The wave runup is used in computing the required crest elevation which, when overtopped, will yield a maximum 3-foot transmitted wave in the lee of the structure. The Cross and Sollit Method was used in computing the crest elevation. Computations indicated that a crest height of +15.5 feet above low water datum is required. The crest width of the breakwater was designed in accordance with the method presented in the Shore Protection Manual and was determined to be 19.0 feet. The calculations for the sand trap breakwater are presented on pages 31 through 37 of this Appendix. The detailed section of the sand trap breakwater is shown on Plate 18 in Appendix A.

c. <u>Recirculation Alternatives</u>

(1) <u>General</u> - Littoral material from the west of Presque Isle Peninsula, as well as the sand from the beaches of the peninsula, is moved

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SUBJECT PRESQUE ISLE	SOURCE DATA		
COMPUTED BY TJB	CHECKED BY RJG	APPROVED BY	

STONE DESIGN

a) Determine H_{MAX} using the Coastal Engineering Technical Aid "Estimating Nearshore Conditions for Irregular Waves" dated 9 July 1979

$H_o = 12.8$ ft. – maximum deepwater significant wave height from the west (see Table C-3)

slope = 0.015

T = 9.0 secs

$L_o = 5.12\,T^2 = 5.12(9.0)^2 = 414.72$ ft.

d = design lake level − LWD + 10.0 = 575.5 − 568.6 + 10.0 = 16.9 ft.

$K_R = 0.97$ · from refraction analysis

$H_o' = (H_o)(K_R)$

$H_o' = (12.8)(.97) = 12.42$ ft.

$$\frac{H_o'}{L_o} = \frac{12.42}{415.0} = .030$$

$$\frac{d_s}{H_o'} = \frac{16.9}{12.42} = 1.36$$

$\frac{H_{MAX}}{H_o'} = 1.05$ - from curves in Coastal Engineering Technical Aid

$H_{MAX} = (1.05)(12.42) = 13.04$ ft. ∴ Use a 13.1 ft. breaking wave

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NAME OF OFFICE NCBED - DC	COMPUTATION STONE DESIGN FOR SANDTRAP BW		
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b.) Armor Layer Stone Weight

$$W = \frac{w_r H^3}{K_D (S_r - 1)^3 \cot\theta}$$

Where $w_r = 155$ lb/ft.^{3}
$K_D = 2.9$
$S_r = \frac{155}{62.4} = 2.48$
$\cot\theta = 1.5$
$H = 13.1$ ft.

$$W = \frac{(155)(13.1)^3}{2.9(2.48-1)^3 1.5}$$

$W = 24{,}710$ lbs

$W_{max} = (2.0)(W) = (2.0)(24{,}710) = 49{,}420$ lbs $= 24.7$ tons

$W_{min} = (0.9)W = (0.9)(24{,}710) = 22{,}239$ lbs. $= 11.12$ tons

$\therefore$ Use 11.0 tons to 25.0 tons

1.) Thickness of Armor Layer

$$r = n k_\Delta \left(\frac{W}{W_r}\right)^{1/3}$$

Where $n = 2$
$k_\Delta = 1.15$
$W = 24{,}710$
$W_r = 155$

$$r = (2)(1.15)\left(\frac{24{,}710}{155}\right)^{1/3}$$

$r = 12.47$ ft. $\therefore$ Use $r = 12.5$ ft.

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SUBJECT PRESQUE ISLE		SOURCE DATA	
COMPUTED BY TJB	CHECKED BY RJG	APPROVED BY	

2) Crest Width of Armor Layer

$$B = n k_\Delta \left(\frac{W}{W_r}\right)^{1/3} \quad \text{Where} \quad n = 3,\ K_\Delta = 1.15,\ W = 24{,}710,\ W_r = 155 \text{ lbs/ft}^3$$

$$B = (3)(1.15)\left(\frac{24{,}710}{155}\right)^{1/3}$$

$$B = 18.71 \text{ ft.} \quad \therefore \text{Use } B = 19.0 \text{ ft.}$$

C.) Underlayer Stone Weight

$$W_{MAX} = (0.2)(W) = (0.2)(24{,}710) = 4942 \text{ lbs} = 2.47 \text{ tons}$$

$$W_{MIN} = (0.06)(W) = (0.06)(24{,}710) = 1483 \text{ lbs} = 0.74 \text{ tons}$$

$\therefore$ Use 0.75 ton to 2.5 tons

1.) Thickness of Underlayer Stone

$$r = n k_\Delta \left(\frac{W}{W_r}\right)^{1/3} \quad \text{Where} \quad n = 2,\ k_\Delta = 1.15,\ W = \frac{W}{10} = \frac{24710}{10} = 2471 \text{ lb},\ W_r = 155 \text{ lb/ft}^3$$

$$r = (2)(1.15)\left(\frac{2471}{155}\right)^{1/3}$$

$$r = 5.79 \text{ ft.} \quad \therefore \text{use } 5.8 \text{ ft.}$$

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NAME OF OFFICE N[illegible] - DC		COMPUTATION STONE DESIGN FOR SA[illegible]TRAP [illegible]	
SUBJECT PRESQUE ISLE		SOURCE DATA	
COMPUTED BY TJB	CHECKED BY RJG	APPROVED BY	

d.) Core and Bedding Stone Weight and Layer Thickness

$W_{max} = 0.01W = (0.01)(24,710) = 247$ lbs

$W_{min} = 0.000125W = (0.000125)(24,710) = 3.09$ lbs

∴ Use 3.0 lbs to 250 lbs.

Use a 3.5 ft. thick layer of bedding stone

WAVE RUNUP

$H_o' = (H_o)(K_R) = (12.8)(0.97)$

$H_o' = 12.42$ ft.

$T = 9.0$ secs

$L_o = 5.12(T^2) = 5.12(9.0)^2 = 415.0$ ft.

$H_i = H_{max} = 13.1$ ft.

$d = 575.5 - 568.6 + 10.0 = 16.9$ ft.

$H_o'/gT^2 = \frac{12.42}{(32.2)(9.0)^2} = 0.0048$

$d/H_o' = 16.9/12.42 = 1.36$

From Fig. 7-10 SPM $d/H_o' = 0.80$, $R/H_o' = 2.41$

$d/H_o' = 1.36$, $R/H_o' = 2.77$ (interpolated)

From Fig. 7-11 SPM $d/H_o' = 2.0$ $R/H_o' = 2.60$

COMPUTATION SHEET	DATE OCTOBER 79	PAGE OF	FILE NUMBER
NAME OF OFFICE [illegible]	COMPUTATION WAVE RUNUP ON [illegible]		
SUBJECT PRESQUE ISLE	SOURCE DATA		
COMPUTED BY TJB	CHECKED BY RJC	APPROVED BY	

$$R = 2.77(H_o') = (2.77)(2.42) = 34.44 \text{ ft.}$$

$$k = 1.206 \text{ Fig. 7-13 SPM}$$

$$R_{SMOOTH} = (34.44)(1.206) = 41.53 \text{ ft.}$$

$$R/H'_{o\,SMOOTH} = 2.77$$

$$R/H'_{o\,RIPRAP} = 1.22$$

$$\frac{R/H'_{o\,RIPRAP}}{R/H'_{o\,SMOOTH}} = \frac{1.22}{2.77} = 0.44$$

$$R_{RIPRAP} = (0.44)(R_{SMOOTH}) = (0.44)(41.53) = 18.27 \text{ ft.}$$

This runup is overestimated due to the fact that Figs. 7-8 through 7-12 and 7-14 through 7-18 are from tests with a 1:10 slope, whereas, the actual beach slope at Presque Isle is approximately 1:100. Therefore, to remedy the discrepancy, we use Goda's charts to calculate the wave heights at the toe depth for the 1:10 slope and for the 1:100 slope. The runup from the SPM charts can be reduced by the ratio of the two waveheights (see NCDED-C 22 August 1978 Guidance for Calculating Decay of Significant Wave Heights in the Surf Zone).

COMPUTATION SHEET	DATE [illegible]	PAGE OF	FILE NUMBER
NAME OF OFFICE NCBED-DC	COMPUTATION CREST HEIGHT OF [illegible] B		
SUBJECT PRESQUE ISLE	SOURCE DATA		
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1:10 slope : $d_s/H_o' = 1.36$, $H_o'/L_o = 0.03$ From Goda curves ⇒ $\frac{H_{sig}}{H_o'} = 1.16$

1:100 slope : $d_s/H_o' = 1.36$, $H_o'/L_o = 0.03$ From Goda curves ⇒ $\frac{H_{sig}}{H_o'} = 0.85$

$$\frac{H_{sig}/H_o'\ _{1:100}}{H_{sig}/H_o'\ _{1:10}} = \frac{0.85}{1.16} = 0.74$$

Actual Runup = $(0.74)(18.27) = 13.52$ ft.

WAVE OVERTOPPING AND TRANSMISSION

The Cross and Sollitt Method is used to determine the wave caused by overtopping

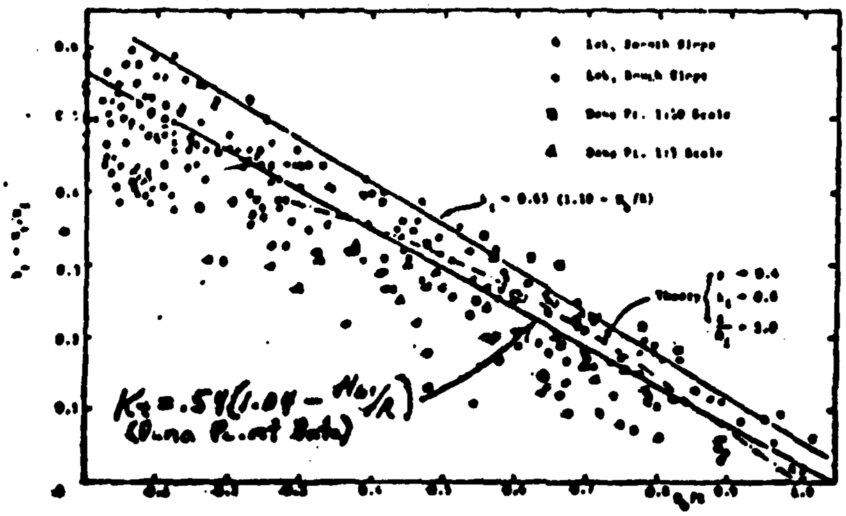

FIG. 7.—? VERSUS H./R. ALL LAB DATA AND DANA POINT MODEL DATA

From Cross & Sollitt

Curve Kt = 0.65 (1.10 - ^{Hb}/R) is too conservative for this project. Therefore, the curve for the Dana Point data was used.

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COMPUTATION SHEET	DATE OCTOBER 79	PAGE OF	FILE NUMBER
NAME OF OFFICE NCBED - DC	COMPUTATION CREST HEIGHT OF SAND TRAP BW		
SUBJECT PRESQUE ISLE	SOURCE DATA		
COMPUTED BY TJB	CHECKED BY RJG	APPROVED BY	

$$K_T = \frac{H_T}{H_i} = 0.54\left(1.04 - H_{bi}/R\right)$$

Solve for breakwater height H_{bi} where the maximum allowable transmitted wave is 3.0 ft.

Therefore:

$$H_{bi} = R\left(1.04 - \frac{H_t}{.54 H_i}\right)$$

$$H_{bi} = (13.52)\left(1.04 - \frac{3.0}{0.54(13.1)}\right)$$

$$H_{bi} = 8.3 \text{ ft.}$$

Crest Height = H_{bi} + SWL = 8.3 + 6.9 = 15.2 ft. ∴ Use 15.5 ft.

Therefore, the Sand Trap Breakwater must have a crest elevation 15.5 ft. above low water datum to limit the maximum transmitted wave in the lee of the structure to 3.0 ft. due to overtopping.

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generally eastward by the predominate easterly drift. As this material moves eastward, some of it moves in the nearshore zone along offshore bars, some of the finer material is lost offshore in deep water, and the bulk of the material is deposited at the distal east end of the peninsula. Therefore, a technically feasible method of beach replenishment is a recirculation system by which sand could be pumped from a borrow area via a pipeline and deposited on the eroded beaches. Two recirculation systems will be developed and described in the following paragraphs.

(2) Sand Recirculation Alternative - As mentioned in the preceding paragraph, the littoral material is moved generally eastward and deposited at the distal east end of Presque Isle Peninsula. A sand recirculation system was developed by which sand from this deposition area could be transferred to various beaches along the peninsula with a pumping system consisting of a permanent pipeline running approximately parallel to the road and a series of permanent booster stations. The sand would be transferred from the borrow area to the pumping system by a hydraulic dredge. A computer program (see page 39) was written to analyze the production time required to pump 260,000 cubic yards of sand annually. The following factors influence the production time:

(a) number of booster pumps;

(b) length of pipeline;

(c) booster efficiency factor which is dependent upon the time schedule as to when work can be accomplished and the number of boosters;

(d) bank factor;

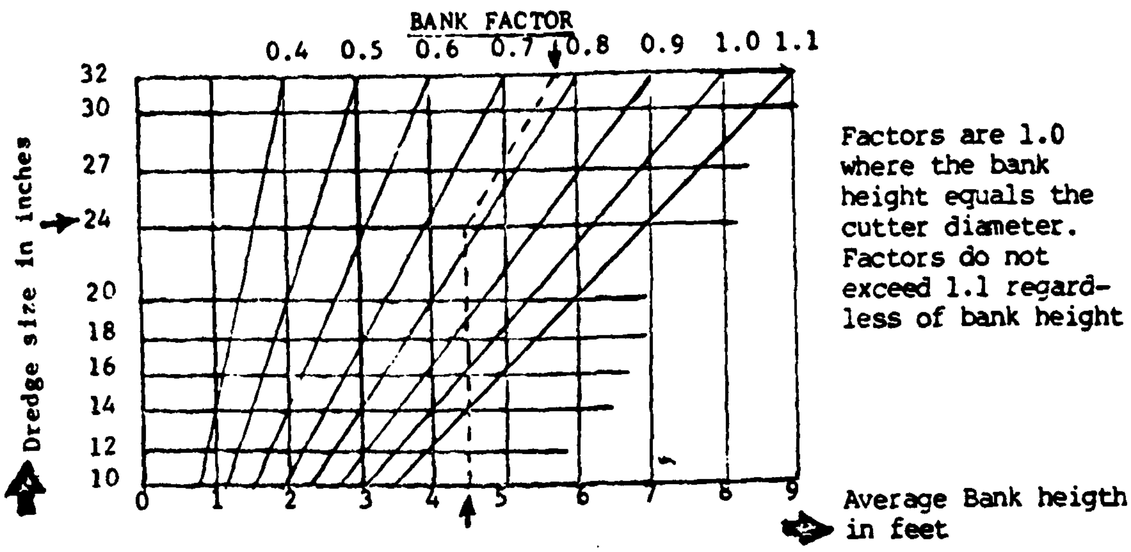
(e) diameter of pipeline; and

(f) distance between boosters.

The number of boosters and diameter of the pipeline were varied to get production times for dredges varying from 14 inches to 24-inch diameter. A pipeline length of about 40,000 feet was used in the analysis and consists of 35,000 feet of permanent pipeline, approximately 3,000 feet of flexible shoreline pipeline, and 2,000 feet of floating pipeline. A booster efficiency factor of 0.8 was used and appears to be conservative when considering there will need to be several changes in the position of the flexible and floating pipeline, as well as the possibility of breakdowns in the booster pumps. The bank factor for various size dredges was obtained from the chart on page C-7 of ER 1110-2-1300 (copy attached as page 40 to this Appendix). The booster interval was assumed to be equivalent to the maximum pumping distance of the dredge and was obtained from the table presented on page C-6 of ER 1110-2-1300 (copy attached as page 41 to this Appendix). The program output for the computer run used to analyze the production time based on the various factors which influence production, as discussed above, is presented in Table C4. After considering the production time in Table C4, the system utilizing the 20-inch diameter pipeline and four boosters was selected. With the 20-inch sand recirculation transfer system, a total of 35 to 40 working

```
      PROGRAM PIPPROD(INPUT,OUTPUT)
      COMMON X1,Y1,X2,Y2
 200  FORMAT(/,5X, *TOTAL HOURS AND DAYS*,/,2X,2F10.2,I7,//)
C
C     THIS PROGRAM CALCULATES THE NUMBER OF WORK DAYS REQUIRED TO
C     PUMP 260,000 CUBIC YARDS OF SANDS ABOUT 40,000 FEET.
C     PROGRAM ASSUMES A PIPELINE DREDGE  BE USED TO ACCOMPLISH
C     THE WORK.
C
  6   CONTINUE
C
      PRINT*,"ENTER-BANK FACTOR, LENGTH1, CY/HR, LEN2, CY/HR",
      READ*,BF,X1,Y1,X2,Y2
      PRINT*, "DISCHARGE INTERVAL, BOOSTER FACTOR, BOOSTER INTERVAL",
      READ*, DI, BBF,DBI
C
      K = 0
      D = DI
      THR = 0.
      CY = 260000.
      BPF = 1.
      CO = CY/(40000./DI)
 1    IF (D . LT . X1) GO TO 2
      IF (D . LT . X2) GO TO 3
      M = IFIX((D-X2)/DBI)
      BPF = BBF**M
      Y = Y2
      GO TO 4
 3    CONTINUE
      CALL V(D,Y)
      GO TO 4
 2    Y = Y1
 4    PROD = BF * Y * BPF
      HR = CO/PROD
      THR = THR + HR
      D = D + DI
      K = K + 1
      IF(D . GT . 40000)GO TO 5
      GO TO 1
 5    CONTINUE
      THR24 = THR/24.
      PRINT 200,THR, THR24, K
      GO TO 6
      END
      SUBROUTINE V(X,Y)
      COMMON X1,Y1,X2,Y2
      AM = (Y2-Y1)/(X2-X1)
      B = Y1 - AM*X1
      Y = AM * X + B
      RETURN
      END
```

(2) Bank Factor. Production in pipeline dredging is controlled either by the ability of the cutter to cut and the pump to transport the material or by the speed with which the dredge advances over the dredging area. The latter is frequently the criterion in shallow banks of easily dredged material. The factors in the following table are suggested to consider the effect of bank height.



EXAMPLE: A 24-inch dredge with an average bank height of 4.5 feet. Projecting from the intersection of these two lines to the factor line at the top of the table would give a bank factor of about 0.78.

(1) Chart Production. Because of the complexity of the effects of pipeline size and length, these parameters cannot be considered in form of a simple multiplication factor. They are, therefore, considered in the following table which lists the average production rate for each size dredge for two critical pipe lengths based on pumping free flowing sand having insitu density of about 2,000 grams/liter and a cutting depth (bank height) equal to the cutter diameter. The pipe length to be used consists of the actual line length increased by "equivalent lengths" for fittings and rise of the discharge end of the piping above the waterline. The appropriate figure is entered in Appendix B and then modified by correction factors.

Hourly production as a function of line length

Dredge Size	Avg. H.P.	Up to this length	CY/HR	At this length	CY/HR
10"	500	2,000	200	4,000	130
12"	800	2,500	270	5,000	180
14"	1,200	3,000	380	6,000	250
16"	1,500	3,500	500	7,000	330
18"	1,800	4,000	650	8,000	420
20"	2,400	4,000	800	8,000	520
24"	4,000	5,000	1,200	10,000	780
27"	5,500	5,500	1,500	11,000	980
30"	7,000	6,000	1,800	12,000	1,170
32"	8,000	6,000	2,100	12,000	1,370

The significance of the two pipe lengths for each size dredge in the foregoing table is explained by the operation of a pipeline dredge. This operation is controlled by two different parameters as the discharge line length increases. For short lines the suction limitation holds the production rate constant. As the line length increases, more power is used until the maximum power is reach. From then on, the power limitation controls the production. That is, longer line lengths can only be achieved by a reduction in effluent velocity (assuming constant density). This continues until the velocity becomes so low that solids start to settle out. From this point on, longer line lengths are generally achieved by adding booster pumps.

Table C4 - Program Output for Production in Pumping Alternatives

ENTER-BANK FACTOR, LENGTH1, CY/HR, LEN2, CY/HR I>.7 ~~[illegible]~~ 5500 1200 10000 780
DISCHARGE INTERVAL, BOOSTER FACTOR, BOOSTER INTERVAL I>1000 .8 10000

24" ø 5 Boosters

TOTAL HOURS AND DAYS
553.67 23.07 40

ENTER-BANK FACTOR, LENGTH1, CY/HR, LEN2, CY/HR I>.8 4000 800 8000 520
DISCHARGE INTERVAL, BOOSTER FACTOR, BOOSTER INTERVAL I>1000 .8 8000

20" ø 4 Boosters

TOTAL HOURS AND DAYS
836.69 34.86 40

ENTER-BANK FACTOR, LENGTH1, CY/HR, LEN2, CY/HR I> .85 4000 650 8000 420
DISCHARGE INTERVAL, BOOSTER FACTOR, BOOSTER INTERVAL I>1000 .8 8000

18" ø 4 Boosters

TOTAL HOURS AND DAYS
974.54 40.61 40

ENTER-BANK FACTOR, LENGTH1, CY/HR, LEN2, CY/HR I>.9 3500 500 7000 330
DISCHARGE INTERVAL, BOOSTER FACTOR, BOOSTER INTERVAL I>1000 .8 7000

16" ø 5 Boosters

TOTAL HOURS AND DAYS
1298.38 54.10 40

ENTER-BANK FACTOR, LENGTH1, CY/HR, LEN2, CY/HR I> 1 3000 380 6000 250
DISCHARGE INTERVAL, BOOSTER FACTOR, BOOSTER INTERVAL I>1000 .8 6000

14" ø 6 Boosters

TOTAL HOURS AND DAYS
1769.81 73.74 40

ENTER-BANK FACTOR, LENGTH1, CY/HR, LEN2, CY/HR I> 1 3000 380 6000 250
DISCHARGE INTERVAL, BOOSTER FACTOR, BOOSTER INTERVAL I>1000 .8 12000

14" ø 3 Boosters

TOTAL HOURS AND DAYS
1241.66 51.74 40

ENTER BANK FACTOR, LENGTH1, CY/HR, LEN2, CY/HR I>1 3000 380 6000 250
DISCHARGE INTERVAL, BOOSTER FACTOR, BOOSTER INTERVAL I>2000 .8 6000

14" ø 4 Boosters

TOTAL HOURS AND DAYS
1829.20 76.22 20

ENTER-BANK FACTOR, LENGTH1, CY/HR, LEN2, CY/HR I>1 3000 380 6000 250
DISCHARGE INTERVAL, BOOSTER FACTOR, BOOSTER INTERVAL I>2000 .8 12000

14" ø 3 Boosters

TOTAL HOURS AND DAYS
1262.32 52.60 20

ENTER-BANK FACTOR, LENGTH1, CY/HR, LEN2, CY/HR I>.85 4000 800 8000 520
DISCHARGE INTERVAL, BOOSTER FACTOR, BOOSTER INTERVAL I>1000 .8 ~~16000~~ 12000

15" ø 2 Boosters - 3 Boosters

TOTAL HOURS AND DAYS
677.12 28.21 40

ENTER-BANK FACTOR, LENGTH1, CY/HR, LEN2, CY/HR I>.85 4000 800 8000 520
DISCHARGE INTERVAL, BOOSTER FACTOR, BOOSTER INTERVAL I>1000 .8 16000

15" ø 2 Boosters

TOTAL HOURS AND DAYS
625.65 26.07 40

days would be required to accomplish the annual replenishment within the 1 April to 20 June time restriction specified by the Commonwealth of Pennsylvania. The boosters would be spaced at 8,000-foot intervals and have a production rate of between 500 and 800 cubic yards per hour.

The sand recirculation alternative will require an initial beach replenishment of approximately 500,000 cubic yards of sand which would be pumped from the borrow area to provide a beach berm with a crest width of 60 feet and crest elevation of +10 feet above low water datum. In addition to this initial beach replenishment, an annual nourishment of about 275,000 cubic yards of sand would be pumped from the borrow area annually to offset losses from the beaches. An annual nourishment of 311,200 cubic yards will balance out the presently estimated longshore transport rate of 289,100 cubic yards which includes 40,000 cubic yards of littoral material which move to the peninsula from the west. The offshore losses are estimated to be 20 percent of the annual nourishment rate or 62,250 cubic yards. With this recirculation alternative, a total of 289,100 cubic yards of sand will accumulate at the distal east end of the peninsula. However, since 311,200 cubic yards of sand are pumped from the east end, the net effect will be an annual loss of 22,100 cubic yards of sand from the distal end. The plan for the sand recirculation alternative is shown on Plate 14 in Appendix A.

(3) Sand Trap Recirculation Alternative - The sand recirculation alternative described in the preceding paragraph will destroy the waterfowl sanctuary that is located at Gull Point. Therefore, if the littoral material that is moving along the peninsula can be trapped before it reaches the distal east end, the destruction of Gull Point could be circumvented. Construction of a sand trap breakwater as designed in paragraph C4.b(4) of this Appendix would allow excavation of a sand trap in its lee from which sand could be pumped onto the beaches via a pumping system. Therefore, a sand recirculation system was developed by which sand from the sand trap would be transferred to various beaches along the peninsula with a pumping system consisting of a permanent pipeline running approximately parallel to the road and a series of permanent booster stations. The sand would be transferred from the sand trap to the pumping system by a hydraulic dredge. Using the same methodology as was used for the sand recirculation alternative in the preceding section, a 20-inch diameter pipeline and a series of three permanent boosters would be required. The pipeline would consist of 29,000 feet of permanent pipeline, 4,000 feet of flexible shoreline pipeline, and 2,000 feet of floating pipeline. The permanent boosters would be spaced at 8,000-foot intervals and have a production rate of between 500 and 800 cubic yards per hour.

The sand trap recirculation alternative will require an initial beach replenishment of approximately 500,000 cubic yards of sandfill. The breakwater would be effective in trapping approximately 260,000 cubic yards annually. Therefore, a sand trap having a 270,000 cubic yard capacity would be excavated in the lee of the breakwater. The sand excavated from the trap would be used in the initial nourishment with the remaining 230,000 cubic yards coming from an outside source. In addition to the initial beach replenishment, an annual nourishment of about 311,200 cubic yards of sand would be required to balance out the presently estimated longshore transport rate of 289,100 cubic yards which includes 40,000 cubic yards of littoral material which move to the peninsula from the west. It is assumed that the breakwater will be about 90 percent effective as a littoral barrier and, therefore, trap about 260,000 cubic yards of the presently estimated 289,100 cubic yards of littoral material which moves annually along the peninsula with the remaining 29,000 cubic yards continuing eastward to Gull Point. The 311,200 cubic yard annual replenishment requirement consists of 227,600 cubic yards of sand being pumped from the trap and distributed on the beaches west of the sand trap, a total of 32,400 cubic yards of sand pumped from the sand trap eastward toward Gull Point, and 83,600 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 61,400 cubic yards of sand would bypass to the distal east end of the peninsula for continued growth and consist of the 29,000 cubic yards naturally bypassing the sand trap and the 32,400 cubic yards pumped from the sand trap. The plan for the sand trap recirculation alternative is shown on Plate 18 in Appendix A.

d. Annual Nourishment Alternative

(1) General - The plan for annual nourishment proposes to replace the natural offshore sand loss and the material which is transported to the east, thus maintaining the existing or desired shoreline. Wave energy causes sand to drift to the east at a rate faster than the natural influx of sand from the west is able to replace it. Consequently, Presque Isle Peninsula migrates to the east and diminishes in size. The intent of the proposed nourishment alternative is to replace the net loss of material and to stabilize the peninsula in its present position while maintaining a recreational beach area. Such an alternative does not reduce the natural drift rate, but rather feeds the littoral currents so that erosion of the existing shoreline is prohibited.

(2) Previous Nourishment - Nourishment has continued periodically since 1955 (see Table C6 in this Appendix). A total of 6,223,900 cubic yards of sand has been added within the past 24 years with about 5 million cubic yards having been placed within the first 10 years. This periodic nourishment has maintained the neck and stabilized the replenished sections of shore. Beach 8 and Beach 10 have experienced erosion until sand was added to these areas during the last 2 years of the current nourishment program. As a result of the previous nourishment activities, Gull Point has experienced rapid growth, and the dredging volumes in the Erie Harbor entrance channel have increased.

(3) Nourishment Plan - An effective plan of nourishment will need to be maintained on an annual basis. Preliminary sediment budget calculations suggest that 289,100 cubic yards of sand are transported to the distal east end plus entrance channel annually. A natural influx of 40,000 cubic yards of littoral material a year comes from the west. Therefore, to maintain the annual transport of 289,100 cubic yards, the remaining balance of 249,100 cubic yards must come from annual nourishment and must also account for offshore losses. Offshore losses are estimated at 20 percent of the annual nourishment. Consequently, 311,400 cubic yards will be needed annually to maintain the existing shoreline. The required material will be a medium sand conforming to the gradation band which has been used for the 1974 through

1979 replenishment programs (reference Appendix D). Experience obtained during the 1950 and 1960 nourishment programs has shown that a gradation finer than the proposed gradation is susceptible to rapid erosion. Placement of a finer-graded sand would probably require not only a greater volume of annual nourishment but also more frequent replenishment to repair the damage to the shoreline caused by individual storms. The proposed gradation provides a composite of the grain sizes normally distributed throughout the beach profile and especially furnishes the coarse sand and fine gravels needed to maintain the foreshore during storm conditions. Fine-sized sand typically is transported rapidly offshore or into the backshore, but does not contain any components for armoring the foreshore-surf zone.

C5. SEDIMENT BUDGET

In order to fully understand the impacts and replenishment needs with each alternative, it was necessary to develop a sediment budget which describes areas and quantities of sediment loss and gain to the Presque Isle system. Such a budget will be different for each alternative. The two sediment budget extremes were determined to be the Do-Nothing alternative in which the existing structures remain in place but there is no sand replenishment, and secondly, the present condition which involves annual replenishment at a rate sufficient to forestall erosion of the peninsula. With the Do-Nothing alternative, the only source of sand will be that which naturally enters the system from the west and erosion of the peninsula itself. This is considered the minimum sediment transport budget model. The present condition prevents or significantly limits erosion of the peninsula through the application of an average annual replenishment of 259,300 cubic yards of sand. This is considered as the maximum sediment transport budget model. As each of the three structure alternative plans would require the application of enough beach fill to prevent erosion of the peninsula, the maximum sediment transport budget model would be used to evaluate the sediment budget for each alternative.

The philosophy behind the identification of the various gain and loss factors in the sediment budget is discussed in detail in the paragraph entitled Sediment Budget of the Presque Isle System in Section B of the Main Report. The following paragraphs and computations develop the assumptions and criteria used to compute the quantities for each significant sediment budget factor.

a. Gains

(1) Influx from the West - As Presque Isle migrates toward the east, new material is added only from the west. Any input from the east is blocked by the Erie Harbor entrance structures. The Presque Isle system is continually losing material as it migrates, building a new platform and leaving its old platform behind. The purpose of this section is to determine the natural littoral sediment load supplied to Presque Isle from the west. The littoral influx from the west is assumed to be totally derived from bluff recession. The streams flow through steep-walled bedrock gorges and have drowned lake effect mouths. Thus, fluvial input is considered as insignificant. The offshore area is till- or rock-surfaced and contains no evidence

Table C5 - Volume of Bluff Recession West of Presque Isle (after Carter, 1977)

State	Reach location	Stretch length (ft)	Recession rate[1]*	Deposit, thickness (ft)[2]	Volume of Annual Bluff Recession (yd³/yr)**
Pennsylvania	Lakeside Cemetery, Erie, to Elk Creek	3,200	very slow	till, 45	Presque Isle Bay
		14,400		protected	
		13,050	very slow	till, 75	
		11,950	slow		66,390
	Walnut Creek	3,600		floodplain	0
		3,450	very slow	till, 60	3830
		750	slow		3330
		2,000	very slow	till, 25	930
		900	very slow	till, 50	830
		1,100	slow		4070
	Trout Run	600		floodplain	0
		5,400	very slow	till, 60	6000
		1,000	very slow	till, 25	460
		1,650	very slow	till, 65	1990
		2,950	slow		14,200
		1,200	very slow	till, 30	670
		3,400	very slow	till, 65	4090
		5,000	slow		24,070
		2,400	very slow	till, 100	4,440
		5,000	slow		37,040
		600	moderate		8,890
	Elk Creek	2,400		floodplain	0
	Elk Creek to Pennsylvania-Ohio line	16,100	very slow	till, 65	19,380
		1,900	slow		9150
	Crooked Creek	1,500		floodplain	0
		2,950	very slow	till, 15	820
		4,400	very slow	till, 20	1630
		200	slow		300
		700	very slow	till, 60	780
		3,100	slow		13,780
		700	very slow	till, 15	190
		700	slow		780
		550	very slow	till, 45	460
		1,650	slow		5,500
		1,600	very slow	till, 20	590
		600	slow		890
		4,050	very slow	till, 45	3375
		2,350	slow		7830
OH	Ashtabula County (1876-1973) Pennsylvania-Ohio line to coal docks at Ashtabula River	6,500	very slow	till, 40; glaciolacustrine clay, 5	4810

*Recession Rate Defined as Very Slow = 0.5 ft/yr, Slow = 2.0 ft/yr, Moderate = 4.0 ft/yr

**Volume of Annual Recession in yd^3/yr = (stretch length(ft) X Recession Rate(ft) X Bluff Thickness(ft)) ÷ 27 of an offshore sand source except in the area of Presque Isle's platform. The platform area is generally 20' to 30' below LWD and therefore is considered as below the influence of the active wave base. The bluff recession rates, heights, section lengths, and surficial geology were extracted from (see Table C5):

Carter, Charles H. (1977) Sediment-Load Measurements Along the United States Shore of Lake Erie; Report of Investigations No. 102; State of Ohio, Department of Natural Resources, 24 p.

The bluff area from Conneaut, OH to the neck of Presque Isle is generally uninterrupted and is considered as a closed section of shore with Presque Isle as the eventual site of deposition for any littoral input. The numerous groins and small creeks, including Elk Creek and Walnut Creek, act as temporary sites of deposition which allow bypassing and promote offshore losses. Table C5 presents the volume of material eroded annually from the bluffs west of Presque Isle. Offshore losses are assumed to be 20 percent of the littoral load. The sand and gravel content of the till bluffs is assumed to be 20 percent based on the work of Carter (1977), Environmental Impact Assessment for the U. S. Steel Plant (1978), and Appendix V and X of the 1952 House Document No. 350. On page 48 of this Appendix, the annual supply of littoral drift from bluff recession is computed. The value of 40,000 yd^3/yr is interpreted as the quantity of natural littoral gain to Presque Isle from the west.

(2) Artificial Beach Replenishment - The history of beach replenishment activities at Presque Isle is described in the paragraph entitled History of Shore Protection at Presque Isle in Section B of the Main Report. The quantity of sand placed per period is listed and totaled in Table C6. Although two-thirds of the total material placed at Presque Isle was placed within the first 2 years (1955-1956), the long-term, 24-year average replenishment rate was computed. This approach was taken because the apparent long-term effect of the total replenishment program has been to maintain the integrity of the peninsula and its protective structures in spite of ongoing erosion. The initial large volume of replenishment probably built up the offshore profile and may still be influencing the littoral processes. Thus, the average annual replenishment rate of 259,300 cubic yards per year is assumed to be necessary to feed the maximum drift potential without loss of peninsula size.

The Do-Nothing alternative would involve zero replenishment, whereas the three structural alternatives would require some portion of the present 259,300 cubic yards per year depending on the efficiency of the protection in reducing littoral drift rates.

b. Losses

(1) Gull Point Growth - The migration of Presque Isle is characterized by an accretionary eastern end. Historical records extending back to 1819 document this phenomenon and show a sporadic, irregular, but continuous growth of the distal end which during modern times has been called Gull Point (see the paragraph entitled Migration of Presque Isle in Section B of the Main Report). Historical maps and aerial photographs provide an excellent

COMPUTATION SHEET	DATE MAY 79	PAGE ___ OF ___	FILE NUMBER
NAME OF OFFICE WCBED-DC	COMPUTATION SEDIMENT BUDGET		
SUBJECT PRESQUE ISLE - GDM I	SOURCE DATA GAIN FROM WEST		
COMPUTED BY [signature]	CHECKED BY RJZ	APPROVED BY	

INFLUX OF LITTORAL MATERIAL TO PRESQUE ISLE FROM BLUFF RECESSION TO THE WEST

TOTAL ANNUAL VOLUME OF BLUFF RECESSION = 251,500 YD^3/YR (FROM TABLE C-5)

ASSUME:

20% OF BLUFF MATERIAL IS SAND AND GRAVEL SIZED (POTENTIAL LITTORAL DRIFT)

20% OF LITTORAL DRIFT IS LOST OFFSHORE

251,500 YD^3/YR x 20% = 50,300 YD^3/YR SAND + GRAVEL RELEASED FROM BLUFFS

50,300 YD^3/YR x 20% = 10,060 YD^3/YR LOST OFFSHORE

$$\begin{array}{r} 50{,}300 \\ -\ 10{,}060 \\ \hline 40{,}240 \end{array}$$

40,240 YD^3/YR LITTORAL DRIFT

∴ 40,000 YD^3/YR IS THE ANNUAL SUPPLY OF LITTORAL DRIFT TO THE PRESQUE ISLE SEDIMENT BUDGET FROM THE WEST.

THIS VALUE IS CONSTANT REGARDLESS OF ALTERNATIVE. WORK DONE ON PRESQUE ISLE WILL NOT EFFECT UPDRIFT RECESSION RATES.

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1 APR 63

COMPUTATION SHEET	DATE 1 DEC 79	PAGE OF	FILE NUMBER
NAME OF OFFICE NCBED-DC	COMPUTATION SEDIMENT BUDGET		
SUBJECT PRESQUE ISLE GDM I	SOURCE DATA GAIN FROM — REPLENISHMENT		
COMPUTED BY J Pope	CHECKED BY RJG	APPROVED BY	

TABLE C 6 ARTIFICAL BEACH REPLENISHMENT

PERIOD	RECORD QUANTITY	VOLUME (YD^3)	TOTAL VOLUME
1955 - 1956		4,150,000	4,150,000
1959 - 1960		33,000	4,183,000
1960 - 1961		681,500	4,864,500
1964 - 1965		402,300	5,266,800
1965 - 1966	45,000 TONS*	29,800	5,296,600
1968 - 1969	102,700 TONS	67,900	5,364,500
1971	152,500 TONS	100,900	5,465,400
1973	100,000 TONS	66,100	5,531,500
1975	187,000 TONS	123,700	5,655,200
1976	183,000 TONS	121,000	5,776,200
1977	287,000 TONS	189,800	5,966,000
1978	173,000 TONS	114,400	6,080,400
1979	217,000 TONS	143,500	6,223,900

* TONS CONVERTED TO CUBIC YARDS BY (TONS/1.512 = YD^3)

AVERAGE ANNUAL NOURISHMENT

24 YEAR, TOTAL NOURISHMENT = 6,223,900 YD^3

AVERAGE = 259,330 YD^3/YR

259,300 YD^3/YR REPRESENTS THE AVERAGE ANNUAL REPLENISHMENT WITH THE PRESENT CONDITION (I.E. THE MAXIMUM SEDIMENT TRANSPORT BUDGET MODEL)

NCD Form 14 8 APR 63 Previous edition may be used until supply is exhausted.

COMPUTATION SHEET	DATE 28 NOV 79	PAGE ___ OF ___	FILE NUMBER
NAME OF OFFICE NCBED-DC	COMPUTATION SEDIMENT BUDGET		
SUBJECT PRESQUE ISLE, PA - GDM I	SOURCE DATA LOSS GROWTH OF GULL POINT		
COMPUTED BY J Pope	CHECKED BY RJG	APPROVED BY	

TABLE C 7

HISTORICAL GROWTH OF GULL POINT, PRESQUE ISLE, PA

PERIOD[1]	WATER LEVEL[2]	No. OF YEARS	SUBAERIAL AREA (A') CHANGE NET (FT²)[3]	VOLUME CHANGE (AREA A' + B') (YD³)[4]		
				NET (YD³)	YEARLY AVERAGE	Σ GROWTH SINCE 1819
1819-1839		20	+ 761,600	+ 885,700	+ 44,300	885,700
1839-1865		26	+ 550,400	+ 640,100	+ 24,600	1,525,800
1865-1873		8	+ 192,000	+ 223,300	+ 27,900	1,749,100
1873-1875		2	+ 595,200	+ 692,200	+ 346,100	2,441,300
1875-1884		9	- 6,400	- 7,400	- 800	2,433,900
1884-1888		4	- 614,400	- 714,500	- 178,600	1,719,400
1888-1894		6	- 691,200	- 803,900	- 134,000	915,500
1894-1896		2	- 121,600	- 141,400	- 70,700	774,100
1896-1898		2	+ 70,400	+ 81,900	+ 40,900	856,000
1898-1907		9	+ 1,056,000	+ 1,228,100	+ 136,500	2,084,100
1907-1929		22	+ 275,200	+ 320,100	+ 14,500	2,404,200
1929-1937		8	+ 710,400	+ 826,200	+ 103,300	3,230,400
1937-1939	+1.8	2	+ 537,600	+ 625,200	+ 312,600	3,855,600
1939-1948	+1.8 - +3.5	9	- 425,000	- 494,300	- 54,900	3,361,300
1948-1950	+3.5 - +2.5	2	+ 397,500	+ 462,300	+ 231,100	3,823,600
1950-1959	+2.5 - +1.7	9	+ 907,500	+ 1,055,400	+ 117,300	4,879,000
1959-1968	+1.7 - +1.9	9	+ 875,000	+ 1,017,600	+ 113,100	5,896,600
1968-1972	+1.9 - +3.9	4	- 297,500	- 346,000	- 86,500	5,550,600
1972-1976	+3.9 - +4.2	4	- 70,000	- 81,400	- 20,400	5,469,200
1976-1978	+4.2 - +2.3	2	+ 630,000	+ 732,700	+ 366,300	6,201,900

1 HISTORICAL MAPS USED FOR 1819 THROUGH 1937. AERIAL PHOTOGRAPHS USED FOR 1939 THROUGH 1978.

2 HISTORICAL MAPS USED DATUM OF 570.5 ABOVE MSL AND, THEREFORE, ARE CORRECTED. THE LISTED WATER LEVEL FOR THE AERIALS IS THE WATER LEVEL ON THE DAY OF FLIGHT RELATIVE TO LWD. WATER LEVELS GIVEN FOR REFERENCE - NO CORRECTIONS WERE MADE.

3 SUBAERIAL CHANGE IN AREA MEASURED FROM HISTORIAL MAPS AND AERIAL PHOTOGRAPHY REDRAWN USEING ZOOM TRANSFER SCOPE TO A COMMON SCALE.

4 VOLUME CHANGE COMPUTED AS EQUAL TO SUBAERIAL AREA CHANGE (A') TIMES THICKNESS PLUS SUBAQUEOUS AREA (B') CHANGE TIMES THICKNESS. SEE SUPPLEMENTAL PAGES WHICH EXPLAIN VOLUME CALCULATIONS.
NET (YD³) = 1.163A'
YEARLY AVERAGE = 1.163A' ÷ No. of YEARS
Σ GROWTH SINCE 1819 = CUMMULATIVE VALUE FOR NET

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data base from which subaerial growth rates can be directly measured. Unfortunately, bathymetric and topographic data is notably lacking from the historical record.

Table C7 was compiled by redrawing the shoreline of each referenced historical map to a common scale of 1" = 800' and each aerial photograph to a common scale of 1" = 500' using a "Bausch and Lomb Zoom Transfer Scope". The accretionary area difference between subsequent data years was measured in square feet. Occasionally, this difference indicated a loss rather than a gain to the distal end, especially in the 1880's through the 1890's and in the 1970's. Both were periods of sustained high water, which documents the effect of lake levels on Gull Point growth rate.

To convert the subaerial measured area change to a volume change for use in the sediment budget, it was necessary to develop a standard for the thickness of the subaerial platform and a logical relationship for the subaqueous perimeter of Gull Point. Comparison of the various profiles available for Gull Point show a characteristic morphology consisting of a subaerial platform with an average elevation of +7 LWD, a plunge point drop just beyond water's edge to the subaqueous platform which has an average elevation of -2 LWD, and a 1:25 platform slope which drops to the lake bottom at -18 LWD. Sediment samples taken June and July of 1979 indicate that the subaqueous platform and slope is sand out to the -12 LWD contour, where 75 percent of the material is sand, while at the -20 LWD contour, less than 25 percent of the material is sand. Therefore, the littoral limit of the sand deposition zone for Gull Point is here defined as at -18 LWD where the offshore slope flattens. This typified cross section is presented on page 52 of this Appendix. It is assumed that the subaqueous platform growth must keep up with the subaerial growth in order for the accretionary zone to be maintained. It is further assumed that the relationship between the subaerial and subaqueous distal end growth and the elevation relationship presently observed have remained constant for the period of record. These assumptions were applied to develop the logic presented on pages 52 and 53 of this Appendix to develop a numerical relationship between the measured subaerial growth and the total volume growth of the distal end. This relationship was then used to derive the volume change values presented in Table C7.

Figure C9 illustrates the total volume of growth of Gull Point since 1819. A cursory examination of Figure C9 indicates a significant increase in the rate of Gull Point growth in the late 1960's following the initiation of replenishment in 1955. A linear regression analysis was prepared and is presented on page 54 of this Appendix to compare the growth rate before replenishment (1819-1950) to the rate with replenishment (1950-1978) and superimposed on Figure C9. Since replenishment, the slope of the regression line has increased by approximately three (from 25,000 to 72,000), indicating a significant growth rate increase. The average annual growth rate for Gull Point is computed for different periods of time on page 54. The growth rate with the present structures but without replenishment (1875-1950) is 18,400 cubic yards per year and is interpreted to represent the growth rate which would be experienced with the Do-Nothing alternative. The rate of growth with replenishment (1950-1978) is 84,900 cubic yards per year and is

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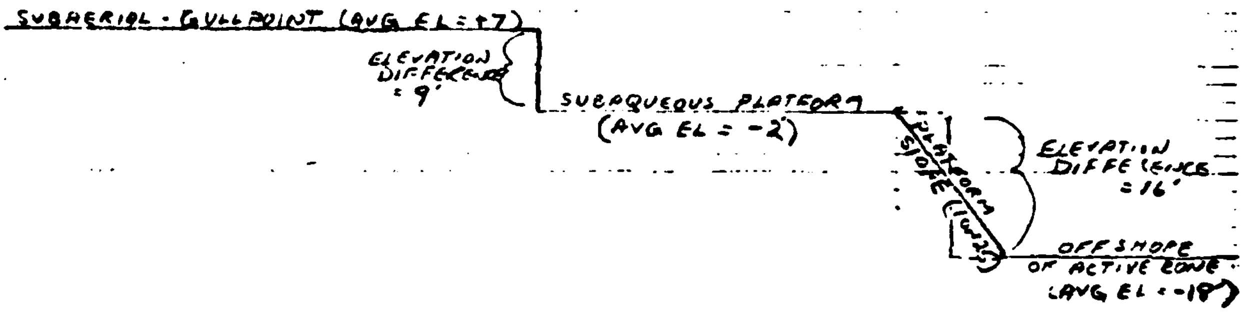
HISTORICAL GROWTH OF GULL POINT, PRESQUE ISLE

VOLUME CALCULATIONS

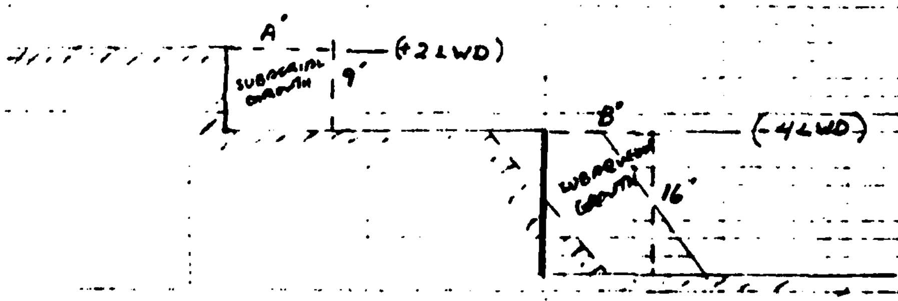
GULL POINT GROWS BOTH SUBAERIALLY AND SUBAQUEOUSLY. THE GULL POINT PLATFORM MUST GROW AT THE SAME RATE AS THE ABOVE WATER PORTION IN ORDER TO MAINTAIN THE FEATURE. THE FOLLOWING SCHEMATIZED PROFILE OF GULL POINT INDICATES THE TYPICAL CROSS-SECTIONAL FEATURES AND THEIR ELEVATIONS AS RECORDED DURING THE MAY 1979 SURVEY. EXAMINATION OF PREVIOUS SURVEY RESULTS INDICATE THE SAME OFFSHORE MORPHOLOGY.



ANY VOLUME CALCULATION MUST INCLUDE BOTH SUBAERIAL AND SUBAQUEOUS GROWTH. THUS, THE TOTAL VOLUME GROWTH OF GULL POINT CAN BE EXPRESSED AS:

CHANGE IN SUBAERIAL AREA × ELEVATION DIFFERENCE (i.e. 9')
\+ CHANGE IN SUBAQUEOUS PLATFORM AREA × ELEV. DIFF. (i.e 16')
= TOTAL VOLUME CHANGE

THIS MAY BE ILLUSTRATED AS FOLLOWS



AREA A' (SUBAERIAL GROWTH) HAS BEEN MEASURED DIRECTLY OFF OF AERIAL PHOTOGRAPHY AND HISTORICAL MAPS

AREA B' (SUBAQUEOUS GROWTH) CAN NOT BE DIRECTLY MEASURED DUE TO A LACK OF BATHYMETRIC DATA BUT ITS VALUE IS HYPOTHESIZED AS MAINTAINING A CONSTANT RATIO WITH A'.

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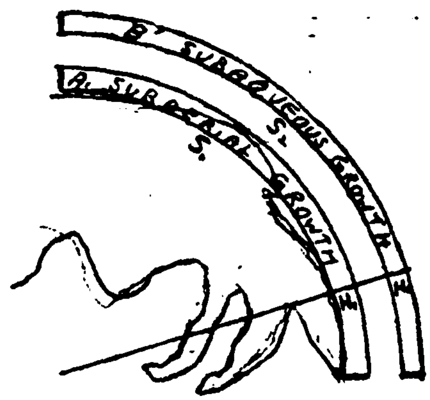
THE RATIO OF AREA B' TO AREA A' IS ASSUMED TO BE THE SAME AS THE RATIO OF THE AREA BETWEEN TWO CONCENTRIC ANNULI SECTORS. ASSUMING THAT THE SUBAQUEOUS GROWTH PARALLELS THE SUBAERIAL GROWTH THE WIDTH OF EACH ANNULI SECTOR IS EQUAL ($H_1 = H_2$).



THUS, THE RATIO OF THE TWO AREAS (A' & B') EQUALS THE RATIO OF THE TWO ANNULI SECTOR ARC LENGTHS. (S_1 & S_2)

$A' \propto H_1 \cdot S_1$

$B' \propto H_2 S_2$

$A'/B' = S_1/S_2$

VARIOUS MEASUREMENTS WERE MADE OF S_1 (THE SHORELINE OR THE +2' CONTOUR) AND OF S_2 (THE TOP OF THE PLATFORM SLOPE OR THE -4' CONTOUR). RATIOS RANGED FROM 1.1 TO 1.50 WITH THE MOST REPETITION OF THE 1.4 VALUE. SUBAQUEOUS AREA $(B') = 1.4 \times A'$

THEREFORE

SUBAERIAL VOLUME $= (9)(A')$

SUBAQUEOUS VOLUME $= (16)(1.4)(A')$

$$\text{TOTAL VOLUME (CU. YDS)} = \frac{(9)(A') + (16)(1.4)(A')}{27} = \frac{A'(31.4)}{27} = 1.163A'$$

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SUMMARY OF HISTORICAL GROWTH FOR GULL POINT

FOLLOWING COMPUTATIONS BASED ON DATA PRESENTED IN TABLE C-7.

AVERAGE ANNUAL GROWTH RATE FOR GULL POINT

BEFORE SHORE PROTECTION (1819 - 1875)
56 YEARS, TOTAL NET GROWTH = 2,441,300 YD^3
AVERAGE = 43,600 YD^3 PER YEAR

WITH PROTECTION - BEFORE REPLENISHMENT (1875-1950)
75 YEARS, TOTAL NET GROWTH = 1,382,300 YD^3
AVERAGE = 18,400 YD^3 PER YEAR

PRE-REPLENISHMENT (1819 - 1950)
131 YEARS, TOTAL NET GROWTH = 3,823,600
AVERAGE = 29,200 YD^3 PER YEAR

WITH REPLENISHMENT (1950 - 1978)
28 YEARS, TOTAL NET GROWTH = 2,378,300
AVERAGE = 84,900 YD^3 PER YEAR

A LINEAR REGRESSION ANALYSIS WAS PERFORMED TO COMPARE THE CUMMULATIVE GROWTH RATES FROM THOSE YEARS WITHOUT REPLENISHMENT (1819-1950) TO THOSE YEARS WITH REPLENISHMENT (1950-1978).

WITHOUT REPLENISHMENT (1819-1950)

y-intercept -45,167,578
SLOPE 24,875
Correlation coefficient 0.81

PREDICTED VALUES
1820 - 105,500
1860 - 1,100,500
1880 - 1,598,000
1900 - 2,095,500
1920 - 2,593,000
1950 - 3,339,200

WITH REPLENISHMENT (1950 - 1978)

y-intercept -136,117,849
SLOPE 71,893
correlation coefficient 0.91

PREDICTED VALUES
1950 - 4,069,357
1960 - 4,788,265
1970 - 5,507,174
1980 - 6,226,083

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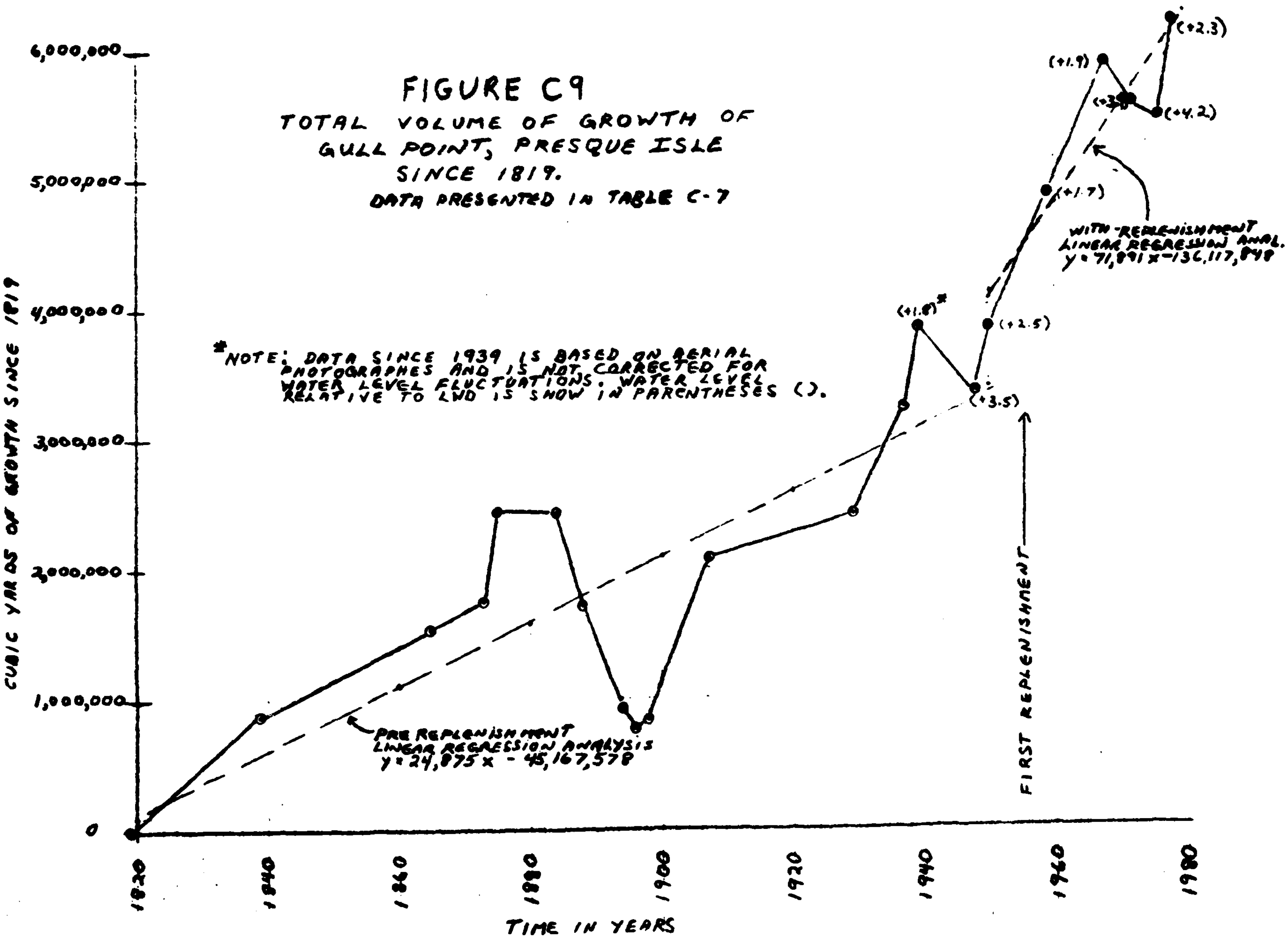
FIGURE C9
TOTAL VOLUME OF GROWTH OF
GULL POINT, PRESQUE ISLE
SINCE 1819.
DATA PRESENTED IN TABLE C-7
*NOTE: DATA SINCE 1939 IS BASED ON AERIAL PHOTOGRAPHES AND IS NOT CORRECTED FOR WATER LEVEL FLUCTUATIONS. WATER LEVEL RELATIVE TO LWD IS SHOW IN PARENTHESES ().
CUBIC YARDS OF GROWTH SINCE 1819
6,000,000
5,000,000
4,000,000
3,000,000
2,000,000
1,000,000
0
1820
1840
1860
1880
1900
1920
1940
1960
1980
TIME IN YEARS
PRE REPLENISHMENT
LINEAR REGRESSION ANALYSIS
y = 24,875 x - 45,167,578
WITH REPLENISHMENT
LINEAR REGRESSION ANAL.
y = 71,891 x - 136,117,848
FIRST REPLENISHMENT
(+1.8)*
(+3.5)
(+2.5)
(+1.7)
(+1.9)
(+4.2)
(+2.3)

FIGURE C9

interpreted to represent the maximum growth model. Depending upon the efficiency of the three structural alternatives, each plan would allow a reduced growth rate for Gull Point.

(2) Erie Harbor Channel Dredging - Littoral drift which travels the length of Presque Isle eventually reaches the depositional east end where some sediment accumulates at Gull Point, some travels beyond Gull Point to build up the sand bars, shoals, and the platform off of Thompson Bay, and some is transported to the Erie Harbor entrance channel. The outer entrance channel is a permanent littoral sink which is annually maintained through dredging.

A search was made of the Government's dredging records in an attempt to identify what years or quantities represent material removed from the outer entrance channel. A detailed breakdown of the dredging record by area is not available, however, it is known that the outer harbor has historically dominated the dredging program at Erie Harbor.

Annual quantities of material dredged from Erie Harbor since 1930 are listed in Table C8. It is important to realize that the quantity dredged in a given year does not necessarily represent the need for dredging. The dredging program is strongly influenced by such factors as: the availability of floating plant, funding, scheduling problems, weather conditions, harbor demand, etc. In spite of the aforementioned difficulties, an examination of the dredging records does suggest that the data before replenishment (1930-1959) follows a different statistical trend than the data from the replenishment period (1960-1977) as illustrated in Figure C10. A linear regression analysis was performed (Table C8) to compare these two trends and is superimposed on Figure C10. Since replenishment, the slope of the regression line has changed from slightly negative to strongly positive (from -468 to 4,356). The prereplenishment linear regression line suggests that less and less littoral material was actually making it around Gull Point to the entrance channel. This may reflect the extensive shore protection efforts of the early 1930's, mid-40's, and mid-50's. The linear regression fit for the data since replenishment shows a definite increasing trend as more littoral sediment is available for transport into the entrance channel. It is predicted that the replenishment period data actually follows a nonlinear relationship. Continual replenishment will reach a cumulative point where almost all the material placed on the beaches ends up in the entrance channel and the annual dredging line will flatten at some maximum value. This will occur as Gull Point continues to migrate along an axis which intersects the entrance channel.

The average annual dredging quantity before 1960 was 130,800 cubic yards and since replenishment, it has increased by 95,150 cubic yards to 225,950 cubic yards. Prior to application of this data to the sediment budget, it is necessary to determine what part of the total dredging actually represents the littoral material from Presque Isle. The logic and computations for eliminating the influence of nonlittoral suspended sediments and littoral drift from the east is presented on page 57.

TABLE C-8
ERIE HARBOR DREDGING RECORDS

DATA POINT	YEAR	QUANTITY (YD³)
1	1930	160,534
2	1931	145,338
3	1932	147,507
4	1933	196,311
5	1934	150,875
6	1935	131,519
7	1936	204,092
8	1937	110,020
9	1938	93,915
10	1939	86,867
11	1940	56,974
12	1941	63,670
13	1942	101,166
14	1943	141,250
15	1944	152,023
16	1945	90,470
17	1946	75,479
18	1947	96,473
19	1948	98,720
20	1949	228,867
21	1950	229,647
22	1951	210,519
23	1952	48,756
24	1953	163,873
25	1955	184,594
26	1956	81,369
27	1957	136,377
28	1958	88,151
29	1959	117,831
30	1960	126,377
31	1961	62,194
32	1963	354,526
33	1964	369,726
34	1965	146,110
35	1966	264,685
36	1967	295,680
37	1968	151,880
38	1969	171,215
39	1970	182,219
40	1971	207,656
41	1972	168,660
42	1973	203,440
43	1974	325,464
44	1975	225,391
45	1976	388,076
46	1977	197,837

EVALUATION

PRE - REPLENISHMENT PERIOD (1930 - 1959)

Σ VOL = 3,793,177 YD^3 OVER 29 YEARS

AVERAGE = 130,800 YD^3/YR

LINEAR REGRESSION
Y-INTERCEPT 1,040,708
SLOPE -468
CORRELATION -.08

PREDICTED VALUES
1930 = 137,432
1940 = 132,752
1950 = 128,072
1960 = 123,392
1970 = 118,712
1980 = 114,032
1990 = 109,351

WITH - REPLENISHMENT PERIOD (1960 - 1977)

Σ VOL = 3,841,136 YD^3 OVER 17 YEARS

AVERAGE = 225,950 YD^3/YR

LINEAR REGRESSION
Y-INTERCEPT -8,350,423
SLOPE 4356
CORRELATION 0.25

PREDICTED VALUES
1950 = 143,698
1960 = 187,258
1970 = 230,818
1980 = 274,377
1990 = 317,937

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SUBJECT PRES QUE ISLE, GDM I		SOURCE DATA ZOSS DREDGING FROM CHANNEL	
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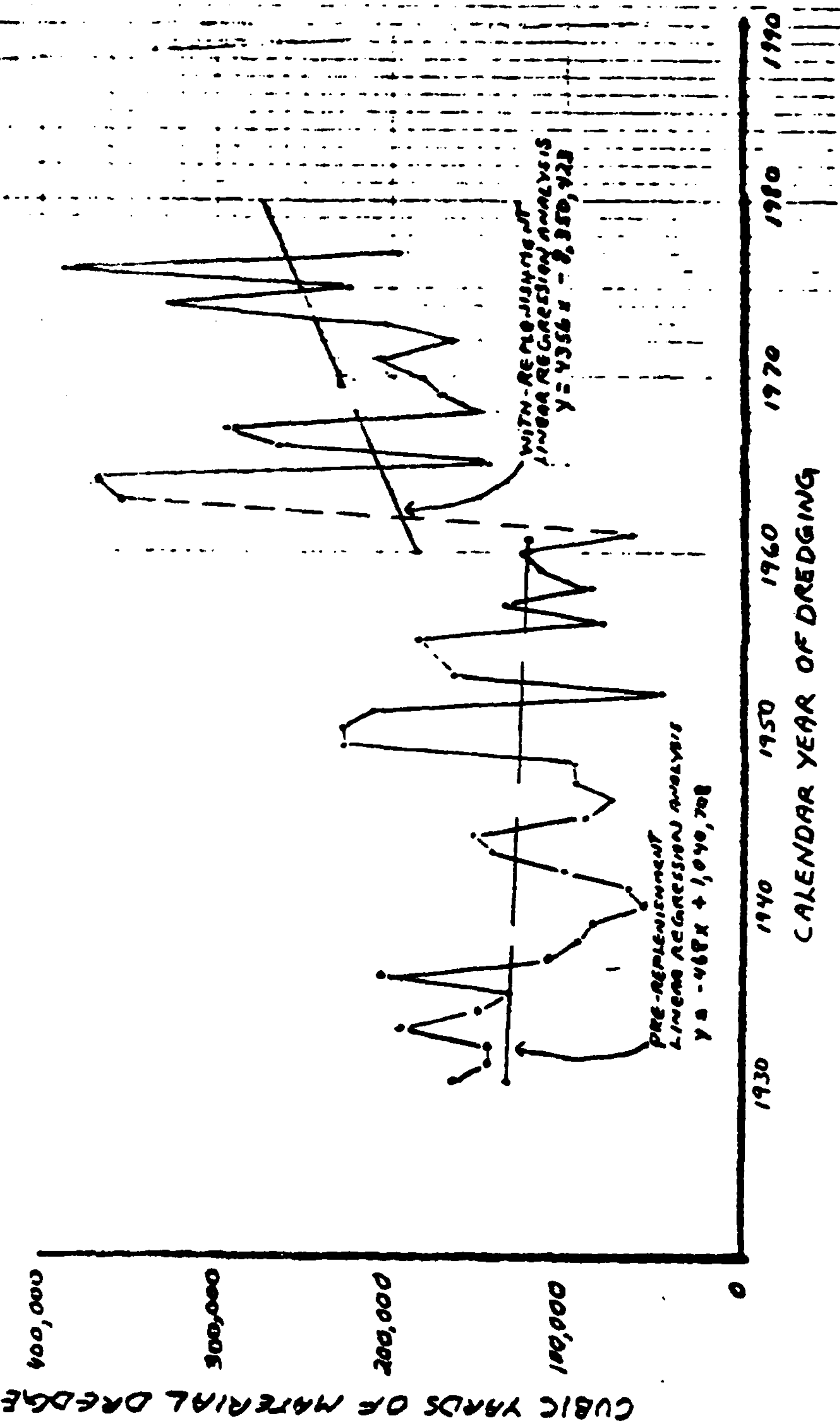

Figure C10 - Dredging Record For Erie Harbor (cubic yards per calendar year)

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NAME OF OFFICE NCBED-DC		COMPUTATION SEDIMENT BUDGET	
SUBJECT PRESQUE ISLE - GDM I		SOURCE DATA LOSS DREDGING FROM CHANNEL	
COMPUTED BY [signature]	CHECKED BY RJG	APPROVED BY	

ERIE HARBOR DREDGING SUMMARY

PRIOR TO DISCUSSION OF THE ERIE HARBOR DREDGING RECORD IT IS NECESSARY TO DETERMINE WHAT PORTION OF THE DREDGING ACTUALLY REPRESENTS LITTORAL TRANSPORTED MATERIAL FROM THE WEST (I.E. FROM PRESQUE ISLE). THE DRIFT RATE FROM THE EAST INTO THE ENTRANCE CHANNEL AND THE AMOUNT OF DREDGING NOT FROM A LITTORAL SOURCE (I.E. SUSPENDED SEDIMENT DEPOSITED IN THE INNER CHANNEL) SHOULD NOT BE EFFECTED BY NOURISHMENT ACTIVITIES ON THE PENINSULA.

DREDGING WITH NOURISHMENT = 225,950 YD³/YR =
NON-LITTORAL SEDIMENTATION + LITTORAL DRIFT FROM EAST + LITTORAL DRIFT FROM WEST

LITTORAL TRANSPORTED DEPOSITION IS DOMINATED BY TRANSPORT FROM WEST. BEB TM 37 "WAVE AND LAKE LEVEL STATISTICS FOR LAKE ERIE" WAS USED TO DOCUMENT THE PERCENT OF THE GROSS DRIFT INTO THE CHANNEL WHICH REPRESENTS DRIFT FROM THE WEST. WINDS FROM THE WSW, W, WNW, NW, AND N WERE ASSUMED TO CAUSE DRIFT FROM THE WEST. THE STATISTICAL ENERGY VALUES PRESENTED IN TABLE C-4 FOR THE WESTERN DIRECTIONS WERE ADDED AND COMPARED TO THE TOTAL.

ENERGY FROM WSW - N	= 318,648 ft-lbs	(81%)	(FROM WEST)
ENERGY FROM NNE - E	= 73,094 ft-lbs	(19%)	(FROM EAST)
TOTAL ENERGY	= 391,742 ft-lbs	(100%)	(GROSS)

ALTHOUGH NO PHYSICAL DATA EXISTS TO DETERMINE THE PERCENT OF DREDGING WHICH REPRESENTS NON-LITTORAL DEPOSITION DISCUSSIONS WITH THE DISTRICTS CONSTRUCTION AND OPERATION PERSONNEL PRODUCED THE ESTIMATE THAT 20% OF THE PRESENT DREDGING IS FROM THE INNER HARBOR.

THEREFORE, ANNUAL AVERAGE DREDGING OF LITTORAL TRANSPORTED MATERIAL FROM THE WEST IS COMPUTED AS FOLLOWS:

TOTAL DREDGING = (.8) 225,950 + (.2) 225,950
LITTORAL FROM WEST = (0.8) 225950 (0.81) = 146,420 YD³/YR

WITH NOURISHMENT LOSS FROM PRESQUE ISLE TO THE HARBOR = 146,420 YD³/YR

PRE-NOURISHMENT LOSS FROM PRESQUE ISLE TO THE HARBOR =
225,950 - 130,800 = 95,150 YD³/YR (ADDITIVE EFFECT OF NOURISHMENT)

146,420 - 95,150 = 51,270 YD³/YR (BASIC LITTORAL SUPPLY FROM P.I TO THE HARBOR)

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The loss of littoral material from Presque Isle to the Erie Harbor entrance channel with the present condition of annual replenishment is 146,420 cubic yards per year. The loss experienced with the Do-Nothing alternative is 51,270 cubic yards per year. Each of the three structural alternatives influences littoral drift rates with a different efficiency. Thus, each plan will allow proportionately less littoral supply to reach the harbor than that allowed with the maximum sediment budget model (i.e., 146,420 cubic yards).

(3) Subaqueous Bars and Platform Growth - Between Gull Point and the entrance channel is an area of subaqueous accretion. The platform and sand bars which cross Thompson Bay build in size in response to the migration of Gull Point toward the entrance channel. Without a historical set of bathymetric maps, the growth of this area cannot be documented, but it is assumed to represent an offshore loss which equals 20 percent of the total peninsula migration (see pages 59 through 61 of this Appendix.

c. Summary

The previously discussed gain and loss parameters were applied to develop five sediment budget models for the Do-Nothing, artificial nourishment (or present condition), the groin, the segmented offshore breakwaters, and the sand trap alternatives. The sediment budget for each alternative is compiled on pages 57 through 59 in this Appendix and illustrated in Figures 14 and 15 in Section B of the Main Report and Figures 18, 19, and 20 in Section D of the Main Report.

Present condition results suggest a maximum net littoral drift toward the east of 289,100 cubic yards per year. This value is collaborated by the LEO program data collected from Beach 6 and Beach 9 during 7 months in 1978. The reduced data indicated a gross drift of 234,638 cubic yards and a net drift toward the east of 212,734 cubic yards at Beach 6 and comparable values for Beach 9. The results of the 1978 LEO program which were prepared by CERC are presented on pages 62 through 67 of this Appendix. This data represents only 7 months of record. Therefore, it is anticipated that a complete LEO data record for the 9-month ice-free season would result in a gross drift of approximately 300,000 cubic yards and a net drift toward the east of approximately 275,000 cubic yards.

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SEDIMENT BUDGET SUMMARY

MAJOR NATURAL SINKS AT EASTERN END (PENINSULA MIGRATION)

(a) GULL POINT GROWTH

(b) ERIE HARBOR ENTRANCE CHANNEL

(c) SUBAQUEOUS BARS AND PLATFORM (BETWEEN GULL POINT AND THE ENTRANCE CHANNEL).

THE SEDIMENT BUDGET VALUES WILL VARY ACCORDING TO THE ALTERNATIVE. FOR EXAMPLE, MORE SEDIMENT COLLECTS IN THE SINKS WITH HIGHER REPLENISHMENT, LESS WITH MORE STRUCTURAL PROTECTION. THE VALUES FOR (a) ARE BASED ON THE MEASURED RATE OF SUBAERIAL AREA OF GROWTH ADJUSTED TO A VOLUME OF GROWTH. THE VALUES OF (b) REPRESENT THE AVERAGE DREDGING RECORDS. THE VALUES FOR (c) ARE ASSUMED TO REPRESENT 20% OF THE PENINSULA'S MIGRATION.

DO NOTHING ALTERNATIVE (NO REPLENISHMENT - EXISTING SHORE PROTECTION REMAINS)

(a) USING 1875 - 1950 RECORD GULL POINT GROWS AT AN AVERAGE ANNUAL RATE OF	18,400 YD³/YR	21%
(b) USING 1930 - 1959 RECORD THE AVERAGE ANNUAL DREDGING REMOVES WHICH IS LITTORAL DRIFT FROM THE WEST	51,300 YD³/YR	59%
(c) 20% OF PENINSULA MIGRATION (x) IS COMPUTED USING x = 20% x + 18,400 + 51,300	17,400 YD³/YR	20%

TOTAL PENINSULA MIGRATION (LOSS TO BUDGET AT WEST END)
87,100 YD³/YR

ARTIFICIAL NOURISHMENT (PRESENT CONDITION WITH 259,300 YD³ OF ANNUAL NOURISHMENT)

(a) USING 1950 - 1978 RECORD GULL POINT GROWS AT AN AVERAGE ANNUAL RATE OF	84,900 YD³/YR	29%
(b) USING 1960 - 1977 RECORD, THE AVERAGE ANNUAL DREDGING REMOVES WHICH IS LITTORAL DRIFT FROM THE WEST	146,400 YD³/YR	51%
(c) 20% OF PENINSULA MIGRATION (x) IS COMPUTED USING x = 20% x + 84,900 + 146,400	57,800 YD³/YR	20%

TOTAL PENINSULA MIGRATION (LOSS TO BUDGET AT WEST END)
289,100 YD³/YR

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SEDIMENT BUDGET - - (CONTINUED)

GROIN ALTERNATIVE (INCLUDES REPLENISHMENT)

ASSUME WITH GROIN ALTERNATIVE THAT ANNUAL NOURISHMENT WILL BE MAINTAINED AT A LEVEL SUFFICIENT TO FEED THE MAXIMUM OBSERVED RATE OF LITTORAL DRIFT, THAT IS THE DRIFT RATE OBSERVED WITH THE PRESENT LEVEL OF NOURISHMENT (I.E. 289,100 YD³/YR). HOWEVER THE GROINS WILL BE 50% EFFECTIVE IN TRAPPING DRIFT (SPM).

(a) GULL POINT GROWS AT 50% OF 84900 YD³/YR = 42,450 YD³/YR

(b) ENTRANCE CHANNEL TRAPS 50% OF 146,400 YD³/YR = 73,200

(c) SUBAQUEOUS GROWTH EQUALS 50% OF 57800 YD³/YR = 28,900

TOTAL PENINSULA MIGRATION : 50% OF 289,100 YD³/YR = 144,550

REQUIRED NOURISHMENT (X) = 144,550 + 0.2X - 40,000

X = 130,700 YD³/YR

OFFSHORE LOSS = 0.2X = 26,100 YD³/YR

SEGMENTED BREAKWATER ALTERNATIVE (INCLUDES REPLENISHMENT)

ASSUME WITH SEGMENTED BREAKWATER ALTERNATIVE THAT ANNUAL NOURISHMENT WILL BE MAINTAINED AT A LEVEL SUFFICIENT TO FEED THE MAXIMUM OBSERVED RATE OF LITTORAL DRIFT, THAT IS THE DRIFT RATE OBSERVED WITH THE PRESENT LEVEL OF NOURISHMENT (I.E. 289,100 YD³/YR). HOWEVER, THE BREAKWATER TRAP DRIFT AND REDUCE THE DRIFT RATE BY 75%

(a) GULL POINT GROWS AT 25% OF 84,900 YD³/YR = 21,200

(b) ENTRANCE CHANNEL TRAPS 25% OF 146,400 YD³/YR = 36,600

(c) SUBAQUEOUS GROWTH EQUALS 25% OF 57,800 YD³/YR = 14,450

TOTAL PENINSULA MIGRATION = 25% OF 289,100 YD³/YR = 72,250

REQUIRED NOURISHMENT (X) = 72,250 + 0.15X - 40,000

X = 37,900 YD³/YR

OFFSHORE LOSS = 0.15X = 5,700 YD³/YR

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SEDIMENT BUDGET (CONTINUED)

SAND TRAP ALTERNATIVE (INCLUDES RECYCLING AND REPLENISHMENT OF SAND)

ASSUME WITH THE SAND TRAP ALTERNATIVE THAT THE ANNUAL NOURISHMENT AND RECYCLING WILL BE MAINTAIN AT A LEVEL SUFFICIENT TO FEED THE MAXIMUM OBSERVED RATE OF LITTORAL DRIFT THAT IS - THE DRIFT RATE OBSERVED WITH THE PRESENT LEVEL OF NOURISHMENT (i.e. 289,100 YD³/YR). FURTHER ASSUME THAT THE SAND TRAP WILL EFFECTIVELY TRAP 90% OF THE DRIFT WITH ONLY 10% NATURALLY PASSING TO ALLOW PENINSULA MIGRATION AND THE GROWTH OF GULL POINT. IN ORDER TO MAINTAIN A MINIMUM GROWTH OF GULL POINT (i.e. THE AVERAGE ANNUAL GROWTH RATE ANTICIPATED WITH THE DO NOTHING ALTERNATIVE - 18,400 YD³/YR) IT WILL BE NECESSARY TO PUMP SAND FROM THE TRAP TOWARD THE EAST. BASED ON THE PRESENT CONDITION RATIO APPROXIMATELY 30% OF THE MIGRATION OF PRESQUE ISLE QUANTITY RESULTS IN GULL POINT GROWTH.

(a) GULL POINT GROWTH MAINTAINED AT	18,400 YD³/YR
(b) ENTRANCE CHANNEL TRAPS 50% OF TOTAL PENINSULA MIGRATION [1⅔ × (a)]	30,700 YD³/YR
(c) SUBAQUEOUS GROWTH EQUALS 20% OF TOTAL PENINSULA MIGRATION [⅔ × (a)]	12,300 YD³/YR
TOTAL PENINSULA MIGRATION EQUALS 18,400/0.3	61,400 YD³/YR
SAND TRAP TRAPS 90% OF TOTAL DRIFT (90% × 289,100)	260,000 YD³/YR
NATURAL BYPASSING OF SAND TRAP (10% × 289,100)	29,000 YD³/YR
PUMPED BYPASSING TO EAST FROM SAND TRAP TO MAINTAIN GULL POINT GROWTH (61,400 - 29,000)	32,400 YD³/YR
SAND RECYCLED FROM SEDIMENT TRAP (260,000 - 32,400)	227,600 YD³/YR
OFFSHORE LOSS OF RECYCLED SAND IS 20% (227,600 × 20%)	45,500 YD³/YR

REQUIRED ANNUAL NOURISHMENT (X)

$$X + 227,600 + 40,000 = 260,000 + 29,000 + 45,500 + .2X$$

$$X = 83,600 \text{ YD}^3\text{/YR}$$

$$\text{OFFSHORE LOSS} = 0.2X = 16,700 \text{ YD}^3\text{/YR}$$

NCD Form 14 1 APR 63 Previous edition may be used until supply is exhausted.

BY J. Pope DATE 22 Oct 80 SUBJECT Presque Isle Sediment Budget - Federal No Action (without Condition Profile) SHEET NO. ...... OF ......
CHKD. BY RSG DATE 22 Oct 80 JOB NO. ......

ASSUME THAT No Federal ACTION ALTERNATIVE WOULD BE ACCOMPANIED BY SOME MINOR LEVEL OF STATE REPLENISHMENT TO REPLACE PENINSULA NET LOSS.

FROM FIGURE 15 (DO NOTHING)
No replenishment results in 47,100 CY NET LOSS

THEREFORE TO MAINTAIN 1972 CONDITIONS, COMMONWEALTH OF PA would replenish with

47,100 + 20%(47,100)* = 56520 CY $\boxed{\text{SAY 57,000}}$

*assume 20% of placed material would be lost offshore

THIS MINOR LEVEL OF REPLENISHMENT RESULTS IN A SEDIMENT BUDGET CONDITION BETWEEN The "DO NOTHING" (FIG 15) and "PRESENT CONDITION" (Fig 14)

BUDGET

GAIN 40,000 (GAIN FROM WEST)
57,000 (ARTIFICAL NOURISHMENT)

TOTAL GAIN = 97,000 CY

LOSS .2(57,000) = 11,400 CY (OFFSHORE LOSS OF PLACED FILL)
x = MIGRATION OF PRESQUE ISLE

FIND x
when replenishment = 0, migration = 87,100 (A)
when replenishment = 259,300 migration = 289,100 (B)
when replenishment = 57,000 migration = x
ASSUME relationship is linear
slope from (A) To (B) is 0.78

x = .78(57,000) + 87,100 x = 131,560 cy

131,600 = (MIGRATION OF PRESQUE ISLE)
(.57)(131,600) = 75,012 (LOSS TO ENTRANCE CHANNEL)
(.23)(131,600) = 30,268 (GROWTH OF GULL POINT)
(.20)(131,600) = 26,320 (SUBAQUEOUS GROWTH)

SUMMARY

GAIN LOSS
40,000 + 57,000 ≠ 11,400 + 131,600

PRESQUE ISLE STILL WILL LOSE 46,000 ± CY/YR

Rev. November 1980

SITE 44501 (BEACH No. 6)

POTENTIAL LONGSHORE TRANSPORT VERSUS TIME-1978

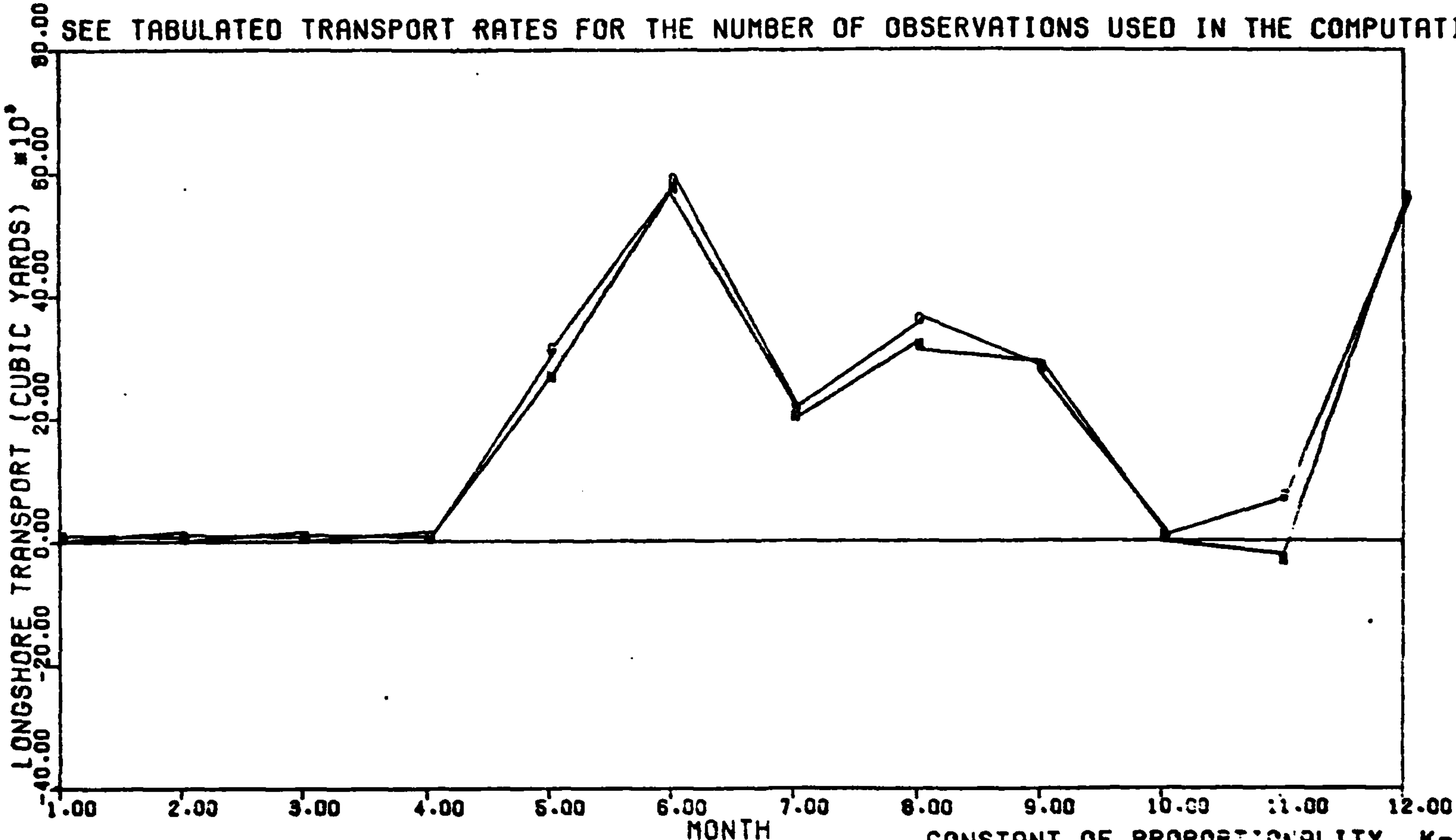
KEY

N- NET LONGSHORE TRANSPORT

G- GROSS LONGSHORE TRANSPORT

ZERO GROSS LONGSHORE TRANSPORT IMPLIES LACK OF DATA

SEE TABULATED TRANSPORT RATES FOR THE NUMBER OF OBSERVATIONS USED IN THE COMPUTATIONS



CONSTANT OF PROPORTIONALITY. K=1.00

88501 PRESQUE ISLE #6 PENNSYLVANIA SUMMARY FOR PERIOD STARTING 5-10-78 AND ENDING 12-20-78

	JAN	FEB	MARCH	APRIL	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	ALL OBS.
SURF OBS.													
HEIGHT (FT)													
MEAN	0.00	0.00	0.00	0.00	.94	1.27	.71	.82	.75	0.00	.79	1.41	.98
STD DEV	0.00	0.00	0.00	0.00	.74	.80	.68	1.06	.65	0.00	.75	1.11	.86
NO. OBS.	0.	0.	0.	0.	7.	15.	11.	11.	4.	0.	8.	8.	64.
PERIOD (SEC)													
MEAN	0.00	0.00	0.00	0.00	2.78	2.97	2.76	3.10	2.93	0.00	3.61	4.27	3.19
STD DEV	0.00	0.00	0.00	0.00	.88	.54	.62	.71	.23	0.00	.85	1.17	.87
NO. OBS.	0.	0.	0.	0.	6.	15.	8.	6.	3.	0.	7.	7.	52.
DIRECTION													
PROTRACTOR METHOD													
% OCC > 90	0.00	0.00	0.00	0.00	28.57	6.67	25.00	33.33	0.00	0.00	57.14	14.29	22.64
% OCC = 90	0.00	0.00	0.00	0.00	14.29	26.67	12.50	16.67	0.00	0.00	14.29	0.00	15.09
% OCC < 90	0.00	0.00	0.00	0.00	57.14	66.67	62.50	50.00	100.00	0.00	28.57	85.71	62.26
MEAN	0.00	0.00	0.00	0.00	82.14	78.00	80.63	81.67	86.33	0.00	99.29	82.14	82.17
STD DEV	0.00	0.00	0.00	0.00	20.59	14.24	20.60	18.89	2.89	0.00	16.44	6.99	16.97
NO. OBS.	0.	0.	0.	0.	7.	15.	8.	6.	3.	0.	7.	7.	53.
BREAKER TYPE													
%OCC SPILL	0.00	0.00	0.00	0.00	14.29	13.33	0.00	0.00	0.00	0.00	0.00	0.00	4.69
SP/PL	0.00	0.00	0.00	0.00	57.14	66.67	36.36	54.55	50.00	0.00	75.00	62.50	57.81
PLUNGE	0.00	0.00	0.00	0.00	28.57	13.33	36.36	0.00	25.00	0.00	12.50	25.00	18.75
SURGE	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
CALM	0.00	0.00	0.00	0.00	0.00	6.67	27.27	45.45	25.00	0.00	12.50	12.50	18.75
NO. OBS.	0.	0.	0.	0.	7.	15.	11.	11.	4.	0.	8.	8.	64.
CURRENT OBS.													
(FT/SEC)													
NET MEAN	0.00	0.00	0.00	0.00	.50	.47	.16	.16	.27	0.00	.32	.47	.33
GROSS MEAN	0.00	0.00	0.00	0.00	.57	.52	.24	.28	.27	0.00	.56	.53	.43
STD DEV	0.00	0.00	0.00	0.00	.65	.58	.27	.25	.24	0.00	.71	.63	.49
NO. OBS.	0.	0.	0.	0.	7.	15.	11.	11.	4.	0.	8.	8.	64.
FORESHORE SLOPE													
MEAN (DEG)	0.00	0.00	0.00	0.00	10.14	9.67	10.55	9.18	9.00	0.00	10.25	8.88	9.72
STD DEV	0.00	0.00	0.00	0.00	2.61	2.19	2.84	1.78	0.00	0.00	1.16	.99	2.03
NO. OBS.	0.	0.	0.	0.	7.	15.	11.	11.	4.	0.	8.	8.	64.
RIPS % OCC	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
MEAN SPAC.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
NO. OBS.	0.	0.	0.	0.	7.	15.	11.	11.	4.	0.	8.	8.	64.
CUSPS % OCC.	0.00	0.00	0.00	0.00	14.29	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.56
MEAN SPAC.	0.00	0.00	0.00	0.00	5.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	.55
NO. OBS.	0.	0.	0.	0.	7.	15.	11.	11.	4.	0.	8.	8.	64.

DATA FROM 44501 PRESQUE ISLE #6
OBSERVATION PERIOD 5/10/78 TO 12/20/78

MONTHS	1	2	3	4	5	6	7	8	9	10	11	12
MEAN NET ENERGY (FT-LBS/FT)	0.	0.	0.	0.	16.	55.	12.	19.	17.	0.	-2.	34.
MEAN GROSS ENERGY (FT-LBS/FT)	0.	0.	0.	0.	19.	36.	13.	22.	17.	0.	4.	34.
IMMERSED WEIGHT NET(LBS)X10000	0.	0.	0.	0.	4263.	9260.	3202.	5084.	4497.	0.	-628.	9018.
IMMERSED WEIGHT GROSS X10000	0.	0.	0.	0.	4999.	9498.	3412.	5776.	4497.	0.	1059.	9033.
BULK VOLUME TO LEFT (CU YDS)	0.	0.	0.	0.	2257.	731.	643.	2120.	0.	0.	5157.	45.
BULK VOLUME TO RIGHT (CU YDS)	0.	0.	0.	0.	28390.	57497.	20274.	33289.	27571.	0.	1333.	55331.
BULK VOLUME NET (CU YDS)	0.	0.	0.	0.	26133.	56767.	19631.	31170.	27571.	0.	-3825.	55287.
BULK VOLUME GROSS (CU YDS)	0.	0.	0.	0.	30647.	58228.	20916.	35409.	27571.	0.	6490.	55376.
NUMBER OF OBSERVATIONS	0.	0.	0.	0.	7.	15.	11.	11.	4.	0.	8.	8.

TOTAL TRANSPORT (SUM OF MONTHLY)

IMMERSED WEIGHT NET(LBS)X10000	34701.
IMMERSED WEIGHT GROSS X10000	38274.
BULK VOLUME TO LEFT (CU YDS)	10952.
BULK VOLUME TO RIGHT (CU YDS)	223686.
BULK VOLUME NET (CU YDS)	212734.
BULK VOLUME GROSS (CU YDS)	234636.

NB=PROPORTIONALITY CONSTANT OF 1.00 USED IN COMPUTATIONS,
ACCEPTED VALUES ARE 0.25(INMAN AND FRAUTSCHY), 0.35(DAS), 0.77(KOMAR)

SITE 44011 (BEACH NO. 9)

POTENTIAL LONGSHORE TRANSPORT VERSUS TIME-1978

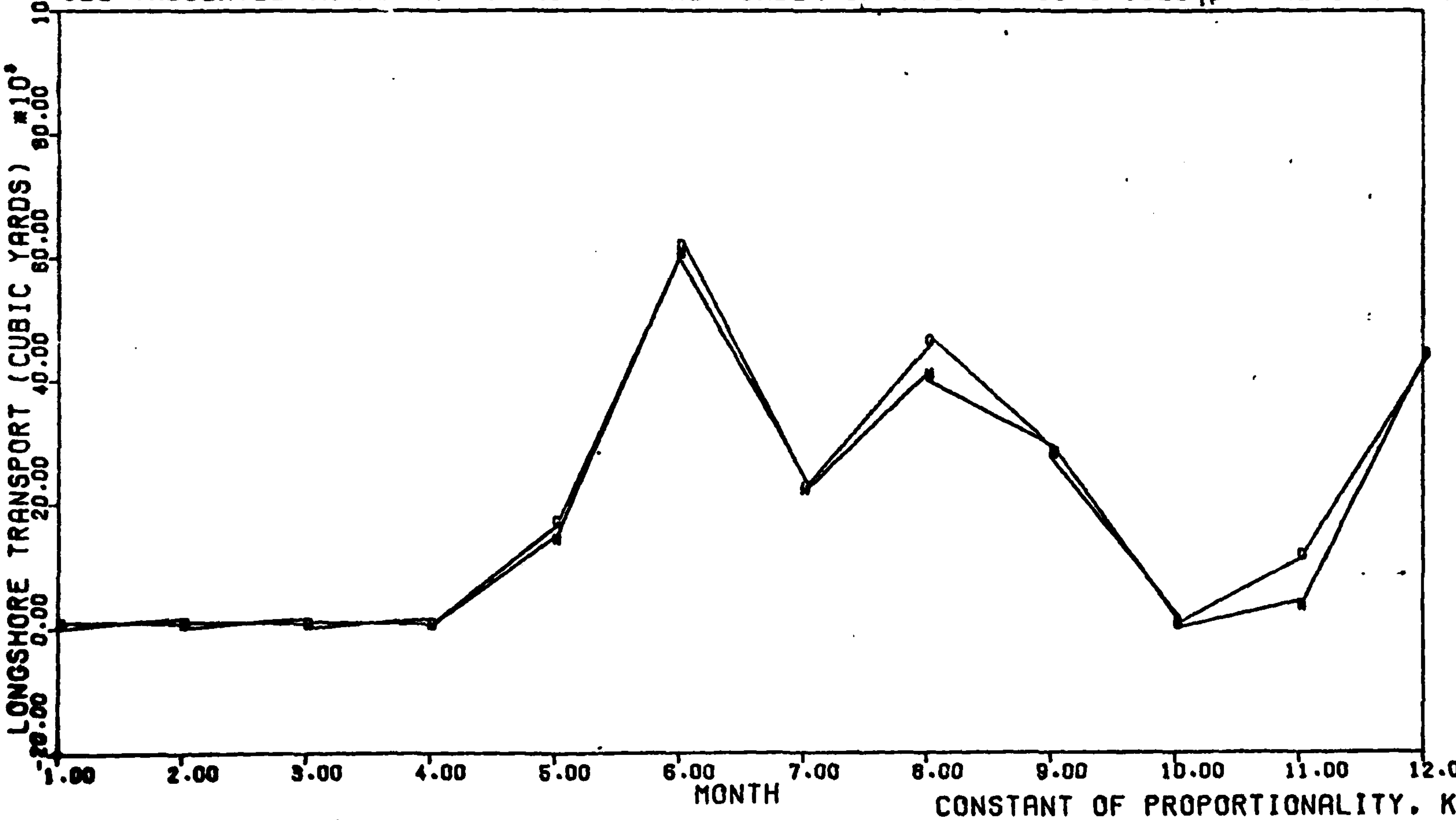
KEY

N- NET LONGSHORE TRANSPORT

G- GROSS LONGSHORE TRANSPORT

ZERO GROSS LONGSHORE TRANSPORT IMPLIES LACK OF DATA

SEE TABULATED TRANSPORT RATES FOR THE NUMBER OF OBSERVATIONS USED IN THE COMPUTATIONS



CONSTANT OF PROPORTIONALITY, K=1.00

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PRESQUE ISLE PENINSULA, FRIE, PENNSYLVANIA. VOLUME II. APPENDIC--ETC(U)
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44011 PRESQUE ISLE #9 PENNSYLVANIA SUMMARY FOR PERIOD STARTING 5-10-78 AND ENDING 12-20-78.

	JAN	FEB	MARCH	APRIL	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	ALL OBS.
SURF OBS.													
HEIGHT (FT)													
MEAN	0.00	0.00	0.00	0.00	.76	1.22	.67	.82	.75	0.00	.74	1.23	.91
STD DEV	0.00	0.00	0.00	0.00	.38	.40	.59	1.06	.65	0.00	.58	.87	.74
NO. OBS.	0.	0.	0.	0.	7.	14.	11.	11.	4.	0.	8.	8.	63.
PERIOD (SEC)													
MEAN	0.00	0.00	0.00	0.00	3.01	2.90	2.93	3.13	2.83	0.00	3.20	3.97	3.14
STD DEV	0.00	0.00	0.00	0.00	1.27	.37	.44	.94	.29	0.00	.28	.82	.74
NO. OBS.	0.	0.	0.	0.	7.	14.	8.	6.	3.	0.	7.	7.	52.
DIRECTION													
PROTRACTOR METHOD													
% OCC > 90	0.00	0.00	0.00	0.00	37.50	7.14	12.50	33.33	0.00	0.00	57.14	14.29	22.64
% OCC = 90	0.00	0.00	0.00	0.00	12.50	21.43	25.00	0.00	0.00	0.00	0.00	0.00	11.32
% OCC < 90	0.00	0.00	0.00	0.00	50.00	71.43	62.50	66.67	100.00	0.00	42.86	85.71	66.04
MEAN	0.00	0.00	0.00	0.00	81.25	77.86	78.13	82.50	68.33	0.00	95.00	81.43	81.13
STD DEV	0.00	0.00	0.00	0.00	20.13	15.20	13.61	21.15	2.89	0.00	17.32	6.90	16.16
NO. OBS.	0.	0.	0.	0.	8.	14.	8.	6.	3.	0.	7.	7.	53.
BREAKER TYPE.													
%OCC SPILL	0.00	0.00	0.00	0.00	14.29	21.43	0.00	0.00	0.00	0.00	0.00	0.00	6.35
SP/PL	0.00	0.00	0.00	0.00	71.43	78.57	36.36	54.55	50.00	0.00	62.50	62.50	60.32
PLUNGE	0.00	0.00	0.00	0.00	14.29	0.00	36.36	0.00	25.00	0.00	25.00	25.00	15.87
SURGE	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
CALM	0.00	0.00	0.00	0.00	0.00	0.00	27.27	45.45	25.00	0.00	12.50	12.50	17.46
NO. OBS.	0.	0.	0.	0.	7.	14.	11.	11.	4.	0.	8.	8.	63.
CURRENT OBS.													
(FT/SEC)													
NET MEAN	0.00	0.00	0.00	0.00	.63	.53	.29	.16	.23	0.00	.24	.39	.36
GROSS MEAN	0.00	0.00	0.00	0.00	.70	.60	.32	.28	.23	0.00	.51	.44	.45
STD DEV	0.00	0.00	0.00	0.00	1.18	.53	.35	.27	.33	0.00	.53	.49	.52
NO. OBS.	0.	0.	0.	0.	7.	14.	11.	11.	4.	0.	8.	8.	63.
FORESHORE SLOPE													
MEAN (DEG)	0.00	0.00	0.00	0.00	7.43	8.64	10.36	9.36	10.00	0.00	9.63	9.13	9.21
STD DEV	0.00	0.00	0.00	0.00	2.64	1.45	2.46	1.12	0.00	0.00	1.06	.64	1.79
NO. OBS.	0.	0.	0.	0.	7.	14.	11.	11.	4.	0.	8.	8.	63.
RIPS % OCC	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
MEAN SPAC.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
NO. OBS.	0.	0.	0.	0.	7.	13.	11.	11.	4.	0.	8.	8.	62.
CUSPS % OCC.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
MEAN SPAC.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
NO. OBS.	0.	0.	0.	0.	7.	13.	11.	11.	4.	0.	8.	8.	62.

DATA FROM 84011 PRESQUE ISLE #9
OBSERVATION PERIOD 5/10/78 TO 12/20/78

MONTHS	1	2	3	4	5	6	7	8	9	10	11	12
MEAN NET ENERGY (FT-LBS/FT)	0.	0.	0.	0.	9.	37.	13.	25.	17.	0.	2.	27.
MEAN GROSS ENERGY (FT-LBS/FT)	0.	0.	0.	0.	10.	38.	14.	28.	17.	0.	7.	27.
IMMERSED WEIGHT NET(LBS)X10000	0.	0.	0.	0.	2242.	9780.	3529.	6568.	4497.	0.	492.	7097.
IMMERSED WEIGHT GROSS X10000	0.	0.	0.	0.	2696.	9987.	3603.	7470.	4497.	0.	1810.	7111.
BULK VOLUME TO LEFT (CU YDS)	0.	0.	0.	0.	1391.	635.	229.	2765.	0.	0.	4042.	45.
BULK VOLUME TO RIGHT (CU YDS)	0.	0.	0.	0.	15136.	60590.	21861.	43029.	27571.	0.	7056.	43550.
BULK VOLUME NET (CU YDS)	0.	0.	0.	0.	13744.	59955.	21632.	40264.	27571.	0.	3014.	43505.
BULK VOLUME GROSS (CU YDS)	0.	0.	0.	0.	16527.	61225.	22090.	45794.	27571.	0.	11098.	43594.
NUMBER OF OBSERVATIONS	0.	0.	0.	0.	7.	14.	11.	11.	4.	0.	8.	8.

TOTAL TRANSPORT (SUM OF MONTHLY)

IMMERSED WEIGHT NET(LBS)X10000	34204.
IMMERSED WEIGHT GROSS X10000	37175.
BULK VOLUME TO LEFT (CU YDS)	9106.
BULK VOLUME TO RIGHT (CU YDS)	218792.
BULK VOLUME NET (CU YDS)	209686.
BULK VOLUME GROSS (CU YDS)	227899.

NB=PROPORTIONALITY CONSTANT OF 1.00 USED IN COMPUTATIONS.
ACCEPTED VALUES ARE 0.25(INMAN AND FRAUTSCHY), 0.35(DAS), 0.77(KOMAR)

PRESQUE ISLE PENINSULA
ERIE, PENNSYLVANIA

PHASE I
GENERAL DESIGN MEMORANDUM

APPENDIX D

CONSTRUCTION MATERIALS

APPENDIX D
CONSTRUCTION MATERIALS

TABLE OF CONTENTS

PLATES

TABLE OF CONTENTS (Cont'd)

TABLES

FIGURES

APPENDIX D

CONSTRUCTION MATERIALS

SAND

D1. General.

a. A materials survey was performed in January 1979, to determine possible beach fill sources for the Cooperative Beach Erosion Control Project at Presque Isle, PA. The survey includes material required for the various design alternatives and is subdivided into two parts: (1) onshore sources and (2) offshore borrow areas. It is estimated that sufficient quantities of sand would be available from both the onshore sources and offshore borrow areas for the initial replenishment and for the annual replenishment measures for the life of the project.

b. The survey consisted of a file search and communication with suppliers in which the following were considered:

(1) an analysis of the results of recent sand pit investigations

(2) an analysis of available laboratory test results

(3) the evaluation of available service records

(4) review of data collected by CERC (Coastal Engineering Research Center) as part of a study conducted in Lake Erie to locate offshore sand borrow areas

(5) determination of interest in producing required material on the part of sand pit operators and lake dredged sand suppliers.

D2. Material Design Criteria.

Sand Gradation. Sand for beachfill consists of washed natural sands conforming to gradation limits shown on Figure D1 and as listed below.

Sieve Designation U.S. Standard Square Mesh	Percent Finer By Weight
3/4-inch	100
3/8-inch	60-100
No. 4	40-100
No. 8	20- 85
No. 16	8- 65
No. 30	2- 40
No. 50	0- 15
No. 100	0- 6
No. 200	0- 4

D3. Material Quality.

The material will be a clean natural sand composed of sound, hard, durable grains. The sand shall be free of shale, clays, organics, or other objectionable materials. The sand shall contain less than 20 percent flat or elongated particles when tested in accordance with CRD-C120.

MATERIAL SOURCES AND SELECTION CRITERIA

D4. Onshore Sources.

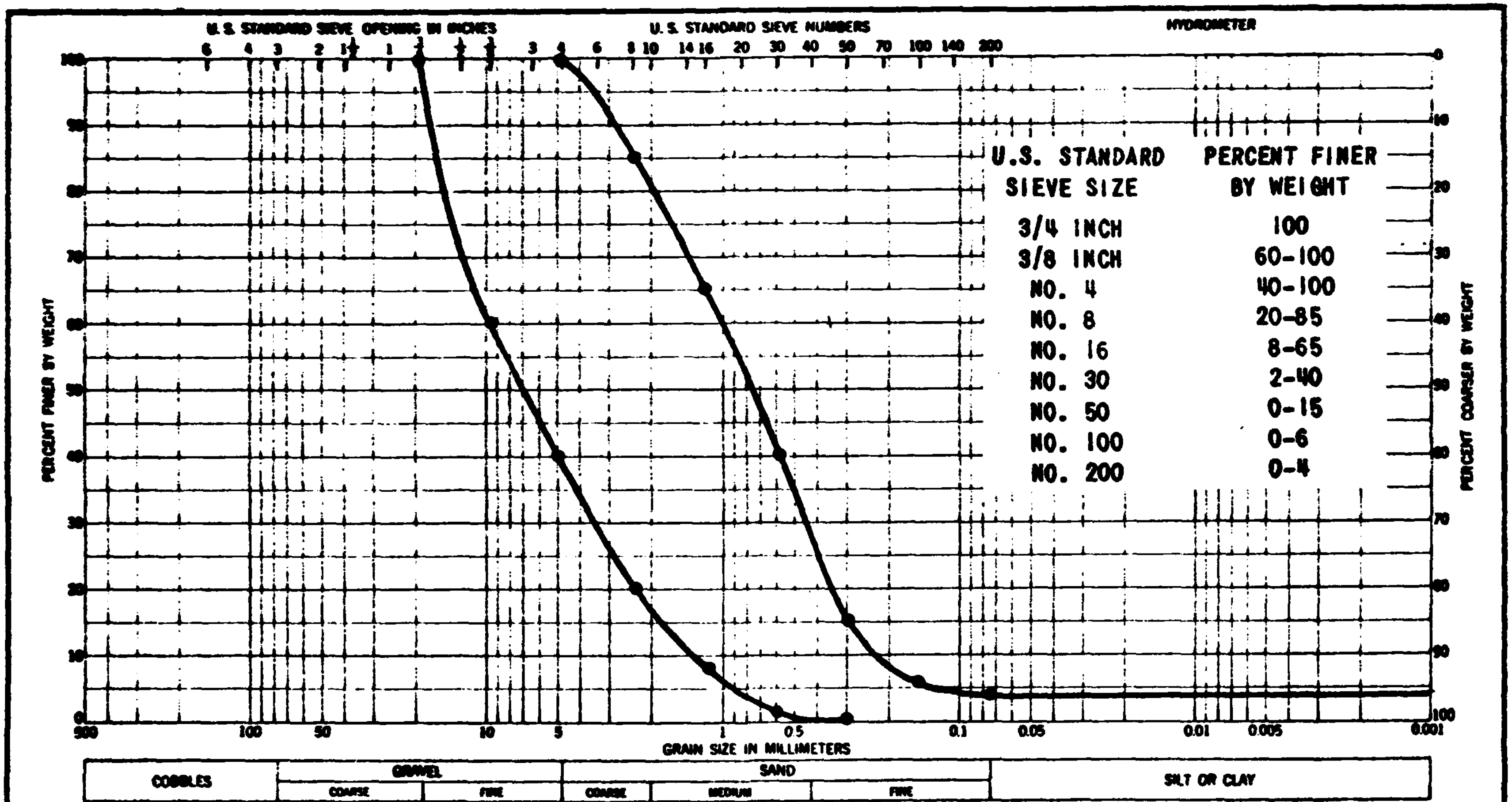
a. General. Various sand and gravel pits were investigated within a 60-mile radius of Presque Isle, PA. Many of the available sources have supplied sand to Presque Isle during previous years.

b. There are two basic types of glacial deposits, in Erie, PA, and adjacent counties, from which sand is being produced. These are: (1) ancestral beach ridges forming a linear belt parallel to the Lake Erie shoreline and (2) stratified drift deposits (including kame terrace and outwash deposits), generally lying above the Appalachian Escarpment. Pits operating in beach ridge deposits represent the nearest inland sources of sand to Presque Isle. However, beach deposits have not been found to be suitable for use as beachfill because of their high percentage of flat and elongated particles which is probably due to a predominance of easily weathered shale and siltstone fragments. Since material from beach ridge deposits does not meet material quality criteria, the onshore survey was limited to the stratified drift deposits found further inland. These deposits are composed of hard, durable grains (primarily quartz, limestone, sandstone, and igneous rock fragments), possessing good particle shape. Several new sources, found in stratified drift deposits, were also investigated. Field examination of material from all of these sources indicated a similar composition and quality to that from sources previously tested and approved.

c. Quantities. Each of the 11 onshore sources listed on Plates D1-D4 contain suitable sand provided that adequate screening is performed to achieve the required gradation. Collectively, these sources represent a total of 270,000 cubic yards of stock-piled sand presently available for use as beachfill at the Presque Isle Project. This figure represents the excess from supply to local demand (e.g., highway departments, local construction), and it is estimated that similar quantities would be available on an annual basis.

D5. Offshore Sources.

a. General. As an alternative or supplement to onshore sources of sand, potential offshore sources in the vicinity of Presque Isle, PA, were investigated. A study consisting of geophysical and coring surveys in nearshore portions of Lake Erie was conducted by CERC (U.S. Army Coastal Engineering Research Center) during 1977 and 1978. The purpose of the study was to locate and delineate offshore sources of sand from Presque Isle, PA, west to Toledo, OH. Preliminary results from analysis of collected Pennsylvania data indicates that a broad ridge exists off the coast of Presque Isle and



U.S. STANDARD SIEVE SIZE	PERCENT FINER BY WEIGHT
3/4 INCH	100
3/8 INCH	60-100
NO. 4	40-100
NO. 8	20-85
NO. 16	8-65
NO. 30	2-40
NO. 50	0-15
NO. 100	0-6
NO. 200	0-4

Sample No.	Elev or Depth	Classification	Nat w %	LL	PL	PI

Project COOPERATIVE BEACH EROSION CONTROL PROJECT

Area PRESQUE ISLE, PA.

Boring No. BEACH FILL

Date FEBRUARY 1979

GRADATION CURVES

ENG FORM 1 MAY 63 2087

FIGURE D1

contains sand suitable for beach nourishment. As shown in Figure D2, the ridge begins about 8 miles off Presque Isle Peninsula and trends northwest towards the Canadian shore. The ridge is mantled by fine to medium sand having a minimum thickness of 2.5 feet and a maximum of up to 20 feet. The deposit is composed of clean, fine to medium sand and, although it is too fine to meet the present beachfill gradation envelope without extensive processing, the use of this material is not precluded. A beachfill stability analysis will be conducted in the detailed design stage during preparation of the Phase II GDM to determine the cost effectiveness of the offshore material relative to the selected alternative. Table D1 provides gross size distribution data for the tops of all cores taken across the ridge. It is estimated in the CERC study that a total of 48.6 million cubic yards of sand suitable for beachfill is present within the defined extent of the offshore source area. This volume estimate is based on a mapped area of 24.3 million square yards and an average sand thickness of 6 feet. Quantities of available sand from the offshore source area appear to far exceed the requirements of each of the various design alternatives.

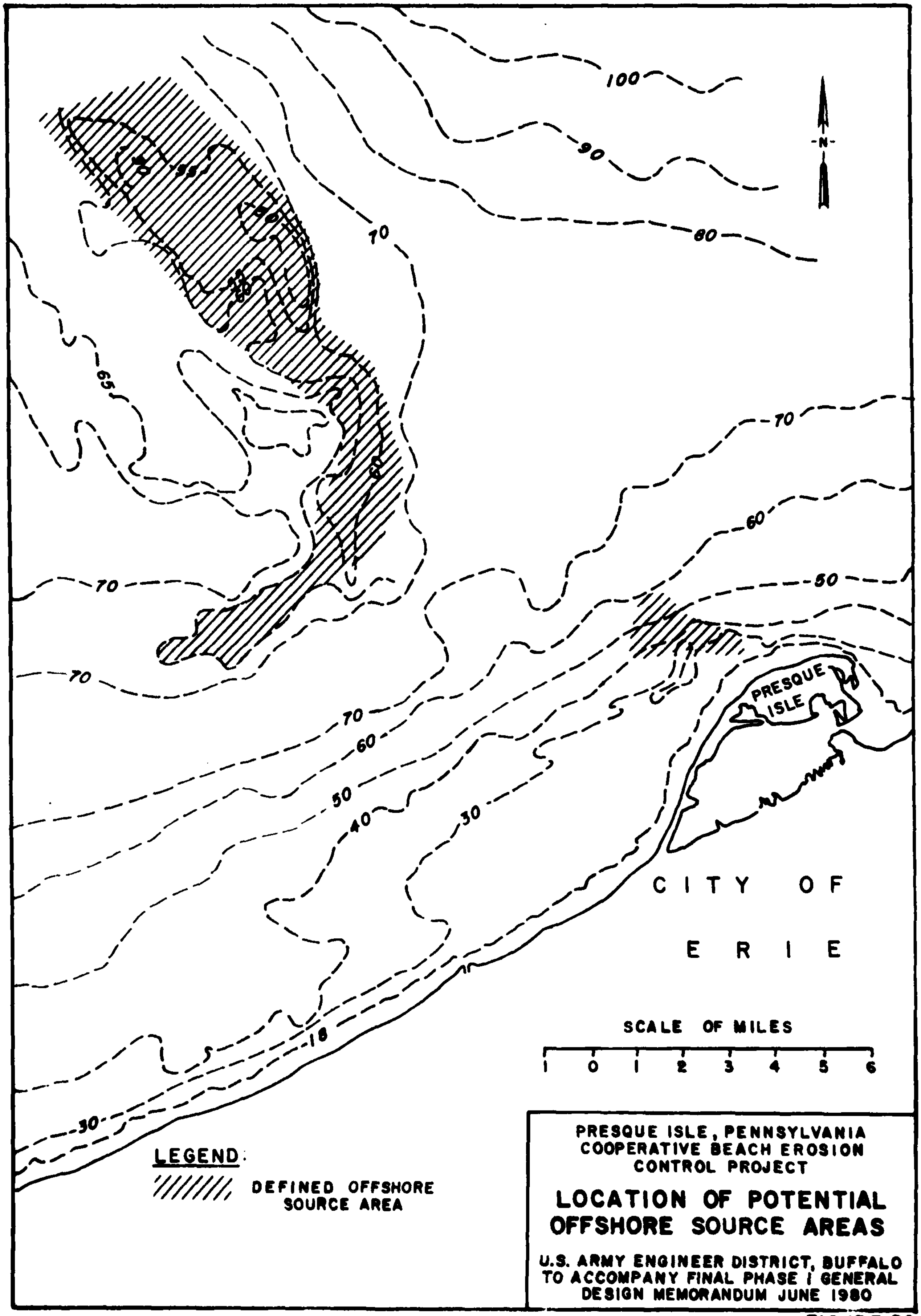
b. Review of dredging permits issued in the Erie, PA, area reveals that the permit dredging area presently used by Erie Sand and Gravel Company for commercial sand production encompasses a portion of the major offshore source area identified in the CERC report (see Figure D3). Expansion of the present permit area to include larger portions of the designated offshore source site would require both Federal and State approval. The State of Pennsylvania Department of Environmental Resources envisions no problem with an expansion of the present permit area in the event that existing reserves become exhausted. Should application be made with the State of Pennsylvania for modification of the dredging permit, a minimum of one year lead time will be required for State review, public hearings, and environmental analysis, if necessary.

c. The second offshore source area identified in the CERC report is a small triangular deposit approximately two miles off Presque Isle. (see Figure D2). It is estimated that the deposit contains 1.9 million cubic yards of sand, however, its proximity to the peninsula presents problems in its consideration as a viable offshore source site. CERC reports that removal of sand from the nearshore deposit may affect both energy levels and energy concentrations on the adjacent shoreline and consequently aggravate erosion problems. Further, it is predicted that the acquisition of State approval for dredging so close to the Pennsylvania shoreline would be difficult if not impossible.

Table D1 - Preliminary Size Distribution Data of Selected Top Samples From Lake Erie ICONS

Core No.	Size Distribution (Percent) 0.850 mm	0.425-0.850 mm	0.250-0.425 mm	0.250 mm	0.25-1.0 mm Percent Medium and Coarse*
1	0.2	0.5	46.0	53.3	46.7
2	0	25.2	44.5	30.3	69.7
3	0	31.3	54.7	14.0	86.0
4	0.1	22.8	48.6	28.5	71.4
5	9.3	3.9	27.7	59.1	40.9
6	0.2	4.9	48.8	46.3	53.9
7	3.6	2.8	7.6	86.0	14.0
8	2.9	51.3	14.5	31.3	68.7
9	COARSE SAND AND PEBBLES				
10	7.3	2.1	23.4	67.3	32.8
15	2.2	16.8	44.7	36.3	63.7
16	0.2	28.5	35.9	35.6	64.6
17	7.0	10.0	47.8	35.4	64.8
18	0.1	3.3	47.8	48.0	51.2
19	0.4	46.7	45.6	7.7	92.7
20	2.2	2.6	63.7	31.3	68.7
21	0	2.3	82.9	14.8	85.2
22	36.2	25.4	22.3	16.0	83.9
23	0.1	0.5	24.2	74.7	24.8
24	29.4	2.3	2.3	66.0	34.0
25	71.1	16.4	7.8	4.6	95.3

* Description of this material as "Medium and Coarse" is based on Udden-Wentworth size grade scale. According to the U. S. Corps of Engineers size grade scale, material in the size range of 0.25 to 1.0 mm is described as Fine to Medium sand.

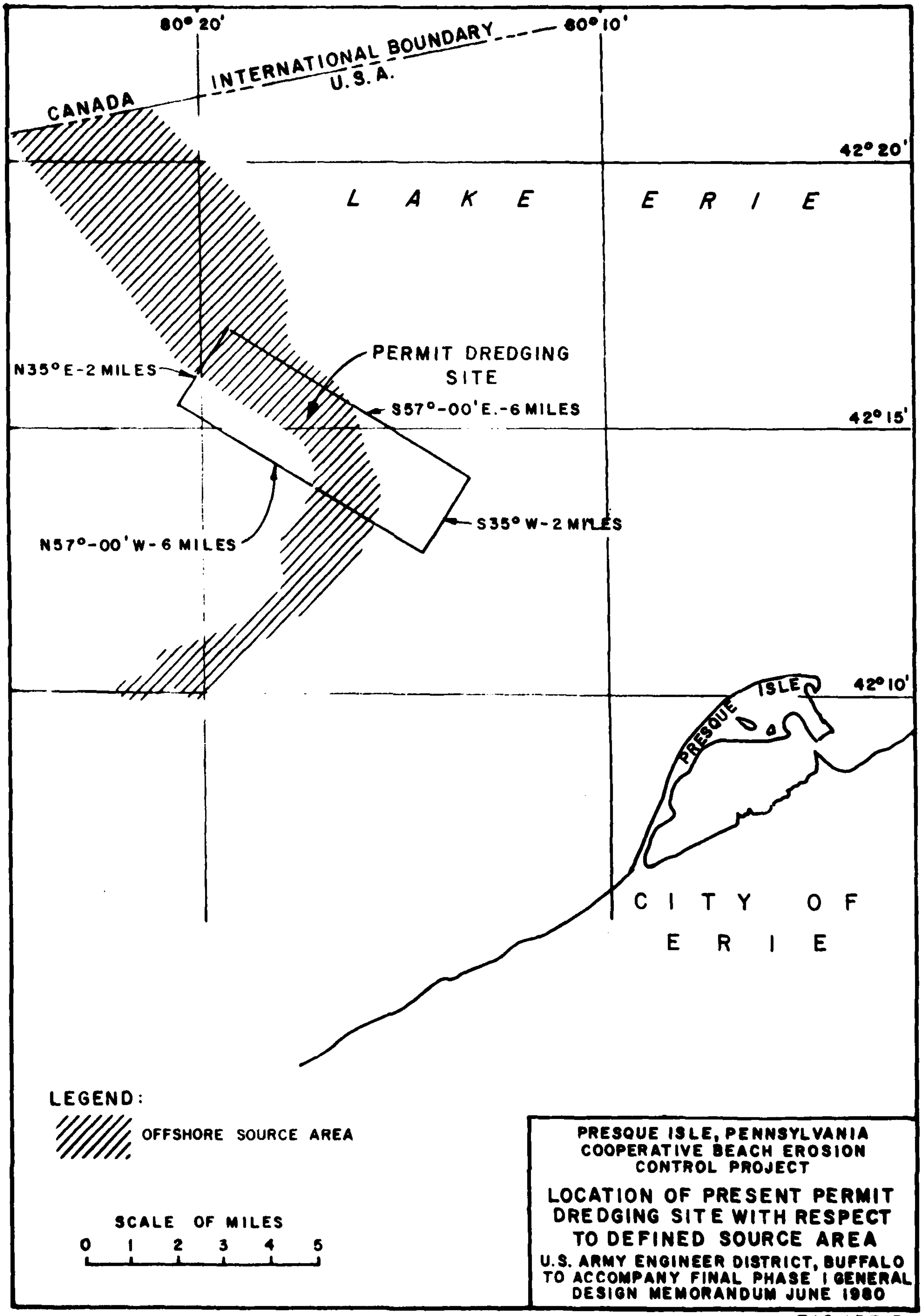


PRESQUE ISLE, PENNSYLVANIA
COOPERATIVE BEACH EROSION
CONTROL PROJECT

LOCATION OF POTENTIAL OFFSHORE SOURCE AREAS

U.S. ARMY ENGINEER DISTRICT, BUFFALO
TO ACCOMPANY FINAL PHASE I GENERAL
DESIGN MEMORANDUM JUNE 1980

FIGURE D2



PRESQUE ISLE, PENNSYLVANIA
COOPERATIVE BEACH EROSION
CONTROL PROJECT

LOCATION OF PRESENT PERMIT
DREDGING SITE WITH RESPECT
TO DEFINED SOURCE AREA

U.S. ARMY ENGINEER DISTRICT, BUFFALO
TO ACCOMPANY FINAL PHASE I GENERAL
DESIGN MEMORANDUM JUNE 1980

FIGURE D3

STONE

D6. <u>General</u>.

a. A materials survey was performed in December 1979 to determine possible stone material sources for the Cooperative Beach Erosion Control Project, Presque Isle, Pennsylvania. The survey includes materials required for Design Alternative I (Groins), Design Alternative II - (Segmented Breakwaters), and Design Alternative III (Sand Trap Breakwater).

b. The survey consisted of a file search in which the following factors were considered:

(1) An analysis of the results of quarry/pit investigations.

(2) An analysis of laboratory test results.

MATERIAL TYPES AND GRADATIONS

D7. <u>Design Alternative I (Groins)</u>.

Stone material for this alternative consists of the following:

a. <u>Head Section</u>. Armor stone, Type A3, 3.0-7.0 tons. Protective pad stone, Type C1, 400-1,400 pounds.

b. <u>Trunk Section</u>. Armor stone, Type A4, 1.0-2.5 tons. Protective pad stone, Type C2, 150-500 pounds.

D8. <u>Design Alternative II (Segmented Breakwaters)</u>.

a. <u>Armor stone</u>, Type A2, 4.0-10.0 tons.

b. <u>Underlayer stone</u>, Type B2, 500-2,000 pounds.

c. <u>Bedding stone</u>, Type D1, 5-100 pounds.

D9. <u>Design Alternative III (Sand Trap Breakwater)</u>.

Stone material for this alternative consists of the following:

a. <u>Armor stone</u>, Type A1, 11.0-25.0 tons.

b. <u>Underlayer stone</u>, Type B1, 0.75-2.5 tons.

c. <u>Bedding stone</u>, Type D2, 3.0-250 pounds.

D10. <u>Specific Gravity of Stone Materials</u>.

A specific gravity of 2.48 (155 pcf) was used to compute the stone sizes specified for each design alternative.

D11. Material Quality.

a. General. Quality requirements for each material type are discussed below. Armor and underlayer stone has been subjected to tests established by the Ohio River Division Laboratories, Cincinnati, OH. Test No. P-11, "Riprap and Breakwater Stone Evaluation" includes a suite of tests to determine stone durability.

b. Armor, Underlayer, Protective Pad, and Bedding Stone. These stones will be composed of a durable material and will be free from significant cracks, seams, and overburden spoil. Only those sources from which the samples did not show any significant breakdown during the freeze-thaw or wet-dry tests are suitable.

D12. Material Sources.

a. Armor, underlayer, protective pad, and bedding stone can be produced from the indicated sources listed in this Appendix. "Possible Material Sources," Plates D5-D12. However, all material from those sources may not be suitable. The right will be reserved in the specifications to reject materials from certain localized areas, zones, strata, channels, or stockpiles, when such materials are unsuitable.

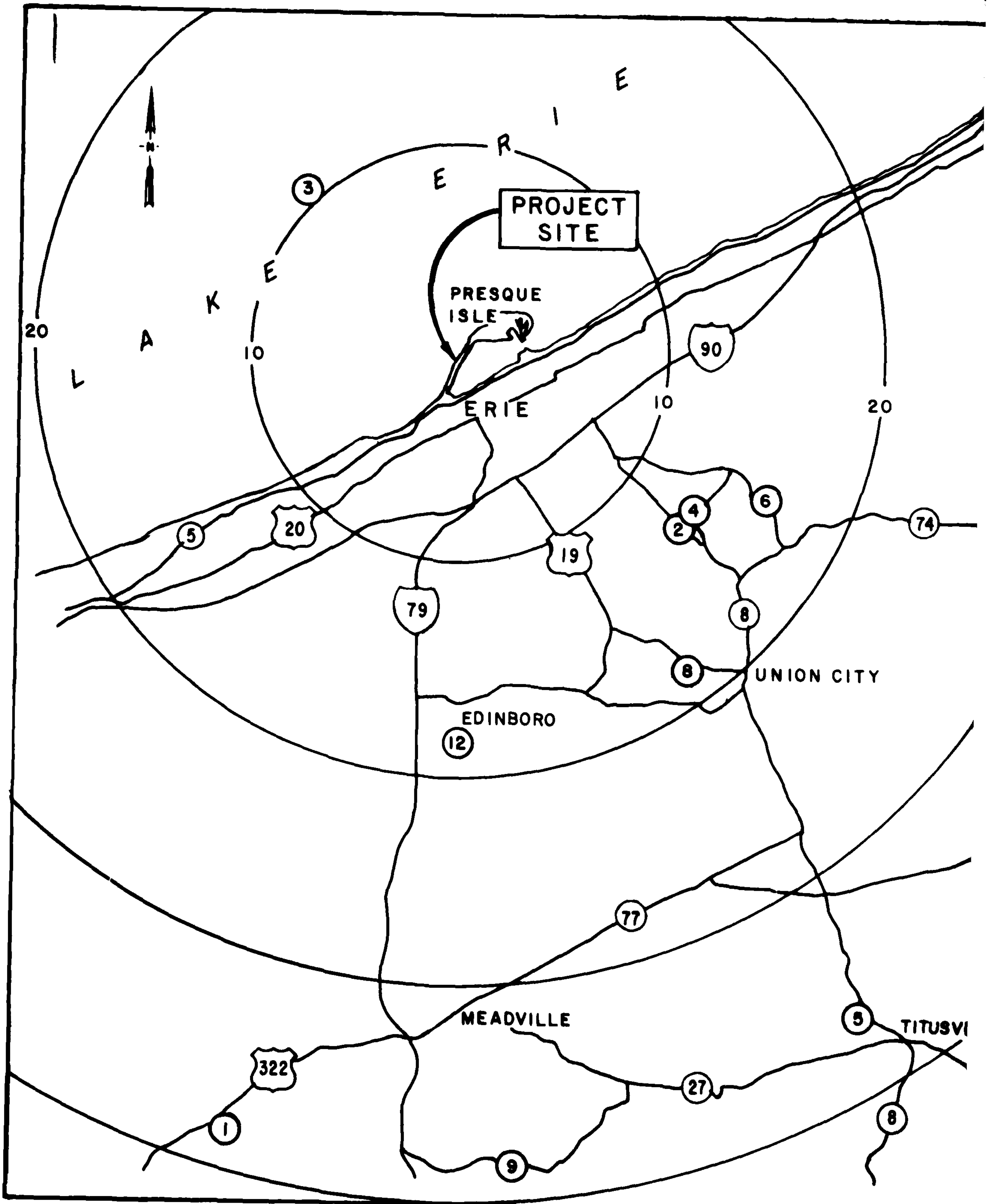
b. It is anticipated that selective quarrying will be required for some material types. Blasting techniques used for normal aggregate production will require adjustments or in some cases complete tailoring to produce armor stone. Also, the specifications will require that shale and other undesirable materials will be excluded by adequate processing. The specifications may also require stockpiling of armor stone prior to use in construction.

c. Twenty-one sources are capable of producing various required stone materials. Transportation and logistics may be a problem for some of the smaller quarry operations as railheads and loading docks are some miles from the quarry. The folowing quarries will be able to utilize water transport: Frontier Stone, Standard Slag at Marblehead, OH, and Quality Quarries at Kelly's Island, OH. The Indiana sources can most likely utilize a combination of rail and water transportation. Material source information and distance from the project site follows:

(1) Armor Stone - Ten possible sources are available within a radius of 400 miles of the project site.

(2) Underlayer and Protective Pad Stone - Sixteen possible sources are available within a radius of 400 miles of the project site.

(3) Bedding Stone - A total of 21 possible sources are available within a radius of 400 mniles of the project site.



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MEADVILLE
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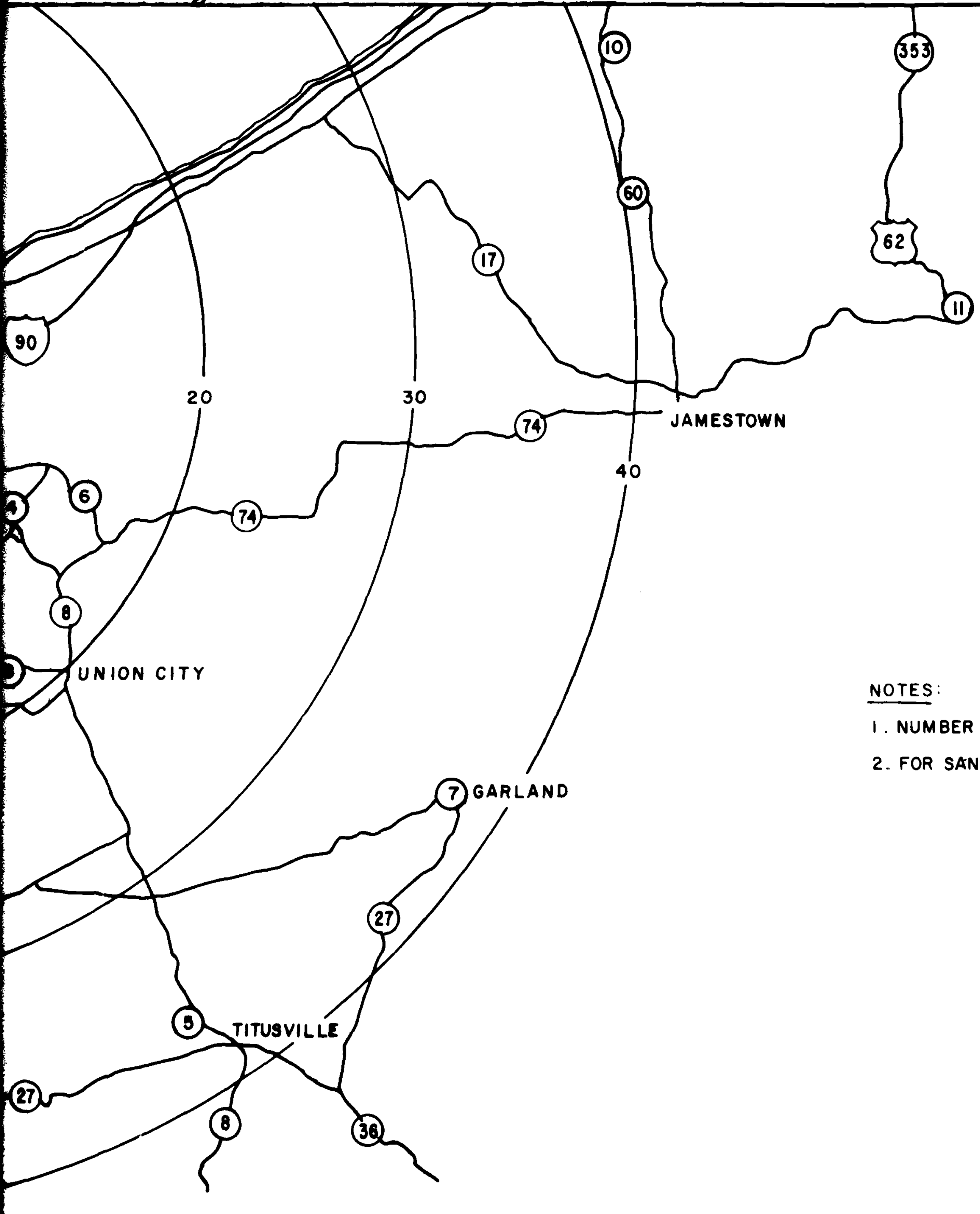
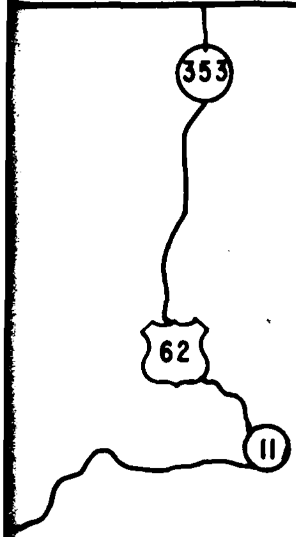


NOTES:

1. NUMBER IN CIRCLE

2. FOR SAND PIT IDEN

3



NOTES:

1. NUMBER IN CIRCLE INDICATES SAND PIT SITE.
2. FOR SAND PIT IDENTIFICATION, SEE FIGURE D2.

PRESQUE ISLE, PENNSYLVANIA
COOPERATIVE BEACH
EROSION CONTROL PROJECT

LOCATION OF SAND SOURCES

U.S. ARMY ENGINEER DISTRICT, BUFFALO

TO ACCOMPANY FINAL PHASE I GENERAL DESIGN MEMORANDUM JUNE 1980

PLATE D1

MAP SUPPLEMENT SHEET
SUMMARY OF POSSIBLE SOURCES FOR CONSTRUCTION MATERIALS

SITE NUMBER	SOURCE	QUARRY OR PIT LOCATION	RADIAL DISTANCE	BEACH FILL
1	ATLAS SAND AND GRAVEL	HARTSTOWN PA	45 MI.	X
2	ERIE AGGREGATES	LAKE PLEASANT, PA.	16 MI.	X
3	ERIE SAND AND GRAVEL	PERMIT DREDGING AREA	12 MI.	X
4	GANZER SAND AND GRAVEL	GREENE TWP,,PA.	16 MI.	X
5	HASBROUCK SAND AND GRAVEL	HYDETOWN, PA.	40 MI.	X
6	MAYBRO ASPHALT CO.	LOWVILLE, PA.	18 MI.	X
7	TIONESTA SAND AND GRAVEL	GARLAND, PA.	40 MI.	X
8	UNION CITY SAND AND GRAVEL	WATERFORD, PA.	14 MI.	X
9	W.L. DUNN	COCHRANTON, PA.	45 MI.	X
10	CASSADAGA SAND AND GRAVEL	CASSADAGA, N.Y.	50 MI.	X
11	CORBETT HILL GRAVEL PRODUCTS	RANDOLPH, N.Y.	60 MI.	X
12	EDINBORO SAND AND GRAVEL	EDINBORO, PA.	18 MI.	X

10	CASSADAGA SAND AND GRAVEL	CASSADAGA, N.Y.	50 MI.	X			
11	CORBETT HILL GRAVEL PRODUCTS	RANDOLPH, N.Y.	60 MI.	X			
12	EDINBORO SAND AND GRAVEL	EDINBORO, PA.	18 MI.	X			

3

NOTES:

X - INDICATES THAT SOURCE CAPABLE OF PRODUCING THAT MATERIAL.

PRESQUE ISLE, PENNSYLVANIA
COOPERATIVE BEACH
EROSION CONTROL PROJECT

MATERIAL SURVEY
SUMMARY OF SAND SOURCES

U.S. ARMY ENGINEER DISTRICT, BUFFALO

TO ACCOMPANY FINAL PHASE I GENERAL DESIGN
MEMORANDUM JUNE 1980

PLATE D2

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SUMMARY OF POSSIBLE SOURCES OF BEACH FILL

SOURCE	ROCK TYPE	PROPOSED USE	RADIAL DISTANCE	LABORATORY TEST RECORD			
				DATE TESTED	LABORATORY	PROJECT FOR WHICH TESTED	DATE U
ATLAS SAND AND GRAVEL INC. PIT AT HARTSTOWN, PA.	STRATIFIED DRIFT (ONSHORE)	BEACH FILL	45 MI.	ANNUALLY	PENN DOT	PENN APPROVED SOURCE OF TYPE A FINE AGGREGATE	UNKNOWN
ERIE AGGREGATES PIT AT LAKE PLEASANT, PA.	STRATIFIED DRIFT (ONSHORE)	BEACH FILL	16 MI.	4 MAY 1978	ORDL 103/78.6158	PRESQUE ISLE BEACH NOURISHMENT PROJECT	1977-1978
ERIE SAND AND GRAVEL ERIE, PA.	OFFSHORE PERMIT DREDGING AREA	BEACH FILL	12 MI.	NOVEMBER 1976	ORDL 103/78.6278	PRESQUE ISLE BEACH NOURISHMENT PROJECT	1975-1976
	OFFSHORE BORROW AREA	BEACH FILL	8 MI.+	JANUARY 1979	CERC	PRELIMINARY RESULTS OF A LAKE ERIE GEOPHYSICAL AND CORING STUDY	
GANZER SAND AND GRAVEL PIT AT GREENE TWP, PA.	STRATIFIED DRIFT (ONSHORE)	BEACH FILL	16 MI.	JULY 1978	ORDL 103/78.6158	PRESQUE ISLE BEACH NOURISHMENT PROJECT	1977-1978
HASBROUCK SAND AND GRAVEL PIT AT HYDETOWN, PA.	STRATIFIED DRIFT (ONSHORE)	BEACH FILL	40 MI.	ANNUALLY	PENN DOT	PA APPROVED SOURCE OF TYPE "A" FINE AGGREGATE	UNKNOWN
MAYBRO ASPHALT CO. PIT AT LOWVILLE, PA.	STRATIFIED DRIFT (ONSHORE)	BEACH FILL	18 MI.	4 MAY 1978	ORDL 103/78.6108	PRESQUE ISLE BEACH NOURISHMENT PROJECT	1977
TIONESTA SAND AND GRAVEL PIT AT GARLAND, PA.	STRATIFIED DRIFT (ONSHORE)	BEACH FILL	40 MI.	ANNUALLY	PENN DOT	PA APPROVED SOURCE OF TYPE "A" FINE AGGREGATE	UNKNOWN
UNION CITY SAND AND GRAVEL PIT AT WATERFORD, PA.	STRATIFIED DRIFT (ONSHORE)	BEACH FILL	17 MI.	17 JULY 1978	ORDL 103/78.6158	PRESQUE ISLE BEACH NOURISHMENT PROJECT	1977-1978
W. L. DUNN PIT AT COCHRANTON, PA.	STRATIFIED DRIFT (ONSHORE)	BEACH FILL	45 MI	1978	PENN DOT	PA APPROVED SOURCE OF TYPE "A" FINE AGGREGATE	
EDINBORO SAND AND GRAVEL PIT AT EDINBORO, PA.	STRATIFIED DRIFT (ONSHORE)	BEACH FILL	18 MI.	2 MARCH 1979	ORDL 103/79.6108	PRESQUE ISLE BEACH NOURISHMENT PROJECT	1977-1978

SUMMARY OF POSSIBLE SOURCES OF BEACH FILL

SOURCE	ROCK TYPE	PROPOSED USE	RADIAL DISTANCE	LABORATORY TEST RECORD			
				DATE TESTED	LABORATORY	PROJECT FOR WHICH TESTED	DATE U
CASSADAGA GRAVEL PRODUCTS PIT AT CASSADAGA N.Y.	STRATIFIED DRIFT (ONSHORE)	BEACH FILL	50 MI.	ANNUALLY	NYS DOT	NYS APPROVED SOURCE OF BITUMINOUS SAND	UNKNOWN
CORBETT HILL GRAVEL PRODUCTS PIT AT RANDOLPH, N.Y.	STRATIFIED DRIFT (ONSHORE)	BEACH FILL	60 MI.	1977-1978	NYS DOT PENN DOT	NYS APPROVED SOURCE OF FINE AGGREGATE	UNKNOWN

TEST RECORD		SERVICE RECORD			REMARKS
Y	PROJECT FOR WHICH TESTED	DATE USED	PROJECT	EVALUATION	
	PENN APPROVED SOURCE OF TYPE A FINE AGGREGATE	UNKNOWN	UNKNOWN		ESTIMATED QUANTITIES OF SAND PRESENTLY AVAILABLE: 27,000 CU. YDS.
	PRESQUE ISLE BEACH NOURISHMENT PROJECT	1977-1978	PRESQUE ISLE BEACH NOURISHMENT PROJECT		ESTIMATED QUANTITIES OF SAND PRESENTLY AVAILABLE: 47,000 CU. YDS.
	PRESQUE ISLE BEACH NOURISHMENT PROJECT	1975-1976	PRESQUE ISLE BEACH NOURISHMENT PROJECT		SEE FIGURE 4 IN TEXT FOR LOCATION OF ERIE SAND AND GRAVEL PERMIT DREDGING AREA WITH RESPECT TO DEFINED OFFSHORE BORROW AREA .
	PRELIMINARY RESULTS OF A LAKE ERIE GEOPHYSICAL AND CORING STUDY				IT IS ESTIMATED THAT AN ADDITIONAL 40 MILLION CUBIC YARDS OF SAND IS PRESENT IN THE DEFINED OFFSHORE BORROW AREA. AVAILABILITY SUBJECT TO STATE AND FEDERAL PERMIT.
	PRESQUE ISLE BEACH NOURISHMENT PROJECT	1977-1978	PRESQUE ISLE BEACH NOURISHMENT PROJECT		ESTIMATED QUANTITIES OF SAND PRESENTLY AVAILABLE: 20,000 CU. YDS.
	PA APPROVED SOURCE OF TYPE "A" FINE AGGREGATE	UNKNOWN			
	PRESQUE ISLE BEACH NOURISHMENT PROJECT	1977	PRESQUE ISLE BEACH NOURISHMENT PROJECT		ESTIMATED QUANTITIES OF SAND PRESENTLY AVAILABLE: 10,000 CU. YDS.
	PA APPROVED SOURCE OF TYPE "A" FINE AGGREGATE	UNKNOWN	UNKNOWN		ESTIMATED QUANTITIES OF SAND PRESENTLY AVAILABLE: 67,000 CU. YDS.
	PRESQUE ISLE BEACH NOURISHMENT PROJECT	1977-1978	PRESQUE ISLE BEACH NOURISHMENT PROJECT		ESTIMATED QUANTITIES OF SAND PRESENTLY AVAILABLE: 27,000 CU. YDS.
	PA APPROVED SOURCE OF TYPE "A" FINE AGGREGATE				ESTIMATED QUANTITIES OF SAND PRESENTLY AVAILABLE: 53,000 CU. YDS.
	PRESQUE ISLE BEACH NOURISHMENT PROJECT	1977-1978	PRESQUE ISLE BEACH NOURISHMENT PROJECT		ESTIMATED QUANTITIES OF SAND: 20,000 CU. YDS.

PRESQUE ISLE, PENNSYLVANIA
COOPERATIVE BEACH
EROSION CONTROL PROJECT

PENN SAND SOURCES MATERIALS SURVEY

U.S. ARMY ENGINEER DISTRICT, BUFFALO

TO ACCOMPANY FINAL PHASE I GENERAL DESIGN MEMORANDUM JUNE 1980

PLATE D3

TEST RECORD		SERVICE RECORD			REMARKS
Y	PROJECT FOR WHICH TESTED	DATE USED	PROJECT	EVALUATION	
	NYS APPROVED SOURCE OF BITUMINOUS SAND	UNKNOWN	UNKNOWN		PIT VISUALLY INSPECTED 12-8-78. ESTIMATED QUANTITIES OF SAND PRESENTLY AVAILABLE: 200,000 CU. YDS.
	NYS APPROVED SOURCE OF FINE AGGREGATE	UNKNOWN	UNKNOWN		ESTIMATED QUANTITIES OF SAND PRESENTLY AVAILABLE: 65,000 CU. YDS.

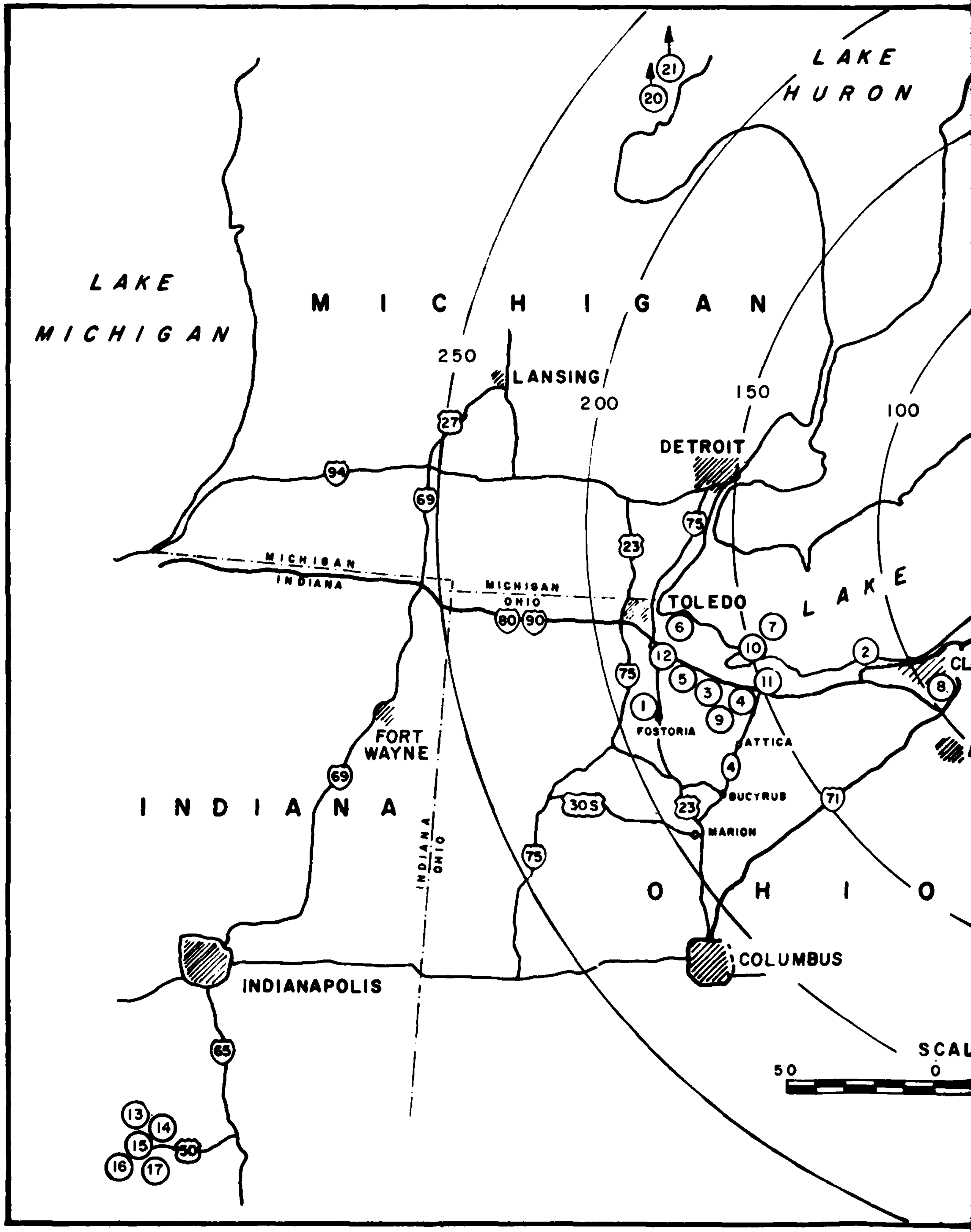
PRESQUE ISLE, PENNSYLVANIA
COOPERATIVE BEACH
EROSION CONTROL PROJECT

NEW YORK SAND SOURCES MATERIALS SURVEY

U.S. ARMY ENGINEER DISTRICT, BUFFALO

TO ACCOMPANY FINAL PHASE I GENERAL DESIGN MEMORANDUM JUNE 1980

PLATE D4



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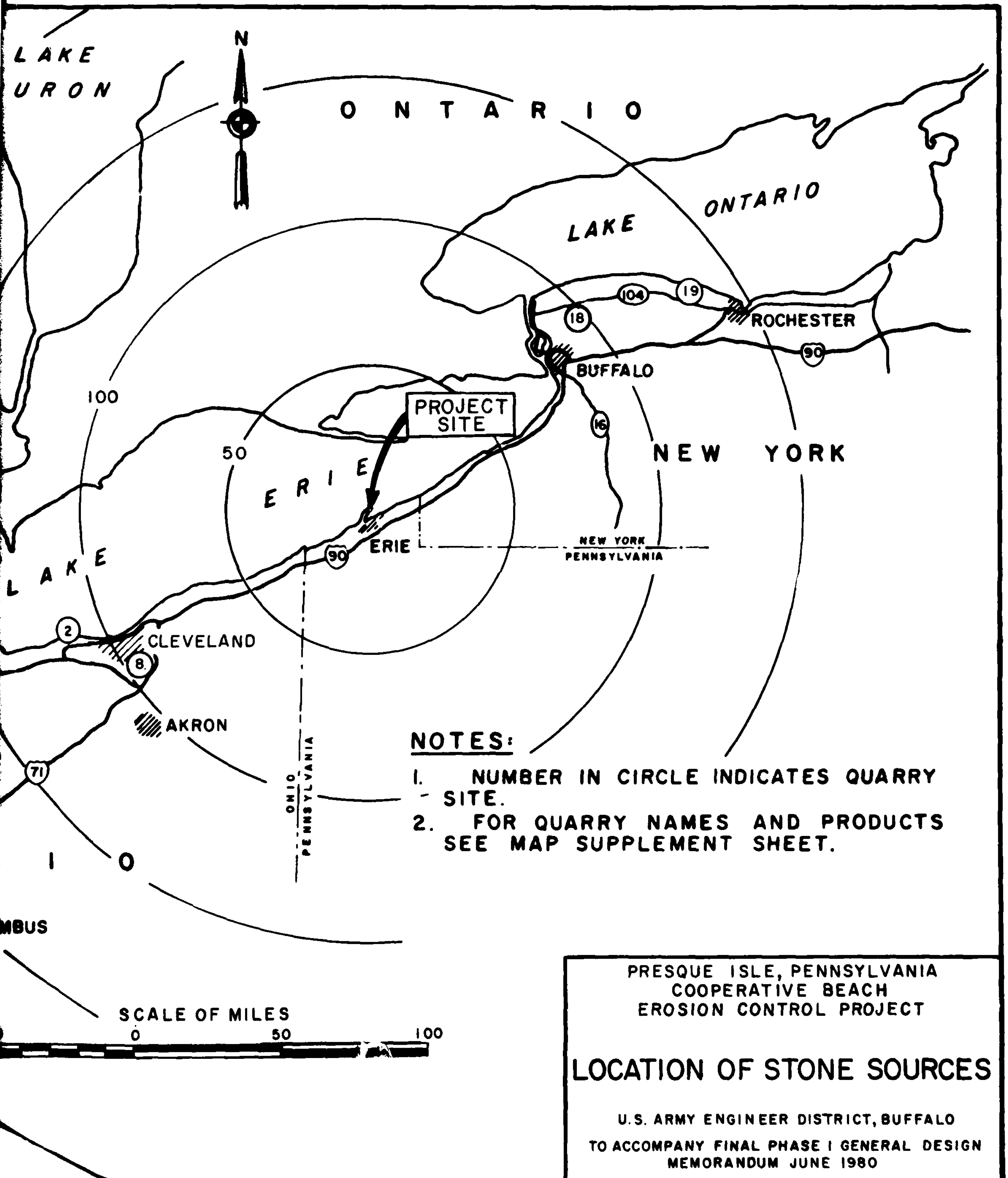

NOTES:

1. NUMBER IN CIRCLE INDICATES QUARRY SITE.
2. FOR QUARRY NAMES AND PRODUCTS SEE MAP SUPPLEMENT SHEET.

PRESQUE ISLE, PENNSYLVANIA
COOPERATIVE BEACH
EROSION CONTROL PROJECT

LOCATION OF STONE SOURCES

U.S. ARMY ENGINEER DISTRICT, BUFFALO

TO ACCOMPANY FINAL PHASE I GENERAL DESIGN MEMORANDUM JUNE 1980

PLATE D5

MAP SUPPLEMENT SHEET
SUMMARY OF POSSIBLE SOURCES FOR CONSTRUCTION MATERIALS

SITE NUMBER	SOURCE	QUARRY OR PIT LOCATION	RADIAL DISTANCE (IN MILES)	ARMOR STONE, TYPE A1	ARMOR STONE, TYPE A2	ARMOR STONE, TYPE A3	ARMOR STONE, TYPE A4	UNDERLAYER STONE, TYPE B1	UNDERLAYER STONE, TYPE B2	PROTECTIVE PAD STONE, TYPE C1	PROTECTIVE PAD STONE, TYPE C2	BEDDING STONE, TYPE D1	BEDDING STONE, TYPE D2
1.	BROUGH STONE CO.	WEST MILLGROVE, OH	190			X	X	X	X	X	X	X	X
2.	CLEVELAND QUARRIES	SOUTH AMHERST	120	X	X	X	X	X	X	X	X	X	X
3.	FRANCE STONE CO.	BELLEVUE, OH	175									X	X
4.	FRANCE STONE CO.	FLAT ROCK, OH	150					X	X	X	X	X	X
5.	GOTTRON BROS.	FREMONT, OH	175				X	X	X	X	X	X	X
6.	E. KRAEMER AND SON, INC.	CLAY CENTER, OH	160									X	X
7.	QUALITY QUARRIES	KELLY'S ISLAND, OH	140	X	X	X	X	X	X	X	X	X	X
8.	ROCKSIDE RECLAMATION INC.	GARFIELD HEIGHTS, OH	100		X	X	X	X	X	X	X	X	X
9.	SANDUSKY CRUSHED STONE	PARKERTOWN, OH	170				X	X	X	X	X	X	X
10.	STANDARD SLAG CO.	MARBLEHEAD, OH	150	X	X	X	X	X	X	X	X	X	X
11.	WAGNER QUARRIES CO.	SANDUSKY, OH	150									X	X
12.	WOODVILLE LIME AND CHEMICAL	WOODVILLE, OH	180				X	X	X	X	X	X	X
13.	EMPIRE WOOD CO.	BLOOMINGTON, IN	400	X	X	X	X	X	X	X	X	X	X
14.	B.G. HOADLEY QUARRIES	BLOOMINGTON, IN	400	X	X	X	X	X	X	X	X	X	X
15.	INDIANA LIMESTONE CO.	BEDFORD, IN	400	X	X	X	X	X	X	X	X		X
16.	VICTOR OOLITIC CO.	BLOOMINGTON, IN	400	X	X	X	X	X	X	X	X		X
17.	WOOLERY STONE CO.	BLOOMINGTON, IN	400	X	X	X	X	X	X	X	X	X	X

13.	[illegible] WOOD CO.	BLOOMINGTON, IN	400	X	X	X	X	X	X	X	X	X	X
14.	B.G. HOADLEY QUARRIES	BLOOMINGTON, IN	400	X	X	X	X	X	X	X	X	X	X
15.	INDIANA LIMESTONE CO.	BEDFORD, IN	400	X	X	X	X	X	X	X	X		X
16.	VICTOR OOLITIC CO.	BLOOMINGTON, IN	400	X	X	X	X	X	X	X	X		X
17.	WOOLERY STONE CO.	BLOOMINGTON, IN	400	X	X	X	X	X	X	X	X	X	X
18.	FRONTIER STONE PRODUCTS INC.	LOCKPORT, N.Y.	100	X	X	X	X	X	X	X	X	X	X
19.	MEDINA STONE QUARRY	HULBERTON, N.Y.	140	X	X	X	X	X	X	X	X	X	X
20.	U.S. STEEL CORP.	ROGER'S CITY, MI.	250										X
21.	U.S. STEEL CORP.	CEDARVILLE, MI.	250										X

NOTES:

ARMOR STONE: TYPE A1, 9.5 - 21.5 TONS
ARMOR STONE: TYPE A2, 4.0 = 10.0 TONS
ARMOR STONE: TYPE A3, 3.0 - 7.0 TONS
ARMOR STONE: TYPE A4, 1.0 - 2.5 TONS
UNDERLAYER STONE: TYPE B1, 0.5 - 2.2 TONS
UNDERLAYER STONE: TYPE B2, 500 - 2000 LBS.
PROTECTIVE PAD STONE: TYPE C1, 400 - 1400 LBS.
PROTECTIVE PAD STONE: TYPE C2, 150 - 500 LBS.
BEDDING STONE: TYPE D1, 5 - 100 LBS.
BEDDING STONE: TYPE D2, 3.0 - 215 LBS.

X - QUARRY CAPABLE OF PRODUCING STONE TYPE INDICATED.

2

PRESQUE ISLE, PENNSYLVANIA
COOPERATIVE BEACH
EROSION CONTROL PROJECT

MATERIALS SURVEY
SUMMARY OF STONE SOURCES

U S ARMY ENGINEER DISTRICT, BUFFALO

TO ACCOMPANY FINAL PHASE I GENERAL DESIGN MEMORANDUM JUNE 1980

POSSIBLE SOURCES FOR ARMOR, UNDERLAYER, PROTECTIVE PAD, AND BEDDING STONE

SOURCE	ROCK TYPE	PROPOSED USE	RADIAL DISTANCE	LABORATORY TEST RECORD: DATE TESTED	LABORATORY	PROJECT FOR WHICH TESTED	DA
BROUGH STONE CO. QUARRY AT WEST MILLGROVE, OHIO OFFICE AT TOLEDO, OHIO	NIAGARAN DOLOMITE	UNDERLAYER PROTECTIVE PAD AND BEDDING STONE	190 MI.	NOVEMBER 1972	ORD LAB LAB *103/73.606C	CONFINED DREDGE SPOIL DISPOSAL PROGRAM (LORAIN DIKE)ARMOR STONE)	UNKNOWN
				AUGUST 1976	ORD LAB LAB *101/76T.307B	CONFINED DREDGE SPOIL DISPOSAL AREA AT LORAIN (CONCRETE AGGREGATE)	UNKNOWN
CLEVELAND QUARRIES QUARRY AT SOUTH AMHERST, OHIO OFFICE AT SOUTH AMHERST., OH	BEREA SANDSTONE	UNDERLAYER PROTECTIVE PAD AND BEDDING STONE	120 MI.	AUGUST 1967	ORD LAB LAB *103/68.604C	PILOT STUDY CONFINED DIKE DISPOSAL PROGRAM CLEVELAND HARBOR (RIPRAP)	UNKNOWN
				APRIL 1972	ORD LAB LAB *103/72.606C	WELLSVILLE REHABILITATION PROJECT, WELLSVILLE N.Y. (DERRICK STONE)	UNKNOWN
				APRIL 1975	ORD LAB LAB *103/75.618B	CONFINED DREDGE SPOIL DISPOSAL AREA NO. 7, LORAIN HARBOR, OHIO	UNKNOWN

POSSIBLE SOURCES FOR ARMOR, UNDERLAYER, PROTECTIVE PAD, AND BEDDING STONE

SOURCE	ROCK TYPE	PROPOSED USE	RADIAL DISTANCE	LABORATORY TEST RECORD: DATE TESTED	LABORATORY	PROJECT FOR WHICH TESTED	DA
FRANCE STONE CO. QUARRY AT BELLEVUE, OH OFFICE AT TOLEDO, OH	COLUMBUS DOLOMITE LUCAS DOLOMITE	BEDDING STONE	64 MI.	MARCH 197?	ORD LAB LAB *103/72.606C	CONFINED DREDGE SPOIL DISPOSAL PROGRAM (COARSE AGGREGATE FOR CONCRETE AND RIPRAP)	UNKNOWN
FRANCE STONE CO. (FORMERLY NORTHERN OHIO STONE CO.) QUARRY AT FLAT ROCK, OH OFFICE AT TOLEDO, OH	LUCAS DOLOMITE	UNDERLAYER, PROTECTIVE PAD AND BEDDING STONE	66 MI.	MARCH 1972	ORD LAB LAB *103/72.606C	CONFINED DREDGE SPOIL DISPOSAL PROGRAM (CELL FILL, CONCRETE AGGREGATES-COARSE AND RIPRAP)	UNKNOWN
GOTTRON BROS. QUARRY AT FREMONT, OH OFFICE AT LORAIN, OH	MONROE DOLOMITE	UNDERLAYER, PROTECTIVE PAD AND BEDDING STONE	79 MI.	AUGUST 1970	ORD LAB LAB *101/71 312C	LOCAL FLOOD PROTECTION SANDUSKY RIVER, FREMONT OH.	1970-19
E. KRAEMER AND SON, INC. QUARRY AT CLAY CENTER, OHIO OFFICE AT CLAY CENTER, OHIO	NIAGARAN DOLOMITE	BEDDING STONE	89 MI.	MARCH 1972	ORD LAB LAB *103/72.606C	CONFINED DREDGE SPOIL DISPOSAL PROGRAM (ARMOR STONE)	UNKNOWN
QUALITY QUARRIES QUARRY AT KELLEY'S ISLAND, OHIO	AMHERSTBURG AND LUCAS DOLOMITE	ARMOR, UNDERLAYER, PROTECTIVE PAD AND BEDDING STONE	55 MI.	JULY 1976	ORD LAB LAB *103/76T.603B	CONFINED DREDGE SPOIL DISPOSAL PROGRAM DIKE 14 (ARMOR STONE)	1976
				DECEMBER 1977	ORD LAB LAB *103/78.601B	CONFINED DREDGE SPOIL DISPOSAL PROGRAM DIKE 4 (ARMOR STONE)	

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…RY	TEST RECORD	SERVICE RECORD			REMARKS
	PROJECT FOR WHICH TESTED	DATE USED	PROJECT	EVALUATION	
…C	CONFINED DREDGE SPOIL DISPOSAL PROGRAM (LORAIN DIKE)(ARMOR STONE)	UNKNOWN	UNKNOWN	UNKNOWN	UNIT WEIGHT VARIES FROM 158 P.C.F. TO 166 P.C.F. RAIL FACILITIES AVAILABLE SEVERAL MILES AWAY FROM QUARRY.
…78	CONFINED DREDGE SPOIL DISPOSAL AREA AT LORAIN (CONCRETE AGGREGATE)	UNKNOWN	UNKNOWN	UNKNOWN	EXCESS AMOUNT (14.8%) OF MINUS #200 MATERIAL WAS RECORDED IN FINE AGGREGATE. WILL REQUIRE WASHING.
…C	PILOT STUDY CONFINED DIKE DISPOSAL PROGRAM CLEVELAND HARBOR (RIPRAP)	UNKNOWN	UNKNOWN	UNKNOWN	UNIT WEIGHT AVERAGES ABOUT 143.5 P.C.F. THIS SANDSTONE HAS A GOOD SERVICE RECORD. IT HAS BEEN USED ON SEVERAL OUTER BREAKWALLS IN THIS DISTRICT. HOWEVER, IT WILL FAIL MOST DURABILITY TESTS.
…C	WELLSVILLE REHABILITATION PROJECT, WELLSVILLE N.Y. (DERRICK STONE)	UNKNOWN	UNKNOWN	UNKNOWN	
[illegible]	CONFINED DREDGE SPOIL DISPOSAL AREA NO. 7, LORAIN HARBOR, OHIO	UNKNOWN	UNKNOWN	UNKNOWN	SPECIFIC GRAVITY VARIES FROM 2.28 TO 2.33. MINIMUM OF 100 DAYS CURING REQUIRED.

PRESQUE ISLE, PENNSYLVANIA
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OHIO STONE SOURCES MATERIALS SURVEY

U.S. ARMY ENGINEER DISTRICT, BUFFALO

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…RY	TEST RECORD	SERVICE RECORD			REMARKS
	PROJECT FOR WHICH TESTED	DATE USED	PROJECT	EVALUATION	
[illegible]	CONFINED DREDGE SPOIL DISPOSAL PROGRAM (COARSE AGGREGATE FOR CONCRETE AND RIPRAP)	UNKNOWN	UNKNOWN	UNKNOWN	SPECIFIC GRAVITY FOR CONCRETE AGGREGATE IS 2.58. UNIT WEIGHT FOR RIPRAP MATERIALS VARY FROM 154 P.C.F. TO 161 P.C.F. LEDGE NO. 5 HAS A VERY LOW UNIT WEIGHT (138.5 P.C.F.) AND IS NOT ACCEPTABLE FOR THIS PROJECT. RAIL FACILITIES AVAILABLE.
[illegible]	CONFINED DREDGE SPOIL DISPOSAL PROGRAM (CELL FILL, CONCRETE AGGREGATES-COARSE AND RIPRAP)	UNKNOWN	UNKNOWN	UNKNOWN	UNIT WEIGHT VARIES FROM 153.5 P.C.F. TO 171 P.C.F. RAIL FACILITIES NOT AVAILABLE.
[illegible]	LOCAL FLOOD PROTECTION SANDUSKY RIVER, FREMONT OH.	1970-1972	LOCAL FLOOD PROTECTION SANDUSKY RIVER, FREMONT, OHIO	SATISFACTORY	SPECIFIC GRAVITY VARIES FROM 2.58 TO 2.67. RAIL FACILITIES AVAILABLE.
[illegible]	CONFINED DREDGE SPOIL DISPOSAL PROGRAM (ARMOR STONE)	UNKNOWN	UNKNOWN	UNKNOWN	UNIT WEIGHT VARIES FROM 167 P.C.F. TO 169 P.C.F. RAIL FACILITIES AVAILABLE. COARSE AGGREGATE FOR CONCRETE WILL REQUIRE TESTING PRIOR TO APPROVAL.
[illegible]	CONFINED DREDGE SPOIL DISPOSAL PROGRAM DIKE 14 (ARMOR STONE)	1976	C.D.D.S. DIKE 14	TOO EARLY TO EVALUATE	
[illegible]	CONFINED DREDGE SPOIL DISPOSAL PROGRAM DIKE 4 (ARMOR STONE)			CURRENTLY BEING TESTED	UNITS KI-L2-I UPPER & LOWER & KI-LIA-I ONLY ACCEPTABLE FOR A STONE.

PRESQUE ISLE PENNSYLVANIA
COOPERATIVE BEACH
EROSION CONTROL PROJECT

OHIO STONE SOURCES MATERIALS SURVEY

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POSSIBLE SOURCES FOR ARMOR, UNDERLAYER, PROTECTIVE PAD, AND BEDDING STONE							
SOURCE	ROCK TYPE	PROPOSED USE	RADIAL DISTANCE	LABORATORY TEST RECORD			
				DATE TESTED	LABORATORY	PROJECT FOR WHICH TESTED	DATE
ROCKSIDE RECLAMATION INC. QUARRY AT GARFIELD HEIGHTS, OHIO	EUCLID SANDSTONE LENTIL OF THE BEDFORD SHALE	ARMOR, UNDERLAYER PROTECTIVE PAD AND BEDDING STONE	10 MI.	JUNE 1974	ORD LAB LAB #103/74.621C	OPERATION FORESIGHT PROJECT REPAIR EASTLAKE, OHIO (LARGE RIPRAP)	UNKNOWN
				AUGUST 1976	ORD LAB LAB #103/76.624B	CLEVELAND CONFINED DREDGE SPOIL DISPOSAL AREA NO. 14 (ARMOR STONE)	UNKNOWN
				DECEMBER 1977	ORD LAB LAB #103/77.623B	CLEVELAND CONFINED DREDGE SPOIL DISPOSAL AREA NO. 14 (ARMOR STONE)	1977
SANDUSKY CRUSHED STONE CO. QUARRY AT PARKERTOWN, OHIO OFFICE AT PARKERTOWN, OHIO	DELAWARE AND COLUMBUS DOLOMITE	ARMOR, UNDERLAYER, PROTECTIVE PAD AND BEDDING STONE	60 MI.	MARCH 1972	ORD LAB LAB #103/72.606C	CONFINED DREDGE SPOIL DISPOSAL PROGRAM (FINE AND COARSE AGGREGATES FOR CONCRETE, CELL FILL AND RIPRAP)	1973-1976
				FEBRUARY 1977	ORD LAB LAB #101/77.310B	CONFINED DREDGE SPOIL DISPOSAL DIKE AT LORAIN (CONCRETE AGGREGATE)	UNKNOWN
STANDARD SLAG CO. QUARRY AT MARBLEHEAD, OHIO OFFICE AT MARBLEHEAD, OHIO	LUCAS FORMATION (DOLOMITE)	ARMOR, UNDERLAYER, PROTECTIVE PAD AND BEDDING STONE	55 MI.	DECEMBER 1968	ORD LAB LAB #103/69.607C	CLEVELAND DIKED DISPOSAL AREA NO. 2 CLEVELAND HARBOR, OH. (CORE STONE AND ARMOR STONE)	1969
				MARCH 1972	ORD LAB LAB #103/72.606C	CONFINED DREDGE SPOIL DISPOSAL PROGRAM (CORE, INTERMEDIATE, FILTER AND ARMOR STONE)	1973-1974
							1974-1977

POSSIBLE SOURCES FOR ARMOR, UNDERLAYER, PROTECTIVE PAD, AND BEDDING STONE							
SOURCE	ROCK TYPE	PROPOSED USE	RADIAL DISTANCE	LABORATORY TEST RECORD			
				DATE TESTED	LABORATORY	PROJECT FOR WHICH TESTED	DATE
WOODVILLE LIME AND CHEMICAL CO. QUARRY AT WOODVILLE, OHIO OFFICE AT WOODVILLE, OHIO	NIAGARAN DOLOMITE	ARMOR, UNDERLAYER, PROTECTIVE PAD AND BEDDING STONE	89 MI.	OCTOBER 1970	ORD LAB LAB #101/71.320C	FREMONT, OHIO LOCAL FLOOD PROTECTION (RIPRAP)	1971
				SEPTEMBER 1970	ORD LAB LAB #101/71.312C	FREMONT, OHIO LOCAL FLOOD PROTECTION (FINE AND COARSE AGGREGATES FOR CONCRETE, GRANULAR FILL, BASE COURSE, BEDDING AND FILTER)	1971
				DECEMBER 1968	ORD LAB LAB #103/69.607C	CLEVELAND DIKED DISPOSAL NO. 2	UNKNOWN
				OCTOBER 1967	UNKNOWN	CLEVELAND PILOT STUDY DISPOSAL AREA (RIPRAP)	1968
WAGNER QUARRIES QUARRY AT SANDUSKY, OH OFFICE AT SANDUSKY, OH	COLUMBUS DOLOMITE	BEDDING STONE	52 MI.	AUGUST 1965	ORD LAB LAB #101/66.304C	LORAIN HARBOR, OH, COARSE AGGREGATE FOR CONCRETE	1966
				APRIL 1972	ORD LAB LAB #103/72.606C	CONFINED DREDGE SPOIL DISPOSAL PROGRAM (FINE AND COARSE AGGREGATES FOR CONCRETE, CELL FILL, GRANULAR FILL AND RIPRAP)	UNKNOWN
				AUGUST 1973	ORD LAB LAB #101/74.305C	VERMILION HARBOR, OH, COARSE AGGREGATE FOR CONCRETE	1973
				SEPTEMBER 1975	ORD LAB LAB #101/76.302B	CONFINED DREDGE SPOIL DISPOSAL DIKE AT HURON, OH (CONCRETE AGGREGATE)	UNKNOWN

TEST RECORD		SERVICE RECORD			REMARKS
Y	PROJECT FOR WHICH TESTED	DATE USED	PROJECT	EVALUATION	
	OPERATION FORESIGHT PROJECT REPAIR EASTLAKE, OHIO (LARGE RIPRAP)	UNKNOWN	OPERATION FORESIGHT PROJECT REPAIR EASTLAKE, OHIO	UNKNOWN	
	CLEVELAND CONFINED DREDGE SPOIL DISPOSAL AREA NO. 14 (ARMOR STONE)	UNKNOWN	UNKNOWN	UNKNOWN	THIS SANDSTONE IS WELL CEMENTED WITH NO "CURING EFFECT" NOTED.
	CLEVELAND CONFINED DREDGE SPOIL DISPOSAL AREA NO. 14 (ARMOR STONE)	1977	OPERATION FORESIGHT PROJECT REPAIR EASTLAKE, OHIO	TOO EARLY TO EVALUATE	UNIT WEIGHT VARIES FROM 140.1 P.C.F. TO 152.2 (NEW PORTION OF QUARRY)
	CONFINED DREDGE SPOIL DISPOSAL PROGRAM (FINE AND COARSE AGGREGATES FOR CONCRETE, CELL FILL AND RIPRAP)	1973-1974	SANDUSKY RIVER LOCAL FLOOD PROTECTION PROJECT, FREMONT OH. (RIPRAP)	TOO EARLY TO EVALUATE	ONLY MATERIAL IN LIFTS 3 AND 5 IS ACCEPTABLE. UNIT WEIGHT VARIES FROM 162.2 P.C.F. TO 169.7 P.C.F. SPECIFIC GRAVITY FOR FINE AGGREGATES IS 2.62; FOR COARSE AGGREGATES 2.65; FOR RIPRAP 2.69; RAIL FACILITIES AVAILABLE.
	CONFINED DREDGE SPOIL DISPOSAL DIKE AT LORAIN (CONCRETE AGGREGATE)	UNKNOWN	UNKNOWN	UNKNOWN	
	CLEVELAND DIKED DISPOSAL AREA NO. 2 CLEVELAND HARBOR, OH.(CORE STONE AND ARMOR STONE)	1969	CLEVELAND DIKED DISPOSAL AREA NO. 2 CLEVELAND HARBOR, OH (RIPRAP STONE)	SATISFACTORY	ALSO TESTED FOR FINE AND COARSE AGGREGATES FOR CONCRETE AND CELL FILL. SPECIFIC GRAVITY FOR FINE AGGREGATE IS 2.59; FOR COARSE AGGREGATE 2.62 LEDGE ROCK VARIES FROM 2.62 TO 2.75. SELF UNLOADING VESSELS AND BARGE FACILITIES AVAILABLE. ONLY UNITS 17 AND MM-1 ARE ACCEPTABLE FOR A STONE. ONLY CRUSHED STONE FROM LIFT 3 ACCEPTABLE FOR CONCRETE AGGREGATE
	CONFINED DREDGE SPOIL DISPOSAL PROGRAM (CORE, INTERMEDIATE, FILTER AND ARMOR STONE)	1973-1974			
		1974-1977	LORAIN DIKED DISPOSAL AREA, LORAIN HARBOR, OH (ARMOR, CORE, AND UNDERLAYER STONE)	TOO EARLY TO EVALUATE	

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OHIO STONE SOURCES
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TEST RECORD		SERVICE RECORD			REMARKS
Y	PROJECT FOR WHICH TESTED	DATE USED	PROJECT	EVALUATION	
	FREMONT, OHIO LOCAL FLOOD PROTECTION (RIPRAP)	1971	FREMONT OHIO LOCAL FLOOD PROTECTION (RIPRAP)	TOO EARLY TO EVALUATE	AVERAGE WEIGHT IS 165 P.C.F. RAIL FACILITIES AVAILABLE. QUARRY CAPABLE OF PRODUCING LARGE ARMOR STONE; HOWEVER, ARMOR STONE WOULD BE OVERSIZE FROM NORMAL PRODUCTION BLASTING.
	FREMONT, OHIO LOCAL FLOOD PROTECTION (FINE AND COARSE AGGREGATES FOR CONCRETE, GRANULAR FILL, BASE COURSE, BEDDING AND FILTER)	1971	FREMONT, OHIO LOCAL FLOOD PROTECTION PROJECT (CONCRETE FLOOD WALLS)	TOO EARLY TO EVALUATE	SPECIFIC GRAVITY FOR FINE AGGREGATE VARIES FROM 2.68 TO 2.70 FM VARIES FROM 3.03 TO 3.30 BOTH FINE AND COARSE AGGREGATES WILL REQUIRE TESTING PRIOR TO APPROVAL.
	CLEVELAND DIKED DISPOSAL NO. 2	UNKNOWN	UNKNOWN	UNKNOWN	
	CLEVELAND PILOT STUDY DISPOSAL AREA (RIPRAP)	1968	CLEVELAND PILOT STUDY DISPOSAL AREA	SATISFACTORY	
	LORAIN HARBOR, OH, COARSE AGGREGATE FOR CONCRETE	1966	LORAIN BREAKWATER, LORAIN, OH CONCRETE CAP	SATISFACTORY	SPECIFIC GRAVITY IS 2.70
	CONFINED DREDGE SPOIL DISPOSAL PROGRAM (FINE AND COARSE AGGREGATES FOR CONCRETE, CELL FILL, GRANULAR FILL AND RIPRAP)	UNKNOWN	UNKNOWN	UNKNOWN	SPECIFIC GRAVITY FOR FINE AGGREGATE IS 2.63; FOR COARSE AGGREGATE 2.69 UNIT WEIGHT FOR RIPRAP IS 171 P.C.F. QUARRY IS RELUCTANT TO PRODUCE A GRADED RIPRAP.
	VERMILION HARBOR, OH, COARSE AGGREGATE FOR CONCRETE	1973	VERMILION BREAKWATER, VERMILION OH, CONCRETE CAP	TOO EARLY TO EVALUATE	SPECIFIC GRAVITY FOR COARSE AGGREGATE IS 2.68.
	CONFINED DREDGE SPOIL DISPOSAL DIKE AT HURON, OH (CONCRETE AGGREGATE)	UNKNOWN	UNKNOWN	UNKNOWN	

PRESQUE ISLE, PENNSYLVANIA
COOPERATIVE BEACH
EROSION CONTROL PROJECT

OHIO STONE SOURCES
MATERIALS SURVEY

U S ARMY ENGINEER DISTRICT, BUFFALO

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POSSIBLE SOURCES FOR ARMOR, UNDERLAYER, PROTECTIVE PAD, AND V

SOURCE	ROCK TYPE	PROPOSED USE	RADIAL DISTANCE	LABORATORY TEST RECORD: DATE TESTED	LABORATORY	PROJECT FOR WHICH TESTED
INDIANA LIMESTONE CO. QUARRY NEAR BEDFORD, INDIANA OFFICE AT BEDFORD, INDIANA	SALEM LIMESTONE	ALL STONE TYPES	311 MI.	JANUARY 1973	ORD LAB LAB #103/73.612C	COMBINED DREDGE SPOIL DISPOSAL PROGRAM (ARMOR STONE)
				OCTOBER 1976	ORD LAB LAB #103/76.629B	CONFINED DREDGE DISPOSAL DIKE AT LORAIN (ARMOR STONE)
EMPIRE WOOD CO. QUARRY AT BLOOMINGTON, IN OFFICE AT WILLIAMS, IN	SALEM LIMESTONE	ALL STONE TYPES	311 MI.	OCTOBER 1976	ORD LAB LAB #103/76.629B	CONFINED DREDGE DISPOSAL DIKE AT LORAIN (ARMOR STONE)
B.G. HOADLEY QUARRIES QUARRY AT BLO[illegible]TON, IN OFFICE AT BL[illegible]ON, IN	SALEM LIMESTONE	ALL STONE TYPES	311 MI.	OCTOBER 1976	ORD LAB LAB #103/76.629B	CONFINED DREDGE DISPOSAL DIKE AT LORAIN (ARMOR STONE)
VICTOR OOLITIC STONE CO. QUARRY AT BLOOMINGTON, IN OFFICE AT BLOOMINGTON, IN	SALEM LIMESTONE	ALL STONE TYPES	311 MI.	OCTOBER 1976	ORD LAB LAB #103/76.629B	CONFINED DREDGE DISPOSAL DIKE AT LORAIN (ARMOR STONE)
WOOLERY STONE CO. QUARRY AT BLOOMINGTON, IN OFFICE AT BLOOMINGTON, IN	SALEM LIMESTONE	ALL STONE TYPES	311 MI.	OCTOBER 1976	ORD LAB LAB #103/76.629B	CONFINED DREDGE DISPOSAL DIKE AT LORAIN (ARMOR STONE)

POSSIBLE SOURCES FOR ARMOR, UNDERLAYER, PROTECTIVE PAD, AND BEDDING STONE

SOURCE	ROCK TYPE	PROPOSED USE	RADIAL DISTANCE	LABORATORY TEST RECORD: DATE TESTED	LABORATORY	PROJECT FOR WHICH TESTED
FRONTIER STONE PRODUCTS, INC. QUARRY AT LOCKPORT, N.Y. OFFICE AT LOCKPORT, N.Y.	LOCKPORT FORMATION (DOLOMITE)	ALL STONE TYPES	192 MI.	FEBRUARY 1971	ORD LAB LAB #103/71.612C	BUFFALO DIKED DISPOSAL AREA #2 (RIPRAP)
				AUGUST 1974	UNKNOWN	CONFINED DIKE DISPOSAL PROGRAM BUFFALO HARBOR, N.Y. SITE 4 (ARMOR STONE)
				SEPTEMBER 1974	ORD LAB LAB #103/75.604B	CONFINED DIKE DISPOSAL PROGRAM, BUFFALO HARBOR, N.Y. SITE 4 (ARMOR STONE)
				FEBRUARY 1976	ORD LAB LAB #103/76.603B	CONFINED DIKE DISPOSAL PROGRAM, BUFFALO HARBOR, N.Y. SITE 4 (ARMOR AND UNDERLAYER STONE)
MEDINA STONE CO. QUARRY AT HULBERTON, N.Y.	MEDINA SANDSTONE	ALL STONE TYPES	220 MI.	19 JULY 1976	ORD LAB LAB #103/76.623B	BUFFALO DIKED DISPOSAL AREA #4 (ARMOR STONE)
U.S. STEEL CORP. QUARRY AT RODGER'S CITY, MI	RODGER'S CITY AND DUNDEE LIMESTONE	BEDDING STONE	200 MI.	22 SEPTEMBER 1977	ORD LAB LAB #103/77.624B	CLEVELAND DIKED DISPOSAL AREA #14 (CORE STONE)
U.S. STEEL CORP. QUARRY AT CEDARVILLE, MI.	ENGADINE DOLOMITE	BEDDING STONE	200 MI.	12 JUNE 1973	ORD LAB LAB #103/73.690C	CLEVELAND DIKED DISPOSAL AREA #12 (CORE STONE)

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TEST RECORD		SERVICE RECORD			REMARKS
	PROJECT FOR WHICH TESTED	DATE USED	PROJECT	EVALUATION	
	COMBINED DREDGE SPOIL DISPOSAL PROGRAM (ARMOR STONE)	JULY 1972	CLEVELAND HARBOR OUTER BREAKWATER REPAIR	TOO EARLY TO EVALUATE	UNIT WEIGHTS VARY FROM 148 P.C.F. TO 155 P.C.F. RAIL FACILITIES AVAILABLE. ONLY CUT STONE AVAILABLE.
	CONFINED DREDGE DISPOSAL DIKE AT LORAIN (ARMOR STONE)	UNKNOWN	CONFINED DREDGED DISPOSAL DIKE AT LORAIN	TOO EARLY TO EVALUATE	
	CONFINED DREDGE DISPOSAL DIKE AT LORAIN (ARMOR STONE)	TESTED BUT NOT USED			UNIT WEIGHTS VARY FROM 146.0 P.C.F. TO 146.6 P.C.F.
	CONFINED DREDGE DISPOSAL DIKE AT LORAIN (ARMOR STONE)	TESTED BUT NOT USED			UNIT WEIGHTS VARY FROM 145.4 P.C.F. TO 147.3 P.C.F.
	CONFINED DREDGE DISPOSAL DIKE AT LORAIN (ARMOR STONE)	TESTED BUT NOT USED			UNIT WEIGHTS VARY FROM 145.4 P.C.F. TO 151.6 P.C.F.
	CONFINED DREDGE DISPOSAL DIKE AT LORAIN (ARMOR STONE)	TESTED BUT NOT USED			UNIT WEIGHTS VARY FROM 148.5 TO 157.3 P.C.F.

PRESQUE ISLE, PENNSYLVANIA
COOPERATIVE BEACH
EROSION CONTROL PROJECT

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U.S. ARMY ENGINEER DISTRICT, BUFFALO

TO ACCOMPANY FINAL PHASE I GENERAL DESIGN MEMORANDUM JUNE 1980

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TEST RECORD		SERVICE RECORD			REMARKS
	PROJECT FOR WHICH TESTED	DATE USED	PROJECT	EVALUATION	
	BUFFALO DIKED DISPOSAL AREA #2 (RIPRAP)	UNKNOWN	UNKNOWN	UNKNOWN	UNIT WEIGHTS VARY FROM 162 P.C.F. RAIL FACILITIES NOT AVAILABLE.
	CONFINED DIKE DISPOSAL PROGRAM BUFFALO HARBOR, N.Y. SITE 4 (ARMOR STONE)	UNKNOWN	BUFFALO DISPOSAL DIKE NO. 4	TOO EARLY TO EVALUATE	ONLY THE GASPORT MEMBER ACCEPTABLE FOR ARMOR STONE. LOADING FACILITIES ON NYS BARGE CANAL AVAILABLE. SELECTIVE QUARRYING REQUIRED. DECEW MEMBER NOT ACCEPTABLE.
	CONFINED DIKE DISPOSAL PROGRAM, BUFFALO HARBOR, N.Y. SITE 4 (ARMOR STONE)	UNKNOWN	UNKNOWN	UNKNOWN	
	CONFINED DIKE DISPOSAL PROGRAM, BUFFALO HARBOR, N.Y. SITE 4 (ARMOR AND UNDERLAYER STONE)	UNKNOWN	UNKNOWN	UNKNOWN	
	BUFFALO DIKED DISPOSAL AREA #4 (ARMOR STONE)	1975 - 1977	BUFFALO DIKED DISPOSAL AREA #4	SATISFACTORY	
	CLEVELAND DIKED DISPOSAL AREA #14 (CORE STONE)	1978 - 1979	CLEVELAND DISPOSAL DIKE NO. 14	SATISFACTORY	
	CLEVELAND DIKED DISPOSAL AREA #12 (CORE STONE)	UNKNOWN	UNKNOWN	UNKNOWN	

PRESQUE ISLE, PENNSYLVANIA
COOPERATIVE BEACH
EROSION CONTROL PROJECT

NEW YORK AND MICHIGAN STONE SOURCES MATERIALS SURVEY

U.S. ARMY ENGINEER DISTRICT, BUFFALO

TO ACCOMPANY FINAL PHASE I GENERAL DESIGN MEMORANDUM JUNE 1980

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PRESQUE ISLE PENINSULA
ERIE, PENNSYLVANIA

PHASE I
GENERAL DESIGN MEMORANDUM

APPENDIX E

PERTINENT CORRESPONDENCE

APPENDIX E
PERTINENT CORRESPONDENCE

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

REPLY TO ATTENTION OF:

DAEN-CWP-A 8 APR 1976

SUBJECT: Presque Isle Peninsula, Erie, Pennsylvania

THE SECRETARY OF THE ARMY

1. I submit for transmission to Congress the report of the Board of Engineers for Rivers and Harbors, accompanied by the reports of the District and Division Engineers, in response to a resolution by the Committee on Public Works of the United States Senate, adopted 14 May 1968, requesting a review of the report of the Chief of Engineers on Presque Isle Peninsula, Erie, Pennsylvania, published as House Document Numbered 397, Eighty-sixth Congress, and other pertinent reports, with a view to determining whether any modifications of the recommendations contained therein are advisable at the present time in the interest of beach erosion control at and in the vicinity of Presque Isle Peninsula and the State Park in Erie, Pennsylvania.

2. The District and Division Engineers recommend that the existing project for beach erosion control at Presque Isle Peninsula be modified to restore approximately 5.5 miles of lake frontage to provide a minimum beach berm of 60 feet in width at a height 10 feet above low water datum and to protect the restored beach with five sections of offshore rubblemound breakwaters located at areas susceptible to critical erosion. Included in the plan is annual redistribution of sand collected behind the breakwaters and replenishment of materials lost to offshore processes. The total first cost of construction is estimated at $21,203,000, including $48,000 for aids to navigation. Based on an interest rate of 5-7/8 percent and a 50-year period of economic analysis, the annual charges are estimated at $1,701,000, including $275,000 for annual redistribution and replenishment, and $26,500 for operation and maintenance of the breakwaters. The annual benefits are estimated at $3,459,000 and the benefit-cost ratio is 2.0. Non-Federal interests would be responsible for 30 percent of total project costs presently estimated at $6,346,300 of the first cost, all annual operation and maintenance costs, and 30 percent of annual beach replenishment and redistribution costs during the preconstruction period and for 5 years after construction, and 100 percent from that time for the life of the project.

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

3. The Board of Engineers for Rivers and Harbors concurs in general in the views and recommendations of the reporting officers. The Board notes, however, that several alternatives are economically feasible and warrant further consideration during postauthorization studies. The Board believes that particular attention should be given to the recirculation-sandtrap alternative because of its high degree of technical reliability, its low first cost for construction, and its high economic ranking. Subject to certain conditions of local cooperation, the Board recommends modification of the existing project for beach erosion control for Presque Isle Peninsula, generally in accordance with the plan of the District Engineer, to include a postconstruction monitoring program at a currently estimated Federal cost of $160,000.

4. I concur in general in the views and recommendations of the Board. However, in commenting on my proposed report, the Secretary of the Pennsylvania Department of Environmental Resources, on behalf of the Governor, endorsed the project but objected to the 5-year cutoff date for Federal participation in periodic beach nourishment. The Secretary believes that the time period should be extended in view of the uncertainty as to when the new beach will stabilize and in light of the experience with the existing project. After reconsidering this matter, I believe that 5 years may not prove to be an adequate period of time for beach stabilization. The many variables that influence beach erosion in this case, including fluctuating levels of Lake Erie, make it difficult to predict just when the new beach will stabilize. Accordingly, I recommend that Federal participation in periodic beach nourishment, at a level of 70 percent of the nourishment costs, be authorized commencing at the expiration of the authorization provided by Section 57 of the Water Resources Development Act of 1974 and extending for the life of the project. Also, I recommend that the item of local cooperation contained in paragraph 17c of the Board's report be changed to "Pay 30 percent of the annual beach redistribution and replenishment costs for the project."

5. Use of the currently prescribed interest rate of 6-1/8 percent would not significantly change the benefit-cost ratio.

J. C. GRIBBLE, JR.
Lieutenant General, USA
Chief of Engineers

EXHIBIT E-1 (continued)

COMMONWEALTH OF PENNSYLVANIA

DEPARTMENT OF ENVIRONMENTAL RESOURCES

P. O. BOX 1467

HARRISBURG, PENNSYLVANIA 17120

Secretary

In reply refer to
RH-R
R25: 1

July 24, 1974

Col. Bernard C. Hughes
District Engineer
Buffalo District - Corps of Engineers
1776 Niagara Street
Buffalo, New York 14207

Dear Colonel Hughes:

Receipt is acknowledged of your letter of July 1, 1974, transmitting revisions of the "Review Report on Cooperative Beach Erosion Control Project at Presque Isle Peninsula, Erie, Pennsylvania." It is also noted that you requested a statement by the Commonwealth of our willingness to sponsor the project.

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. The popularity of this park, with an annual attendance of over 3,500,000 visitors, is evidence of the importance of Presque Isle State Park to the Commonwealth and adjacent areas. Since 1956, the Commonwealth has cooperated with the Corps of Engineers to protect Presque Isle Peninsula and restore and protect the beaches. In addition, capital improvements by the Commonwealth, either completed or planned, are in accordance with the Master Plan for the development of Presque Isle State Park as a public recreation area.

The Commonwealth of Pennsylvania, in order to protect its previous investments and maintain the recreation value of the park, agrees with the recommendations of the Review Report.

Also, the Commonwealth is willing to sponsor the project and accept and fulfill the required items of sponsorship. However, we feel that additional consideration should be given to the recommendation that would limit Federal participation in the Cooperative Beach Nourishment Project to a period of no more than five years after construction. Such a stipulation would require the Commonwealth to provide 100 percent of the annual replenishment costs from that time, for the life of the project.

Based on previous experience on the Cooperative Beach Erosion Project, it is our opinion that the five-year period is too short for evaluation of the

EXHIBIT E-2

performance of the project. The occurrence of a period of low water during the five-year period could result in an unreliable low estimate of the beach nourishment requirements throughout the life of the project. Consequently, it is recommended that further consideration be given to qualifying this period of time so as to enable some flexibility in extending the cooperative agreement, depending on the efficiency which can be realized from the completed project.

Item (2), page 53, requires the Commonwealth to provide a cash contribution of 30 percent of final construction cost. We are agreeable to this term, however, sufficient lead time must be made available to obtain the required funds through the State Legislature.

In summary, the Department concurs with the recommendations of the Review Report and is willing to accept the responsibilities of sponsorship for the recommended project. At the same time, we desire that the Review Study be amended to include a qualifying statement which would grant some flexibility in extending the period of joint cost sharing.

Because of the serious erosion conditions which exist at Presque Isle State Park, it is recommended that the project be transmitted to Congress as soon as possible. We are hopeful that the project will receive favorable consideration by Congress at a very early date.

Sincerely yours,

Maurice K. Goddard

MAURICE K. GODDARD

COMMONWEALTH OF PENNSYLVANIA

DEPARTMENT OF ENVIRONMENTAL RESOURCES
P. O. BOX 1467
HARRISBURG, PENNSYLVANIA 17120

The Secretary

In reply refer to
RN-R
R 25:1

March 7, 1978

Colonel Daniel D. Ludwig
District Engineer
Buffalo District - Corps of Engineers
1776 Niagara Street
Buffalo, New York 14207

Dear Colonel Ludwig:

This is in response to your letter of February 21, 1978 requesting assurance that the Commonwealth of Pennsylvania has the capability and willingness to continue to provide the nonfederal share of the cost for future beach nourishment at Presque Isle Peninsula in Erie as well as willingness to cooperate in development, construction and future maintenance of the future "permanent" project.

The Commonwealth of Pennsylvania, through the Department of Environmental Resources, is committed to the protection of Presque Isle Peninsula from erosion. House Bill No. 1322 in the current session of the Legislature provides funds for the cooperative project. In addition, the Governor's 1978-79 Capital Budget request also includes sufficient funds to cover the Commonwealth's 30% share for beach nourishment next fiscal year. Our office has alerted Pennsylvania Legislators in the Erie area of the necessity of their support and leadership for passage of this request. We are confident that they will work for passage of the legislation.

The Department will continue to participate in cost-sharing for periodic nourishment prior to the construction of the "permanent" beach erosion control project projected to start construction in the 1980's.

In further answer to your request, this letter will serve to reiterate the Pennsylvania Department of Environmental Resources' commitment to act as the sponsor for the "permanent" beach erosion control project on behalf of the Commonwealth of Pennsylvania. We intend to meet the terms required for local cooperation in a Local Assurance Agreement.

Sincerely yours,

Maurice K. Goddard

MAURICE K. GODDARD

EXHIBIT E-3

COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF ENVIRONMENTAL RESOURCES
POST OFFICE BOX 2063
HARRISBURG, PENNSYLVANIA 17120
The Secretary

In reply refer to
RM-R
R 25:1
F 25:1

August 23, 1979

Colonel George P. Johnson
District Engineer
Corps of Engineers - Buffalo District
1776 Niagara Street
Buffalo, New York 14207

Dear Colonel Johnson:

This is in reply to the letter of July 11, 1979 from Lt. Col. Thomas R. Braun of your office, requesting that this Department recertify our intention to furnish the necessary items with local cooperation and have our State Attorney General's Office issue an opinion as to the Commonwealth's authority to enter into such an agreement.

In regard to recertification of our intent to furnish the necessary items of local cooperation, be advised that the Commonwealth of Pennsylvania is committed to the protection of Presque Isle Peninsula against erosion. Adequate funds to cover the Commonwealth's 30% for beach nourishment are included in our capital budget request. We are confident that the Pennsylvania Legislators in the Erie area will support the passage of the necessary legislation to secure funding for this purpose. This Department will continue to participate in cost-sharing for periodic nourishment prior to the construction of the "permanent" beach erosion control project projected to start construction in 1980.

In regard to the Commonwealth's authority to enter into such an agreement, we had been advised by our legal staff that 1906-A of the Commonwealth's Administrative Code of 1929 authorized the Department of Environmental Resources "to supervise, maintain, improve, regulate, police, and preserve, all parks belonging to the Commonwealth...". Be advised that we may legally continue to enter into contracts with the Federal government for beach nourishment for Presque Isle.

In summary, this letter will confirm that the Pennsylvania Department of Environmental Resources is committed to act as a sponsor for the permanent beach erosion control project on behalf of the Commonwealth of Pennsylvania. We intend to meet the terms required for local cooperation under Section 101(a) of the Water Resources Development Act.

Sincerely,

Clifford L. Jones

CLIFFORD L. JONES

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

REPLY TO
ATTENTION OF:

DAEN-BR

2 August 1974

SUBJECT: Presque Isle Peninsula, Erie, Pennsylvania

Chief of Engineers
Department of the Army
Washington, D.C. 20314

1. Authority.--This report is in response to the following resolution adopted 14 May 1968:

> Resolved by the Committee on Public Works of the United States Senate, That the Board of Engineers for Rivers and Harbors, created under Section 3 of the River and Harbor Act approved June 13, 1902, be, and is hereby requested to review the report of the Chief of Engineers on Presque Isle Peninsula, Erie, Pennsylvania, published as House Document Numbered 397, Eighty-sixth Congress, and other pertinent reports, with a view to determining whether any modifications of the recommendations contained therein are advisable at the present time in the interest of beach erosion control at and in the vicinity of Presque Isle Peninsula and the State Park in Erie, Pennsylvania.

2. Description.--Presque Isle Peninsula is located at Erie, Pennsylvania, on the south shore of Lake Erie, about 78 miles southwest of Buffalo, New York, and about 102 miles northeast of Cleveland, Ohio. The peninsula is a sandspit, 6-1/4 miles long, that arches lakeward in a northeasterly direction from its narrow connection with the mainland just west of the city of Erie. The lakeward perimeter of the entire formation is about 9 miles. Encircled between the peninsula and the mainland is Erie Harbor, the eastern part of which has been improved as a Federal deep-draft navigation project. During its years of migratory growth, the extreme eastern end of the peninsula has curved sharply shoreward and would be reconnected to the mainland if it were not for the navigation channel which is maintained into Erie Harbor. Practically the entire 3,200-acre peninsula is owned by the Commonwealth of Pennsylvania and is developed as a park. The park provides facilities for bathing, boating, hiking, fishing, and picnicking. Extensive acreages are also set aside for botanical and biological studies. The United States owns two small parcels of land, one near the harbor entrance, the other near the lighthouse, which are occupied by United States Coast Guard facilities.

DAEN-BR
SUBJECT: Presque Isle Peninsula, Erie, Pennsylvania

3. Economic development.--The population of Erie County was 263,654 in 1970. This is a 46-percent increase since 1940, considerably above the 19-percent increase recorded by the Commonwealth of Pennsylvania for the same time period. The 1970 population for the city of Erie was 129,231. The economy of the area is based on tourism and metal products manufacturing. Over the past 10 years, the annual attendance at Presque Isle State Park averaged about 3,500,000 persons, contributing an estimated $60,000,000 annually to the local economy. In 1971, 496 industrial plants employing about 45,000 workers were located in Erie County. The area is well served by an excellent transportation network, including an airport, four railroads, and two interstate highways. Erie Harbor is considered to be one of the finest natural harbors on the Great Lakes and is both a lake and world port.

4. Existing improvements.--The cooperative beach erosion control project authorized by the River and Harbor Act of 1954, and completed in 1956, provided for artificial placement of sandfill, and construction of a seawall, a bulkhead, and a groin system along the neck portion of the peninsula to supplement an existing field of 12 short groins and bulkheads previously constructed by the State and Federal government. The project was modified by the River and Harbor Act of 1960, when Congress authorized Federal sharing of one-third of the cost of beach nourishment for a period of 10 years following the first major replenishment operation. Later, in accordance with Section 103c of the River and Harbor Act of 1962, the Federal share of project costs was increased to 70 percent. In addition to contributing its share of the cost of replenishment of the beach fill and groin modifications for the cooperative project, the Commonwealth of Pennsylvania has expended over $6,000,000 in capital improvements in the park, including highways, parking areas, bathhouses, a new administration building, a small boat marina, and utility lines.

5. Problems.-- Since completion of the cooperative project in 1956, progressive erosion has continued to occur, seriously affecting the narrow neck of the peninsula. Beaches throughout the entire project are depleted in spite of nourishment provided in 1960, 1964, 1968, 1971, and 1973. Experience has shown that sand replenishment requirements have exceeded design estimates, and that replenishment materials having the required gradation are not available from practicable sources in the quantities needed to assure beach stabilization.

6. Improvements desired.--Local interests, concerned over the high replenishment costs for maintaining the beaches and the recurring threat to established public facilities, desire a more permanent solution to the erosion problems of the peninsula. They also have expressed opposition to measures that would disrupt the natural geologic growth of the peninsula.

DAEN-BR
SUBJECT: Presque Isle Peninsula, Erie, Pennsylvania

7. Plan of improvement.--The District Engineer finds that the most suitable plan of improvement would be a sand replenishment program to provide a minimum beach berm of 60 feet along approximately 5.5 miles of lake frontage, protected by five sections of offshore rubblemound breakwaters located at critical areas of erosion. He estimates that 1,630,000 cubic yards of sandfill would be required to restore the beach to project dimensions. Each section of breakwaters would consist of several segments, each 500 feet long and separated by a 100-foot gap. The breakwaters would have a crest height of 8.5 feet above low water datum (LWD) and would be located from 800 to 1,150 feet offshore.

8. Environmental considerations.-- Careful consideration has been given to the esthetic impact of alternative protective works and to the effects each would have on the continued geologic growth of the peninsula's eastern end. Under existing conditions, littoral currents erode sand from the west beaches and deposit it on the eastern tip, forming a complicated network of ponds and sand dune ridges. These ponds and ridges constitute a setting for a unique ecological laboratory where the processes of plant and animal succession can be studied in ecosystems varying in age from one year to several centuries. The District Engineer finds that the proposed rubblemound breakwaters would interrupt the view of the horizon, but would have an appearance in harmony with the coastal area. He further finds that the proposed provisions for bypassing sufficient quantities of sand to effectively nourish downdrift areas will continue to produce the desired geologic growth of the peninsula, and will preserve its unique environment.

9. Economic evaluation.--Using May 1974 price levels, the District Engineer estimates the total first cost of the proposed project to be $21,203,000, of which $14,857,000 would be Federal, and $6,346,000 non-Federal. Annual charges, based on an interest rate of 5-7/8 percent and a 50-year period of economic analysis, are estimated at $1,701,000, including $301,500 for annual maintenance and replenishment by non-Federal interests. Annual benefits attributed to the proposed improvements are estimated at $3,459,000, and the benefit-cost ratio is 2.0.

10. Recommendations of reporting officers.--The District Engineer recommends that the existing cooperative beach erosion control project at Presque Isle Peninsula, Pennsylvania, be modified generally in accordance with plans described in his report, subject to certain items of local cooperation. The Division Engineer concurs.

11. Public notice.--The Division Engineer issued a public notice stating his recommendations and affording interested parties an opportunity to present additional information to the Board. Careful consideration has been given to the communications received.

DAEN-BR
SUBJECT: Presque Isle Peninsula, Erie, Pennsylvania

Views and Recommendations of the Board of Engineers for Rivers and Harbors.

12. Views.--The Board of Engineers for Rivers and Harbors concurs in general in the views and recommendations of the reporting officers and finds the improvements to be economically justified and the requirements of local cooperation appropriate. In reaching its conclusion, the Board carefully considered the environmental effects of the proposed improvements, including those discussed in the Preliminary Draft Environmental Impact Statement dated December 1973, and believes that the recommended plan will result in no significant adverse environmental impact. The Board also considered the effects of the proposed project on regional development and social well-being, as required by the Principles and Standards for Planning Water and Related Land Resources established by the Water Resources Council. The Board believes that the recommended plan will contribute to regional economic development and improved social well-being.

13. The Board notes that the authorized plan for periodic nourishment has not proved successful because replenishment materials having the required gradation cannot be economically obtained from available sources in the quantities needed to assure beach stabilization. The Board finds that the proposed partial breakwater plan will minimize future replenishment needs and will provide the permanent structural solution desired by local interests. However, the Board notes that several alternatives are economically feasible and warrant further consideration during postauthorization studies. The Board believes that particular attention should be given to the recirculation-sandtrap alternative because of its high degree of technical reliability, its low first cost for construction, and its high economic ranking.

14. The Board concurs that an intensive program of technical and environmental data collection, including a hydraulic model study of the proposed breakwater system, should be made during postauthorization studies to verify technical designs and to obtain essential ecological information to assure that the improvements are also of sound environmental design. The Board believes that funds in the amount of $511,000, included in the project cost estimate for these postauthorization studies, are adequate.

15. The Board notes that Federal participation in periodic nourishment of Presque Isle Peninsula has been extended for a period of at least 5 years by the Water Resources Development Act of 1974. The Board concurs in the recommendations of the reporting officers that Federal participation in periodic nourishment be further extended for a period not to exceed 5 years after project construction to allow for the normal period of time for the beaches to stabilize and further nourishment needs to minimize.

16. The Board further agrees that a postconstruction monitoring program should be established to study project effects. The Board believes that these studies would not only provide valuable information relative to changes on Presque Isle, which may result from implementation of the project, but would also establish operation and maintenance needs, and would contribute knowledge having widespread application in future partial breakwater system designs elsewhere. The Board believes that two field surveys per year until the beaches stabilize and one per year for an additional two years would be adequate to evaluate system performance and to detect adverse project impacts. The cost of this monitoring program is estimated at $160,000, and, because of the widespread applicability of the information to be obtained, the Board believes that it should be borne by the Federal government.

17. Recommendations.--Accordingly, the Board recommends that the existing project for beach erosion control for Presque Isle Peninsula, Pennsylvania, authorized by the River and Harbor Acts approved 3 September 1954 and 14 July 1960, as amended, be modified generally in accordance with the plan of the District Engineer and with such modifications thereof as in the discretion of the Chief of Engineers may be advisable, at an estimated cost to the United States of $14,857,000 for initial construction, and that a postconstruction monitoring program be established to monitor project effects at a cost currently estimated to be $160,000: *Provided that*, prior to commencement of construction, non-Federal interests will 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 $6,346,000 or 30 percent;

c. Pay 30 percent of annual beach redistribution and replenishment costs during the preconstruction period and for 5 years after construction, and 100 percent from that time for the life of 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;

DAEN-BR
SUBJECT: Presque Isle Peninsula, Erie, Pennsylvania

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.

18. The Board further recommends that the cooperative agreement between the Federal government and the Commonwealth which provides for Federal participation in beach nourishment be extended beyond the 5-year period authorized in Section 57 of the 1974 Water Resources Development Act, Public Law 93-251, to include the preconstruction period at an annual Federal cost presently estimated at $580,000 and for a period not to exceed 5 years after construction, at an annual Federal cost presently estimated at $193,000.

19. The Board also recommends that the required cash contribution be paid in a lump sum prior to the start of construction or, as may be permitted by the Chief of Engineers, in installments prior to the start of pertinent project units or sections and in accordance with his construction schedules.

FOR THE BOARD:

/s/D. A. Raymond
D. A. RAYMOND
Major General, USA
Chairman

COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF FORESTS AND WATERS
HARRISBURG
17120

THE SECRETARY

P. O. Box 1467

March 8, 1967

In reply refer to
WCE
R 25:1

Col. R. Wilson Neff
District Engineer
U. S. Army Engineer District, Buffalo
Corps of Engineers
Foot of Bridge Street
Buffalo, New York 14207

RE: Your File No. NCBED
Presque-Isle Peninsula Cooperative
Erosion Control Project

Dear Colonel Neff:

A recent inspection of erosion damage to the Presque-Isle beaches, conducted by G. A. Lynde and F. J. Henry of your office and T. H. May and R. P. Adams of this Department, indicates that corrective measures should be initiated as soon as possible at several different sites. Specific consideration should be given to serious erosion downdrift of each of the groins between Groin No. 3 and Groin No. 11; a reach east of the lighthouse groin; and erosion of the berm bank along Beach No. 6.

Will your office please initiate action to start a planning program for the necessary corrective action. I presume any work accomplished will be patterned after previous projects performed in the protection of these beaches in that the Department of Forests and Waters would prepare construction drawings and specifications, advertise and award contracts after approval by your office and supervise construction. Our present agreement, calling for 30% Commonwealth participation and 70% Federal participation in this work, terminates in 1971.

In light of the long history of beach erosion at Presque-Isle we feel the present system of protection should be revaluated to determine if more effective means of protection can be developed. We would like to have our engineers meet with your staff to discuss some ideas which we feel are worthy of consideration. If you concur that a revaluation study should be made we will be happy to cooperate in any way we can.

Sincerely yours,

Maurice K. Goddard

MAURICE K. GODDARD

EXHIBIT E-6

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

NCBED-DC 16 December 1977

SUBJECT: Phase I Study Classification Report for the Beach Erosion Control Project at Presque Isle Peninsula, Erie, PA.

Division Engineer, North Central
ATTN: NCDED-T

1. Enclosed is the Phase I Study Classification Report for the Beach Erosion Control Project at Presque Isle Peninsula prepared in accordance with EC 1105-2-78, pages A-21 through A-27.

2. Request approval of the subject report and authority to proceed with a Reformulation Phase I AE&D Study.

1 Incl
as

Daniel D. Ludwig
DANIEL D. LUDWIG
Colonel, Corps of Engineers
District Engineer

Exhibit E-7

PRESQUE ISLE PENINSULA
ERIE, PENNSYLVANIA

PHASE I AE&D STUDY CLASSIFICATION REPORT

I - PROJECT AUTHORIZATION DATA

1. Project Authorization Data.

Section 101 of the Water Resources Development Act of 1976 (Public Law 587 - 94th Congress), approved 22 October 1976, authorized undertaking of 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. The plan of improvement provides for construction of five sections of segmented, rubblemound, breakwaters located offshore from susceptable areas of erosion, and placement of sand fill.

2. Environmental Impact Statements Filed with CEQ.

a. A Draft EIS for the cooperative beach erosion control project at Presque Isle Peninsula dated May 1973 was sent to CEQ in August 1973;

b. Summary of Environmental Considerations, 5-Year Nourishment Project at Presque Isle Peninsula on file at the Buffalo District, dated March 1975;

c. A revised Draft EIS for the cooperative beach erosion control project at Presque Isle Peninsula dated December 1973 was sent to CEQ in April 1975;

d. A Final EIS for the cooperative beach erosion control project at Presque Isle Peninsula dated September 1975 was sent to CEQ in September 1976;

3. Significant Correspondence with OCE.

None.

II - STATEMENT OF CONTROVERSIAL ISSUES AND AREAS OF CONCERN

There are several alternatives that can provide a practicable and economical solution to the erosion problem. These alternatives include a full breakwater scheme, a partial breakwater scheme, annual nourishment, a groin plan, a sand recirculation scheme, and a sandtrap-recirculation scheme. Comment sheets were attached to the 2 June 1972 public meeting invitation and rating sheets were handed out during the meeting. Public opinion was overwhelmingly (98 percent) in favor of some sort of project with fifty percent of those responding to these sheets preferring some type of partial breakwater. Each alternative has certain advantages and disadvantages and public opinion may vary as to which alternative will provide the best long term solution to the erosion problem. However, there are no known controversial issues or areas of concern among the general public and State and local governmental agencies.

III - CLASSIFICATION OF PHASE I STUDY AND DISCUSSION OF COMPLETION-TIME OBJECTIVE

1. Classification of Phase I Study.

The Buffalo District's original intentions were to prepare a brief Phase I GDM which would reaffirm the findings of the Review Report. However, the Board of Engineers for Rivers and Harbors has noted that several of the alternatives presented in the Review Report are economically feasible and warrant further consideration during postauthorization studies; therefore, the District's Stage 1 planning recommendation is for a reformulation study.

The segmented offshore breakwater appears to be the best alternative, however, the BERH has noted that particular attention should be given to the recirculation-sandtrap alternative because of its high degree of technical reliability, its low first cost for construction, and its high economic ranking. In the Phase I GDM, an in-depth analysis of the segmented offshore breakwater and recirculation-sandtrap alternatives and only a brief mentioning of the other feasible alternatives which were discussed in the Review Report will be presented.

2. Discussion of Completion-Time Objective.

The Water Resources Development Act of 1976 authorized only the Phase I GDM stage for the Presque Isle project, therefore, two schedules which reflect alternative courses of action that can be followed have been prepared. The first schedule, Schedule A (see Exhibit 1), assumes that the Phase I GDM will go to Congress for approval and funding. This schedule has a definite impact on the date for completion of construction of the project since there is a 28 month period between the submission of the final Phase I GDM to NCD and initiation of Phase II study effort. Schedule A is also based on NCD guidance that funding for the initiation of the Phase II work effort can be included in the District's budget request which is prepared (April-June 1981) prior to passage of the Omnibus Bill (September-November 1981) and Appropriations Bill (May-June 1982) by Congress. The second schedule, Schedule B (see also Exhibit 1), assumes that the Chief of Engineers will determine that Phase I GDM is without substantial controversy and is in accordance with the conditions of the project authorized by Congress, thereby allowing the Secretary of the Army to approve initiation of the Phase II study effort with funds that are available at that time. This option is provided for by Paragraph 12.b.(1). of ER 1105-2-30 (draft).

For scheduling purposes Schedule A will be implemented. However, if the Chief of Engineers makes an affirmative finding that the Phase I GDM is not controversial and the project is in accord with the conditions of authorization, thereby permitting a favorable decision to approve initiation of Phase II GDM, a switch to Schedule B can be made and save about one year. It appears very unlikely that the Chief would make such a finding until he has the opportunity to review the Phase I GDM. That opportunity will come in the summer of 1980 (the two schedules are identical through submittal of Final Phase I in June 1980). In any event, the Chief of Engineers will have four options from which to choose that will have an impact upon the schedule for completion of the project. These options are as follows:

a. Option 1: The Chief makes a favorable decision to initiate the Phase II GDM after reviewing the final Phase I GDM and the Secretary of the Army approves initiation of the Phase II study. At that point, there would still be time to budget for Phase II work in the FY 1982 budget. This option is presented as Schedule B on Exhibit 1.

b. Option 2: The Chief makes a favorable decision to initiate the Phase II GDM at an early date without reviewing the Phase I GDM (possible in the POS stage) and the Secretary of the Army approves initiation of the Phase II study. This would allow budgeting for Phase II initiation in FY 1981 and thereby shorten Schedule B by about six months.

c. Option 3: The Chief makes a favorable decision to initiate the Phase II GDM after reviewing the final Phase I GDM and the Secretary of the Army approves initiation of the Phase II study and transfers funds which might be available in the Corpswide AE&D program to the Presque Isle project. This option will shorten Schedule B by at least six months.

d. Option 4: The Chief makes an unfavorable decision to approve initiation of the Phase II GDM thereby making FY 1983 the earliest for budgeting for Phase II work (Schedule A on Exhibit 1) because the budget process would then have to follow Congressional authorization for construction.

IV - RECOMMENDATIONS

Since the Board of Engineers for Rivers and Harbors noted that several of the alternatives presented in the Review Report warrant further consideration, reformulation is considered necessary. It is recommended that this Study Classification Report be approved for use as a basis for performing a reformulation type Phase I AE&D Study investigation.

EXHIBIT 1

	Schedule A [1]		Schedule B [2]	
	Start Date	Completion Date	Start Date	Completion Date
Prepare Plan of Study	1 Nov 1977	30 Apr 1978	1 Nov 1977	30 Apr 1978
Submit Plan of Study to NCD	30 Apr 1978	-	30 Apr 1978	-
Prepare Draft Phase I and EIS	1 Jun 1978	30 Nov 1979	1 Jun 1978	30 Nov 1979
Submit Draft Phase I and EIS to NCD	30 Nov 1979	-	30 Nov 1979	-
Model Study	1 Dec 1979	30 Nov 1980	1 Dec 1979	30 Nov 1980
Submit Final Phase I and EIS to NCD	1 Jun 1980	30 Jun 1980	1 Jun 1980	30 Jun 1980
Prepare Phase II GDM	1 Nov 1982	31 Oct 1983	1 Oct 1981	30 Sep 1982
Submit Phase II GDM to NCD	1 Nov 1983	30 Nov 1983	1 Oct 1982	31 Oct 1982
Prepare Plans and Specifications	1 Mar 1984	31 Aug 1984	1 Feb 1983	31 Jul 1983
Submit Plans and Specs to NCD	1 Sep 1984	30 Sep 1984	1 Aug 1983	31 Aug 1983
Advertise	1 Dec 1984	31 Jan 1985	1 Nov 1983	31 Dec 1983
Award	1 Feb 1985	28 Feb 1985	1 Jan 1984	31 Jan 1984
Construction	1 May 1985	31 Dec 1986	1 May 1985	31 Dec 1985

1/ **Schedule requires the Phase I GDM go to Congress for approval and funding of the Phase II study effort.**

2/ **Schedule assumes that the Chief of Engineers will determine that the Phase I GDM is without substantial controversy and is in accordance with the conditions of the project authorized by Congress, thereby allowing the Secretary of the Army to approve the initiation of the Phase II study effort with funds that are available at that time (ER 1105-2-30 (draft), Paragraph 12.b.(1).).**

NCDED-T (10 Dec 77) 1st Ind
SUBJECT: Phase I Study Classification Report for the Beach Erosion Control Project at Presque Isle Peninsula, Erie, PA

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

TO: District Engineer, Buffalo 8 FEB 1978

Approval is given to undertake a reformulation type of study for the subject project.

FOR THE DIVISION ENGINEER:

Incl
nc

JERRY E. SMITH
Colonel, Corps of Engineers
Deputy Division Engineer

Copy furnished:
DAEN-CWP-C

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

NCBED-DC 31 October 1979

Mr. Clifford L. Jones, Secretary
Pennsylvania Department of Environmental Resources
P.O. Box 2063
Harrisburg, Pennsylvania 17120

Dear Mr. Jones:

The purpose of this letter is to solicit the Commonwealth of Pennsylvania's views on the financial contribution required under the President's proposed revised cost-sharing policy. Such views should indicate the Commonwealth's understanding that a firm, binding commitment on the estimated contribution toward the first costs of construction of the "permanent" project at Presque Isle Peninsula will be required subsequent to Congressional authorization as a basis for the Corps to initiate construction.

The President, 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 non-vendible outputs and 10 percent of costs associated with vendible outputs. "Vendible outputs" as defined in the President's message and further modified in recent drafts of the Administration's proposed cost-sharing legislation shall include only municipal and industrial water supply; agricultural water supply; and hydroelectric power.

Application of this policy to the "permanent" Presque Isle Peninsula beach erosion control project requires an additional cash contribution from the Commonwealth of Pennsylvania of an estimated $1,600,000 (5 percent of $31,900,000 total estimated first costs of construction assigned to non-vendible project purposes, based on October 1979 price levels). This contribution is in addition to other items of local cooperation usually required for shore protection projects including cost participation based on shore ownership and use. The total non-Federal cost would be $11,200,000 or 35 percent.

Exhibit E-9

NCBED-DC
Mr. Clifford L. Jones

Section 101(a) of the 1976 Water Resources Development Act authorized only the Phase I design memorandum stage of advanced engineering and design of the project for beach erosion control at Presque Isle Peninsula. Therefore, the recommendation which will be made in the Phase I GDM must go back to Congress to obtain authorization to proceed with the detailed design and construction. Because this Phase I GDM must go back to Congress for authorization to construct, the Presque Isle "permanent" project is subject to the President's proposed cost-sharing legislation.

Enclosed is a copy of your letter dated 23 August 1979 in which you reiterated your department's commitment to act as the sponsor for the permanent beach erosion control project on behalf of the Commonwealth of Pennsylvania and your intent to meet the terms required for local cooperation.

I am required, at this stage of planning, to obtain the views of Commonwealth of Pennsylvania about its intent to cooperate in the development, construction, and maintenance of the future "permanent" project at Presque Isle Peninsula if the President's proposed cost-sharing policy becomes law. I want to emphasize that your views at this stage of preauthorization are not binding and do not obligate future legislatures. This proposed cost-sharing policy would be applicable to the initial construction costs. The costs for periodic nourishment is exempt from the increase in cost-sharing and would remain at the 70/30 percent Federal/non-Federal cost-sharing requirements.

If you have any questions concerning the matters presented herein, please feel free to contact me or my staff.

Sincerely yours,

GEORGE P. JOHNSON
Colonel, Corps of Engineers
District Engineer

Incl
as stated

COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF ENVIRONMENTAL RESOURCES
POST OFFICE BOX 2063
HARRISBURG, PENNSYLVANIA 17120

The Secretary

717-787-2814

In reply refer to
RM-R
R 25:1

December 13, 1979

Colonel George P. Johnson
District Engineer
Buffalo District - Corps of Engineers
1776 Niagara Street
Buffalo, New York 14207

Dear Colonel Johnson:

This is in reply to your letter of October 31, 1979, regarding the Commonwealth's support for, and financial contribution to, the "permanent" Presque Isle Peninsula beach erosion control project.

As you are aware, this Department has repeatedly expressed its continuing commitment to completion of the Presque Isle project. That commitment has, further, been demonstrated by continuing year-by-year funding of Pennsylvania's portion of costs for the "temporary" Presque Isle project while awaiting authorization and completion of the permanent beach erosion control program.

The Commonwealth remains committed to this effort. This commitment includes the understanding that, subsequent to Congressional authorization of the "permanent" project, the Commonwealth will be required to enter into a firm and binding agreement to finance a significant portion of the project, in accordance with the statutory provisions governing cost-sharing then in effect and applicable to this project.

While we understand the Administration's proposed cost-sharing arrangements, if enacted by Congress, may be applied to this project, I should note that our expressed support for the Presque Isle project should not be construed as implying support for the proposed cost-sharing legislation. We believe that the Administration's proposal for an additional five percent "up-front" contribution by States does not serve the intended purpose of providing the States with increased decision-making responsibility, and only results in placing increased financial burdens on States. This is especially true in the case of beach erosion control projects, such as Presque Isle, where States are already required to finance 30 percent of project costs and provide all necessary lands, rights of way, and easements.

EXHIBIT E10

In conclusion, this letter confirms that the Department of Environmental Resources remains committed to act as a sponsor for the permanent beach erosion control project on behalf of the Commonwealth of Pennsylvania. We intend to meet, if at all possible, the terms required for local cooperation and cost-sharing established by existing law or hereafter enacted by Congress.

Sincerely,

for

CLIFFORD L. JONES

COMMONWEALTH OF PENNSYLVANIA

DEPARTMENT OF ENVIRONMENTAL RESOURCES

The Secretary

P. O. BOX 1467
HARRISBURG, PENNSYLVANIA 17120

In reply refer to
RM
F25:1

June 4, 1975

Lt. Gen. W. C. Gribble, Jr.
Chief of Engineers
Office of the Chief of Engineers
Department of the Army
Washington, DC 20314

Dear General Gribble:

Reference is made to your letter of April 1, 1975, and my reply of April 8, 1975, in which I suggested that the project report and draft environmental statement on Presque Isle Peninsula, Erie, Pennsylvania, be resubmitted to the State Clearing House for final review. This matter has been reconsidered and in the interest of avoiding any possible delay in your submittal of these reports to the Secretary of the Army, we have decided to coordinate this matter with the Commonwealth agencies responsible for Fish and Wildlife. Therefore, please disregard my letter of April 8, 1975.

The Department previously reviewed the report on Presque Isle Peninsula and our comments were sent to Colonel Bernard C. Hughes, District Engineer, Buffalo District, in a letter dated July 24, 1974, which is Exhibit E-5 in the report. You will note that the letter indicates our willingness to sponsor the project, however, we object to the 5-year cutoff date for Federal participation in beach nourishment.

Generally, we concur with the recommendations of the Board of Engineers for Rivers and Harbors. We understand that the Corps will determine suitable borrow areas within Lake Erie from which the necessary supply of sand can be dredged. The Commonwealth will share the cost of these activities at the rate of 30%.

When this project was proposed in 1960, it was not expected to continue as a major undertaking. It has, however, been a major problem each year and for this reason we feel that the recommended 5-year cutoff date for Federal participation should be extended to a more realistic time period. We have no assurance that the present proposed plan will bring about the stabilization desired. Until the beach erosion has stabilized, it would seem proper to provide the Chief of Engineers with the authorization necessary to commit further Federal resources to achieve satisfactory results. When a stabilized condition has been verified over a reasonable period of years, the Commonwealth would then be willing to assume the full responsibility for periodic sand replenishment and redistribution as needed.

With regard to the draft environmental statement, we have reviewed your responses to our previous comments and find them to be satisfactory.

We have contacted the Pennsylvania Fish Commission and the Pennsylvania Game Commission regarding these reports and we were advised that they have no objections or comments to offer on this project.

The Commonwealth strongly supports the cooperative beach erosion project at Presque Isle Peninsula and urges that the report be transmitted to Congress for approval at the earliest possible date.

Sincerely yours,

Maurice K. Goddard

MAURICE K. GODDARD

PRESQUE ISLE PENINSULA
ERIE, PENNSYLVANIA

PHASE I
GENERAL DESIGN MEMORANDUM

APPENDIX F

PUBLIC INVOLVEMENT AND COORDINATION

APPENDIX F
PUBLIC INVOLVEMENT AND COORDINATION

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NEWS

CORPS OF ENGINEERS

BUFFALO DISTRICT

1776 NIAGARA STREET BUFFALO, N.Y. 14207

COLONEL DANIEL D. LUDWIG
District Engineer

Ronald B. Hoskins
AC716 876-5454

BUFFALO, NEW YORK, October 19, 1977: The Buffalo District of the US Army Corps of Engineers has begun work on a report which will recommend a plan to prevent the loss of beach sand at Presque Isle State Park. The recommended plan, which will probably involve some form of offshore breakwater, should eliminate the need for the beach nourishment projects that have been done at the Park almost every year since 1960. The report should be completed in the summer of 1980.

The 1976 Water Resources Development Act authorized the report, which will be sent back to Congress when it is completed. The plan recommended in the report must receive congressional approval for design and construction and funds must be appropriated before construction could begin.

Several alternative plans, outlined in a survey report in 1973, will be investigated. In addition, experimental breakwater segments may be constructed off the shore of Presque Isle next summer. They would be monitored for two years and provide data for the 1980 report.

-30-

EXHIBIT F-1

ERIE. PA
3/30/78

GENTELMEN

SAW YOUR AD ON T.V. CALLING FOR COMMENTS ON THE ERIE PENINSULA BREAKWALL. I HAVE HEARD FROM OLD TIMERS HERE IN ERIE THAT AT ONE TIME THERE WAS A CHANNEL THROUGH WHAT IS NOW THE NECK OF THE PENINSULA.

SINCE IT WAS CLOSED THE CURRENTS ARE FORCED DUE EAST ALONG THE SHORE CARRYING THE SAND EAST AROUND THE END OF THE PENINSULA CAUSING THE BEACHES TO ERODE.

I PROPOSE THAT YOU RETURN THE CHANNEL AT THE NECK OF THE PENINSULA, WITH A BREAKWALL EXTENDING DUE NORTH. THERBY FEEDING THE WIND DRIVEN WATER THROUGH THE CHANNEL INSTEAD OF ALONG THE BEACHES. I THINK IT WOULD SERVE 2 PURPOSES, ONE STOP THE EROSION, TWO HELP FLUSH THE ERIE BAY

SINCERLY
LEO ALLEN
3211 [illegible]
ERIE PA 16508

EXHIBIT F-2

DEPARTMENT OF THE ARMY
COASTAL ENGINEERING RESEARCH CENTER
KINGMAN BUILDING
FORT BELVOIR, VIRGINIA 22060

CEREN-CD 3 April 1978

SUBJECT: Plan of Study: Beach Erosion Control Project, Presque Isle, Pa.

District Engineer
U.S. Army Engineer District, Buffalo
1776 Niagara Street
Buffalo, New York 14207

1. Review of the subject plan of study has been completed. This report is concerned only with general concepts so in like manner, our comments are also general.

2. The proposed plan on Plate 1 will probably be successful but an attempt should be made to minimize the number of detached breakwaters during the final design. A few long structures should be more effective as littoral barriers than more numerous short ones. Also, since settlement problems most often occur at the structure heads, having fewer structures is advantageous. The experimental breakwaters at Beach 10 should yield useful information concerning the optimum spacing, offshore distance and breakwater length.

3. The full breakwater concept on Plate 4 may be viable from an engineering viewpoint, but it may not be the best solution when the high recreational and historic value of this park is considered. Structural solutions at this site should be as unobtrusive as possible.

4. The historical evidence indicates that groins, as shown on Plate 5, have not been totally effective at this site. When choosing the final protection plan, the District sould consider that an initial favorable reaction to offshore breakwaters may give way to dissatisfaction as the memories of the erosion problems fade. The experience gained from the prototype test at Beach 10 and from the Lakeview Park breakwaters may indicate whether the public will accept this type of shore protection at a heavily used recreational beach.

EXHIBIT F-3

CERFN-CD 3 April 1978

SUBJECT: Plan of Study: Beach Erosion Control Project, Presque Isle, Pa.

5. A non-structural or minimum structural alternative such as the recirculation and sandtrap concepts of Plates 6 and 7 would seem to lend themselves most readily to the present uses of this park.

1 Incl
wd

JOHN H. COUSINS
Colonel, Corps of Engineers
Commander and Director

EXHIBIT F-3 (continued)

IN REPLY REFER TO

United States Department of the Interior

1780.14 (930)

BUREAU OF LAND MANAGEMENT

EASTERN STATES OFFICE
7981 Eastern Avenue
Silver Spring, Maryland 20910

APR 7 1978

Mr. Daniel D. Ludwig, P.E.
District Engineer, Buffalo District
Corps of Engineers
1776 Niagara Street
Buffalo, New York 14207

Dear Mr. Ludwig:

We have no comments to offer on the study plan for the Cooperative Beach Erosion Control Project at Presque Isle Peninsula, Erie, Pennsylvania. The Bureau of Land Management has no surface or sub-surface mineral ownership responsibilities on or near the Presque Isle Peninsula.

Thank you for the opportunity to comment on this planning document.

Sincerely yours,

Claude A. Martin

ACTING Director
Eastern States

EXHIBIT F-4

COMMONWEALTH OF PENNSYLVANIA

DEPARTMENT OF ENVIRONMENTAL RESOURCES

P O BOX 1467

HARRISBURG, PENNSYLVANIA 17120

In reply refer to
RM-R
R 25:1

April 10, 1978

Colonel Daniel D. Ludwig
District Engineer
Buffalo District - Corps of Engineers
1776 Niagara Street
Buffalo, New York 14207

Dear Colonel Ludwig:

We have reviewed the Draft Plan of Study for accomplishing the Phase I design memorandum stage of advanced engineering and design for the cooperative beach erosion control project at Presque Isle Peninsula in Erie, Pennsylvania and present comments and suggestions on the specific sections as noted below:

Page 2, Section 2.b. - The 30% nonfederal cash contribution for construction cost is now noted to be \$8,800,000 compared with \$6,346,300 in 1974 cost, a 38% increase in the nonfederal contribution from the 1974 estimate.

Page 6, Section 7 - The last part of this section should be removed or rewritten to acknowledge Secretary Goddard's March 7, 1978 letter to Colonel Ludwig again expressing the Commonwealth of Pennsylvania's intention to act as the sponsor for a "permanent" beach erosion control project at Presque Isle. A copy of the letter could be included in the Appendix.

Page 7, Section 8 - According to this section all sandfill for beach replenishment operations are to be purchased from commercial suppliers. Since a natural source of sand must be found before it can be dug or dredged by either a commercial supplier or a public agency, we believe it would be very advantageous for the Corps during Phase I studies to undertake a comprehensive investigation for sand borrow areas. We would particularly like to see the investigation concentrate on offshore sources that could be utilized by the Corps' hopper dredge, Markham.

Page 7, Section 10 - The Pennsylvania Department of Environmental Resources is opposed to the recirculation sandtrap alternative for use at Presque Isle State Park. This alternative would adversely effect the natural environment enjoyed by the many visitors to Presque Isle.

EXHIBIT F-5

Noise would be increased in the vicinity of the pipe line, booster stations and particularly around the dredge. We understand that the pipe line must be above ground so it can be rotated to increase its service life. Since the pipe line would not be buried, it would become a physical and visual obstruction. If the pipe line were buried, the invert would wear through due to the abrasive action of the moving sand and water. The noise plus the physical and visual obstruction of the pipe will greatly deteriorate the natural aspects of Presque Isle.

There were a few printing errors that should be corrected before final printing.

Page i, Plate No. 4 - Comcept (should be concept).

Page 8, Section 13 - During..., coat (should be cost estimate).

Page A-7, Section 32 - The end of the tenth line, bset (should be best).

Sincerely yours,

C. H. McConnell

C. H. McConnell, Deputy Secretary
Resources Management

Presque Isle Audubon Society
P. O. Box 1783
Erie, Pa. 16507

April 11, 1978

Col. Daniel D. Ludwig
Buffalo District, Corps of Engineers
1776 Niagara St.
Buffalo, N.Y. 14207

Dear Col. Ludwig:

Your immediate response to our letter concerning the prototype breakwalls at Presque Isle is appreciated. The "Phase I Plan of Study..." will be placed on file along with your personal answers to our questions.

The attached newspaper copy from the Erie Times brought to our attention the fact that the recirculation-sandtrap method of erosion control at Presque Isle is also now being considered. This concept, according to your 1975 EIS spells the complete and permanent loss of Gull Point. We are firmly opposed to this replenishment method and urge that no further consideration of it be made.

As the prototype breakwalls are being built and after their completion, we will be closely watching Gull Point for changes, especially in regard to nesting and migrating birds. We sincerely hope that the breakwalls will be successful with no adverse ecological effects.

Very truly yours,

Jean Stull
R.D. 2, Benson Rd.
Waterford, Pa. 16441

Enc. 1

Mar. 2[illegible], 197[illegible]

$1 Million Awarded For Presque Isle Work

The U.S. Army Corps of Engineers has awarded a $1 million contract for beach sand replenishment and three experimental breakwalls at Presque Isle State Park.

Work is expected to start April 1 and be completed by June 10.

The Corps' Buffalo District Office also has completed a plan of study for the proposed $30 million permanent erosion-control project on the peninsula.

The contract for the breakwalls and sand was awarded to Luedtke Engineering, Inc., Frankfort, Mich. Funds will come from the scheduled $1 million in annual maintenance provided through the federal Rivers and Harbors Act. The federal government provides 70 percent of the funds in the five-year beach nourishment project; Pennsylvania Department of Environmental Resources, 30 percent.

Luedtke's bid was $323,570 for the three, 125-foot-long breakwalls to be built off Beach 10. The remainder of the contract provides for 173,000 tons of sand at $3.91 per ton, or $676,430.

For the second year in a row, the sand to be placed on Presque Isle beaches will be from land sources and of a medium-coarse grade. The sand will be similar to that placed along Beach 2 and some other sections last year, much coarser than the natural fine-grain lake sand of Presque Isle beaches.

A Corps spokesman said the coarse sand is more resistant to erosion. Prior to 1977, sand dredged from the floor of the lake was used.

The three prototype breakwalls will be constructed parallel to shore between Sunset Point and Beach 10.

One will be a wire basket filled with rocks. The second is called a stapods, or a concrete trunk standing on four legs. The third will be an interlocked concrete Z-wall.

The prototype breakwalls will be studied and evaluated in preparation for a draft design of the permanent erosion-control project. The design is scheduled to be completed by December 1979.

The Corps and DER also will study fish, bird and plant life on Presque Isle and determine how various breakwall concepts would effect them. These studies will be part of a draft environmental impact statement, to be submitted with the design recommendations.

Copies of the plan of study will be available for review and comment at the Erie Public Library, a Corps spokesman said. Citizens are invited to comment on it through April 14. Written comments can be mailed to the Corps at 1776 Niagara St., Buffalo, N.Y., 14207.

Public meetings tentatively are scheduled for September 1979 on the design study and April 1980, when the final plan is scheduled for completion.

The prototype breakwalls all are related to the basic concept of five segmented offshore breakwalls as the permanent erosion-control project. Each breakwall segment would be 500 feet long and they would be 100 feet apart. Each breakwall cluster would have four segments.

In addition to the breakwall concept, the Corps plans to study one other proposal which was discussed in the early 1970s.

It is known as the recirculation sandtrap method of beach nourishment in which a permanent pipeline would be buried under the beaches from the neck of the peninsula out to Gull Point.

Sand would be dredged from the lake off the end of the peninsula and pumped via the pipeline to the beaches.

EXHIBIT F-6 (continued)

DEPARTMENT OF TRANSPORTATION
UNITED STATES COAST GUARD

Address reply to:
COMMANDER (mep)
Ninth Coast Guard District
1240 East 9th St.
Cleveland, Ohio 44199
Phone: (216) 522-3919
293-3919 (FTS)

16450

20 APR 1978

From: Commander, Ninth Coast Guard District
To: Commandant (G-WEP-7/73)

Subj: Plan of Study, Presque Isle Peninsula POS Erie, Erie City, Pennsylvania

Ref: (a) (G-WEP-7/73) ltr 16476/7.b.424
(b) TELCON 13 April 1978 Mr. Jerry P. Olmes/Mr. F. T. Daugherty

1. This office has reviewed subject Plan of Study and has no comments or objections to offer at this time.

R. L. PICKUP
By direction

Copy to:
Department of the Army, Buffalo District Corps of Engineers

EXHIBIT F-7

United States Department of the Interior

NATIONAL PARK SERVICE
WASHINGTON, D.C. 20240

IN REPLY REFER TO:
L7619(460)

APR 21 1978

Colonel Daniel D. Ludwig
District Engineer
Department of the Army
Buffalo District, Corps of Engineers
1776 Niagara Street
Buffalo, New York 14207

Dear Colonel Ludwig:

We have reviewed your proposed plan of study for an erosion control project at Presque Isle, Pennsylvania and have the following suggestions:

Any structural solution for controlling the eastward migration of the Presque Isle sandspit will have effects on the area's significant terrestrial and aquatic ecological communities that are at once adapted to and dependent upon continual change in this dynamic physiographic system. We endorse the Corps' proposal to conduct studies of plant succession, avian ecology, and aquatic habitat values to provide information for use in evaluating the impacts of design alternatives. However, we believe that the primary emphasis of these studies should be on determining the relationship between ecosystem functions and the geological processes responsible for the continuing evolution of the sandspit. Changes in ecological conditions associated with previous human manipulation of natural shoreline processes should be thoroughly documented to the extent possible to help provide a sound basis for predicting future effects. In addition, we believe that studies should be conducted to fully characterize the sediment budget for the area, as well as the relative importance of various shoreline processes (aeolian transport, inlet formation, overwash, etc.) in the natural migration and evolution of the system. This information is prerequisite to a scientifically supportable assessment of the impacts of any project that will alter the rate, magnitude, or intensity of these processes.

We are encouraged to note that text frequently places quotation marks around the word "permanent" when referring to the effectiveness of the project in controlling shoreline migration in the long term. We believe that every effort should be made to determine the effective life of the project and what is likely to be required to control further sandspit migration after that lifespan has elapsed. Further, we believe that particular attention should be given to the impact the project may have on land use trends, both on the sandspit and on the mainland. If the

EXHIBIT F-8

implementation of the project were to promote development based on the assumption that the sandspit has been permanently stabilized, the economic, social, and ecological disruption could be highly significant in the event this assumption were proven incorrect at some future time. While there may be no reasonable alternative to an erosion control project in this area, we believe that it is incumbent upon the Corps to make known the full extent of long-term risks associated with the project so that the State and local governments can plan effectively to deal with them.

Sincerely yours,

ASSOCIATE Director

GANNON COLLEGE

PERRY SQUARE
ERIE, PENNSYLVANIA 16501

THE LIBRARY

April 21, 1978

U. S. Army Corps of Engineers
1776 Niagara Street
Buffalo, New York 14207

Gentlemen:

A recent news story in the Erie Daily Times mentioned a plan of study for the proposed 30-million-dollar permanent errosion project at Fresque Isle.

Students at Gannon College often request information concerning the peninsula. Would it be possible for us to receive a copy of this study? We would appreciate, too, being placed on a mailing list to receive other publications referring to the peninsula and the Erie harbor.

Sincerely yours,

Grace A. Davies

(Mrs.) Grace A. Davies
Acquisitions Librarian

GAD/lk

EXHIBIT F-9

Niles, Ohio
April 28, 1978

Dear Sirs:

Our library did not receive a draft about Presque Isle as a recent newspaper article stated. Even though the deadline has passed-and it's quite some time yet before summer 1980, I would be pleased to receive a copy of the plan, for which I enclose a stamped, addressed envelope.

Many in our area greatly enjoy Presque Isle and feel fortunate to have such an unique place to visit. We are saddened about the past few years' damage and erosion there.

I wish you great success.

Appreciatively,

Elizabeth Spencer

(Mrs. Steve Spencer)

EXHIBIT F-10

UNITED STATES
DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE
112 West Foster Avenue
State College, Pa 16801

June 27, 1978

Colonel Daniel L. Ludwig
Buffalo Corps of Engineers
1776 Niagara Street
Buffalo, NY 14207

Re: Beach erosion control at Presque Isle, Erie County, Pennsylvania

Dear Colonel Ludwig:

These are our comments on the draft Plan of Study for the Phase I GDM stage, dated April 1978.

Environmental data to be gathered during Phase I are mentioned in paragraphs I4f(i), (ii) and (iii). Item (i), plant succession at Gull Point and item (ii), use of Presque Isle by birds, already seem fairly well understood, as evidenced by the discussion in Appendix A. Therefore, we question the need for additional investigation of these subjects.

The fish fauna of the lake shore is well known (see our January 18, 1977 planning aid letter on the proposed harbor development at Elk Creek). We can safely assume that near-shore shallows are used for feeding by most resident fishes and for spawning by many, including alewife, trout-perch, carp, shiners and smallmouth bass. Furthermore, it can be predicted that if the five authorized rubblemound breakwaters are constructed they will increase diversity of near-shore fishery habitat and will attract forage and game fishes. In these circumstances, the need for a detailed aquatic survey (item iii) also is debatable.

We suggest that paragraph 9 on page 7 would be more logically placed on page 5 immediately following the heading, II-STATEMENT OF CONTROVERSIAL ISSUES AND AREAS OF CONCERN.

Sincerely yours,

Philip H. Edmunds
for Charles J. Kulp
Field Supervisor

EXHIBIT F-11

YOU ARE INVITED TO A

PUBLIC MEETING

ON THE

PRESQUE ISLE PENINSULA

COOPERATIVE BEACH EROSION CONTROL STUDY

WHEN

TUESDAY, 30 MAY 1978
7:30 P.M.

WHERE

TECHNICAL MEMORIAL HIGH SCHOOL AUDITORIUM
3325 CHERRY STREET
ERIE, PENNSYLVANIA
(See map on reverse side)

WHY

THE CORPS OF ENGINEERS RECENTLY INITIATED A STUDY FOR THE PHASE I GENERAL DESIGN MEMORANDUM ON THE FEASIBILITY OF CONSTRUCTING A BEACH EROSION CONTROL PROJECT ON LAKE ERIE AT PRESQUE ISLE STATE PARK... AT THIS MEETING, THE CORPS WILL PRESENT INFORMATION ON OUR STUDY PROCESS AND STUDY PLANS FOR YOUR REVIEW AND COMMENTS.

Please tell other interested people about this meeting...

Their attendance and comments are encouraged and vital to a GOOD PUBLIC INVOLVEMENT PROGRAM.

FOR ADDITIONAL INFORMATION
Contact:
BUFFALO DISTRICT
U.S.Army Corps of Engineers
1776 Niagara Street
Buffalo, N.Y. 14207
716-876-5454 ext. 2227

EXHIBIT F-12

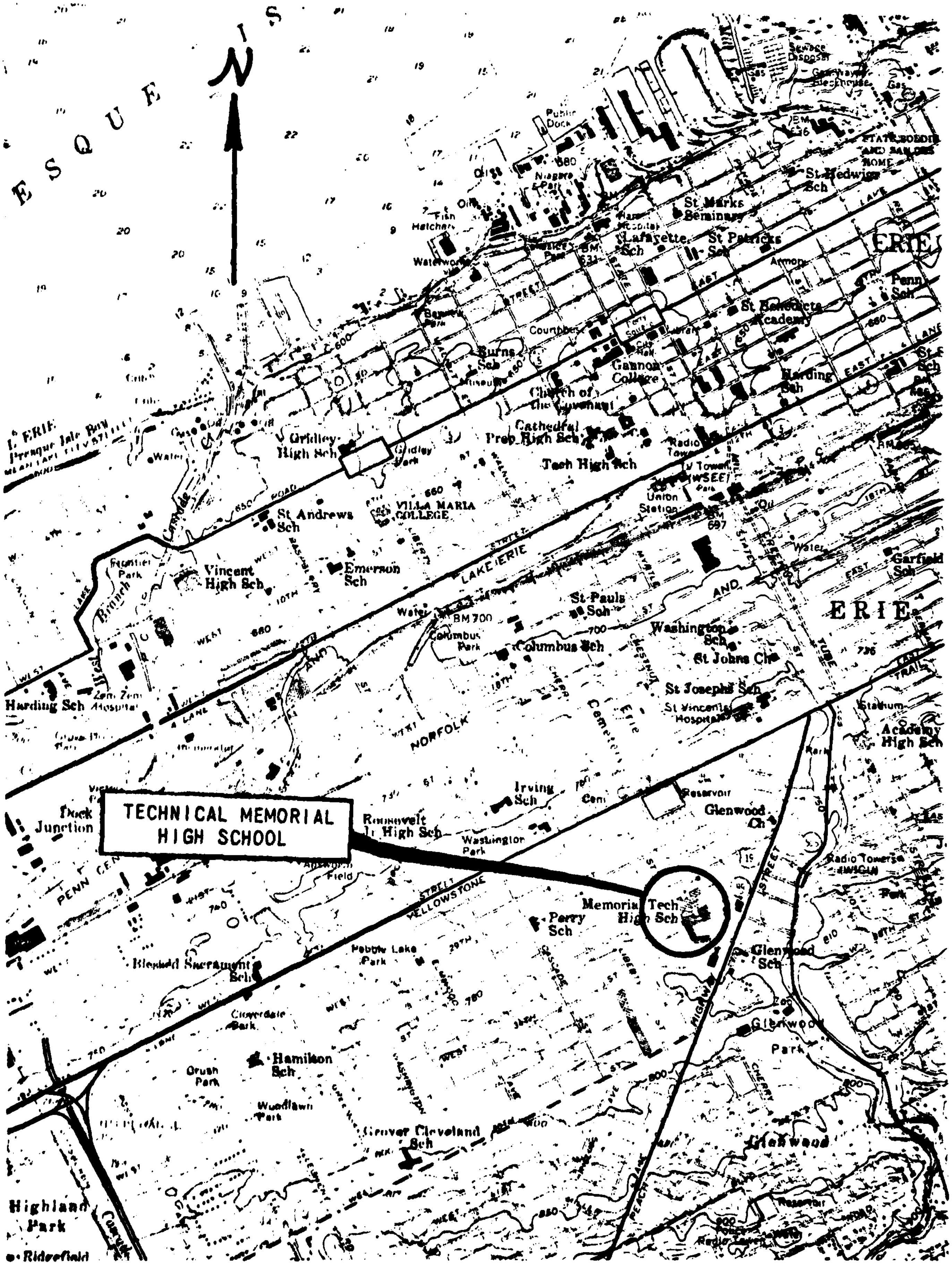


EXHIBIT F-12 (continued)

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

NCBED-DC

15 May 1978

Dear Participant:

The enclosed information packet on the Cooperative Beach Erosion Control Project at Presque Isle Peninsula in Erie, PA, is provided for your review. It describes the plan formulated in our previous study and informs you of the present status of the project prior to the public meeting at Technical Memorial High School, on 30 May 1978. Your attendance and participation at the public meeting is encouraged since it will assist the Corps in developing a plan that will satisfy the needs of the public.

Sincerely yours,

DANIEL D. LUDWIG
Colonel, Corps of Engineers
District Engineer

1 Incl
as stated

EXHIBIT F-13

PRESQUE ISLE

COOPERATIVE BEACH EROSION

CONTROL PROJECT

AN INFORMATION PACKET
SUMMARIZING ALTERNATIVES TO BE
INVESTIGATED DURING PHASE I DESIGN

PREPARED BY:

US ARMY CORPS OF ENGINEERS
BUFFALO DISTRICT
BUFFALO, NEW YORK 14207

MAY 1978

EXHIBIT F-13 (continued)

NOTES AND AGENDA

Public Meeting on Cooperative Beach Erosion Control Study

Presque Isle Peninsula

30 May 1978 - Erie, PA

1. NOTES:

a. Notice of Public Meeting. Notice of this meeting was issued previously.

b. Registration Card. You will be given a registration card at the meeting. Please give your completed registration card to any meeting official. These cards become part of the meeting record. Make sure you indicate whether you wish to make a statement.

c. Statements. Written statements are preferred for sake of accuracy, but oral statements may be made. Written statements need not be read; they become part of the official record whether or not read aloud. Prepared statements may be submitted to any meeting official.

d. Meeting Proceedings. You may record the proceedings of the meeting if you wish; however, a professional stenographer will record the proceedings, and transcripts of this record will be available at cost from the District Engineer, U.S. Army Engineer District, Buffalo, 1776 Niagara Street, Buffalo, NY 14207.

2. AGENDA:

a. 7:30 p.m. - Opening Remarks. Introductions, and Corps Presentation: Colonel Daniel D. Ludwig, District Engineer, U.S. Army Engineer District, Buffalo.

b. Presentation of Views. (Each group will have an opportunity to speak in the order listed).

(1) Members of Congress (or their Representatives)
(2) Representatives of the Governor
(3) Members of State Legislature
(4) Representatives of Civic and Environmental Organizations
(5) Representatives of Federal Agencies
(6) Representatives of State Agencies
(7) County Officials
(8) City Officials
(9) Interested Individuals

c. Closing Comments. Colonel Daniel D. Ludwig

EXHIBIT F-13 (continued)

AREA DESCRIPTION

Presque Isle Peninsula is located in the city of Erie, PA, on the south shore of Lake Erie, about 78 miles southwest of Buffalo, NY, and about 102 miles northeast of Cleveland, OH.

The peninsula is a compound recurved sand-spit projecting lakeward in a generally northeasterly direction from its narrow connection with the mainland shore. The large bay between the peninsula and mainland provides a spacious harbor, the easterly part of which has been improved for deep-draft navigation by the Federal government under the navigation project for Erie Harbor.

Presque Isle Peninsula provides valuable protection to this harbor. Practically, the entire peninsula, which contains about 3,200 acres, is owned by the Commonwealth of Pennsylvania and is developed as a 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 peninsula has a lakeward perimeter of about nine miles. 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 shore has been segmented into eleven bathing beaches by the Pennsylvania State Park Service.

HISTORY OF PROTECTION

The Cooperative Beach Erosion Control Project at Presque Isle Peninsula was originally authorized by the 1954 River and Harbor Act. 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 sand fill, and Federal participation in the cost equivalent

EXHIBIT F-13 (continued)

to one-third of the total first cost. This original project was completed during 1955 and 1956 at a total cost of $2,450,000.

Since that time, the project has proven to be inadequate in controlling erosion and stabilizing and improving the beaches along the peninsula. To protect the structures and park facilities, a modification to the original project was enacted under the 1960 River and Harbor Act. This modification authorized Federal participation in beach nourishment to the extent of seventy percent of the total cost for a period of ten years following the first major replenishment operation. The authorization under the 1960 Act expired in 1971 with $2,180,000 spent to replenish the beaches.

The beaches along the neck of the peninsula became so depleted in 1972, however, that an emergency program to place sand on them was initiated in February 1973. Subsequently, the Water Resources Development Act of 1974 reinstated and extended Federal participation in sand replenishment for a period of five years in accordance with the terms of the 1960 Act. Three phases of this five year program have been completed at a cost of $3,290,000 and the fourth phase is now underway and will be completed at a cost of $1,070,000.

The costs for placing sand on the beaches are rising each year and nourishment is an increasingly expensive means of controlling beach erosion. To date, $7,920,000 ($4,450,000 Federal and $3,470,000 Commonwealth of Pennsylvania) have been spent under the authorities for the Cooperative Beach Erosion Control Project to control erosion and maintain the recreational beaches. These protection and maintenance features have included placement of approximately 9,200,000 tons of sand on the beaches.

PRESENT PLANS FOR EROSION CONTROL

Since completion of the original Cooperative Beach Erosion Control Project in 1955-1956, sand replenishment requirements authorized by the 1960 River and Harbor Act and extended by the 1974 Water Resources Development Act have far exceeded the estimated requirements. Further, as these replenishment measures were not a complete solution to the erosion problems, the Commonwealth of Pennsylvania expressed a desire that sand replenishment as a method of protection against beach erosion at Presque Isle be reevaluated to determine if a more effective means of protection could be developed.

The Corps of Engineers was authorized in 1970 to make a complete restudy of the Presque Isle Cooperative Beach Erosion Control Project in order to develop a more effective and permanent solution to the erosion problem. A final Review Report was prepared by the Corps'

EXHIBIT F-13 (continued)

Buffalo District in 1974 and submitted to Congress. That report presents the results of investigations of alternatives which would provide a long-term solution to the erosion problem that exists on the peninsula. The recommendation of that report was for construction of segmented, offshore breakwaters and placement of sand fill as shown on Plate 1. This is also the plan of improvement which Congress authorized for the Phase I Design Memorandum stage of advanced engineering and design by the 1976 Water Resources Development Act and is presently being undertaken.

The Water Resources Development Act of 1976 also extended Federal participation in the cost for sand replenishment at the expiration of the authorization provided in Section 57 of the Water Resources Development Act of 1974.

PURPOSE OF PHASE 1 GENERAL DESIGN

Federal funds to initiate the Phase I GDM study for the beach erosion control project at Presque Isle Peninsula were provided the Buffalo District of the Corps in October 1977. The basic purpose of the Phase I GDM study is to develop a plan of improvement which is technically sound, environmentally acceptable, and economically feasible for preserving the beaches along Presque Isle Peninsula.

The Board of Engineers for Rivers and Harbors (BERH) has noted that several of the alternatives presented in the Review Report prepared by Buffalo District in 1974 are economically feasible and warrant further consideration during post-authorization studies. Therefore, the Phase I GDM study will consist of an analysis of the following alternatives: the partial breakwater scheme shown on Plate 1 and possible variations of this scheme, a full breakwater scheme (Plate 2), a groin plan (Plate 3), a sand recirculation scheme (Plate 4), a sandtrap-recirculation scheme (Plate 5), annual nourishment, and "no action" approach. Public response and suggestions will be solicited throughout the Phase I study. Public acceptance of each alternative will be determined and a plan will be selected in consideration of public concern and comments.

LOCAL COOPERATION

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 7 March 1978 stating intent to meet the terms required for local cooperation in a Local Assurance Agreement. In order for a beach erosion control project to be constructed at Presque Isle, the

EXHIBIT F-13 (continued)

local cooperator must give assurances satisfactory to the Secretary of the Army 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;

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 $8,800,000 or 30 percent;

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

ENVIRONMENTAL CONSIDERATIONS

The uniqueness of Presque Isle and its scientific value make it especially important that the Corps of Engineers obtain and consider all essential ecological information for sound design. Draft, revised Draft and Final Environmental Impact Statements were prepared during preparation of the 1974 Review Report. In addition, a Summary of Environmental Considerations for the interim five-year Cooperative Beach Nourishment project as authorized by the 1974 Water Resources Development Act and an Environmental Assessment for the experimental prototype breakwater project presently being constructed at Beach No. 10 have been prepared.

The investigations and data presented in the above environmental reports are the results of a literature search made of published studies that have dealt with plant ecology, botany, animal ecology, algae and bacteria, limnology and water quality as well as field investigations by Corps of Engineers ecologists and consultations with various experts.

Since the Corps has no original data available to properly assess the impacts of various alternatives in development of an environmentally acceptable plan, an intensive program of environmental data collection will be made during the Phase I GDM study. The environmental data will be incorporated into a Draft and Final Environmental Impact Statement (EIS) which will be prepared as part of the Phase I General Design Memorandum study. The EIS's will discuss all known or foreign impacts of any proposed project on the marine and terrestrial environments affected by the project.

PROPOSED STUDY SCHEDULE

A tentative time schedule for the Presque Isle beach erosion control project is shown on Inclosure 1. The Corps' study process involves several stages of planning at increasing levels of detail with opportunities for public participation and review of each stage.

The Water Resources Development Act of 1976 authorized only the Phase I GDM stage for the Presque Isle project. Therefore, the schedule assumes that the Phase I GDM will be submitted to Congress for approval and authorization for construction before proceeding with the Phase II study effort. This "two phase" authorization has a definite impact on the date for initiation of construction of the project since there is a 27-month period between submission of the Final Phase I GDM and initiation of the Phase II study effort.

Assuming that an acceptable beach erosion control plan is developed, the earliest construction would begin is in the spring of 1985.

The Corps has prepared the Presque Isle "Plan of Study" (POS) which presents information about the study area, identifies problems, and outlines work efforts to be accomplished during preparation of the Phase I GDM. The Draft POS was distributed (March 1978) for review and comment to all Senators and Congressmen for the Erie, PA area, all Federal and State agencies, and all private clubs and associations who have expressed an interest to the Corps. Copies of the Draft POS were also placed on reserve in all Erie City and County libraries to allow the public an opportunity to review and provide comments. The availability of the Draft POS at the libraries was announced in the news media and letters were sent to all individuals who had requested information on the project. The Final POS has been submitted to the North Central Division Engineer for approval and for authority to proceed with the Phase I General Design Memorandum studies.

PUBLIC INVOLVEMENT

In order to address the needs and concerns of all interested parties, the Corps needs your input. At this point, we are seeking information that will help us answer the following questions:

a. What are the specific needs for modification to the existing beach erosion control project at Presque Isle?

b. The Corps proposes to analyze a partial breakwater plan, a full breakwater plan, a groin plan, a sand recirculation plan, a sandtrap-recirculation plan, annual nourishment and the "no action" approach. Are there any other plans that you want us to look at? Are there any of those that the Corps proposes that you do not consider necessary?

c. What specific environmental, institutional, and social concerns should be addressed in the planning process?

Please feel free to sketch your ideas and/or write your comments and hand them in at the public meeting or mail directly to the Buffalo District, Corps of Engineers. The more you tell us about what you want or don't want for the Presque Isle beach erosion control project, the greater the chances are that the plans for the proposed project will address your concerns and serve your needs.

EXHIBIT F-13 (continued)

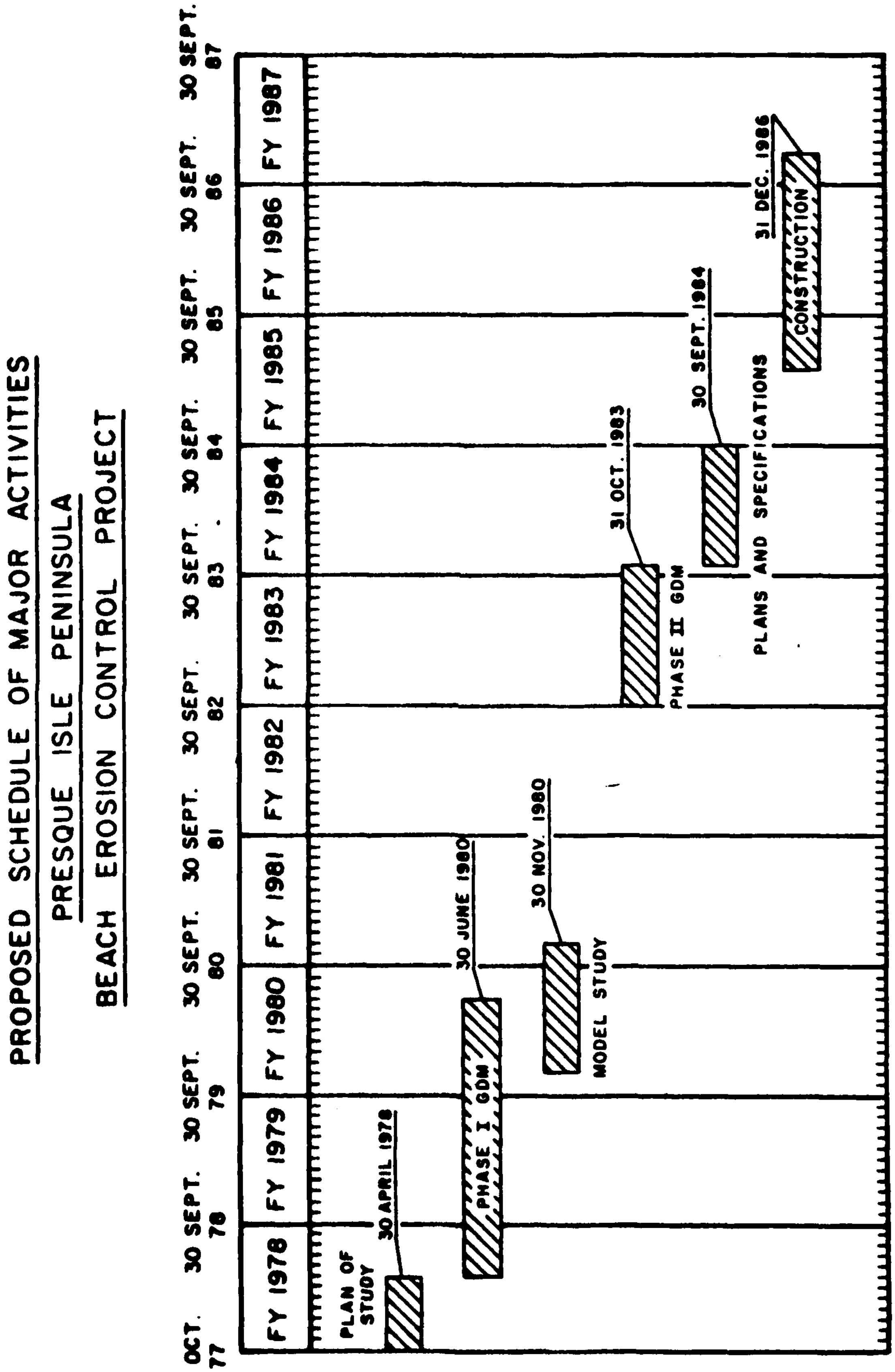
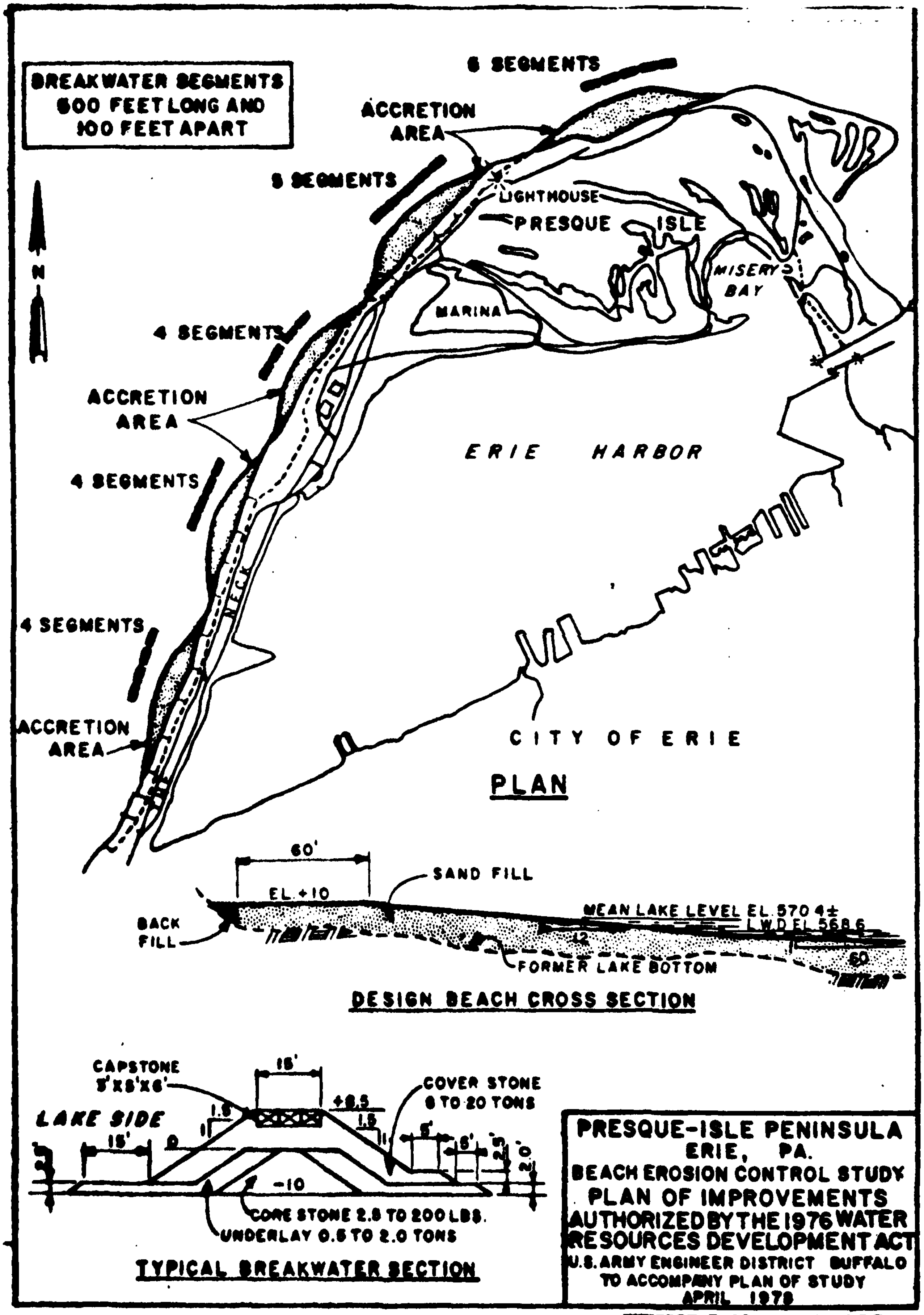
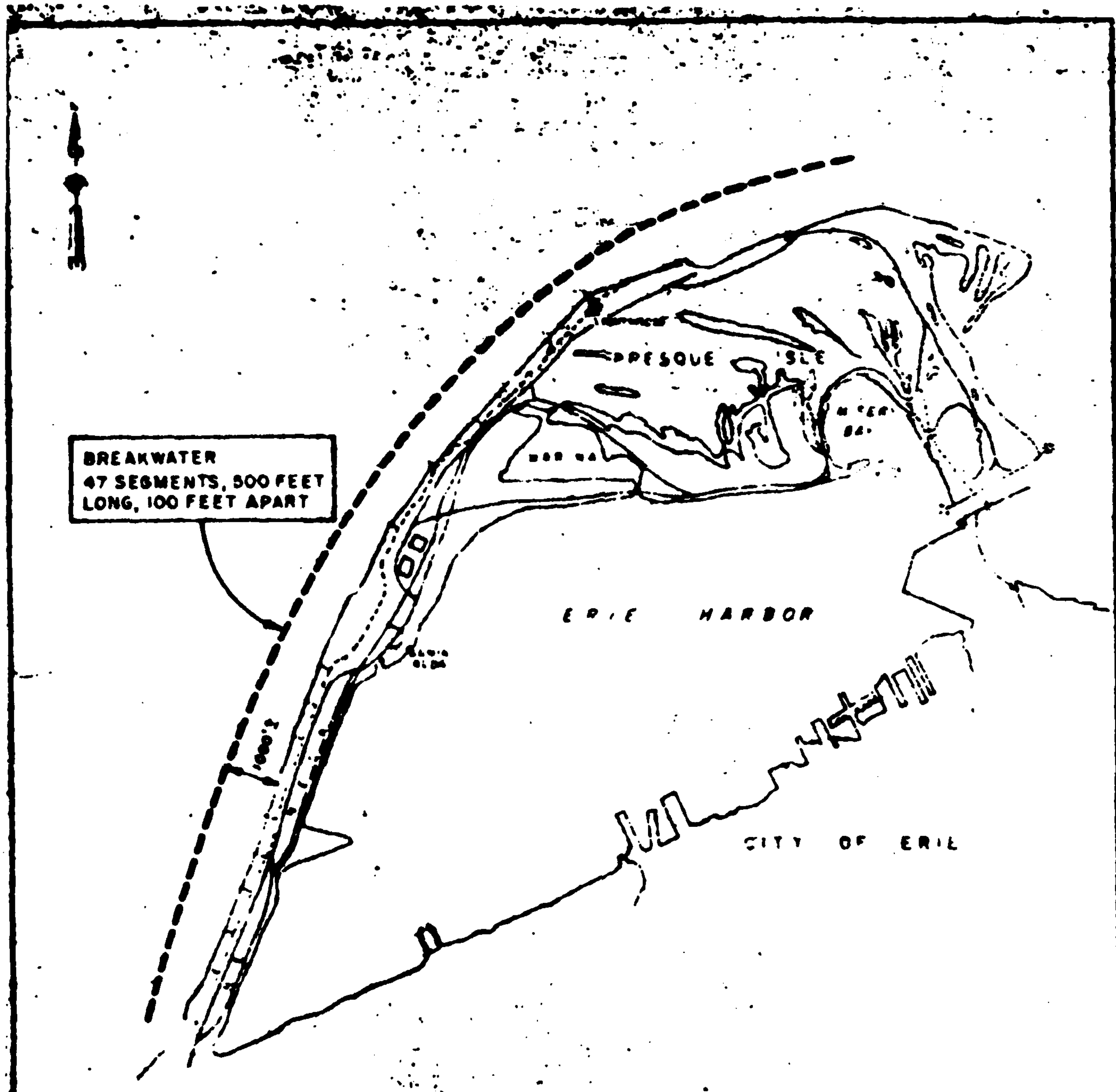


EXHIBIT F-13 (continued)


BREAKWATER SEGMENTS
500 FEET LONG AND
100 FEET APART
6 SEGMENTS
ACCRETION AREA
5 SEGMENTS
LIGHTHOUSE
PRESQUE ISLE
MISERY BAY
MARINA
N
4 SEGMENTS
ACCRETION AREA
4 SEGMENTS
ERIE HARBOR
4 SEGMENTS
ACCRETION AREA
CITY OF ERIE
PLAN
60'
EL.+10
SAND FILL
BACK FILL
MEAN LAKE LEVEL EL. 570.4±
L.W.D. EL. 568.6
FORMER LAKE BOTTOM
DESIGN BEACH CROSS SECTION
CAPSTONE
5'X5'X6'
15'
+8.5
COVER STONE
8 TO 20 TONS
LAKE SIDE
15'
-10
CORE STONE 2.5 TO 200 LBS.
UNDERLAY 0.5 TO 2.0 TONS
TYPICAL BREAKWATER SECTION
PRESQUE-ISLE PENINSULA
ERIE, PA.
BEACH EROSION CONTROL STUDY
PLAN OF IMPROVEMENTS
AUTHORIZED BY THE 1976 WATER
RESOURCES DEVELOPMENT ACT
U.S. ARMY ENGINEER DISTRICT BUFFALO
TO ACCOMPANY PLAN OF STUDY
APRIL 1979

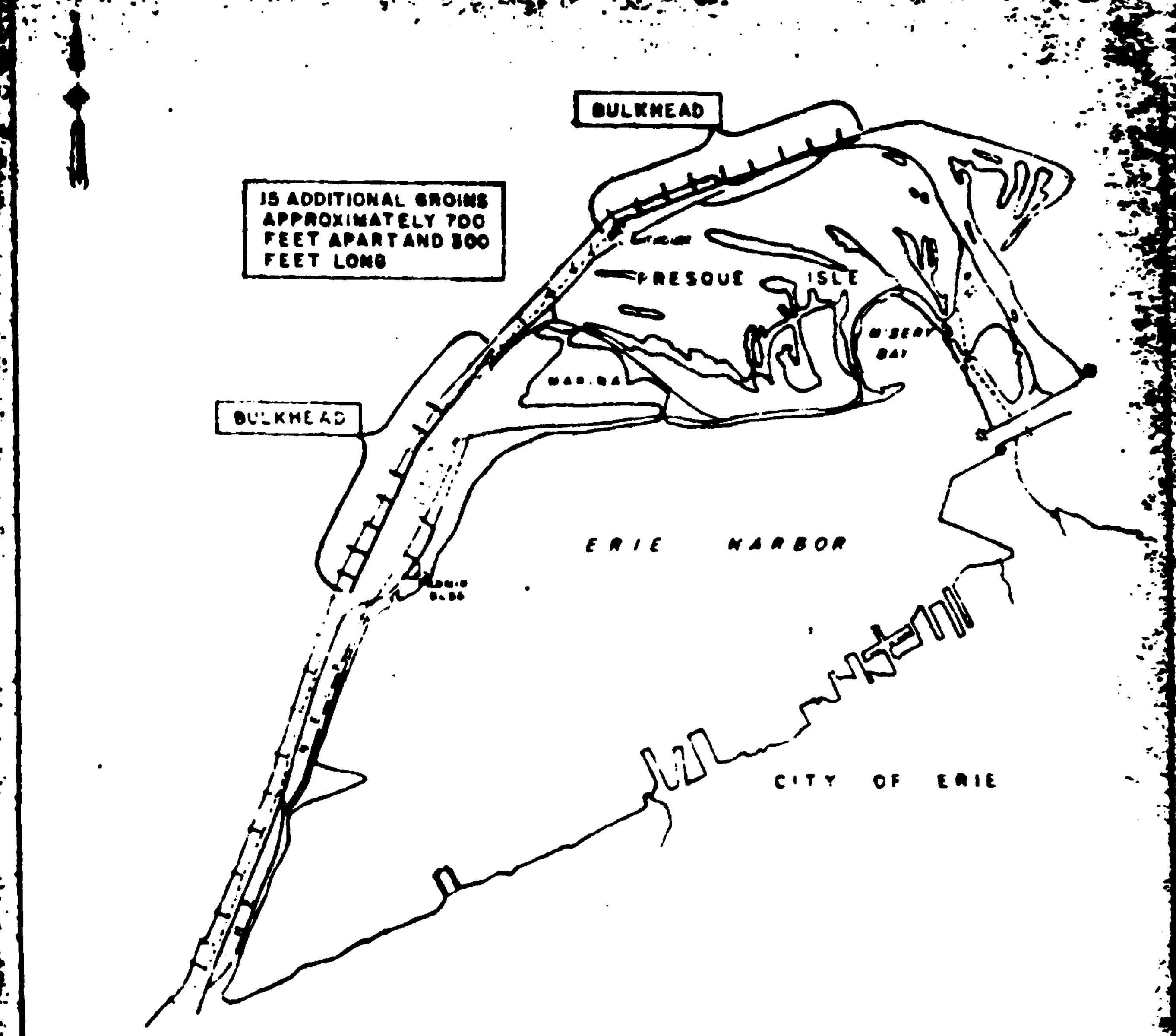


FULL BREAKWATER CONCEPT

PRESQUE ISLE PENINSULA
ERIE, PA.
BEACH EROSION CONTROL STUDY

ALTERNATIVE CONCEPT

U.S. ARMY ENGINEER DISTRICT, BUFFALO
TO ACCOMPANY PLAN OF STUDY
APRIL 1978



GROIN CONCEPT

PRESQUE ISLE PENINSULA
ERIE, PA.
BEACH EROSION CONTROL STUDY

ALTERNATIVE CONCEPT

U.S. ARMY ENGINEER DISTRICT, BUFFALO
TO ACCOMPANY PLAN OF STUDY
APRIL 1978

PLATE 3

EXHIBIT F-13
(continued)

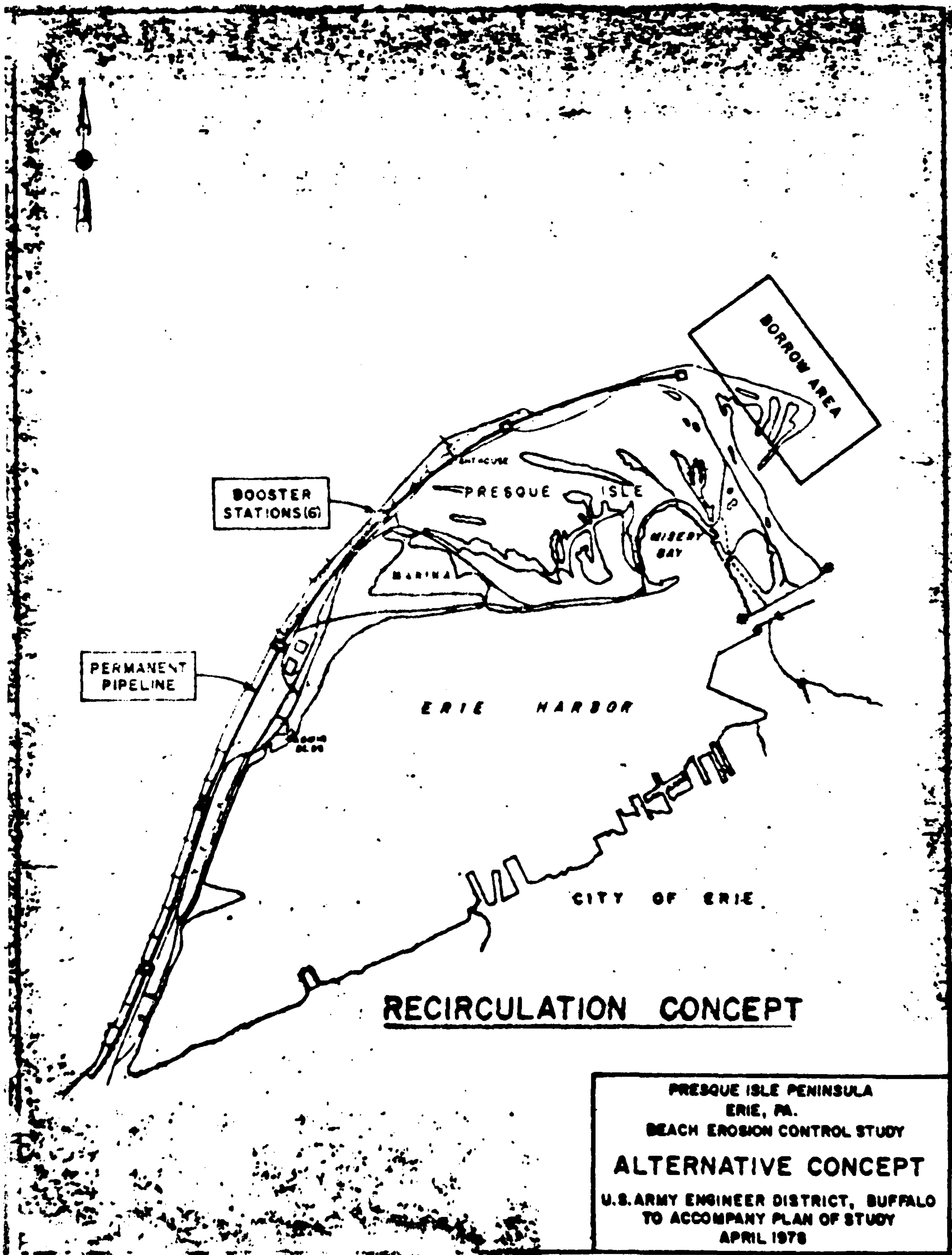
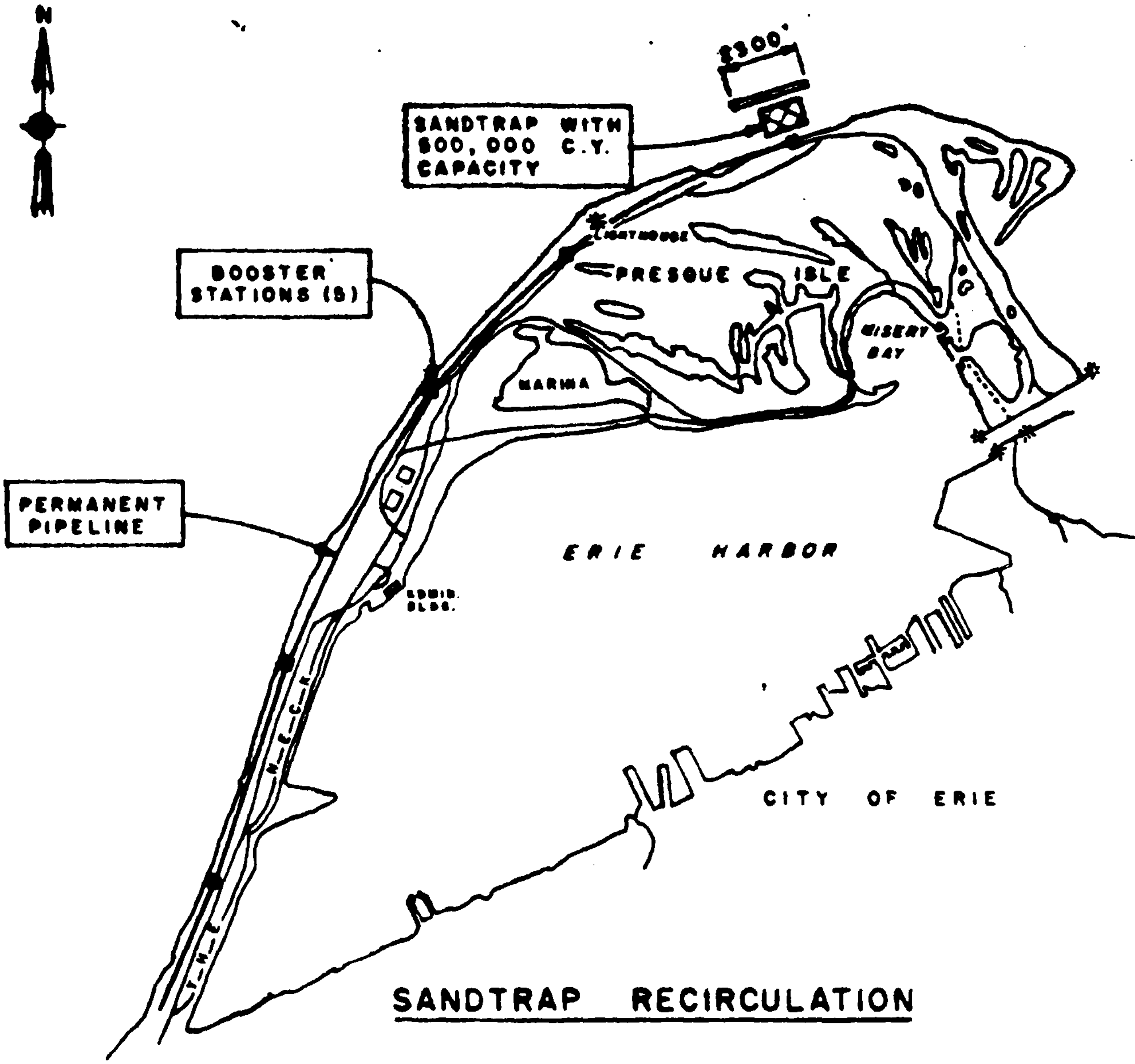
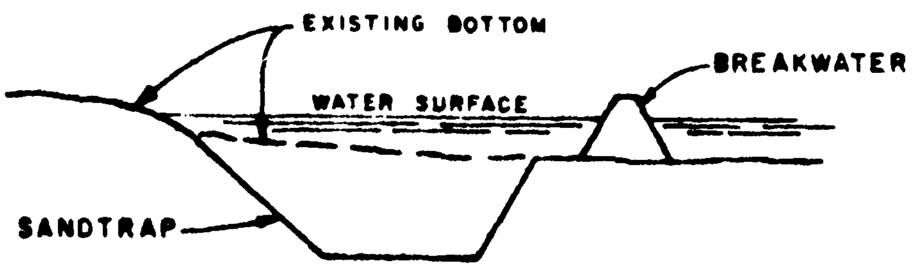


PLATE 4

EXHIBIT F-13 (continued)



SANDTRAP RECIRCULATION



SANDTRAP SECTION
(N.T.S.)

PRESQUE ISLE PENINSULA
ERIE, PA.
BEACH EROSION CONTROL STUDY

ALTERNATIVE CONCEPT

U.S. ARMY ENGINEER DISTRICT, BUFFALO
TO ACCOMPANY PLAN OF STUDY
APRIL 1979

PLATE

EXHIBIT F-13 (continued)

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PRESQUE ISLE PENINSULA, FRIE, PENNSYLVANIA. VOLUME II. APPENDIC--ETC(U)
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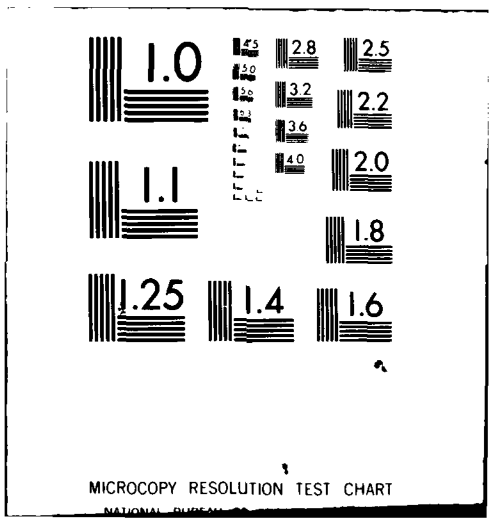
1.0
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MICROCOPY RESOLUTION TEST CHART

DRAFT STATEMENT FOR MAY 30, 1978 PUBLIC MEETING
ON PHASE I GENERAL DESIGN MEMORANDUM
BEACH EROSION CONTROL PROJECT
PRESQUE ISLE PENINSULA

Thank you for the opportunity to present comments for the Pennsylvania Department of Environmental Resources concerning the Plan of Study for the Phase I General Design Memorandum on the feasibility of constructing a cooperative beach erosion control project at Presque Isle Peninsula, Erie, Pennsylvania.

First, let me present what we believe are some of the important benefits of Presque Isle Peninsula.

The Commonwealth considers Presque Isle as one of the most important and outstanding state parks in its system. In 1977, over four million visitors came to Presque Isle. They were attracted by recreational opportunities for picnicking, swimming and boating, and found special meaning in its unique geological and biological features, and its historical significance.

The attraction of tourists to the Erie area because of Presque Isle Peninsula is a positive contribution to the local economy. The four million plus park visitors are considered to contribute substantially to the Erie area economy.

The Peninsula's value to the ecologist and student of nature is beyond question, since Presque Isle is considered by experts as one of the rarest and finest examples of the development of a sand pit to be found anywhere. It is a unique example of biological progression from bare sand to mature forests in a distance of a few thousand feet.

The Peninsula also provides a natural breakwater for the protection of the port of Erie against severe storms on the lake. The harbor and port facilities have contributed significantly to Erie's growth and economy.

Presque Isle is a valuable natural resource in which the Commonwealth of Pennsylvania and the United States Corps of Engineers have a long-standing record of interest and concern. The Department of Environmental Resources has been very active in providing support for the Corps of Engineers' projects as well as providing beach protection projects for Presque Isle by State funded construction.

The Department of Environmental Resources has for many years endorsed and worked closely with the Buffalo District, U.S. Army Corps of Engineers toward developing a workable beach erosion control project which will have the highest recreational environmental benefits at the least cost. We again express our willingness and support in this Phase I study.

EXHIBIT F-14

The Department is in general agreement with the plan of study presented, but we do have a few specific areas of the study we felt deserved special comment.

First. The need for sandfill for beach replenishment operations has been and will continue to some degree to be a problem at Presque Isle. We believe, therefore, at this time it would be best to undertake a comprehensive investigation for offshore sand borrow areas. If adequate sources of offshore borrow could be located, project and maintenance costs can be reduced.

Second. The Department is not in agreement with the recommendation by the Board of Engineers for Rivers and Harbors that the recirculation - sandtrap alternative warrants further consideration. We believe there are certain serious environmental and maintenance problems in connection with this alternative that deserve consideration. We understand that the pipeline must be above ground so it can be rotated to increase the service life. If the pipe were not rotated, the invert would be quickly worn through by the erosive action of the sand water fluid. The above ground position of the pipeline would be a physical and visual obstruction to the bathers, picnickers and other visitors along the lakeside of the Peninsula. In addition the noise would be increased in the vicinity of the pipeline, booster station and particularly around the dredge. We believe, therefore, in view of the potential negative environmental impacts of the recirculation sandtrap alternative, that this proposal may be adverse to the environment and aesthetic values of the park.

Third. The Department favors, at this time, construction of the segmented, rubblemound breakwaters located offshore and recommended in the Report of the Chief of Engineers, April 8, 1976. We 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.

Over the years, we have had a good working relationship with the Buffalo District in development of shore protective projects for Presque Isle. We look forward to continued cooperation with the Corps of Engineers and offer our assistance and support in arriving at the best possible beach erosion control project at Presque Isle.

DAG NUMMEDAL, Ph.D.
Consulting Geologist

267 Clara Drive
Baton Rouge, Louisiana 70808
Phone (504) 769–0316

August 3, 1979

Ms. Joan Pope
Buffalo District, Corps of Engineers
1776 Niagara Street
Buffalo, N.Y. 14207

Dear Joan,

Enclosed is the Draft Presque Isle Stage II Document. I have read through it and listed my comments below. Numbers correspond to those in the manuscript margin.

1. Is there a difference between "plates" and "figures"?

2. A "cuspate bar" is probably not a precise term to most readers.

3. Beach no. 11 hasn't.

4. Is that really true? The rest of the text and table 2 suggest a water level high in May/June and a low in late fall or early winter.

5. Has this statement really been tested? I would like to see a series of bluff profiles to the west of, within, and to the east of Erie harbor. I suspect we would find significant differences!

6. The Army Corps 1953 report (plate 3) shows recurved spits existed in 1875 and 1888, although they were not as big as the present Gull Point. However, the overall morphological shape of the east end of Presque Isle in the late eighteen hundreds was very similar to that at the present.

7. This is an interesting idea, but it should not be presented without some evidence regarding longshore transport along beaches to the west, the on-offshore sediment balance and the depth difference east and west of the peninsula.

8. Is it really true that a breaching of the neck would adversely affect Erie harbor? I doubt that argument very much.

EXHIBIT F-15

9. I think I understand what you mean because we have discussed it extensively. But it may not be evident to other readers.

10. Do we know that?

11. It still is very likely that these streams contribute sediment during periods of low lake levels.

12. These numbers are of course the ones I asked for in pt. 7; the general conclusions should not be presented before this section of evidence.

13. I have no basis for suggesting that bar mobility is related to a net sediment loss from the peninsula. Actually, I am somewhat skeptical about the idea of a net loss from Presque Isle at the present. Without having done any measurements, it certainly appears from Messinger's maps (fig.7) and Army Corps bathymetric charts (House Document No. 231, 1953) as if the peninsula has steadily grown. Whether the growth is more or less than what can be attributed to artificial nourishment remains to be tested by detailed measurements.

14. The stated 40% loss to the harbor entrance channel regardless of what shore protection alternative is chosen is inconsistent with an earlier statement on page 40 of the report. If the arrival of a "slug" of sediment is responsible for the sudden development of Gull Point as a "mini Presque Isle", then it appears that the trap efficiency of this recurved spit was changed with the increase in total sediment supply rate. Therefore, as groins and segmented offshore breakwaters reduce the total longshore transport rate, the trap efficiency of the recurved spit may again change.

<u>General comments</u>:

A very thorough report, well written and quite informative. The sediment budget approach to the different alternatives is good; yet we still need to nail down some specific problems as suggested above. Probably the most important ones are:

1. Is there really a natural loss from the peninsula system as a whole, and if so, what is this loss rate?
2. How do the bars respond to the various types of structures emplaced along the shore?
3. Does the Gull Point trap efficiency depend on the rate of sediment supply?

I will try to focus the annual report for 1979 on some of these problems.

Cheers!

Dag

COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF ENVIRONMENTAL RESOURCES
P.O. BOX 1467, HARRISBURG, PENNSYLVANIA 17120

August 13, 1979

In reply refer to
RM-R
R 25:1

Colonel George P. Johnson
Corps of Engineers - Buffalo District
1776 Niagara Street
Buffalo, New York 14207

Dear Colonel Johnson:

Secretary Jones requested that I reply to your letter of June 20, 1979 soliciting comments on the Stage II documentation for Presque Isle Peninsula, Erie, Pennsylvania. The documentation has been reviewed by the Bureaus of State Parks and Resources Programming and a field inspection was made at Presque Isle State Park on July 19, 1979.

The attempts to control beach erosion at Presque Isle go back many years. The need to continue erosion control work stems from the necessity of providing protection to both the harbor and the peninsula. Public comments at meetings heavily supported the need to provide active control measures versus a "do nothing" approach.

We feel that the following criteria is important in developing and evaluating erosion control measures:

1. The "permanent" project, by implication, requires a minimum annual energy use.

2. The project needs a minimum annual operation and maintenance effort, including beach nourishment.

3. Initial cost be kept to a minimum in relation to the total effectiveness of the project.

4. Aesthetics must be considered in any solution developed to minimize erosion.

5. Safety for boaters, bathers, and others must be considered.

6. The project structure should allow minimum sand migration to Gull Point and to the harbor entrance channel.

The following comments are submitted in relation to selection of the type of project:

1. We reiterate our opposition to the sand recirculation plan because of the energy needs and also because of the installation of a 20" diameter pipe from one end of the park to the other.

2. Since displacement of some armor stone has occurred on the experimental breakwaters at Beach #10, we recommend that stone used for the breakwaters should be larger than those used previously.

3. Inasmuch as the no action alternative is not an acceptable solution as explained in your documentation, it follows that the segmented breakwater is the only realistic alternative for beach erosion control.

The proposed segmented breakwater, described on page 77 of the report, consists of 58 breakwaters, 300 to 400 feet offshore, each 150' long with gaps of 350'. We are concerned with this spacing since a sawtooth configuration may occur on the beach with the beach extending out to the breakwaters. Also, the breakwaters may be a dangerous attraction to bathers.

It is requested that you consider a deeper water breakwater system with the distance from the existing shore being constant, instead of the three foot depth contour as given on pages 77-78. Height and spacing of the breakwaters could be adjusted accordingly to provide longer reaches of nonhazardous beach.

We feel also that consideration should be given to the use of the segmented breakwater in areas of existing beach erosion structures. Perhaps a test utilizing the breakwater in conjunction with the groin field would be appropriate at this time. There may be an optimum position of the breakwater with respect to the existing groin locations. Consideration could also be given to the alteration of the grout fill bags on Beach #6 to fit with the proposed segmented breakwater configuration.

In summary, we feel that the segmented breakwater should be positioned in such a way to allow enhanced beach utilization. Using wider gaps between breakwaters and possibly longer breakwater segments at a greater distance from the shore may be the best solution to the beach erosion problem at Presque Isle State Park.

Sincerely,

C. H. McConnell, Deputy Secretary
Resources Management

UNITED STATES
DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE

112 West Foster Avenue
State College, Pennsylvania 16801

August 20, 1979

District Engineer
Buffalo District, Corps of Engineers
1776 Niagara Street
Buffalo, New York 14207

Re: Beach erosion control at Presque Isle, Erie County, Pennsylvania

Dear Colonel Johnson:

This is in response to your August 2, 1979 letter requesting comments on a document labeled Stage 2 Documentation, May 1979.

In its 1974 Review Report, the District recommended sandfill and five sections of segmented, rubblemound breakwater as a structural plan for controlling erosion along the lake side of Presque Isle peninsula. The Division Engineer, the Board of Engineers for Rivers and Harbors, and the Chief of Engineers concurred with the recommendation. The plan was authorized for advanced engineering and design by the 1976 Water Resources Development Act. Under these circumstances, I do not understand why the District continues to consider other alternatives. If there is new information indicating the authorized plan is now imprudent, the information should be included in the Stage 2 Documentation Report.

The Service's June 27, 1978 letter of comment on the Plan of Study should be included in Appendix A with similar correspondence from other agencies and individuals.

I agree with your determination (page E-13) that segmented rubblemound breakwaters qualify as an Environmental Quality (EQ) plan; they would contribute to both of the listed EQ objectives. I do not agree that the No Action alternative also qualifies as an EQ plan. The No Action alternative would not contribute to the second listed EQ Objective (enhancement of bathing beaches).

The penultimate paragraph on page E-18 states that ..."post-construction monitoring would need to be a feature of any structural plan, with a possibility of mitigation in the form of sand nourishment to preserve Gull Point if the biological resources are threatened by the project." I concur.

There are several discrepancies between the Appendix E text and the plates that accompanied the Stage 2 Documentation Report.

a) Paragraph one on page E-10 and paragraph six on page E-21 mention a 1,600-foot steel pipeline of 12-inch diameter whereas Plate 9 shows 32,000 feet of 20-inch pipeline and Plate 10 shows 24,000 feet of 20-inch pipeline.
b) Paragraph two on page E-20 mentions Plate 5 in connection with the groin alternative, but the reference should be to Plate 6.
c) Paragraph four on page E-22 mentions Plate 7 in connection with a 2,300-foot breakwater, 1,400 feet offshore and with a crest height of 14' LWD. It is Plate 10, not Plate 7, that depicts the sandtrap breakwater. Furthermore, according to Plate 10, the breakwater would have a length of 2000 feet, would be 1200 feet offshore, and would have a crest height of 18.5' LWD.

Three experimental rubblemound breakwaters that were constructed at Beach No. 10 during 1978 are mentioned only briefly (item g, page 111) in the Stage 2 Documentation Report. I suggest the Report should describe these structures and indicate whether they are having the desired effect.

Sincerely yours,

Charles J. Kulp

Charles J. Kulp
Field Supervisor

COMMONWEALTH OF PENNSYLVANIA
PENNSYLVANIA FISH COMMISSION

Division of Fisheries
Robinson Lane
Bellefonte, PA 16823

814-359-2754

October 11, 1979

Colonel George P. Johnson
District Engineer
Buffalo District, Corps of Engineers
1776 Niagara Street
Buffalo, NY 14207

Re: Beach Erosion Control
Presque Isle Peninsula
Erie, Pennsylvania
Stage II Documentation

Dear Colonel Johnson:

The subject document has been reviewed and satisfactorily presents the problem and alternative solutions.

The Pennsylvania Fish Commission approves of the conclusion to proceed to a Stage 3 level of investigation and the preparation of a Phase I Design Memorandum on the project.

In regard to the three control methods to be included in the Stage 3 investigation, from a fisheries viewpoint we prefer the segmented breakwater plan. This will provide structure in an area which is now a current maintained sand flat. This area is now relatively unproductive as far as a fishery is concerned. The addition of structure and the creation of low current areas which such a breakwater would create should be beneficial toward improving the area for fish habitat.

Thank you for the opportunity to comment on this document and we would appreciate reviewing the plans that are developed in the additional studies.

Sincerely,

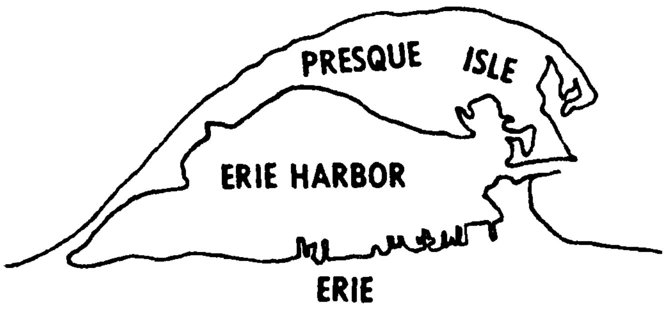
Jack G. Miller

Jack G. Miller, Chief
Fisheries Environmental Services

JGM:dms

cc: Delano Graff
Walter Lazusky
~~Roger Kenyon~~
James Carter
Charles Kulp

EXHIBIT F-18



You Are Invited To A

PUBLIC MEETING

ON THE

PRESQUE ISLE PENINSULA

COOPERATIVE BEACH EROSION CONTROL STUDY

WHEN WEDNESDAY, 26 September 1979
7:30 P.M.,

WHERE GANNON COLLEGE'S ZURN THEATRE
109 West 6th Street Erie, Pennsylvania
(See map on reverse side)

WHY The Corps of Engineers recently completed Stage II of a study for the Phase I General Design Memorandum on the feasibility of constructing a Beach Erosion Control Project On Lake Erie At Presque Isle State Park... At this meeting, the Corps will present information on alternative plans for controlling erosion and preserving the recreational beaches on Presque Isle Peninsula and hear public comments about the plans.

Please tell other interested people about this meeting... Their attendance and comments are encouraged and vital to a GOOD PUBLIC INVOLVEMENT PROGRAM.

FOR ADDITIONAL INFORMATION
Contact: BUFFALO DISTRICT
U.S. Army Corps of Engineers
1776 Niagara Street
Buffalo, N.Y. 14207
716-876-5454 ext. 2227

EXHIBIT F-19

EXHIBIT F-19 (continued)

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

NCBED-DC

11 September 1979

Dear Participant:

The enclosed information packet on the Cooperative Beach Erosion Control Project at Presque Isle Peninsula in Erie, PA, is provided for your review. It describes the most recent plans of protection and improvement for the beaches along Presque Isle Peninsula and informs you of the present status of the project prior to the public meeting which will be held at the Gannon College Zurn Theatre on 26 September 1979. Your attendance and participation at the public meeting is encouraged since it will assist the Corps in selecting a plan that will satisfy the needs of the public.

Sincerely yours,

GEORGE P. JOHNSON
Colonel, Corps of Engineers
District Engineer

Incl
as stated

EXHIBIT F-20

PRESQUE ISLE

COOPERATIVE BEACH EROSION CONTROL PROJECT

AN INFORMATION PACKET
SUMMARIZING RESULTS OF INVESTIGATIONS
UNDERTAKEN THROUGH
STAGE II OF THE PHASE I DESIGN

Prepared by:

U.S. Army Corps of Engineers
Buffalo District
Buffalo, New York 14207

U.S. ARMY CORPS OF ENGINEERS
ESSAYONS
BUFFALO DISTRICT

SEPTEMBER 1979

EXHIBIT F-20 (continued)

NOTES AND AGENDA

Public Meeting on Cooperative Beach Erosion Control Study

Presque Isle Peninsula

26 September 1979 - Erie, PA

1. NOTES:

a. Notice of Public Meeting. Notice of this meeting was issued previously.

b. Registration Card. You will be given a registration card at the meeting. Please give your completed registration card to any meeting official. These cards become part of the meeting record. Make sure you indicate whether you wish to make a statement.

c. Statements. Written statements are preferred for sake of accuracy, but oral statements may be made. Written statements need not be read; they become part of the official record whether or not read aloud. Prepared statements may be submitted to any meeting official.

d. Meeting Proceedings. You may record the proceedings of the meeting if you wish; however, a professional stenographer will record the proceedings, and transcripts of this record will be available at cost from the District Engineer, U.S. Army Engineer District, Buffalo, 1776 Niagara Street, Buffalo, NY 14207.

2. AGENDA:

a. 7:30 p.m. - Opening Remarks. Introductions, and Corps Presentation: Colonel George P. Johnson, District Engineer, U.S. Army Engineer District, Buffalo.

b. Presentation of Views. (Each group will have an opportunity to speak in the order listed).

(1) Members of Congress (or their Representatives)
(2) Representatives of the Governor
(3) Members of State Legislature
(4) Representatives of Civic and Environmental Organizations
(5) Representatives of Federal Agencies
(6) Representatives of State Agencies
(7) County Officials
(8) City Officials
(9) Interested Individuals

c. Closing Comments. Colonel George P. Johnson

AREA DESCRIPTION

Presque Isle Peninsula is located in the city of Erie, PA, on the south shore of Lake Erie, about 78 miles southwest of Buffalo, NY, and about 102 miles northeast of Cleveland, OH.

The peninsula is a compound recurved sand-spit projecting lakeward in a generally northeasterly direction from its narrow connection with the mainland shore. The large bay between the peninsula and mainland provides a spacious harbor, the easterly part of which has been improved for deep-draft navigation by the Federal government under the navigation project for Erie Harbor.

Presque Isle Peninsula provides valuable protection to this harbor. Practically, the entire peninsula, which contains about 3,200 acres, is owned by the Commonwealth of Pennsylvania and is developed as a 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 peninsula has a lakeward perimeter of about nine miles. 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 shore has been segmented into eleven bathing beaches by the Pennsylvania State Park Service.

HISTORY OF PROTECTION

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 first cost for completing the project was $2,451,000 ($817,000 Federal and $1,634,000 non-Federal).

When the cooperative beach erosion control project authorized by the 1954 River and Harbor Act was adopted, it was recognized that periodic replenishment with sand fill would be required to preserve the full protective and recreational function of the project. However, the sand losses were greater than estimated because the predominant west-to-east littoral movement continued to remove more sand from the peninsula beaches than was supplied by littoral drift from the shore to the west. Therefore, a modification of the beach erosion control project was enacted under the 1960 River and Harbor Act to control the erosion to the point where the Federal shore protection structures and the State's park facilities would not be threatened. 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 1,940,000 tons of sand were placed on the beaches at a total cost of $2,178,000 ($1,329,000 Federal and $849,000 non-Federal).

The cooperative beach erosion control project was further modified by the 1974 Water Resources Development Act which authorized an additional five-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 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 a more permanent solution to the serious erosion problem at Presque Isle. Five years of sand replenishment (1975 - 1979), as authorized by the 1974 and 1976 Water Resources Development Acts, have been completed during which three experimental prototype breakwaters were constructed and a total of about 1,050,000 tons of sand were placed on the beaches at a total cost of $5,428,000 ($3,800,000 Federal and $1,628,000 non-Federal). Another five years are currently scheduled to provide sand replenishment for the period before construction of any improvements could be implemented.

The costs for placing sand on the beaches are rising each year thereby making the continuation of annual nourishment an increasingly expensive means of controlling beach erosion. In addition, the availability of sufficient quantities of suitable quality sand from land sources is decreasing each year as the demand continually increases. This decrease may eventually lead to acquisition of higher priced sand from offshore zones. Approximately $10,057,000 ($5,946,000 Federal and $4,111,000 Commonwealth of Pennsylvania) has been spent in attempts to control erosion and maintain the recreational beaches under the authorities for the cooperative beach erosion control project. These erosion control and maintenance measures have included placement of approximately 9,260,000 tons of sand on the beaches.

PRESENT PLANS FOR EROSION CONTROL

The periodic sand replenishment requirements authorized by the 1960 River and Harbor Act exceeded the estimated requirements and were not a complete solution to the erosion problem. Therefore, in March 1967, the Commonwealth of Pennsylvania expressed a desire that sand replenishment, as a method of protection against beach erosion at Presque Isle, be reevaluated to determine if a more effective method of protection could be developed.

The Corps of Engineers was authorized in 1970 to make a complete restudy of the Presque Isle Cooperative Beach Erosion Control Project in order to develop a more effective and permanent solution to the erosion problem. A final Review Report was prepared by the Corps' Buffalo District in 1974 and submitted to Congress. That report presents the results of investigations of alternatives which would provide a long-term solution to the erosion problem that exists on the peninsula. The recommendation of that report was for construction of segmented, offshore breakwaters and placement of sand fill as shown on Plate 1. This is also the plan of improvement which Congress authorized for the Phase I Design Memorandum stage of advanced engineering and design by the 1976 Water Resources Development Act and is presently being undertaken.

PHASE I GENERAL DESIGN MEMORANDUM STAGE

Federal funds to initiate the Phase I GDM study for the beach erosion control project at Presque Isle Peninsula were provided the Buffalo District of the Corps in October 1977. The basic purpose of the Phase I GDM study is to develop a plan of improvement which is technically sound, environmentally acceptable, and economically feasible for preserving the beaches along Presque Isle Peninsula.

The Board of Engineers for Rivers and Harbors (BERH) has noted that several of the alternatives presented in the Review Report prepared by Buffalo District in 1974 are economically feasible and warrant further consideration during post-authorization studies. Therefore, the Phase I GDM study consists of an analysis of the following alternatives: a segmented breakwater, groins, sand recirculation, sand trap-recirculation, annual sand nourishment, and "no action".

Stage II of the Phase I design was recently completed and the above alternatives, which would provide long-term solutions to the erosion problem, were formulated, assessed, and evaluated. Each of the alternatives, excluding no action, require an initial beach replenishment and all but the sand recirculation alternative (and no action) require some degree of annual beach replenishment from an outside source. A descriptive summary of these alternatives is presented below and a comparative summary is provided in Table 1.

a. Segmented Breakwater Alternative: A segmented breakwater plan which will function as a wave-attenuating and beach-building system and effectively preserve the entire peninsula and its recreational facilities from the natural erosion processes was developed. The plan was designed after reviewing existing literature on offshore breakwaters and then analyzing information obtained by observing the three experimental prototype breakwaters which have been very effective in attenuating waves and functioning as beach builders at Beach No. 10. The plan consists 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 three-foot depth contour (based on low water datum) and have a crest elevation of 8.5 feet above low water datum. The segmented breakwater alternative would require an initial replenishment of 750,000 cubic yards of sand fill and an average 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 +10.0 feet above low water datum. With the segmented breakwater plan, approximately 65,000 cubic yards of sand would be bypassed naturally each year to the east end of the peninsula for continued growth. The estimated first cost for the breakwater plan is $15,000,000. In addition, about $240,000 would be required each year for annual operation and maintenance. The details of the segmented breakwater plan are shown on Plate 2.

b. Groin Alternative: The groin concept presented in the 1974 Review Report was simply an extension of the existing Federal groin field which itself has been inadequate in preserving the peninsula and reducing the erosion. Therefore, a groin plan was designed which would function more efficiently and reduce the annual sand replenishment requirements. This groin plan 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 sand fill and an average 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. With this groin plan, approximately 130,000 cubic yards of sand would be bypassed naturally each year to the east end of the peninsula for continued growth. The estimated first cost for the groin plan is $24,400,000. In addition, about $850,000 would be required each year for annual operation and maintenance. The details of the groin plan are shown on Plates 3 and 4.

c. Sand Recirculation Alternative: Littoral material from the west as well as the sand from the peninsula beaches is moved generally eastward by the predominant easterly drift and is deposited at the east end of the peninsula. Therefore, a method of replenishment was developed in which sand from the natural deposition area of Gull Point would be recirculated and deposited on eroded beaches via transmission through a pipeline. Sand would be transferred to a pumping system from a borrow area at Gull Point with the use of a hydraulic dredge. The pumping system would consist of 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 plan would require an initial replenishment of 750,000 cubic yards of sand fill and an average annual replenishment requirement 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 a borrow area at Gull Point and would cause an initial loss of 750,000 cubic yards of sand from the east end and a net annual loss of 15,000 cubic yards of sand over the 50-year life of the project. The estimated first cost for the sand recirculation plan is $15,600,000. In addition, about $2,280,000 would be required each year for annual operation and maintenance. The general plan of the sand recirculation plan is shown on Plate 5.

d. Sand Trap Recirculation: With the sand recirculation alternative presented above, the waterfowl sanctuary that is located at the east end of the peninsula could eventually be destroyed and the ecological progression of Presque Isle would be virtually stopped. Therefore, a sand trap recirculation plan was developed to circumvent the potential 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 plan 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; excavation of a sand trap with a 270,000 cubic yard capacity in the lee of the breakwater; a 20-inch diameter permanent pipeline running approximately parallel to the park's lake shore road, and a series of three booster pumps located at 8,000-foot intervals. The sand trap recirculation plan would require an initial replenishment of 750,000 cubic yard of sand fill (270,000 cubic yards from the sand trap and 480,000 cubic yards from an outside source) and an average 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 for the average annual replenishment requirement consists of 220,000 cubic yards of sand being pumped from the trap by hydraulic dredge 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 plan, a total of 40,000 cubic yards of sand would bypass to the east end of the peninsula for continued growth. The estimated first cost for the sand trap plan is $22,200,000. In addition, about $2,500,000 would be required each year for annual operation and maintenance. The details of the sand trap recirculation plan are shown on Plate 6.

e. Annual Nourishment: Beach replenishment 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. In addition, the availability of sufficient quantities of suitable quality sand from land sources is decreasing each year as the demand continually increases. This decrease may eventually lead to acquisition of higher priced sand from offshore zones. However, an annual nourishment plan was developed whereby an initial placement of 750,000 cubic yards of sand fill would be needed to restore the beaches to a design width of 60 feet and crest elevation of +10 feet above low water datum. This plan would then require 275,000 cubic yards of sand fill annually to maintain the beach width and crest elevation. With the annual nourishment plan, about 260,000 cubic yards of sand would bypass naturally to the east end of the peninsula. Presently there is such an increased volume of sand reaching the 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 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 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. This deposition of sand in the entrance channel to Erie Harbor is increasing the amount of annual dredging and, thereby, the maintenance costs for Erie Harbor. The estimated first cost for the annual nourishment plan if $6,200,000. In addition, about $2,000,000 would be required each year for annual sand replenishment.

f. Do Nothing Approach: By this plan, the Corps of Engineers would not participate in the protection or improvement of Presque Isle Peninsula. 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 of the peninsula 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 the 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 the material from the west would be reincorporated into the eastern beaches. New ponds will be formed and the peninsula will retain its sand spit nature. It is impossible to predict the rate of eastward migration that would occur, the future morphology of the peninsula, or the time required before the peninsula is ultimately destroyed by the same natural forces which created and maintain Presque Isle Peninsula. In any event, the natural features and processes, whether they be formation of sand spits or destruction of beaches, would continue.

LOCAL COOPERATION

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 7 March 1978 stating their intent to meet the terms required for local cooperation in a Local Assurance Agreement. In order for a beach erosion control project to be constructed at Presque Isle, the local cooperator must give assurances satisfactory to the Secretary of the Army 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;

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;

EXHIBIT F-20 (continued)

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;

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.

PROJECT STATUS

The Water Resources Development Act of 1976 authorized only the Phase I GDM stage for the Presque Isle project. Therefore, our schedule assumes that the Phase I GDM will be submitted to Congress for approval and authorization for construction before proceeding with the Phase II study effort. This "two phase" authorization has a definite impact on the date for initiation of construction of the project since there is a time interval, presently indeterminate in length but assumed to be about 27 months, between submission of the Final Phase I GDM and initiation of the Phase II study effort.

Assuming that an acceptable beach erosion control plan is developed, the earliest construction would begin is in the spring of 1985.

A tentative time schedule for the Presque Isle beach erosion control project is shown on Table 2. The Corps' study process involves several stages of planning at increasing levels of detail with opportunities for public participation and review of each stage.

Stage I planning consisted of preparation of the Plan of Study which presented information about the study area, identified problems, and outlined work efforts to be accomplished during preparation of the Phase I GDM. Stage I planning was completed in May 1978 and was the subject of the last public meeting which was held in Erie on 30 May 1978.

Stage II planning was just recently completed and consists of formulation, assessment, and evaluation of alternatives which would provide long-term solutions to the erosion problems at Presque Isle Peninsula. The alternatives developed in Stage II planning were previously discussed in this Information Packet and are shown on Plates 2 through 6 attached to this packet.

Stage III planning which is the final stage of the Phase I GDM study is scheduled to be completed in July 1980. Stage III consists of more detailed analysis, assessment and evaluation of the alternatives listed above and the preparation of an Environmental Impact Statement (EIS) from which a plan of protection and improvement will be selected. A draft Phase I GDM and EIS will be prepared by December 1979 and circulated for agency and public review prior to preparation of the final reports.

PUBLIC INVOLVEMENT

In order to address the needs and concerns of all interested parties, the Corps needs your input. At this point, we are seeking public response, suggestions, and acceptance of the alternative plans of protection prior to initiation of Stage III planning. It is important for the public to become involved at this time in order that their concerns and comments on the study and alternative plans of protection can be taken into consideration during the selection process for the final plan of improvement. The plan which is selected will be recommended to Congress for authorization to proceed with design and construction.

Please feel free to sketch your ideas and/or write your comments and hand them in at the public meeting or mail directly to the Buffalo District, Corps of Engineers. The more you tell us about what you want or don't want for the Presque Isle beach erosion control project, the greater the chances are that the plans for the proposed project will address your concerns and serve your needs.

TABLE 1 - COMPARATIVE SUMMARY OF ALTERNATIVES

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.

TABLE 2

PROPOSED SCHEDULE OF MAJOR ACTIVITIES

PRESQUE ISLE PENINSULA

BEACH EROSION CONTROL PROJECT

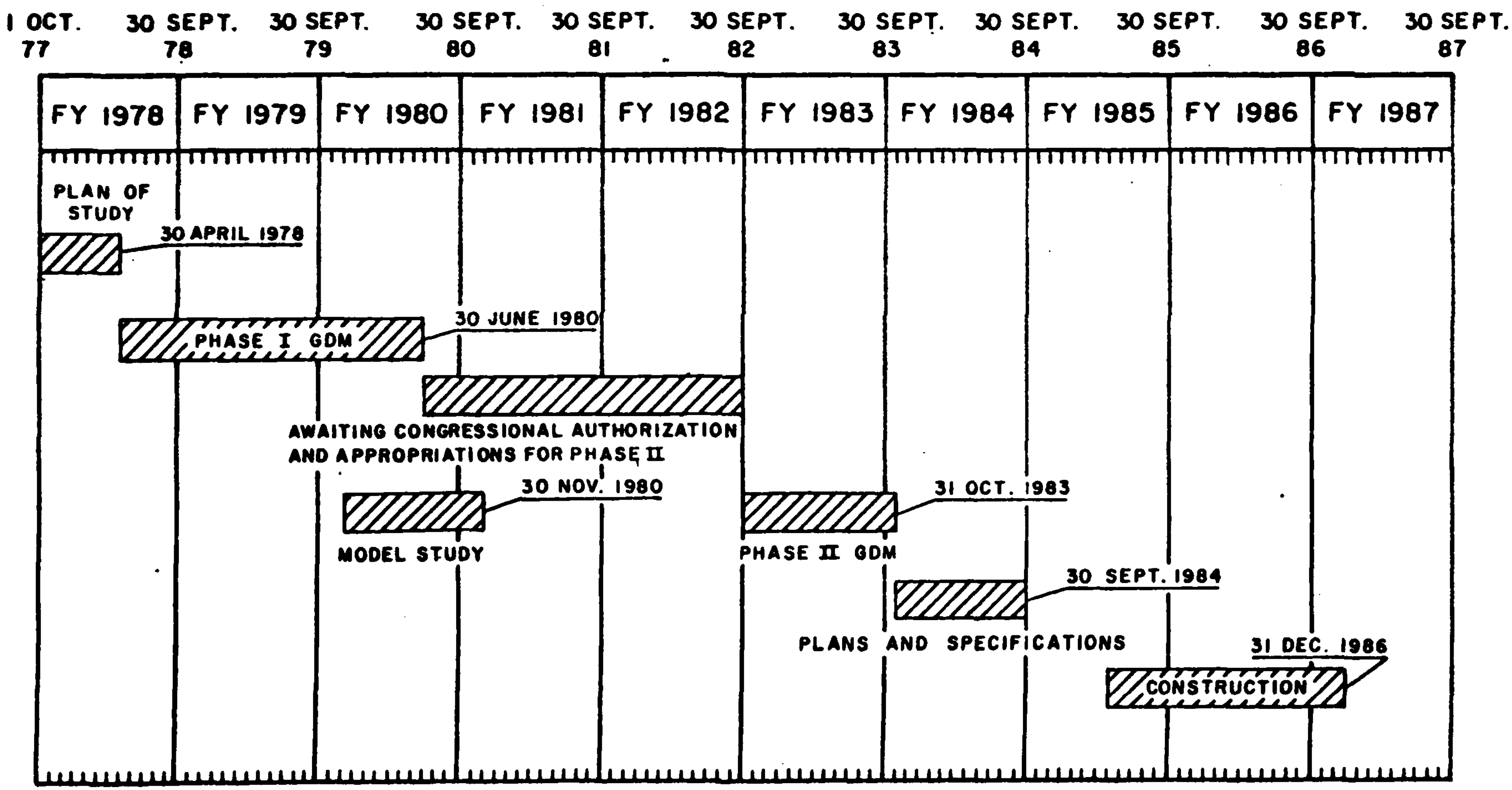


EXHIBIT F-20 (continued)

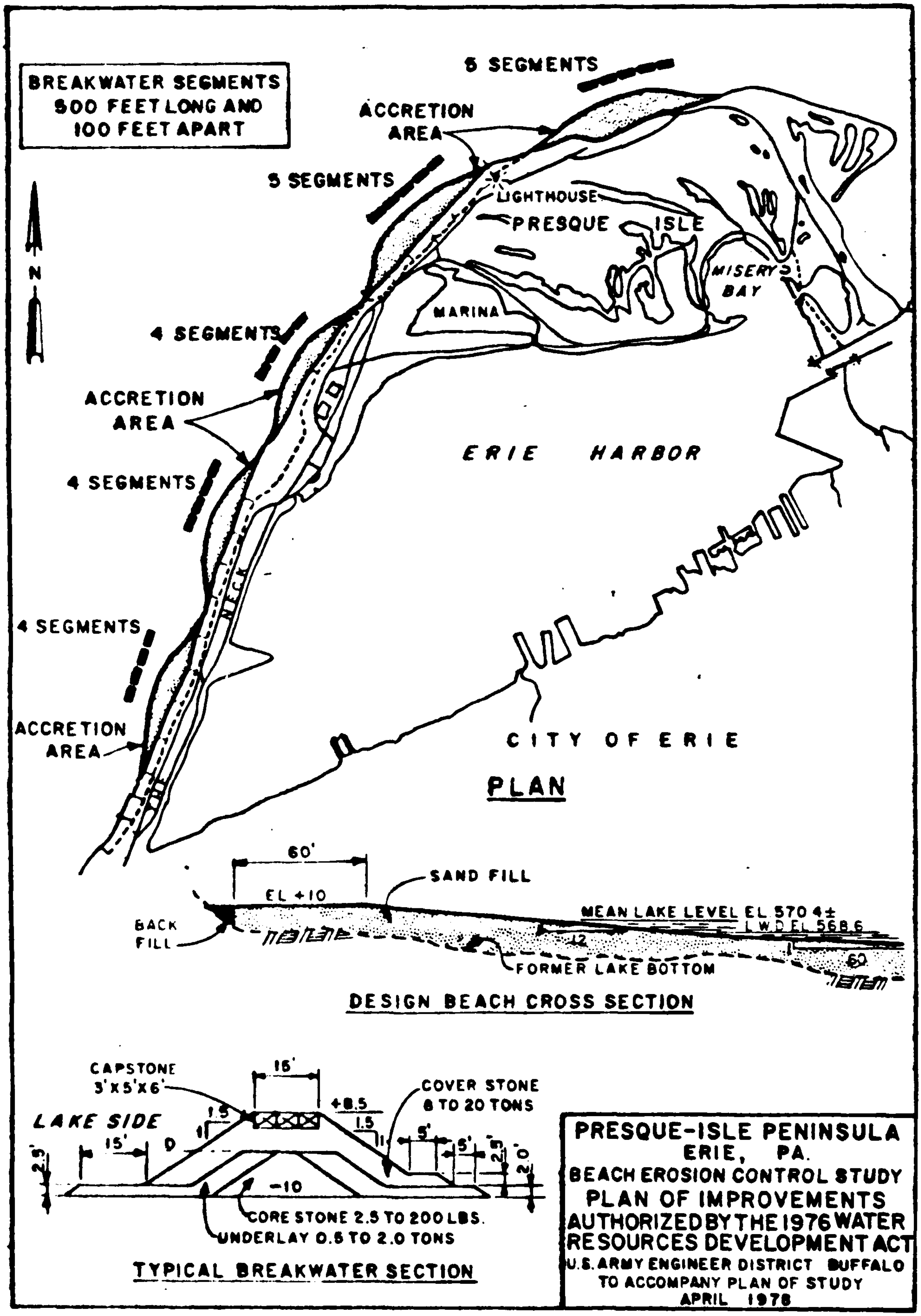
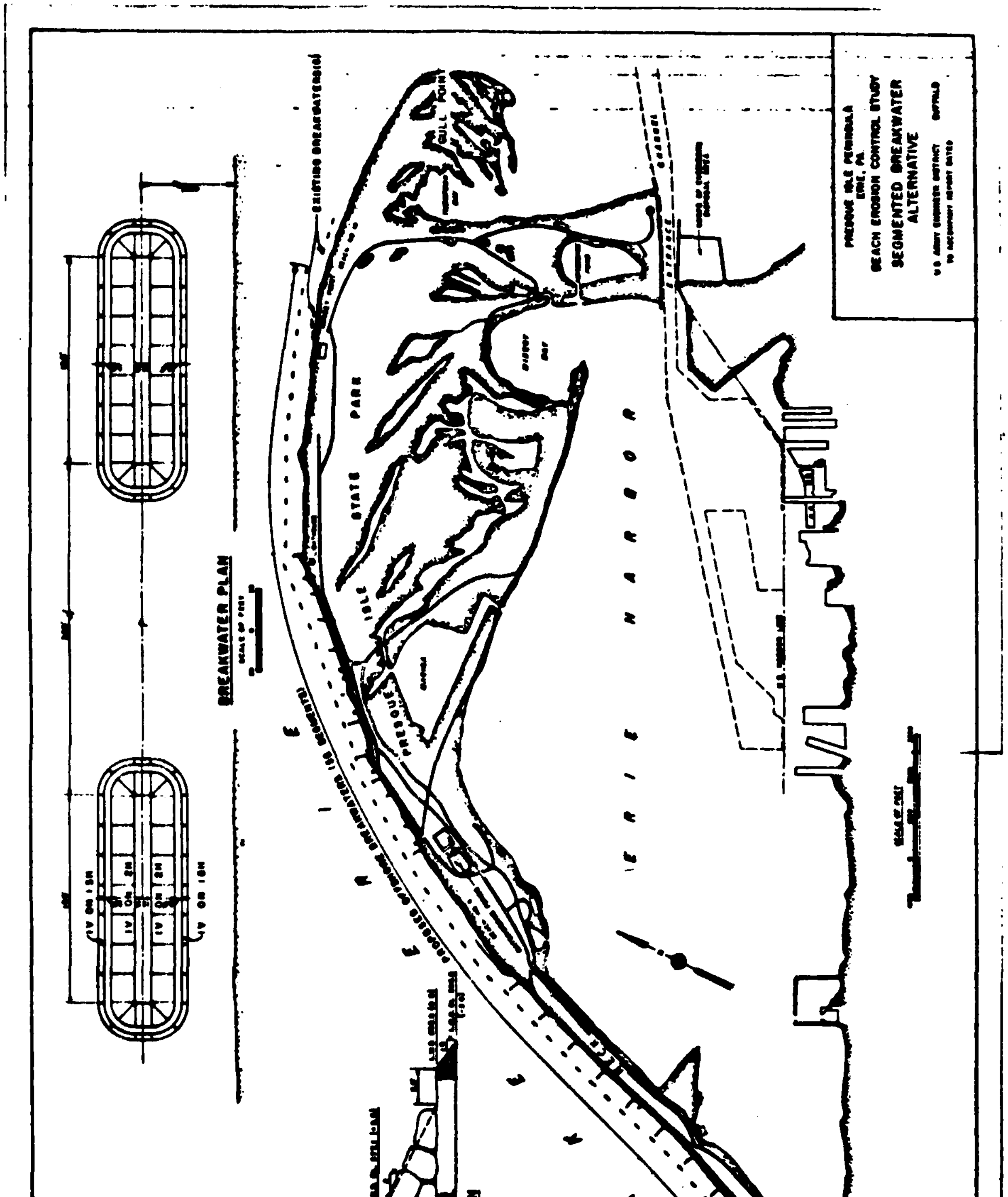


EXHIBIT F-20 (continued) PLATE I


PRESQUE ISLE PENINSULA
ERIE, PA.
BEACH EROSION CONTROL STUDY
SEGMENTED BREAKWATER
ALTERNATIVE
BREAKWATER PLAN
TYPICAL SECTION
GULL POINT
PRESQUE ISLE STATE PARK
E R I E H A R B O R

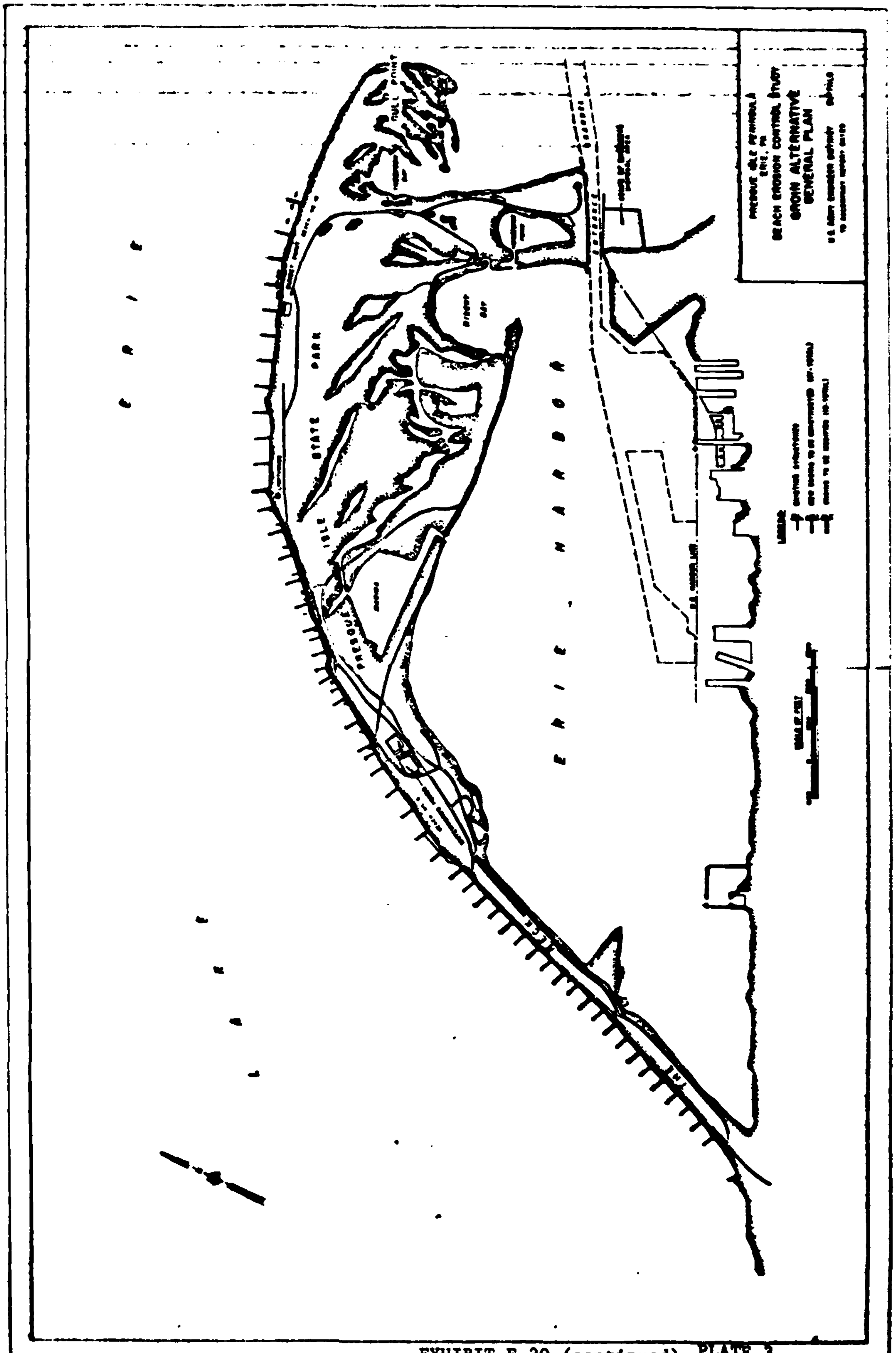
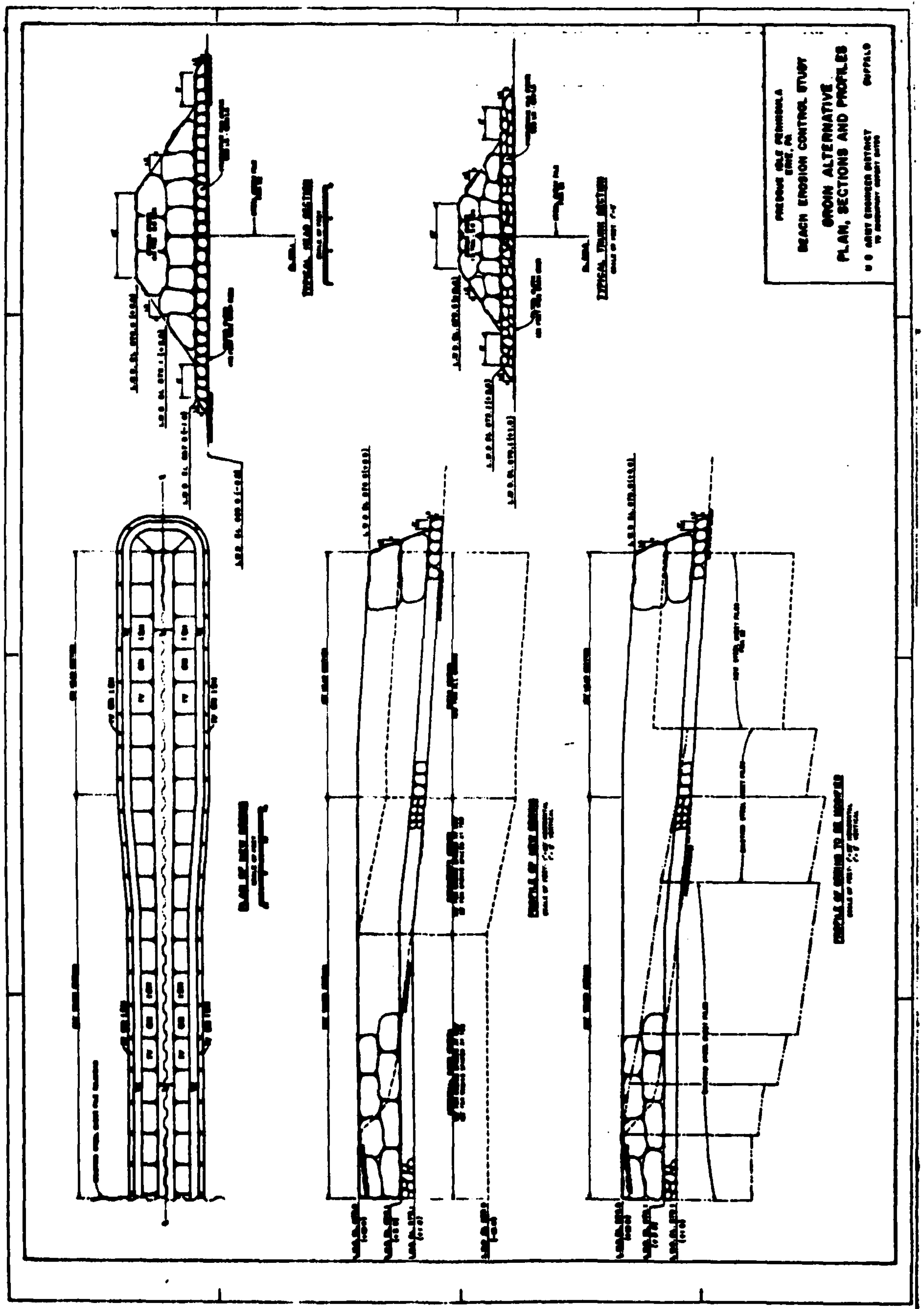


EXHIBIT F-20 (continued) PLATE 3


BEACH EROSION CONTROL STUDY
GROIN ALTERNATIVE
PLAN, SECTIONS AND PROFILES

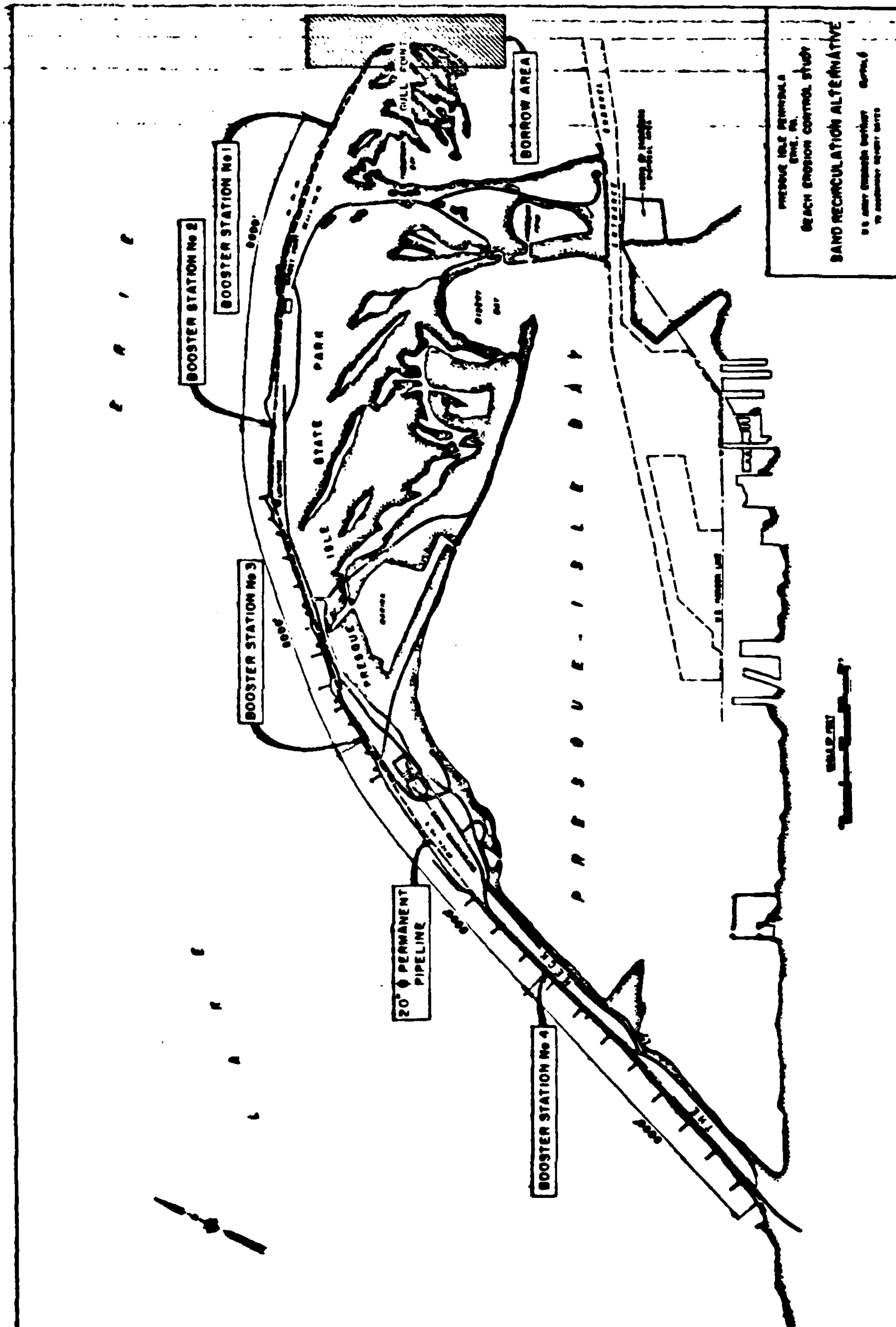
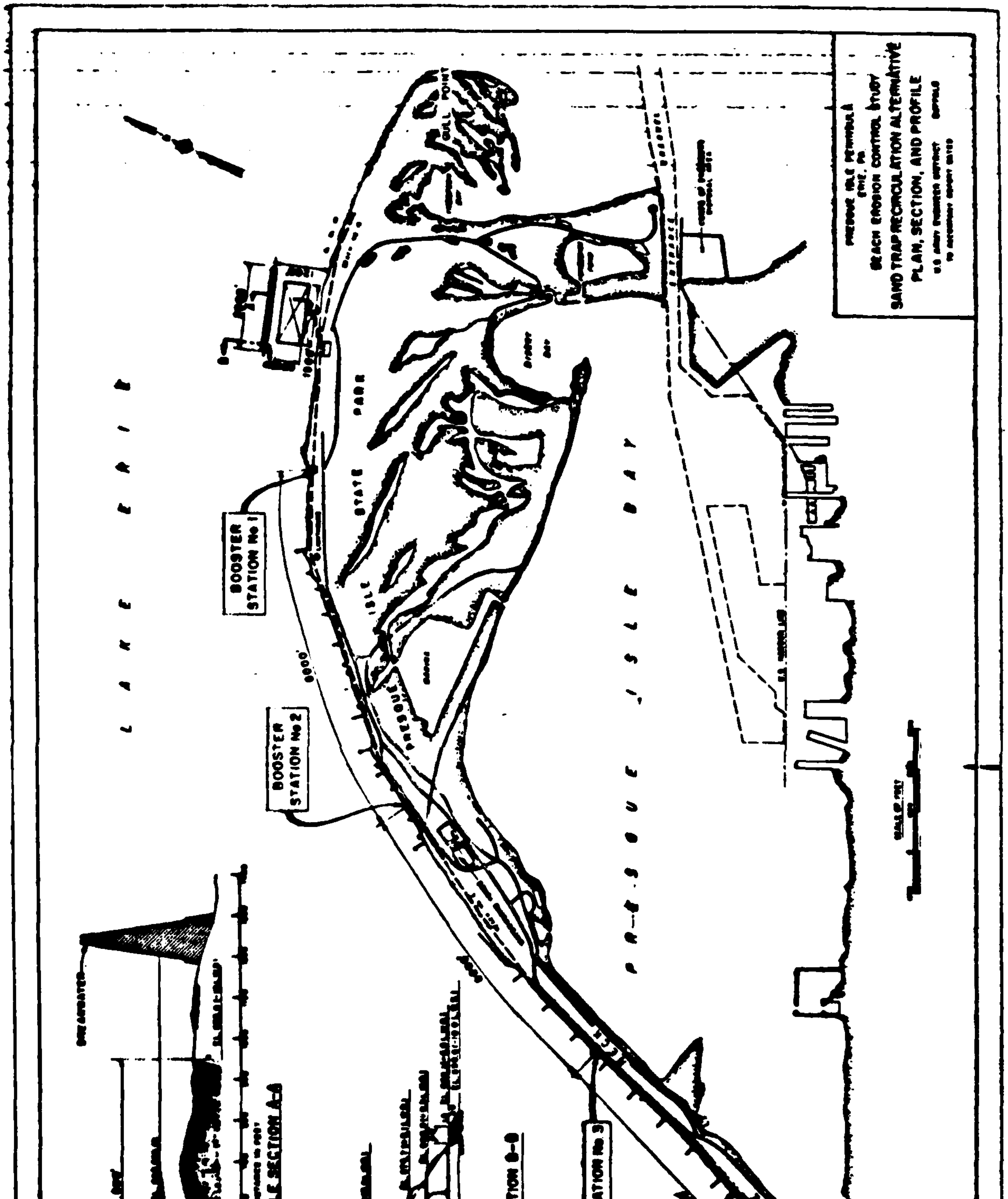


EXHIBIT F-20
(continued)

PLATE 5


LAKE ERIE
PRESQUE ISLE STATE PARK
PRESQUE ISLE BAY
BOOSTER STATION No 1
BOOSTER STATION No 2
BOOSTER STATION No 3
20" PERMANENT PIPELINE
PROFILE SECTION A-A
TYPICAL BREAKWATER SECTION B-B
BEACH EROSION CONTROL STUDY
SAND TRAP RECIRCULATION ALTERNATIVE
PLAN, SECTION, AND PROFILE

STATEMENT OF THE DEPARTMENT OF ENVIRONMENTAL RESOURCES
GIVEN AT THE SEPTEMBER 26, 1979 PUBLIC MEETING
ON STAGE II PHASE I GENERAL DESIGN MEMORANDUM
BEACH EROSION CONTROL PROJECT
PRESQUE ISLE PENINSULA

Thank you for the opportunity to present comments for the Pennsylvania Department of Environmental Resources concerning the Plan of Study for the Stage II Phase I General Design Memorandum, Presque Isle Cooperative Beach Erosion Control Project.

Presque Isle Peninsula provides a number of important benefits which make it an important and unique resource to the Commonwealth of Pennsylvania.

Presque Isle State Park, which encompasses most of the peninsula, is considered one of the most important and'outstanding state parks in the Commonwealth's system. In 1978 attendance was over 4,000,000 visitors. Park visitors are attracted by recreational opportunities for picnicking, swimming, and boating. Additionally, special meaning can be found in its unique geological and biological features and its historical significance.

The Peninsula's value to the ecologist and student of nature is beyond question, since Presque Isle is considered by experts as one of the rarest and finest examples of the development of a sand spit to be found anywhere. It is a unique example of biological progression from bare sand to mature forests in a distance of a few thousand feet.

The Peninsula also provides a natural breakwater for the protection of the port of Erie against severe storms on the lake. The harbor and port facilities have contributed significantly to Erie's growth and economy.

Presque Isle is a valuable natural resource in which the Commonwealth of Pennsylvania and the Unites States Corps of Engineers have a long-standing record of interest and concern. The Department of Environmental Resources has been very active in providing support for the Corps of Engineers' projects as well as providing beach protection projects for Presque Isle by State funded construction.

The Department of Environmental Resources has for many years worked closely with the Buffalo District, U. S. Army Corps of Engineers toward developing a workable beach erosion control project.

We feel that the following criteria is important in developing and evaluating beach erosion control measures:

1. The "permanent" project, by implication, requires a minimum annual energy use.

2. The project needs a minimum annual operation and maintenance effort, including beach nourishment.

3. Initial cost be kept to a minimum in relation to the total effectiveness of the project.

4. Aesthetics must be considered in any solution developed to minimize erosion.

5. Safety for boaters, bathers, and others is a prime consideration.

6. The project structure should allow minimum sand migration to Gull Point and to the harbor entrance channel.

Based on these criteria we offer the following comments on recently completed Stage II of the Design Memorandum for Beach Erosion Control.

1. We reiterate our opposition to the sand recirculation plan because of the energy needs and also because of the adverse aesthetics of a 20 inch diameter pipe from one end of the park to the other.

2. We believe that the "no action" alternative is not an acceptable solution.

3. We presently favor the segmented breakwater, with the stipulation that the following areas of concern be given adequate consideration.

   a. The proposed segmented breakwater, described on Page 6 of the information packet, consists of 58 breakwaters, 300 to 400 feet offshore, each 150' long with gaps of 350'. Since breakwaters are a dangerous attraction to bathers, we feel that fewer larger units in deeper water with an increased gap would provide for safer beach utilization.

b. We feel also that consideration should be given to the use of the segmented breakwater in areas of existing beach erosion structures. Perhaps a test utilizing the breakwater in conjunction with the groin field would be appropriate at this time. There may be an optimum position of the breakwater with respect to the existin groin locations. If model testing shows that groins are detrimental to the segmented breakwater system, consideration should be given to removal of the groins. The bulkhead should,however, be allowed to remain as a shore defense.

c. We agree that the armour stone should be at least 3 to 7 ton, as shown on Plate No. 2, rather than the 1½ to 3 ton which was used in the experimental breakwater. The larger stone should better resist the displacement that has occurred on the experimental breakwater.

Because of our above mentioned areas of concern we would hope the model study which is to begin in December, 1979 will adequately investigate and evaluate the segmented breakwater to develop the optimum configuration.

This Department strongly supports the installation of permanent facilities for beach erosion control at Presque Isle State Park and is committed to a continued cooperative effort with the Corps of Engineers to achieve this end. We encourage the Corps to proceed as rapidly as possible toward construction of the facilities.

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

OCT 9 1979

PUBLIC NOTICE

COOPERATIVE BEACH EROSION CONTROL PROJECT,
PRESQUE ISLE PENINSULA, ERIE, PA

1. This Public Notice has been prepared and distributed to identify what dredged or fill materials will be discharged into waters of the United States by implementation of the proposed project, and to provide an opportunity for any person affected by such discharge of materials, to request a public hearing.

2. The Corps of Engineers has been authorized by numerous legislative acts to study the erosion problem at Presque Isle and to participate in beach nourishment. The Water Resources Development Act of 1976 provided an extension of Federal participation in beach replenishment for erosion control and provided authorization for a study to develop the Phase I Design Memorandum Stage of advanced engineering and design for which this public notice is given.

3. The specific concern of this Public Notice is a segmented breakwater plan which will function as a wave-attenuating and beach-building system. The plan includes periodic beach nourishment in amounts required to maintain the beaches along the peninsula shoreline at a design width of 60 feet and a crest elevation of +10 feet above low water datum. Section 404 of Public Law 92-500 concerns the impacts of placing dredged or fill material into waters of the United States. Section 404 concerns of the Presque Isle Cooperative Beach Erosion Control Project include deposition of fill material both in the form of the breakwater construction materials and beach nourishment material. If beach nourishment material is obtained from offshore sources, the action will also include deposition of dredged material.

a. The plan consists of 58 parallel-to-shore breakwater segments which are 150 feet long and separated by gaps of 350 feet, extending from the base of the peninsula eastward through Sunset Point. The breakwaters would be constructed of rubblemound stone construction.

b. The plan includes an initial replenishment of 750,000 cubic yards of sandfill distributed along the entire peninsula shoreline in the lee of the breakwaters and an average annual replenishment of 30,000 cubic yards as required to maintain the design width of the beaches. Sand would be obtained from an upland source, or from a Corps-approved Lake Erie offshore borrow area.

c. The Federal Project is scheduled for construction initiation in May 1985, to be completed in December 1986. Nourishment would occur as required during the life of the project, usually to be performed in May and June.

4. Preliminary evaluation indicates that the proposed deposition of material and the activity associated with it will not cause significant permanent unacceptable disruption of the beneficial water quality uses or the affected aquatic ecosystem.

5. This notice is being published in conformance with 40 U. S. Code of Federal Regulations 230 and Section 404 of Public Law 92-500. Any person who has an interest which may be affected by the deposition of dredged material or fill material associated with the Cooperative Beach Erosion Control Project at Presque Isle may request a public hearing. The request must be submitted, in writing, to the District Enngineer within 30 days of the date of this notice and must clearly set forth the interest which may be affected and the manner in which the interest may be affected by this activity.

GEORGE P. JOHNSON
Colonel, Corps of Engineers
District Engineer

Notice to Postmaster: It is requested that the above notice be conspicuously displayed for 30 days from the date of issuance.

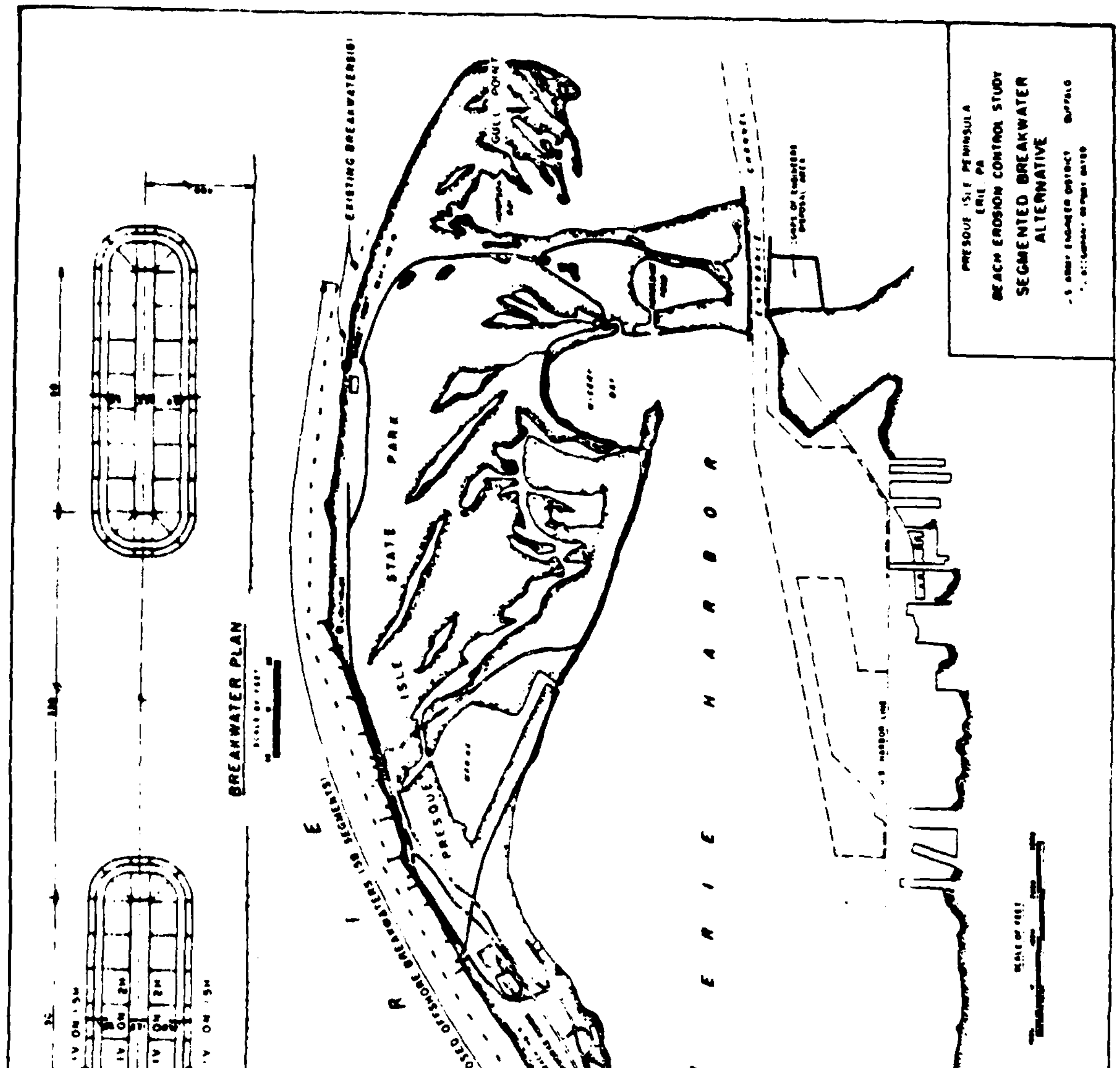


EXHIBIT F-22 (continued)

UNITED STATES
DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE
112 West Foster Avenue
State College, PA 16801

October 22, 1979

Colonel George P. Johnson
District Engineer, Buffalo District
Corps of Engineers
1776 Niagara Street
Buffalo, NY 14207

Re: Beach erosion control at Presque Isle, Erie County, Pennsylvania

Dear Colonel Johnson:

Your October 9, 1979, Public Notice announces the District's intention to proceed with detailed design of a string of 59 rubblemound breakwater segments, each 150 feet long and separated by gaps of 350 feet, with the string extending from the base of the peninsula to Sunset Point.

We have no problem with the selected plan, although it differs substantially from the work authorized by the 1976 Water Resources Development Act (22 500-foot segments in elongated clusters of 4 or 5 segments, with the clusters approximately 3,000 and 4,000 feet apart). Since the proposed work is unlikely to adversely affect fish and wildlife and since no construction is scheduled before 1985, I see no need for further study and analysis by the Fish and Wildlife Service during FY80.

We agree with your conclusion to proceed with further planning and development of a Phase I GDM on the project.

We appreciate being kept advised of planning for the project.

Sincerely yours,

Charles J. Kulp
Field Supervisor

EXHIBIT F-23

COMMONWEALTH OF PENNSYLVANIA
PENNSYLVANIA HISTORICAL AND MUSEUM COMMISSION
P. O. BOX 1026, HARRISBURG, PENNSYLVANIA 17108

EXECUTIVE DIRECTOR

July 30, 1973

Colonel Robert L. Moore
District Engineer
Buffalo District
U.S. Army Corps of Engineers
1776 Niagara Street
Buffalo, New York 14207

Dear Colonel Moore:

The Draft Enviornmental Impact Statement for the Cooperative Beach Erosion Project at Presque Isle Penninsula, Erie County, Erie, Pennsylvania was reviewed by our staff.

An examination of project plans and location indicates that the project will not affect a known archaeological or historical site or historical structure. The project appears to be consistent with the plans and objectives of the Pennsylvania Historical and Museum Commission.

Sincerely yours,

William J. Wewer

William J. Wewer

EXHIBIT F-24

COMMONWEALTH OF PENNSYLVANIA
PENNSYLVANIA HISTORICAL AND MUSEUM COMMISSION
WILLIAM PENN MEMORIAL MUSEUM AND ARCHIVES BUILDING
BOX 1026
HARRISBURG, PENNSYLVANIA 17120

May 22, 1979

Mr. Donald M. Liddell
Chief, Engineering Division
Department of the Army
Buffalo District
Corps of Engineers
1776 Niagara Street
Buffalo, New York 14207

Dear Mr. Liddell:

We have reviewed the information you sent to us on the proposed Cooperative Beach Erosion Project at Presque Isle Peninsula, Erie, Pennsylvania. The proposed work will not have any affect on any known historic or archaeologic resources. We are pleased to be of assistance in this matter.

Sincerely yours,

Ed Weintraub
State Historic Preservation Officer

EXHIBIT F-25

MFR

SUBJECT: Proposed Model Study of Presque Isle Peninsula, Erie, PA

1. A meeting was held at the state park headquarters on 21 August 1979 to discuss the feasibility of accomplishing a model study by the Waterways Experiment Station. BERH, CERC, WES, OCE, NCD and State of Pennsylvania representatives were requested to attend by the District. The attendance list for the meeting is attached as Inclosure 1.

2. The meeting began with a briefing by the District on the status of the Phase I project. The briefing included discussion of the alternatives being considered, existing shore protection structures, beach nourishment efforts and littoral data available or being collected. A ground and aerial inspection of the peninsula followed the briefing.

3. It was concluded at the meeting that a fixed-bed, physical model with tracer material would be a useful tool in determining the optimum breakwater spacing and alignment,

the interactions between the proposed breakwaters and the existing groin field, and the potential for sand transport through the breakwater system. It was recommended that the data from the Imperial Beach model be reviewed to determine its usefulness to this study, as ~~[illegible]~~ well as several available mathematical techniques for predicting shoreline response to structures. Efforts should be made to obtain as much prototype littoral data as necessary to calibrate the model. Pre versus existing conditions at the prototype breakwaters would also be helpful in calibrating the model and extrapolating information to the proposed project.

4. Additional discussions will be needed with WES to establish time and cost estimates for the model. OCE and CERC will participate in the pre-design model meetings.

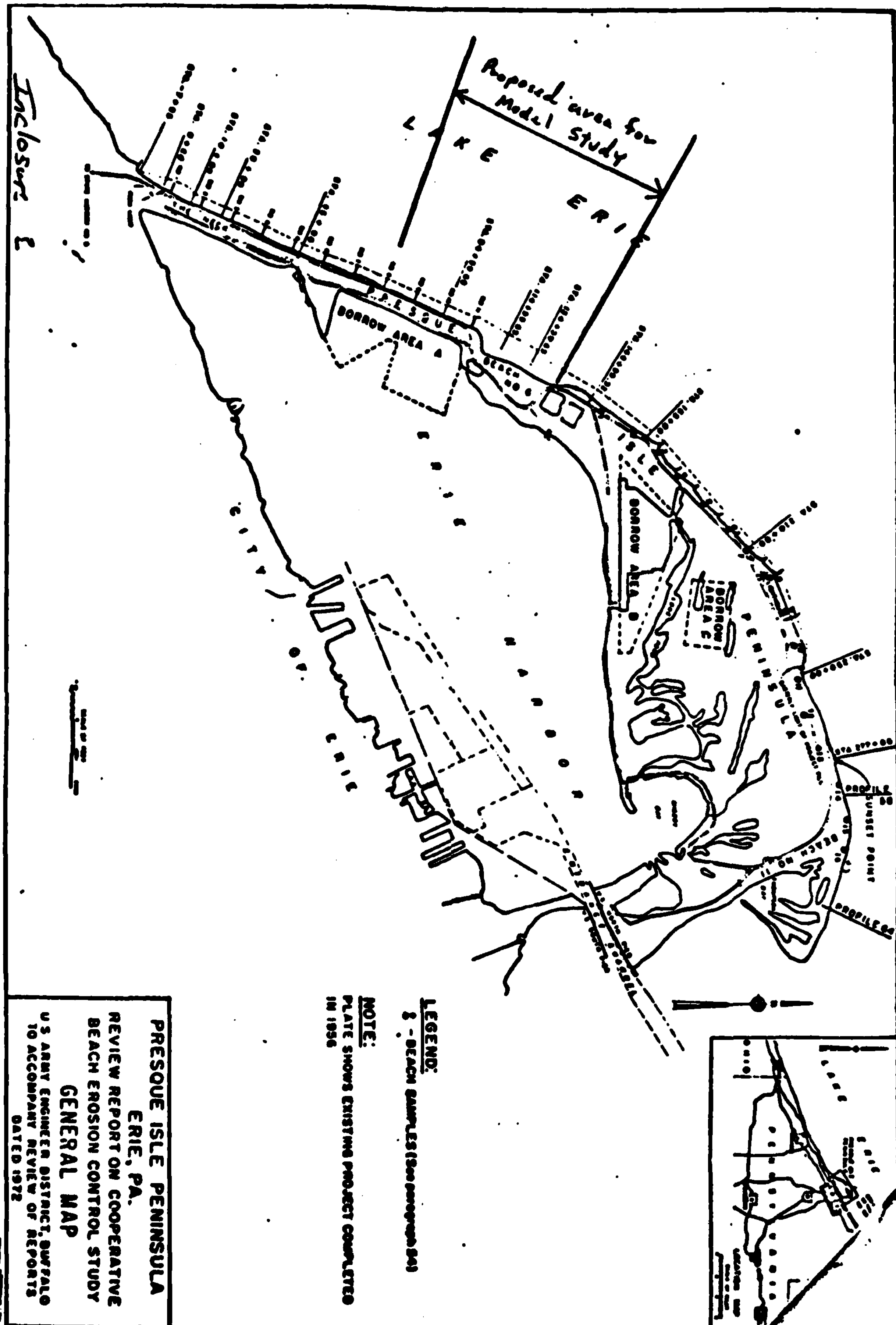
5. The District will initiate the request for the model study within the next several weeks.

Mike Kirchhoff	NED	8/21/79	Robert Ray	CERC	8/21/79
Denton Clark Jr.	NCB	8/21/79	[illegible]	[illegible]	
KR Hallock	NCB	8/21/79			
Richard [illegible]	NCB	8/21/79			
Rich Weggel	CERC	8/21/79			

EXHIBIT F-26 (continued)

Name	Organization	
Mike Kieslich	North Central Division	
Rich Weggel	CERC.	(202) 325-7127
Todd Walton	CERC	" 7138
Bob Ray	CERC	" " 7126
Rich Gorecki	Buffalo District	
Danton Clark Jr	"	"
Bill Seabergh	WES	601-636-3111 ext3788
[illegible] Lockhart Jr.	[illegible]	202-[illegible]
Ken Hallock	Buffalo District	
M.E. WARGO	SUPT PRESQUE ISLE S. PARK	
R.P. Adams	DER Harrisburg	

Inclosure 1



Inclosure 2

EXHIBIT F-26 (continued)

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

NCBED-DC

31 August 1979

SUBJECT: Proposed Model Study of Presque Isle Peninsula, Erie, PA

Division Engineer, North Central
ATTN: NCDED-C

1. References:

a. NCBED-DC letter dated 26 April 1979, subject as above, attached as Exhibit 1.

b. MRF, subject as above, attached as Exhibit 2.

2. The purpose of this letter is to request that a model study of a portion of Presque Isle Peninsula be conducted by the Waterways Experiment Station. A fact sheet with general information about Presque Isle Peninsula, the original cooperative beach erosion control project, and the segmented breakwater plan which was developed during Stage II Planning is attached as Inclosure 1.

3. At the meeting held in Erie, PA, on 21 August (see reference 1b), it was concluded that a fixed-bed, physical model with tracer material would be a useful tool for the design and arrangement of structures for prevention of erosion of the Presque Isle Peninsula shoreline. The purpose of the model study would be to determine 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. The portion of the peninsula shoreline which would be modeled consists of a 1-1/2 to 2-mile reach from Groin No. 8 through Beach Nos. 6, 7, and 8 as shown on the enclosed full-sized drawing.

4. The Water Resources Development Act of 1976 authorized undertaking the Phase I design memorandum stage of advanced engineering and design of the project for beach erosion control at Presque Isle Peninsula. Therefore, the study is being accomplished under a two-phase authorization whereby the Phase I GDM will go to Congress to obtain authorization for implementation of the recommended plan. To shorten the project completion time by over one year, a model study is scheduled to be accomplished as a Phase I activity. This allows the Buffalo District to proceed directly with the Phase II GDM as soon as authorization and funds become available without having to conduct the model study during Phase II study effort. The President's budget for Fiscal Year 1980 includes $500,000

NCBED-DC
SUBJECT: Proposed Model Study of Presque Isle Peninsula, Erie, PA

($225,000 for the model study) for continuing the Phase I study efforts. A schedule of major engineering and design milestones for the Presque Isle beach erosion control project is shown on Table 1.

5. I consider that a model study is necessary for a project of this magnitude where an optimum plan of improvement must be developed to preserve the peninsula and its recreational facilities with the least amount of destruction to the environment and geological growth of the area. The consensus of those attending the 21 August meeting at Presque Isle was that a model study could be a useful tool in developing the parameters stated in paragraph 3 above, and thereby assist in determing the optimum plan.

6. In accordance with the procedures for initiating hydraulic model studies as contained in ER1110-1-8100, paragraph 9a(3), I request authority to have the model study of a portion of Presque Isle Peninsula conducted by Waterway Experiment Station. It is also requested that the Waterway Experiment Station furnish an estimate of the cost and schedule to conduct the study for the plan described in the Fact Sheet attached as Inclosure 1. Prior to preparation of the cost estimate for the model study, I recommend that a meeting be held at WES to discuss the scope of the model study and that CERC and OCE be invited to attend. Funds for this model study would be available in FY 1980 and FY 1981.

Incl
as

GEORGE P. JOHNSON
Colonel, Corps of Engineers
District Engineer

CF: DAEN-CWE-H
Waterways Experiment Station

EXHIBIT F-27 (continued)

NCDED-C (31 Aug 79) 1st Ind
SUBJECT: Proposed Model Study of Presque Isle Peninsula, Erie, PA

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

6 SEP 1979

TO: Commander and Director
Waterways Experiment Station

Forwarded in accordance with the requirements of ER 1110-1-8100 for cost and time estimate.

FOR THE DIVISION ENGINEER:

Incl
nc

ZANE M. GOODWIN, P.E.
Chief, Engineering Division

WESHH (31 Aug 79) 2d Ind
SUBJECT: Proposed Model Study of Presque Isle Peninsula, Erie, PA

DA, Waterways Experiment Station, Corps of Engineers, P. O. Box 631, Vicksburg, MS 39180 19 September 1979

TO: Division Engineer U. S. Army Engineer Division, North Central, 536 South Clark Street, Chicago, IL 60605

1. Based on information contained in the basic letter and its inclosures; the conference at Erie, Pennsylvania, on 21 August 1979; and numerous telephone conversations between personnel of the Buffalo District (NCB) and the Waterways Experiment Station (WES); time and cost estimates for the subject study have been prepared and are as follows:

Item	Time (mo)	Cost
Model design	1	$ 15,000
Model construction	2	100,000
Equipment calibration & checkout	1	10,000
Testing	8	96,000
Data analysis conferences, travel & misc. items	1	10,000
Final Report:		
Draft copy	2	5,000
Published copy	6	5,000
TOTALS	21	$241,000

2. The above estimates are based on a recommended scale of 1:50 (undistorted), reproducing approximately 9500 ft of shoreline, modeling underwater contours to about -24 ft, and a testing program of about 8 months. These are reasonable values based on past experience with this type of model and should be adequate for planning purposes. WES concurs with the statement in paragraph 6 of the basic letter, however, that prior to initiation of the study a design conference should be held at WES to work out final details. The above estimates may vary slightly depending on results of that meeting.

3. At the conference on 21 August 1979, there was considerable discussion regarding model tests to verify conditions existing at the three offshore breakwaters constructed in the vicinity of beach 10. There are several ways in which this could be accomplished, depending on the importance

NCB places on such a verification. It is suggested that further discussion on this topic take place at the proposed design conference at WES. Time and cost estimates for verification then can be furnished based on the type of tests proposed. For planning purposes, it is estimated that such tests (i.e., some type of verification of erosion/accretion due to the three offshore breakwaters constructed near beach 10) will cost between $30,000 and $80,000.

4. Based on our present workload, shelter space, and wave generator availability, it is estimated that model design could be accomplished in December 1979 and model construction initiated in January 1980. This schedule is dependent upon WES receiving permission to demolish the Oceanside Harbor and Beach model, currently occupying the site proposed for Presque Isle, and upon availability of sufficient model construction crews to build this and several other authorized models.

5. In summary, the proposed model study can be completed and a final report furnished in about 21 months (data available in 13 months) from date of initiation (presently estimated to be in December 1979) for a cost of approximately $241,000. If verification tests of the existing breakwaters at beach 10 are deemed necessary, an additional $30,000 to $80,000 will be required. If NCB has any questions regarding these estimates, please call Mr. C. E. Chatham (FTS 542-2460) directly.

FOR THE COMMANDER AND DIRECTOR:

1 Incl
nc

HB Brown
for F. R. BROWN
Engineer
Technical Director

NCDED-C (31 Aug 79) 3rd Ind
SUBJECT: Proposed Model Study of Presque Isle Peninsula, Erie, PA

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

1 OCT 1979

TO: District Engineer, Buffalo

1. Forwarded for your review are WES's time and cost estimates for conducting the subject model study.

2. If the District Engineer wishes to request the subject model study, WESHH comments, recommendations, and cost estimates should be returned with the request to the Division Engineer, ATTN: NCDED-C. This office will then forward the District Engineer's request to HQDA for approval in accordance with ER 1110-1-8100, paragraph 9a (3).

3. This office feels that modeling the erosion/accretion patterns at the prototype breakwaters is necessary for calibrating the proposed model at Presque Isle. WES estimates that these tests would require an additional $30,000 to $80,000. It is requested that the District indicate its capability for providing the additional funds necessary to conduct verification tests with the prototype breakwaters.

4. It is recommended that following approval to conduct the model study, the meeting discussed in paragraph 6 of the basic letter be held at WES to discuss in detail our modeling requirements.

FOR THE DIVISION ENGINEER:

Lee R. Hoy...

for ZANE M. GOODWIN, P.E.
Chief, Engineering Division

Incl
nc

Copy furnished:
Commander and Director
ATTN: WESHH, w/o incl

NCBED-DC (31 Aug 79) 4th Ind
SUBJECT: Proposed Model Study of Presque Isle Peninsula, Erie, PA

DA, Buffalo District, Corps of Engineers, 1776 Niagara Street, Buffalo, New York 14207 — 11 October 1979

TO: Division Engineer, North Central
ATTN: NCDED-C

1. The time and cost estimates prepared by WES for conducting the subject model study have been reviewed and appear to be satisfactory.

2. Buffalo District concurs that modeling the erosion/accretion patterns at the prototype breakwaters is necessary for calibrating the proposed model of a portion of Presque Isle Peninsula. The WES cost estimates indicate that between $270,000 to $320,000 would be required to conduct both the model study and verification tests. The District presently has $240,000 scheduled for conducting the study and feels that the remaining $30,000 to $80,000 will become available through a transfer of funds from another GI study within the District later in FY 1980 or FY 1981.

3. In accordance with the procedures for initiating hydraulic model studies as contained in ER 1110-1-8100, paragraph 9a(3), I request authority to have the model study of a portion of Presque Isle conducted by WES. In addition, I also request authority to have WES model the prototype breakwaters for calibration of the larger model and verification of the results. Upon approval to conduct these model studies, the District will schedule the meeting at WES to discuss the scope of the model studies and request a detailed estimate from WES for the cost to conduct the study of the prototype breakwaters.

4. The District will initiate a transfer of funds from another GI study to the Presque Isle study either late in FY 1980 or early in FY 1981.

FOR THE DISTRICT ENGINEER:

Thomas R. Braun

Incl
nc

THOMAS R. BRAUN
LTC, Corps of Engineers
Deputy District Engineer

CF: Commander and Director
ATTN: WESHH, w/o incl

Exhibit F-27 (continued)

NCDED-C (31 Aug 79) 5th Ind
SUBJECT: Proposed Model Study of Presque Isle Peninsula, Erie, PA

DA, North Central Division, Corps of Engineers, 536 South Clark Street, Chicago, Illinois 60605 18 OCT 1979

TO: HQDA (DAEN-CWE-H) WASH DC 20314

It is recommended that the proposed model study be approved. WES estimates $270,000 to $320,000 would be required to conduct both the model study and the additional verification tests using field data from the prototype breakwaters. Funds in the amount of $240,000 have been scheduled by the District for conducting the study, the remaining $30,000 to $80,000 needed for the additional verification tests will be made available through a transfer of funds from another GI study within the District either in FY 1980 or in FY 1981 when required. The need for the additional verification tests was discussed at the 21 August 1979 conference attended by OCE, CERC, WES, NCD and the District personnel described in Exhibit 2 to the basic letter.

FOR THE DIVISION ENGINEER:

Lee R. Hoglind
for ZANE M. GOODWIN, P.E.
Chief, Engineering Division

Incl
nc

Copies furnished:
Commander & Director
ATTN: WESHH, w/o incl
District Engineer
ATTN: NCBED-DC, w/o incl

Exhibit F-27 (continued)

DAEN-CWE-HD (NCBED-DC, 31 Aug 79) 6th Ind
SUBJECT: Proposed Model Study of Presque Isle Peninsula, Erie, PA

DA, Office of the Chief of Engineers, Washington, DC 20314 30 Oct 79
14 NOV 1979

TO: Division Engineer, North Central
ATTN: NCDED-C

1. Approved.

2. It is understood that the model design meeting will be held at WES during the first week in December 1979.

FOR THE CHIEF OF ENGINEERS:

wd all incl

Jack L. Thompson
for LLOYD A. DUSCHA
Chief, Engineering Division
Directorate of Civil Works

NCDED-C (31 Aug 79) 7th Ind
SUBJECT: Proposed Model Study of Presque Isle Peninsula, Erie, PA

DA, North Central Division, Corps of Engineers, 536 South Clark Street, Chicago, Illinois 60605
14 NOV 1979

TO: District Engineer, Buffalo
ATTN: NCBED-DC

1. OCE approval of the District Engineer's request for the subject model study is referred for action.

2. It is understood that the District has tentatively scheduled a meeting on 29 November at WES. The appropriate persons from OCE, CERC, and perhaps BERH, should be invited. Messrs. Mike Kieslich and Larry Hiipakka will attend from this office.

FOR THE DIVISION ENGINEER:

Zane M. Goodwin
ZANE M. GOODWIN, P.E.
Chief, Engineering Division

CF:
Commander and Director
Waterways Experiment Station
ATTN: WESHH

Commander and Director
Coastal Engineering Research Center

DEPARTMENT OF THE ARMY
WATERWAYS EXPERIMENT STATION
CORPS OF ENGINEERS
P. O. BOX 631
VICKSBURG, MISSISSIPPI 39180

IN REPLY REFER TO: WESHH

17 December 1979

MEMORANDUM FOR RECORD:

SUBJECT: Presque Isle Model Study Conference at WES, 29 November 1979

1. Representatives of WES, the Buffalo District, North Central Division, Office, Chief of Engineers, and CERC (see Incl 1 for list of attendees) met at WES on 29 November 1979 to discuss the upcoming model study of Presque Isle, Pennsylvania.

2. To open the meeting, Mr. Denton Clark (Buffalo District) discussed the necessity of a model study to aid in the design of offshore breakwaters which will front the lakeside portion of the Presque Isle penninsula, a reach of almost 9 miles (see Incl 2 for map). A total of 58 offshore breakwater structures are included in the initial plan of shore protection. Due to the lack of firm design criteria for offshore breakwaters (such as length of breakwater, gap between, distance offshore, and crest elevation); the total number of structures involved; and the need to study the interaction between the existing groin field and the offshore breakwaters, it was the concensus of the attendees that a model study would be beneficial in optimizing the plan. It was proposed that a 9500-ft segment of the penninsula be modeled in detail, beginning at Groin No. 8 and extending to the northeast from that location. The model limits were adjusted slightly in later discussions at this meeting, shifting the model to the southwest so that more of the existing groins could be included. A starting location of Groin No. 5 was selected with the model extending 9500 ft to the northeast from this point.

3. Mr. C. E. Chatham, WES, initiated discussion on WES' approach to the study with a slide presentation of the Imperial Beach and Oceanside model studies, both of which were similar in concept to the Presque Isle Study.

4. The Presque Isle model will be constructed on a 1:50 undistorted scale in the south half of Building 3275. This scale was thought to be appropriate by all. The scale was deemed necessary due to the relatively shallow depths at the breakwater structures (-5 ft below IGLD).

5. A topic of discussion which arose during this part of the meeting concerned the desire of the Buffalo District and the North Central Division to request that some verification procedure be used for the study.

This request was based on the existence of three experimental breakwaters which were built in early 1978 at Beach No. 10, located at the far eastern end of the peninsula. There are bathymetric surveys and aerial photographs covering this area at fairly frequent intervals over the last year and a half. However, there are difficulties involved in conducting an "authentic" verification of the model based on these data. The region of the experimental breakwaters is at the far eastern, lakeward end of the peninsula, a region of accretion, while the model area is located roughly in the middle of the peninsula, in the region of high erosion, where many groins are located. Also the orientation of the peninsula and thus wave exposure is different for the two locations and the experimental breakwaters are set in shallower water than that of the proposed design structures. Even with the above difficulties and differences not withstanding, there is a lack of wave information for this location and a complete hindcast of waves should be performed for the region if a complete verification is to be expected. A cost and time estimate for Dr. Resio to perform the hindcast was given as $50,000 and 9 months. This time estimate is a most significant constraint on the study as the Buffalo District needs to have a large portion of the study performed in FY 80, with model design and construction to begin as soon as possible. Therefore, the hindcast data would not be available in time for use in a model verification. In addition, the cost of a verification model would be on the same order of magnitude as the originally proposed model study.

6. A possible solution to the verification dilemma would be to build the 9500 ft of suggested beachline but have a midportion recessed so that a movable bed coal beach could be put in similar to that of the experimental breakwaters (offshore contours are fairly uniform along Presque Isle). A test of the existing experimental breakwaters would be conducted to see if beach response in the model was generally similar to that of the prototype. This would not be called a verification but only a test to make qualitative comparisons which might aid in making adjustments to the techniques and materials used in testing of the design breakwaters. Hopefully the results will instill confidence in the movable bed portion of the model study. A high degree of confidence was placed in fixed-bed testing where alongshore currents and rip currents would be investigated with the aid of treacer materials. The above approach was agreed upon by all present. Before finalization and implamentation of the above approach, all present agreed to a suggestion of Dr. Whalin's that a Hydraulic Laboratory consultant (or consultants) be contacted to offer his (or their)opinion on the study and approach proposed.

7. Test conditions discussed included waves and water levels. A range of wave heights and periods will be tested, with the upper limits determined by Resio's work. The average lake level will probably be used for most testing, with tests of the optimized plans also being examined for both extreme high and low lake levels.

WESHH 17 December 1979
SUBJECT: Presque Isle Model Study Conference at WES, 29 November 1979

8. The anticipated scheduling for the study includes starting model design in December 1979, and initiating construction in March 1980. Testing would then probably begin in May 1980.

9. It was mentioned that Mr. Todd Walton and Dr. Rich Weggel, CERC, had obtained some prototype data at the experimental breakwater location in October 1979. Mr. Walton said that wave activity was low and that offshore winds had hampered their efforts, but he would send WES a copy of the data collected.

10. A brief discussion on the possibility of using a structural model to optimize breakwater design concluded that such a study was advisable. Final details of these tests were deferred until a later date.

W.C. Seabergh

2 Incl
as

W. C. SEABERGH
Engineer
Wave Processes Branch

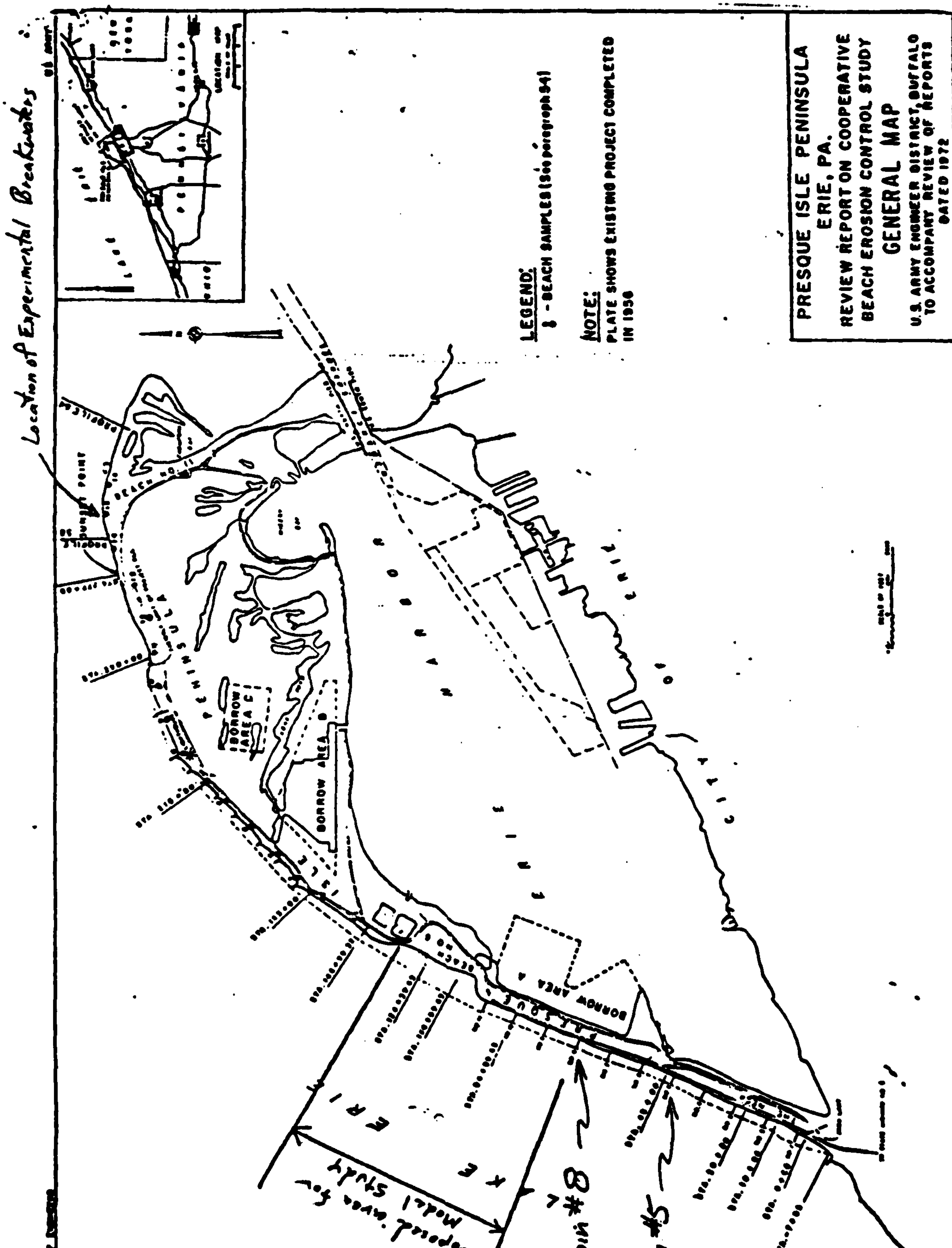
CF w/incl:
Clark
Lockhart
Housley
Walton
Hiipikka

PRESQUE ISLE MODEL STUDY CONFERENCE
29 November 1979

List of Attendees

Name	Organization
Mr. Larry Hiipikka	North Central Division, (NCD)
Mr. Mike Kieslich	NCD
Mr. Denton Clark	Buffalo District (NCB)
Mr. Richard Gorecki	NCB
Mr. Joe Foley	NCB
Mr. John Lockhart	Office, Chief of Engineers (OCE)
Mr. John Housley	OCE
Mr. Todd Walton	Coastal Engineering Research Center (CERC)
Dr. Robert W. Whalin	Waterways Experiment Station (WES)
Mr. Gene Chatham	WES
Mr. Bill Seabergh	WES
Mr. Ed Lane	WES

Incl 1


PRESQUE ISLE PENINSULA
ERIE, PA.
REVIEW REPORT ON COOPERATIVE
BEACH EROSION CONTROL STUDY
GENERAL MAP
U.S. ARMY ENGINEER DISTRICT, BUFFALO
TO ACCOMPANY REVIEW OF REPORTS
DATED 1972
LEGEND:
NOTE:
PLATE SHOWS EXISTING PROJECT COMPLETED
IN 1956
BORROW AREA A
BORROW AREA B
BORROW AREA C
PRESQUE ISLE PENINSULA
LAKE ERIE
CITY OF ERIE
Location of Experimental Breakwaters
Proposed area for Model Study
Groin #8
Groin #5

Incl 2

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DEPARTMENT OF TRANSPORTATION
UNITED STATES COAST GUARD

Address reply to:
COMMANDER (oan)
Ninth Coast Guard District
1240 East 9th St.
Cleveland, Ohio 44199
Phone: 293-3992

16500
Ser 9
14 January 1980

From: Commander, Ninth Coast Guard District
To: District Engineer, Buffalo District, Corps of Engineers

Subj: Planned Breakwaters at Presque Isle Peninsula, Erie, PA.

Ref: (a) NCBED-DC dtd 17 December 1979

1. The breakwaters are located in shallow water and follow the natural contour of the shoreline. We do not plan on establishing navigation lights at this time.

C. A. Millradt

C. A. MILLRADT
By direction

EXHIBIT F-28

PRESQUE ISLE
COOPERATIVE BEACH EROSION CONTROL PROJECT
ERIE, PENNSYLVANIA

SECTION 404 EVALUATION

1. INTRODUCTION.

1.01 Presque Isle State Park, located in Erie, PA, is situated on a 6-mile long club-shaped peninsula extending northeastward into Lake Erie. One of the features of the peninsula is that it is the site of intensive use during the summer season as a recreational bathing area. The lakeshore of the peninsula is characterized by the development of a series of 11 beaches with parking areas for each and several bathhouses. The beaches along Presque Isle tend to become seriously depleted of sand by natural erosive forces and alongshore sand transport. It is likely that without the intervention of human agencies the neck of the peninsula would be breached, and travel on the peninsula would be disrupted. Also, without human intervention, the peninsula would more quickly migrate eastward, reducing the size of Presque Isle Bay and increasing shoaling in the harbor channels and thereby increasing harbor maintenance costs for dredging.

2. PROJECT AUTHORIZATION AND SUMMARY

2.01 The Corps of Engineers has been authorized by numerous legislative acts to study the erosion problem at Presque Isle and to participate in beach nourishment. The Water Resources Development Act of 1976 provided an extension of Federal participation in beach replenishment for erosion control and provided authorization for a study to develop the Phase I General Design Memorandum Stage of advanced engineering and design for which this Section 404 Evaluation has been prepared.

2.02 The Selected Plan is a Segmented Breakwater plan which will function as a wave-attenuating and beach-building system. The plan includes periodic beach nourishment in amounts required to maintain the beaches along the peninsula shoreline at a design width of 60 feet and a crest elevation of +10 feet above low water datum.

3. SECTION 404 EVALUATION PURPOSE

3.01 Section 404 of the Federal Water Pollution Control Act of 1972 (PL 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.

3.02 The factors, considerations, and analyses addressed in this Evaluation are those which are specified by Section 404(b) Guidelines (40 CFR 230), dated 5 September 1975. EC 1105-2-97, issued by the Office of the Chief of Engineers on 8 May 1979, includes an itemized format intended to help facilitate thorough and complete Section 404 evaluation. That format has been employed here.

4. SECTION 404 PROJECT CONCERNS - DREDGED OR FILL MATERIAL

4.01 Section 404 concerns of the Presque Isle cooperative beach erosion control project include deposition of fill material both in the form of the breakwater construction materials and beach nourishment material. If beach nourishment material is obtained from offshore sources, the action will also include deposition of dredged material.

a. The plan consists of 58 parallel-to-shore breakwater segments which are 150 feet long and separated by gaps of 350 feet, extending from the base of the peninsula eastward through Sunset Point. The breakwaters would be constructed of stone, placed in a depth of 5 feet below LWD.

b. The plan includes an initial replenishment of 500,000 cubic yards of sandfill distributed along the entire peninsula shoreline in the lee of the breakwaters and an average annual replenishment of 38,000 cubic yards as required to maintain the design dimensions of the beaches. Sand would be obtained from an upland source or from a Corps-approved Lake Erie offshore borrow area.

c. The Federal project is scheduled for construction initiation in May 1985, to be completed in December 1986. Beach replenishment would occur as required during the life of the project, usually to be performed in May and June.

5. SECTION 404 ECOLOGICAL SUMMARY EVALUATION FOR THE PLACEMENT OF STONE BREAKWATER CONSTRUCTION MATERIAL, AND PLACEMENT OF BEACH REPLENISHMENT MATERIAL PLAN COMPONENTS

5.01 Physical Effects (40 CFR 230.4-1(a)).

a. No wetlands will be lost through the implementation of either plan component.

b. Effects upon the water column could occur upon the implementation of both plan components. This would be a short-term increase in turbidity as the bottom is disturbed and becomes suspended during placement of rubblemound stone, or as beach nourishment material becomes suspended in supernormal amounts during and immediately following its placement on the shore. This effect would probably be negligible as the littoral zone is normally a fairly turbulent area.

Aesthetic values will be negatively affected. The breakwater plan component would detract from the natural appearance of the lake by the presence of the structures. The beach nourishment plan component would provide a departure from natural conditions, as the beach nourishment material (judging from past occurrences) is likely to be darker and more variable in texture, with a greater proportion of coarse materials than the native sand, and it may also be subject to gully-type erosion.

c. There will be no direct effects upon nekton or plankton as a result of implementation of either plan component.

d. Covering of benthos will occur within both plan components. Breakwaters will cover 23 acres along a total length of 8,700 feet. The total length of lakeshore within the region of shore bounded by the proposed breakwater system is roughly 30,000 feet. The approximate acreage underwater within the -5 LWD depth contour is 240 acres. Roughly 9.6 percent of the area of this benthic habitat within the immediate project area will be covered by breakwater material. Replenishment material will be placed both above and below the water level at several sites as needed. Quantities cannot be accurately specified for any placements other than the initial placement of material, which will be 500,000 cubic yards of material, expected to cover an estimated 34 acres of subaqueous surface.

Deposited beach replenishment material will gradually become dispersed by littoral transport processes over the length of the peninsular shoreline, slowly covering existing substrate. Recolonization by nearby benthic organisms or vertical migration of existing ones will probably keep pace with sand deposition and there will be no resultant effect on existing benthic communities. Because benthic fauna of areas of active sand transport is generally very sparse, the effect that the project will exert by covering existing benthos is anticipated to be negligible. The breakwaters are expected to have a significant positive effect on benthos by providing suitable substrate for colinization by organisms.

e. Changes will occur in bottom geometry, as intended, with beach buildup occurring on the shoreward side of the breakwaters. Substrate composition will be basically unaltered, except as the replenishment material might differ slightly from the native beach sand.

f. Because the deposition material is inert, no change in biological communities due to exchange of constituents between sediments and overlying water is expected to occur.

5.02 Chemical-Biological Interactive Effects (40 CFR 230.4-1(b)).

a. Breakwater construction material is chemically inert and physically immobile under the conditions existing at the lakeshore. These characteristics clearly eliminate the possibility of occurrence of chemical-biological interaction, and any testing specified under 40 CFR 230.4-1(b) (2) and (3) - elutriate testing and bioassay testing, respectively - is not applicable in this instance.

b. Fill material for beach nourishment which is composed predominantly of sand, gravel, or shell having particle sizes compatible with material on receiving shores is excluded from testing under 40 CFR 230.4-1(b) (2) and (3); this category embraces the beach nourishment component of the Presque Isle cooperative beach erosion control project.

5.03 Description of site comparison (40 CFR 230.4-1(c)).

a. The breakwater plan component includes only a disposal site (no dredging site, since the material is obtained from upland sources), therefore, a comparison of sites is not applicable here. This is also the case for beach nourishment if the material is obtained from upland sources. It is herein decided that beach nourishment material obtained from offshore sources would not be the subject of an inventory of total concentration of critical chemical constituents. Because sand is generally chemically inert, such an inventory would not be of value in a site comparison.

b. Similarly, no site comparison is applicable for a biological community analysis.

5.04 Applicable Water Quality Standards.

a. Because the fill material is inert, no direct effects upon water quality are anticipated.

b. The nearshore waters of Presque Isle State Park are utilized for recreational bathing. The Commonwealth of Pennsylvania specifies a maximum safe level of fecal coliform organism density, above which use of a bathing beach is not permitted. The water quality at the park is monitored regularly throughout the bathing season; the Erie County Department of Health, in a letter dated 20 November 1979, reported that there have been no official beach closings due to contamination since before 1970.

c. Structural measures implemented to control shoreline erosion might cause a degradation in water quality by lessening circulation along shore, 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). Studies intended to assess the magnitude of this effect, and thus determine if the discharge will be compatible with applicable standards, are scheduled to take place during the Phase II General Design Memorandum stage of Advanced Engineering and Design.

5.05 Selection of Discharge Sites (40 CFR 230.5).

a. The proposed activity is intended to meet the need for long-term beach erosion control at Presque Isle State Park for the purpose of preserving the recreational bathing beaches there.

b. Breakwaters and beach replenishment material are planned to be placed at locations which are considered to be the best sites to satisfy the need for beach erosion control.

c. Objectives considered in discharge determination (40 CFR 230.5(a)) include the following impacts on chemical, physical, and biological integrity of aquatic ecosystems, evaluated in terms of their impact upon water uses at the discharge site (40 CFR 230.5(b)(1-10), and incorporating considerations to minimizing harmful effects (40 CFR 230.5(c)(1-7)):

(1) There will be an insignificant impact upon the food chain during construction of breakwaters and placement of beach replenishment material. After construction, breakwaters will provide a more diverse habitat, thereby increasing the variability of the local aquatic food chain;

(2) There will be an increase in diversity of plant and animal species, as the breakwaters should act as artificial reefs, providing substrate for attachment of algae and invertebrate animal communities, and protective cover for fish;

(3) There will be no significant impact on movement into and out of feeding, spawning, breeding, and nursery areas;

(4) There will be no impact on wetlands;

(5) Turbidity increases during construction may occur which will be minimized, as necessary, by environmental protection aspects of construction requirements;

(6) There will be no impact on areas which serve to retain natural high waters or flood waters;

(7) Degradation of aesthetic values is minimized in the breakwater plan component by limiting, to whatever extent possible, the height and length of the breakwaters, and providing maximum possible spacing of the structures. These design features also serve to reduce costs, thereby minimizing degradation of economic values. Within the beach replenishment plan component, aesthetic and economic value degradation will be minimized by utilizing the most natural-appearing suitable beach replenishment material which is available, consistent with favorable plan economics. Minimization of degradation of recreational values is a major planning objective of the cooperative beach erosion control project;

(8) There will be no impact on threatened or endangered species;

(9) There will be no impact upon municipal water supply intakes.

5.06 Statement as to Contamination of Fill Material from Land Sources (40 CFR 230.5(d)).

The fill material planned to be utilized in the Presque Isle cooperative beach erosion control project has been determined not to contain unacceptable quantities, concentrations, or forms of the constituents deemed critical by the District Engineer of the Buffalo Office of the U. S. Army Corps of Engineers or the Regional Administrator of the U. S. Environmental Protection Agency.

6. <u>DETERMINATIONS</u>

a. An ecological evaluation has been made following the evaluation guidance in 40 CFR 230.4, in conjunction with the evaluation considerations in 40 CFR 230.5 (40 CFR 230.3(d)).

b. Appropriate measures have been identified and incorporated into the proposed plan to minimize adverse effects on the aquatic environment as a result of discharge (40 CFR 230.3(d)(1)).

c. Consideration has been given to the need for the proposed activity, the availability of alternative sites, and methods of disposal that are less damaging to the environment, and such water quality standards as are appropriate and applicable by law (40 CFR 230.5).

d. Wetlands 40 CFR 230.5(b)(8) - Not applicable.

7. FINDINGS

On the basis of the above determinations, the finding is made that the discharge site, for the Presque Isle cooperative beach erosion control project, Erie, PA, has been specified through the application of the Section 404(b)(1) Guidelines.

12/21/79
Date

GEORGE P. JOHNSON
Colonel, Corps of Engineers
District Engineer

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

NCBED-DC 24 March 1980

SUBJECT: Presque Isle Peninsula, Erie, PA - Late Stage Public Meeting

Division Engineer, North Central
ATTN: NCDED-C

1. Reference paragraph 6.a.(3) of ER 1105-2-502 entitled Public Meetings.

2. Public involvement and coordination activities during the Presque Isle beach erosion control study have included two public meetings to date. 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 (see Inclosure 1).

3. The late stage public meeting for the Presque Isle study is scheduled to be held during May 1980. 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 has been no objections to the breakwater plan, NCD approval to dispense with the late stage public meeting is requested.

FOR THE DISTRICT ENGINEER:

Joseph A. Foley
for/ DONALD M. LIDDELL
Chief, Engineering Division

Incl
as

EXHIBIT F-30

UNITED STATES
DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE
112 West Foster Avenue
State College, PA 16801

October 22, 1979

Colonel George P. Johnson
District Engineer, Buffalo District
Corps of Engineers
1776 Niagara Street
Buffalo, NY 14207

Re: Beach erosion control at Presque Isle, Erie County, Pennsylvania

Dear Colonel Johnson:

Your October 9, 1979, Public Notice announces the District's intention to proceed with detailed design of a string of 59 rubblemound breakwater segments, each 150 feet long and separated by gaps of 350 feet, with the string extending from the base of the peninsula to Sunset Point.

We have no problem with the selected plan, although it differs substantially from the work authorized by the 1976 Water Resources Development Act (22 500-foot segments in elongated clusters of 4 or 5 segments, with the clusters approximately 3,000 and 4,000 feet apart). Since the proposed work is unlikely to adversely affect fish and wildlife and since no construction is scheduled before 1985, I see no need for further study and analysis by the Fish and Wildlife Service during FY80.

We agree with your conclusion to proceed with further planning and development of a Phase 1 GDM on the project.

We appreciate being kept advised of planning for the project.

Sincerely yours,

Charles J. Kulp
Field Supervisor

EXHIBIT F-30 (continued)

Incl. 1

NCDED-C (24 Mar 1980) 1st Ind
SUBJECT: Presque Isle Peninsula, Erie, PA - Late Stage Public Meeting

DA, North Central Division, Corps of Engineers, 536 South Clark Street, Chicago, Illinois 60605 3 APR 1980

TO: District Engineer, Buffalo
ATTN: NCBED-DC

This office agrees that there probably is no need to conduct the subject meeting given the apparent public acceptance of the plan. However, before final approval is given to dispense with the late stage public meeting, the District should have a press release informing appropriate state agencies and local citizens that another public meeting for the Presque Isle study is not considered necessary. The release should contain a summary of the engineering, economic and environmental aspects of the selected plan. If this release does not generate expressions of support for another meeting, the late stage public meeting need not be conducted. This office should be informed if it is found necessary to hold the meeting.

FOR THE DIVISION ENGINEER:

Zane M. Goodwin

ZANE M. GOODWIN, P.E.
Chief, Engineering Division

Copies furnished:
DAEN-CWP-P
NCDPD

News...

from the Corps of Engineers, Buffalo District

1776 Niagara Street
Buffalo, NY 14207

FOR INFORMATION CONTACT
Dick Broussard
AC716 876-5454

May 23, 1980

FOR IMMEDIATE RELEASE:

Due to the lack of opposition to the selected plan for the Cooperative Beach Erosion Control Project at Presque Isle State Park, the Buffalo District of the Army Corps of Engineers has decided that no further public meetings are necessary for the Phase I of the study.

At the last two public meetings concerning the project, held May 30,1978 and September 26, 1979, comments from the Pennsylvania Department of Environmental Resources and interested citizens indicated that the segmented off-shore breakwater plan is the preferred plan for protection and improvement of Presque Isle Peninsula.

This plan calls for 58 rubblemound breakwaters to be located along the lakeward side of the peninsula. The 150-foot long breakwaters would be placed 350 feet apart, 300 to 400 feet offshore. The breakwaters are intended to lessen wave action so as to reduce long shore sand movement, thus reducing erosion and helping to maintain the beach area.

MORE . . .

In addition the plan calls for 500,000 cubic yards of sand fill to be placed along the shoreline to provide a recreation beach with a berm width of 60 feet.

Even though the Corps sees no value in holding further public meetings on the Phase I Study, if a person feels they have an interest that may be affected by the project, a public hearing may be requested. The request must be submitted, in writing, to the District Engineer within 15 days (by June 11) and must clearly state the interest and the manner in which that interest may be affected by the project.

- 30 -

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

NCBED-DC

27 May 1980

Dear Study Participant:

The enclosed information packet on the Cooperative Beach Erosion Control Project at Presque Isle Peninsula in Erie, PA, is provided for your review. It describes 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. 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. However, after review of this packet, should there by any person who has an interest that may be affected by the said project, a public hearing may be requested. The request must be submitted, in writing, to the District Engineer within 15 days of the date of this notice and must clearly set forth the interest which may be affected and the manner in which the interest may be affected by this activity.

Sincerely,

GEORGE P. JOHNSON
Colonel, Corps of Engineers
District Engineer

Incl
as stated

EXHIBIT F-33

PRESQUE ISLE

COOPERATIVE BEACH EROSION

CONTROL PROJECT

AN INFORMATION PACKET
SUMMARIZING RESULTS OF INVESTIGATIONS
UNDERTAKEN THROUGH STAGE III
OF THE PHASE I DESIGN

/

Prepared by:

U.S. Army Corps of Engineers

Buffalo District

Buffalo, New York 14207

U.S. ARMY CORPS OF ENGINEERS
ESSAYONS
BUFFALO DISTRICT

May 1980

EXHIBIT F-33 (continued)

AREA DESCRIPTION

Presque Isle Peninsula is located in the city of Erie, PA, on the south shore of Lake Erie, about 78 miles southwest of Buffalo, NY, and about 102 miles northeast of Cleveland, OH.

The peninsula is a compound recurved sand-spit projecting lakeward in a generally northeasterly direction from its narrow connection with the mainland shore. The large bay between the peninsula and mainland provides a spacious harbor, the easterly part of which has been improved for deep-draft navigation by the Federal Government under the navigation project for Erie Harbor.

Presque Isle Peninsula provides valuable protection to this harbor. Practically the entire peninsula, which contains about 3,200 acres, is owned by the Commonwealth of Pennsylvania and is developed as a park. Presque Isle State Park is popular recreational area and provides facilities for bathing, boating, hiking, fishing, bird watching, picnicking, and other recreational opportunities.

The peninsula has a lakeward perimeter of about 9 miles. 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 shore has been segmented into 11 bathing beaches by the Pennsylvania State Park Service.

HISTORY OF PROTECTION

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 first cost for completing the project was $2,451,000 ($817,000 Federal and $1,634,000 non-Federal).

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 sand losses were greater than estimated because the predominant west-to-east littoral movement continued to remove more sand from the peninsula beaches than was supplied by littoral drift from the shore to the west. Therefore, a modification of the beach erosion control project was enacted under the 1960 River and Harbor Act to control the erosion to the point where the Federal shore protection structures and the State's park facilities would not be threatened. 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 1,940,000 tons of sand were placed on the beaches at a total cost of $2,178,000 ($1,329,000 Federal and $849,000 non-Federal).

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. Six years of sand replenishment (1975-1980), as authorized by the 1974 and 1976 Water Resources Development Acts, have been completed (the 1980 nourishment project will be completed by the end of June 1980). During this period, three experimental prototype breakwaters were constructed and a total of about 1,263,000 tons of sand were placed on the beaches at a total cost of $6,500,000 ($4,550,000 Federal and $1,950,000 non-Federal). Another 4 years are currently scheduled to provide sand replenishment for the period before construction of any improvements could be implemented.

The costs for placing sand on the beaches are rising each year thereby making the continuation of annual nourishment an increasingly expensive means of controlling beach erosion. In addition, the availability of sufficient quantities of suitable quality sand from land sources is decreasing each year as the demand continually increases. This decrease may eventually lead to acquisition of higher priced sand from offshore zones. Since 1960, approximately $11,130,000 ($6,696,000 Federal and $4,434,000 Commonwealth of Pennsylvania) has been spent in attempts to control erosion and maintain the recreational beaches under the authorities for the cooperative beach erosion control project. These erosion control and maintenance measures have included placement of approximately 9,500,000 tons of sand on the beaches.

PRESENT PLANS
FOR EROSION CONTROL

The periodic sand replenishment requirements authorized by the 1960 River and Harbor Act exceeded the estimated requirements and were not a complete solution to the erosion problem. Therefore, in March 1967, the Commonwealth of Pennsylvania expressed a desire that sand replenishment, as a method of protection against beach erosion at Presque Isle, be reevaluated to determine if a more effective method of protection could be developed.

The Corps of Engineers was authorized in 1970 to make a complete restudy of the Presque Isle Cooperative Beach Erosion Control Project in order to develop a more effective and permanent solution to the erosion problem. A final Review Report was prepared by the Corps Buffalo District in 1974 and submitted to Congress. That report presents the results of investigations of alternatives which would provide a long-term solution to the erosion problem that exists on the peninsula. The recommendation of that report was for construction of segmented, offshore breakwaters and placement of sandfill as shown on Plate 1. This is also the plan of improvement which Congress authorized for the Phase I Design Memorandum stage of advanced engineering and design by the 1976 Water Resources Development Act. This Phase I Design Memorandum stage is presently nearing completion and the final document will go back to Congress to obtain authorization to proceed with the detailed design and construction.

PHASE I GENERAL DESIGN
MEMORANDUM STAGE

Federal funds to initiate the Phase I GDM study for the beach erosion control project at Presque Isle Peninsula were provided the Buffalo District of the Corps in October 1977. The basic purpose of the Phase I GDM study is to develop a plan of improvement which is technically sound, environmentally acceptable, and economically feasible for preserving the beaches along Presque Isle Peninsula.

The Board of Engineers for Rivers and Harbors (BERH) has noted that several of the alternatives presented in the Review Report prepared by Buffalo District in 1974 are economically feasible and warrant further consideration during post-authorization studies. Therefore, the Phase I GDM study consisted of an analysis of the following alternatives: a segmented breakwater, groins, sand recirculation, sand trap-recirculation, annual sand nourishment, and "no action."

Stage III of the Phase I design was recently completed and the groin, segmented breakwater, and sand trap recirculation alternatives, which would provide long-term solutions to the erosion problem, were further formulated, assessed, and evaluated. The sand recirculation alternative was deleted from the study during Stage II because it was found to be environmentally unacceptable. It was concluded that the sand recirculation alternative would be harmful to the bird sanctuary located at Gull Point due to the presence and noise of sand pumping equipment and to the loss of vast quantities of sand which would be used to replenish the beaches along the peninsula. The annual nourishment alternative was also deleted from further study at the end of Stage II because it was found to be technically unacceptable and economically unsound since it required large quantities of sand annually and will greatly increase the annual maintenance dredging costs of Erie Harbor. The segmented breakwater, groin, and sand trap recirculation alternatives require an initial beach replenishment and some degree of annual beach replenishment from an outside source. A descriptive summary of these alternatives is presented below and a comparative summary is provided in Table 1.

a. Segmented Breakwater Alternative: A segmented breakwater plan which will function as a wave-attenuating and beach-building system and effectively preserve the entire peninsula and its recreational facilities from the natural erosion processes was developed. The plan was designed after reviewing existing literature on offshore breakwaters and then analyzing information obtained by observing the three prototype breakwaters which were built in 1978 and which have been very effective in attenuating waves and functioning as beach builders at Beach No. 10. The plan consists 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 at the mainland shore, eastward through Sunset Point. 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 of 10.2 feet above low water datum. The segmented breakwater alternative would require an initial replenishment of 500,000 cubic yards of sandfill and an average 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 +10.0 feet above low water datum. With the segmented breakwater plan, approximately 72,000 cubic yards of sand would be bypassed naturally each year to the east end of the peninsula for continued growth. The estimated first cost for the breakwater plan is $19,900,000. In addition, about $310,000 would be required each year for annual operation and maintenance. The details of the segmented breakwater plan are shown on Plate 2.

b. Groin Alternative: The groin concept presented in the 1974 Review Report was simply an extension of the existing Federal groin field which itself has been inadequate in preserving the peninsula and reducing the erosion. Therefore, a groin plan was designed which would function more efficiently and reduce the annual sand replenishment requirements. This groin plan consists of construction of 37 new 300-foot long rubblemound groins with a steel sheet pile cutoff to make the groins impermeable. In addition, 11 existing 300-foot long groins would be modified by placement of stone along the entire 300-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 850,000 cubic yards of sandfill and an average annual replenishment of 130,700 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. With this groin plan, approximately 145,000 cubic yards of sand would be bypassed naturally each year to the east end of the peninsula for continued growth. The estimated first cost for the groin plan is $17,700,000. In addition, about $950,000 would be required each year for annual operation and maintenance. The details of the groin plan are shown on Plates 3 and 4.

c. A sand trap recirculation plan was designed to insure continued ecological progression of Presque Isle and preservation and growth of its distal end at Gull Point by allowing a net eastward movement of a predetermined amount of sand. This would be accomplished by trapping the littoral material in a sand trap created offshore from Sunset Point which is about 5,000 feet to the west of Gull Point. The sand trap plan consists of a 2,000-foot long breakwater with a crest elevation of 17.5 feet above low water datum and located about 1,200 feet offshore from Sunset Point at the 10-foot depth contour; excavation of a sand trap wth a 270,000 cubic yard capacity in the lee of the breakwater; a 20-inch diameter permanent pipeline running approximately parallel to the park's lake shore road, and a series of three booster pumps located at 8,000-foot intervals. The sand trap recirculation plan would require an initial replenishment of 500,000 cubic yard of sandfill (270,000 cubic yards from the sand trap and 230,000 cubic yards from an outside source) and an average annual replenishment of 344,000 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 344,000 cubic yards for the average annual replenishment requirement consists of 228,000 cubic yards of sand being pumped from the trap by hydraulic dredge and distributed on the beaches west of the sand trap, a total of 32,000 cubic yards of sand pumped from the sand trap eastward toward Gull Point, and 84,000 cubic yards of sand from an outside source for distribution along the neck of the peninsula. With the sand trap recirculation plan, a total of 61,000 cubic yards of sand would bypass to the east end of the peninsula for continued growth. The estimated first cost for the sand trap plan is $19,900,000. In addition, about $3,110,000 would be required each year for annual operation and maintenance. The details of the sand trap recirculation plan are shown on Plate 5.

d. Do Nothing Approach: By this plan, the Corps of Engineers would not participate in the protection or improvement of Presque Isle Peninsula. 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 of the peninsula 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 the 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 the material from the west would be reincorporated into the eastern beaches. New ponds will be formed and the peninsula will retain its sand spit nature. It is impossible to predict the rate of eastward migration that would occur, the future morphology of the peninsula, or the time required before the peninsula is ultimately destroyed by the same natural forces which created and maintain Presque Isle Peninsula. In any event, the natural features and processes, whether they be formation of sand spits or destruction of beaches, would continue.

The Commonwealth of Pennsylvania has made a decision that it is committed to the protection of Presque Isle Peninsula from erosion and intends to continue replenishment in whatever manner they are able. Therefore, the ultimate destruction of Presque Isle Peninsula would be forestalled.

RECOMMENDED PLAN

The alternative which was selected as the recommended plan in Stage III of the Phase I study is the segmented breakwater alternative consisting of 58 rubblemound breakwaters located along the lakeward length of the peninsula. The breakwaters are intended to attenuate 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 their lee. Having observed the three experimental breakwaters at Beach No. 10 for the past 2 years, substantial design information and confidence has been gained due to their successful functioning.

As shown on Plate 2, the breakwaters will each be 150 feet long, separated by gaps of 350 feet, positioned 300 to 400 feet offshore, and have a crest elevation of +10.2 feet above low water datum. A model study is being accomplished to refine these breakwater parameters. The placement of 500,000 cubic yards of sandfill along the shoreline in the lee of the breakwaters will provide a recreation beach berm with a width of 60 feet and a crest elevation of +10.0 feet LWD.

The segmented breakwater alternative was selected as the National Economic Development (NED) Plan because it clearly outweighs the other alternatives in terms of net benefits (see Table 1 for comparison). The segmented breakwater alternative has net discounted benefits of $1,109,000 compared to $581,000 for the groin alternative, $-1,682,000 for the sand trap recirculation alternative, and $0 for the no action plan.

The segmented breakwater alternative was also designated the Environmental Quality (EQ) Plan because it was found to be the most environmentally sound alternative because it creates the largest amount of aquatic habitat for benthic organisms and free swimming life and maintains the ecological integrity of the area by providing a continuous supply of littoral transported sand for habitat conditions which depend upon a supply of sand. This plan was also found to be most favorable in terms of causing least adverse effects to aquatic habitat, water quality, wetland disruption, terrestrial habitat, and air quality.

LOCAL COOPERATION

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 7 March 1978 stating their intent to meet the terms required for local cooperation in a Local Assurance Agreement. 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;

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 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 Relocations 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.

PROJECT STATUS

The Water Resources Development Act of 1976 authorized only the Phase I GDM stage for the Presque Isle project. Therefore, our schedule assumes that the Phase I GDM will be submitted to Congress for approval and authorization for construction before proceeding with the Phase II study effort. This "two phase" authorization has a definite impact on the date for initiation of construction of the project since there is a time interval, presently indeterminate in length but assumed to be about 27 months, between submission of the Final Phase I GDM and initiation of the Phase II study effort.

Assuming that the recommended plan is approved and authorized for design, the earliest construction would begin is in the spring of 1985.

A tentative time schedule for the Presque Isle beach erosion control project is shown on Table 2. The Corps study process involves several stages of planning at increasing levels of detail with opportunities for public participation and review of each stage.

Stage I planning consisted of preparation of the Plan of Study which presented information about the study area, identified problems, and outlined work efforts to be accomplished during preparation of the Phase I GDM. Stage I planning was completed in May 1978 and was the subject of the public meeting which was held in Erie on 30 May 1978.

Stage II planning was completed in July 1979 and consisted of formulation, assessment, and evaluation of alternatives which would provide long-term solutions to the erosion problems at Presque Isle Peninsula. The results from Stage II was the subject of the public meeting which was held in Erie on 26 September 1979.

Stage III planning which is the final stage of the Phase I GDM study is scheduled to be completed in July 1980. Stage III consists of more detailed analysis, assessment, and evaluation of the alternatives previously addressed in this packet and the preparation of an Environmental Impact Statement (EIS). In Stage III, the plan of protection and improvement is selected. A Draft Phase I GDM and EIS was prepared in December 1979 and circulated for agency and public review in February 1980. The Final Phase I GDM which includes the EIS is scheduled to be prepared during June 1980.

PUBLIC INVOLVEMENT

Due to the lack of any opposition to the alternative which was selected as the recommended plan, (the segmented breakwater plan) at the previous public meeting (September 1979) and to the general acceptance of the project plans to date by all Federal and State agencies, it has been deemed unnecessary to hold a late-stage public meeting to present the results of the Stage III planning in May 1980 as was previously scheduled. Also preliminary evaluation indicates that the selected plan will not cause significant permanent unacceptable disruption of the beneficial water quality uses or the affected aquatic ecosystem.

Any person who has an interest which may be affected by the segmented breakwater plan may request a public hearing. The request must be submitted, in writing, to the District Engineer within 15 days of the date of this notice and must clearly set forth the interest which may be affected and the manner in which the interest may be affected by this activity.

In the Final Phase I GDM, the segmented breakwater plan will be chosen as the recommended plan since it was determined that it will preserve and restore Presque Isle in the most economical and environmentally pleasing manner.

EXHIBIT F-33 (continued)

Table 1 - Comparative Summary of Alternatives

Alternative	Total First Cost $ 1/	Annual Maintenance Cost $ 2/	Total Annual Cost $ 3/	Average Annual Benefits	Net Discounted Benefits 5/	Initial Sand Fill Requirement	Annual Sand Fill Requirement	Sand Quantities Reaching Gull Point Area Annually
Groins	17,700,000	948,000	2,250,000	2,831,000	581,000	850,000 C.Y. 4/	130,700 C.Y.	144,550 C.Y.
Segmented Breakwaters	19,900,000	310,000	1,775,000	2,884,000	1,109,000	500,000 C.Y.	37,900 C.Y.	72,250 C.Y.
Sand Trap Recirculation	19,900,000	3,110,000	4,575,000	2,893,000	-1,682,000	500,000 C.Y.	343,600 C.Y.	61,400 C.Y.
No Action	-	-	-	-	-	-	-	87,100 C.Y.

1/ Total First Cost includes the cost for initial sandfill, 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.

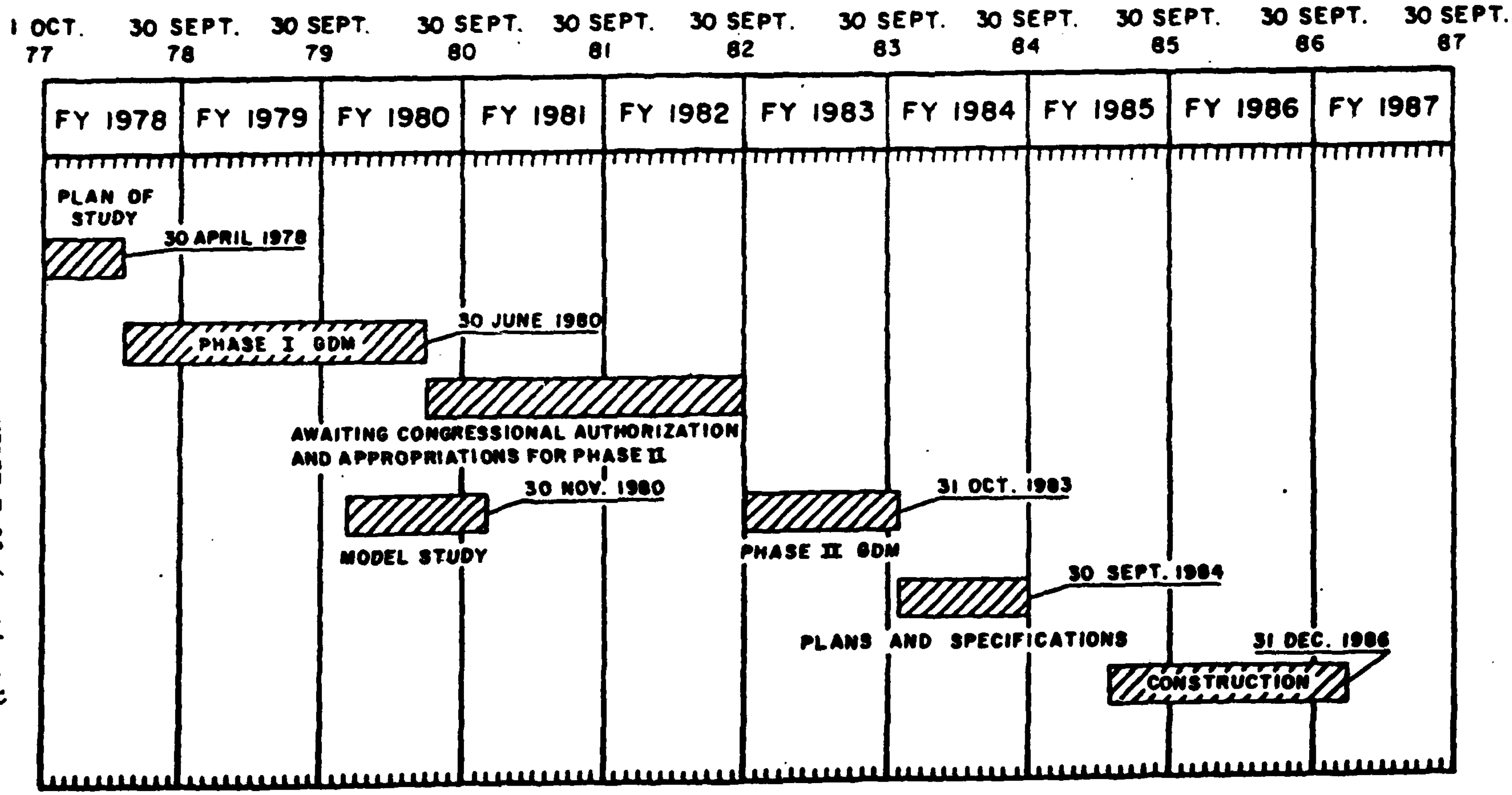
3/ Total Annual Cost includes the annual maintenance cost plus interest and amortization charges on the initial investment.

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

5/ Net Discounted Benefits are the Total Annual Costs minus the Average Annual Benefits.

EXHIBIT F-33 (continued)

TABLE 2
PROPOSED SCHEDULE OF MAJOR ACTIVITIES
PRESQUE ISLE PENINSULA
BEACH EROSION CONTROL PROJECT



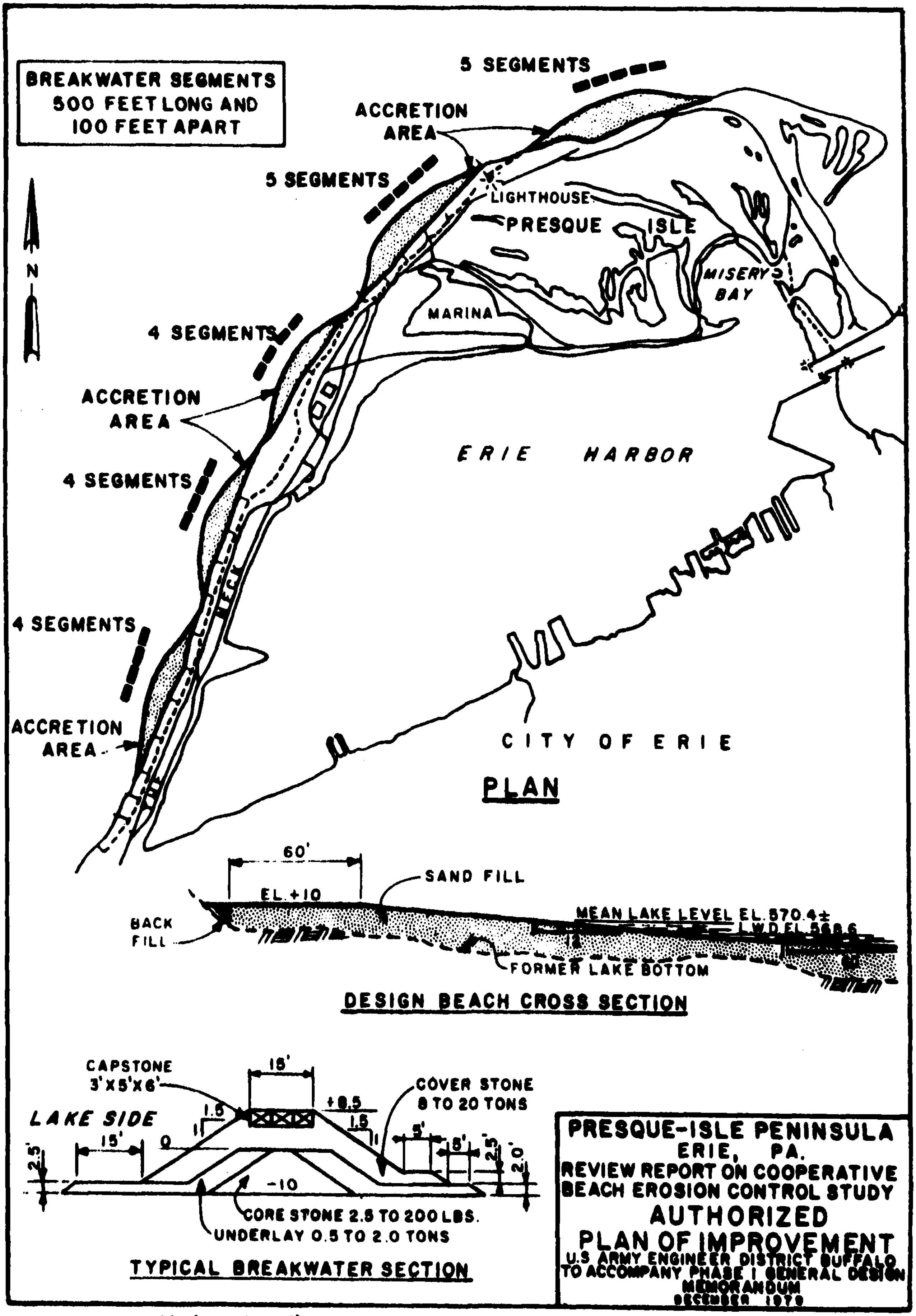


EXHIBIT F-33 (continued)

PLATE I

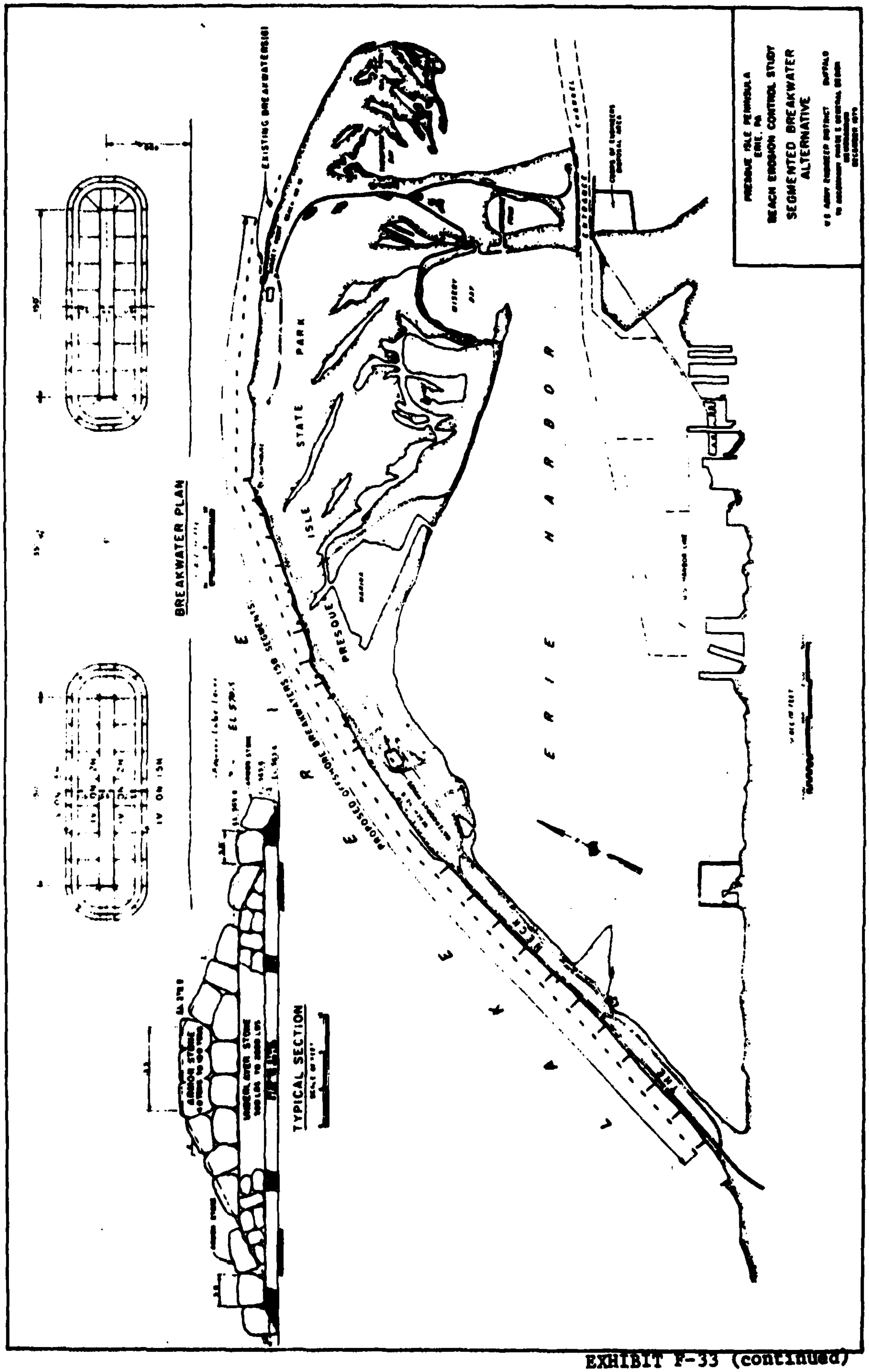


EXHIBIT F-33 (continued)

PLATE 2

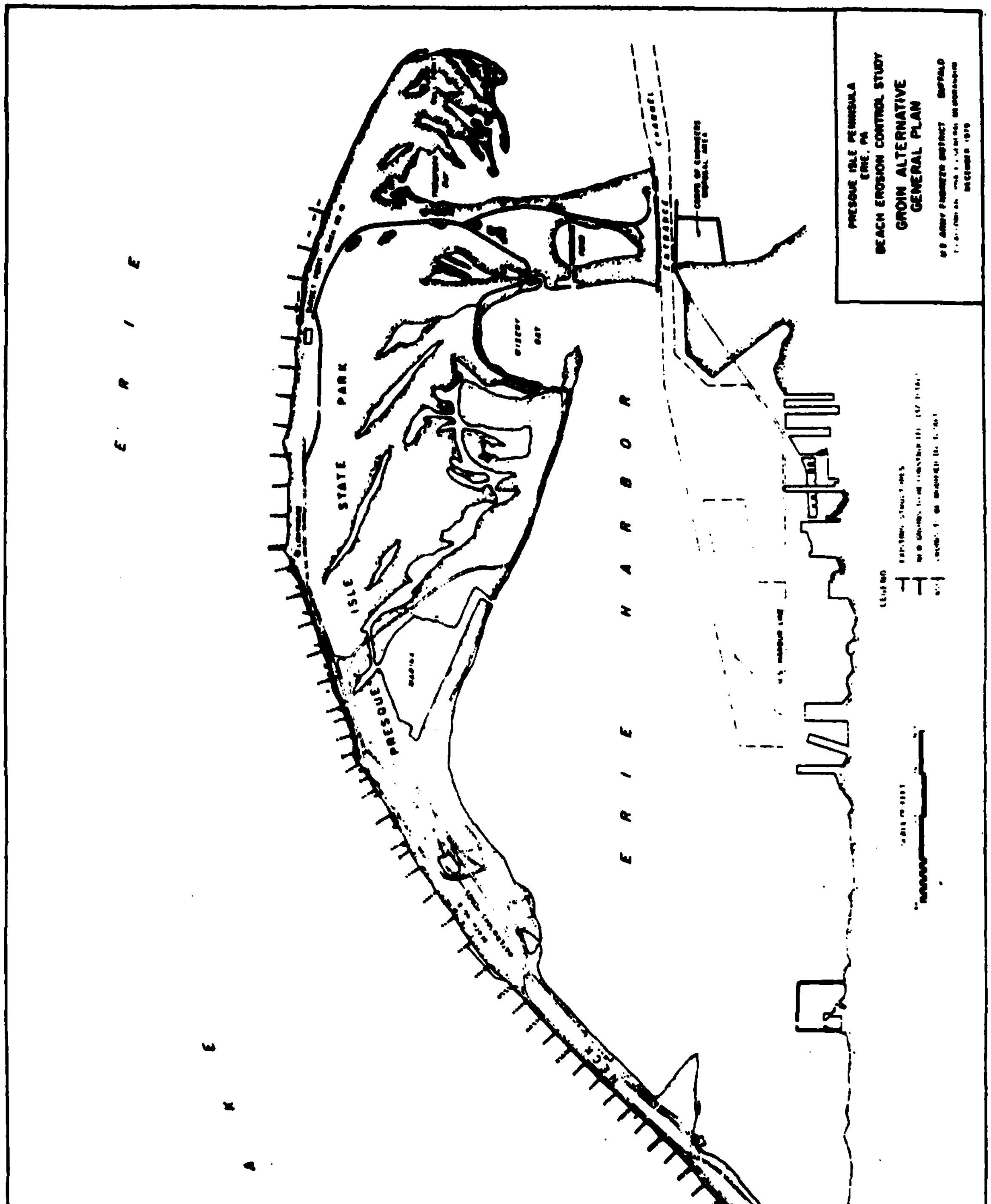


EXHIBIT F-33 (continued)

PLATE 3

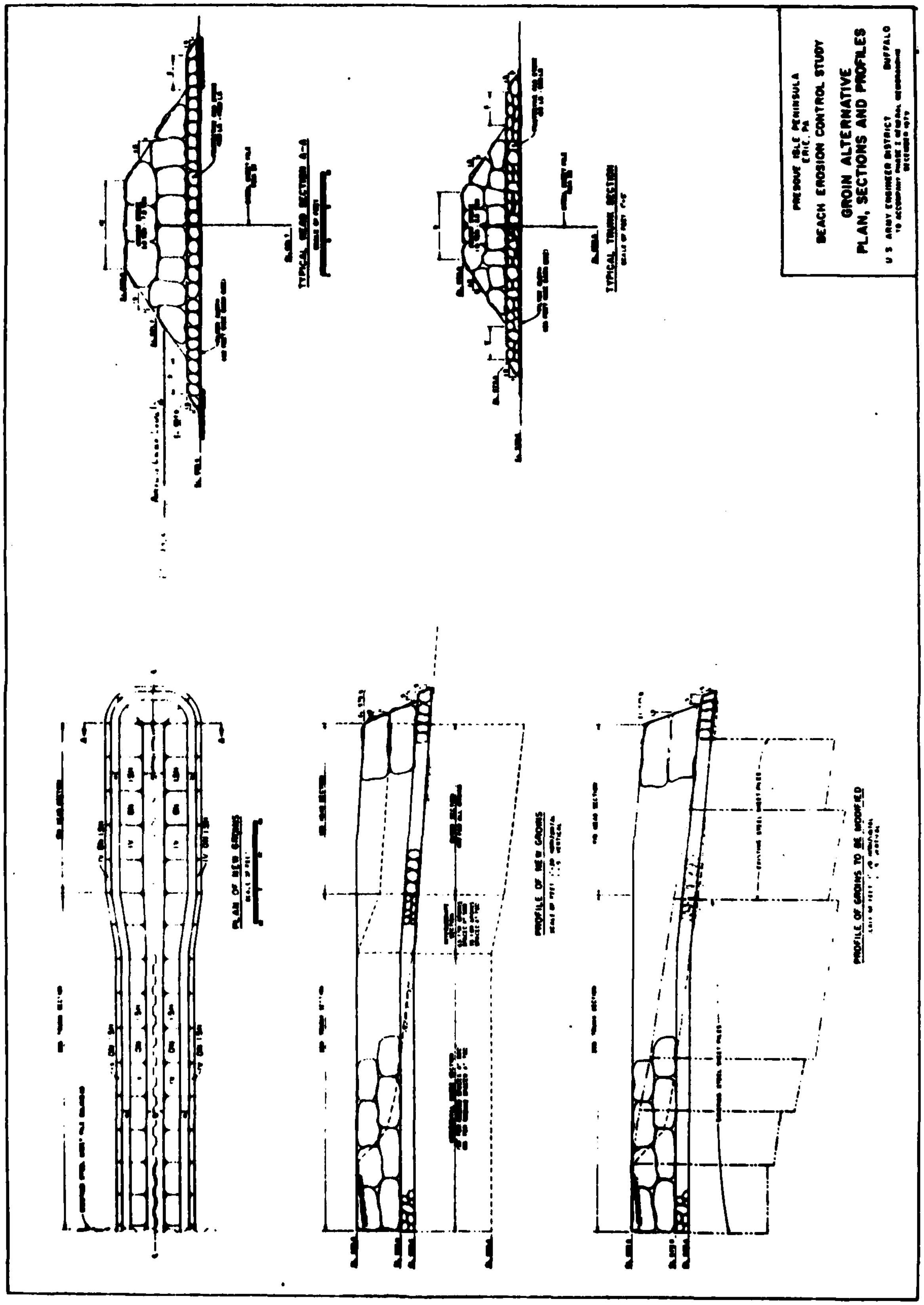


EXHIBIT F-33 (continued)

PLATE 4

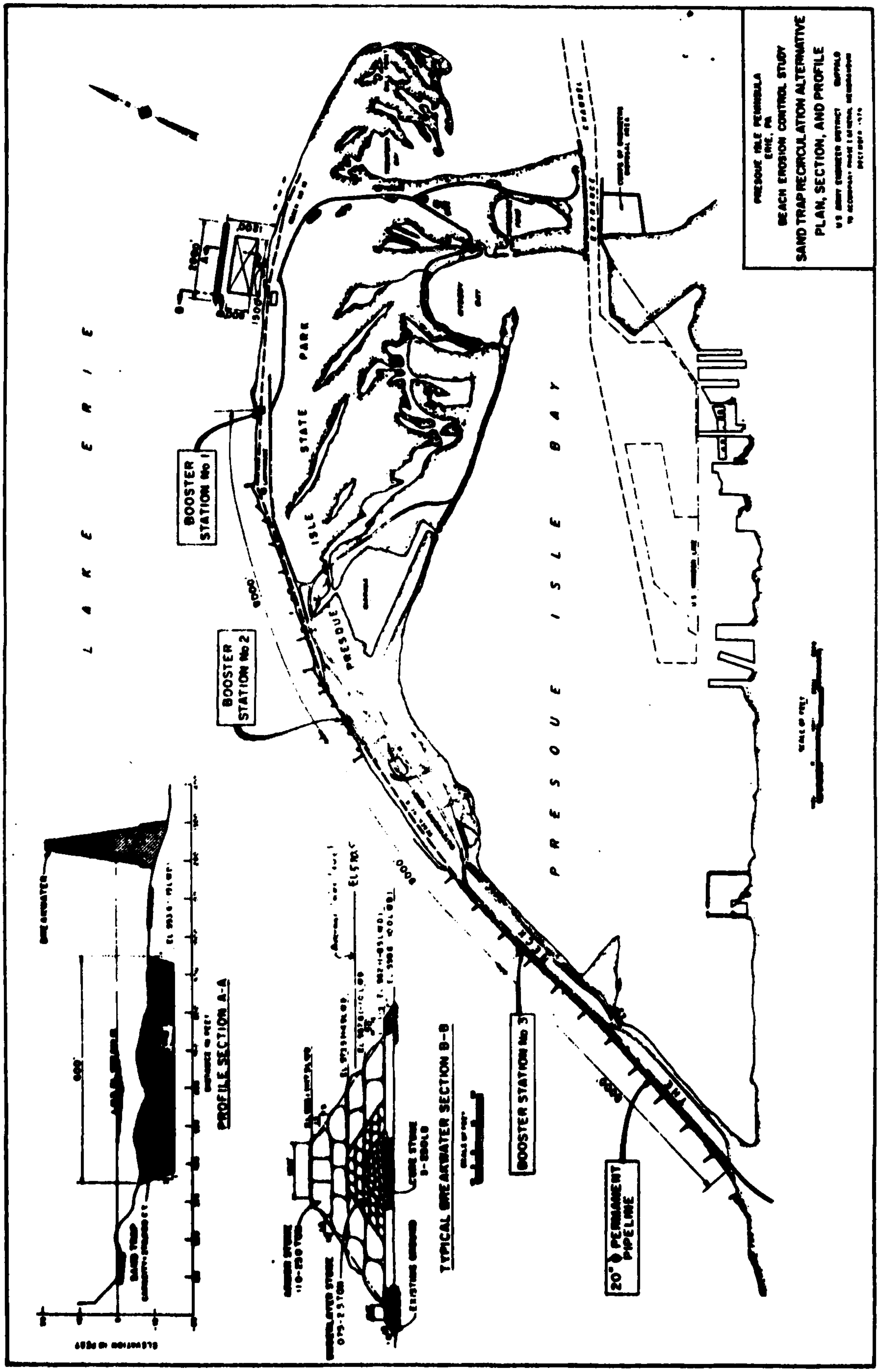


EXHIBIT F-33 (continued)

PLATE 5

Gannon University
PERRY SQUARE • ERIE, PENNSYLVANIA • 16541

NASH LEARNING RESOURCE CENTER

March 6, 1980

Colonel George P. Johnson
Corps of Engineers
Buffalo District
1776 Niagara Street
Buffalo, New York 14207

Dear Colonel Johnson:

Thank you for the two copies of Draft Phase I General Design Memorandum (GDM) including the Draft Environmental Impact Statement (DEIS), and associated Appendices for the beach erosion control project at Presque Isle Peninsula in Erie, Pennsylvania.

We have posted a copy of your letter and a notice on the bulletin board in the Nash Learning Resource Center that these publications are available for review at the circulation desk.

We appreciate receiving your publications and keep adding them to our Environmental collection.

Sincerely yours,

Grace A. Davies

(Mrs.) Grace A. Davies
Acquisitions Librarian

GAD:dc

EXHIBIT F-34

DEPARTMENT OF TRANSPORTATION
UNITED STATES COAST GUARD

Address reply to:
COMMANDER (dpl-2)
Ninth Coast Guard District
1240 East 9th St.
Cleveland, Ohio 44199
Phone: (216) 522-3919

16475
APR 9 1980

Department of the Army
Buffalo District, Corps of Engineers
1776 Niagara Street
Buffalo, New York, 14207

Re: Draft Phase I General Design Memorandum Presque Isle Peninsula, Erie, Pennsylvania, December, 1979

Dear Sir:

The Ninth Coast Guard District has reviewed the referenced General Design Memorandum and Draft Environmental Impact Statement, and we have no comments or objections to offer at this time.

Sincerely,

R. L. Andrews

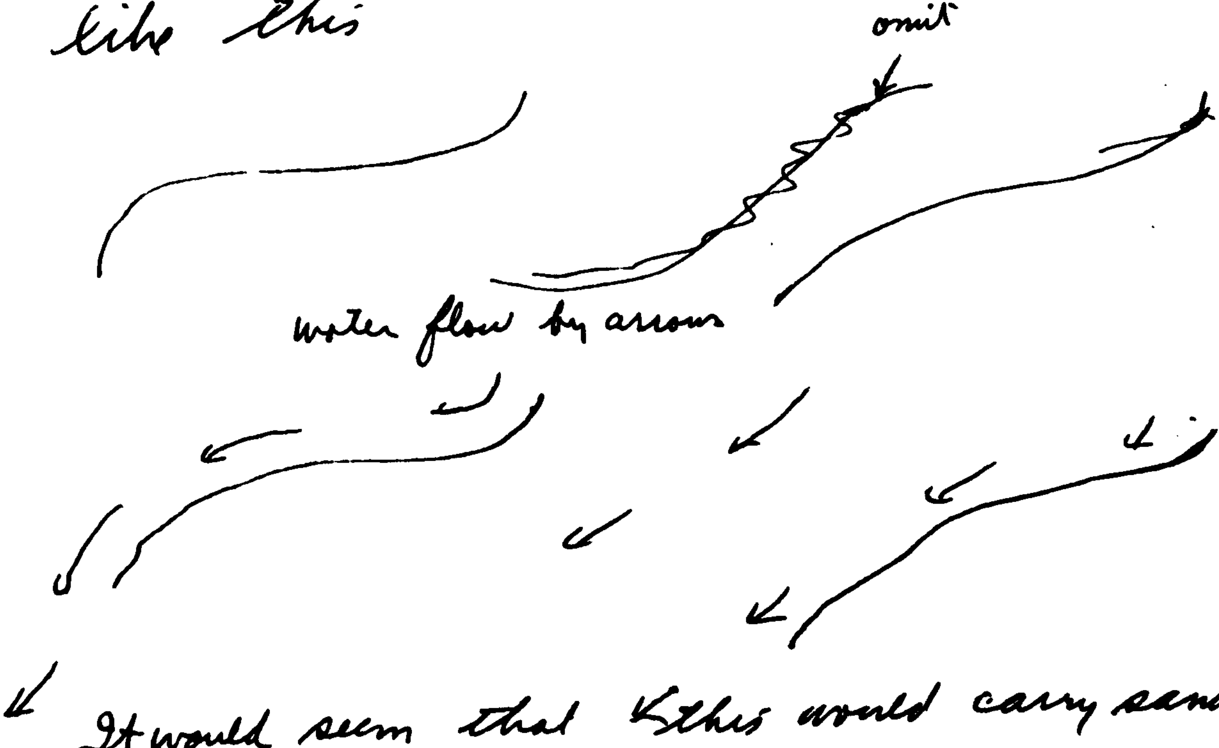
R. L. ANDREWS
Commander, U. S. Coast Guard
Water Resources Planning Officer
By direction of the Commander,
Ninth Coast Guard District

Copy to COMDT(G-WEP-7)

1505 So Shore Dr
Erie Pa 16505
April 10 1980

Dear Col Johnson

Re Draft Phase I General Design Memorandum for project for Beach Erosion control at Presque Isle Peninsula in Erie using segmented breakwaters located offshore, at one of the meetings I attended on this subject I suggested the use of the segmented breakwaters being sine shaped to maintain fresh clean water behind the breakwaters. A rough sketch of my plan looks like this



It would seem that this would carry sand and fresh water back of each segment. Your comments on above will be appreciated

Sincerely
John W Brauns.

EXHIBIT F-36

UNITED STATES DEPARTMENT OF COMMERCE
Office of the Secretary

April 15, 1980

Colonel George P. Johnson
District Engineer
Buffalo District, Corps of Engineers
1776 Niagara Street
Buffalo, New York 14207

Dear Colonel Johnson:

In response to the request for comments on the General Design Memorandum on Presque Isle Peninsula, Erie, Pennsylvania, we would like to see comments from the Pennsylvania Coastal Zone Management Program located in the Department of Environmental Resources.

Sincerely,

Linda A. Sadler

LINDA A. SADLER
Deputy Representative
of the Secretary

U.S. DEPARTMENT OF COMMERCE
Office of the Secretary
Federal Region III
Wm. J. Green Federal Building
600 Arch Street · Room 10412
Philadelphia, Pennsylvania 19106

UNITED STATES DEPARTMENT OF COMMERCE
The Assistant Secretary for Science and Technology
Washington, D.C. 20230
(202) 377-4335

April 25, 1980

Colonel George P. Johnson
U.S. Army Engineer District, Buffalo
1776 Niagara Street
Buffalo, New York 14207

Dear Colonel Johnson:

This is in reference to your environmental impact statement entitled "Presque Isle Peninsula, Erie, Pennsylvania." The enclosed comments from the National Oceanic and Atmospheric Administration are forwarded for your consideration.

Thank you for giving us an opportunity to provide these comments, which we hope will be of assistance to you. We would appreciate receiving six (6) copies of the final environmental impact statement.

Sincerely,

Bruce R. Barrett

Bruce R. Barrett
Acting Director, Office of
Environmental Affairs

Enclosure Memo from: Mr. Eugene J. Aubert
NOAA

EXHIBIT F-38

U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
ENVIRONMENTAL RESEARCH LABORATORIES
Great Lakes Environmental Research Laboratory
2300 Washtenaw Avenue
Ann Arbor, MI 48104

Rec'd PP/EC
14 APR 1980

April 2, 1980

TO: PP/EC - Joyce M. Wood

FROM RD/RF24 - Eugene J. Aubert

SUBJECT: DEIS 8003.07 - Presque Isle Peninsula; Erie, Pennsylvania

The subject DEIS prepared by the Corps of Engineers, Buffalo District, on cooperative beach erosion control project at Presque Isle Peninsula, Lake Erie has been reviewed and comments herewith submitted.

The selected plan to alleviate an erosion problem at the Presque Isle Peninsula will provide 58 offshore breakwaters, each 15.2 feet high, 150 feet long with 350-foot gaps between breakwaters. They will be aligned parallel to the shoreline and positioned in the trough between the first and second offshore bars. The length and spacing of the design breakwaters were based on experimental prototype breakwaters built in 1978 at Beach No. 10. These experimental breakwaters are located in a region of accretion where small reduction in wave energy reaching the shoreline causes drift deposition. Direct transfer of the design data for the experimental breakwaters, although successful at the given location, to an area of extensive erosion cannot be justified. Therefore, the selected plan should be considered as preliminary and may require revisions. It appears that variable spacing of breakwaters along the shoreline is indicated. Model tests are scheduled to check the design parameters. It is known that in coastal processes models do not provide reliable quantitative results. An effective way to check the design data would be to place a few prototype breakwaters in the region of extensive erosion.

In the aesthetics of the offshore structures, the most critical parameter is the height of the structures above water. The Impact Statement indicates that the experimental breakwaters at Beach No. 10 are acceptable to the public. Crest elevation of these breakwaters is 574.6 feet and the height above the long-term mean lake level is 4.1 feet. However, the crest elevation of the 58 proposed breakwaters is 578.8 feet and the height above water will be 8.3 feet. The proposed much higher breakwaters will greatly interrupt the view of the lake and would be objectionable. The statement lists as a main element in determining crest elevation the thickness of the layers of stone required in the cross-section of the structure (page F-3).

AD-A097 491 CORPS OF ENGINEERS BUFFALO N Y BUFFALO DISTRICT F/G 13/2
PRESQUE ISLE PENINSULA, FRIE, PENNSYLVANIA. VOLUME II. APPENDIC--ETC(U)
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5 of 5

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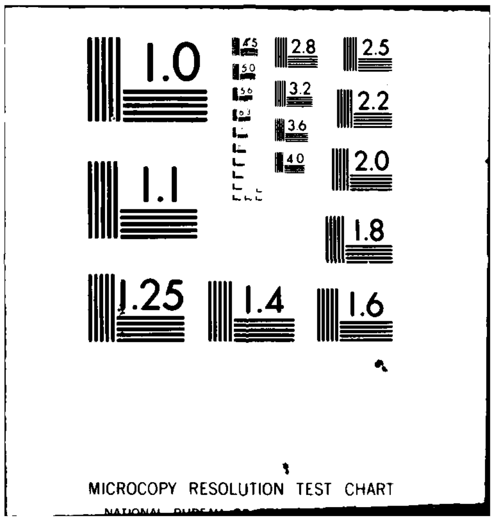
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MICROCOPY RESOLUTION TEST CHART

It is recommended that a revision to the project be considered with first priority given to the development and model test of stable structures of lesser height. In case the stability of structures would indeed require a minimum height of 15.2 feet, there are ways to reduce the height of structures above water. One, to move the breakwaters further away from shore in deeper water, and the other, to dredge lake bottom at the proposed lake sites.

United States Department of Agriculture

Soil Conservation Service

P. O. Box 985
Federal Square Station
Harrisburg, Pennsylvania 17108

April 30, 1980

Col. George P. Johnson, District Engingeer
Buffalo District Corps of Engineers
1776 Niagra Street
Buffalo, NY 14207

Dear Colonel Johnson:

The Soil Conservation Service has reviewed the draft Phase I, General Design Memorandum for the Cooperative Beach Erosion Control Project at Presque Isle Peninsula, Erie, Pennsylvania. We feel the statement displays a good environmental assessment and adequately addresses all areas within our expertise.

We appreciate the opportunity to comment on this project.

Sincerely,

Graham T. Munkittrick

Graham T. Munkittrick
State Conservationist

cc:
William Branigan, Acting Area Conservationist, SCS, Clarion, PA
Lewis Steckler, District Conservationist, SCS, Waterford, PA

EXHIBIT F-39

United States Department of the Interior

OFFICE OF THE SECRETARY
WASHINGTON, D.C. 20240

ER-80/186

May 9, 1980

Colonel George P. Johnson
District Engineer
Buffalo District, Corps of Engineers
1776 Niagara Street
Buffalo, New York 14207

Dear Colonel Johnson:

This responds to your letter (NCBED-PE) of February 28, 1980, requesting our review and comments on the draft environmental statement and draft Phase I General Design Memorandum for Presque Isle Peninsula, Erie County, Pennsylvania.

The Department of the Interior has no objection to construction of the project as planned and finds the subject documents adequately discuss our concerns.

Sincerely,

William Patterson

William Patterson
Regional Environmental Officer

EXHIBIT F-40

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
REGIONAL OFFICE
CURTIS BUILDING, SIXTH AND WALNUT STREETS
PHILADELPHIA, PENNSYLVANIA 19106

REGION III

MAY 13 1980

IN REPLY REFER TO:
3CE

Colonel George P. Johnson
District Engineer
Buffalo District
Corps of Engineers
1776 Niagara Street
Buffalo, New York 14207

Dear Colonel Johnson:

We have completed our review of the Draft Environmental Impact Statement prepared for the Cooperative Beach Erosion Control Project at Presque Isle Peninsula, Erie, Pennsylvania, and have no comments to offer.

Thank you.

Sincerely,

For Thomas C. Maloney
Regional Administrator

EXHIBIT F-41

COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF ENVIRONMENTAL RESOURCES

PRESQUE ISLE STATE PARK
P. O. BOX 8006
ERIE, PA 16505

May 28, 1980

Colonel George P. Johnson
Corps of Engineers, Buffalo District
1776 Niagara Street
Buffalo, NY 14207

Dear Colonel Johnson:

I am in receipt of the letter and copy of the Draft Phase I General Design Memorandum (GDM), including the Draft Environmental Impact Statement (DEIS), and associated appendices entitled "Presque Isle Peninsula, Erie, PA".

I sincerely appreciate your cooperation in furnishing this information. It has been helpful to me, as a relatively new superintendent assigned to Presque Isle State Park, to understand the enormous task of preserving the beaches along Presque Isle peninsula.

In line with the recommended plan of a system of 58 rubble mound breakwaters off shore, I am enclosing correspondence regarding a Lake Erie boat launch ramp.

Sincerely,

Eugene V. Giza
Park Superintendent

EVG/dak
Enclosure

Special Projects

October 16, 1979

Lake Erie Boat Launch Ramp

Ray W. Martz, Regional Supt.
Park Region #2

Eugene V. Giza, Park Supt.
Presque Isle State Park

The attached public notice from the Corps of Engineers regarding the Cooperative Beach Erosion Control Project at Presque Isle State Park is self-explanatory.

The plan to erect breakwater segments from the base of the peninsula eastward through Sunset Point lends itself to the proposed Groin #2 boat launch ramp.

If we do not contact the Corps of Engineers and request a feasibility study to develop Groin #2 as a boat ramp in conjunction with the segments breakwater plan, we will do the boating public a grave injustice.

EVG/dak
Attachment

January 4, 1980

Boat Ramp Request
Lakeside Boat Ramp
Presque Isle State Park

William C. Forrey
Director
Bureau of State Parks

Attn: Jim Lesher

Ray W. Martz
Regional Superintendent
Park Region #1

It has been requested by the public that a Lakeside Boat Ramp be constructed near Beach #1 at Presque Isle.

The boat ramp would serve as a general launching area and would also be a means for trailering boats caught in the quick storms that come up on Lake Erie. When the storms come up boaters have too far to go to get back to the Marina and other bay side launch areas.

We have looked over the Beach #1 area and agree that a launch could be placed in the area, with parking in the Beach #1 parking lot. The roadway to the ramp should go over the sand mound so as not to weaken the natural barrier that has formed. It is important for wave protection.

I am requesting that if you concur, to have the Planning Section make a study, draw plans, and allot monies for construction.

JWP/kld
Attachments
cc: Presque Isle
File

EXHIBIT F-42 (continued)

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION III
6TH AND WALNUT STREETS
PHILADELPHIA, PENNSYLVANIA 19106

MAY 30 1983

Colonel George P. Johnson
District Engineer
Buffalo District
U.S. Army Corps of Engineers
1776 Niagara Street
Buffalo, New York 14207

Dear Colonel Johnson:

We have completed our review of the Draft Phase I General Design Memorandum (2 vols.) concerning the Presque Isle Peninsula, Erie, Pa. The project concerns the Cooperative Beach Erosion Control Project.

We have no objections to the proposal as it is presented in the Design Memorandum or the Impact Statement. We would classify the project in EPA's reporting category LO-1.

We thank you for the opportunity to review the documents and look forward to receiving the final reports.

Sincerely yours,

John R. Pomponio
Chief
EIS & Wetlands Review Section

EXHIBIT F-43

Comments and Responses on Draft Phase I GDM

A number of reviewers have provided comments on the draft Phase I General Design Memorandum which was issued on 28 February 1980. Their comments and our responses follow. Comments are addressed in the order that they were received.

Gannon University
PERRY SQUARE • ERIE, PENNSYLVANIA • 16541

NASH LEARNING RESOURCE CENTER

March 6, 1980

Colonel George P. Johnson
Corps of Engineers
Buffalo District
1776 Niagara Street
Buffalo, New York 14207

Dear Colonel Johnson:

Thank you for the two copies of Draft Phase I General Design Memorandum (GDM) including the Draft Environmental Impact Statement (DEIS), and associated Appendices for the beach erosion control project at Presque Isle Peninsula in Erie, Pennsylvania.

1. We have posted a copy of your letter and a notice on the bulletin board in the Nash Learning Resource Center that these publications are available for review at the circulation desk.

We appreciate receiving your publications and keep adding them to our Environmental collection.

Sincerely yours,

Grace A. Davies

(Mrs.) Grace A. Davies
Acquisitions Librarian

GAD:dc

GANNON UNIVERSITY

1. Thank you for your acknowledgment. No response needed.

Exhibit F-44 (Continued)

DEPARTMENT OF TRANSPORTATION
UNITED STATES COAST GUARD

Address reply to
COMMANDER
Ninth Coast Guard District
1240 East 9th St.
Cleveland, Ohio 44199
Phone (216) 522-3919

16475
APR 9 1980

Department of the Army
Buffalo District, Corps of Engineers
1776 Niagara Street
Buffalo, New York, 14207

Re: Draft Phase I General Design Memorandum Presque Isle Peninsula, Erie, Pennsylvania, December, 1979

Dear Sir:

1. The Ninth Coast Guard District has reviewed the referenced General Design Memorandum and Draft Environmental Impact Statement, and we have no comments or objections to offer at this time.

Sincerely,

R. L. ANDREWS
Commander, U. S. Coast Guard
Water Resources Planning Officer
By direction of the Commander,
Ninth Coast Guard District

Copy to COMDT(G-WEP-7)

U. S. DEPARTMENT OF TRANSPORTATION, UNITED STATES COAST GUARD

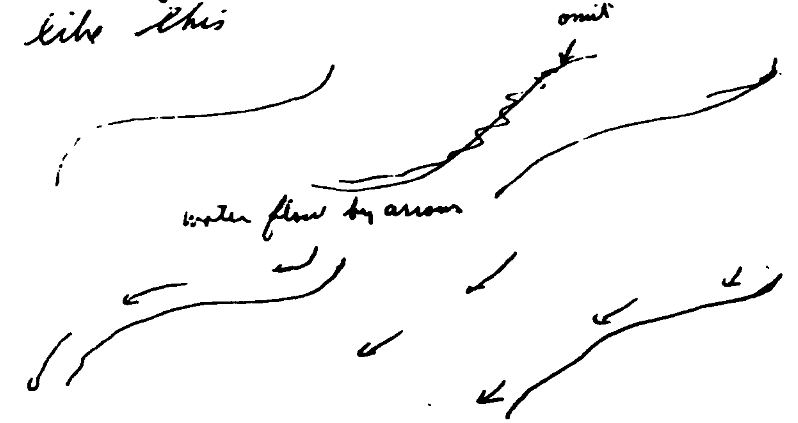
1. Thank you for your review. No response needed.

Exhibit F-44 (Continued)

1505 So Shore Dr
Erie Pa 16505
April 10 1980

Dear Col Johnson

1. Re Draft Phase I General Design Memorandum for project for Beach Erosion control at Presque Isle Peninsula in Erie using segmented breakwaters located offshore, at one of the meetings I attended on this subject I suggested the use of the segmented breakwaters being sine shaped to maintain fresh clean water behind the breakwaters. a rough sketch of my plan looks like this



It would seem that this would carry sand and fresh water back of each segment.
Your comments on above will be appreciated

Sincerely
John W Brauns

JOHN W. BRAUNS

1. Your concerns were answered by letter dated 23 April 1980. A copy of that letter is included as Exhibit F-45 in Appendix F of this report.

UNITED STATES DEPARTMENT OF COMMERCE
Office of the Secretary

April 15, 1980

Colonel George P. Johnson
District Engineer
Buffalo District, Corps of Engineers
1776 Niagara Street
Buffalo, New York 14207

Dear Colonel Johnson:

1. In response to the request for comments on the General Design Memorandum on Presque Isle Peninsula, Erie, Pennsylvania, we would like to see comments from the Pennsylvania Coastal Zone Management Program located in the Department of Environmental Resources.

Sincerely,

Linda A. Sadler

LINDA A. SADLER
Deputy Representative
of the Secretary

U.S. DEPARTMENT OF COMMERCE
Office of the Secretary
Federal Region III
Wm. J. Green Federal Building
600 Arch Street - Room 10412
Philadelphia, Pennsylvania 19106

U. S. DEPARTMENT OF COMMERCE, OFFICE OF THE SECRETARY

1. Thank you for your acknowledgment. No response necessary. As indicated in our 25 April 1980 letter, no comments have been received from the Pennsylvania Coastal Zone Management Program.

Exhibit F-44 (Continued)

UNITED STATES DEPARTMENT OF COMMERCE
The Assistant Secretary for Science and Technology
Washington, D.C. 20230
(202) 377-4335

April 25, 1980

Colonel George P. Johnson
U.S. Army Engineer District, Buffalo
1776 Niagara Street
Buffalo, New York 14207

Dear Colonel Johnson:

This is in reference to your environmental impact statement entitled "Presque Isle Peninsula, Erie, Pennsylvania." The enclosed comments from the National Oceanic and Atmospheric Administration are forwarded for your consideration.

1. Thank you for giving us an opportunity to provide these comments, which we hope will be of assistance to you. We would appreciate receiving six (6) copies of the final environmental impact statement.

Sincerely,

Bruce R. Barrett

Bruce R. Barrett
Acting Director, Office of
Environmental Affairs

Enclosure Memo from: Mr. Eugene J. Aubert
NOAA

U. S. DEPARTMENT OF COMMERCE, ASSISTANT SECRETARY FOR SCIENCE AND TECHNOLOGY

1. Thank you for your acknowledgment. You will be sent the requested copies of the documents when they become officially available in final form. The comments of the National Oceanic and Atmospheric Administration are answered below.

Exhibit F-44 (Continued)

U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
ENVIRONMENTAL RESEARCH LABORATORIES
Great Lakes Environmental Research Laboratory
2300 Washtenaw Avenue
Ann Arbor, MI 48104

14 APR

April 2, 1980

TO: PP/EC - Joyce M. Wood

FROM RD/RF24 - Eugene J. Aubert

SUBJECT: DEIS 8003.07 - Presque Isle Peninsula;
Erie, Pennsylvania

The subject DEIS prepared by the Corps of Engineers, Buffalo District,
2. on cooperative beach erosion control project at Presque Isle Peninsula,
Lake Erie has been reviewed and comments herewith submitted.

The selected plan to alleviate an erosion problem at the Presque Isle
Peninsula will provide 58 offshore breakwaters, each 15.2 feet high,
150 feet long with 350-foot gaps between breakwaters. They will be aligned
3. parallel to the shoreline and positioned in the trough between the first and
second offshore bars. The length and spacing of the design breakwaters were
based on experimental prototype breakwaters built in 1978 at Beach No. 10.
These experimental breakwaters are located in a region of accretion where
small reduction in wave energy reaching the shoreline causes drift deposition.
4. Direct transfer of the design data for the experimental breakwaters, although
successful at the given location, to an area of extensive erosion cannot be
justified. Therefore, the selected plan should be considered as preliminary
and may require revisions. It appears that variable spacing of breakwaters
along the shoreline is indicated. Model tests are scheduled to check the
5. design parameters. It is known that in coastal processes models do not
provide reliable quantitative results. An effective way to check the design
data would be to place a few prototype breakwaters in the region of
extensive erosion.

In the aesthetics of the offshore structures, the most critical parameter
is the height of the structures above water. The Impact Statement indicates
that the experimental breakwaters at Beach No. 10 are acceptable to the public.
Crest elevation of these breakwaters is 574.6 feet and the height above the
long-term mean lake level is 4.1 feet. However, the crest elevation of the
6. 58 proposed breakwaters is 578.8 feet and the height above water will be 8.3
feet. The proposed much higher breakwaters will greatly interrupt the view
of the lake and would be objectionable. The statement lists as a main element
in determining crest elevation the thickness of the layers of stone required
in the cross-section of the structure (page F-3).

<u>U. S. DEPARTMENT OF COMMERCE, ASSISTANT SECRETARY FOR SCIENCE AND TECHNOLOGY (cont'd)</u>

2. Thank you for your comments, which are answered below.

3. The selected design is based not only on experience with the prototype breakwaters but also on research and technical literature on the topic of offshore breakwaters.

4. Beach No. 10 has been an area of severe erosion since the early 1970's and, therefore, was selected as the site for the prototype project. When the breakwaters were constructed in 1978, there was virtually no beach present and the existing parking lot was being severely damaged. The present beach condition is the result of the initial placement of 70,000 tons of sand in the lee of the breakwaters as well as the functioning of the breakwaters as wave attenuators and beach builders.

5. We concur that the model tests will check the design parameters. Although these tests will not provide precise quantitative predictions of littoral transport rate, they will fairly accurately depict the effects of the structures on the wave action and subsequent littoral processes. They will also provide qualitative indications of the potential for sand transport through the breakwater system. Concur that an effective way to check design data would be to construct a few additional prototype breakwaters. This would also provide added benefits of protecting the beaches behind them and eliminating the need for beach nourishment at the location of the structures, thereby allowing placement of sandfill at other critical areas of erosion under our present nourishment program. However, there is no existing authorization under which additional prototype breakwaters can be constructed.

6. This comment is acknowledged and the section entitled AESTHETICS on page H-22 of the EIS has been amended to more accurately depict the expected aesthetic impacts. Note that while the planned structures are higher, they are also further offshore and more widely spaced. These latter characteristics will tend to ameliorate the interruption of the view of the lake.

7. It is recommended that a revision to the project be considered with first priority given to the development and model test of stable structures of lesser height. In case the stability of structures would indeed require a minimum height of 15.2 feet, there are ways to reduce the height of structures above water. One, to move the breakwaters further away from shore in deeper water, and the other, to dredge lake bottom at the proposed lake sites.

U. S. DEPARTMENT OF COMMERCE, ASSISTANT SECRETARY FOR SCIENCE AND TECHNOLOGY (cont'd)

7. Stability of breakwater section designs will be tested in two-dimensional model studies. However, the efficacy of reducing the height of the structures above the water surface by moving them off shore is questionable, because placement in deeper water would subject them to larger waves, thereby requiring larger stone sizes, causing a need for increased layer thicknesses which would require greater height of the breakwater structures. However, such design alternatives as excavation and/or change in structure slope to reduce th rquired structure height wil be addressed in the Phase II studies to optimize the structure design and public acceptability.

United States Department of Agriculture

Soil Conservation Service

P. O. Box 985
Federal Square Station
Harrisburg, Pennsylvania 17108

April 30, 1960

Col. George P. Johnson, District Engineer
Buffalo District Corps of Engineers
1776 Niagra Street
Buffalo, NY 14207

Dear Colonel Johnson:

1. The Soil Conservation Service has reviewed the draft Phase I, General Design Memorandum for the Cooperative Beach Erosion Control Project at Presque Isle Peninsula, Erie, Pennsylvania. *We feel the statement* displays a good environmental assessment and adequately addresses all areas within our expertise.

We appreciate the opportunity to comment on this project.

Sincerely,

Graham T. Munkittrick
State Conservationist

cc:
William Branigan, Acting Area Conservationist, SCS, Clarion, PA
Lewis Steckler, District Conservationist, SCS, Waterford, PA

U. S. DEPARTMENT OF AGRICULTURE, SOIL CONSERVATION SERVICE

1. Thank you for your review. No response is needed.

Exhibit F-44 (Continued)

United States Department of the Interior

OFFICE OF THE SECRETARY
WASHINGTON, D.C. 20240

ER-80/186

May 9, 1980

Colonel George P. Johnson
District Engineer
Buffalo District, Corps of Engineers
1776 Niagara Street
Buffalo, New York 14207

Dear Colonel Johnson:

This responds to your letter (NCBED-PE) of February 28, 1980, requesting our review and comments on the draft environmental statement and draft Phase I General Design Memorandum for Presque Isle Peninsula, Erie County, Pennsylvania.

1. The Department of the Interior has no objection to construction of the project as planned and finds the subject documents adequately discuss our concerns.

Sincerely,

William Patterson

William Patterson
Regional Environmental Officer

<u>U. S. DEPARTMENT OF THE INTERIOR, OFFICE OF THE SECRETARY</u>

1. Thank you for your review. No response needed.

Exhibit F-44 (Continued)

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
REGIONAL OFFICE
CURTIS BUILDING, SIXTH AND WALNUT STREETS
PHILADELPHIA, PENNSYLVANIA 19106

REGION III

MAY 13 1980

IN REPLY REFER TO:
3CE

Colonel George P. Johnson
District Engineer
Buffalo District
Corps of Engineers
1776 Niagara Street
Buffalo, New York 14207

Dear Colonel Johnson:

1. We have completed our review of the Draft Environmental Impact Statement prepared for the Cooperative Beach Erosion Control Project at Presque Isle Peninsula, Erie, Pennsylvania, and have no comments to offer.

Thank you.

Sincerely,

Thomas C. Maloney
Regional Administrator

AREA OFFICES
BALTIMORE, MARYLAND • PHILADELPHIA, PENNSYLVANIA • PITTSBURGH, PENNSYLVANIA • RICHMOND, VIRGINIA • WASHINGTON, D.C.
Insuring Offices
Charleston, West Virginia • Wilmington, Delaware

U. S. DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT

1. Thank you for your review. No response needed.

Exhibit F-44 (Continued)

COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF ENVIRONMENTAL RESOURCES
PRESQUE ISLE STATE PARK
P. O. BOX 8006
ERIE, PA 16505

May 28, 1980

Colonel George P. Johnson
Corps of Engineers, Buffalo District
1776 Niagara Street
Buffalo, NY 14207

Dear Colonel Johnson:

1. I am in receipt of the letter and copy of the Draft Phase I General Design Memorandum (GDM), including the Draft Environmental Impact Statement (DEIS), and associated appendices entitled "Presque Isle Peninsula, Erie, PA".

I sincerely appreciate your cooperation in furnishing this information. It has been helpful to me, as a relatively new superintendent assigned to Presque Isle State Park, to understand the enormous task of preserving the beaches along Presque Isle peninsula.

2. In line with the recommended plan of a system of 58 rubble mound breakwaters off shore, I am enclosing correspondence regarding a Lake Erie boat launch ramp.

Sincerely,

Eugene V. Giza
Park Superintendent

EVG/dak
Enclosure

PRESQUE ISLE STATE PARK

1. Thank you for your acknowledgment of having received the report and of its value to you.

2. Under the established authorization for the Cooperative Beach Erosion Control Project, there is no provision for study of the feasibility of a boat launching ramp. However, because it is important to the aims of the erosion control project, the Corps would like to be kept fully informed of any plans that the Commonwealth of Pennsylvania might implement regarding a boat launching facility. If this were to be constructed in the vicinity of the Federal project, its presence there could influence project design.

Exhibit F-44 (Continued)

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION III
6TH AND WALNUT STREETS
PHILADELPHIA, PENNSYLVANIA 19106

MAY 16 [illegible]

Colonel George P. Johnson
District Engineer
Buffalo District
U.S. Army Corps of Engineers
1776 Niagara Street
Buffalo, New York 14207

Dear Colonel Johnson:

We have completed our review of the Draft Phase I General Design Memorandum (2 vols.) concerning the Presque Isle Peninsula, Erie, Pa. The project concerns the Cooperative Beach Erosion Control Project.

1. We have no objections to the proposal as it is presented in the Design Memorandum or the Impact Statement. We would classify the project in EPA's reporting category LO-1.

We thank you for the opportunity to review the documents and look forward to receiving the final reports.

Sincerely yours,

John R. Pomponio
Chief
EIS & Wetlands Review Section

U. S. ENVIRONMENTAL PROTECTION AGENCY

1. Thank you for your review. No response necessary other than to concur with your classification of the project.

Exhibit F-44 (Continued)

NCBED-DC 23 April 1980

Mr. John W. Brauns
1505 South Shore Drive
Erie, PA 16505

Dear Mr. Brauns:

This is in response to your letter dated 10 April 1980, in which you suggested using segmented breakwaters at Presque Isle Peninsula that are sine shaped in order to maintain fresh clean water behind the breakwaters.

As you are aware, the Phase I General Design Memorandum which was recently prepared for the Presque Isle beach erosion control project, recommends that a series of 58 breakwaters be constructed in Lake Erie offshore from Presque Isle Peninsula. Each breakwater segment would be 150 feet long, separated by a gap of 350 feet, and be positioned approximately 400 feet offshore. The breakwater system would extend from the west end of the peninsula eastward through Sunset Point. We feel that the breakwater plan would restore the beaches and provide permanent protection to the peninsula and its recreational facilities in the most economical and environmentally pleasing manner.

The breakwater plan will reduce the wave energy which reaches the shoreline by about one third. However, the 350-foot gap between breakwater segments will allow some wave action to impinge upon the entire length of shoreline and will generate an alongshore current 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 breakwater segments and assuring onshore-offshore water exchange. The generation of the alongshore current and return flows will allow sufficient water circulation such that sand and fresh water are provided behind each breakwater segment.

To analyze the effectiveness of the segmented breakwater plan, a model study is presently being initiated by the Corps of Engineers Waterways Experiment Station in Vicksburg, Mississippi. The model study will consist of reproducing, at an undistorted scale of 1:50, approximately 9,500 feet of peninsula shoreline and modeling underwater contours to about the 24-foot depth. The purpose of the model study will be to determine breakwater parameters such as length, height, orientation, optimum breakwater spacing and distance

NCBED-DC
Mr. John W. Brauns

offshore, the interactions between the proposed breakwaters and existing structures, the effects of the breakwaters on the littoral processes, and the potential for sand transport through the breakwater system. The model study will simulate various wave conditions and lake levels in order to determine the parameters which will provide the most effective wave attenuator and beach building plan.

Experience with offshore breakwaters has shown that structures, which are either aligned parallel to the shoreline or at a skew to face the direction of primary wave attack, will perform most satisfactorily in attenuating waves and protecting the backshore. The gaps between breakwaters in series will allow sufficient water circulation in the lee of structures to prevent degradation of water quality, especially stagnation which could be caused by improper water quality. Therefore, there would be no advantages to building sinusoidal shaped breakwaters as you suggest. In fact, the cost for implementing a plan with sine shaped breakwaters would probably be much greater than using straight breakwaters because of the additional material costs and additional engineering, design, and construction costs for laying out the plan.

I trust that this information meets your present needs. However, if you have any questions or desire further information, please feel free to contact my office.

Sincerely,

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

GEORGE P. JOHNSON
Colonel, Corps of Engineers
District Engineer

CF:
NCBED-D
NCBED-DC

Gorecki ________
Clark ________
Foley ________
Hallock/Liddell ________
Braun ________
Johnson ________

Exhibit F-45 (Continued)

WESHM

SUBJECT: Presque Isle Model Studies

Division Engineer
U. S. Army Engineer Division, North Central
ATTN: Mr. Larry Hiipakka
536 S. Clark Street
Chicago, IL 60605

1. Reference:

a. BERH-PLN letter, paragraph 6, dated 25 September 1980, subject: Phase I Report for Presque Isle, Pennsylvania.

b. Telephone conversations between Mr. Larry Hiipakka of the North Central Division (NCD) and Mr. C. E. Chatham of the Waterways Experiment Station (WES) on 3 and 9 October 1980.

2. Testing of the Presque Isle model is underway, with efforts to date being devoted to a qualitative reproduction of shoaling in the vicinity of the three experimental breakwaters constructed by the Buffalo District (NCB) in 1978. No definite conclusions have been reached during these early stages of testing, but it appears that the tests are satisfactorily reproducing the shoreline changes which have occurred during the past two years. Successful duplication of these changes substantiates our confidence in the model's ability to successfully predict the performance of the offshore breakwater plan. These tests will continue through October, and a meeting with NCD and NCB personnel is scheduled at WES on 27 and 28 October to discuss results.

3. Upon completion of the tests discussed above, we will initiate testing of the proposed offshore breakwater plan. Due to the highly successful performance of the experimental breakwaters, we do not anticipate that model test results will dictate major changes to this proposed plan of beach protection. Rather, we envision the model as a tool to

Exhibit F-46
Rev. November 1980

WESHH
SUBJECT: Presque Isle Model Studies

study, refine, and optimize the breakwater design (i.e., breakwater length, spacing between structures, interaction of breakwaters with existing groins, etc.). It is felt that continued careful monitoring of performance of the existing experimental breakwaters by NCB, along with model study results, will provide the information necessary to optimize what appears to be a technically sound basic design for mitigation of shoreline erosion problems at Presque Isle.

FOR THE COMMANDER AND DIRECTOR:

H. B. SIMMONS
Engineer
Chief, Hydraulics Laboratory

CF:
NCB, Attn: Denton Clark

DAT
ILM