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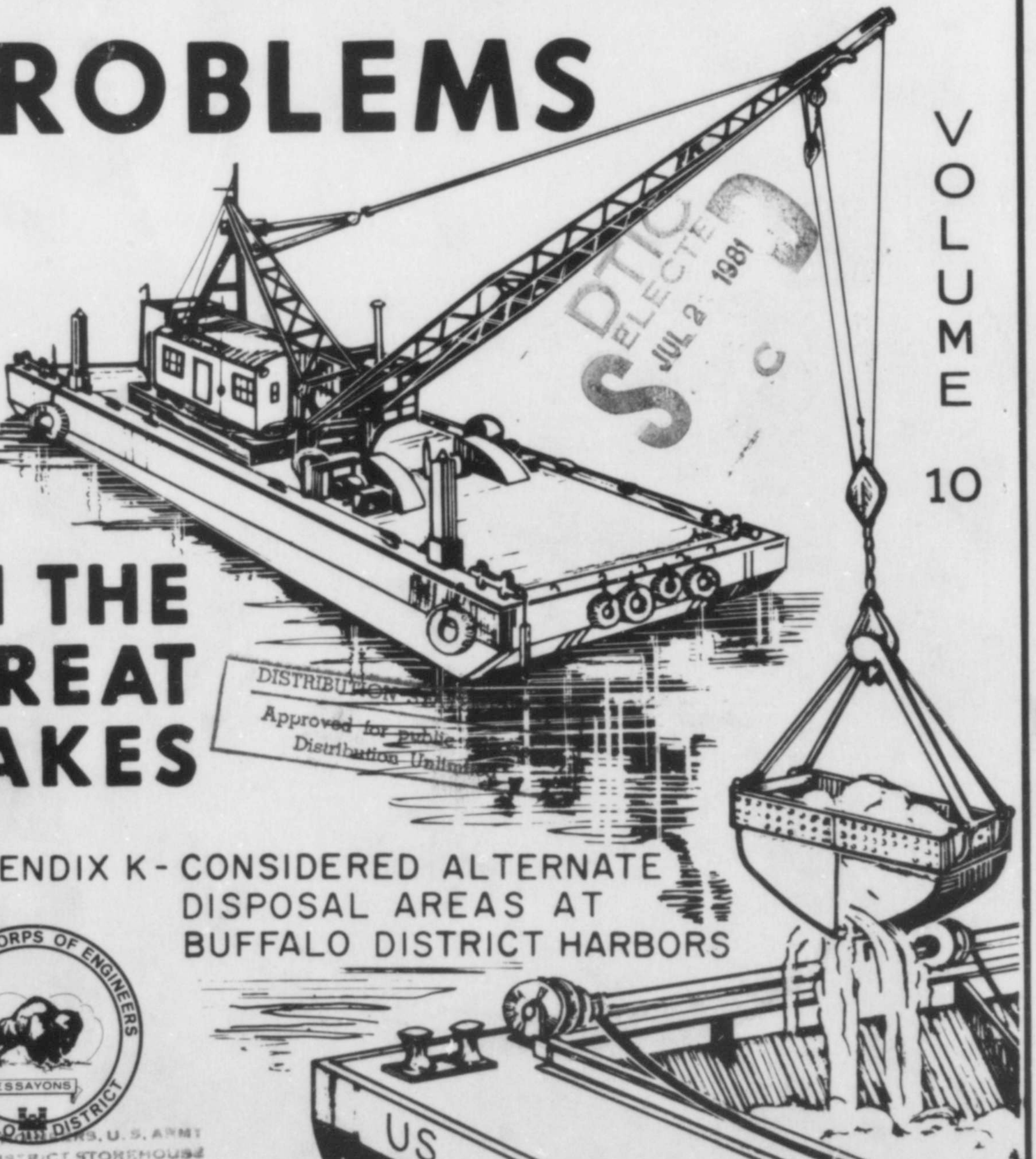
# DREDGING and WATER QUALITY PROBLEMS IN THE GREAT LAKES

VOLUME 10




APPENDIX K - CONSIDERED ALTERNATE DISPOSAL AREAS AT BUFFALO DISTRICT HARBORS

U. S. ARMY CORPS OF ENGINEERS
ESSAYONS
BUFFALO DISTRICT

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

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

The present report presents the results of a study conducted by the Corps of Engineers with cooperation of the Federal Water Pollution Control Administration to evaluate the effects of water quality of current dredging practices including the disposal of dredged material in unconfined open water areas of the Great Lakes, as well as to develop the most practical methods for management of pollution problems that may be identified as resulting from dredging operations on the Lakes. The investigations conducted during the study included contruction and operation of diked areas, treatment

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SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered) of the dredged material, modifications to dredge equipment and in dredging operations, functional studies of the effects on lake ecology of open-lake disposal, surveys of possible alterate disposal areas at 37 Great Lakes harbors and connecting channels, and an economic evaluation of benefits which might accrue from improved Great Lakes water quality.

APPENDIX K4

STUDY OF

ALTERNATE DISPOSAL AREAS

FOR

CONNEAUT HARBOR, OHIO



U. S. ARMY ENGINEER DISTRICT, BUFFALO
CORPS OF ENGINEERS
1776 NIAGARA STREET
BUFFALO, NEW YORK 14207



OCTOBER 1968

DREDGING AND WATER QUALITY PROBLEMS
IN
THE GREAT LAKES

APPENDIX K4

STUDY OF ALTERNATE DISPOSAL AREAS
FOR
CONNEAUT HARBOR, OHIO

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## APPENDIX K4 - CONNEAUT HARBOR

## LOCATION AND DESCRIPTION

1. Conneaut Harbor, Ohio is located at the mouth of Conneaut Creek, 73 miles east of Cleveland. The Conneaut Creek basin encompasses some 191 square miles. Details of the navigation project are shown in fig. K4-1.

2. The harbor is an important commercial port. The total waterborne commerce for 1966 amounted to 12,822,154 tons and for the 10-year period, 1957-1966, inclusive, has averaged 7,053,453 tons. The principal commodities handled in 1966 were: receipts of 7,079,613 tons of iron ore (55% of total commerce); shipments of 5,010,900 tons of bituminous coal (39%); and receipts of 731,286 tons of limestone (6%). A new coal loader of modern design was placed in service in 1965. It is estimated that future waterborne commerce will average about 7,100,000 tons annually.

## EXISTING CORPS OF ENGINEERS PROJECT

3. PROJECT

The existing project was authorized by the 1910, 1917, 1935, 1962 and 1966 River and Harbor Acts which provide for:

a. An outer harbor, the deepened portion of which is about 142 acres in area formed by a system of breakwaters comprising a west breakwater 5,938 feet long, connected with the shore, and an east breakwater 3,675 feet long with an extension 1,187 feet to shore with a circulation gap at the shoreward end of east breakwater.

b. A west breakwater pierhead of timber-crib substructure with concrete superstructure.

c. An east breakwater light foundation of concrete superstructure founded on the outer end of the rubble mound breakwater.

d. An entrance 600 feet wide between the west breakwater pierhead and the east breakwater light foundation.

e. The outer (lakeward) 300-foot long portion of west pier.

f. A depth of 28 feet in soft material and 29 feet in hard material in the eastern portion of the outer harbor, and for a depth of 22 feet in soft material and 23 feet in hard material in the remaining triangular area of the outer harbor.

g. An access channel 8 feet deep, 200 to 150 feet wide from the outer harbor to the city dock.

h. A depth of 27 feet in soft material and 28 feet in hard material in the inner harbor for a distance of 2,450 feet upstream of the outer end of the west pier.

i. A recreational small-boat harbor provided by: a stone dike about 2,200 feet long; access channels 6 feet deep, 2,800 feet long and 100 feet wide; and personnel guard rail on west breakwater lakeward of junction with dike.

## 4. PROGRESS

Contract operations for deepening the inner and outer harbor channels as authorized by 1962 River and Harbor Act have been completed. The construction of a recreational small boat harbor remains to be done to complete the project.

## 5. PROCEDURES

All project areas and channels are maintained annually by U.S. hopper dredges. Permit dredging is accomplished by clamshell dredges and dump scows.

## 6. WORKING SEASON

The available season for dredging work at Conneaut Harbor corresponds generally with the navigation season. In recent years the earliest and latest openings and closings of navigation were:

| | Opening | Closing |
|---|---|---|
| Earliest date | Apr 1 | Nov 29 |
| Latest date | Apr 19 | Dec 23 |

## 7. QUANTITY AND TYPE OF MATERIALS

During the past 10 years approximately 75,000 cubic yards has been dredged annually by hopper dredge in maintaining the outer harbor. Over the same period permit dredging has amounted to about 40,000 cubic yards annually. A 1960 modification of the project, recently completed, involved deepening and enlarging the outer harbor and deepening a portion of the river previously maintained under permit. As a result of the recently completed project modification future maintenance dredging will amount to 100,000 cubic yards annually and permit dredging about 15,000 cubic yards annually. The material removed during annual maintenance dredging is mostly sand and silt.

## 8. NATURE OF POLLUTION

The nature of pollution in Conneaut Creek is discussed in "Lake Erie Report, A Plan for Water Pollution Control", by FWPCA, dated August 1968. The report states that the lower reach of the creek receives the poorly treated wastes from the municipal treatment plant in Conneaut. Water in the upper reaches is relatively unpolluted except in the vicinity of Conneautville and Springboro, Pennsylvania.

## PRESENT DISPOSAL PRACTICE

9. METHOD OF DISPOSAL

Dredged material from the harbor is disposed of by bottom dumping, from hopper dredges or dump scows, into established open lake disposal areas.

10. DISPOSAL AREAS

There are two established open lake disposal areas in Lake Erie at Conneaut Harbor, one for earth and the other for rock. The earth disposal area is rectangular, 2 miles by 1¼ miles, and is located 4 miles, N 66° W, from the west breakwater light. The present practice is to spoil all material dredged from harbor maintenance and soft material dredged from authorized new work in the earth disposal area. The rock disposal area is the same size and is located 6 miles, N 63° W, from the west breakwater light. Hard and unclassified material removed during the recent deepening contract was disposed of in the rock disposal site. At present maintenance dredging rates it is estimated that the capacity of the earth disposal site is sufficient to serve for well over 200 years without impeding navigation.

11. COST OF DREDGING

The unit cost for maintenance dredging by hopper dredge, with disposal in the earth disposal area, is $0.40 per cubic yard.

## ALTERNATE DISPOSAL AREAS

12. GENERAL

A survey was made in 1968 to locate sites for diked disposal areas as an alternative to the present open water lake disposal for at least a 10-year period. The overall dredging disposal problem and the need for alternate disposal areas were discussed with city officials, representatives of the Conneaut Port Authority and local shipping interests. The only disposal areas suggested by local interests would conflict with plans for an authorized Corps of Engineers project, which would provide a small boat harbor on the west side of the harbor. The Conneaut Port Authority suggested three possible disposal sites within this area.

13. The materials dredged annually from Conneaut Harbor and Conneaut River channel consist of recently deposited material derived primarily from erosion of upstream land areas and stream banks, sand washed over the west breakwater, and various amounts of industrial and sanitary wastes. The suitability of this material for commercial landfill development projects is unknown at present. Several years of testing would be required to determine the long range strength characteristics of the material and its suitability for various types of development. However, any land areas created with dredged material could probably be used for recreational or agricultural purposes even if the material would not support structures.

14. A study of available information and a reconnaisance of the Conneaut area indicated several possible alternate disposal areas in addition to the ones suggested by local interests. Most of the land on the west side of the river is already developed. Land disposal areas, that would hold several years of dredging material, would have to be located on the east side of the river, which is essentially undeveloped. The entire area on the east side of the river is owned by U.S. Steel Company except for a few parcels owned by others. Three areas located along the shore, four off-shore areas and one inland area were considered as possible sites. A discharge piping system with booster pumps would be required to utilize

the inland site. The remaining sites could be reached by direct pump discharge from the hopper dredge. The sites are shown on fig. K4-2, and discussed individually in the following paragraphs.

15. SITE 1

This is a 155-acre site located between Woodworth Road and Thompson Road and about midway between the Bessemer and Lake Erie Railroad and the Penn-Central Railroad. The area appears to be undeveloped, partially wooded, with heavy brush over the remainder of the land. The land is generally high ground and slopes towards Lake Erie. The headwaters of a small creek that discharges into the lake, are located within the disposal site. The capacity of the site when filled to Elevation 643.5 is approximately one million cubic yards. This volume is equivalent to ten years of maintenance dredging material based on an average annual volume of 100,000 cubic yards. The considered plan for disposing of dredged materials at this site would provide a retention structure that incloses the area, an overflow structure to discharge effluent into the existing creek, a mooring facility in the harbor, and a piping system leading to the disposal area. The retention structure would consist of an earth dike about 9,000 feet in length and varying in height from 5 to 17 feet. The earth dike would be constructed from existing material within the disposal area. The overflow structure would consist of a 72-inch pipe constructed vertically in the dike, with removable flashboards framed into the landfill side, and discharge pipes that connect into the other side. The mooring facility would be provided on the harbor side of the existing east breakwater. It would incorporate the necessary equipment for making and handling flexible connections between the floating plant and the fixed discharge line leading to the disposal area. Dredged material from the river and harbor would be pumped from a hopper dredge, through an 18-inch piping system, into the disposal area. The discharge system would require two booster pumps to move the material through the 9,600-foot pipeline. Details for site 1 are shown in fig. K4-3. The haul distance from the outer dredging limit of the harbor approach channel to the mooring facility is a little over one-half mile. The distance from the upstream limit of dredging in the river to the mooring facility is a little under three-quarters of a mile. The open lake disposal area, currently being used, is located 4 miles from the harbor.

16. Representatives of U.S. Steel were contacted regarding the availability of site No. 1 or some adjacent area for spoil disposal. They would prefer not to have their property used for spoil disposal. The land will probably be used for future industrial development and they are concerned over the unknown strength characteristics of the spoil material.

17. SITE 2

This is an alongshore site located between the Conneaut East Breakwater and a point opposite the end of Thompson Road. The area extends out from the shoreline about 1200 feet. The adjacent shoreline property is undeveloped, consisting of a high bluff overlooking Lake Erie and a rough narrow beach. The Bessemer and Lake Erie Railroad parallels the shoreline for about half the length of the disposal area. The top of track bed is at least 15 feet higher than the proposed top of fill. Therefore, no encroachment upon the railroad right-of-way is anticipated. The major portion of the site is underwater. The capacity of the site when filled to a height of 6 feet above LWD is approximately one million cubic yards. This volume is equivalent to ten years of maintenance dredging material. The considered plan for disposing of dredged materials at this site would provide a retention structure that incloses the area, an overflow weir to discharge effluent into Lake Erie and a mooring facility on the harbor side of the breakwater. The retention structure would consist of a cellular sheet pile dike about 3800 feet in length and filled with granular materials. The dike would be constructed to a height of 15 feet above LWD to provide adequate protection against lake storms. The overflow weir would consist of removable flashboards framed between two sheet pile cells. The mooring facility would incorporate the necessary equipment for making and handling flexible connections between the floating plant and a fixed 18-inch discharge line leading to the disposal area. Details for site 2 are shown in fig. K4-4.

18. The only land required for site 2 would be a narrow strip of undeveloped shoreline. It was assumed that rights to this land could be purchased. Since the area to be filled, if this site were used, is mostly underwater, the land created would probably be owned by the State of Ohio. The unknown strength characteristics,of the filled area would probably limit its use to some form of recreational development.

19. SITE 3

This is an offshore site located on the lake side of the existing east breakwater near its outer end. The site is a semicircular area with a radius of about 830 feet. The capacity of the site when filled to a height of 5 feet above LWD is approximately one million cubic yards. This volume is equivalent to ten years of maintenance dredging material. The considered plan for disposing of dredged materials at this site would provide a retention structure that incloses the area, an overflow weir to discharge effluent into Lake Erie, and a mooring facility on the harbor side of the breakwater. The retention structure would consist of a cellular dike similar to the design for site 2, having a total length of about 2850 feet. A 7.0 foot thickness of graded filter material would be dumped along the lakeward slope of the existing breakwater within the disposal area to prevent the spoil from seeping through the existing rubble mound structure. The overflow structure and mooring facilities would be similar to the design for site 2. Details for site 3 are shown in fig. K4-5.

20. It is assumed that any land areas created by filling this site would become the property of the State of Ohio. Possible future uses would probably be limited to some form of recreational development. The site is presently limited

to access by water. There are no known objections to using this site for spoil disposal.

21. OTHER SITES INVESTIGATED

Site 4, shown in fig. K4-2, was considered a possible offshore site for disposal of dredged material. The site is similar in most respects to site 3. Since it is located adjacent to the west breakwater, the site has the advantage of direct land access via the breakwater. The completed land fill would be a useful addition to the authorized small boat harbor project. However, effluent discharges from the disposal area and possible obnoxious odors might be detrimental to a nearby bathing beach at Conneaut Park. The preliminary cost estimates for site 3 have indicated that offshore disposal areas are considerably more expensive than inland areas. Therefore, site 4 was not studied in detail.

22. Site 5 would be an alongshore disposal area adjacent to property used by the Pittsburgh and Conneaut Dock Company. Representatives of the company indicated that they had neither the need nor the desire for land expansion in the area. They were concerned as to whether or not the use of the area as a disposal site would be a benefit or a detriment to unforeseen future expansion of their dock facilities. Since the area is inside the protection of the harbor breakwaters, it could become valuable property for future harbor expansion. The location of the site is shown in fig. K4-2.

23. Sites 6, 7 and 8 were not seriously considered because they conflict with plans for a small boat harbor, which is an authorized Corps of Engineers project. The locations of these sites are also shown in fig. K4-2.

## ESTIMATES OF COSTS

24. GENERAL

Costs of the spoil retention structure, mooring facilities and spoil discharge system were estimated for each site. Land costs, where applicable, were included in the estimate for the retention structure. All costs were based on 1968 price levels. Salvage value for the two booster pumps was credited to the total cost of site 1. Salvage value of piping and mooring facilities was considered negligible at all sites. The construction period for both sites 2 and 3 was assumed to be two years. Total investment costs for these sites included interest on the first cost over half the construction period at 3-1/4 percent, the current Federal risk-free interest rate. Site 1 could be constructed in less than one year. Total investment was therefore equal to total first costs for this site. Land costs were included at rough appraised values. No salvage or value of lands after filling was considered as future use would probably be limited to agricultural or recreational purposes.

25. Annual costs for each site included interest at 3-1/4 percent on the total investment. The investment was amortized over the ten-year filling period for sites 2 and 3. The investment less salvage was amortized for site 1. Other annual charges included the cost of dredging 100,000 cubic yards of spoil material and disposal at the designated mooring site. Annual operation and maintenance costs were estimated for each site. Total annual costs were converted to a cost per cubic yard for comparison. Estimate for sites 1, 2 and 3 are shown in the following paragraphs.

26. Site 1

a. First Costs

| | |
|---|---|
| Spoil retention structures | $ 1,182,000 (1) |
| Mooring facilities | 143,000 |
| Spoil discharge system | 750,000 |
| Total Investment Cost | $ 2,075,000 |
| Salvage value | - 75,000 |
| Investment less Salvage | $ 2,000,000 |

b. Annual Costs

| | |
|---|---|
| Interest, $2,075,000 @ .0325 | $ 67,000 |
| Amortization, 10 yrs., $2,000,000 @ .0862 | 172,000 |
| Maintenance dredging, 100,000 c.y. @ $.40 | 40,000 |
| Operation and maintenance | 44,000 |
| Total Annual Cost | $ 323,000 |
| Cost per Cubic Yard | $ 3.23 |

(1) Predominantly land acquisition cost

27. Site 2

a. First Costs

| | |
|---|---|
| Spoil retention structures | $ 3,200,000 (1) |
| Mooring facilities | 135,000 |
| Spoil discharge system | 141,000 |
| Total First Cost | $ 3,476,000 |
| Interest during construction | 113,000 |
| Total Investment Cost | $ 3,589,000 |

b. Annual Costs

| | |
|---|---|
| Interest, $3,589,000 @ .0325 | $ 117,000 |
| Amortization, 10 yrs. $3,589,000 @ .0862 | 309,000 |
| Maintenance dredging, 100,000 c.y. @ $0.41 | 41,000 |
| Operation and maintenance | 8,000 |
| Total Annual Cost | $ 475,000 |
| Cost per Cubic Yard | $ 4.75 |

(1) Includes land acquisition cost

28. Site 3

a. First Costs

| | |
|---|---|
| Spoil retention structures | $ 5,040,000 |
| Mooring facilities | 120,000 |
| Spoil discharge system | 60,000 |
| Total First Cost | $ 5,220,000 |
| Interest during construction | 170,000 |
| Total Investment Cost | $ 5,390,000 |

b. Annual Costs

| | |
|---|---|
| Interest, $5,390,000 @ .0325 | $ 175,000 |
| Amortization, 10 yrs., $5,390,000 @ .0862 | 465,000 |
| Maintenance dredging, 100,000 c.y. @ $0.44 | 44,000 |
| Operation and maintenance | 9,000 |
| Total Annual Cost | $ 693,000 |
| Cost per Cubic Yard | $ 6.93 |

29. COST COMPARISONS

A summary of costs for three of the considered alternate disposal areas is shown below. The cost of disposal in the open lake disposal area is shown for comparison purposes.

| Site | Capacity Cu. Yds. | Capacity Years | Cost per cubic yard ($) |
|---|---|---|---|
| Open lake | – | 200+ | 0.40 |
| 1 | 1,000,000 | 10 | 3.23 |
| 2 | 1,000,000 | 10 | 4.75 |
| 3 | 1,000,000 | 10 | 6.93 |

## DISCUSSION

30. The considered alternate disposal sites were sized to handle the estimated future volume of maintenance dredging spoil only, 100,000 cubic yards annually. It was assumed that permit dredging, estimated at 15,000 cubic yards annually, could be disposed of at the same sites if necessary. Since costs per cubic yard are being compared this analysis is considered adequate.

31. The least costly alternate disposal area at Conneaut Harbor would be a landfill site. Site 1 was the only landfill site considered although adjacent areas could have been found where costs would be in the same range. The owner of most of the land required for site 1 has expressed an objection to use of the land as an alternate disposal site.

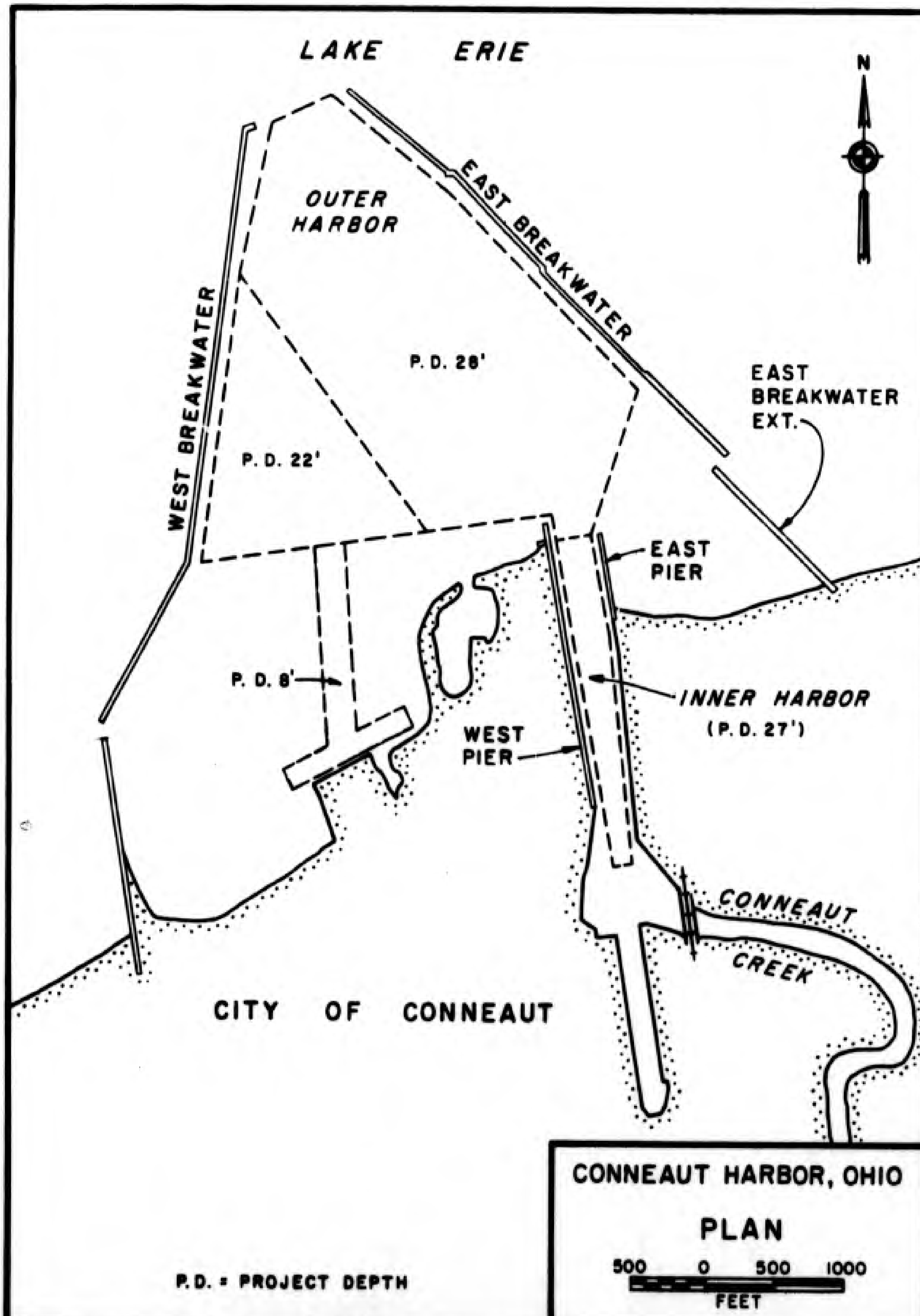

LAKE ERIE
N
OUTER HARBOR
EAST BREAKWATER
WEST BREAKWATER
P. D. 28'
P. D. 22'
EAST BREAKWATER EXT.
EAST PIER
P. D. 8'
INNER HARBOR (P. D. 27')
WEST PIER
CONNEAUT CREEK
CITY OF CONNEAUT
P.D. = PROJECT DEPTH
CONNEAUT HARBOR, OHIO
PLAN
500 0 500 1000
FEET

FIG. K4-1

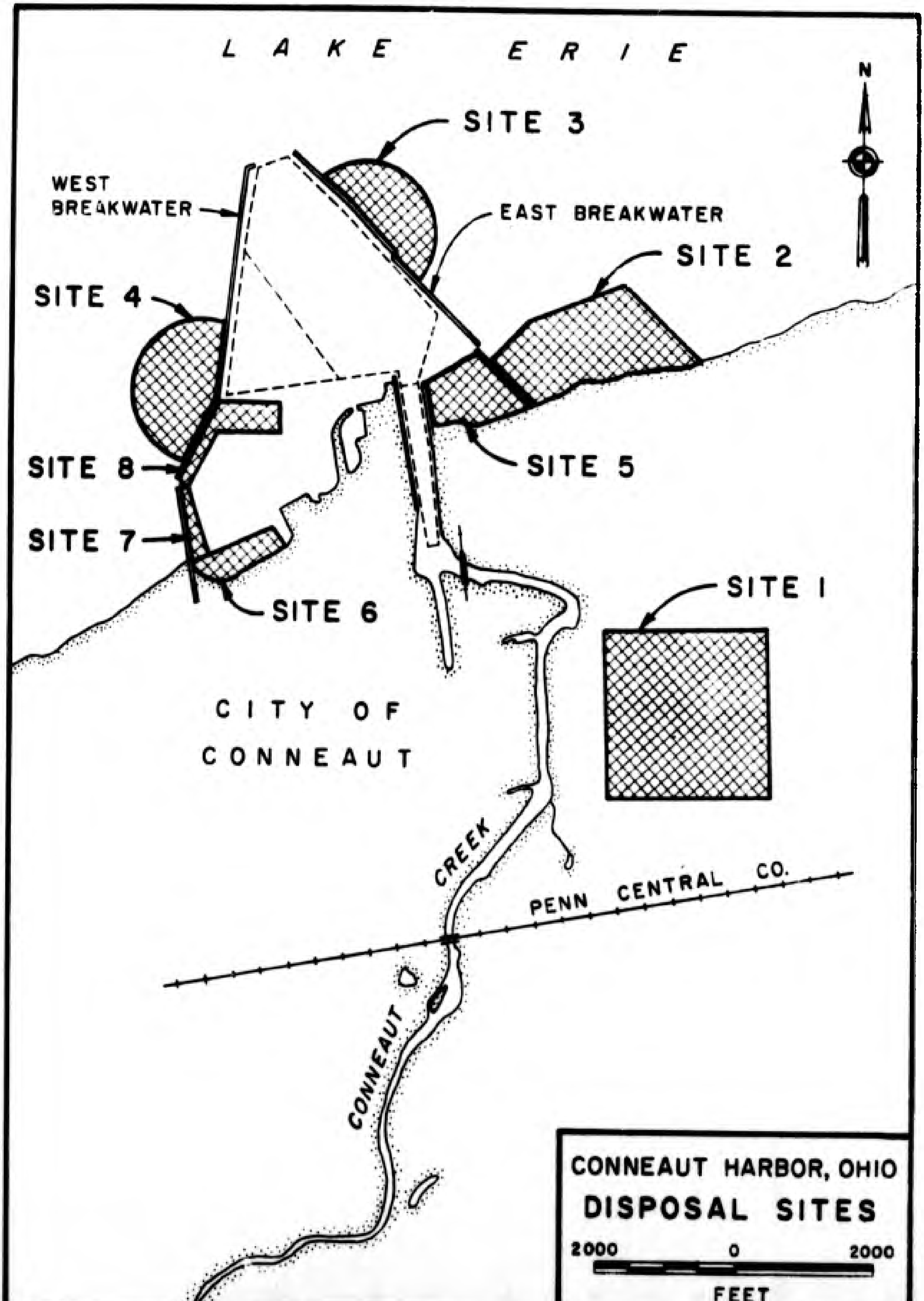

LAKE ERIE
N
SITE 3
WEST BREAKWATER
EAST BREAKWATER
SITE 2
SITE 4
SITE 8
SITE 5
SITE 7
SITE 6
SITE 1
CITY OF CONNEAUT
CONNEAUT CREEK
PENN CENTRAL CO.
CONNEAUT HARBOR, OHIO
DISPOSAL SITES
2000 0 2000
FEET

FIG. K4-2

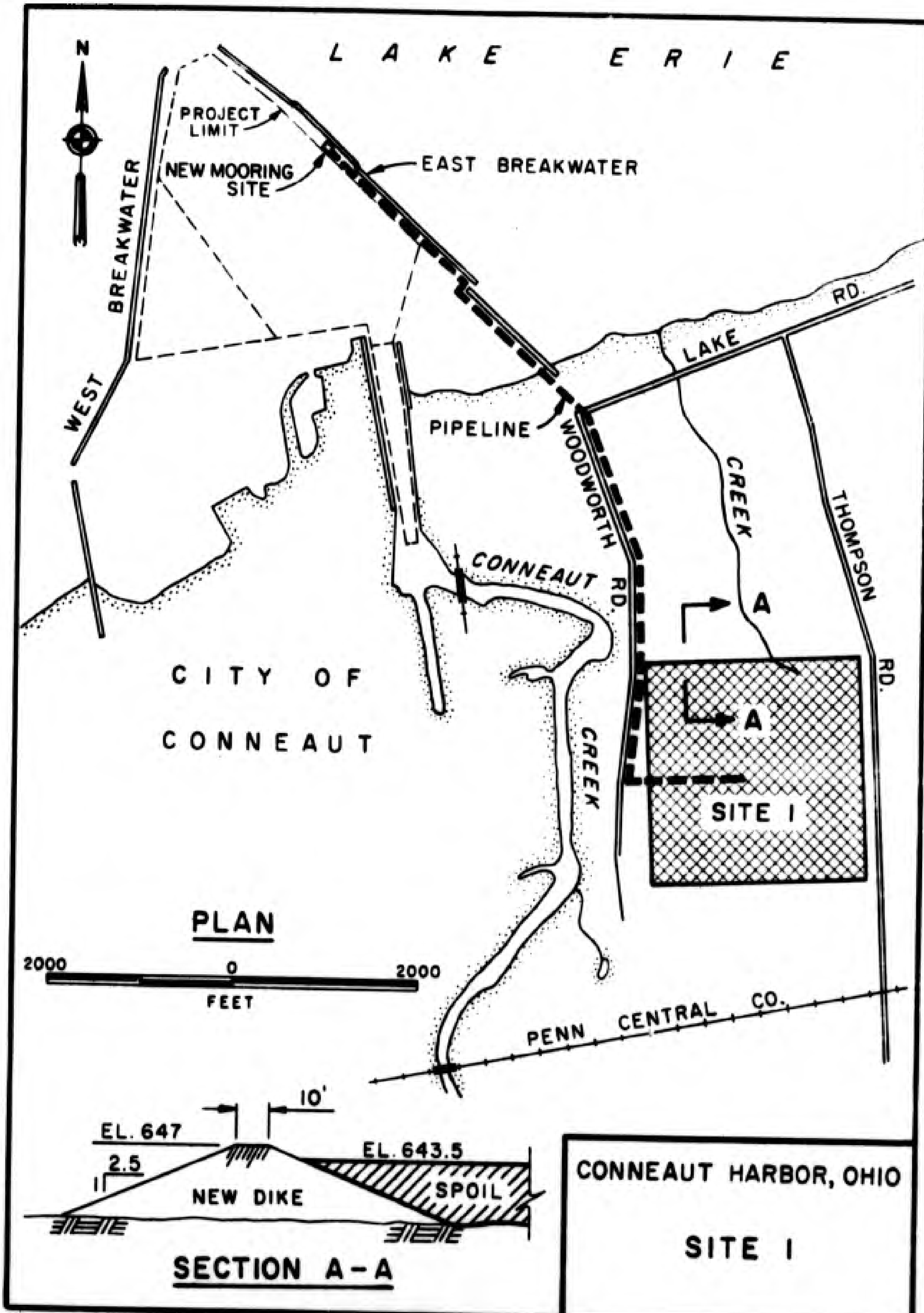
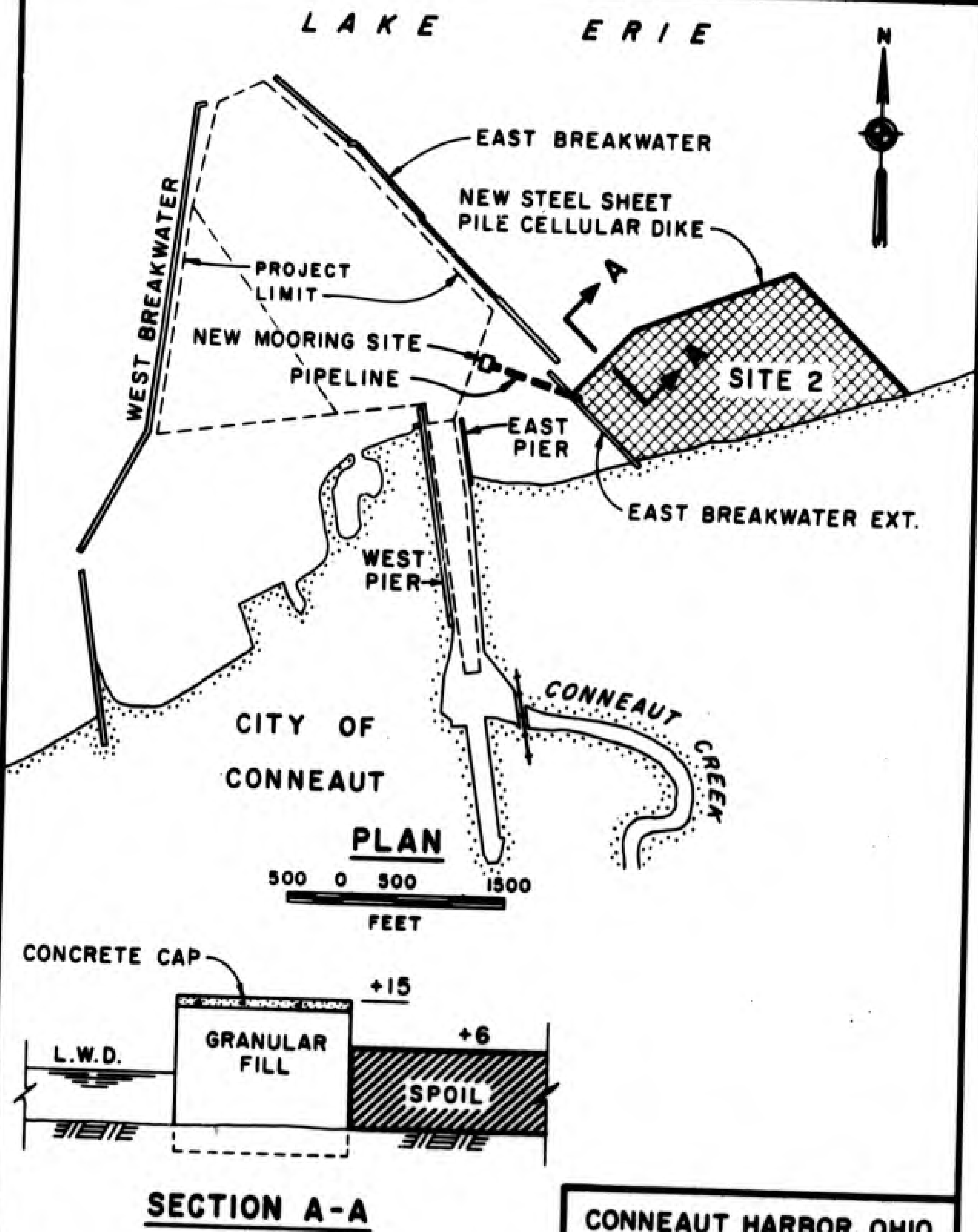

N
LAKE ERIE
PROJECT LIMIT
NEW MOORING SITE
EAST BREAKWATER
WEST BREAKWATER
PIPELINE
LAKE RD.
WOODWORTH RD.
CREEK
THOMPSON RD.
CONNEAUT CREEK
A
A
SITE I
CITY OF CONNEAUT
PLAN
2000
0
2000
FEET
PENN CENTRAL CO.
10'
EL. 647
EL. 643.5
2.5
1
NEW DIKE
SPOIL
SECTION A-A
CONNEAUT HARBOR, OHIO
SITE I

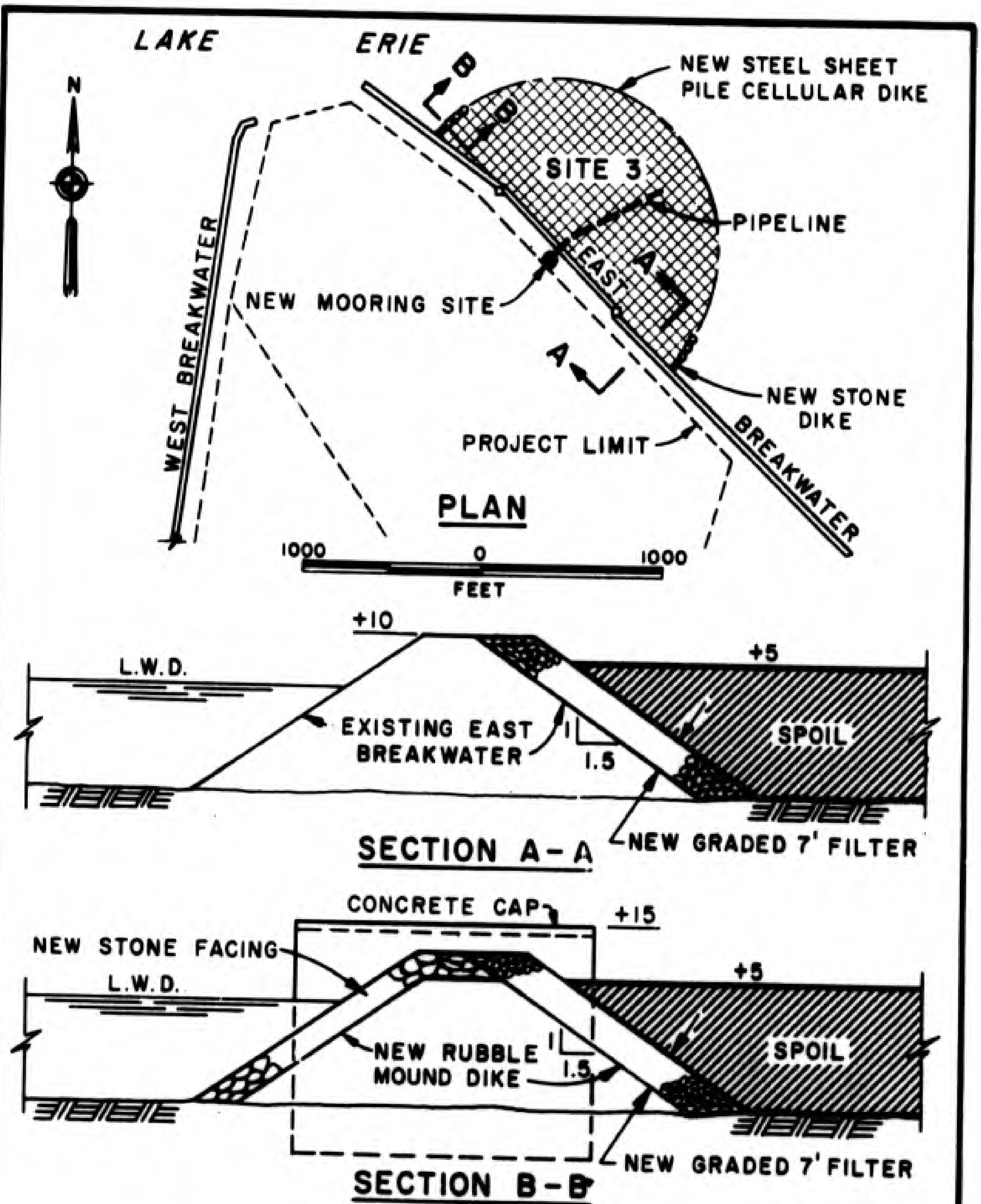
FIG. K4-3




CONNEAUT HARBOR, OHIO

SITE 2

FIG. K4-4




CONNEAUT HARBOR, OHIO

SITE 3

FIG. K4-5

APPENDIX K5

STUDY OF

ALTERNATE DISPOSAL AREAS

FOR

ERIE HARBOR, PENNSYLVANIA

U. S. ARMY ENGINEER DISTRICT, BUFFALO
CORPS OF ENGINEERS
1776 NIAGARA STREET
BUFFALO, NEW YORK 14207

OCTOBER 1968

DREDGING AND WATER QUALITY PROBLEMS
IN
THE GREAT LAKES

APPENDIX K5

STUDY OF ALTERNATE DISPOSAL AREAS
FOR
ERIE HARBOR, PENNSYLVANIA

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# APPENDIX K5 - ERIE HARBOR

## LOCATION AND DESCRIPTION

1. Erie Harbor, Pennsylvania is located on the southerly side of the bay formed by Presque Isle Peninsula, 78 miles west of Buffalo Harbor. Details of the navigation project are shown in fig. K5-1.

2. The harbor is a deep-draft commercial port. The total waterborne commerce for 1966 amounted to 975,187 tons, and for the 10-year period, 1957-1966, inclusive, has averaged 2,905,278 tons. The principal commodities in 1964 were: receipts and shipments of 335,403 tons of sand and gravel (34%); receipts of 294,694 tons of limestone (30%); and overseas imports and exports of 8.067 tons of general cargo. Shipment of coal was discontinued in 1965. Future waterborne commerce is estimated to be 750,000 tons annually.

## EXISTING CORPS OF ENGINEERS PROJECT

3. PROJECT

The existing project was authorized by the 1824, 1899, 1910, 1922, 1935, 1945, 1954, 1960, and 1962 River and Harbor Acts which provide for:

a. An entrance channel 29 feet deep, from the 29-foot contour in Lake Erie to a point opposite the inner end of the north pier, 500 feet wide lakeward of the piers and 300 feet wide between the piers, and within the harbor 28 feet deep in soft material and 29 feet in hard material, 300 feet wide, from the inner end of the north pier to the 28-foot deep harbor area at the easterly ore dock.

b. A harbor basin adjacent to the easterly ore dock, irregularly shaped, 28 feet deep in soft material and 29 feet deep in hard material, generally 1,500 feet wide, extending from the entrance channel to a line 50 feet outside of the United States harbor line at the ore terminal.

c. Adjacent to the southerly limit of the 28-foot harbor basin an irregularly shaped approach area to the Erie International Marine Terminal No. 1 to depths of 27 feet in soft and 28 feet in hard material.

d. A harbor area 21 feet deep, immediately adjacent to the 28-foot and 27-foot deep harbor basins, extending westerly therefrom 1,200 feet to a line perpendicular to the harbor line 200 feet west of the city dock, and extending southerly from the 23-foot deep approach channel, to a line 50 feet from the United States harbor line at the city dock.

e. An additional harbor area 18 feet deep, of about 35 acres, extending westerly from the 21-foot area and northerly from the harbor line off the public dock, to natural deep water in the bay.

f. An approach channel, 23 feet deep and 300 feet wide, from the 28-foot deep harbor area to and including a turning basin adjacent to the westerly docks, 23 feet deep, 1,200 feet long and 1,000 feet wide.

g. Harbor entrance piers 360 to 450 feet apart extending to the 14-foot contour in the lake, the north pier 3,248 feet long and the south pier 2,215 feet long, further extension lakeward of the north pier to be made when required to meet advance of said contour.

h. A south breakwater 1,200 feet long (original length, 2,530 feet) extending from the inner end of the south pier toward the mainland, to maintain a closure at the eastern end of the harbor and for plant growth and emergency protection work in the peninsula.

4. PROGRESS

The existing project is 41% completed. Contract operations for deepening the approach channel to the Erie International Marine Terminal No. 1, as authorized by the 1962 R & H Act, were initiated in June 1966 and completed in August 1966. The work remaining to be done to complete the project consists of: completion of deepening of the strips adjacent to the north and south piers, as authorized by the 1960 River and Harbor Act, which is to be restudied; deepening of the channel and basin at the westerly end of the harbor, as authorized by the 1945 River and Harbor Act, which is considered inactive; and, the conditional extension of the north pier, as authorized by the 1899 River and Harbor Act, which is to be restudied.

## PRESENT DREDGING PRACTICES

5. PROCEDURES

The project areas and channels are maintained annually by U. S. hopper dredges. A clamshell dredge and dump scows are used for permit dredging.

6. WORKING SEASON

The available season for dredging work at Erie Harbor corresponds generally with the navigation season. In recent years the earliest and latest opening and closing of navigation at the harbor were:

| | Opening | Closing |
|---|---|---|
| Earliest date | Mar 10 | Dec 4 |
| Latest date | Apr 21 | Dec 23 |

7. QUANTITY AND TYPE OF MATERIAL

During the past 10 years the volume of material removed annually to maintain this project is 182,000 cubic yards. However, during this period the harbor entrance channel, in which the bulk of the maintenance effort is needed, was deepened. Consequently, it is estimated that, in the future, maintenance dredging volumes will average about 300,000 cubic yards annually. Permit dredging by terminal operators to maintain dockside depths amounts to about 15,000 cubic yards annually. The material dredged consists primarily of sand and silt which has been deposited since the area was last dredged.

8. NATURE OF POLLUTION

The nature of pollution in Erie Harbor and at the adjacent Presque Isle State Park is discussed in a report by FWPCA entitled "Lake Erie Report, A Plan for Water Pollution Control," dated August 1968. The report states that foam, foul odor, and black-brown discoloration are much in evidence for ten mile downshore from Hammermill Paper Company's discharge to Lake Erie under the prevailing westerly wind. The paper company is located a short distance east of Erie Harbor and is shown in fig. K5-1. Three polluted streams flow through Erie to the harbor and receive the combined sewer overflow and storm water discharges from the Erie collection system. Bottom deposits in the harbor at the mouth of these streams are a brownish-black combination of mud, silt and detritus. Sewer and chemical odors eminate from sediments taken the bottom, inside and outside of the harbor.

## PRESENT DISPOSAL PRACTICE

9. METHOD OF DISPOSAL

Dredged material from the harbor is disposed of by bottom dumping, from hopper dredges or dump scows, into an established open lake disposal area.

10. DISPOSAL AREA

All material is now dumped in an area 1 mile square, located 3 miles due north from Erie Harbor entrance lighted buoy No. 2. At present dredging rates it is estimated that the capacity of this disposal area is sufficient to serve for nearly 60 years without impeding navigation.

11. COST OF DREDGING

The unit cost for harbor maintenance by hopper dredge is $0.38 per cubic yard.

## ALTERNATE DISPOSAL AREAS

12. A survey was made in 1968 to locate diked disposal areas as an alternative to the present open lake disposal practice for at least a 10-year period. Possible disposal areas were discussed with City officials, a representative of Interlake Steel Company, Presque Isle State Park officials and representatives of other State agencies. As a result of these discussions, four sites were selected for further study. One site was a small land disposal area and the other three were alongshore sites. Future plans of the various agencies involved were given due consideration in the design of the four sites. The location of each site is shown in Fig. K5-2 and discussed individually in the following paragraphs.

13. SITE 1

This is an alongshore site adjacent to Front Street that would be constructed between an existing railroad pier to the west and the Rubberoid Company's property to the east. The site would extend out to the U. S. Harbor Line about 1,600 feet from the existing shore line. It would have a capacity, when filled to an elevation of 10 feet above LWD, of three million cubic yards. This volume is equivalent to ten years of maintenance dredgings. A stone dike, about 4,600 feet long, would be constructed on the harbor side of the site. It was assumed that effluent would be lost by seepage through the dike. The average hauling distance, from the harbor to the disposal site, is about one mile. The haul distance to the open lake disposal area varies from three to six miles. Mooring facilities would be provided at some point along the dike and spoil would be pumped directly into the disposal area. Details for Site 1 are shown in Fig. K5-3.

14. The existing waterfront extending from the City's waterworks pumping station to the Pennsylvania Railroad's Dock No. 4 is undeveloped except for a few dilapidated structures used as boat houses. They are leased by the city at low rates to private operators who provide services to small boats. In a report entitled "Port of Erie Waterfront Development Plan", April 1968, prepared for the City of Erie by a consulting firm, this general area was discussed. The city is interested in having the area filled and eventually used for commercial or recreational purposes. The site shown in the consultants report is somewhat smaller than Site 1. The western boundary would be located 650 feet east of the railroad pier to provide room for a proposed small boat marina and the eastern boundary would be at the waterworks pumping station.

The outer limit would be about 500 feet inside the U. S. Harbor Line. The western boundary of Site 1 would extend to the railroad pier and would no doubt preclude the city's plans for a small boat marina at that location. In addition the eastern boundary would extend to the property owned by the Rubberoid Co.. If the western boundary of Site 1 were moved 650 feet east to provide room for the marina, the capacity of the site would be limited to seven years of maintenance dredging material. To provide capacity for 10 years and leave room for the marina, the depth of fill would be raised to about 16 feet above LWD. Either modification would increase the cost per cubic yard considerably.

15. SITE 2

This is an offshore site that would be constructed on underwater property owned by the Interlake Steel Corporation. It would be bounded on the north by the south pier of the entrance channel, on the east by a cellular dike structure, and on the south and west by waterfront property owned by the steel corporation. The capacity of the site, when filled to a height of eight feet above LWD, is 2,700,000 cubic yards. This volume is equivalent to nine years of maintenance dredging. The dike would be a 4,300-foot cellular steel structure, filled with granular material, and capped with concrete. The existing south pier of the entrance channel would be strengthened with sheet piling and a new concrete deck. An overflow structure would be provided by constructing a waste weir between two cells in the east dike to discharge effluent into the harbor. A mooring facility and booster pump would be provided on the reconstructed south pier. Spoil would be pumped directly from the dredge to the disposal area. The hauling distance to the site averages less than one mile. Details for Site 2 are shown in Fig. K5-4.

16. Interlake Steel Corporation was contacted regarding the availability of Site 2 for spoil disposal. The underwater property is not being used at the present time and future plans for the site are indefinite.

17. SITE 3

This is a small land disposal site on the Presque Isle peninsula. The site is a 7-acre basin filled with water about 20 feet deep. At one time it was a part of the city water supply system and is now abandoned. The site would hold about 200,000 cubic yards of fill which is less than the volume of annual maintenance dredging for one year. The State Park officials have requested that the site be filled with maintenance dredging spoil to a depth three feet below the water line. A similar basin adjacent to site 3 is used by the State Fish Commission and is not available for spoil disposal. A temporary mooring facility would be constructed 2,300 feet offshore and spoil would be pumped to the basin through a piping system placed on the harbor bottom. A booster pump would be required at the mooring site. Shallow water depths would prevent the dredge from mooring closer to the site. Effluent would be discharged to the harbor through an existing overflow line. No dikes or retention structures would be required. Details for the site are shown in fig. K5-5.

18. The State Park authorities would like to use site 3 for ice skating during the winter months. By filling the basin to within three feet of the water surface, the water would freeze faster and it would be less dangerous. Park authorities expressed some concern over the possibility of polluting the nearby recreational facilities.

19. SITE 4

This is an alongshore site located on the harbor side of the Presque Isle peninsula. The underwater land and adjacent shoreline is owned by the State of Pennsylvania. The site has been used in the past as a sand borrow area. Several deep holes were excavated and a serious erosion problem now exists. The capacity of the site would be three million cubic yards when filled to a depth of five feet above LWD. This volume is equivalent to ten years of maintenance dredging. The harbor side of the 200-acre site would be inclosed by a quarry stone dike. It was assumed that effluent would be lost by seepage through the dike. Mooring facilities would be constructed offshore due to shallow water depths. Spoil would be pumped through an 18-inch pipeline supported above the water surface by steel pile bent structures. A booster pump would be required at the mooring site. The cost of dredging and maintaining a channel from the harbor to the spoil area so that the dredge could pump directly to the spoil area might prove to be slightly less expensive. This operating procedure should be investigated if actual construction is contemplated. Details for site 4 are shown in fig. K5-6

20. State Park authorities suggested that site 4 be used for spoil disposal. They would prefer to have only the deep holes filled and eventually use the inclosed water area for a small-boat marina. A plan that would fill the site to a depth of nine feet below LWD was considered.

It would hold the maintenance dredging spoil for only about two years. The cost of this plan was estimated and found to be about $7.00 per cubic yard. Since this was considerably more than the cost of other sites, no further consideration was given to the two-year plan. The ten-year plan at site 4 would create a new land area that could probably be used for additional recreational facilities or provide a parking area after a stabilization period. Park authorities have expressed concern over the possibility of the fill polluting existing recreational facilities.

## ESTIMATES OF COSTS

21. GENERAL

Costs of the spoil retention structure, mooring facilities and spoil discharge system were estimated for each site. Land costs for site 2 were included in the estimate for the retention structure. It was assumed that these would be no land costs for the other sites. All costs were based on 1968 price levels. Salvage value for a booster pump was credited to the total cost of sites 2, 3 and 4. Salvage value of piping and mooring facilities was considered negligible at all sites. The construction period for site 2 was assumed to be two years. Total investment cost for this site included interest on the first cost over half the construction period at 3-1/4 percent, the current Federal risk-free interest rate. The other sites could be constructed in less than one year. Total investment was therefore equal to total first costs for these sites. Future land use benefits were not evaluated because of the unknown strength characteristics of the land fill areas.

Annual costs for each site included interest at 3-1/4 percent on the total investment. The investment was amortized over the filling period for site 1. The investment less salvage was amortized for sites 2, 3 and 4. Other annual charges included the cost of dredging 300,000 cubic yards of spoil material and disposal at the designated mooring site. The unit cost would vary with the distance to the disposal area and the method of disposal.

22.

It was assumed that maintenance of the stone dikes, for sites 1 and 4, would probably be required for some unknown period after filling. Wave action is expected to cause periodic damage to the dikes. Repairs should be effected as pollution abatement measure until such time as the fill has stabilized. It was assumed that maintenance would be required for 10 years after the site is filled. The annual maintenance over the total maintenance period was converted to a present worth value and amortized over the filling period. Cost estimates for individual sites are shown in the following paragraphs.

23. Site 1

a. First Costs

| | |
|---|---|
| Spoil retention structures | $ 2,640,000 |
| Mooring facilities | 140,000 |
| Spoil discharge system | 90,000 |
| Total Investment Cost | $ 2,870,000 |

b. Annual Costs

| | |
|---|---|
| Interest, $2,870,000 @ .0325 | $ 93,000 |
| Amortization, 10 yrs., $2,870,000 @ .0862 | 247,000 |
| Maintenance dredging, 300,000 c.y. @ $0.67 | 201,000 |
| Operation and maintenance | 40,000(1) |
| Total Annual Cost | $ 581,000 |
| Cost per Cubic Yard | $ 1.94 |

(1) Includes $10,000 annually for 18 years for maintenance of the stone dike, which is equivalent to $17,000 annually for 10 years. ($10,000 x 14.539 x .1187)

24. Site 2

a. First Costs

| | |
|---|---|
| Spoil retention structures | $ 9,910,000 (1) |
| Mooring facilities | 20,000 |
| Spoil discharge system | 320,000 |
| Total First Cost | $ 10,250,000 |
| Interest during construction | 330,000 |
| Total Investment Cost | $ 10,580,000 |
| Salvage Value | - 40,000 |
| Investment less Salvage | $ 10,540,000 |

b. Annual Costs

| | |
|---|---|
| Interest, $10,580,000 @ .0325 | $ 344,000 |
| Amortization, 9 yrs., $10,540,000 @ .0974 | 1,027,000 |
| Maintenance dredging, 300,000 c.y. @ $0.54 | 162,000 |
| Operation and maintenance | 84,000 |
| Total Annual Cost | $ 1,617,000 |
| Cost per Cubic Yard | $ 5.39 |

(1) Includes land costs.

25. Site 3

a. First Costs

| | |
|---|---|
| Spoil retention structures | $ 0 |
| Mooring facilities | 143,000 |
| Spoil discharge system | 481,000 |
| Total Investment Cost | $ 624,000 |
| Salvage valve | - 140,000 |
| Investment less Salvage | $ 484,000 |

b. Annual Costs

| | |
|---|---|
| Interest, $624,000 @ .0325 | $ 20,000 |
| Amortization, 1 yr., $484,000 @ 1.000 | 484,000 |
| Maintenance dredging, 200,000 c.y. @ $0.80 | 160,000(1) |
| Operation and maintenance | 41,000 |
| Total Annual Cost | $ 705,000 |
| Cost per Cubic Yard | $ 3.53 |

(1) Note: Site 3 will hold only about two-thirds of one years maintenance dredging.

26. Site 4

a. First Costs

| | |
|---|---|
| Spoil retention structures | $ 2,280,000 |
| Mooring facilities | 130,000 |
| Spoil discharge system | 710,000 |
| Total Investment Cost | $ 3,120,000 |
| Salvage Value | - 40,000 |
| Investment less Salvage | $ 3,080,000 |

b. Annual Costs

| | |
|---|---|
| Interest, $3,120,000 @ .0325 | $ 101,000 |
| Amortization, 10 yrs., $3,080,000 @ .0862 | 265,000 |
| Maintenance dredging, 300,000 c.y. @ $0.80 | 240,000 |
| Operation and maintenance | 113,000(1) |
| Total Annual Cost | $ 719,000 |
| Cost per Cubic Yard | $ 2.40 |

(1) Includes $17,000 annually for 20 years for maintenance of the stone dike, which is equivalent to $29,000 annually for 10 years ($17,000 x 14.539 x .1187)

## 27. COST COMPARISONS

A summary of costs for the four sites considered is shown below in tabular form. The cost of open lake disposal is shown for comparison.

| Site | Capacity Cu. yds. | Capacity Years | Cost per cubic yard ($) |
|---|---|---|---|
| Open lake | - | 60 | 0.38 |
| 1 | 3,000,000 | 10 | 1.94 |
| 4 | 3,000,000 | 10 | 2.40 |
| 3 | 200,000 | 1- | 3.53 |
| 2 | 2,700,000 | 9 | 5.39 |

## DISCUSSION

28. The considered alternate disposal sites were sized to handle up to ten years of future maintenance dredging spoil only, estimated at 300,000 cubic yards annually. It was assumed that future permit dredging, about 15,000 cubic yards annually, could be disposed of by using the same sites if necessary. Since costs per cubic yard are being compared, this method of analysis is considered adequate.

29. The least costly plan would utilize site 1 for the entire ten-year period. The plan is generally compatible with future development plans of the City of Erie except for a considered small-boat marina which would be excluded by the use of site 1.

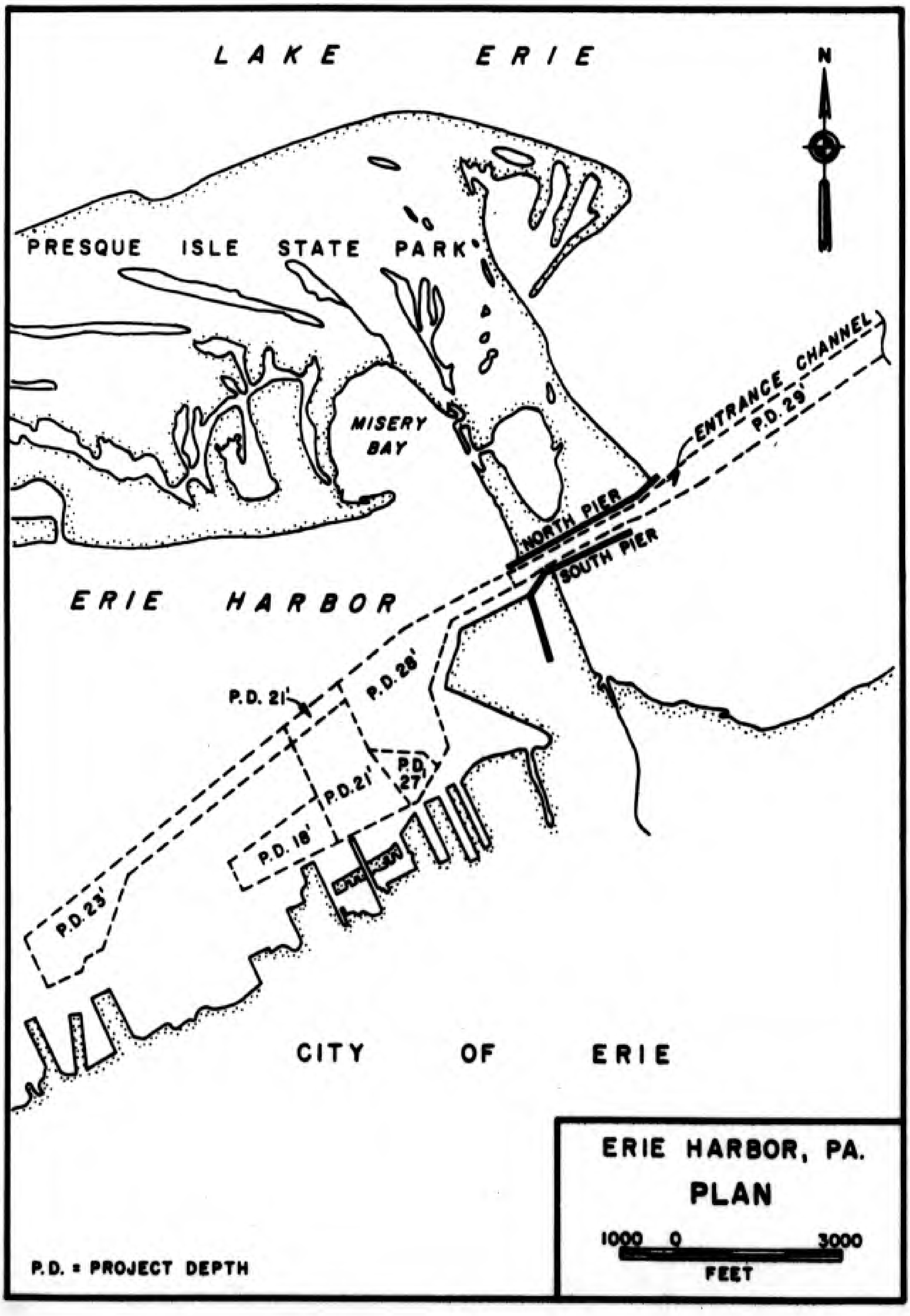

LAKE ERIE
N
PRESQUE ISLE STATE PARK
MISERY BAY
ENTRANCE CHANNEL
P.D. 29'
NORTH PIER
SOUTH PIER
ERIE HARBOR
P.D. 28'
P.D. 21'
P.D. 21'
P.D. 27'
P.D. 18'
P.D. 23'
CITY OF ERIE
ERIE HARBOR, PA.
PLAN
1000 0 3000
FEET
P.D. = PROJECT DEPTH

FIG. K5-1

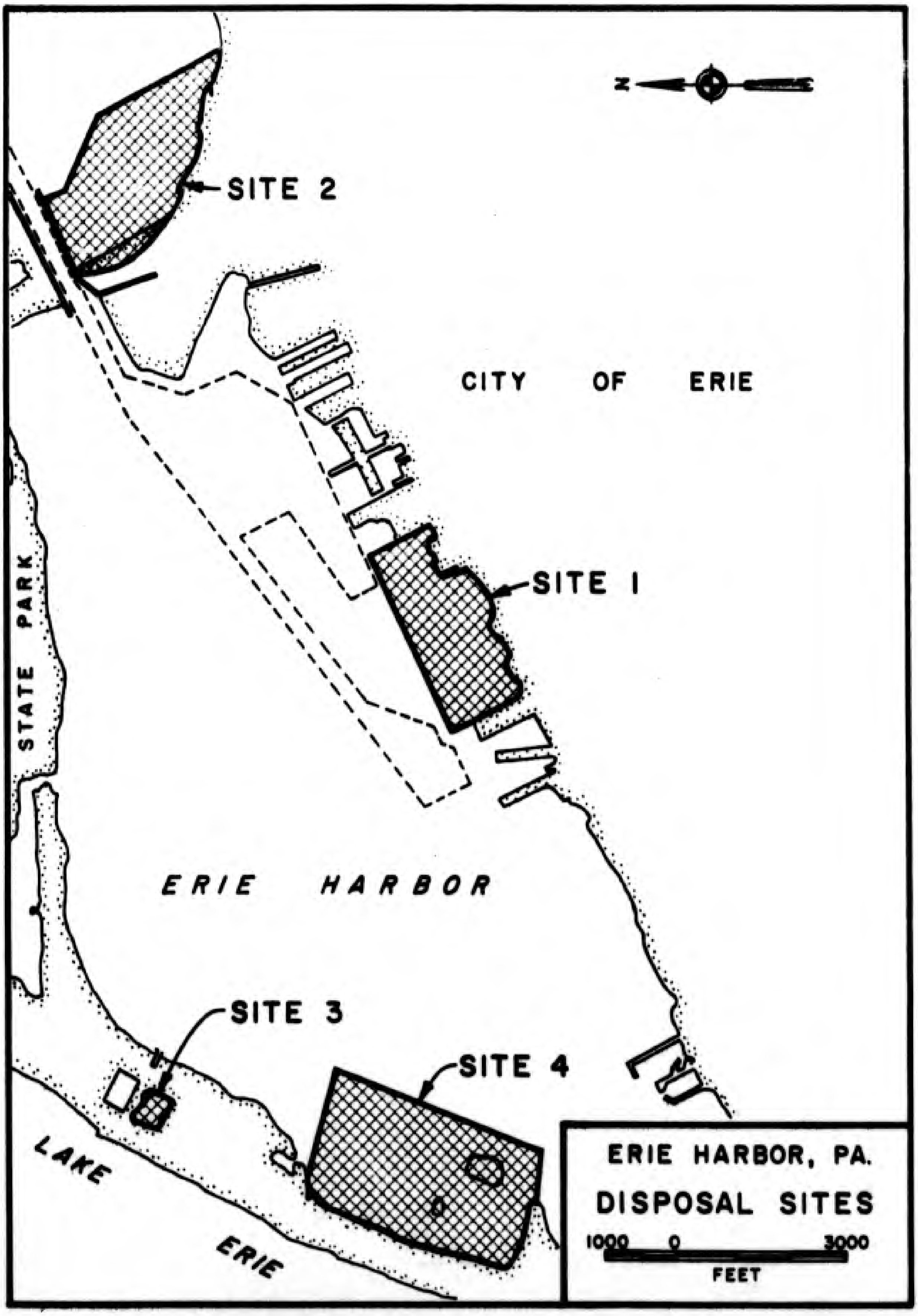
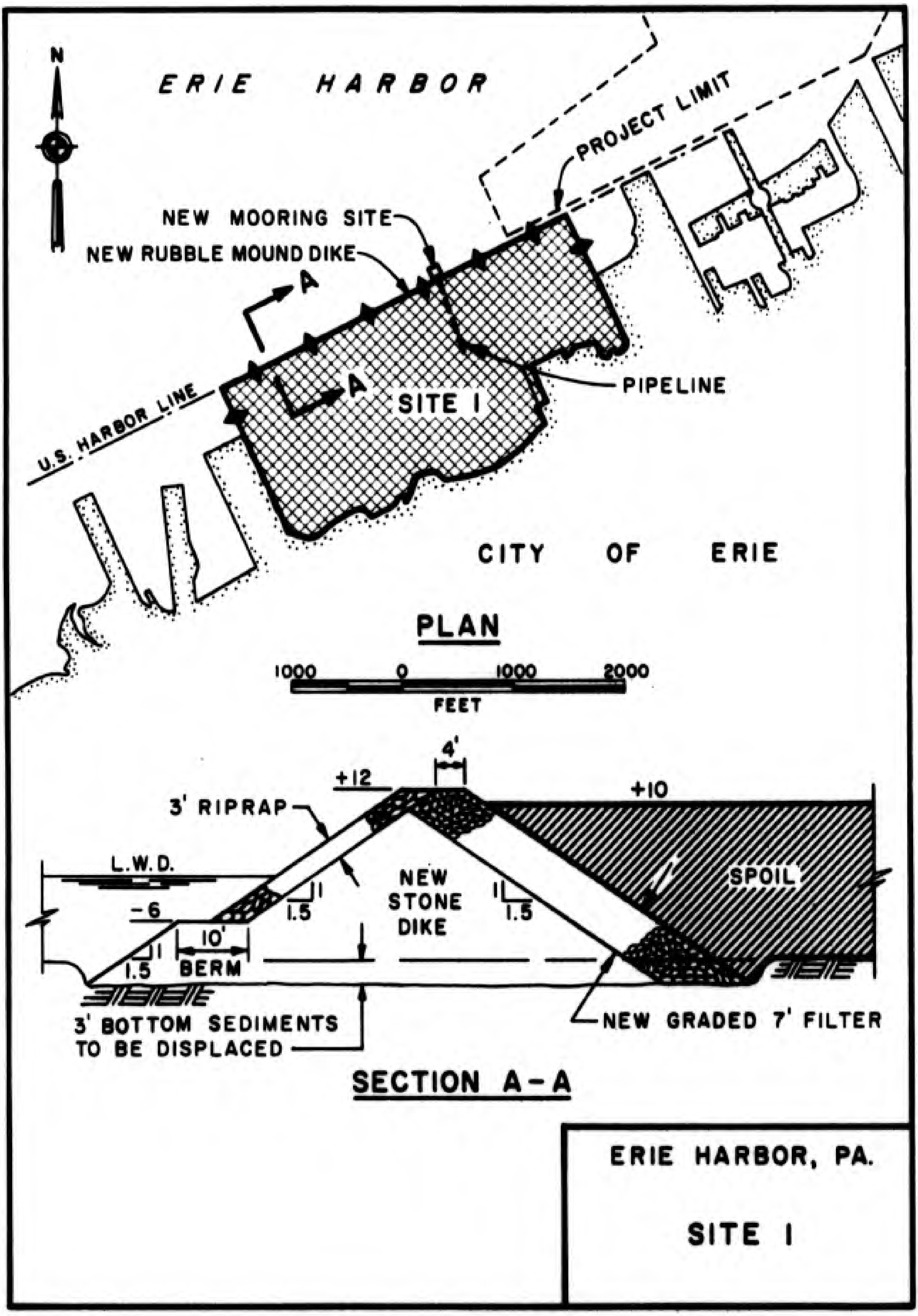

N
SITE 2
CITY OF ERIE
SITE 1
STATE PARK
ERIE HARBOR
SITE 3
SITE 4
LAKE
ERIE
ERIE HARBOR, PA.
DISPOSAL SITES
1000 0 3000
FEET

FIG. K5-2



N
ERIE HARBOR
PROJECT LIMIT
NEW MOORING SITE
NEW RUBBLE MOUND DIKE
A
A
U.S. HARBOR LINE
SITE I
PIPELINE
CITY OF ERIE
PLAN
1000 0 1000 2000
FEET
4'
+12
+10
3' RIPRAP
L.W.D.
-6
NEW STONE DIKE
SPOIL
1.5
1.5
10'
1.5
BERM
3' BOTTOM SEDIMENTS TO BE DISPLACED
NEW GRADED 7' FILTER
SECTION A-A
ERIE HARBOR, PA.
SITE I


FIG. K5-3

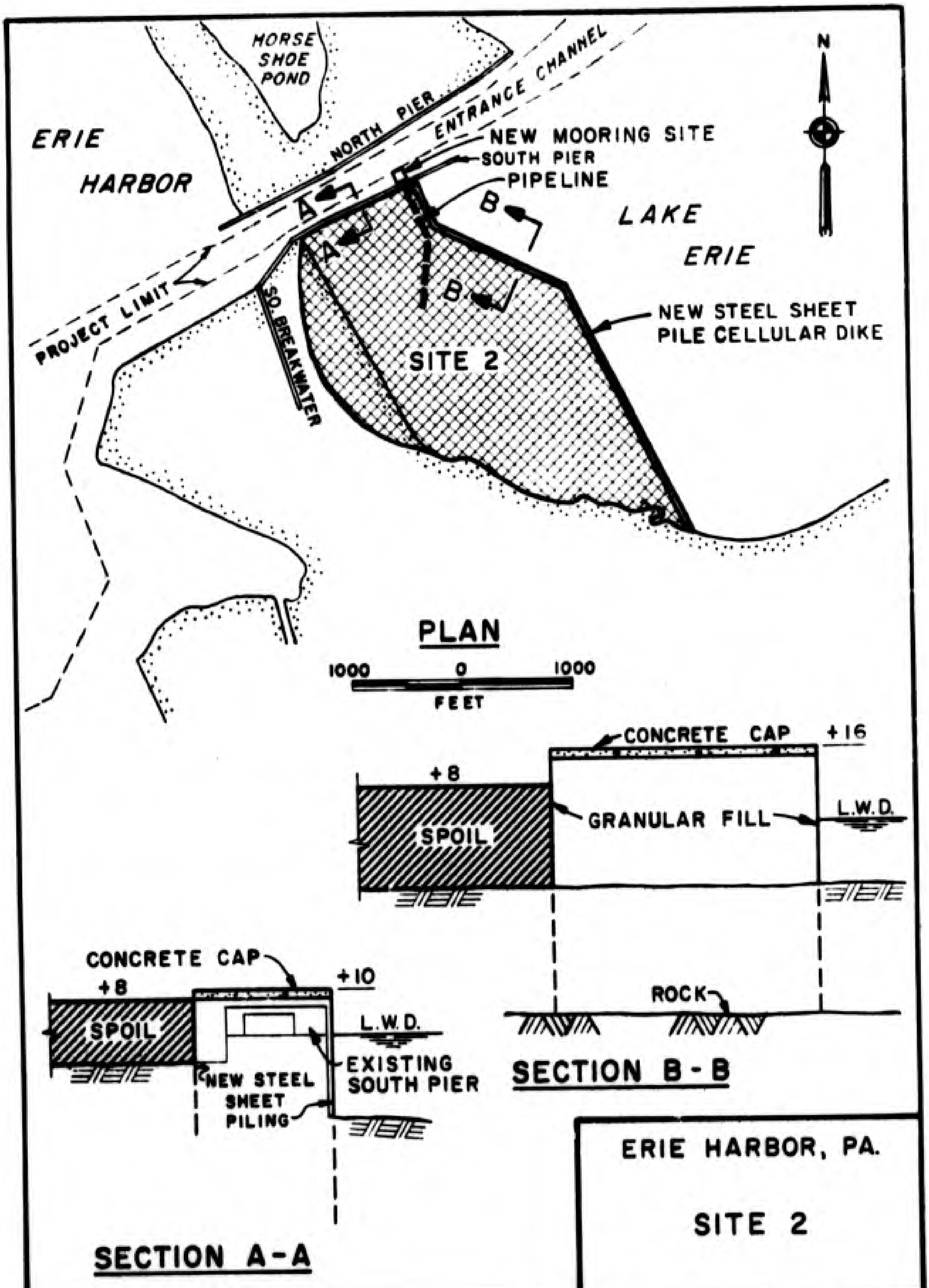

HORSE SHOE POND
ERIE HARBOR
NORTH PIER
ENTRANCE CHANNEL
NEW MOORING SITE
SOUTH PIER
PIPELINE
LAKE ERIE
N
PROJECT LIMIT
SO. BREAKWATER
SITE 2
NEW STEEL SHEET PILE CELLULAR DIKE
PLAN
1000 0 1000
FEET
CONCRETE CAP
+16
+8
SPOIL
GRANULAR FILL
L.W.D.
ROCK
SECTION B - B
CONCRETE CAP
+8
+10
SPOIL
L.W.D.
EXISTING SOUTH PIER
NEW STEEL SHEET PILING
SECTION A-A
ERIE HARBOR, PA.
SITE 2

FIG. K5-4

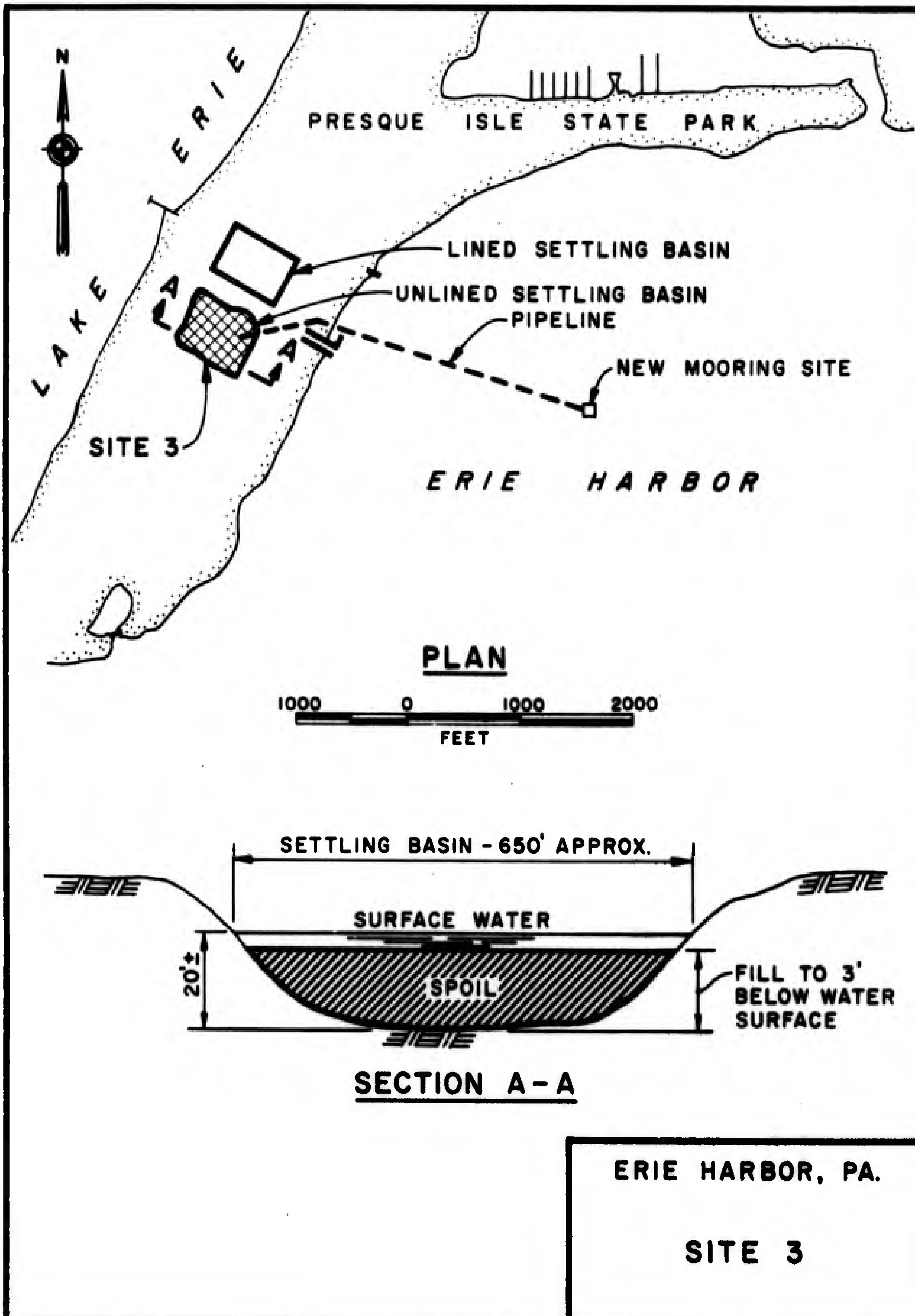
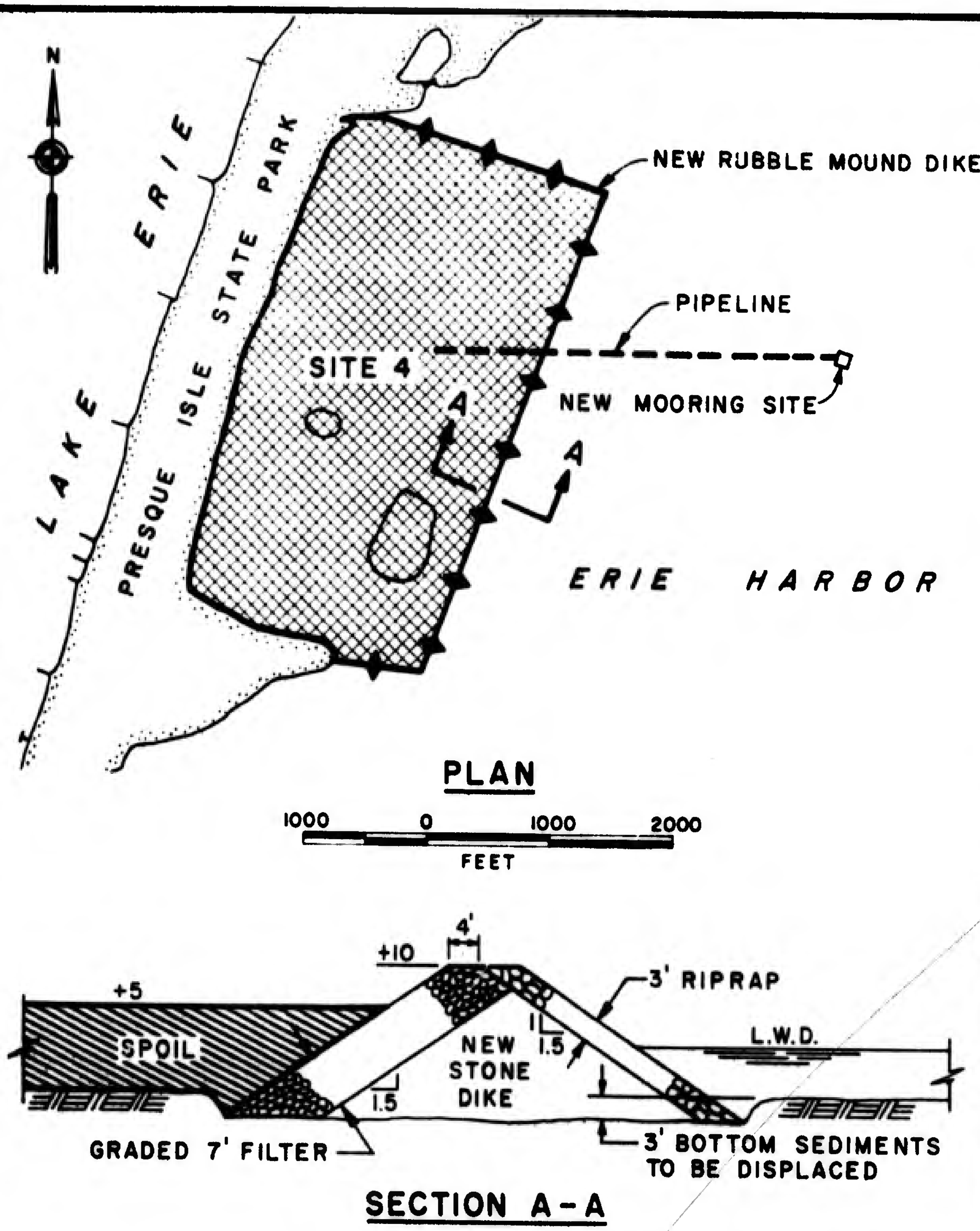

N
LAKE ERIE
PRESQUE ISLE STATE PARK
LINED SETTLING BASIN
UNLINED SETTLING BASIN
PIPELINE
NEW MOORING SITE
A
A
SITE 3
ERIE HARBOR
PLAN
1000 0 1000 2000
FEET
SETTLING BASIN - 650' APPROX.
SURFACE WATER
20'±
SPOIL
FILL TO 3' BELOW WATER SURFACE
SECTION A-A
ERIE HARBOR, PA.
SITE 3

FIG. K5-5




ERIE HARBOR, PA.

SITE 4

FIG. K5-6

# APPENDIX K6

# STUDY OF
# ALTERNATE DISPOSAL AREAS
# FOR
# FAIRPORT HARBOR, OHIO

U. S. ARMY ENGINEER DISTRICT, BUFFALO
CORPS OF ENGINEERS
1776 NIAGARA STREET
BUFFALO, NEW YORK 14207

OCTOBER 1968

DREDGING AND WATER QUALITY PROBLEMS
IN
THE GREAT LAKES

APPENDIX K6

STUDY OF ALTERNATE DISPOSAL AREAS
FOR
FAIRPORT HARBOR, OHIO

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# APPENDIX K6 - FAIRPORT HARBOR

## LOCATION AND DESCRIPTION

1. Fairport Harbor, Ohio is located at the mouth of Grand River, 33 miles east of Cleveland. The Grand River basin encompasses some 712 square miles. Details of the navigation project are shown in fig. K6-1.

2. The harbor is a deep-draft commercial port. The total waterborne commerce for 1966 amounted to 2,074,456 tons and for the 10-year period 1957-1966, inclusive, has averaged 2,778,418 tons. The principal commodities in 1966 were: receipts of 1,341,207 tons of limestone (65%) ; receipts of 390,168 tons of stone, sand and gravel (19%); and shipments of 292,367 tons of non-metallic minerals (14%). It is estimated that waterborne commerce will average about two million tons annually in the future.

## EXISTING CORPS OF ENGINEERS PROJECT

3. PROJECT

The existing project was authorized by the 1825, 1896, 1905, 1919, 1927, 1930, 1935, 1937, 1946, and 1960 River and Harbor Acts which provide for:

a. An outer harbor about 360 acres in area formed by a system of breakwaters comprising a west breakwater, 3,878 feet long, connected with the shore, and an east breakwater, 6,750 feet long.

b. A west breakwater pierhead of steel sheet piling with concrete cap and an east breakwater pierhead of timber-crib substructure with concrete superstructure.

c. An east river pier 1,252 feet long.

d. Removal of the old west pier and construction of cellular steel sheet pile pier 500 feet long and 300 feet west of the westerly face of the east pier.

e. A depth of 29 feet in a lake approach channel flaring from deep water in the lake to the 600-foot wide opening between the lakeward ends of the west and east breakwaters.

f. A depth of 28 feet in the outer harbor in a channel generally 800 feet wide from the lake approach channel to the mouth of Grand River.

g. Depths of 25 feet in soft material and 26 feet in hard material in the remaining authorized portions of the outer harbor.

h. A depth of 27 feet in soft material and 28 feet in hard material in Grand River from its mouth to the upstream project limit at the end of the stone receiving terminal of the Diamond Alkali Company a total distance of 7,700 feet, generally 200 feet wide except at the turning basin where increased to 350 feet and at the upstream end of the project where reduced to 100 feet.

i. A turning basin 21 feet deep of about 10 acres in area, located west of the river channel and about 5,100 feet above the mouth of the river.

j. A channel in Grand River 8 feet deep at the upper end of and adjacent to the west side of the 27-foot project channel, no dredging to be done closer than 20 feet from the westerly dock lines.

4. PROGRESS

The work authorized by the 1960 Act, presently classified as inactive, remains to be done to complete the project. This consists of deepening the lake approach to 29 feet, an 800-foot wide channel through the outer harbor to 28 feet, the main channel in the river to 22 feet, and deepening and enlarging the turning basin to 21 feet. At present the outer harbor areas are maintained to a depth of 25 feet, the lower 3,700 feet of the river channel to 23 feet, the balance of the main river channel to 21 feet, and the turning basin to 18 feet.

## PRESENT DREDGING PRACTICES

5. PROCEDURES

The project areas and channels are maintained annually by U. S. hopper dredges. Clamshell dredges and dump scows are used for permit dredging.

6. There is a reasonable likelihood that the new work dredging authorized by the 1960 Act might be accomplished in the next ten years. However, the scope of this report is limited to consideration of alternative methods of disposing of maintenance dredging material only. The alternate disposal areas discussed in this Appendix do not provide for disposal of new work dredged material.

7. WORKING SEASON

The available season for dredging work at Fairport Harbor corresponds generally with the navigation season. In recent years the earliest and latest openings and closings of navigation at the harbor were:

| | Opening | Closing |
|---|---|---|
| Earliest date | Mar 13 | Dec 2 |
| Latest date | Apr 10 | Dec 24 |

8. QUANTITY

The volume of material removed annually in maintaining the project is about 370,000 cubic yards based on records of the last 10 years. Permit dredging is also accomplished periodically. Future harbor maintenance requirements are estimated at 400,000 cubic yards annually and permit dredging is estimated at 20,000 cubic yards.

9. The estimated volume of material to be removed in the event that the inactive new work is accomplished would be 1,143,000 cubic yards; 1,034,000 cubic yards of earth and 109,000 cubic yards of rock. At about the same time, local interests would be expected to accomplish related dockside deepening, removing an estimated 85,000 cubic yards of materials; 54,000 cubic yards of earth and 31,000 cubic yards of rock.

10. TYPE OF MATERIALS

The material removed from maintenance of the project areas and channels is predominantly silt, with some sand. For the new work similar materials, undisturbed earth and, as indicated in paragrpah 9, some bedrock (requiring some drilling and blasting) would be removed.

11. NATURE OF POLLUTION

The nature of pollution in the Grand River and Fairport Harbor is discussed in a report by FWPCA entitled "Lake Erie Report, A Plan for Water Pollution Control," dated August 1968. The report states that the Grand River in its lower reach, is one of the most chemically polluted waterways within the Lake Erie watershed. Chemical companies discharge over 3,000 tons of dissolved solids daily to the river. The Painesville and Fairport severage systems discharge poorly treated wastes which, along with septic tank effluents, produce heavy bacterial pollution. At times the lower river is brightly colored, ranging from bright green to yellow which results from chemical discharges. Untreated sewage has been observed floating on the surface. A survey by the Corps of Engineers in 1967 indicates that about 12 percent of the solids in the maintenance dredgings is organic. Appendix C contains data on this survey.

## PRESENT DISPOSAL PRACTICE

### 12. METHOD OF DISPOSAL

Dredged material from the harbor is disposed of by bottom dumping, from hopper dredges or dump scows, into an open disposal area in Lake Erie about 1 mile square located 3½ miles, N11°-15'E, from the east breakwater light. At present dredging rates it is estimated that the capacity of this area is sufficient to serve for at least 40 years without impeding navigation.

### 13. COST OF DREDGING

The unit cost of harbor maintenance dredging by hopper dredge is $0.37 per cubic yard. The estimated composite unit cost for accomplishment of the new work by contract, with disposal of all materials in the Lake Erie disposal area is about $3.11 per cubic yard ($2.25/c.y. for earth; $11.25/cy for rock.) The estimated composite unit cost for the related non-Federal dockside dredging is $5.99 per cubic yard ($2.25/c.y. for earth; $12.50 c.y. for rock).

## ALTERNATE DISPOSAL AREAS

14. GENERAL

A survey was made in 1968 to locate sites for a diked disposal area as an alternative to the present open water lake disposal for at least a ten year period. Based on a reconnaissance of the area and discussions with city officials and some property owners, several sites were selected for further study. The alternate disposal areas considered include an offshore site that could contain the maintenance dredging spoil for the entire ten-year period, and several inland sites. Possible uses for the land areas that would be filled by inland disposal are indefinite in most cases. The sites that were investigated are shown in fig. K6-2 and K6-3 and discussed individually in the following paragraphs. Typical dike sections for the inland sites are shown in fig. K6-4. It was assumed that the dikes would be constructed from readily available material in or adjacent to each land disposal area. Overflow structures would be provided at each land disposal area to drain off the effluent.

15. SITE 1

This site, shown in figure K6-5 is an offshore disposal area. It would have a capacity of four million cubic yards when filled and would contain the spoil from about ten years of maintenance dredging. Essentially, it comprises: a new dike constructed of steel sheet pile cells filled with granular materials, on a circular arc alinement, confining an area north of the existing stone east breakwater; placement of a filter on the north slope of the existing breakwater for the full length within the diked area; and provision of a mooring facility on the south side of the existing breakwater near the west end of the new dike. The mooring facility would incorporate the necessary equipment for making and handling flexible connection between the plant to be pumped out and a fixed 18-inch discharge line.

16. Since this is an offshore area, it is assumed that the owner of land created, if this site is used, would be the State of Ohio. Strength characteristics of any offshore area created from polluted maintenance dredging spoil would probably limit the ultimate use to some form of recreation. There are no known objections to using this site as an alternate disposal area.

17. SITE 2

This site shown in figure K6-6 , is a land area near the existing Grand River channel. The site would be inclosed by existing embankments and a new dike around the southern end. It would have a capacity of 800,000 cubic yards when filled to an average depth of 13 feet, which is equivalent to about two years of maintenance dredging. The spoil would be pumped to the site directly from a dredge located at mooring Site 2. This mooring site, which could also be used for other land disposal areas, is shown in figure K6-7.

18. The disposal site is owned by the Baltimore and Ohio Railroad. The area is heavily wooded with some low lying areas where ponding occurs. Railroad representatives were contacted and they have no objection to utilizing the area for disposal of maintenance dredging spoil. The site would ultimately be used by the railroad for a coal storage and reclaiming facility.

19. The existing dock where the mooring facilities would be installed is owned by Diamond Shamrock Corporation. They have property nearby, site 9A and B, that they would like to have filled. This site is discussed in paragraph 24. Representatives of the Corporation have tentatively agreed to provide the dock space for installation of mooring facilities without charge.

20. SITE 3A

The site is a land area located on the west side of the Grand River in an area known as Mentor Marsh. The site, shown in figure K6-8, is now undeveloped marsh land. Dikes would be required around the site except for the west side where an existing embankment would be adequate. The site would have a capacity of four million cubic yards, which is equivalent to about ten years of maintenance dredging. When the site is filled to capacity, the average depth of spoil would be about 17 feet. Another plan was considered at this site whidh would hold the spoil from six years of maintenance dredging. The average depth when filled would be 10 feet. This plan might be more desirable for possible future development considering the unknown strength characteristics of the spoil for use as fill material. Spoil would be pumped from the dredge located at mooring site 3, a distance of about 1,200 feet. The mooring facility would be similar to the one shown on figure K6-7.

21. The Mentor Marsh area has been designated as a national landmark by the National Park Service. Most of the area has been deeded to the Ohio Department of Natural Resources and subleased to the Cleveland Museum of Natural History. Discussions with officials from the Ohio Department of Natural Resources, in October 1968, revealed that the area will eventually be developed as a habitat for waterfowl. This will probably preclude any serious consideration of the marsh area for spoil disposal.

22. SITE 3A & B

The considered plan for this site would extend the southern limits of Site 3A to include Site 3B. The dikes would be lower and spoil would have an average depth of about 10 feet when the site is filled. Capacity of the site is estimated to be four million cubic yards which is equivalent to about ten years of maintenance dredging. An existing highway embankment along the east side of Site 3B would be utilized so that dike costs are about the same as for Site 3A alone. The added land costs for the combined site would make it somewhat more expensive. Operating procedures would be the same as discussed in paragraph 20.

23. The discussion in paragraph 21 for site 3A also applies to the combined site. Use of site 3A and B for spoil disposal would not be compatible with the proposed plans to use the site as a refuge for waterfowl.

24. SITE 9A & B

This land disposal site is located on the right bank of the Grand River, one mile upstream of mooring Site 2. Sites 9A and 9B are separated by the embankment of N. St. Clair Street. They are considered together because of the limited capacities. The areas are now undeveloped marsh land. The sites, shown in figure K6-9, would hold the maintenance dredgings for one year, 400,000 cubic yards, when filled to an average depth of 18 feet. The area north of Site 9A has already been filled to comparable depths with a poor quality fill material. It was assumed that the site would be filled only after Site 2 has been filled. The mooring facilities and piping system installed for Site 2 would be utilized for Site 9A and 9B. An additional 4,000 feet of piping would be required to reach the new site.

25. Diamond Shamrock Corporation owns all of site 9A and part of Site 9B. They would use the filled areas for future industrial development. The Village of Fairport Harbor owns the remainder of Site 9B. Future use would be in connection with their existing sewage treatment plant facilities adjacent to the disposal site. Both owners are anxious to have the areas filled and would allow the land to be used for this purpose without charge.

26. SITE 6

This is a land disposal site, shown in figure K6-10, located 18,000 feet upstream from mooring Site 2. The area is flat and used for agricultural purposes. Most of the land is used for growing fruit trees and corn. The site would have a capacity of 2,800,000 cubic yards when filled to an average depth of 17 feet, equivalent to seven years of maintenance dredging. The site would be completely inclosed with dikes. It was assumed that this site would be used only after Site 2 and Site 9A & B are filled.

Mooring facilities and the piping system would be extended from Site 9A & B. An additional 12,800 feet of piping and three booster pumps would be required.

27. There are several property owners in Site 6. Although the considered plan was not discussed with the owners, it was assumed that rights could be purchased for use of the land as a disposal area. Future use of the land is expected to be for agricultural or recreational purposes. The spoil material is expected to be satisfactory for growing crops after a stabilization period.

28. SITE 8

This land disposal area is located in an oxbow bend in the river, over five miles upstream of mooring Site 2. The site shown in figure K6-11 is now undeveloped and heavily wooded. It would have a capacity of 2,800,000 cubic yards when filled to an average depth of 29 feet, equivalent to about seven years of maintenance dredging. The site would be completely inclosed with dikes. The site is considered as an alternative to site 6. It would be used only after sites 2 and 9A & B were filled. The piping system used for site 9A & B would be extended 25,000 feet and five additional booster pumps would be required.

29. The site is owned by several property owners. It was assumed that the property could be obtained for use as a disposal site. The owners were not contacted. The site is near the City of Painesville and future use of the land area would probably be for some form of recreation. Local interests have indicated a desire to relocate the river channel to cut off the oxbow bend. Such a plan would provide additional areas, within the existing river channel, for spoil disposal and the land created would be more accessible for some future use. The modified plan would also help to solve serious bank erosion problems that exist in the sinuous channel. A dike would be provided along the right bank of the new channel and seven years of maintenance dredging spoil would be pumped into the disposal site. The average depth of spoil would be about 17 feet. Preliminary studies show that the cost of this modified plan would exceed the cost of dikes inclosing the existing area. The channel modification would require several structures and a continuing maintenance problem after the site is filled. However, the obvious advantages of this modified plan would probably be more acceptable to local interests. Detailed studies of the modified plan are continuing.

30. OTHER SITES INVESTIGATED

Sites 3C, 3D and 3E were studies as possible sites for disposal of dredged material in the event that alternate disposal areas are needed beyond the assumed ten-year period. The sites are similar in all respects to Sites 3A and 3B. Spoil would be pumped from mooring Site 3. Future use of this area as a habitat for waterfowl, as discussed in paragraph 21, would preclude serious consideration of these sites for spoil disposal.

31. Site 4 was not considered to be a good choice as an alternate disposal area. The site is small and the owner places a high value on the underlying clay soil. Site 5 was not seriously considered because relocation costs would be high. Site 7 includes as existing golf course. The cost of acquiring this property would be too expensive. These sites are shown in figure K6-3.

## ESTIMATES OF COSTS

32. GENERAL

There are three mooring sites that could be used for considered spoil areas. One is for the offshore site, another for the land sites east of the Grand River, and a third for the spoil area west of the river. Estimates of costs have been obtained for dredging the river and harbor material and disposition at each of the mooring sites. Even though the travel time to the mooring sites is less than the time required to transport the spoil to the open lake disposal area, the pump-out time at the mooring site would increase the net cost somewhat over present costs.

33. Costs of the spoil retention structure, mooring facilities, and spoil discharge system were estimated for each site. Land costs, where applicable, were included in the estimate for the retention structure. All costs were based on 1968 price levels. Some of the sites would utilize mooring facilities, booster pumps and piping that was installed for a site closer to the mooring site. Extensions of existing facilities would be constructed to reach the more distant sites. The pumps would have salvage value that was credited to the proper site and added to the cost of the spoil discharge system for the next site in line. Salvage value of piping and mooring facilities was considered negligible. It was assumed that each of the land disposal sites could be constructed in less than one year. Total investment for these sites was therefore equal to the total first cost.

34. Annual costs included interest at 3-¼ percent, the current value of the Federal risk-free interest rate. The total investment less

slavage was amortized over the filling period. Annual operation, maintenance, and dredging costs were added in to obtain a total annual cost. This cost was divided by 400,000 cubic yards to obtain the cost per cubic yard. Considered disposal sites were sized to handle only maintenance dredging spoil. Permit dredging could be disposed of, in most cases, by using the same sites but since it represents only 5% of the maintenance dredging volume, and costs per cubic yard are being compared, this analysis is considered adequate. Cost estimates for individual sites are shown in the following paragraphs.

35. SITE 1

Site 1 was the only offshore site considered at Fairport Harbor. The construction period was assumed to be two years. Total investment costs included interest on the first cost at 3-¼ percent over half the construction period. Consideration was given to possible maintenance costs on the retention structure after the 10 year filling period. The structure would have to be maintained for an unknown period while the spoil material solidifies. Since the structures would be constructed of steel cells, filled with granular material and capped with concrete, it was assumed that maintenance costs after filling would be negligible. Costs for site 1 are shown below.

a. First Costs

| | |
|---|---|
| Spoil retention structure | $ 5,515,000 |
| Mooring Facilities | 130,000 |
| Spoil discharge system | 105,000 |
| Total first costs | 5,750,000 |
| Interest during construction | 187,000 |
| Total investment costs | $ 5,937,000 |

b. Annual Costs

| | |
|---|---|
| Interest, $5,937,000 @ .0325 | $ 193,000 |
| Amortization, 10 yrs., $5,937,000 @ .0862 | 512,000 |
| Maintenance dredging, 400,000 c.y. @ $0.45 | 180,000 |
| Annual operation and maintenance | 21,000 |
| Total Annual Cost | $ 906,000 |
| Cost per Cubic Yard | $2.27 |

36. SITE 2

a. First Costs

| | |
|---|---|
| Spoil retention structures | $244,000 |
| Mooring facilities | 16,000 |
| Spoil discharge system | 250,000 |
| Total Investment Cost | $510,000 |
| Salvage Value | -120,000 |
| Investment less Salvage | $390,000 |

b. Annual Costs

| | |
|---|---|
| Interest, $510,000 @ .0325 | $ 17,000 |
| Amortization, 2 yrs., $390,000 @ .4920 | 192,000 |
| Maintenance dredging, 400,000 c.y. @ $0.45 | 180,000 |
| Operation and Maintenance | 50,000 |
| Total Annual Cost | $439,000 |
| Cost per Cubic Yard | $1.10 |

37. SITE 3A (6 Year Plan)

a. First Costs

| | |
|---|---|
| Spoil retention structures | $ 964,000 |
| Mooring facilities | 16,000 |
| Spoil discharge system | 250,000 |
| Total Investment Cost | $1,230,000 |
| Salvage value | - 68,000 |
| Investment less Salvage | $1,162,000 |

b. Annual Costs

| | |
|---|---|
| Interest, $1,230,000 @ .0325 | $ 40,000 |
| Amortization, 6 yrs., $1,162,000 @ .1536 | 178,000 |
| Maintenance dredging, 400,000 c.y. @ $0.45 | 180,000 |
| Operation and maintenance | 50,000 |
| Total Annual Cost | $ 448,000 |
| Cost per Cubic Yard | $1.12 |

38. SITE 3A (10 Year Plan)

a. First Costs

| | |
|---|---|
| Spoil retention structures | $1,281,000 |
| Mooring facilities | 16,000 |
| Spoil discharge system | 250,000 |
| Total Investment Cost | $1,547,000 |
| Salvage value | - 38,000 |
| Investment less Salvage | $1,509,000 |

b. Annual Costs

| | |
|---|---|
| Interest, $1,547,000 @ .0325 | $ 50,000 |
| Amortization, 10 yrs., $1,509,000 @ .0862 | 130,000 |
| Maintenance dredging, 400,000 c.y. @ $0.45 | 180,000 |
| Operation and maintenance | 50,000 |
| Total Annual Cost | $ 410,000 |
| Cost per Cubic Yard | $1.03 |

39. SITE 3A & B

a. First Costs

| | |
|---|---|
| Spoil retention structures | $1,854,000 |
| Mooring facilities | 16,000 |
| Spoil discharge system | 480,000 |
| Total Investment Cost | $2,350,000 |
| Salvage value | -75,000 |
| Investment less Salvage | $2,275,000 |

b. Annual Costs

| | |
|---|---|
| Interest, $2,350,000 @ .0325 | $ 76,000 |
| Amortization, 10 yrs., $2,275,000 @ .0862 | 196,000 |
| Maintenance dredging, 400,000 c.y. @ $0.45 | 180,000 |
| Operation and maintenance | 100,000 |
| Total Annual Cost | $ 552,000 |
| Cost per Cubic Yard | $1.38 |

40. SITE 9A & B

a. First Costs

| | |
|---|---|
| Spoil retention structures | $105,000 |
| Mooring facilities | -- |
| Spoil discharge system | 298,000 |
| Total Investment Cost | $403,000 |
| Salvage value | - 105,000 |
| Investment less Salvage | $298,000 |

b. Annual Costs

| | |
|---|---|
| Interest, $403,000 at .0325 | $13,000 |
| Amortization, 1 yr., $298,000 at 1.000 | 298,000 |
| Maintenance dredging, 400,000 c.y. at $0.45 | 180,000 |
| Operation and maintenance | 103,000 |
| Total Annual Cost | $594,000 |
| Cost per Cubic Yard | $1.49 |

41. SITE 6

a. First Costs

| | |
|---|---|
| Spoil retention structures | $915,000 |
| Mooring facilities | -- |
| Spoil discharge system | 895,000 |
| Total Investment Cost | $1,810,000 |
| Salvage value | - 218,000 |
| Investment less Salvage | $1,592,000 |

b. Annual Costs

| | |
|---|---|
| Interest, $1,810,000 at .0325 | $59,000 |
| Amortization, 7 yrs., $1,592,000 at .1295 | 206,000 |
| Maintenance dredging, 400,000 c.y. at $0.45 | 180,000 |
| Operation and maintenance | 228,000 |
| Total Annual Cost | $673,000 |
| Cost per Cubic Yard | $1.68 |

42. SITE 8

a. First Costs

| | |
|---|---|
| Spoil retention structures | $ 890,000[1] |
| Spoil discharge system | 1,650,000 |
| Total Investment Cost | $ 2,540,000 |
| Salvage value | - 300,000 |
| Investment less Salvage | $ 2,240,000 |

b. Annual Costs

| | |
|---|---|
| Interest, $2,540,000 @ .0325 | $ 83,000 |
| Amortization, 7 yrs., $2,240,000 @ .1295 | 290,000 |
| Maintenance dredging, 400,000 c.y. @ $0.45 | 180,000 |
| Operation and maintenance | 303,000 |
| Total Annual Cost | $ 856,000 |
| Cost per Cubic Yard | $ 2.14 |

(1) Includes land costs

43. COST COMPARISONS

A summary of the cost per cubic yard for the considered alternate disposal sites is given below. The open lake site is presently being used to dispose of dredged material at Fairport Harbor. The cost of disposal by this method is given for comparison with the more expensive alternate disposal sites. Site 1 is an offshore diked area. The other sites are land disposal areas.

| Site | Capacity cu. yds. | Capacity years | Cost per cu. yd. ($) |
|---|---|---|---|
| Open lake | - | 40+ | 0.37 |
| 2 | 800,000 | 2 | 1.10 |
| 3A | 4,000,000 | 10 | 1.03 |
| 9A & B | 400,000 | 1 | 1.49 |
| 3A | 2,400,000 | 6 | 1.12 |
| 3A & B | 4,000,000 | 10 | 1.38 |
| 8 | 2,800,000 | 7 | 2.14 |
| 6 | 2,800,000 | 7 | 1.68 |
| 1 | 4,000,000 | 10 | 2.27 |

44. The land disposal sites would require mooring facilities and a piping system to transport the spoil from the dredge to the site. It was assumed that three sites would use existing mooring facilities and piping systems that were constructed to fill a site closer to the mooring site. The costs shown above would be higher for sites 9A & B, 6, and 8 if the filling schedule shown below were not followed.

a. Site 2 would be filled before site 9A & B.

b. Sites 2 and 9A & B would be filled before site 6.

c. Sites 2 and 9A & B would be filled before site 8.

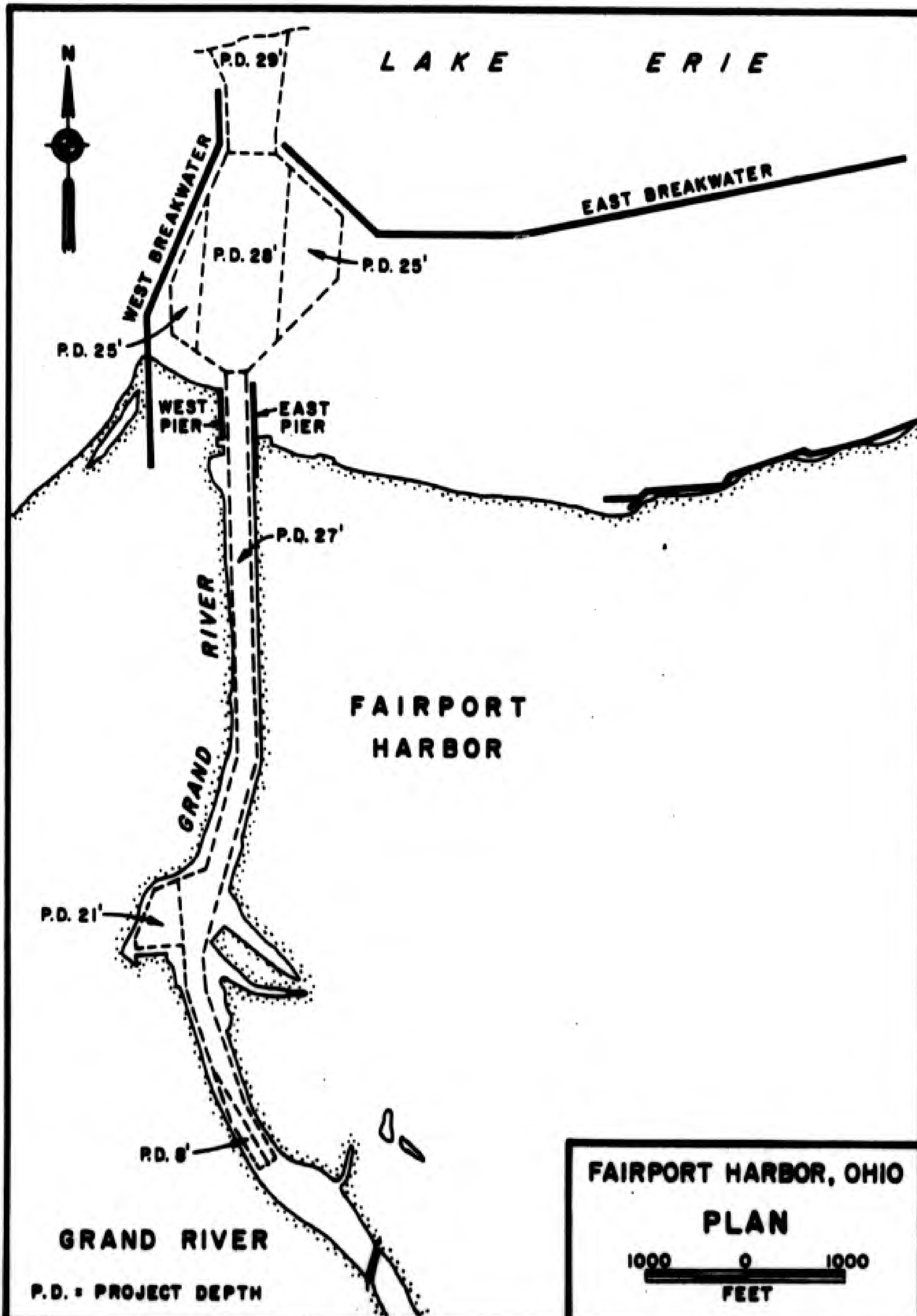
45. The three most likely 10-year plans for alternate spoil disposal are shown below. Plans II and III would each utilize three disposal sites. Construction of the latter two spoil areas for each plan could be deferred until needed. The investment costs for these sites were reduced to present worth values and the annual costs per cubic yard were recalculated. The average 10-year cost per cubic yard was obtained by adding the product of cost per cubic yard times the years of use for each site, and dividing the total by ten.

| | Site | Years | Cost per cu. yd. ($) | Average 10-year cost per cu. yd. ($) |
|---|---|---|---|---|
| Plan I | 3A | 10 | 1.03 | 1.03 |
| Plan II | 2 | 2 | 1.10 | |
| | 9A & B | 1 | 1.44(1) | |
| | 6 | 7 | 1.62(1) | 1.50 |
| Plan III | 2 | 2 | 1.10 | |
| | 9A & B | 1 | 1.44(1) | |
| | 8 | 7 | 2.06(1) | 1.81 |

(1) Investment costs have been reduced to present worth values and the annual cost per cubic yard was recalculated.

## DISCUSSION

46. The least costly plan (planI) would utilize site 3A for the entire 10-year period. However, this area is expected to be developed as a habitat for waterfowl by the Ohio Department of Natural Resources. It has been assumed that the site would not be available as a spoil disposal site. The next less costly plan (plan II) would utilize site 2 for the first two years, site 9A & B for the next year and site 6 for the last seven years. The owners of sites 2 and 9A & B would like to have their areas filled and would provide the lands without cost. Site 6 is used primarily for agricultural purposes. It was assumed that rights could be acquired to use this site. Plan III would substitute site 8 for site 6. This is a more costly plan and probably would not receive serious consideration unless some beneficial land use could be clearly established to warrant the additional charges.



N
LAKE ERIE
P.D. 29'
WEST BREAKWATER
EAST BREAKWATER
P.D. 28'
P.D. 25'
P.D. 25'
WEST PIER
EAST PIER
P.D. 27'
GRAND RIVER
FAIRPORT HARBOR
P.D. 21'
P.D. 8'
GRAND RIVER
P.D. = PROJECT DEPTH
FAIRPORT HARBOR, OHIO
PLAN
1000 0 1000
FEET


FIG. K6-1

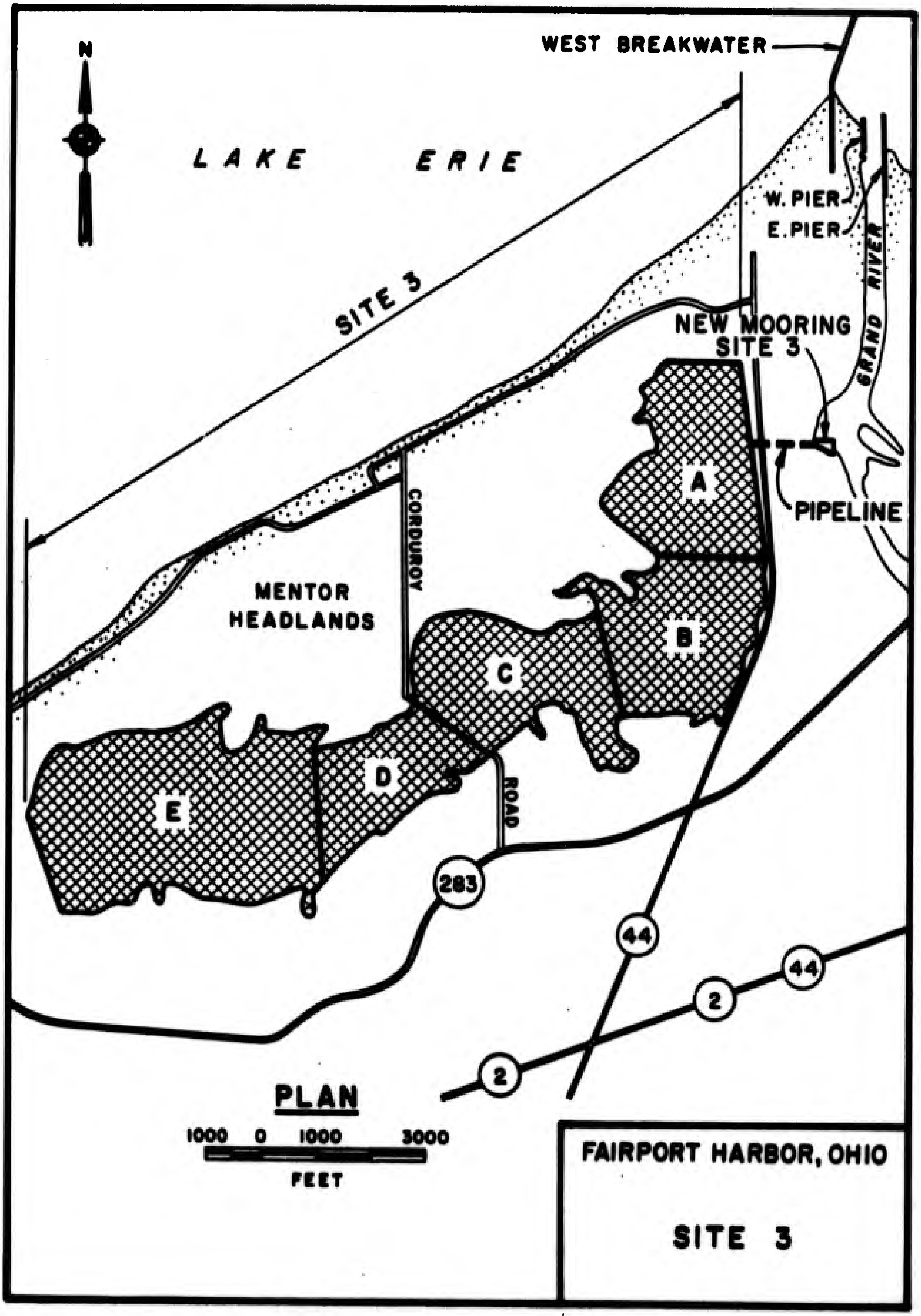
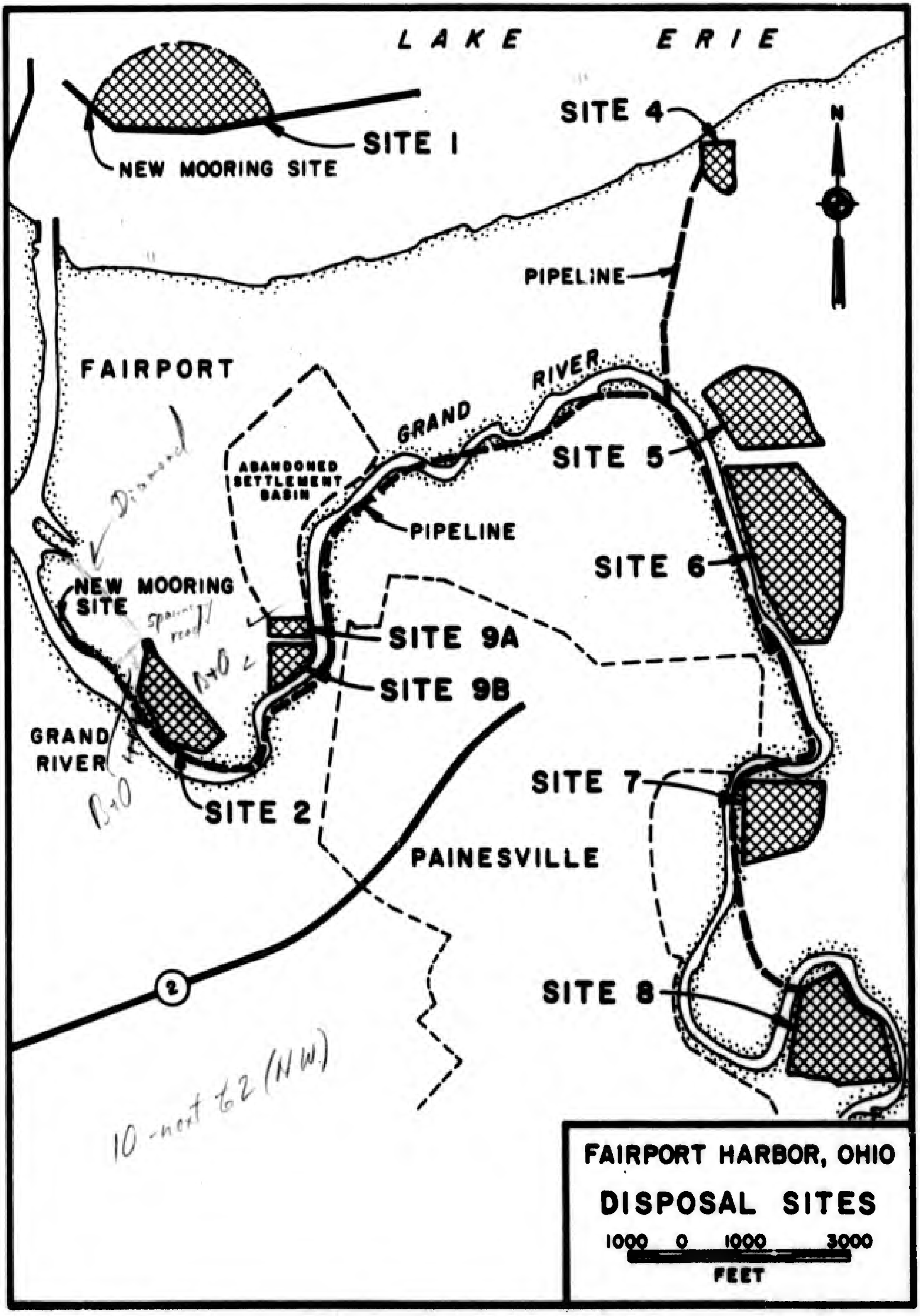

WEST BREAKWATER
N
LAKE ERIE
W. PIER
E. PIER
GRAND RIVER
SITE 3
NEW MOORING
SITE 3
PIPELINE
CORDUROY
MENTOR
HEADLANDS
A
B
C
D
E
ROAD
283
44
2
44
2
PLAN
1000 0 1000 3000
FEET
FAIRPORT HARBOR, OHIO
SITE 3

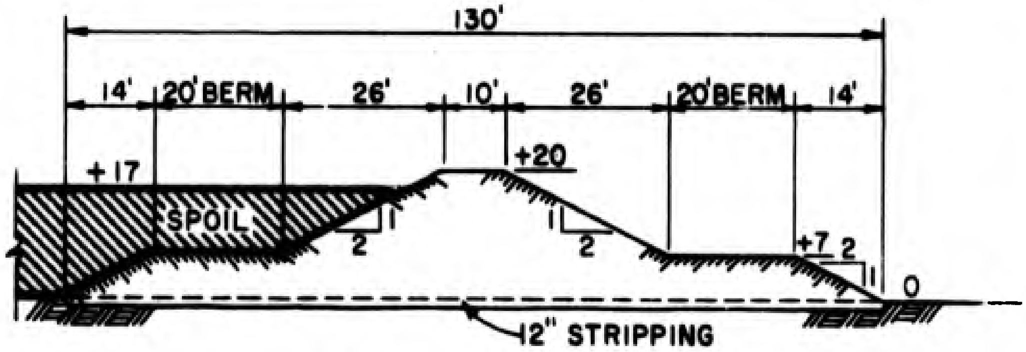
FIG. K6-2




FAIRPORT HARBOR, OHIO

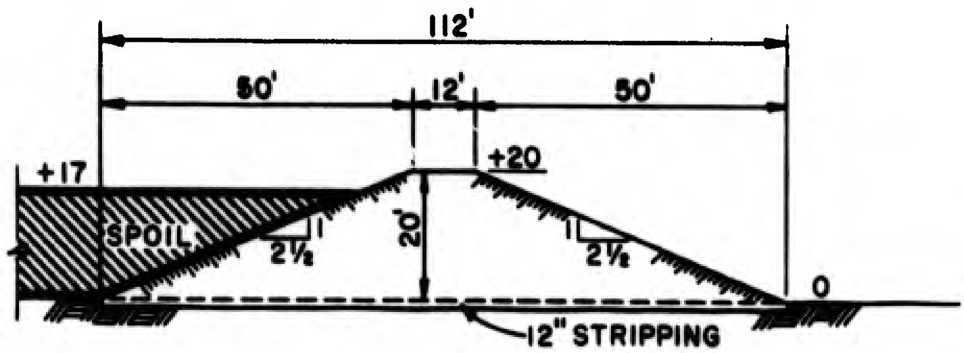
DISPOSAL SITES

FIG. K6-3




**TYPICAL DIKE SECTION - TYPE "A"**

(ALONG RIVER AND SET BACK 50' TO 75')




**TYPICAL DIKE SECTION - TYPE "B"**

(UPLAND)

FAIRPORT HARBOR, OHIO

TYPICAL
DIKE SECTIONS

FIG. K6-4

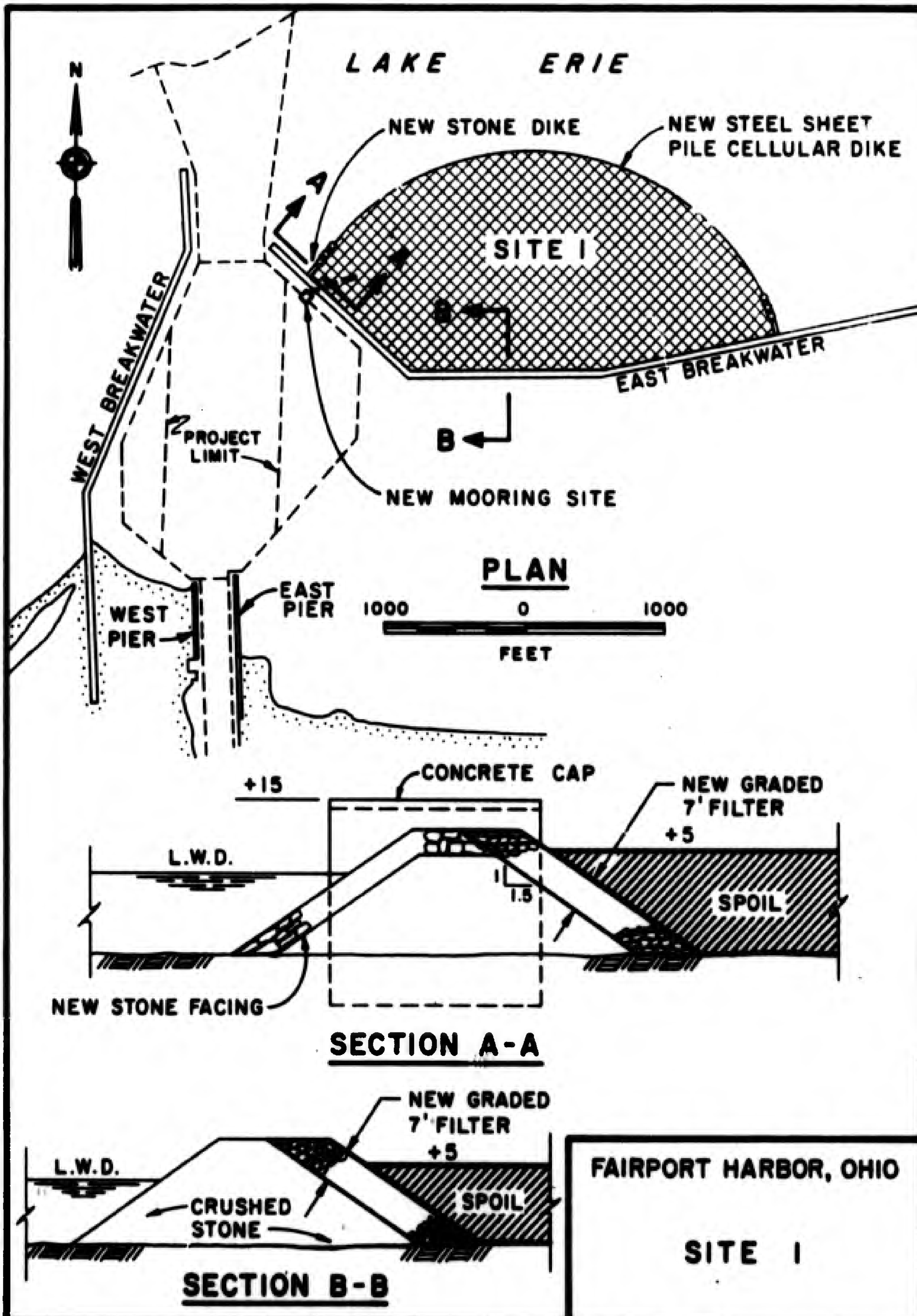
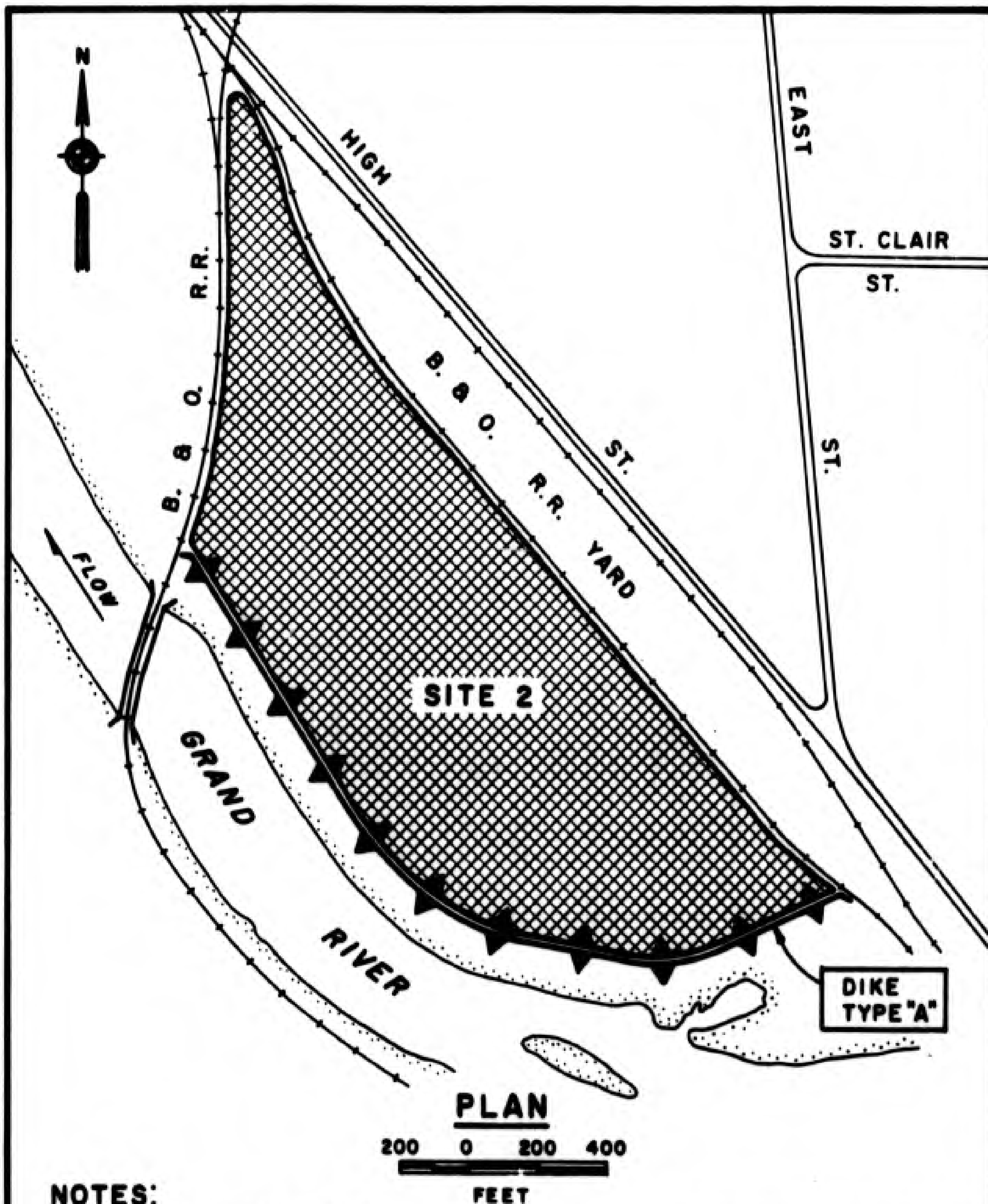

LAKE ERIE
N
NEW STONE DIKE
NEW STEEL SHEET PILE CELLULAR DIKE
A
SITE I
B
WEST BREAKWATER
EAST BREAKWATER
PROJECT LIMIT
NEW MOORING SITE
PLAN
WEST PIER
EAST PIER
1000 0 1000
FEET
+15
CONCRETE CAP
NEW GRADED 7' FILTER
+5
L.W.D.
1
1.5
SPOIL
NEW STONE FACING
SECTION A-A
NEW GRADED 7' FILTER
+5
L.W.D.
CRUSHED STONE
SPOIL
SECTION B-B
FAIRPORT HARBOR, OHIO
SITE I

FIG. K6-5



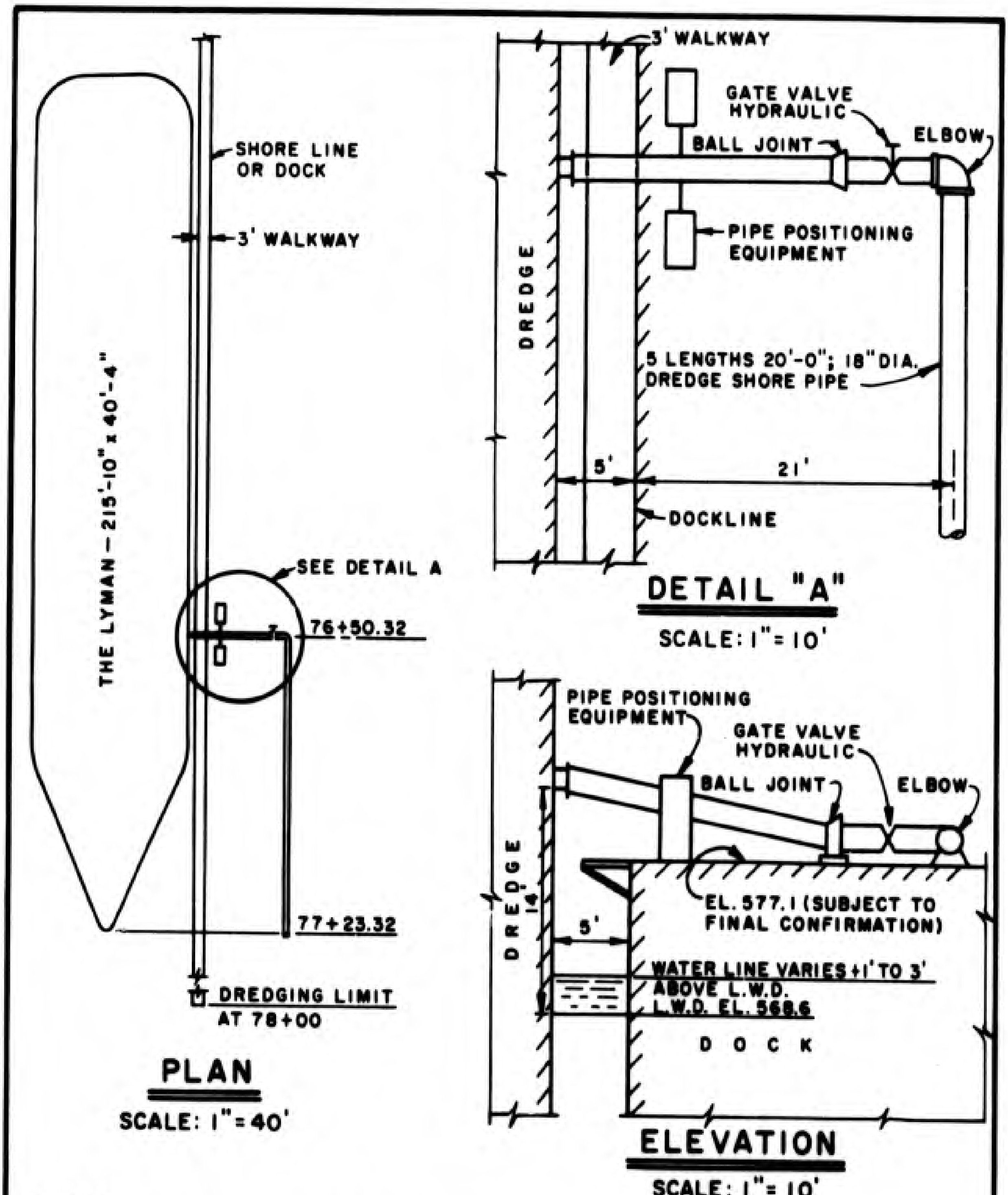

**NOTES:**

DIKE, TYPE "A" = EARTH DIKE
TOP OF DIKE = EL. 590.0
TOP OF SPOIL = EL. 587.0
AVERAGE HEIGHT OF SPOIL = 13.0'
AREA OF SPOIL = 37.0 ACRES
VOLUME OF SPOIL = 768,000 CU. YDS.
STORAGE PERIOD = 2.0 YEARS

FAIRPORT HARBOR, OHIO

SITE 2

FIG. K6-6



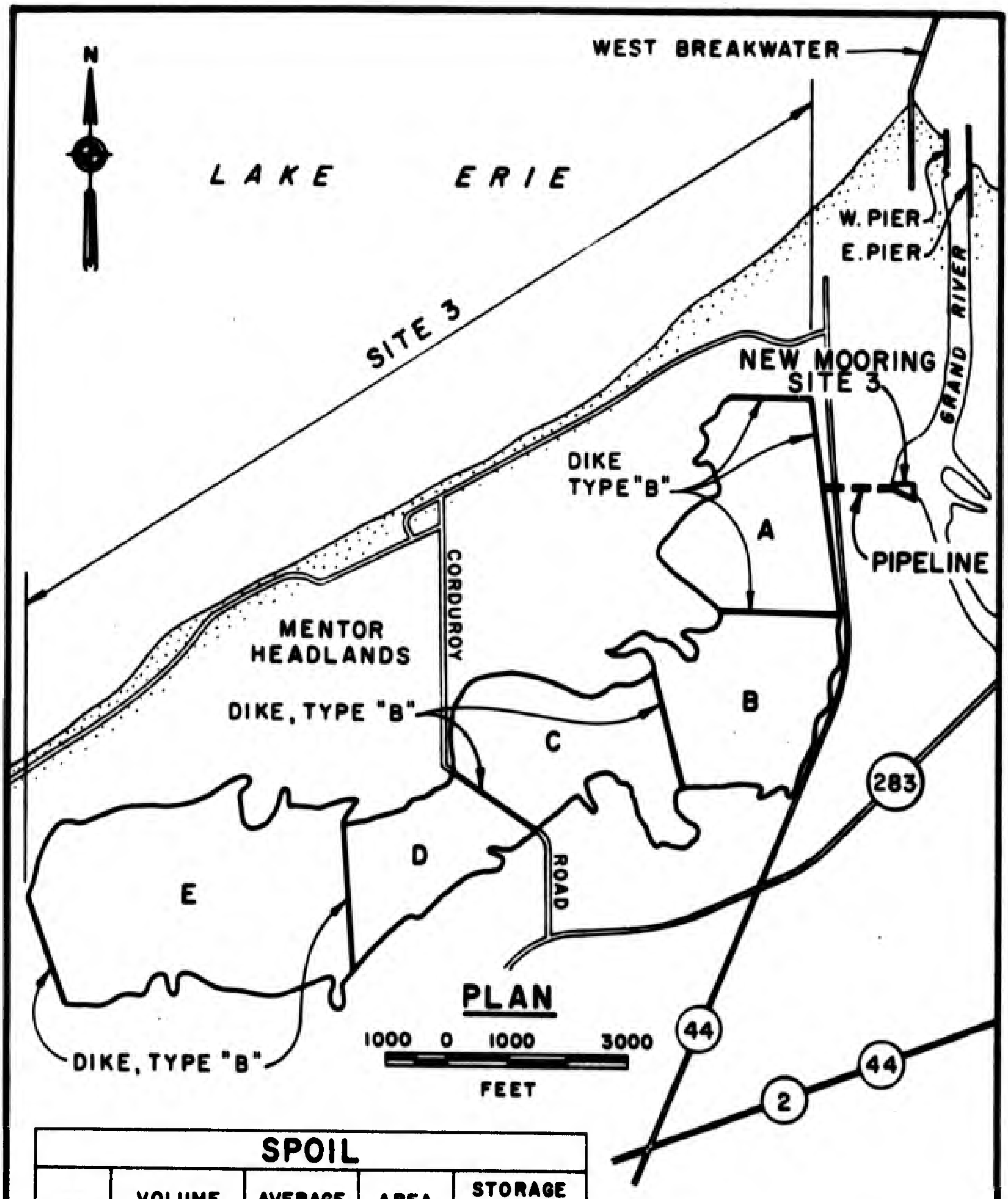

**NOTE:**

LOCATION OF DREDGE AND PIPING ARRANGEMENT FOR MOORING THE LYMAN TO DIAMOND SHAMROCK DOCK, FAIRPORT HARBOR, OHIO.

**FAIRPORT HARBOR, OHIO**

**MOORING FACILITIES SITE 2**

FIG. K6-7

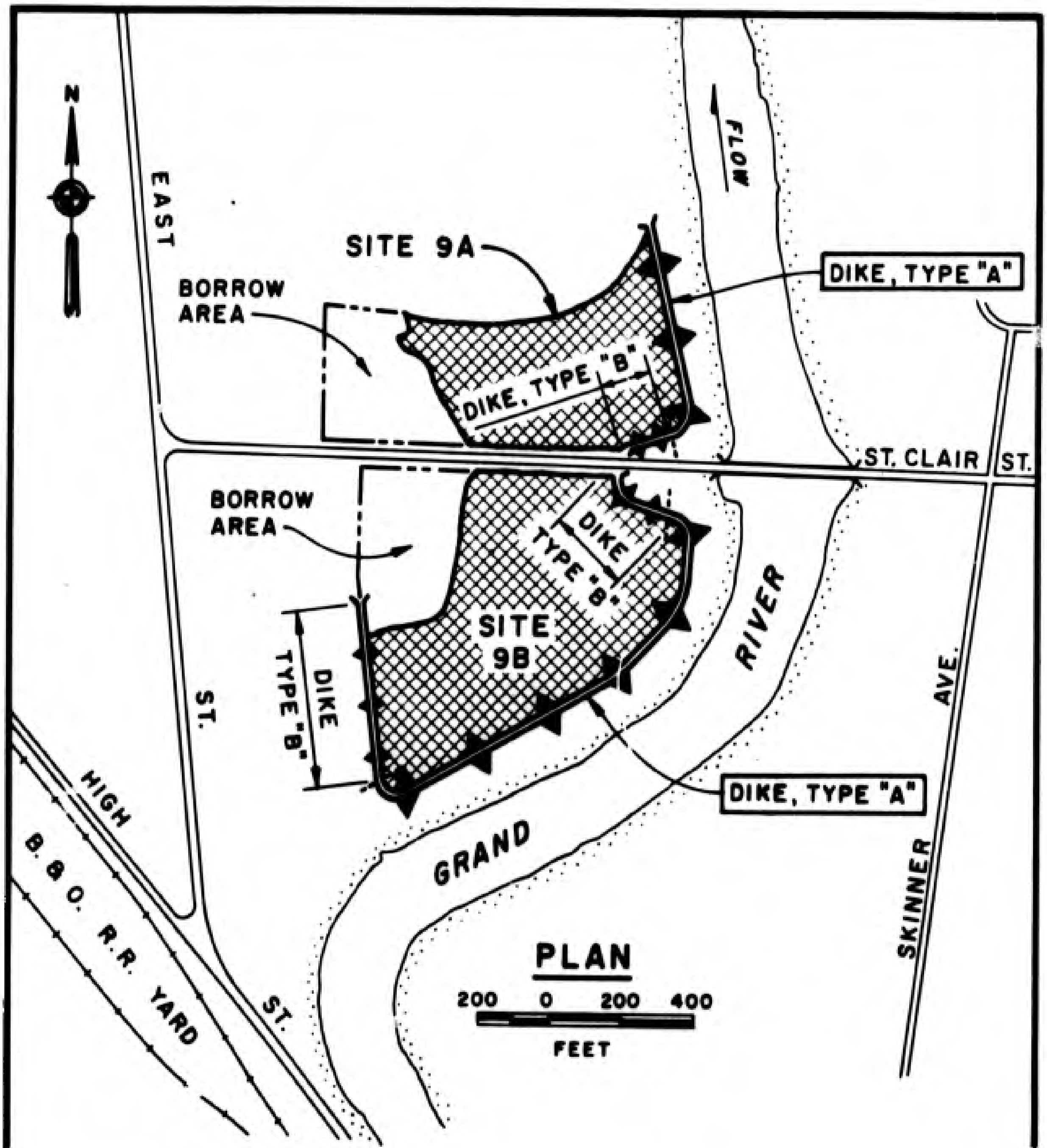



| SPOIL | | | | |
|---|---|---|---|---|
| AREA | VOLUME CU. YDS. | AVERAGE HEIGHT | AREA ACRES | STORAGE PERIOD YEARS |
| A | 4,000,000 | 15.6' | 160 | 10.0 |
| A+B | 4,000,000 | 8.0' | 338 | 10.0 |
| C | 1,200,000 | 10.0' | 77 | 3.0 |
| D | 1,400,000 | 10.0' | 90 | 3.5 |
| E | 4,000,000 | 10.0' | 264 | 10.0 |

FAIRPORT HARBOR, OHIO

SITE 3

FIG. K6-8



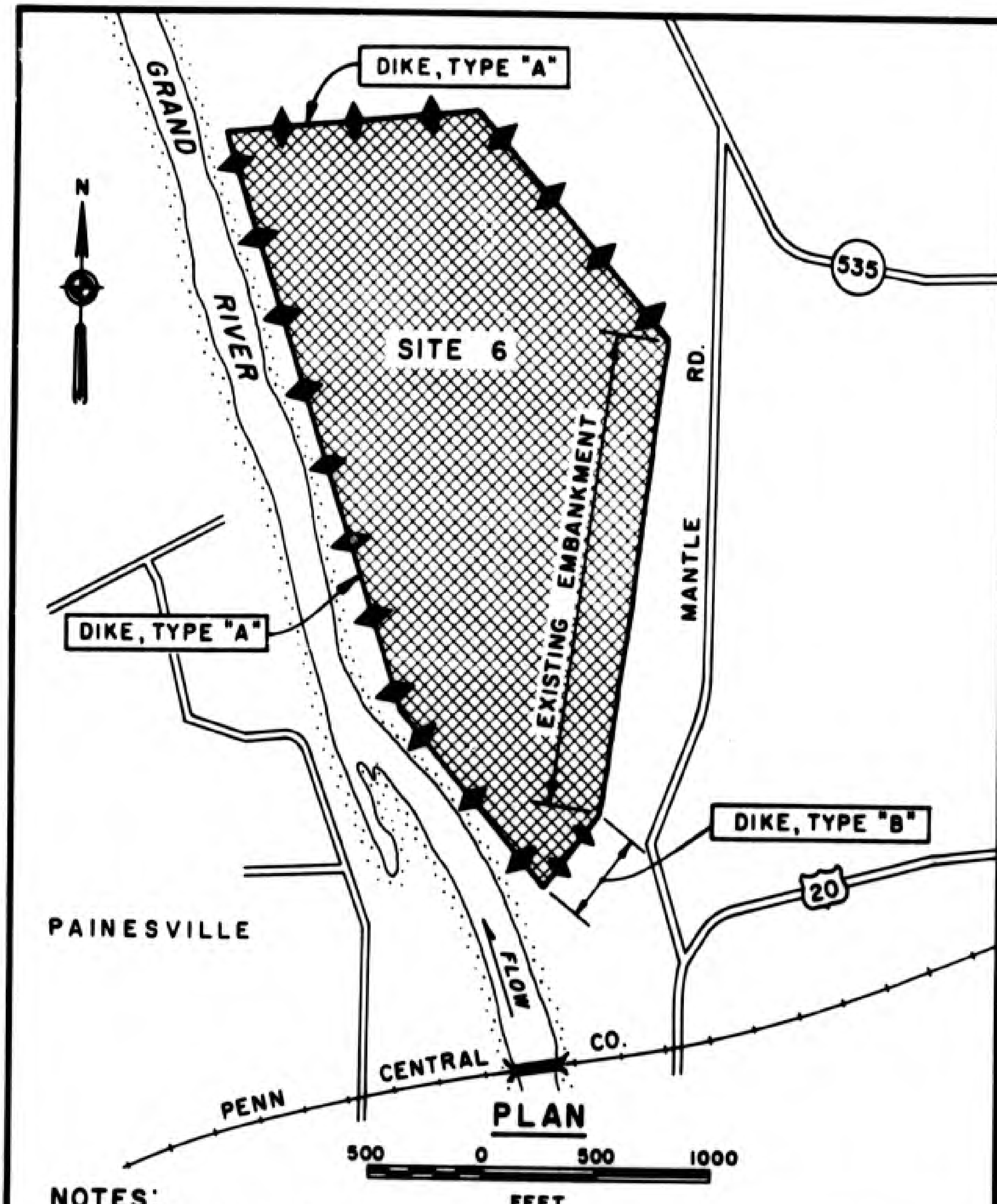

**NOTES:**

DIKE, TYPE "A" AND "B" = EARTH DIKE
TOP OF DIKES = EL. 590.0
TOP OF SPOIL = EL. 587.0
AVERAGE HEIGHT OF SPOIL = 13.0'
AREA OF SPOIL, SITE 9A = 6.75 ACRES
AREA OF SPOIL, SITE 9B = 10.25 ACRES
VOLUME OF SPOIL = 368,000 CU. YDS.
STORAGE PERIOD = 1.0 YEARS

FAIRPORT HARBOR, OHIO

SITES 9A AND 9B

FIG. K6-9




PLAN

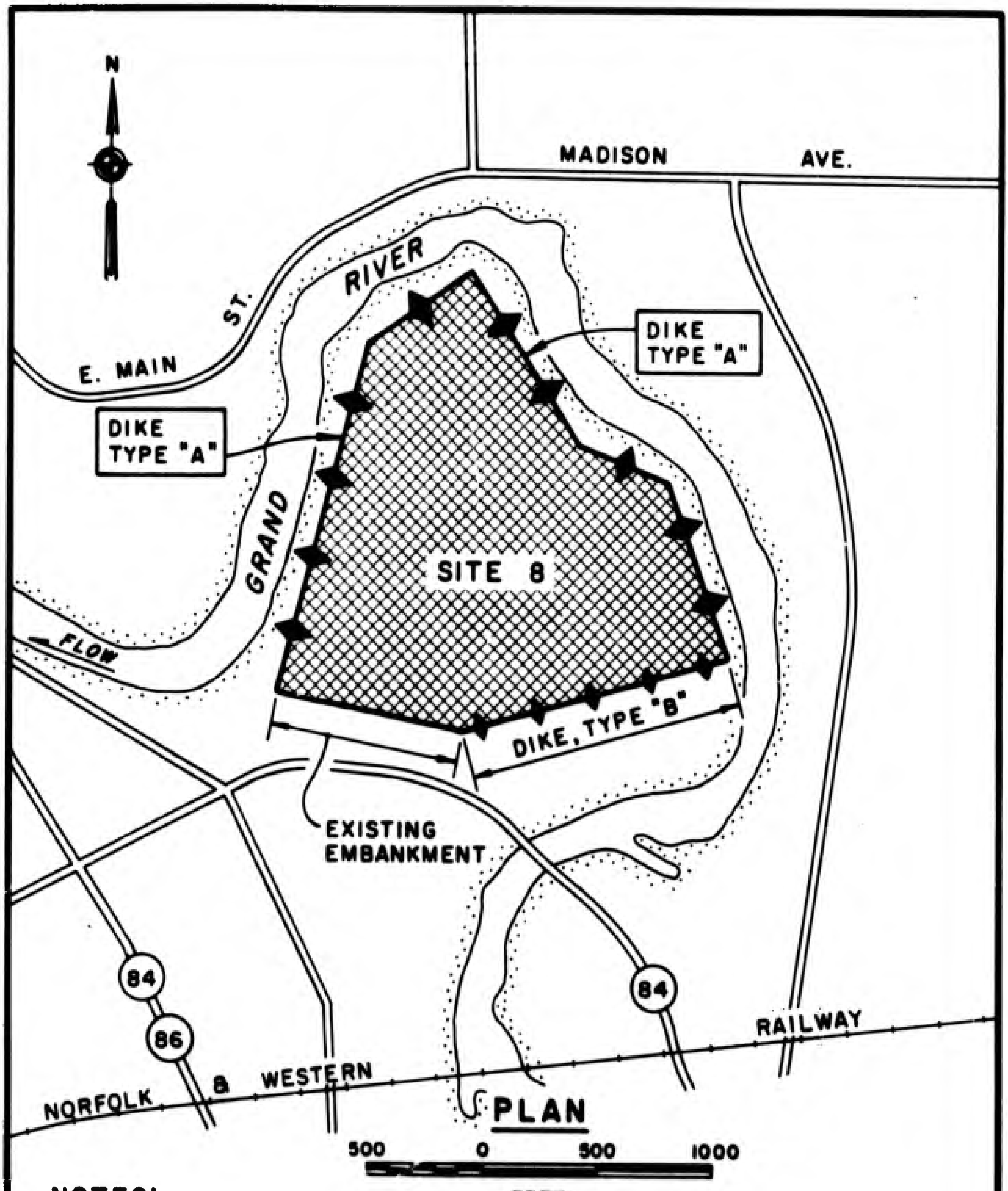
NOTES:

DIKE, TYPE "A" AND "B" = EARTH DIKE
TOP OF DIKES = EL. 610.0
TOP OF SPOIL = EL. 608.0
AVERAGE HEIGHT OF SPOIL = 18.0'
AREA OF SPOIL = 97.0 ACRES
VOLUME OF SPOIL = 2,800,000 CU. YDS.
STORAGE PERIOD = 7.0 YEARS

FAIRPORT HARBOR, OHIO

SITE 6

FIG. K6-10




**NOTES:**

DIKE, TYPE "A" AND "B" = EARTH DIKE
TOP OF DIKES = EL. 622.0
TOP OF SPOIL = EL. 620.0
AVERAGE HEIGHT OF SPOIL = 28.0'
AREA OF SPOIL = 60.0 ACRES
VOLUME OF SPOIL = 2,800,000 CU. YDS.
STORAGE PERIOD = 7.0 YEARS

FAIRPORT HARBOR, OHIO

SITE 8

FIG. K6-11

APPENDIX K

CONSIDERED ALTERNATE DISPOSAL AREAS

AT

BUFFALO DISTRICT HARBORS

CONTENTS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| Erie Harbor, Ohio | K5 |
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| Huron Harbor, Ohio | K11 |

## FOREWORD

This Appendix was prepared by the Buffalo District, U. S. Army Corps of Engineers to evaluate alternate disposal sites at harbors within the District boundaries. Studies were conducted at harbors where there is a Federal navigation project that requires periodic maintenance dredging. Possible alternate disposal sites that would contain the dredged materials for a ten-year period were analyzed at each harbor. The costs of alternate disposal methods were estimated and compared with the costs of present dredging practices.

The individual harbors were studied without knowing to what extent present dredging practices might be contributing to pollution of the Great Lakes. If these practices require modification, the use of alternate disposal areas instead of open lake disposal represents one possible alternative. Other alternatives are discussed elsewhere in the report.

APPENDIX K1

# STUDY OF
# ALTERNATE DISPOSAL AREAS
# FOR
# ASHTABULA HARBOR, OHIO

U. S. ARMY ENGINEER DISTRICT, BUFFALO
CORPS OF ENGINEERS
1776 NIAGARA STREET
BUFFALO, NEW YORK 14207

OCTOBER 1968

DREDGING AND WATER QUALITY PROBLEMS
IN
THE GREAT LAKES

APPENDIX K1

STUDY OF ALTERNATE DISPOSAL AREAS
FOR
ASHTABULA HARBOR, OHIO

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## APPENDIX K1 - ASHTABULA HARBOR

### LOCATION AND DESCRIPTION

1. Ashtabula Harbor, Ohio is located at the mouth of Ashtabula River, 59 miles east of Cleveland, Ohio. The Ashtabula River basin encompasses some 137 square miles. Details of the navigation project are shown in fig. K1-1.

2. The harbor is an important commercial port. The total waterborne commerce for 1966 amounted to 9,314,794 tons. The principal commodities in 1966 were: receipts of 5,276,682 tons of iron ore (57% of total commerce); shipments of 2,868,816 tons of limestone, (7%); and overseas imports and exports of 99,163 tons (about 1%). It is estimated that waterborne commerce will average ten million tons annually in the future.

### EXISTING CORPS OF ENGINEERS PROJECT

3. PROJECT

The existing project was authorized by the 1896, 1905, 1910, 1919, 1935, 1937, 1945, 1954, 1960, and 1965 River and Harbor Acts which provide for:

a. An outer harbor about 185 acres in area protected by breakwaters, the west breakwater 7,891 feet long, and the east breakwater 4,342 feet long.

b. A west pierhead of timber-crib substructure and concrete superstructure.

c. An east light foundation located 600 feet easterly from the west pierhead, consisting of a concrete superstructure founded on the outer end of the east breakwater.

d. The removal of 250 feet of the old inner east breakwater and of such additional lengths as may be necessary.

e. An entrance channel from deep water in Lake Erie to a point just inside the outer ends of the breakwaters, 29 feet deep in soft material and 30 feet in hard material.

f. A channel generally 1,100 feet wide through the outer harbor, parallel to and 100 feet from the west breakwater, extending from the entrance channel to just opposite the inner breakwater, 28 feet deep in soft material and 29 feet in hard material.

g. A channel extending from inside the inner breakwater to the Penn Central Railroad Company s Minnesota slip and also to a point 2,000 feet upstream from the mouth of Ashtabula River, to depths of 27 feet in soft material and 28 feet in hard material with no Federal dredging to be done within 50 feet of the docks

h. Deepening and enlarging of the turning basin in the easterly portion of the outer harbor to depths of 22 feet in soft material and 23 feet in hard material; this enlargement provides an irregularly shaped area, about 1,200 feet by 1,300 feet.

i. A modified approach channel to Penn Central's Minnesota slip at such time as the authorized conditional removal of 250 feet of the inner breakwater is accomplished; the modified approach provides for deepening to 28 feet in soft material and 29 feet in hard material, the triangular-shaped area portion of the enlarged turning basin and a rectangular-shaped area in the vicinity of the portion of the inner breakwater so removed.

j. In the outer harbor a 700-foot wide access channel leading southeastward from the harbor channel and terminating in a basin having a width of 1,200 feet and a length of 1,500 feet, all dredged to a depth of 28 feet in earth and 29 feet in rock.

k. A channel in Ashtabula River upstream of the terminus of the lower 27-foot deep river channel, to a depth of 18 feet (except where ledge rock may be encountered) with a bottom width of 160 feet decreasing to 100 feet and suitably widened at the southerly end, to the upper car-ferry slip; thence a channel 16 feet deep (except where ledge rock may be encountered) with a bottom width of 100 feet suitably widened at bends and in the turning basin, to the southerly end of the turning basin; thence a channel 16 feet deep with a bottom width of 100 feet to a point 1,550 feet upstream of the turning basin.

4. PROGRESS

Deepening of the modified approach channel to the Minnesota slip and the conditional removal of the east inner breakwater are to be restudied. The remaining parts of the existing project have been completed.

## PRESENT DREDGING PRACTICES

5. PROCEDURES

All project areas and channels are maintained annually by U. S. hopper dredges. Permit dredging is accomplished by clamshell dredges and dump scows.

6. WORKING SEASON

The available season for dredging work at Ashtabula Harbor approximates the navigation season. In recent years the earliest and latest opening and closing of navigation at the harbor were:

| | Opening | Closing |
|---|---|---|
| Earliest date | Jan 1 | Dec 3 |
| Latest date | Apr 12 | Dec 31 |

7. QUANTITY

The volume of material removed annually in maintaining the project was 130,000 cubic yards, based on records for the past 10 years. However, the future volume of material to be removed annually in maintaining the project is expected to increase to an estimated 220,000 cubic yards by virtue of the increased depths and area resulting from the recently completed projects. Permit dredging by the terminal operators to maintain dockside depths has been done 5 times in the past 10 years; in total, about 150,000 cubic yards of material were removed. Future permit dredging is expected to average 15,000 cubic yards annually.

8. TYPE OF MATERIALS

The material removed from maintenance of Ashtabula Harbor is predominantly silt, although some sand is removed from the outer harbor areas.

9. NATURE OF POLLUTION

The nature of pollution in the Ashtabula River is discussed in a report by FWPCA entitled "Lake Erie Report, A Plan for Water Pollution Control," dated August 1968. The report states that strong chemical and medicinal odors accompany the ever-present milky white or brown discoloration of Fields Brook, a tributary of the lower Ashtabula River. These conditions are caused by industries in the area which discharge organic and inorganic wastes to the river with Fields Brook as an intermediary stream. Within the Ashtabula area bacterial pollution exists from the unsewered residential areas and from raw sewage discharged by dock activities and vessels.

## PRESENT DISPOSAL PRACTICE

### 10. METHOD OF DISPOSAL

Dredged material from the harbor is disposed of by bottom dumping, from hopper dredges or dump scows, into established open lake disposal areas in the lake. There are two established disposal areas in Lake Erie at Ashtabula Harbor; one for earth and the other for rock. The earth disposal area is a ½ mile square area located 2 miles, N 45° E, from the east breakwater light and the rock disposal area, of the same size, is 2¼ miles due north from the east breakwater light. All material removed from maintenance dredging is disposed of in the earth disposal area. At the assumed future dredging rates it is estimated that the capacity of the earth disposal area within its existing limits, is sufficient to serve for 25-30 years without impeding navigation.

### 11. COST OF DREDGING

The unit cost of maintenance dredging by hopper dredge, with disposal in the earth disposal area, is $0.35 per cubic yard.

ALTERNATIVE DISPOSAL AREAS

12. GENERAL

A survey was made in 1968 to locate sites for diked disposal areas for at least a 10-year period as an alternative to the present open water lake disposal method. The overall dredging disposal problem and the need for alternate disposal areas were discussed with city officials, representatives of the Ashtabula Port Authority and local shipping interests. During these discussions numerous possible disposal areas were suggested. Subsequent research indicated that most of the proposed sites were either unavailable, too small, or too expensive. Several of the proposed sites are part of long range harbor improvement plans, currently being considered by local interests.

13. The materials dredged annually from Ashtabula Harbor and Ashtabula River channel are derived primarily from the erosion of upstream land areas and stream banks with various amounts of industrial and sanitary wastes. The suitability of this material for commercial landfill development projects is unknown at present. Several years of testing would be required to determine the long range strength characteristics of the material and its suitability for various types of development. However, any land areas created with dredged material could probably be used for recreational or agricultural purposes even if the material would not support structures.

14. A study of available information and a reconnaissance of the Ashtabula area failed to disclose any additional inland disposal areas other than those suggested by local interests. One additional offshore site was included in the study. Most of the land on the west side of the river

within a reasonable distance from the harbor is developed residential and commercial property. The majority of land on the east side of the river is developed commercial and industrial property. Land disposal areas, that would hold several years of dredging material would have to be located at least three and one half miles from the harbor. Land adjacent to Ashtabula River is developed primarily for industrial purposes and either city or township parks. Possible disposal sites near the navigation channel would have only a one to two year capacity. Six areas located along the shore, two offshore areas, three areas along the river and two inland areas were considered as possible sites. A discharge piping system with booster pumps would be required to utilize the inland sites. Some new work channel dredging would be required to use two of the small areas along the river. The remaining sites could be reached by direct pump discharge from the hopper dredge. The sites are shown in Fig. K1-2 and discussed individually in the following paragraphs.

15. SITE 1

This is a 233-acre landfill site located just east of Gerald Road and between Wade Avenue and the Penn Central Railroad. The area, appears to be undeveloped, partially wooded, with brush over the remainder of the land. The land is generally high ground, sloping towards Wade Avenue, with some low areas in the northern half of the site. A small creek flows through the area and discharges into the lake. The headwaters of this creek would have to be diverted into a nearby branch of the same creek. The capacity of the site when filled to Elevation 644.25 is approximately 2,200,000 cubic yards. This volume is equivalent to ten years of maintenance dredging material based on an average annual volume of 220,000 cubic yards. The considered plan for disposing of dredged materials at this site would provide a retention structure on three sides that ties into the railroad embankment, an overflow structure to discharge effluent into the existing creek, a mooring facility in the river, and a piping system leading to the disposal area. The retention structure would consist of an earth dike about 9,400 feet in length and varying in height up to 18 feet. The earth dike would be constructed from existing material within the disposal area. The overflow structure would consist of a 72-inch pipe constructed vertically in the dike, with removable flashboards, framed into the landfill side, and discharge pipes that connect into the other side. The mooring facility would be constructed on the west bank of Ashtabula River about one mile above the mouth. It would incorporate the necessary equipment for making and handling flexible connections between the floating plant and the fixed discharge line leading to the disposal area. Dredged material from the river and harbor would be pumped from a hopper dredge, through an 18-inch piping system, into the disposal area. The discharge system would require four booster pumps to move the material through the 20,000-foot pipeline. Details for site 1 are shown in Fig. K1-3. The haul distance from the outer dredging limit of the harbor approach channel to the mooring facility is a little under two miles. The distance from the present upstream limit of dredging in the river to the mooring facility is a little under one-quarter of a mile. The open lake disposal area, currently being used, is located two miles from the harbor.

16. The land required for site 1 is owned by several individuals. Approximately half of the property is controlled by Mr. Benham G. Cheney, a member of the Ashtabula Port Authority. The availability of this portion of the site was discussed with Mr. Cheney. He indicated that the area will soon be developed for some unstated purpose and he would prefer not to have the property used for spoil disposal. He is concerned over the unknown strength characteristics of the spoil material. The considered plan was not discussed with the other owners. It was assumed that rights to the land required for Site 1 could be purchased. The land will probably be used for future commercial development.

17. SITE 2.

This is a 75-acre landfill site located just east of State Road and between Prospect Road and the Penn Central Railroad. The area appears to be undeveloped with heavy brush covering most of the land. A 200-foot wide powerline easement separates the site from the railroad. The land is generally high ground, sloping towards the railroad, with some low areas near the railroad embankment. A drainage ditch leads from the area to a small creek that discharges into the lake. The capacity of the site when filled to Elevation 654.0 is approximately 660,000 cubic yards. This volume is equivalent to three years of maintenance dredging material. The considered plan for disposing of dredged materials at this site would provide a retention structure that completely incloses the area, an overflow structure to discharge effluent into the existing drainage ditch. A mooring facility in the river, and a piping system leading to the disposal area. The retention structure would consist of an earth dike about 6,400 feet in length and varying in height up to 12 feet. The earth dike, the overflow structure and the mooring facility would be similar to the design for site 1. The mooring facility would be constructed on the east bank of Ashtabula River about one mile above the mouth. Dredged material would be pumped from a hopper dredge, through an 18-inch piping system, into the disposal area. The discharge system would require three booster pumps to move the material through the 16,000-foot pipeline. Details for site 2 are shown in Fig. K1-4. The haul distances would be similar to those required for site 1.

18. Another plan for disposing of dredged materials at this site was considered. This plan would incorporate a temporary holding area on the east side of the river adjacent to the Penn Central Railroad yards. Dredged material would be pumped from a hopper dredge, through an 18-inch pipeline, into the holding area. A waterjet system would mix the material in the holding area and allow it to be pumped, through a 14-inch piping system, into the disposal area. The discharge system would require a bar screen and grinder, built into the intake, and three booster pumps to move the material through the 16,000 foot pipeline. The additional equipment costs, the initial land cost for the holding area and the increased annual operation and maintenance charges combine to make this plan more expensive. No further consideration was given to the use of holding areas and smaller diameter discharge systems.

19. The major portion of the land required for site 2 is owned by the Nelson Machine and Manufacturing Company. There may be several parcels owned by others. Although the considered plan was not discussed with the owners, it was assumed that rights to the property could be purchased for use as a disposal area. The land will probably be used for either future commercial or industrial development.

20. SITE 3

This is an offshore site located on the lake side of the existing east breakwater near its outer end. The site is a semicircular area with a radius of about 1,020 feet. The capacity of the site when filled to a height of 5 feet above LWD is approximately 2,200,000 cubic yards. This volume is equivalent to ten years of maintenance dredging material. The considered plan for disposing of dredged materials at this site would provide a retention structure that incloses the area, an overflow weir to discharge effluent into Lake Erie, and a mooring facility on the harbor side of the breakwater. The retention structure would consist of a cellular sheet pile dike about 3800 feet in length. The cells would be filled with granular materials and capped with concrete. The dike would be constructed to a height of 15 feet above LWD to provide adequate protection against lake storms. A seven foot thickness of graded filter material would be dumped along the lakeward slope of the existing breakwater within the disposal area to prevent the spoil from seeping through the existing rubble mound structure. The overflow weir would consist of removable flashboards framed between two sheet pile cells. The mooring facility would incorporate the necessary equipment for making and handling flexible connections between the floating plant and a fixed 18-inch discharge line leading to the disposal area. Details for site 3 are shown in fig. K1-5. The haul distance from the outer dredging limit of the harbor approach channel to the mooring facility is a little under one-half mile. The distance from the present upstream limit of dredging in the river to the mooring facility is a little under one and three-quarter miles.

21. It is assumed that any land areas created by filling this site would become the property of the State of Ohio. Possible future uses would probably be limited to some form of recreational development. The site is presently limited to access by water. There are no known objections to using this site for spoil disposal.

22. OTHER SITES INVESTIGATED

Preliminary studies of several spoil disposal areas in the Ashtabula area were discontinued before detailed designs and cost estimates were developed. These sites, shown in Fig. K1-2, are discussed briefly. Site 4 was considered as a possible offshore site for disposal of dredged material. The site is similar in most respects to Site 3. Since it is located adjacent to the west breakwater, the site has the advantage of direct land access via the breakwater. The completed landfill would be a useful addition to the nearby beaches and recreational facilities. However, effluent discharges from the disposal area and possible obnoxious odors might be detrimental to the nearby city water intakes and the bathing beach at Walnut Beach Park. The preliminary cost estimates for Site 3 have indicated that offshore disposal areas are considerably more expensive than inland areas.

23. Site 5 was suggested by city officials. It would be part of a 65-acre city owned area, located along the west bank of the river at the end of West 19th Street. The city is planning to construct a small boat marina on the northern third of the property in the near future. Another part of the area is presently being used for a landfill-refuge disposal operation by the city. The remaining land, which could be used for maintenance dredging spoil, would have a capacity for only about one or two years of dredged material. The City of Ashtabula has subsequently withdrawn this property from consideration as a disposal area. They are re-evaluating their future plans for the entire area.

24. Sites 6, 7 and 10 were suggested by city officials and are either owned or controlled by the Penn Central Railroad. Site 6 is a finger slip that is presently being used for ship salvage operations and also contains a few small boat docks. The area would have a capacity for only about one-half year of dredged material. Site 7 is an alongshore site between the inner breakwater and the Union Dock. The area is part of a long-range expansion program currently being considered by Penn Central and would have about a one and one-half year capacity. Site 10, known as the Lane Yards, is an abandoned railroad yard that is scheduled to be used for ore storage in the long-range plans of Penn Central. It would have about a two-year capacity. Representatives of the railroad indicated that spoil disposal in these areas would not fit in with their plans. They are concerned over the unknown strength characteristics of the spoil material.

25. Sites 8 and 9 were suggested as possible fill areas by Mr. Benham G. Cheney, a member of the Ashtabula Port Authority and an official of the Pinney Dock and Transport Company. Site 8 would be an alongshore disposal area adjacent to property owned by the Town of Ashtabula, Cleveland Electric and Illuminating Company, Pinney Dock and others. Site 9 would be a smaller version of Site 8 with the western boundary moved about 700 feet to the east. This would exclude property owned by Pinney Dock and several other small property owners. Mr. Cheney indicated that Site 9 should only be used in conjunction with an overall harbor improvement project. He prefers to see the area filled with virgin material, namely earth and rock from a new-work project.

The capacity of either area would be considerably over the required ten year volume and could provide a possible multiple usage disposal area in cooperation with the city, town and local industry. The Town of Ashtabula operates a recreation area, Lake Shore Park, along most of the existing shoreline of Site 9. Several unsuccessful attempts were made to obtain the views of park officials. It is assumed that many of the existing recreational activities would be restricted by a spoil disposal area at either Site 8 or 9.

26. Offshore Sites 11, 12 and 13 were suggested by Penn Central Railroad in lieu of Sites 6, 7 and 10. Site 11, owned mainly by the railroad, is an unused land and water area between the west breakwater and the Penn Central yards. It would have about a three year capacity as a disposal area. The possibility of polluting the adjacent Walnut Beach Park would probably preclude serious consideration of this site for spoil disposal. The site will probably be developed eventually as a small boat harbor. Site 12, is a narrow offshore site owned by the railroad, adjacent to the east side of Union Dock. Site 13, owned by Pinney Dock and Transport Company, extends from Site 12 to the Pinney Dock. The combined area would have about a two and one-half year capacity. The Pinney Dock Company is currently expanding its pier facilities into the bay area and probably would not be interested in having the area used for spoil disposal.

## ESTIMATES OF COSTS

27. GENERAL

Costs of the spoil retention structure, mooring facilities and spoil discharge system were estimated for each site. Land costs, where applicable, were included in the estimate for the retention structure. All costs were based on 1968 price levels. Salvage value for the booster pumps was credited to the total cost of sites 1 and 2. Salvage value of piping and mooring facilities was considered negligible at all sites. The construction period for site 3 was assumed to be two years. Total investment costs for this site included interest on the first cost over half the construction period at 3-1/4 percent, the current Federal risk-free interest rate. Sites 1 and 2 could be constructed in less than one year. Total investment was therefore equal to total first costs for these sites. No salvage or value of lands after filling was considered because future use would probably be limited to agricultural or recreational purposes.

28. Annual costs for each site included interest at 3-1/4 percent on the total investment. The investment was amortized over the ten-year filling period for site 3. The investment less salvage was amortized over the filling period for sites 1 and 2. Other annual charges included the cost of dredging 220,000 cubic yards of spoil material and disposal at the designated mooring site. Annual operation and maintenance costs were estimated for each site. Total annual costs were converted to a cost per cubic yard for comparison. Estimate for sites 1, 2 and 3 are shown in the following paragraphs.

29. Site 1

a. First Costs

| | |
|---|---|
| Spoil retention structure | \$ 607,000 (1) |
| Mooring facilities | 138,000 |
| Spoil discharge system | 1,475,000 |
| Total Investment Cost | \$2,220,000 |
| Salvage value | - 150,000 |
| Investment less Salvage | \$2,070,000 |

b. Annual Costs

| | |
|---|---|
| Interest, \$2,220,000 @ .0325 | \$ 72,000 |
| Amortization, 10 yrs., \$2,070,000 @ .0862 | 178,000 |
| Maintenance dredging, 220,000 c.y. @ \$.58 | 128,000 |
| Operation and maintenance | 140,000 |
| Total Annual Cost | \$ 518,000 |
| Cost per cubic yard | \$2.36 |

(1) Predominantly land acquisition cost

30. SITE 2

a. First Costs

| | |
|---|---|
| Spoil retention structure | $ 335,000 (1) |
| Mooring facilities | 139,000 |
| Spoil discharge system | 1,153,000 |
| Total Investment Cost | $ 1,627,000 |
| Salvage value | -320,000 |
| Investment less Salvage | $ 1,307,000 |

b. Annual Costs

| | |
|---|---|
| Interest, $1,627,000 @ .0325 | $ 53,000 |
| Amortization, 3 yrs., $1,307,000 @ .3227 | 422,000 |
| Maintenance dredging, 220,000 c.y. @ $.58 | 128,000 |
| Operation and maintenance | 124,000 |
| Total Annual Cost | $ 727,000 |
| Cost per Cubic Yard | $ 3.31 |

(1) Predominantly land acquisition cost

31. SITE 3

a. First Costs

| | |
|---|---|
| Spoil retention structure | $ 6,485,000 |
| Mooring facilities | 140,000 |
| Spoil discharge system | 60,000 |
| Total First Cost | $ 6,685,000 |
| Interest during construction | 217,000 |
| Total Investment Cost | $ 6,902,000 |

b. Annual Costs

| | |
|---|---|
| Interest, $6,902,000 @ .0325 | $ 224,000 |
| Amortization, 10 yrs., $6,902,000 @ .0862 | 595,000 |
| Maintenance dredging, 220,000 c.y. @ $.54 | 119,000 |
| Operation and maintenance | 16,000 |
| Total Annual Cost | $ 954,000 |
| Cost per Cubic Yard | $ 4.34 |

32. Cost Comparisons

A summary of costs for three of the considered alternate disposal areas is shown below. The cost of disposal in the open lake disposal area is shown for comparison purposes.

| Site | Capacity: Cu. Yds. | Capacity: Years | Cost per cubic yard ($) |
|---|---|---|---|
| Open lake | -- | 25-30 | 0.35 |
| 1 | 2,200,000 | 10 | 2.36 |
| 2 | 660,000 | 3 | 3.31 |
| 3 | 2,200,000 | 10 | 4.34 |

## DISCUSSION

33. The considered alternate disposal sites were sized to handle the estimated future volume of maintenance dredging spoil only, 220,000 cubic yards annually. It was assumed that permit dredging, estimated at 20,000 cubic yards annually, could be disposed of at the same sites if necessary. Since costs per cubic yard are being compared this analysis is considered adequate.

34. The least costly alternate disposal area at Ashtabula Harbor would be a 10-year capacity landfill site that could be found within a reasonable distance from the harbor. The owner of most of the land required for Site 1 has expressed an objection to use of the land as an alternate disposal site. It has been assumed that rights to the property could be acquired, if necessary, for this site.

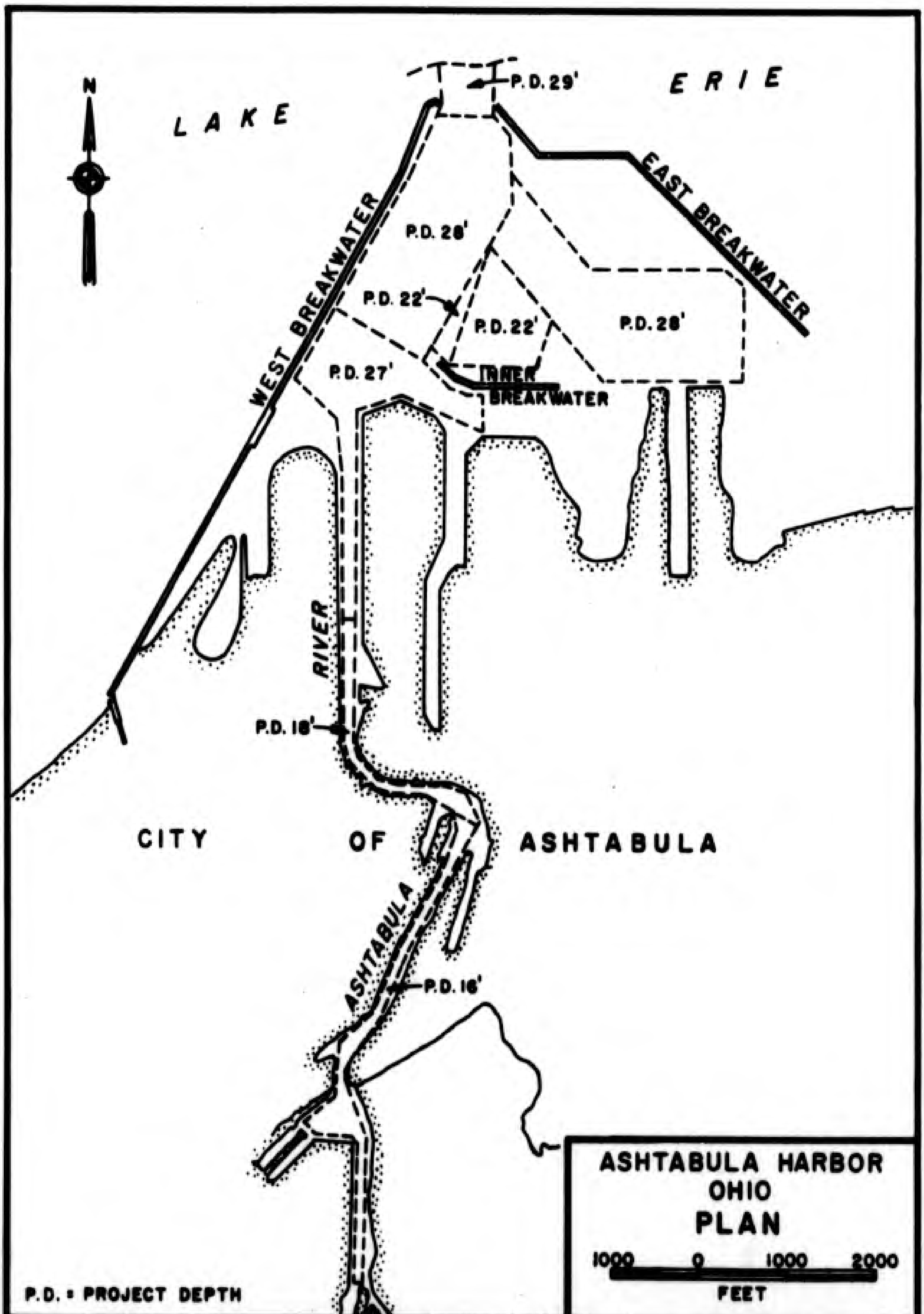
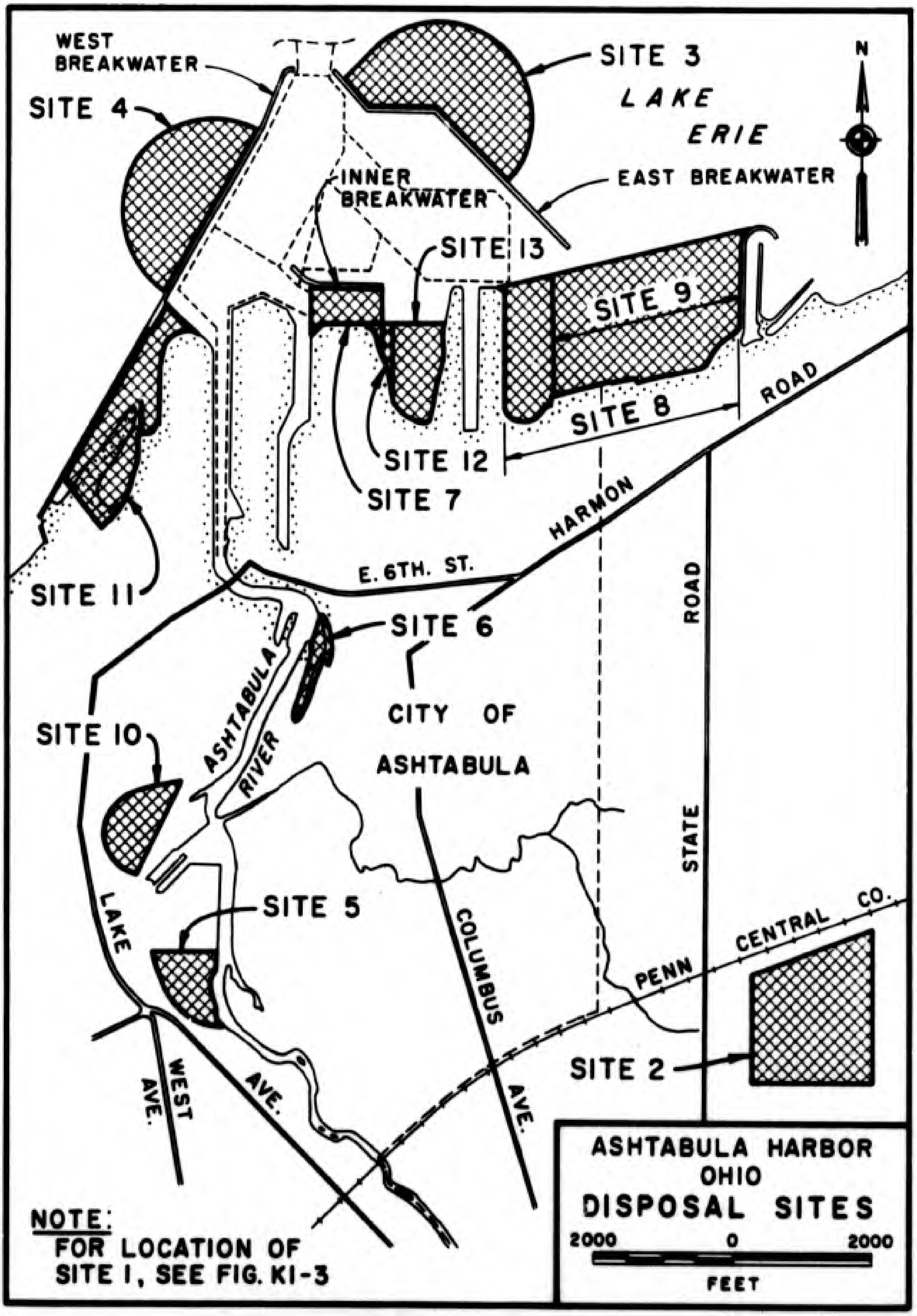

N
LAKE
ERIE
P.D. 29'
P.D. 28'
P.D. 22'
P.D. 22'
P.D. 28'
P.D. 27'
WEST BREAKWATER
EAST BREAKWATER
INNER BREAKWATER
RIVER
P.D. 18'
CITY OF ASHTABULA
ASHTABULA
P.D. 16'
P.D. = PROJECT DEPTH
ASHTABULA HARBOR
OHIO
PLAN
1000 0 1000 2000
FEET

FIG. K1-1




NOTE:
FOR LOCATION OF SITE 1, SEE FIG. K1-3

FIG. K1-2

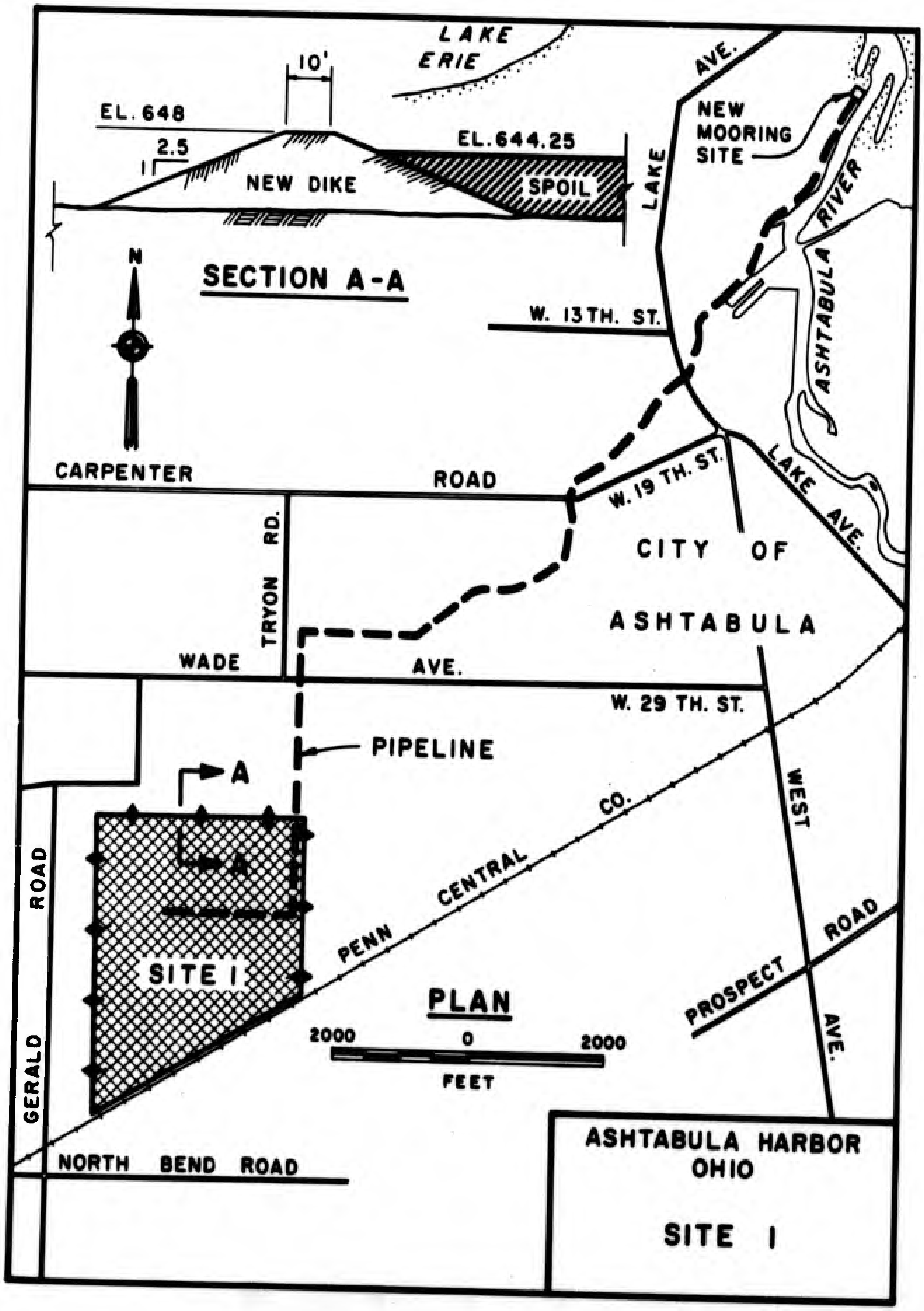

LAKE ERIE
10'
EL. 648
2.5
1
NEW DIKE
EL. 644.25
SPOIL
SECTION A-A
N
LAKE AVE.
NEW MOORING SITE
ASHTABULA RIVER
W. 13TH. ST.
CARPENTER ROAD
W. 19 TH. ST.
LAKE AVE.
TRYON RD.
CITY OF ASHTABULA
WADE AVE.
W. 29 TH. ST.
PIPELINE
A
A
WEST AVE.
PENN CENTRAL CO.
ROAD
SITE I
PLAN
2000 0 2000
FEET
PROSPECT ROAD
GERALD ROAD
NORTH BEND ROAD
ASHTABULA HARBOR
OHIO
SITE I

FIG. K1-3

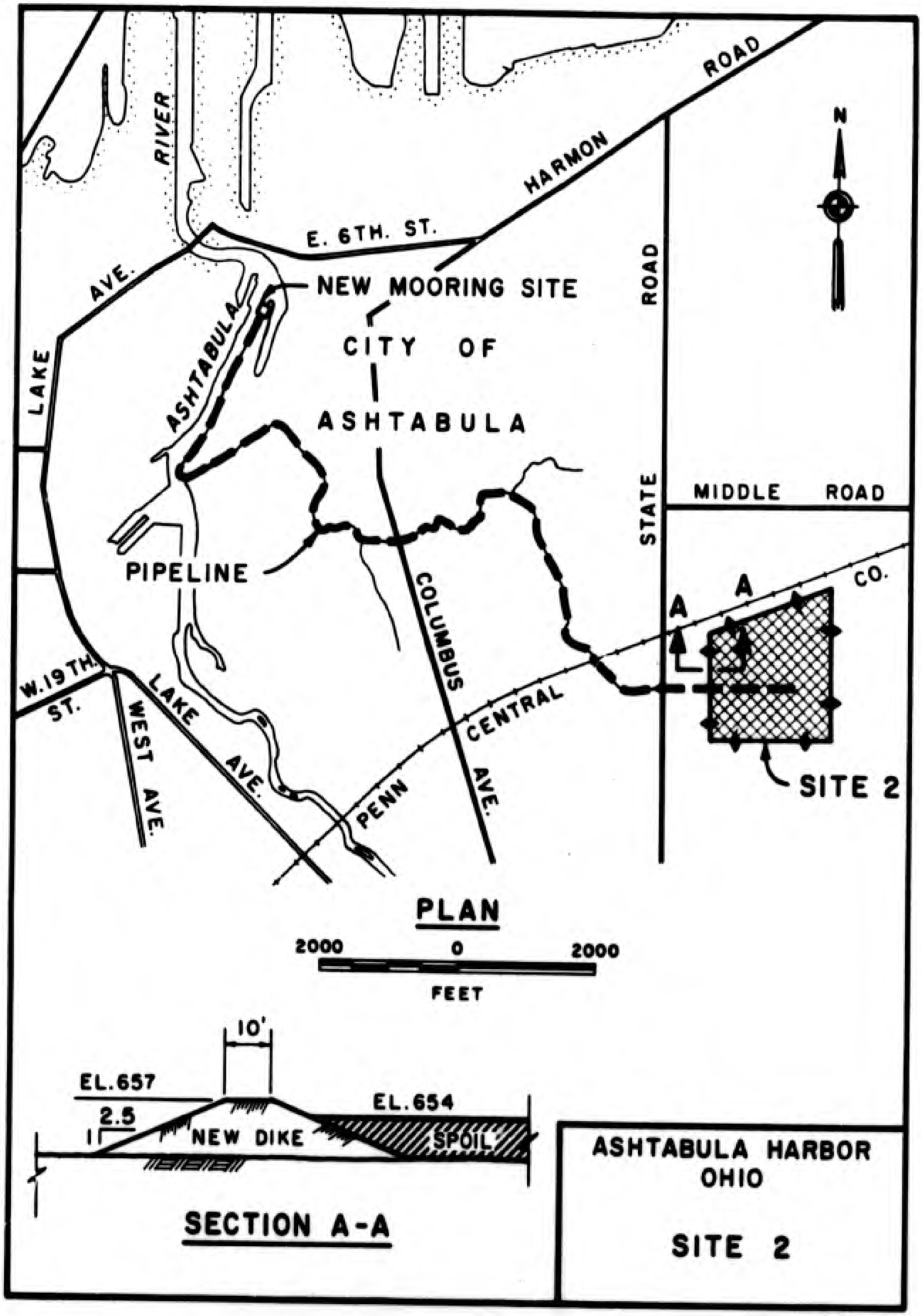
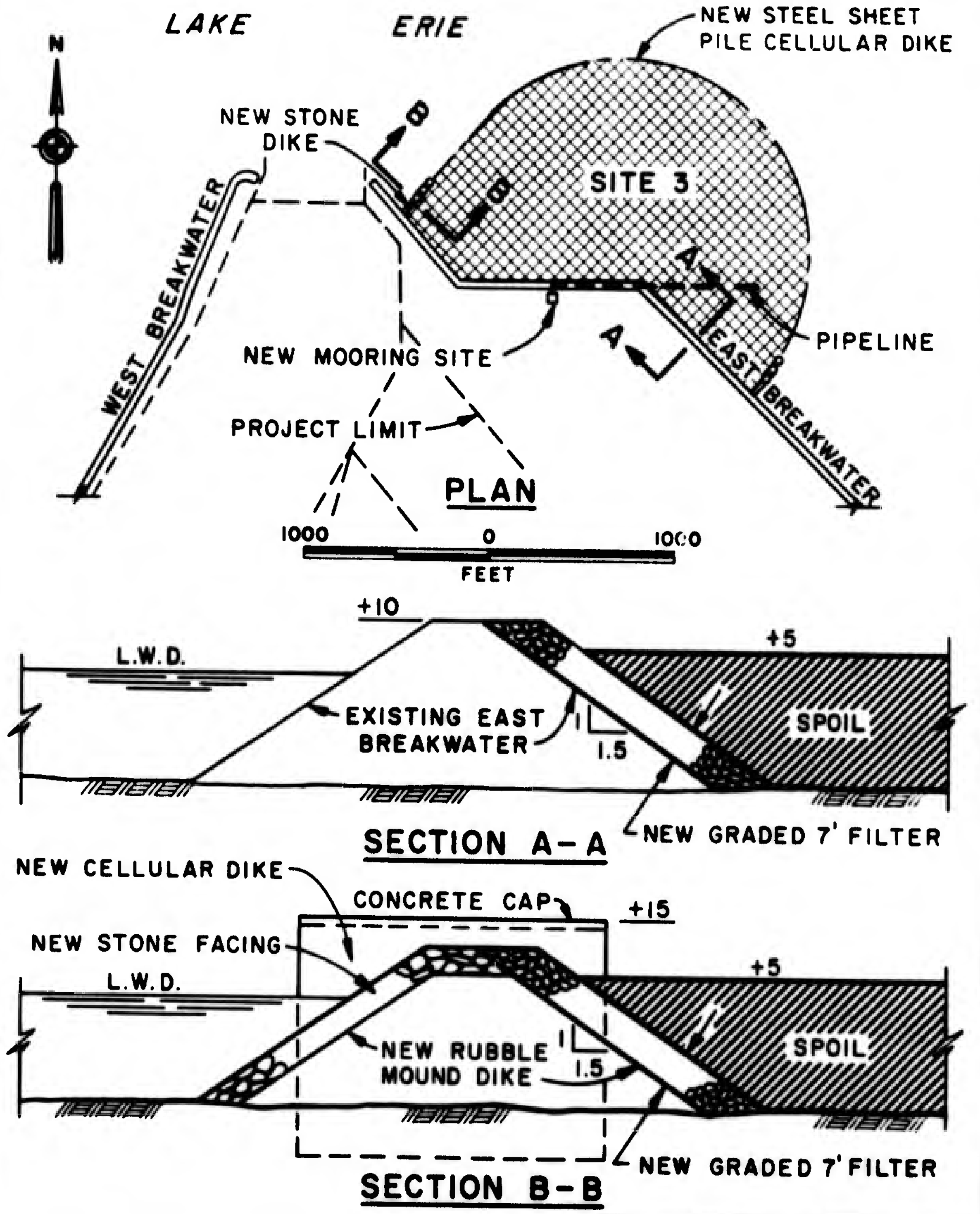

RIVER
ASHTABULA
E. 6TH. ST.
HARMON
ROAD
N
LAKE
AVE.
NEW MOORING SITE
CITY OF
ASHTABULA
STATE
ROAD
MIDDLE
ROAD
PIPELINE
COLUMBUS
AVE.
CENTRAL
PENN
CO.
A
A
SITE 2
W. 19 TH.
ST.
WEST
AVE.
LAKE
AVE.
PLAN
2000
0
2000
FEET
10'
EL. 657
2.5
1
NEW DIKE
EL. 654
SPOIL
SECTION A-A
ASHTABULA HARBOR
OHIO
SITE 2

FIG. K1-4




ASHTABULA HARBOR
OHIO

SITE 3

FIG. KI-5

APPENDIX K2

STUDY OF

ALTERNATE DISPOSAL AREAS

FOR

BUFFALO HARBOR, NEW YORK

U. S. ARMY ENGINEER DISTRICT, BUFFALO
CORPS OF ENGINEERS
1776 NIAGARA STREET
BUFFALO, NEW YORK 14207

OCTOBER 1968

DREDGING AND WATER QUALITY PROBLEMS
IN
THE GREAT LAKES

APPENDIX K2

STUDY OF ALTERNATE DISPOSAL AREAS
FOR
BUFFALO HARBOR, NEW YORK

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## APPENDIX K2 - BUFFALO HARBOR

## LOCATION AND DESCRIPTION

### 1. INTRODUCTION

Considered alternate disposal sites in this Appendix were sized to include storage of spoil from three contiguous navigation projects in the Buffalo area; Buffalo Harbor, Tonawanda Harbor, and Black Rock Channel. Tonawanda Harbor is located about 13½ miles north of Buffalo Harbor. Black Rock Channel is a separate project which includes a navigation channel, about eight miles in length, extending north from Buffalo Harbor. The Black Rock Channel project is required to navigate from Buffalo to Tonawanda Harbor.

### 2. BUFFALO HARBOR

Buffalo Harbor, New York is located at the east end of Lake Erie, just above the head of Niagara River. The inner harbor channels are in the lower reaches of Buffalo River, which has a drainage basin encompassing some 446 square miles. The outer harbor extends southerly from the mouth of Buffalo River in the City of Buffalo to the adjoining City of Lackawanna. The existing Buffalo Harbor navigation project is shown in fig. K2-1.

3. Buffalo is an important commercial port. The total waterborne commerce for 1966 amounted to 16,549,225 tons and for the 10-year period, 1957-1966 inclusive, has averaged 14,523,624 tons. The principal commodities in 1966 were: receipts of 9,124,758 tons of iron ore (55% of total commerce); receipts of 2,960,871 tons of limestone (18%); receipts of 1,690,196 tons of wheat (10%); receipts of 370,565 tons of bituminous

coal (2%); shipments of 314,508 tons of pig iron (2%); receipts of 188,463 tons of corn (1%); and overseas import and export of 75,634 tons of general cargo. Future waterborne commerce at Buffalo Harbor is expected to average 14,500,000 annually.

4. BLACK ROCK CHANNEL AND TONAWANDA HARBOR

The Black Rock channel and Tonawanda Harbor projects extends navigation from the north entrance, Buffalo Harbor to the City of North Tonawanda, New York. Tonawanda Harbor provides access to the western end of the New York State Barge Canal. Details of the Federal projects are shown in fig. K2-2.

5. The total waterborne commerce at Tonawanda Harbor for 1966 amounted to 2,107,183 tons, and for the 10 year period 1957-1966 inclusive, has averaged 3,096,353 tons. The principal commodities in 1966 were receipts of 814,047 tons of bituminous coal (39% of total commerce); receipts and shipments of 580,876 tons of petroleum products (28%); receipts of 265,819 tons of iron ore (13%); and receipt of 122,360 tons of sand and gravel (6%). Future waterborne commerce at Tonawanda Harbor is expected to average 3,100,000 tons annually.

EXISTING PROJECT

6. BUFFALO HARBOR

The existing project was authorized by the 1826, 1866, 1874, 1896, 1899, 1900, 1902, 1907, 1909, 1910, 1912, 1919, 1927, 1930, 1935, 1945, 1960, and 1962 River and Harbors Acts which provide for:

a. An outer harbor about 4-1/2 miles long and 1,600 feet wide, formed by a breakwater system, approximately parallel to the lake shore extending from Stony Point to the head of Niagara River, with entrances near the north and south ends, and consisting of the Stony Point breakwater (including the south entrance arm) 3,603 feet long; the south breakwater 10,200 feet long; the old breakwater 7,608 feet long including a 982-foot opening for the north entrance channel; the north breakwater 2,203 feet long; a south entrance 550 feet wide; a centrally located circulation gap about 150 feet wide and natural depth of 20 feet; and a north entrance 800 feet wide.

b. A south pier at the entrance to the inner harbor (Buffalo River).

c. A west breakwater, 1,800 feet in length, located in Lake Erie, 2,475 feet westerly of the north entrance channel opening in the existing breakwater.

d. A depth of 28 feet in the portion of the outer harbor south of a line prependicular to and 2,000 feet north of the southerly end of the south breakwater with the easterly project limit 50 feet from the harbor line, a depth of 27 feet over a 500-foot width, 2,500 feet northward from the 28-foot project area widening within a distance of 1,700 feet to the westerly project limit 150 feet from the axis of the breakwaters and to within 75 feet of the harbor line on the easterly side and continuing northward within these limits for a distance of 7,000 feet, a depth of 23 feet north of the 27-foot project area, with the westerly project limit 150 feet from the axis of the Old breakwater and the easterly project limit 100 feet from the harbor line, and a depth of 23 feet in the remainder of the outer harbor north of the 28-foot area and westerly of the 27-foot area, to within 150 feet of the axis of the South breakwater.

e. Removal of two shoal areas in Lake Erie located about 3-1/4 miles from the South Pierhead light, to a depth of 27 feet; and deepening to 30 feet the shoals located on the approach to the south entrance channel on the navigation course, 11,000 feet from the south entrance, in an area 1,000 feet by 2,800 feet.

f. A south entrance channel consisting of: an outer channel 30 feet deep, 1,000 feet wide, from deep water in the lake to a point just lakeward of the south pierhead light; an inner channel 29 feet deep from the outer area limit flaring to between the 500-foot wide opening between the end of the south breakwater and the angle junction point of the south entrance and Stony Point breakwater; the inner area channel then joining the 28-foot south outer harbor.

g. A north entrance channel, 800 feet wide with a depth of 25 feet in soft material and 26 feet in hard material, from deep water in the lake to the outer harbor.

h. A depth of 22 feet in soft material and 23 feet in hard material in the Buffalo River entrance channel from the outer harbor to the junction of the Buffalo River and Buffalo Ship Canal, with widening of the entrance channel at its southerly junction with the outer harbor. In this widened portion, the southerly project limit of the entrance channel is 10 feet from the bulkhead and the remainder of the southerly project limit is 5 feet from the south pier and the northerly project limit 40 feet from the dock of the Erie-Lackawanna Railroad Company.

i. Channels with depths of 22 feet in soft material and 23 feet in hard material in Buffalo River to the upper Erie-Lackawanna Railroad Company bridge and in Buffalo Ship Canal a distance of about one mile upstream from its confluence with Buffalo River; with widths generally of 150 and 125 feet; respectively, without dredging closer than 25 feet to dock lines except at bends, and with the rock ledge just above the Ohio Street bridge cut back approximately 13 feet.

7. BLACK ROCK CHANNEL AND TONAWANDA HARBOR

The existing project was authorized by the 1888, 1902, 1905, 1916, 1919, 1922, 1925, 1934, 1935, 1945 and 1954 River and Harbor Acts which provide for:

a. A channel 21 feet deep from Buffalo Harbor north entrance channel, to opposite Sixth Avenue, North Tonawanda, total length 13-1/2 miles, as follows: from Buffalo north entrance channel to the foot of Maryland St., Buffalo, a distance of about 4,200 feet, about 1,000 to 500 feet wide, with a short branch channel leading to Erie Basin; thence 350 feet wide, narrowing to 200 feet wide, 500 feet northwest; thence generally 200 feet wide, through Black Rock Channel to the ship lock at the foot of Bridge Street, a distance of 3.3 miles, widening at the curve opposite the foot of Porter Avenue and at the angle immediately south of the International Bridge. From the lock the channel is 400 feet wide in the Niagara River to the natural deepwater pool at the upstream end of Rattlesnake Island, a distance of 3.4 miles; thence through natural deepwater to the downstream end of the deepwater pool at the Tonawanda waterworks intake crib, a distance of about 4.7 miles, widened to 500 feet opposite the Colorado Iron & Fuel Corporation's plant, by the removal of 200 feet of the westerly end of Rattlesnake Island Shoal; thence 400 feet wide to the foot of Tonawanda Island opposite Second Avenue, North Tonawanda, a distance of 5,000 feet, ending in a turning basin about 1,230 feet long and 1,250 feet wide extending to a point opposite Sixth Avenue.

b. The removal of rock shoals from the Lake Erie entrance to the canal, and in the canal south of the Ferry Street Bridge, to a depth of 22 feet.

c. A channel 6,800 feet long, and generally 400 feet wide in Tonawanda inner harbor. The lower 1,500 feet to be 21 feet deep and the remainder 16 feet deep.

d. A channel 16 feet deep, 1,400 feet long, and generally 180 feet wide in Tonawanda Creek.

e. A ship lock.

f. The repair and 800-foot extension of Bird Island pier.

g. The improvement and extension of the guide pier and the repair of the towpath wall.

8. PROGRESS

The Buffalo Harbor project was completed in 1965. The Black Rock Channel and Tonawanda Harbor project is about 89 percent complete. The work remaining to be done consists of: improvement and extension of the guide pier which is considered to be inactive; and deepening of the lower 1,500 feet of the Tonawanda Inner Harbor which is to be restudied.

## PRESENT DREDGING PRACTICES

### 9. PROCEDURES

All project areas and channels are maintained annually; the outer harbor, entrance channels, Black Rock Channel and Tonawanda Harbor by U. S. hopper dredged and Buffalo River and Buffalo Ship Canal by contract with use of clamshell dredge and dump scows. Some of the permit dredging for dock owners at the harbor is accomplished by the Government's Buffalo River maintenance contractor, under separate contracts with the individual owners, concurrently with the Government work, using the same plant and procedures. Other permit dredging is accomplsihed during the course of the year with the same kind of plant.

### 10. WORKING SEASON

The available season for dredging work approximates the navigation season. In recent years the earliest and latest opening and closing of navigation at Buffalo Harbor were:

| | Opening | Closing |
|---|---|---|
| Earliest date | 20 Mar | 17 Dec |
| Latest date | 28 Apr | 31 Dec |

### 11. QUANTITY AND TYPE OF MATERIALS

Over the past 10 years the volume of material removed annually in maintenance of the Buffalo Harbor project has averaged 456,000 cubic yards by Government hopper dredges and 134,000 cubic yards by contract.

During the last several years there has been a reduction in the amount of required dredging, possibly as a result of improved agricultural methods employed upstream in the Buffalo River basin. Taking this into consideration it is estimated that in the future, maintenance dredging volumes at Buffalo Harbor will average 400,000 cubic yards by hopper dredge and 125,000 cubic yards by contract annually. At Black Rock Channel and Tonawanda Harbor it is estimated that future maintenance dredging will average 100,000 cubic yards annually, to be removed by hopper dredge. Future permit dredging requirements are expected to be about 50,000 cubic yards annually at Buffalo and about 15,000 cubic yards in the Black Rock Channel. The material dredged consists primarily of sand and silt which has been deposited since the area was last dredged.

12. NATURE OF POLLUTION

The nature of pollution in the Buffalo River is discussed in a report by FWPCA entitled "Lake Erie Report, A Plan for Water Pollution Control," dated August 1968 - The report states that the river is a repulsive holding basin for industrial and municipal wastes under prevalent sluggist flow conditions. The water is devoid of oxygen and almost sterile. Oil, phenols, color, oxygen-demanding materials, iron, acid, sewage, and exotic organic compounds are present in large amounts. Thick films of oil are present on the water surface at all times except during flood conditions. During high flows, oils and other contaminants are flushed into the Niagara River where they interfere with water intakes, and recreational and wildlife uses. Polluted wastes travel both upstream and downstream from Buffalo Harbor contaminating the Black Rock Channel and Tonawanda Harbor.

13. METHOD OF DISPOSAL

Prior to 1967, material dredged in maintenance and permit work was disposed of by bottom dumping from hopper dredges or dump scows into the established open lake disposal area in Lake Erie. About 100,000 cubic yards of polluted maintenance dredging spoil from the Buffalo River in 1967, and 120,000 cubic yards in 1968, were placed in a diked disposal area in Buffalo outer harbor as a part of the Pilot Program. The remainder of the dredged material was disposed of in the open lake disposal area.

14. DISPOSAL AREAS

There are two established open lake disposal areas for Buffalo Harbor, Black Rock Channel and Tonawanda Harbor; one for disposal of hopper dredged material and the other for disposal of material from contract maintenance and new work dredging. The hopper dredge disposal area is located 1.4 miles, S 25° W, from South Buffalo Pierhead Light. Specific boundaries are not defined; the dredges use this point as the approximate center of their turn to return to the harbor and generally discharge their loads while turning. The other disposal area, used for disposal of all types of material, is presently about one square mile in area and located 4/5 of a mile, S 5°-30'E, from South Buffalo Pierhead Light. Generally, the southerly portion of this area is used for disposal of hard material and the northerly portion for disposal of soft material. Capacities of the existing disposal areas are not clearly established. Specific location for disposal is now based upon periodic inspection soundings and, from year to year, the outer limit is adjusted farther lakeward as necessary to accommodate the volume of spoil expected for the period.

15. The diked area used for disposal of the maintenance dredging spoil from the Buffalo River during 1967 and 1968 is shown in fig. K2-1. It is an alongshore site, adjacent to a small-boat harbor, inclosed with slag dikes. In 1967 the spoil was transferred mechanically from scows. The site has the capacity to hold maintenance dredging spoil for about one more year. Starting about 1970, the area known as "Times Beach," discussed later in this Appendix as site 2, has been proposed for Buffalo River spoil disposal.

16. COST OF DREDGING

The unit cost for outer harbor and entrance channel maintenance dredging by hopper dredge with disposal in the lake is approximately $0.36 per cubic yard. The latest contract cost for maintenance dredging in the inner harbor channel with disposal in the lake averaged $1.55 per cubic yard. The latest contract ccst for maintenance dredging in this area with disposal in a diked area in the outer harbor is $4.58 per cubic yard. This cost does not include the cost of constructing the dike. The unit cost for dredging the Black Rock Channel and Tonawanda Harbor by hopper dredge with disposal in Lake Erie is approximately $0.75 per cubic yard.

## ALTERNATE DISPOSAL AREAS

### 17. GENERAL

A survey was made in 1968 to locate sites for diked disposal areas for at least a 10-year period as an alternative to the present open lake disposal. Considered sites were sized to handle the estimated future volumes of maintenance dredging, 625,000 cubic yards annually. This volume includes 400,000 cubic yards in Buffalo Harbor, 125,000 cubic yards in Buffalo River, and 100,000 cubic yards from Black Rock Channel and Tonawanda Harbor. It was assumed that the total volume of permit dredging, estimated to be 65,000 cubic yards annually, could be disposed of in the same sites if necessary. The problem of securing disposal areas adequate for disposal of such large volumes is complicated by the limited dimensions of the available lakefront and the developments within the harbor area. The outer harbor is protected by approximately four miles of offshore breakwater. Within this four mile length of harbor the shore line is occupied by developments of the Niagara Frontier Port Authority encompassing several port terminals, piers and small boat facilities as well as City piers, slips and private commercial port installations. The areas available for development are limited and include the disposal area presently being filled with polluted spoil from Buffalo River under the Pilot Study program and an area known as "Times Beach," adjacent to the U. S. Coast Guard Station which will be the next site used under this program. The development of both of these areas is in conformance with the desires of the Port Authority and officials from the City of

Buffalo. Landfill sites in the Buffalo area are in great demand by industry and local municipalities for disposal of solid wastes and other refuse. The landfill sites investigated were already scheduled for use by others or were inaccessible. The individual sites studied are shown in Fig. K2-3 and discussed in the following paragraphs.

18. SITE 1

This is an offshore site that would be formed by construction of a steel pile cellular wall on a semicircular alignment, confining an area just lakeward of the existing stone south breakwater; placement of a filter on the lakeward slope of the existing breakwater for the full length within the enclosed area; and provision of two cellular dolphins for mooring on the harbor side of the existing breakwater. The cellular structure would be designed for a depth of about 30 feet below LWD and would extend to a height of 15 feet above LWD to protect the spoil area from lake storms. The mooring facility would incorporate the necessary equipment to tie up floating plant and to make pipeline connections between the plant to be pumped out and fixed discharge lines installed along the top of the existing breakwall. The capacity of the disposal area is about 6,250,000 cubic yards, sufficient to contain the maintenance dredging spoil from the Buffalo area for a 10-year period. Details of Site 1 are shown in fig. K2-4.

19. Since the diked disposal area is situated lakeward of the outer harbor south breakwater about midway between the north and south entrance channels, the site does not constitute an obstruction to navigation channels and would be available for spoil disposal. It is assumed that the land area created by this plan would become the property of the State of New York. Future use of the property would probably be limited to some form of recreational development because there would be no land access and the unknown strength characteristics of the spoil material would probably preclude more productive uses.

20. SITE 2

This is an alongshore site, known locally as "Times Beach," that comprises an undeveloped reach of the shoreline within the outer harbor adjacent to the southerly boundary of the U. S. Coast Guard Station. The area is about 2000 feet long by 1200 feet wide and will contain approximately 625,000 cubic yards when filled to an elevation eight feet above LWD. The capacity of the area is adequate for about 5 years of grossly polluted maintenance dredgings from the Buffalo River only. The elevation of adjacent property on the northerly, easterly and about half of the southerly boundaries of the area is about ten feet above LWD. The area is unused, unsightly and unattended. Utilization of this area for spoil disposition was anticipated by placement of rock fill, made available during previous harbor deepening operations, to form portions of a dike along the lakeward side of the area. It would be necessary to complete the dike structure to utilize the site. The spoil would be transferred from dump scows to the disposal area by either pumping from a mooring facility or unloading by clamshell crawlers and trucking the spoil to the site. Preliminary studies indicate that rehandling and trucking would be the least costly method of disposal. Spoil was pumped to site 9 during the 1968 dredging season. Plugged pipelines and delays resulted in costs that were somewhat higher than the rehandling and trucking estimate. The actual method to be employed would be left to the discretion of the contractor who does the work. The haul distance from Buffalo River to site 2 is about four miles less than the distance to the open lake disposal area. Details of site 2 are shown in fig. K2-5.

21. The site is presently available for spoil disposition. Approximately 46 acres, comprising the underwater land in the area, is currently being transferred from the Federal Government to the City of Buffalo with the reservation that the Federal Government may utilize the area for spoil disposal within the next seven year period. The remaining 11 acres are owned by the city and will be made available for filling with dredged material. After the site is filled, the property will probably be developed by the city for a park or other recreation facilities. Construction of the necessary facilities to utilize this site has been proposed for 1969 as an interim measure prior to possible authorization and construction of a ten-year plan for alternate disposal of maintenance dredgings in the Buffalo area. The site could be used to hold the total maintenance dredging volume for one year in lieu of the five-year plan discussed above. The cost of each plan for site 2 is shown later in this Appendix.

22. SITE 3

This is a landfill site situated on the easterly side of the harbor, south of the Buffalo River and bounded on the east by extensive railroad yards. The area is owned by Republic Steel Corporation and was formerly a ship dockage area connected to the Buffalo Ship Canal. The connecting waterway was filled some years ago during reconstruction of the super highway adjacent to the area. A portion of the underwater area was also filled with spoil material from new work dredging operations. The capacity of the site is estimated at 3.6 million cubic yards which would be adequate for over 5 years disposition of all maintenance dredging in the Buffalo area. Development of the area would require construction of an earth embankment to retain the spoil which would be pumped from the nearest point in the harbor. The cost of utilizing site 3 for disposition of maintenance dredging has not been estimated because the owner, Republic Steel Corporation, plans to use the area in the near future for disposition of solid waste products from their operations. It is noteworthy that this area has also been considered for disposition of other materials including city refuse. The general location of site 3 is shown in fig. K2-3.

23. SITE 4

This is part of an offshore area being considered by Bethlehem Steel Corporation for slag disposal. Since 1900, Bethlehem Steel has disposed of its slag and certain other waste and by-product materials by filling the adjacent water of Lake Erie to an elevation approximately 45 feet above lake level. Several grants were issued by the State of New York during the period 1900-1959 for this purpose and approximately 543 acres of underwater property has been transformed into dry land and used for expansion of the Lackawanna Plant. The area currently being considered by Bethlehem Steel contains approximately 620 acres which is in addition to some 80 acres that were requested in 1966. The area would be inclosed by a cellular retaining structure beginning at the lakeward end of the existing south entrance channel breakwater, extending approximately 3,000 feet westerly, thence 9,000 feet southerly to a point opposite the outlet from Smokes Creek, thence approximately 5,300 feet southeasterly to meet the existing shoreline just north of the village of Woodlawn. The approximate location is shown in Figure K2-3.

24. Bethlehem Steel has suggested that the area within the proposed inclosure could be used by the Government for spoil disposal as well as their own interests. The area has sufficient capacity to contain the maintenance dredging spoil combined with the Bethlehem disposal materials for many years. It appears that all of the spoil materials could be deposited simultaneously thereby forming

a well-consolidated mass. Because of its proximity to the south entrance channel, the effect of the spoil inclosure on navigation will have to be model studied. A model study would also be necessary to determine the effects of the inclosure on lake currents in the vicinity of water intakes for the Wanakah Water Works, Erie County Water Authority and City of Buffalo.

25. The New York State Conservation Department, Division of Water Resources has jurisdiction over the use of underwater lands in New York State and has directed Bethlehem Steel to discontinue the practice of slag disposal in Lake Erie by 31 December 1968. The State is studying the proposed inclosure project but has rendered no commitment as of September 1968. Since the inclosure project was first proposed by Bethlehem Steel in January 1968, the company has engaged the services of a marine biologist to make a study of offshore fisheries and their relation to solid waste disposal operations and has also arranged with the St. Anthony Falls Hydraulic Laboratory, University of Minnesota, to perform a model study of the considered inclosure. These investigations are still incomplete.

26. During the last few months Bethlehem has conducted as extensive search for all possible land disposal areas within a 25-mile radius of the Lackawanna Plant. Their search disclosed only three sites worthy of consideration. The largest of these is referred to as site 3 in this report and the others are referred to as sites 7 and 8. Bethlehem considers site 3 unobtainable, site 8 as too small and site 7 questionable because of the heavy traffic that would be created by slag hauling equipment.

27. For the purposes of this report a portion of the area considered by Bethlehem Steel would be sufficient to hold ten years of maintenance dredging material fron the Buffalo area. This area, referred to as site 4, would hold 6,250,000 cubic yards of maintenance dredging spoil when filled to an average depth of 14 feet above LWD. It would require a cellular retaining structure, about 4,400 feet long, extending in a circular arc from the south entrance channel breakwater to existing high ground owned by Bethlehem Steel. Mooring facilities would be provided so that spoil could be pumped from floating plant to the disposal area. This design is considered adequate to estimate the cost of a single purpose project for alternate spoil disposal. It is assumed that the cost allocated to spoil disposal in the event that the Bethlehem Steel proposal is approved would be no more than the cost of the single purpose project. Details of site 3 are shown in fig. K2-6.

28. SITE 5

The general location of this landfill site is shown in Fig. K2-3. The site is a reach of the old Erie Canal which parallels the Niagara River downstream from the South Grand Island Bridge. A length of about 4000 feet of old canal has not been filled and could be used for disposal of maintenance dredging. The width of the site is limited, being bounded on the east by the River Road highway and on the west by the bank of the Niagara River. The width of the spoil area would be less than 100 feet at the bottom, assuming that the existing dike along the river side would be built up to contain about a 15 foot depth of fill. The site would hold less than one years maintenance dredging spoil, and the costs required to construct the confining embankment would be relatively large. The added costs to rehandle dredged material into the area would further compound an uneconomical situation. For these reasons no detailed estimates were prepared and the study of site 5 was discontinued.

29. SITE 6

This landfill site is located on Strawberry Island, a low offshore area in the Niagara River about one-half mile upstream from Grand Island. The existing island is roughly horseshoe shaped, about 2,000 feet long, 1,300 feet wide and rises about 12 feet above water at the highest point. The interior of the island has been excavated to about 25 feet below LWD to remove the natural sand and gravel deposits. The upstream end and flanks of the island have been preserved because of their control over the division of river flow around Grand Island. About 200,000 cubic yards of material have been removed by hydrualic dredging under a Government permit. The Town of Tonawanda acquired ownership of the island after removal of the interior sand and gravel materials.

30. Officials of the Town of Tonawanda were contacted regarding the availability of the site for alternate spoil disposal. The town officials indicated that there is a growing need for sites for disposal of solid waste products in the town and Strawberry Island would be reserved for that future use. They are also concerned with the preservation of a water supply intake which is located upstream from the island. The intake pipe crosses the southeasterly corner of Strawberry Island.

31. The capacity of the site when filled to an average depth of ten feet above LWD is about 700,000 cubic yards. This would accomodate the Black Rock Channel maintenance material for about 7 years or the total maintenance dredging in the Buffalo area for slightly over one year. Because of the

limited capacity, no further consideration was given to site 6. The general location of the site is shown in fig. K2-3.

32. SITES 7 and 8

These are undeveloped landfill sites located 10 to 12 miles south of Buffalo Harbor. The sites are over a mile inland from the lakefront, east of the main lines of the Penn Central Railroad and about 120 feet above the elevation of the lake. Site 7 would have a capacity of 1,800,000 cubic yards and site 8 would hold about 400,000 cubic yards. Total capacity of the two sites would be equivalent to about 3-1/2 years of maintenance dredging from the Buffalo area. The high cost of transporting spoil to the sites would make them far more expensive than other sites investigated near the harbor. The spoil would have to be hauled from the harbor by rail or truck after an expensive rehandling operation. There is no harbor closer than Buffalo and transporting dredged material ashore from an offshore anchorage is not practical. The general location of sites 7 and 8 are shown in fig. K2-3.

33. SITE 9

This is an alongshore site, inclosed by a slag dike, that is currently being filled as part of the Pilot Study program. About 220,000 cubic yards of maintenance dredging spoil from Buffalo River has been deposited in the site during dredging operations in 1967 and 1968. The site is expected to hold the dredging spoil from Buffalo River for at least one more year. The general location of the site is shown in fig. K2-3.

## ESTIMATES OF COSTS

34. General

The costs of the diked inclosure, mooring facilities and spoil discharge system were estimated for sites 1 and 4. All costs were based on 1968 price levels. It was assumed that the construction period for each would be two years. Total investment costs would include interest on the first cost over half the construction period at 3-1/4 percent, the current Federal risk-free interest rate. The estimated first costs for two considered plans at site 2 are also shown. Site 2 could be constructed in one year and first costs would be equal to investment costs. Costs for the other considered sites are not shown.

35. Annual costs for each site include interest and amortization over the filling period at 3-1/4 percent on the total investment. The annual cost of dredging and disposal at each site was estimated. The operation and maintenance costs were added to the other annual costs and the total was divided by the annual volume to obtain costs per cubic yard for comparison. The costs for each of the three sites are shown in the following paragraphs.

36. SITE 1

a. First Costs

| | | |
|---|---|---|
| Spoil retention structures | | $ 9,500,000 |
| Mooring facilities | | 140,000 |
| Spoil discharge system | | 80,000 |
| Total First Cost | | 9,870,000 |
| Interest during construction | | 320,000 |
| Total Investment cost | | 10,190,000 |

b. Annual Costs

| | | |
|---|---|---|
| Interest and amortization, $10,190,000 @ .1187 | | $ 1,210,000 |
| Dredging costs: | | |
| Buffalo River | 125,000 @ $4.60 | 575,000 |
| Buffalo Harbor | 400,000 @ $0.47 | 188,000 |
| Tonawanda/Black Rock | 100,000 @ $0.94 | 94,000 |
| Operation and maintenance | | 25,000 |
| Total Annual Cost | | $ 2,092,000 |
| Cost per Cubic Yard | | $3.35 |

37. SITE 4

a. First Costs

| | |
|---|---|
| Spoil retention structures | $ 7,400,000 |
| Mooring facilities | 140,000 |
| Spoil discharge system | 80,000 |
| Total First Cost | $ 7,620,000 |
| Interest during construction | 250,000 |
| Total Investment Cost | $ 7,870,000 |

b. Annual Costs

| | | |
|---|---|---|
| Interest and amortization, $7,870,000 @ .1187 | | $ 934,000 |
| Dredging costs: | | |
| Buffalo River | 125,000 c.y. @ $4.60 | 575,000 |
| Buffalo Harbor | 400,000 c.y. @ $0.47 | 188,000 |
| Tonawanda/Black Rock | 100,000 c.y. @ $0.99 | 99,000 |
| Operation and maintenance | | 25,000 |
| Total Annual Cost | | $ 1,821,000 |
| Cost per Cubic Yard | | $2.91 |

38. SITE 2 (Contract dredging, Buffalo River, for 5 years)

a. First Costs

| | |
|---|---|
| Spoil retention structures | $ 300,000 |
| Mooring facilities | 0 |
| Spoil Discharge system | 0 |
| Total First Cost | $ 300,000 |

b. Annual Costs

| | |
|---|---|
| Interest and amortization, 5 yrs., @ .2199 | $ 66,000 |
| Contract dredging, 125,000 c.y. @ $4.60 | 575,000 |
| Operation and maintenance | 5,000 |
| Total Annual Costs | $ 646,000 |
| Cost per Cubic Yard | $5.17 |

39. SITE 2 (All maintenance dredging in the Buffalo area for one year)

a. First Costs

| | |
|---|---|
| Spoil retention structures | $ 300,000 |
| Mooring facilities | 140,000 |
| Spoil discharge system | 80,000 |
| Total First Cost | $ 520,000 |

b. Annual Costs

| | | |
|---|---|---|
| Interest and amortization, 1 yr., @ 1.0325 | | $ 537,000 |
| Dredging costs: | | |
| Buffalo River | 125,000 c.y. @ $4.60 | 575,000 |
| Buffalo Harbor | 400,000 c.y. @ $0.50 | 200,000 |
| Tonawanda/Black Rock | 100,000 c.y. @ $0.80 | 80,000 |
| Operation and maintenance | | 25,000 |
| Total Annual Cost | | $1,417,000 |
| Cost per cubic yard | | $2.27 |

40. COST COMPARISONS

A summary of costs for the ten-year plans for sites 1 and 4 and the one-year plan for site 2 are shown below for comparison. The five-year plan for site 2 is not suitable for comparison purposes because the dredging costs are for Buffalo River only. The cost of open lake disposal of all maintenance dredgings is also shown.

| Site | Capacity cu. yds. | Capacity years | Cost per cu. yd. |
|---|---|---|---|
| Open lake | - | - | $0.66(1) |
| 2 | 625,000 | 1 | $2.27 |
| 4 | 6,250,000 | 10 | $2.91 |
| 1 | 6,250,000 | 10 | $3.34 |

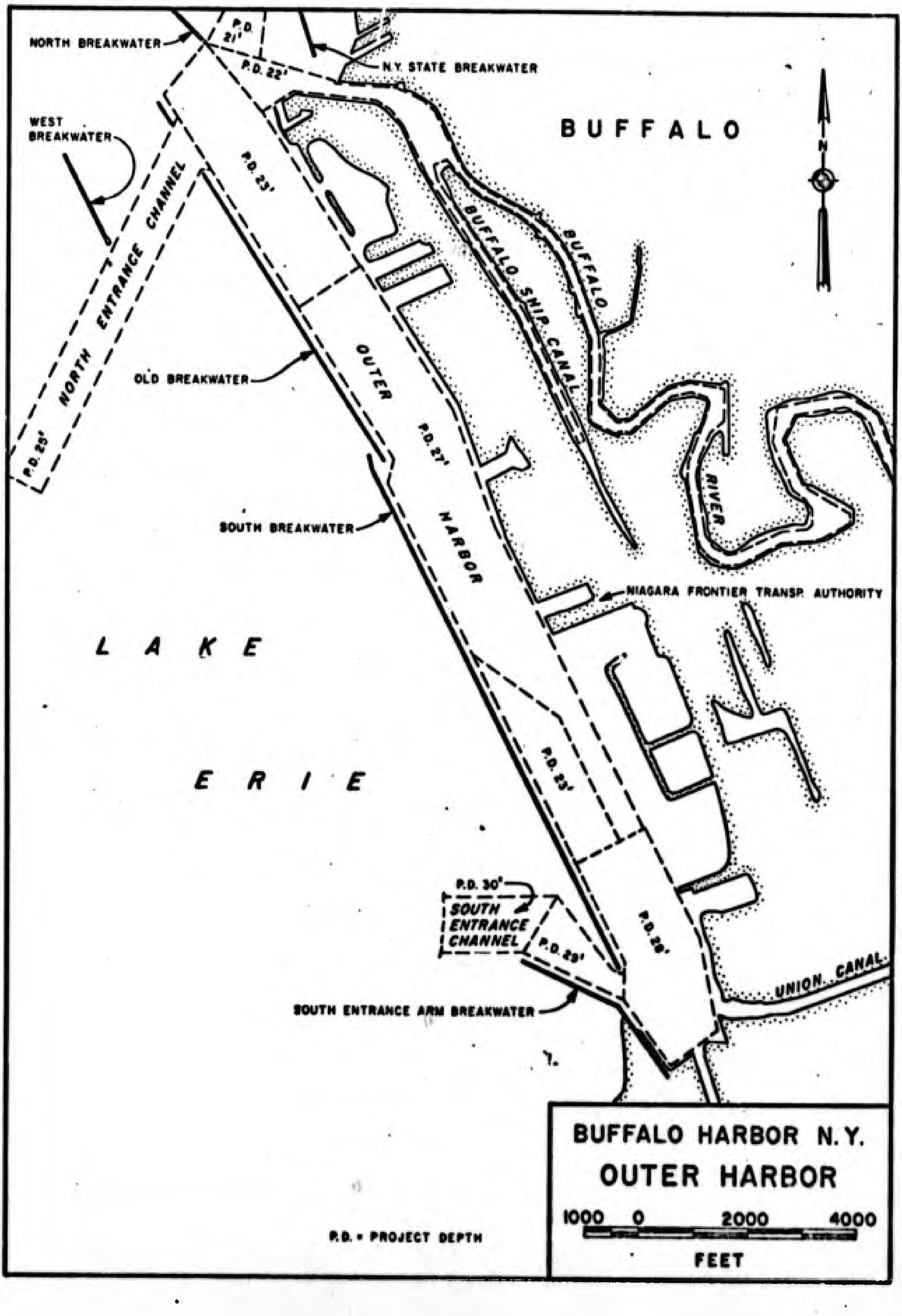
(1) 400,000 c.y. @ $0.36, 125,000 c.y. @ $1.55, and 100,000 c.y. @ $0.75.

## DISCUSSION

41. Studies in the vicinity of Buffalo Harbor revealed two available sites that would hold ten years of maintenance dredging spoil from Buffalo Harbor, Buffalo River, Black Rock Channel and Tonawanda Harbor. The least costly plan would utilize site 4 for the entire ten-year period. There is a possibility that the site could be expanded for joint use with Bethlehem Steel Corporation.

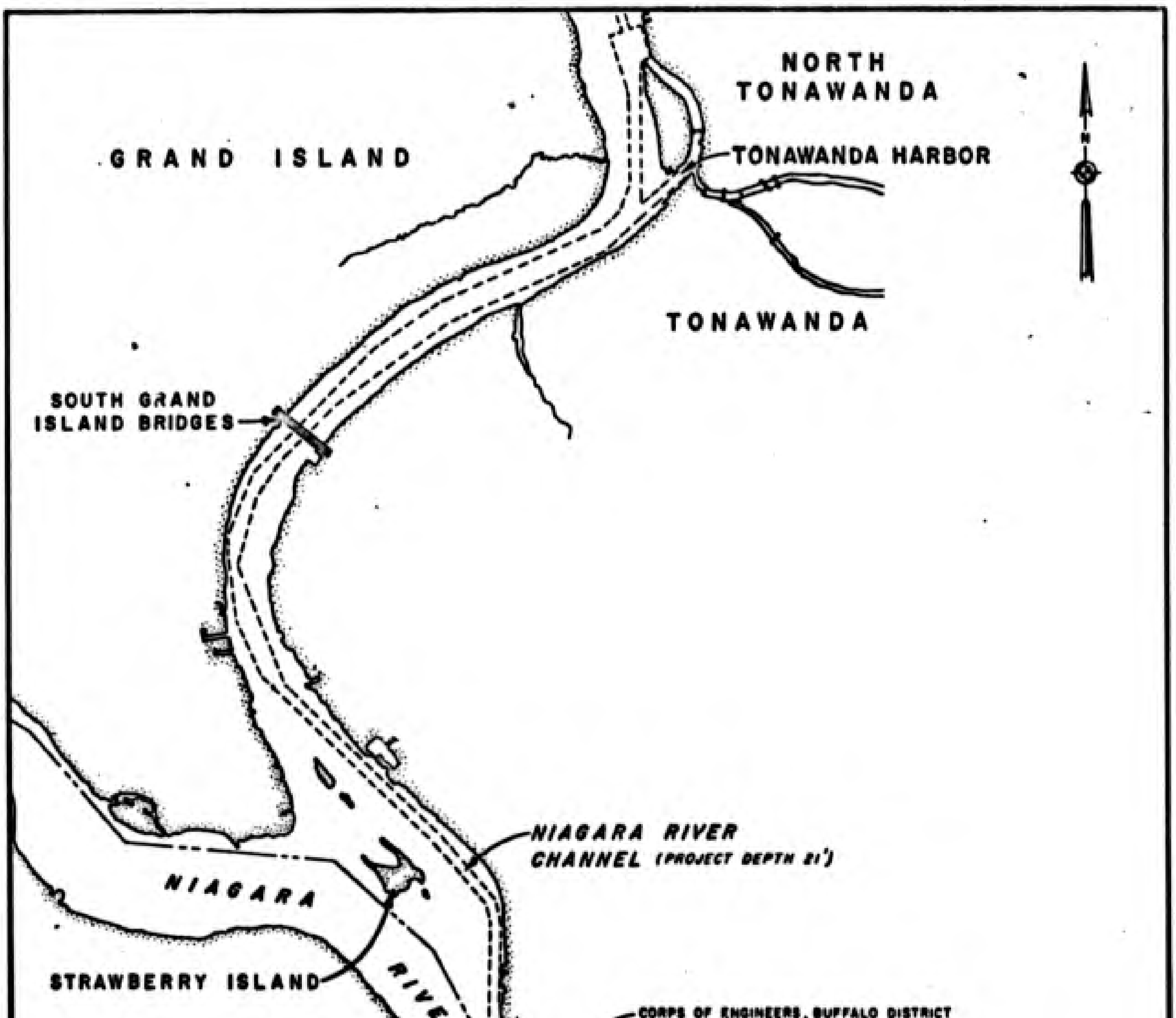
42. Site 2, the "Times Beach" area, has been proposed for use in the near future as an interim site to be used after the Pilot Study site is filled. It would hold about five years of dredging spoil from the Buffalo River or spoil from all sources in the Buffalo area for about one year. It is assumed that the site would be filled completely during construction of a ten-year site.

43. An informal meeting was held in Buffalo on 9 January 1969 to discuss the considered alternate disposal site with public officials, community planners, and principle property owners. A representative from Bethleham Steel Corporation indicated strong support for a joint-use project to be used for disposal of dredged materials and slag from the steel plant. They are still waiting for the State of New York to act on their request to develop the 620-acre site that includes site 4. A joint-use project would result in a substantial reduction in the costs chargeable to alternate disposal of dredged materials.



NORTH BREAKWATER
P.D. 21'
P.D. 22'
N.Y. STATE BREAKWATER
BUFFALO
N
WEST BREAKWATER
P.D. 23'
NORTH ENTRANCE CHANNEL
BUFFALO SHIP CANAL
BUFFALO
OLD BREAKWATER
OUTER
P.D. 27'
HARBOR
RIVER
P.D. 23'
SOUTH BREAKWATER
NIAGARA FRONTIER TRANSP. AUTHORITY
LAKE
ERIE
P.D. 25'
P.D. 30'
SOUTH ENTRANCE CHANNEL
P.D. 29'
P.D. 28'
UNION CANAL
SOUTH ENTRANCE ARM BREAKWATER
BUFFALO HARBOR N.Y.
OUTER HARBOR
1000 0 2000 4000
FEET
P.D. = PROJECT DEPTH


FIG. K2-1




BUFFALO HARBOR, N.Y.
BLACK ROCK CHANNEL & TONAWANDA HARBOR PROJECT

FIG. K2-2

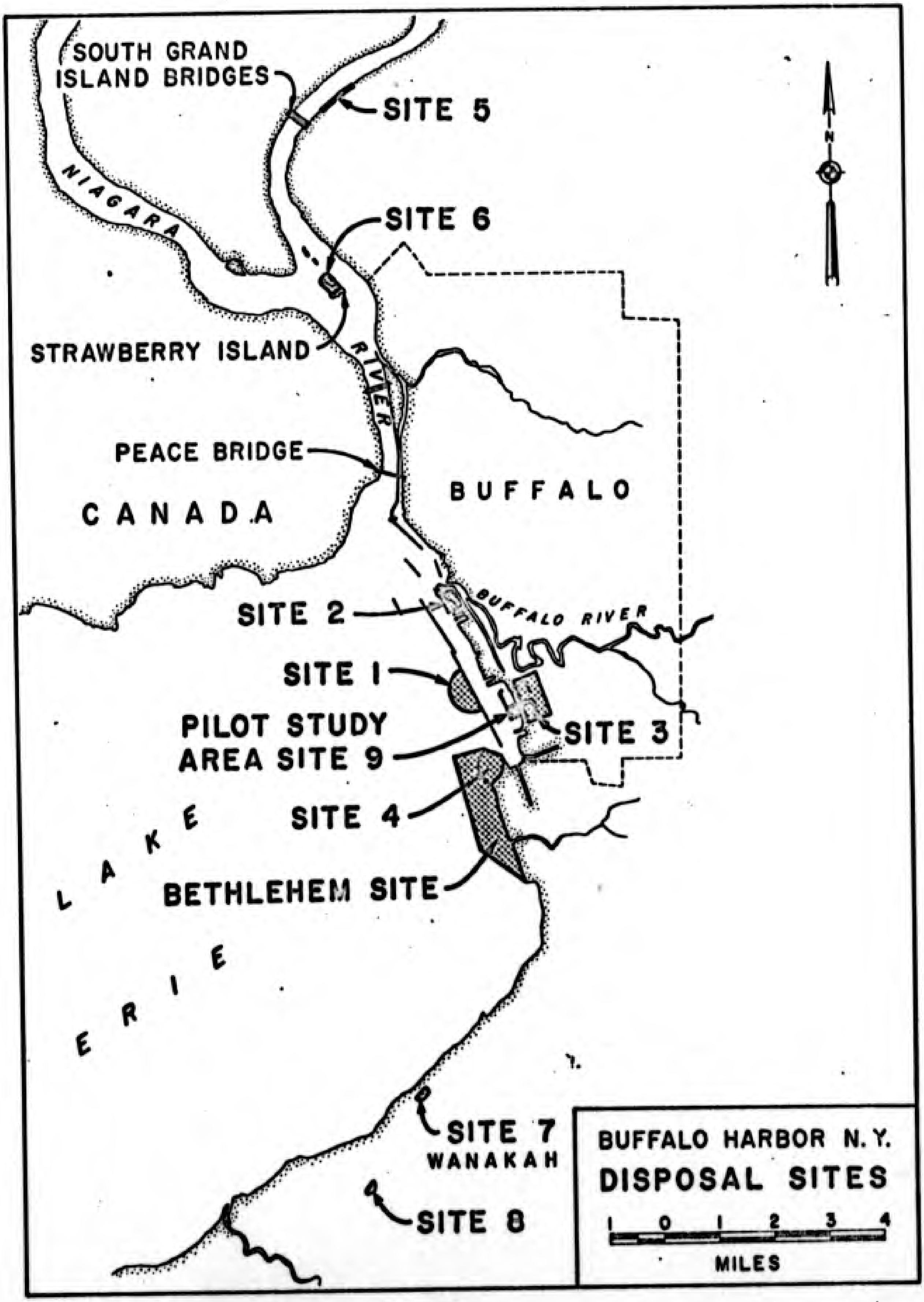
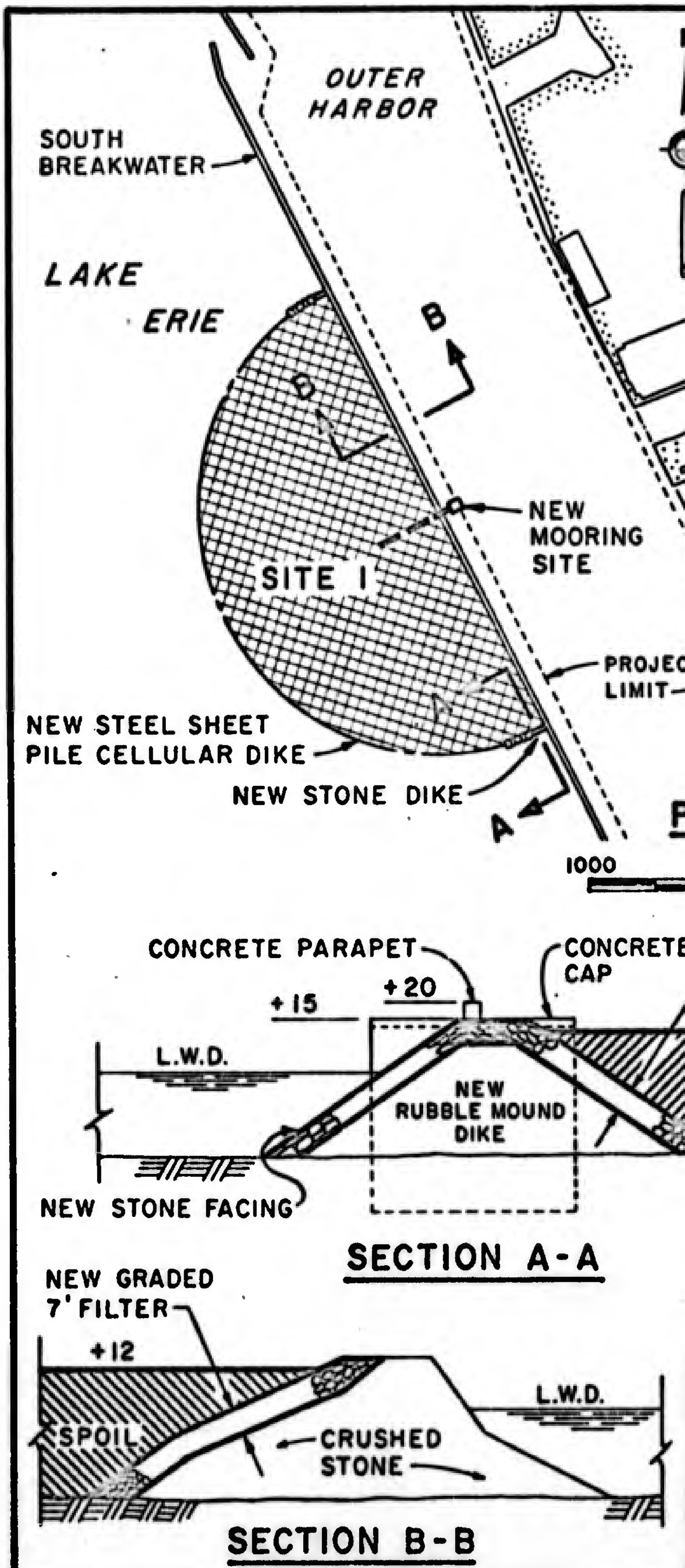

SOUTH GRAND ISLAND BRIDGES
SITE 5
NIAGARA
SITE 6
STRAWBERRY ISLAND
RIVER
PEACE BRIDGE
BUFFALO
CANADA
SITE 2
BUFFALO RIVER
SITE 1
PILOT STUDY AREA SITE 9
SITE 3
SITE 4
LAKE
BETHLEHEM SITE
ERIE
SITE 7
WANAKAH
SITE 8
BUFFALO HARBOR N.Y.
DISPOSAL SITES
1 0 1 2 3 4
MILES

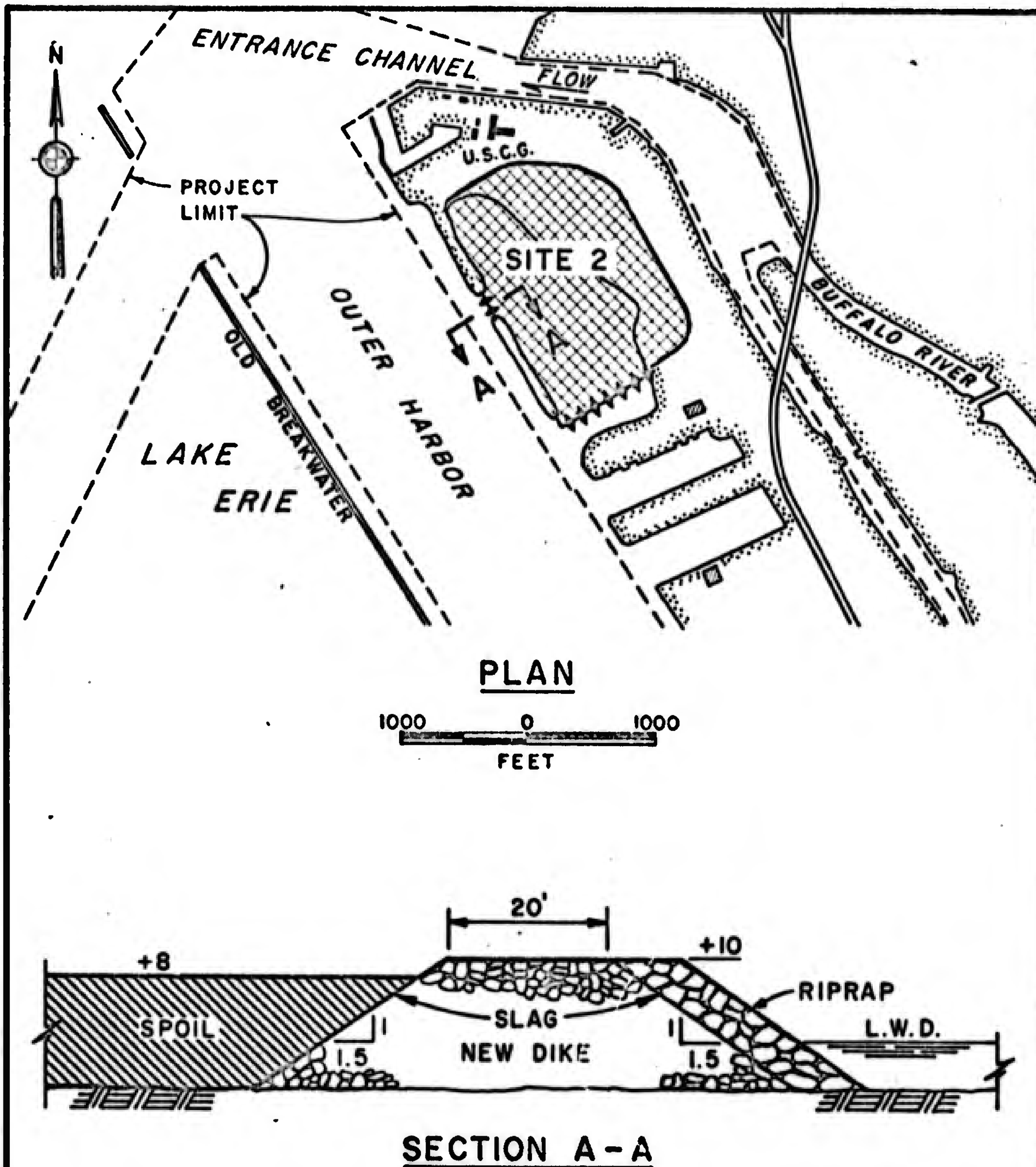
FIG. K2-3




BUFFALO HARBOR, N.Y.

SITE I

FIG. K2-4




BUFFALO HARBOR, N.Y.

SITE 2

FIG. K2-5

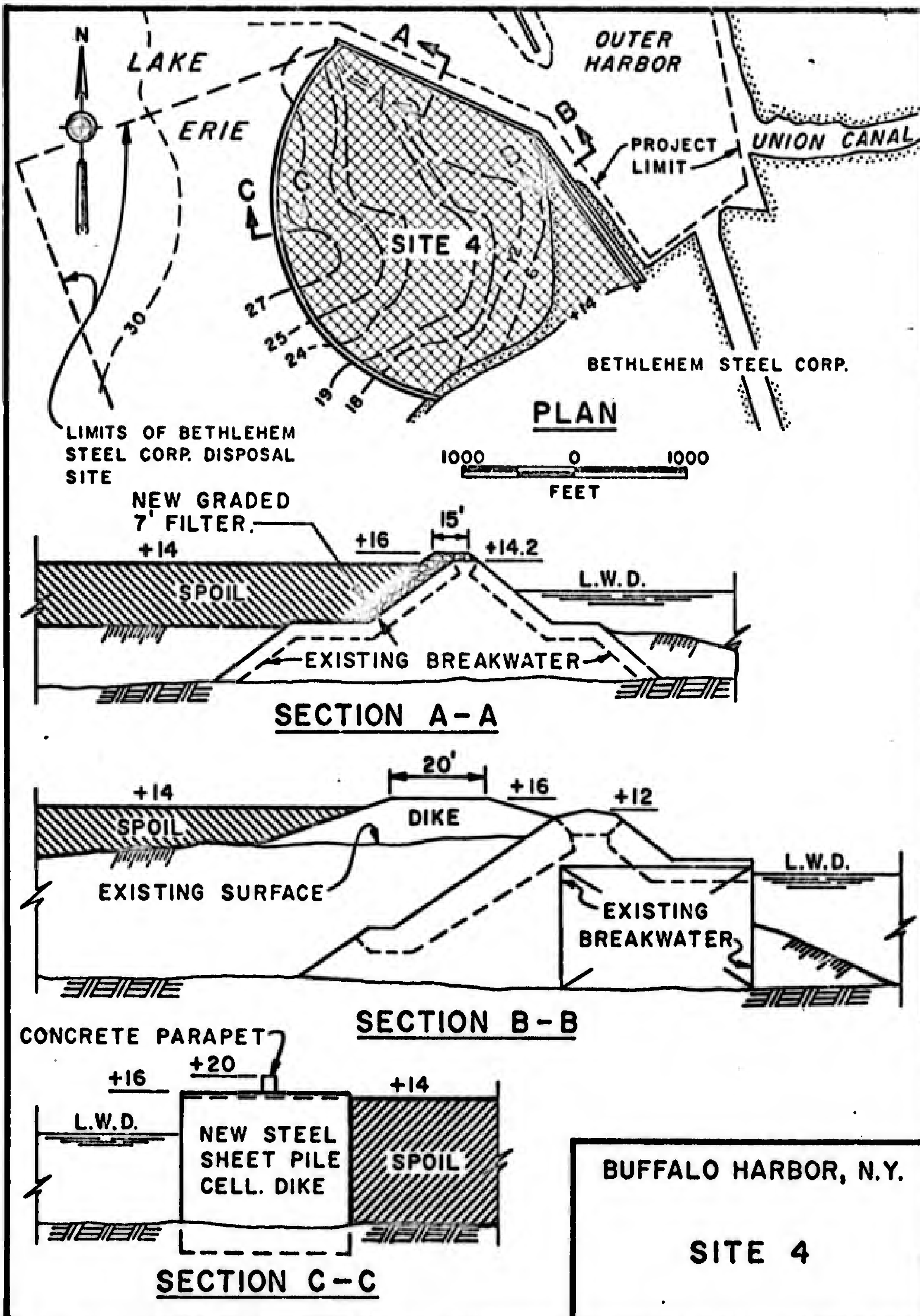

N
LAKE
ERIE
OUTER HARBOR
A
B
C
PROJECT LIMIT
UNION CANAL
SITE 4
30
27
25
24
19
18
+14
BETHLEHEM STEEL CORP.
LIMITS OF BETHLEHEM STEEL CORP. DISPOSAL SITE
PLAN
1000
0
1000
FEET
NEW GRADED 7' FILTER
+14
+16
15'
+14.2
SPOIL
L.W.D.
EXISTING BREAKWATER
SECTION A-A
20'
+14
+16
+12
SPOIL
DIKE
EXISTING SURFACE
L.W.D.
EXISTING BREAKWATER
SECTION B-B
CONCRETE PARAPET
+20
+16
+14
L.W.D.
NEW STEEL SHEET PILE CELL. DIKE
SPOIL
SECTION C-C
BUFFALO HARBOR, N.Y.
SITE 4

FIG. K2-6

APPENDIX K3

STUDY OF

ALTERNATE DISPOSAL AREAS

FOR

CLEVELAND HARBOR, OHIO

U. S. ARMY ENGINEER DISTRICT, BUFFALO
CORPS OF ENGINEERS
1776 NIAGARA STREET
BUFFALO, NEW YORK 14207

OCTOBER 1968

DREDGING AND WATER QUALITY PROBLEMS
IN
THE GREAT LAKES

APPENDIX K3

STUDY OF ALTERNATE DISPOSAL AREAS
FOR
CLEVELAND HARBOR, OHIO

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# APPENDIX K3 - CLEVELAND HARBOR

## LOCATION AND DESCRIPTION

1. Cleveland Harbor, Ohio is located at the mouth of Cuyahoga River, 99 miles east of Toledo Harbor and 176 miles west of Buffalo Harbor. The Cuyahoga River basin encompasses some 813 square miles. The existing navigation project is shown in figs. K3-1 and K3-2.

2. The harbor is an important commercial port. The total waterborne commerce for 1966 amounted to 24,020,820 tons, and for the 10-year period, 1957-1966, inclusive, has averaged 17,907,785 tons. The principal commodities in 1966 were: receipts of 17,436,648 tons of iron ore (73% of total commerce); receipts of 2,542,726 tons of limestone (11%); receipts of 985,922 tons of sand and gravel (4%); Canadian import of 968,450 tons of crushed stone (4%); and overseas import and export of 581,783 tons of general cargo (2½%). Future waterborne commerce is expected to average 17,900,000 tons annually.

## EXISTING CORPS OF ENGINEERS PROJECT

3. PROJECT

The existing project was authorized by the 1875, 1886, 1888, 1896, 1899, 1902, 1907, 1910, 1916, 1917, 1935, 1937, 1945, 1946, 1958, 1960, and 1962 River and Harbor Acts which provide for:

a. A breakwater protected outer harbor area of about 1,300 acres, 5 miles long and 1,600 to 2,400 feet wide, inclosed by a breakwater system comprising an east breakwater 20,970 feet long, a west breakwater connected with the shore 6,048 feet long with a gap of 201 feet about 662 feet from the shore end, and east and west arrowhead breakwaters each 1,250 feet long.

b. A rubblemound spur breakwater 400 feet long to protect the gap in the west breakwater shorearm.

c. A 29-foot depth in the lake approach channel to the main entrance flaring from deep water in the lake to a clear channel width of 600 feet between the outer ends of the arrowhead breakwaters, then continuing between the arrowhead breakwaters for 1,250 feet to a width of 750 feet between the opening of the main breakwaters.

d. An entrance channel 28 feet deep from the inner end of the lake approach through the outer harbor to the lakeward ends of the piers at the mouth of the Cuyahoga River, varying from 750 to 220 feet in width.

e. A depth of 28 feet in the west basin over an area bounded by project limits of 100 feet from the west breakwater and on the landward side generally by a line 75 feet lakeward of and parallel to the harbor line.

f. The outer harbor basin easterly of the entrance channel to varying depths as follows: a depth of 28 feet easterly of the entrance channel for about 800 feet to a line drawn perpendicular to the east main breakwater; easterly from this perpendicular line a 27-foot deep area extending easterly 3,800 feet bounded by project limits of 380 feet from the east breakwater and on the landward side generally by a line 75 feet lakeward of and parallel to the harbor line.

g. Easterly of this area, a channel with a depth of 25 feet, generally 500 feet wide about 14,600 feet long, parallel to and 380 feet from the east breakwater.

h. A dock approach channel to the Nicholson Cleveland Terminal Company pier, at the easterly end of the east basin, 25 feet deep from the 25-foot depth contour to a limit 75 feet north of the pierhead line, 400 feet wide at the shoreward end and flared toward the lake.

i. Two parallel stone-filled timber crib piers with concrete superstructure, 325 feet apart, at the mouth of Cuyahoga River; the east pier 1,602 feet long and the west pier 1,440 feet long.

j. A depth of 27 feet in the lower Cuyahoga River from the lakeward ends of the piers to immediately above the junction with Old River.

k. Improvement of the channel in the remainder of Cuyahoga River to the vicinity of mile 5.8 to a depth of 23 feet, suitably widened at bends, with a turning basin in Cuyahoga River to a depth of 18 feet in the vicinity of mile 4.8.

l. Improvement of the channel in Old River to a 27-foot depth with suitable widening at bends.

m. Replacement of seven railroad bridges over Cuyahoga River, and replacement of one railroad bridge and one highway bridge over Old River.

4. PROGRESS

The existing project is 75% complete. Preconstruction planning is continuing for replacement of railroad bridges No. 19 over Cuyahoga and No. 32 over Old River and widening and deepening portions of Cuyahoga and

Old Rivers, all as authorized by the 1958 River and Harbor Act. Under authority of section 107 of the 1960 R&H Act, preconstruction planning was initiated for deepening 1,000 feet of channel in Old River above Sand Products Corp. dock from 21 to 23 feet. Deepening the 1,000-foot area to the authorized 27-foot project depth and the remainder of the Old River above this area to 27-foot depth will be done after local interests terminal developments are completed. Remaining work authorized by 1960 R&H Act, which consists of deepening remainder of Cuyahoga River from bridge No. 1 to junction with Old River and deepening Old River, all to 27-foot project depth, will be done after completion of bridge replacement program authorized by 1958 R&H Act. Remaining work authorized by 1946 R&H Act consisting of widening and deepening right bank of Cuyahoga River at downstream end of Cut 4 is classified inactive.

## PRESENT DREDGING PRACTICES

### 5. PROCEDURES

All project areas and channels are maintained annually; the outer harbor areas and Cuyahoga River up to Bridge No. 1 by Government plant and hired labor; and the inner harbor channels above Bridge No. 1 by contract.

a. The three Buffalo District hopper dredges - the MARKHAM, LYMAN, and HOFFMAN - are generally berthed in Cleveland during the winter months, at the Corps' wharf on the east outer harbor. All three are set to work at the outer harbor maintenance in early spring, as soon as ice conditions in and near the harbor permit. With continued abatement of ice conditions on the lake, the hopper dredges are dispatched to other harbors. The outer harbor maintenance is completed before the last one departs - generally some time in April.

b. The contracts for maintenance dredging of the inner harbor channels provide for starting the work in the fall of one year and completing it in the spring of the following year. Under the contract the upper mile of the Cuyahoga River channel is dredged in the late fall to 3 feet below project depth. This is the area where most of the sediment load from up river tends to settle out; the extra depth provides room for storage of most of this load over the winter, concentrating it for ease of dredging in the spring. In spring, this area is first redredged to project depth, then the lesser and more scattered shoal areas downstream in Cuyahoga and Old Rivers are dredged. The fall work requires about two months, the spring work about four. The contractor uses the following plant: a clamshell dredge, one tug, and 4-6 dump scows. The tug is used both for moving the dredge and dump scows in the harbor and hauling the loaded scows to disposal areas.

6. Some of the permit dredging for dock owners at the harbor is accomplished by the Government's maintenance contractor, under separate contracts with the individual owners, concurrently with the maintenance work, using the same plant and procedures. Other permit dredging during the course of the year is done with the same kind of plant - clamshells and dump scows.

7. WORKING SEASON

The available season for dredging work at Cleveland Harbor roughly corresponds with the navigation season. In recent years the earliest and latest opening and closing of navigation at the harbor were:

| | Opening | Closing |
|---|---|---|
| Earliest date | Mar 5 | Dec 18 |
| Latest date | Apr 4 | Dec 30 |

As a matter of practice, as outlined in paragraph 5, above, the bulk of the dredging at the harbor is, from year to year, consistently performed in certain periods of the working season.

8. QUANTITY AND TYPE OF MATERIALS

During the past ten years the average annual quantity of material dredged to properly maintain channel depth is 500,000 cubic yards from the outer harbor with a hopper dredge and 720,000 cubic yards by contract from the river channels. Permit dredging requirements are about 50,000 cubic yards annually. Future maintenance dredging requirements approximate the same quantities. The material dredged consists primarily of sand and silt which has been deposited since the last dredging.

9. NATURE OF POLLUTION

The nature of pollution in the lower Cuyahoga River is discussed in a report by FWPCA entitled "Lake Erie Report, A Plan for Water Pollution Control," dated August 1968. The report states that the lower river and navigation channel throughout the Cleveland area is a virtual waste treatment lagoon. At times the river is choked with debris, oils, scum, and floating organic sludges. Foul smelling gases can be seen rising from decomposing materials on the river's bottom. Viewed from the city's observation towers, the river appears to be chocolate-brown or rust-colored. During most of the year this section has no visible life, not even low forms such as leeches and sludge worms which usually thrive on wastes.

10. The inadequately treated wastes from the Cleveland Southerly Treatment Plant, and an undetermined number of storm water overflows and sewage by-passes discharge large quantities of oxygen-demanding wastes and bacterial contamination, including numerous species of enteric pathogens, to the lower river. These domestic wastes are joined by the discharges from the major industrial complex in the Cleveland area. Steel and chemical companies discharge solids, nickel, flourides, iron, oil, sulfates, ammonia, acids and other deleterious materials into the lower river.

## PRESENT DISPOSAL PRACTICE

### 11. METHOD OF DISPOSAL

Dredged material from the harbor is disposed of by bottom dumping from hopper dredges or dump scows into the established open lake disposal areas in Lake Erie. An exception to this is about 90,000 cubic yards of material from the Cuyahoga River channel that was placed in a diked area in the outer harbor in the spring of 1968 and about 200,000 cubic yards of Cuyahoga River material that will be placed in the same area during the fall of 1968. This is a part of the Pilot Study program.

### 12. DISPOSAL AREAS

For many years a rectangular disposal area, 1 mile by 2 miles, located 9 miles due north of Cleveland Harbor was used. Recently a new area, 3/4 mile by 2 miles, north of and parallel to the east outer breakwater, beginning 1/2 mile northeast of the east pierhead light, was established. Except for material placed in the diked area in connection with the Pilot Study the present practice is to spoil all material dredged from the harbor in the new area except for any rock, stone or other hard material which is taken to the 9-mile disposal area. At the present dredging rate it is estimated that the capacity of the new disposal area within its existing limits is sufficient for at least 20 years. The capacity of the 9-mile disposal area, as now being used, is indefinite.

## 13. COST OF DREDGING

The unit cost for outer harbor maintenance by hopper dredge, with disposal in the **near** disposal area, is about $0.25 per cubic yard. The latest contract costs for maintenance of the inner harbor channels, with disposal in the **near** disposal area is about $1.15 per cubic yard. The average of the latest contract costs for maintenance of inner harbor channels, with disposal in the diked disposal area, is $2.35 per cubic yard, exclusive of the cost of constructing the dikes. **The estimated cost of outer harbor maintenance by hopper dredge, with disposal in diked disposal areas, is $0.43 per cubic yard.**

## ALTERNATE DISPOSAL SITES

### 14. GENERAL

A survey was made in 1968 to locate alternate disposal sites in the Cleveland area for at least a 10-year period. The volume of maintenance dredging in the Cuyahoga River and Cleveland Harbor is estimated to be 1,220,000 cubic yards annually. Consideration was given to plans which include rehandling and transporting the dredged material to distant inland sites, a settlement basin where sediment could be trapped and removed upstream of the navigation channel, and conventional alongshore and offshore diked inclosures. Many of the 10-year plans considered would utilize more than one site. A brief discussion of each disposal site is given in the following paragraphs. The sites are shown in figs. K3-3, K3-4, and K3-5. The plans which would utilize the various sites are discussed later in this Appendix.

### 15. SITE 1

This is an offshore site that would be constructed on the north side of the existing east breakwater. The site would be inclosed with steel sheet pile cells filled with granular material on a semicircular alinement. A seven-foot graded filter would be placed along the existing stone breakwater inside the inclosure. Effluent would pass through the filter and dike. Maximum depth for cell design would be about 33 feet below LWD. The top elevation would be about 15 feet above LWD and five feet above the top of spoil when the site is filled. It would contain 12,200,000 cubic yards of dredged material which is equivalent to 10 years of maintenance dredging. A mooring facility would be provided on the protected side of the breakwater so that the dredging could be pumped from the floating plant to the site. Details of site 1 are shown in fig. K3-6

16. SITE 2

This is a landfill site shown in fig. K3-7, located on the west side of the Cuyahoga River navigation channel. The site is now undeveloped property owned by the Penn Central Railroad. The site would be inclosed by earth and stone dikes having top elevations 15 feet above LWD. The site would hold about 680,000 cubic yards of dredged material from either the Cuyahoga River or Cleveland Harbor. The dredgings would be pumped from dump scows into the disposal area. Effluent would pass through stone dikes into Cleveland Harbor on the north side of the site. The spoil would be rehandled by bulldozer and clamshell and transported to more distant sites by rail or truck. The site would probably be available for spoil disposal every other year. It would be necessary to allow the spoil to settle and drain before the rehandling operation could be accomplished. The spoil would be transported to landfill sites near Elyria during the off years. Another possibility would be to divide the site with a dike and fill half of the area each year and dispose of the material that was deposited the previous year on the other side of the dike.

17. SITES A - F

These are undeveloped landfill sites near Elyria, Ohio. They would be used in connection with rehandling operations from site 2. Sites A and B would be the most convenient disposal areas if the spoil were transported by truck. Sites C, D, E and F would be available in the event that rail transportation was most economical. Each of the seven sites is large enough to hold the maintenance dredgings from the Cuyahoga River, every other year for ten years, or about 3,600,000 cubic yards. Preliminary studies showed that rail transportation would be the least expensive method of transportation. Site E was the only one of the seven sites that was studied in detail. Earth dikes would be constructed around the 380-acre site and the spoil would have an average depth of about 6 feet at the end of the 10-year period. The owners of site E were not contacted.

18. SITE 3

This is a landfill site located about ten miles above the mouth of the Cuyahoga River. The site would be used in connection with the considered settlement basin (site 8) in the river located about eight miles above the mouth. Spoil would be trucked from the basin to site 3 for disposal. Site 3 is a gravel pit, the present use of which appears to be limited. The site would hold the volume of sediment that could be trapped and removed from the settlement basin for about five years, 2,750,000 cubic yards, without providing dikes or other closure structures. The site is shown in fig. K3-8. Area 3B represents a deep hole that would contain a large portion of the spoil. The owner of the property was not contacted.

19. SITE 4

This is another landfill site near site 3 that would be used in connection with the considered settlement basin. The site is undeveloped except for power lines which pass through the area. It would hold about five years of spoil from the settlement basin without requiring dikes or other closure structures. The site is owned by several property owners. They were not contacted regarding the availability of the site. The site is shown in fig K3-9.

20. SITE 5

This landfill site is located south of site 4 on the opposite side of the Penn Central railroad tracks. Nearly half of the area is owned by the Southerly Sewage Treatment Plant. The remaining portion is privately owned. This site is similar to sites 3 and 4 and would hold the spoil trucked from the settlement basin for at least five years without requiring dikes or other structures. Power lines pass through the site but would not interfere with spoil disposal. The property owners were not contacted regarding the availability of the site. The site is shown in Fig K3-10.

21. SITE 6

This is a large, undeveloped, landfill site located west of the river, about 12 miles above the mouth. The property is owned by many individuals, none of whom were contacted regarding the availability of the site. It would hold the spoil volume from the downstream settlement basin for the entire 10-year period. No dikes or other closure structures would be required. The spoil would be trucked from the basin to the site. Other forms of spoil transport would be more expensive. Details for site 6 are shown in fig K3-11.

22. SITE 7

This site is similar in all respects to site 6. Access from the settlement basin would be more difficult and the least costly method of spoil transport would probably be by truck. Of all the sites discussed previously for disposal of spoil from the settlement basin, this site would be the most expensive. Site 7 is shown in fig K3-5.

23. SITE 8

Plans for site 8 would provide a settlement basin as a widened reach of the Cuyahoga River about two miles above the head of navigation. The settlement basin would be formed by widening and deepening a 4,000-foot reach of river channel. The basin would have a 300-foot bottom width and a cross sectional area that is comparable in size to the navigation channel downstream. It is expected that the sediment that normally settles in the navigation channel would be deposited in the settlement basin. It is assumed that 550,000 cubic yards of sediment would be deposited in the basin annually. This is equivalent to the annual volume dredged from the upper portion of the navigation channel. Trapped material would be dredged from the basin and transported to landfill sites. There are several possible operating plans for dredging and disposal of the sediments. Holding areas would be required to retain the spoil for rehandling after it has settled and drained in connection with a plan that would remove the sediments from the settlement basin by hydraulic dredge. The least expensive plan, using the Sauerman tower cable excavating system, would not require holding areas.

24. The land required for the settlement basin is now undeveloped property. Most of the land is owned by Aluminum Company of America and U.S. Steel Corporation. It is assumed that rights to the property could be acquired. Details of the site are shown in fig K3-12.

25. SITE 9

This is an alongshore site in the east basin of Cleveland Harbor which is being developed as an interim diked area for disposal of Cuyahoga River dredgings pending completion of the pilot study. Stone dikes will form an inclosure with a capacity of about two million cubic yards. Construction of the dikes was started in 1968 and will have progressed to a point where the diked area can be used for 1969 Cuyahoga River dredgings which probably will be pumped directly from scows to the disposal area. The land area created will be used in connection with the future expansion of the adjacent Burke Lakefront Airport. The site is shown in fig. K3-13.

26. SITE 10

This is an alongshore site in the east basin of the harbor, adjacent to and westerly from site 9. A stone dike would form an inclosure with a capacity of about four million cubic yards. This area when filled, together with the new land area created by the pilot area (site 13) presently being filled and the new land area which will be created by filling site 9, would form a continuous strip of new land needed for expansion of Burke Lakefront Airport. The site is shown in fig. K3-14.

27. SITE 11

This is an offshore site that would be on the lake side of the existing west breakwater. A new dike, to be constructed of steel sheet pile cells filled with granular material, would tie into the breakwater with short sections of rubble mound dike. A graded filter would be placed along the breakwater inside the inclosure. Effluent from spoil disposal would drain through the filter and breakwater. Several 10-year plans considered this site for all or part of the spoil disposal. The site could be used to contain the spoil from the river and harbor for the entire 10-year period, 12,200,000 cubic yards. The land area created by using site 11 would probably become the property of the State of Ohio. It would be land connected after construction of proposed Westerly Wastewater Treatment Plant facilities and could be used for some form of recreational development or for a part of the long sought for highway bypass of Cleveland. Details of site 11 are shown in figs. K3-15.

28. SITE 12

This is an offshore area in the east basin of the harbor extending easterly from the east wall of the diked area being constructed on site 9. A stone dike would form an inclosure which could hold about 2,680,000 cubic yards of dredgings. The land area probably would become the property of the State of Ohio, would be land connected, and might be used to extend the proposed new runway for Burke Lakeport Airport. The site is shown in fig. K3-16.

29. SITE 13

This is a small existing alongshore diked area that is currently being filled in connection with the Pilot Study program. It is scheduled to be filled to capacity early in 1969.

ALTERNATE DISPOSAL PLANS

30. GENERAL

Several 10-year plans for alternate disposal of the total maintenance dredgings from the Cuyahoga River and Cleveland Harbor were investigated. Each of the plans is discussed in the following paragraphs. The cost estimates for each are given in the next section of this Appendix. Several of the landfill sites, discussed in previous paragraphs, that would be used after rehandling from a site closer to the harbor would not be needed because more economical sites having sufficient capacity, are available.

31. PLAN 1

This plan would utilize the upstream settlement basin, site 8, to remove 550,000 cubic yards of sediments annually by the Sauerman tower cable excavating system, shown in fig. K3-12. Spoil would be dumped directly into trucks and hauled to disposal sites 3 and 4. Five years of excavation could be disposed of in each site. This was found to be the least costly method of removing and disposing of the material.

32. The remainder of the annual maintenance dredging, 670,000 cubic yards annually, would be pumped into diked areas on sites 10 and 12, located in the east basin of Cleveland Harbor. These two sites have the capacity to hold the remainder of the 10-year volume of maintenance dredging. It was assumed that sediment removed from the settlement basin upstream normally would have been deposited in the Cuyahoga River. The estimated river dredging volume was reduced to 170,000 cubic yards and the harbor dredging volume was assumed to remain at 500,000 cubic yards.

33. PLAN 2

This plan would also use the upstream settlement basin with disposal in sites 3 and 4. The only change from plan 1 would be the use of the diked area at site 11 to store the remaining 6,700,000 cubic yards of dredgings.

34. PLAN 3

This plan would utilize site 11 for the entire 10-year period. The diked area would be enlarged to hold 12,200,000 cubic yards.

35. PLAN 4

This plan is similar to plan 3 except that the diked area at site 1 would be used for the entire 10-year period.

36. PLAN 5

This plan would utilize two diked inclosures in Cleveland Harbor. The diked area at site 10 would be used for 4,000,000 cubic yards of spoil and the one at site 11 would be used to store 8,200,000 cubic yards to complete the 10-year plan for alternate disposal. The smaller diked area would be constructed and used first.

37. PLAN 6

This is not a 10-year plan for alternate disposal of all maintenance dredgings from the river and harbor. It was developed to compare the costs of transporting dredged materials over comparatively long distances by rail and truck. The plan would utilize site 2 for temporary storage of about 680,000 cubic yards every other year or the site could be subdivided to handle 340,000 cubic yards annually. Following a one-year settlement period the spoil would be rehandled and transported by railroad to site E near Elyria, about 26 miles away. Spoil transport by railroad was found to be the least expensive method from site 2. Cost estimates for this plan showed that it was too expensive to warrant serious consideration as part of a 10-year plan.

## ESTIMATES OF COST

38. GENERAL

The cost of necessary lands, structures and spoil discharge systems have been estimated for each plan. The construction periods for the disposal areas at sites 1 and 11, formed with cellular dikes, are estimated to be two years. Investments costs for these sites include interest on the first cost over half the construction period at 3-½ percent, the current Federal risk-free rate. The other sites could each be constructed in one year and the first costs would be equal to the investment costs. All costs are based on 1968 price levels.

39. Annual costs include interest and amortization over the 10-year period at 3-½ percent. Other annual charges include dredging costs with disposal at a specific site, spoil transportation costs with disposal at some inland site in some cases, and operation and maintenance costs. A summary of costs for each plan is shown in the following paragraphs.

40. PLAN 1

a. The costs of the upstream settlement basin with truck haul to sites 3 and 4 are shown below. It is estimated that the salvage value of the Sauerman equipment after 10 years would be about $250,000. Annual costs include interest on the total investment and amortization of investment less salvage.

Investment Costs

| | |
|---|---|
| Settlement basin: | |
| Lands | $ 600,000 |
| Excavation and dikes | 1,780,000 |
| Sauerman system | 810,000 |
| Disposal sites 3 and 4 | 560,000 |
| Total | 3,750,000 |
| Salvage value | - 250,000 |
| Investment less Salvage | $ 3,500,000 |

Annual Costs

| | |
|---|---|
| Interest, $3,750,000 @ .0325 | $ 122,000 |
| Amortization, $3,500,000 @ .0862 | 302,000 |
| Truck haul, 550,000 c.y. @ $0.38 | 209,000 |
| Dredging, operation and maintenance 550,000 c.y. @ $0.20 | 110,000 |
| Total | $ 743,000 |

b. The cost of dredging and disposal in sites 10 and 12 is shown below. The combined investment was amortized over 10 years. Construction of site 12 could actually be delayed until site 10 is nearly full. The cost of site 12 could be reduced to a present worth value and each site could be amortized over its portion of the 10-year period. However, site 12 would have to be constructed at least one or two years before site 10 is filled. The net reduction in annual charges for this alternate method of cost analysis are neglibible when considering the degree of accuracy of the estimated investment costs.

Investment Costs

| | |
|---|---|
| Site 10 | $4,830,000 |
| Site 12 | 2,950,000 |
| Total | $7,780,000 |

Annual Costs

| | |
|---|---|
| Interest and amortization, 10 yrs. @ .1187 | $ 923,000 |
| Dredging costs: | |
| Contract, Cuyahoga River, 170,000cy @ $2.35 | 400,000 |
| Cleveland Harbor, 500,000 cy @ $0.43 | 215,000 |
| Operation and maintenance | 28,000 |
| Total | $1,566,000 |

c. Total costs for Plan 1

| | Investment ($) | Annual Cost ($) | Annual Volume (cu.yd.) | Cost per Cubic yard ($) |
|---|---|---|---|---|
| Settlement basin | 3,750,000 | 743,000 | 550,000 | 1.35 |
| Sites 10 and 12 | 7,780,000 | 1,566,000 | 670,000 | 2.34 |
| Total | 11,530,000 | 2,309,000 | 1,220,000 | 1.89 |

41. PLAN 2

a. Settlement basin with truck haul to sites 3 and 4.

(see cost estimate in para. 40a)

b. Dredging and disposal in site 11.

Investment Costs

| | |
|---|---|
| Retention structure | $ 9,400,000 |
| Mooring facilities | 90,000 |
| Spoil discharge system | 150,000 |
| First Cost | $ 9,640,000 |
| Interest during construction | 310,000 |
| Total Investment | $ 9,950,000 |

Annual Costs

| | |
|---|---|
| Interest and amortization, 10 yrs. @ .1187 | $ 1,181,000 |
| Dredging costs | |
| Contract, Cuyahoga River, 170,000cy @ $2.35 | 400,000 |
| Cleveland Harbor, 500,000 cy @ $0.43 | 215,000 |
| Operation and maintenance | 28,000 |
| | $ 1,824,000 |

c. Total costs for Plan 2.

| | Investment ($) | Annual Cost ($) | Annual Volume (cy. yd.) | Cost per Cubic yard ($) |
|---|---|---|---|---|
| Settlement basin | 3,750,000 | 743,000 | 550,000 | 1.35 |
| Site 11 | 9,950,000 | 1,824,000 | 670,000 | 2.72 |
| Total | 13,700,000 | 2,567,000 | 1,220,000 | 2.10 |

42. PLAN 3

Dredging and disposal in site 11 (1,220,000 c.y. annually)

Investment Costs

| | |
|---|---|
| Retention structure | $13,240,000 |
| Mooring facilities | 90,000 |
| Spoil discharge system | 150,000 |
| First Costs | $13,480,000 |
| Interest during construction | 440,000 |
| Total Investment | $13,920,000 |

Annual Costs

| | |
|---|---|
| Interest and amortization, 10 yrs., @ .1187 | $ 1,652,000 |
| Dredging costs: | |
| Contract, Cuyahoga River, 720,000cy @ $2.35 | 1,692,000 |
| Cleveland Harbor, 500,000 c.y. @ $0.43 | 215,000 |
| Operation and maintenance | 28,000 |
| Total | $ 3,587,000 |
| Cost per Cubic Yard | $2.94 |

43. PLAN 4

Dredging and disposal in site 1 (1,220,000 c.y. annually)

<u>Investment Costs</u>

| | |
|---|---|
| Retention structure | $14,100,000 |
| Mooring facilities | 200,000 |
| Spoil disposal system | 150,000 |
| First costs | $14,450,000 |
| Interest during construction | 470,000 |
| Total | $14,920,000 |

<u>Annual Costs</u>

| | |
|---|---|
| Interest and amortization, 10 yrs @ .1187 | $ 1,771,000 |
| Dredging costs: | |
| Contract, Cuyahoga River, 720,000 c.y. @ $2.35 | 1,692,000 |
| Cleveland Harbor, 500,000 c.y. @ $0.43 | 215,000 |
| Operation and maintenance | 28,000 |
| Total | $ 3,706,000 |
| Cost per Cubic Yard | $3.04 |

44. PLAN 5

The cost of dredging and disposal in sites 10 and 11 is shown below. The combined investment was amortized over 10 years. Site 10 would be used for about the first third of the 10-year period. Construction of site 11 would be initiated about one year after site 10 is first used. The net reduction in annual costs for this plan by reducing the first cost of site 11 to a present worth value is negligible when considering the degree of accuracy of the estimates.

**Investment Costs**

| | |
|---|---|
| Site 10 | $ 4,830,000 |
| Site 11 | 11,370,000 |
| Total | $16,200,000 |

**Annual Costs**

| | |
|---|---|
| Interest and amortization, 10 yrs @ .1187 | $ 1,923,000 |
| Dredging costs: | |
| Contract, Cuyahoga River, 720,000 c.y. @ $2.35 | 1,692,000 |
| Cleveland Harbor, 500,000 c.y. @ $0.43 | 215,000 |
| Operations and maintenance | 28,000 |
| Total | $ 3,858,000 |
| Cost per cubic yard | $3.16 |

45. PLAN 6

Assume Cuyahoga River dredging with disposal in site 2 and railroad transportation to site E. (340,000 c.y. annually)

Investment Costs

| | |
|---|---|
| Site 2 | $ 1,250,000 |
| Site E | 1,450,000 |
| Railroad modification | 400,000 |
| Total | $ 3,100,000 |

Annual Costs

| | |
|---|---|
| Interest and amortization 10 yrs. @ .1187 | $ 368,000 |
| Dredging costs, 340,000 c.y. @ $2.35 | 799,000 |
| Transportation costs, railroad | 780,000 |
| Operation and maintenance | 26,000 |
| Total | $ 1,973,000 |
| Cost per Cubic Yard | $5.80 |

46. COST COMPARISONS

A summary of costs for the five 10-year plans considered are shown in the table below for comparison. The cost of open lake disposal is also shown.

| Plan | Sites | 10-year Capacity (cy.yds) | Investment Cost ($) | Annual Cost ($) | Cost per Cubic yard ($) |
|---|---|---|---|---|---|
| - | Open lake | 5,000,000 | - | 125,000 | 0.25 |
| | | 7,200,000 | - | 828,000 | 1.15 |
| | | 12,200,000 | - | 953,000 | 0.78 |
| 1 | Settlement basin | | | | |
| | to sites 3 & 4 | 5,500,000 | 3,750,000 | 743,000 | 1.35 |
| | Sites 10 & 12 | 6,700,000 | 7,780,000 | 1,566,000 | 2.34 |
| | | 12,200,000 | 11,530,000 | 2,309,000 | 1.89 |
| 2 | Settlement basin | | | | |
| | to sites 3 & 4 | 5,500,000 | 3,750,000 | 743,000 | 1.35 |
| | Site 11 | 6,700,000 | 9,950,000 | 1,824,000 | 2.72 |
| | | 12,200,000 | 13,700,000 | 2,567,000 | 2.10 |
| 3 | Site 11 | 12,200,000 | 13,920,000 | 3,587,000 | 2.94 |
| 4 | Site 1 | 12,200,000 | 14,920,000 | 3,706,000 | 3.04 |
| 5 | Sites 10 & 11 | 12,200,000 | 16,200,000 | 3,858,000 | 3.16 |

47. Studies in the Cleveland area resulted in several possible 10-year plans for alternate disposal of maintenance dredging material from the Cuyahoga River and Cleveland Harbor. The least costly plan would utilize the upstream settlement basin to remove about 550,000 cubic yards annually with the spoil transported by truck to sites 3 and 4. The remaining volume, 670,000 cubic yards annually, would be dredged from the river and harbor and pumped into alongshore diked disposal sites 10 and 12.

48. Site 13 is currently being filled with contract dredging spoil from Cuyahoga River as part of the Pilot Study program. Site 9 is under construction and will be the next site to be filled as an interim measure prior to possible authorization and construction of a 10-year plan.

49. An informal meeting was held in Cleveland, Ohio on 17 December 1968 to explore the considered plans in this report with public officials, community planners and principle property owners. Officials from the Village of Cuyahoga Heights expressed concern that offensive odors might create a nuisance for neighboring property owners if sites 3 and 4 are used. Representatives from the Burke Lakefront Airport indicated that the use of sites 10 and 12 would probably fit in with their future plans although they would prefer to have the areas filled sooner than would be accomplished with plan 1. Representatives from the Penn Central Railroad stated that the use of site 2 would conflict with their plans for future development. Representatives from the Aluminum Company of America felt that site 8, the

considered settlement basin, might encroach on land they have reserved for waste disposal. They would need more detailed plans to determine how it would affect their operations.


N
LAKE
ERIE
P.D. 29'
P.D. 27'
P.D. 28'
P.D. 27'
P.D. 28'
P.D. 25'
EAST BREAKWATER
EAST
BASIN
WEST BREAKWATER
WEST
BASIN
BURKE
LAKEFRONT
AIRPORT
CORPS OF ENGINEERS
CITY OF CLEVELAND
CUYAHOGA R.
RIVER
OLD
P.D. = PROJECT DEPTH
CLEVELAND HARBOR
OHIO
PLAN
2000 0 2000 4000
FEET

FIG. K3-1

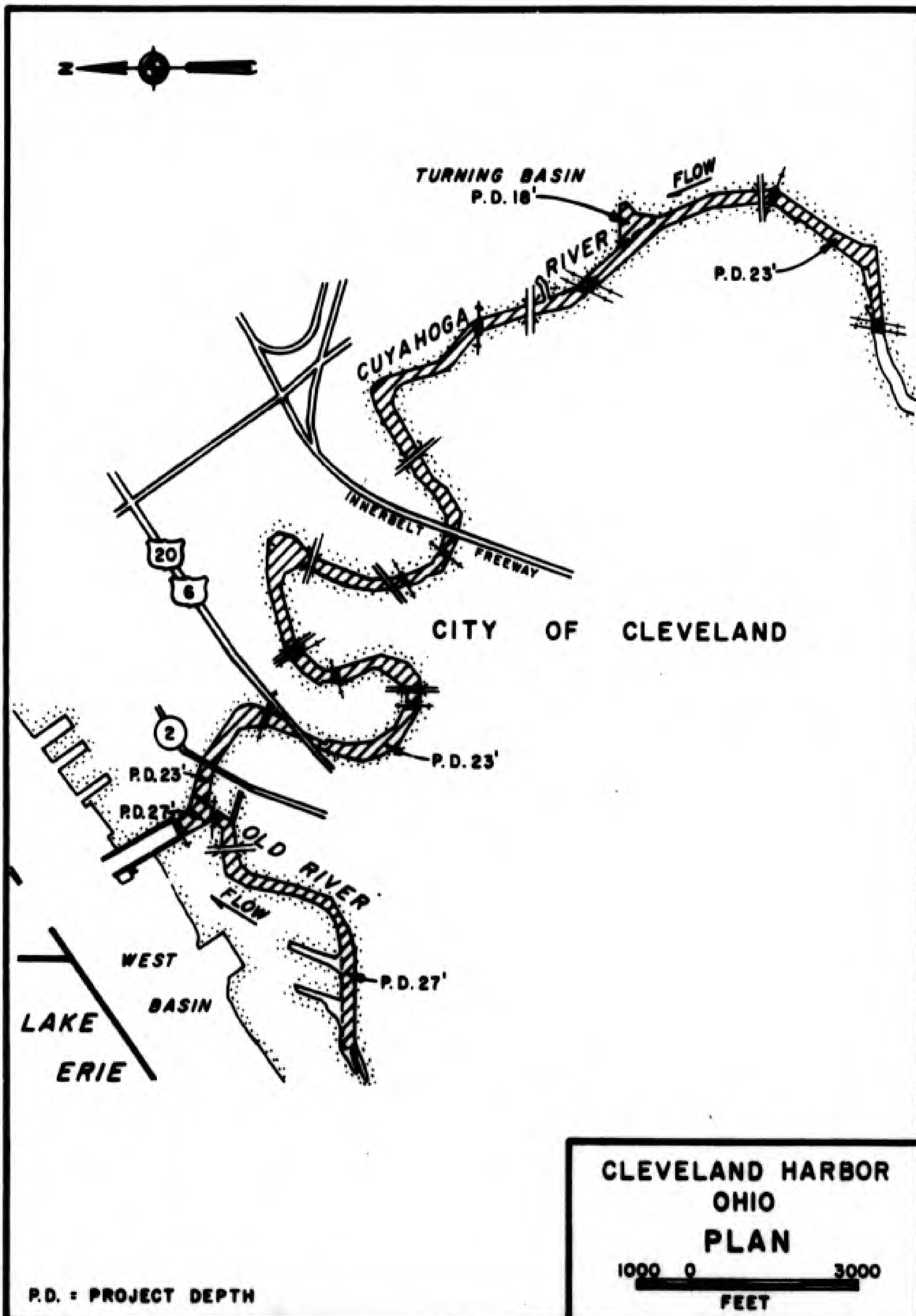
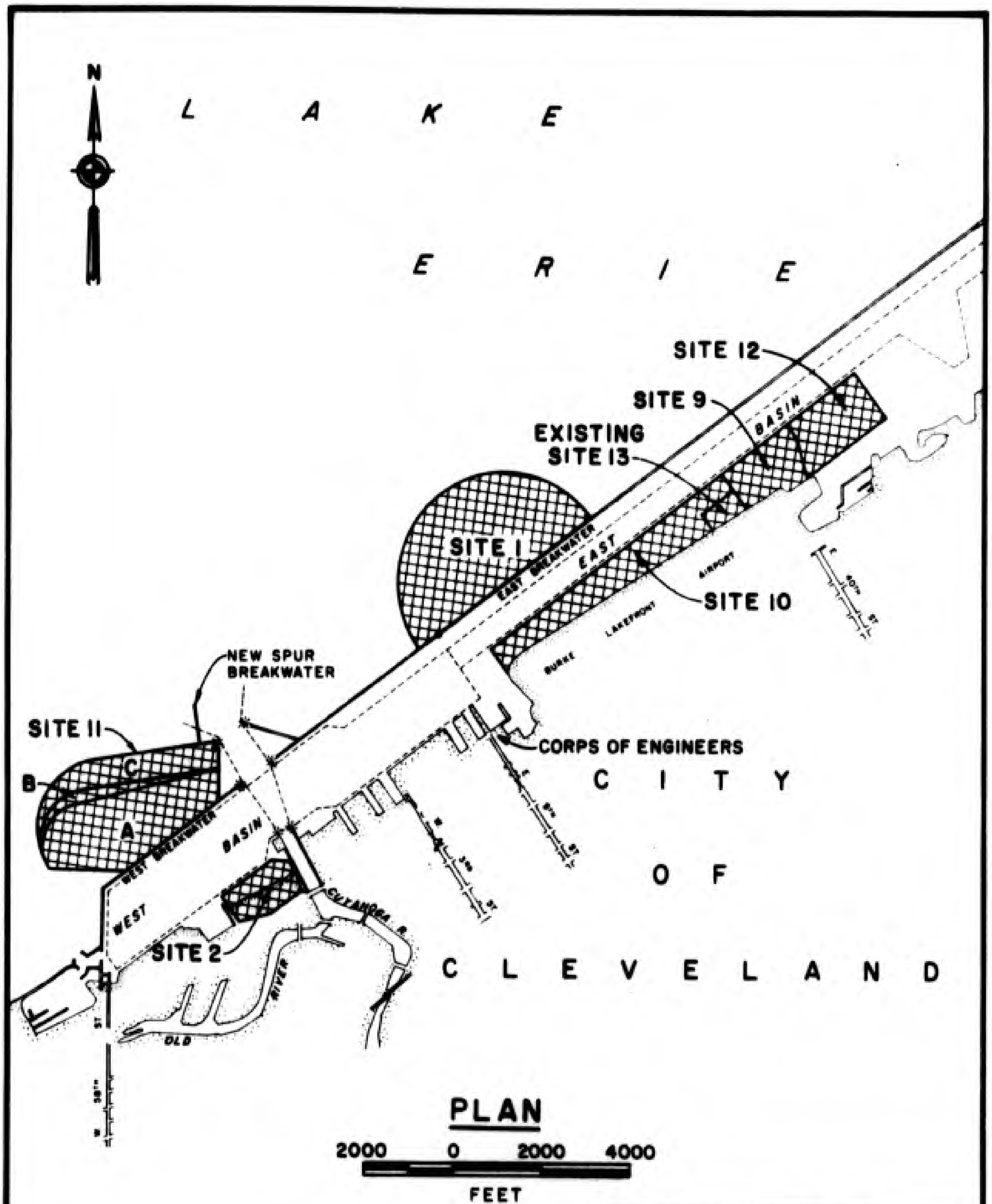

N
TURNING BASIN
P.D. 18'
FLOW
CUYAHOGA RIVER
P.D. 23'
INNERBELT FREEWAY
20
6
CITY OF CLEVELAND
2
P.D. 23'
P.D. 23'
P.D. 27'
OLD RIVER
FLOW
WEST BASIN
P.D. 27'
LAKE ERIE
P.D. = PROJECT DEPTH
CLEVELAND HARBOR
OHIO
PLAN
1000 0 3000
FEET

FIG. K3-2




CLEVELAND HARBOR
OHIO

DISPOSAL SITES

FIG. K3-3

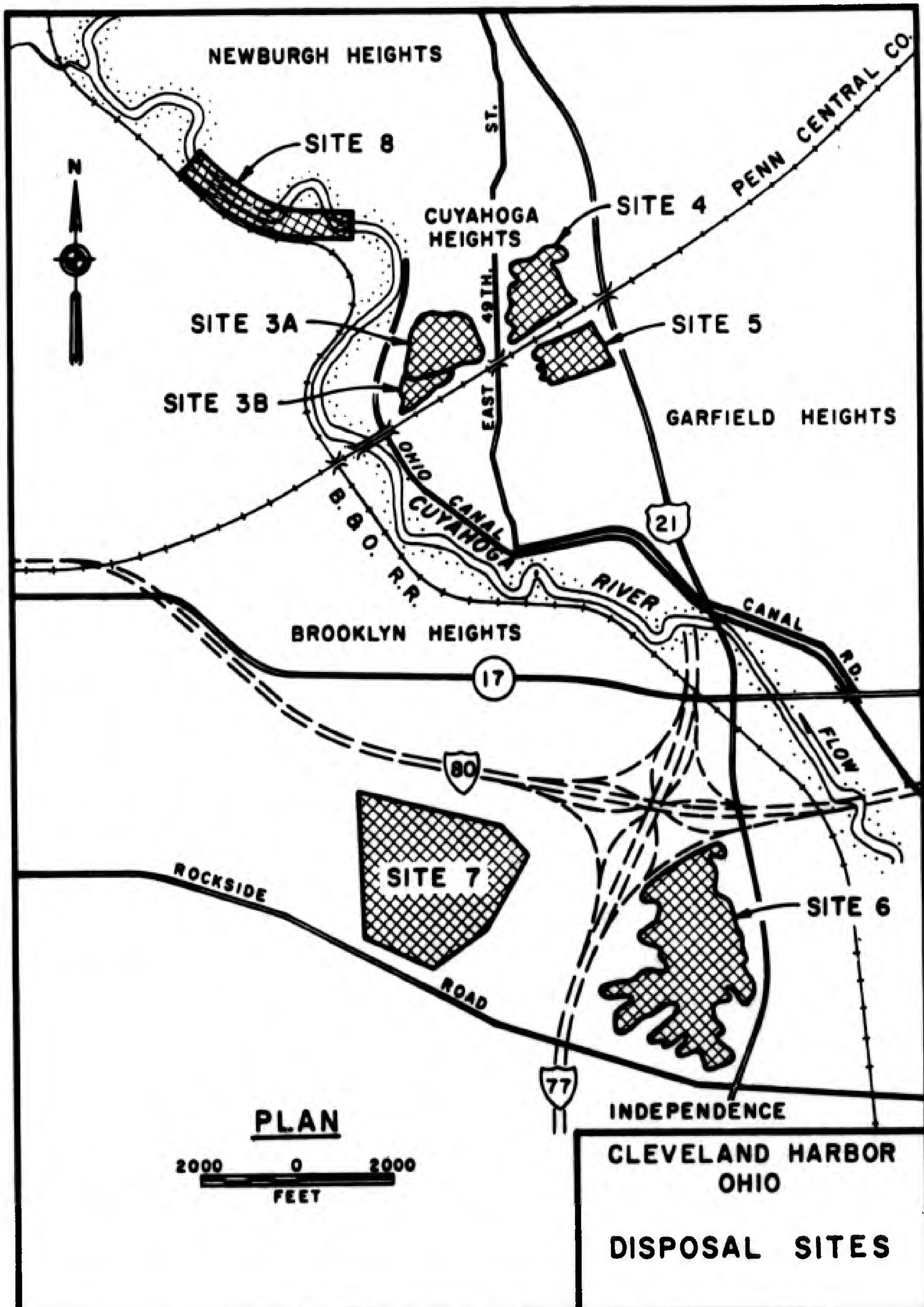
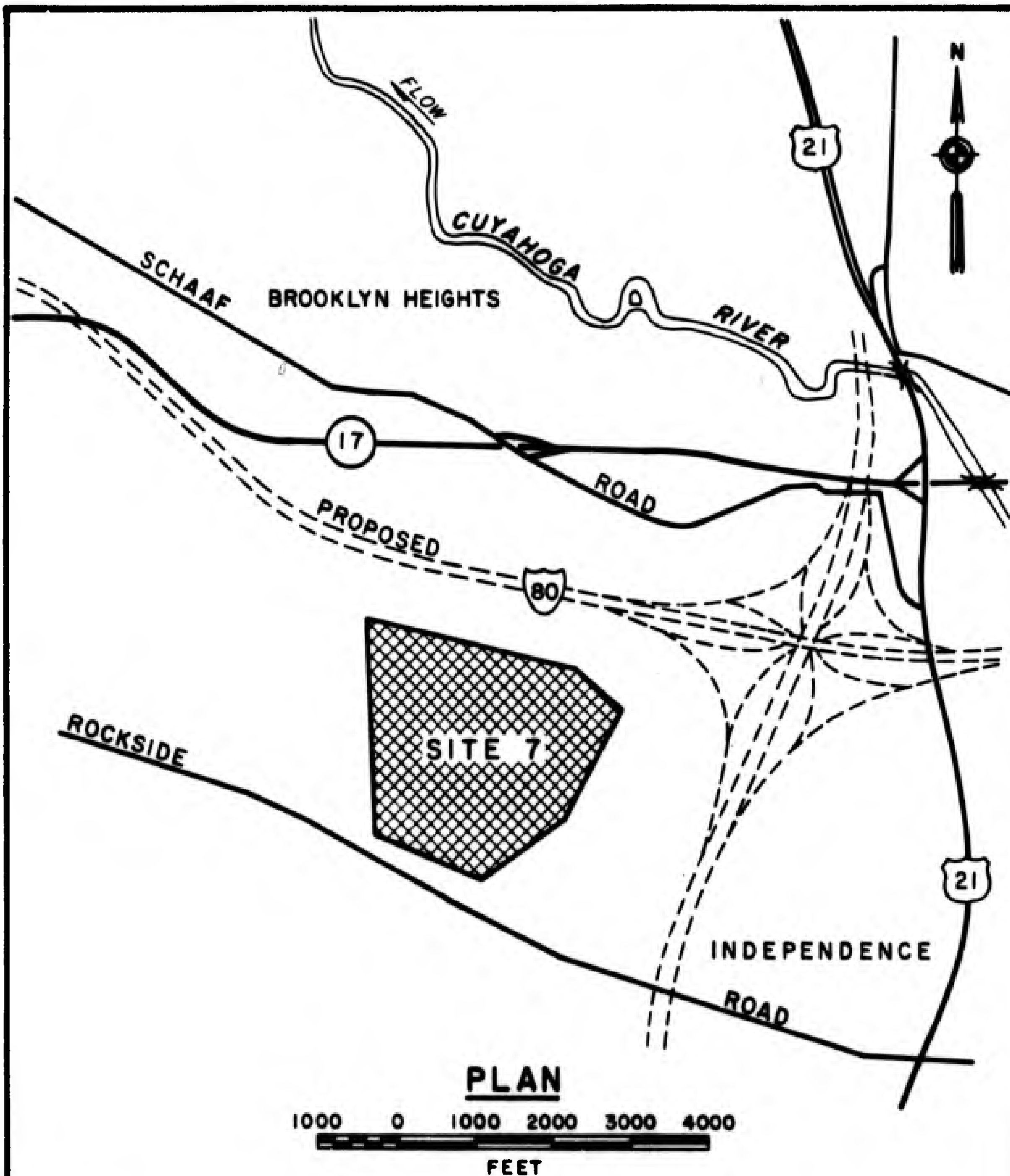

NEWBURGH HEIGHTS
PENN CENTRAL CO.
SITE 8
N
EAST 49TH. ST.
CUYAHOGA HEIGHTS
SITE 4
SITE 3A
SITE 5
SITE 3B
GARFIELD HEIGHTS
OHIO CANAL
CUYAHOGA RIVER
B. & O. R.R.
21
CANAL RD.
BROOKLYN HEIGHTS
17
FLOW
80
SITE 7
ROCKSIDE ROAD
SITE 6
77
INDEPENDENCE
PLAN
2000 0 2000
FEET
CLEVELAND HARBOR
OHIO
DISPOSAL SITES

FIG. K3-4



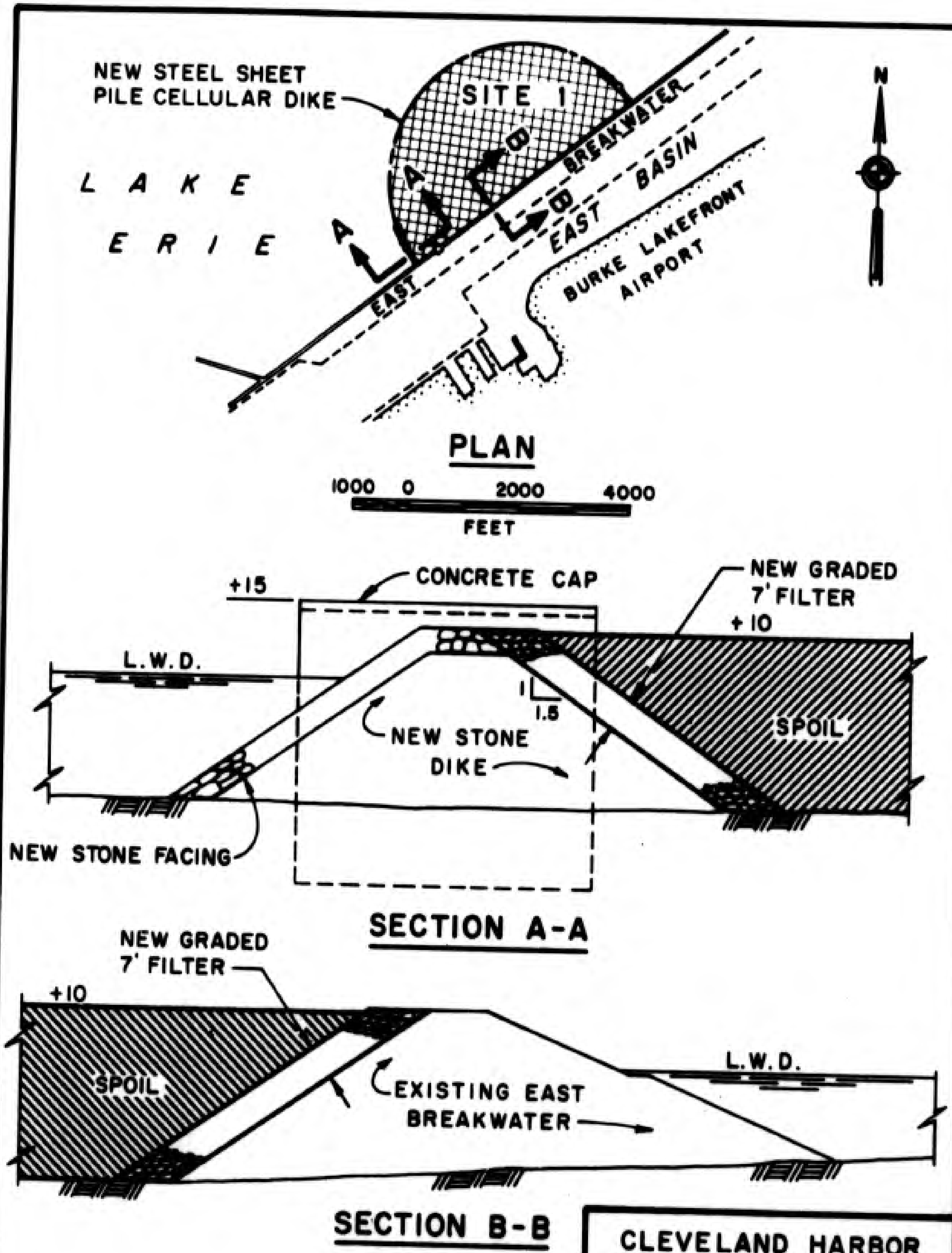

NOTES:

TOP OF SPOIL = EL.780.0
VOLUME OF SPOIL = 10,015,000 CU. YDS.
AREA OF SPOIL = 153 ACRES
USE A 10 YR. DEMAND OF 550,000 CU. YDS. PER YEAR
OR A CAPACITY OF 5,500,000 CU. YDS.

CLEVELAND HARBOR
OHIO

SITE 7

FIG. K3-5




CLEVELAND HARBOR
OHIO

SITE 1

FIG. K3-6

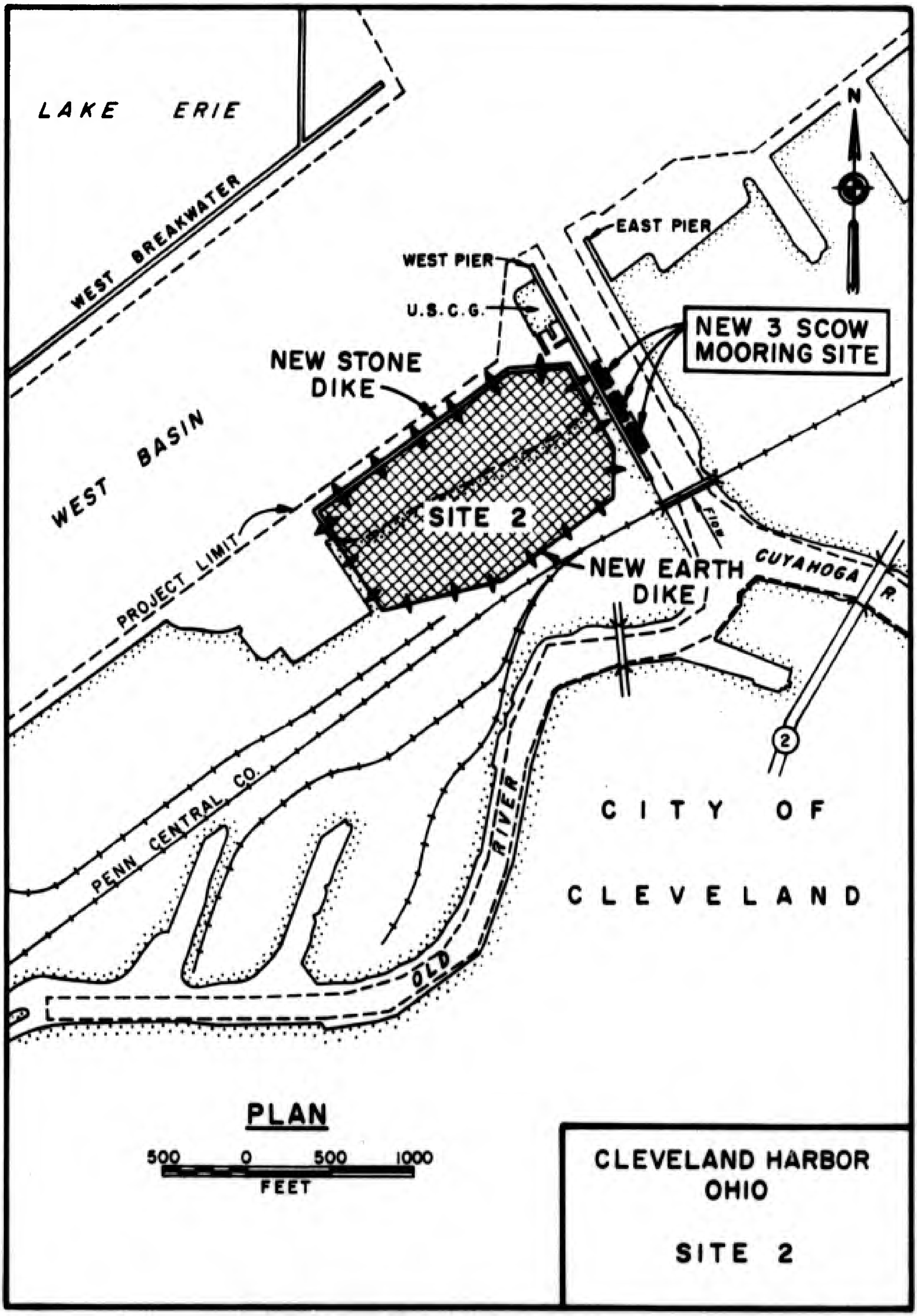
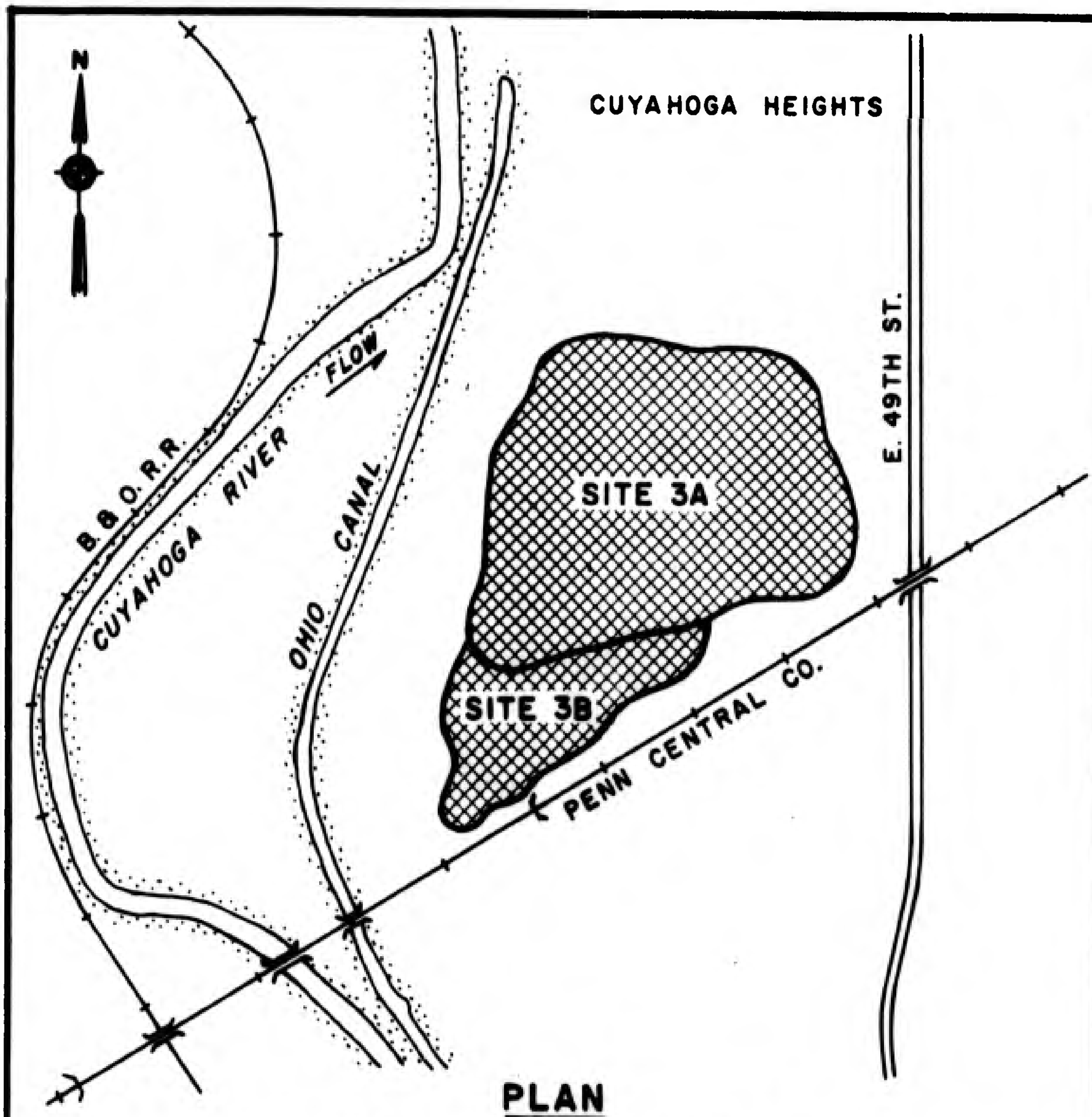

LAKE ERIE
WEST BREAKWATER
WEST PIER
EAST PIER
U.S.C.G.
N
NEW 3 SCOW MOORING SITE
NEW STONE DIKE
WEST BASIN
SITE 2
PROJECT LIMIT
NEW EARTH DIKE
CUYAHOGA R.
2
PENN CENTRAL CO.
OLD RIVER
CITY OF CLEVELAND
PLAN
500 0 500 1000
FEET
CLEVELAND HARBOR OHIO
SITE 2

FIG. K3-7




PLAN

**NOTES:**

TOP OF SPOIL = EL.710.0

VOLUME OF SPOIL = 2,825,000 CU. YDS.

SITE 3A 26.4 ACRES

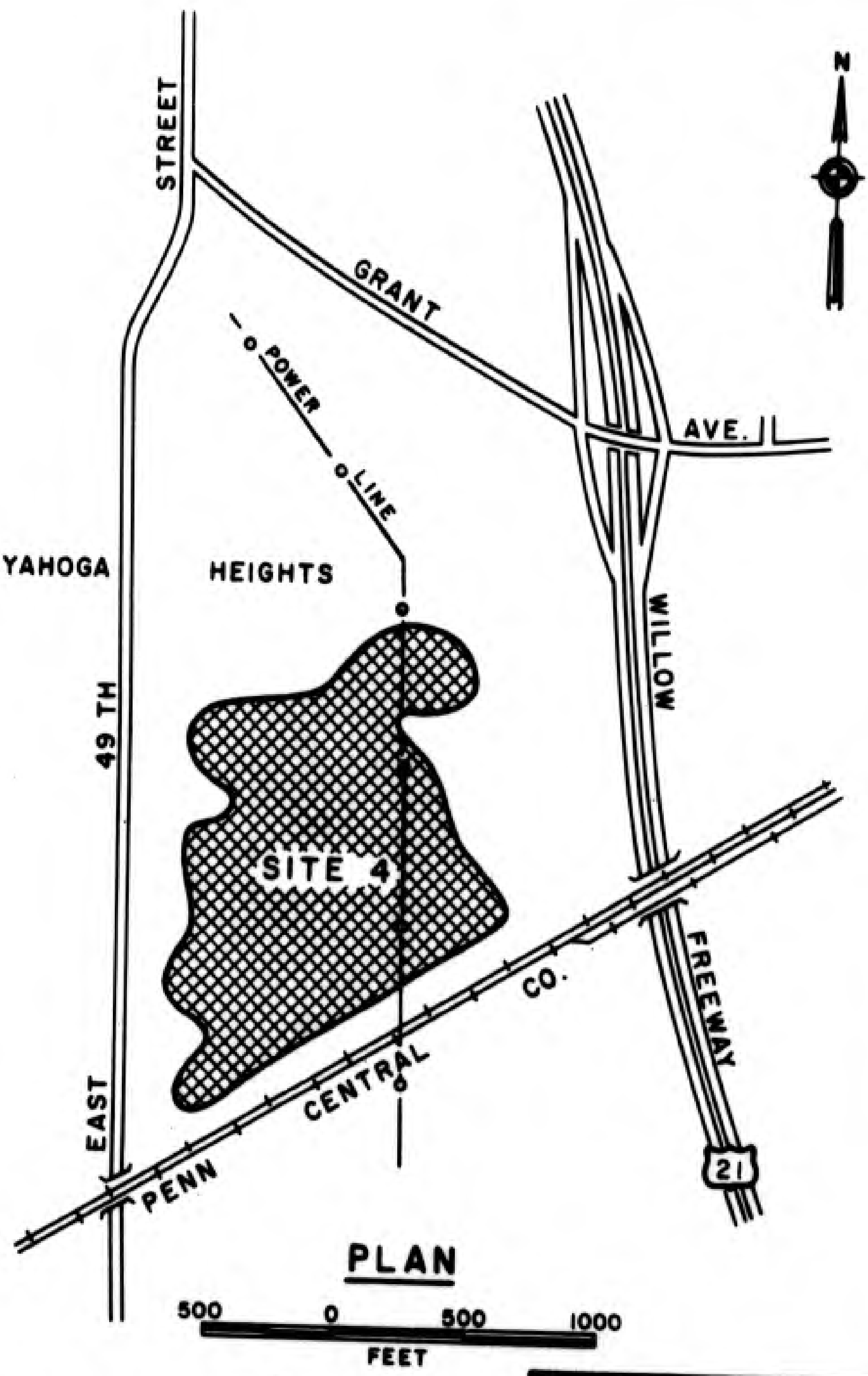
SITE 3B 6.1 ACRES

TOTAL 32.5 ACRES

USE A 5 YEAR DEMAND OF 550,000 C.Y./YR.
OR A CAPACITY OF 2,750,000 CU. YDS.

CLEVELAND HARBOR
OHIO

SITE 3



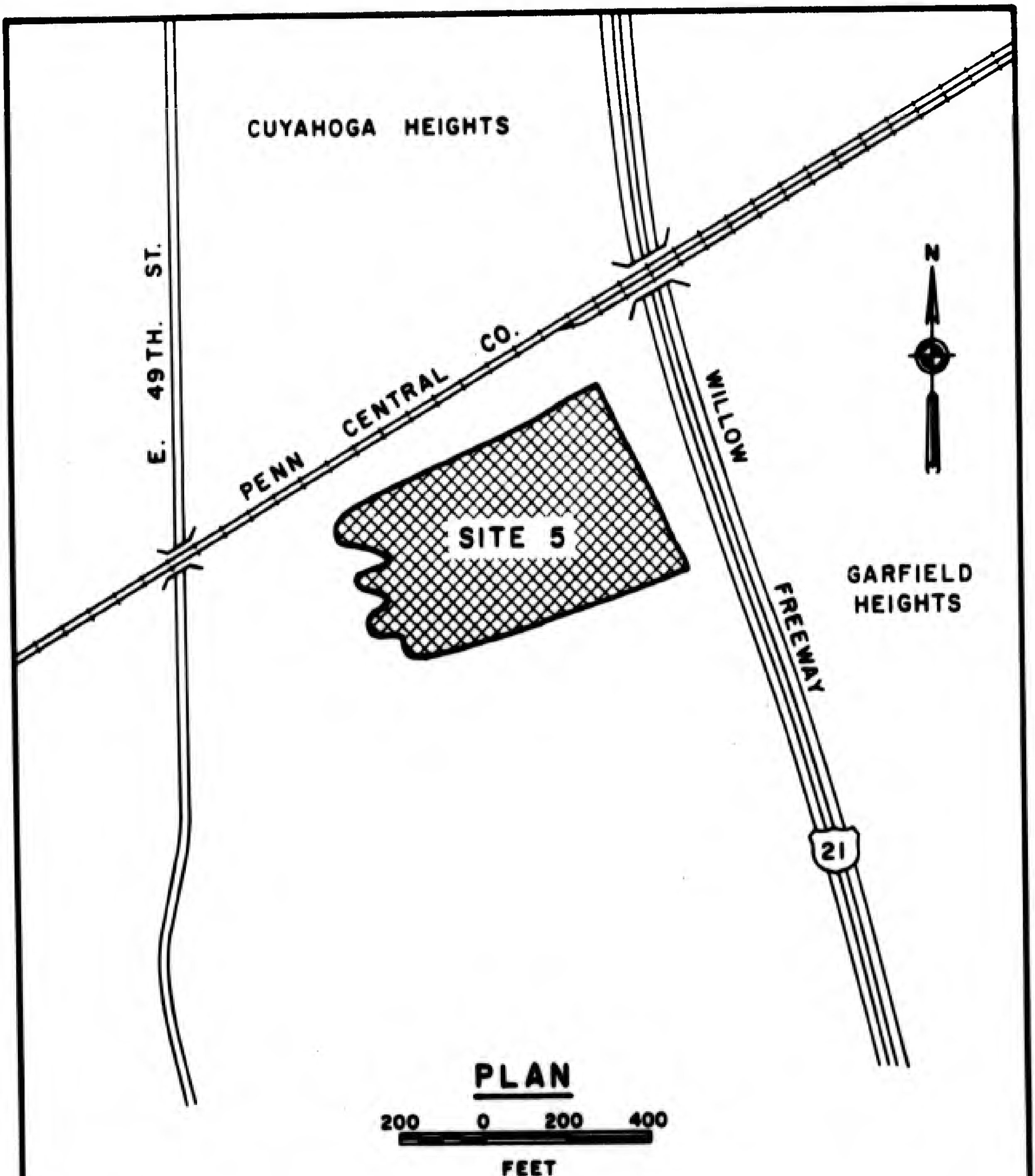

**NOTES:**

TOP OF SPOIL = EL. 720.0
VOLUME OF SPOIL = 2,746,000 CU. YDS.
AREA OF SPOIL = 44 ACRES
USE A 5 YR. DEMAND OF 550,000 CU. YDS. PER YEAR OR A CAPACITY OF 2,750,000 CU. YDS.

CLEVELAND HARBOR
OHIO

SITE 4

FIG. K3-9



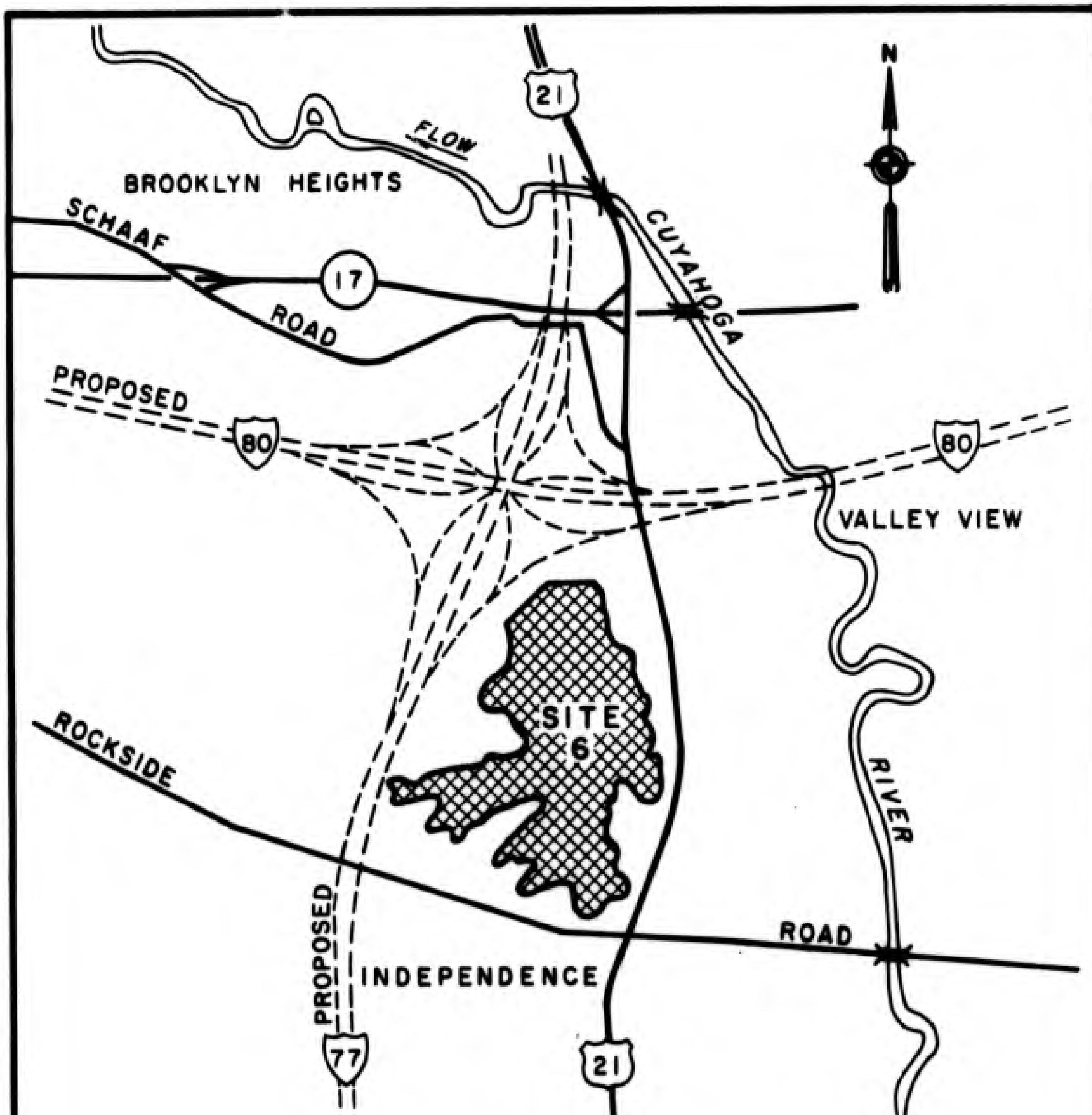

NOTES:

TOP OF SPOIL = EL.690.0
VOLUME OF SPOIL = 3,545,000 CU.YDS.
AREA OF SPOIL = 89 ACRES
USE A 5 YR. DEMAND OF 550,000 CU. YDS. PER YEAR OR A CAPACITY OF 2,750,000 CU. YDS.

CLEVELAND HARBOR
OHIO

SITE 5

FIG. K3-10




## PLAN

1000 0 1000 2000 3000 4000

FEET

**NOTES:**

TOP OF SPOIL = EL.730.0
VOLUME OF SPOIL = 9,984,000 CU. YDS.
AREA OF SPOIL = 134 ACRES
USE A 10 YR. DEMAND OF 550,000 CU. YDS. PER YEAR
OR A CAPACITY OF 5,500,000 CU. YDS.

CLEVELAND HARBOR
OHIO

SITE 6

FIG. K3-11

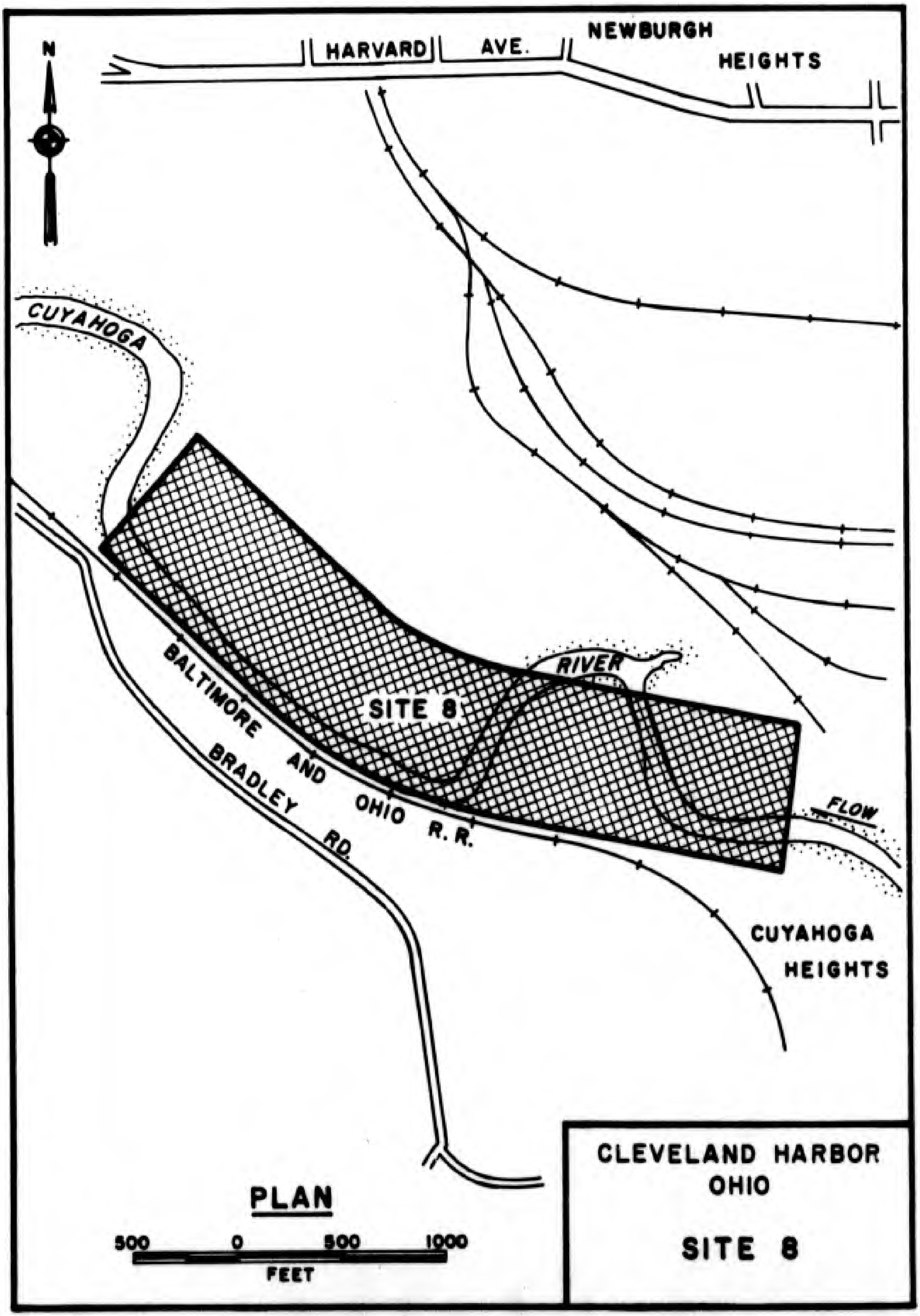
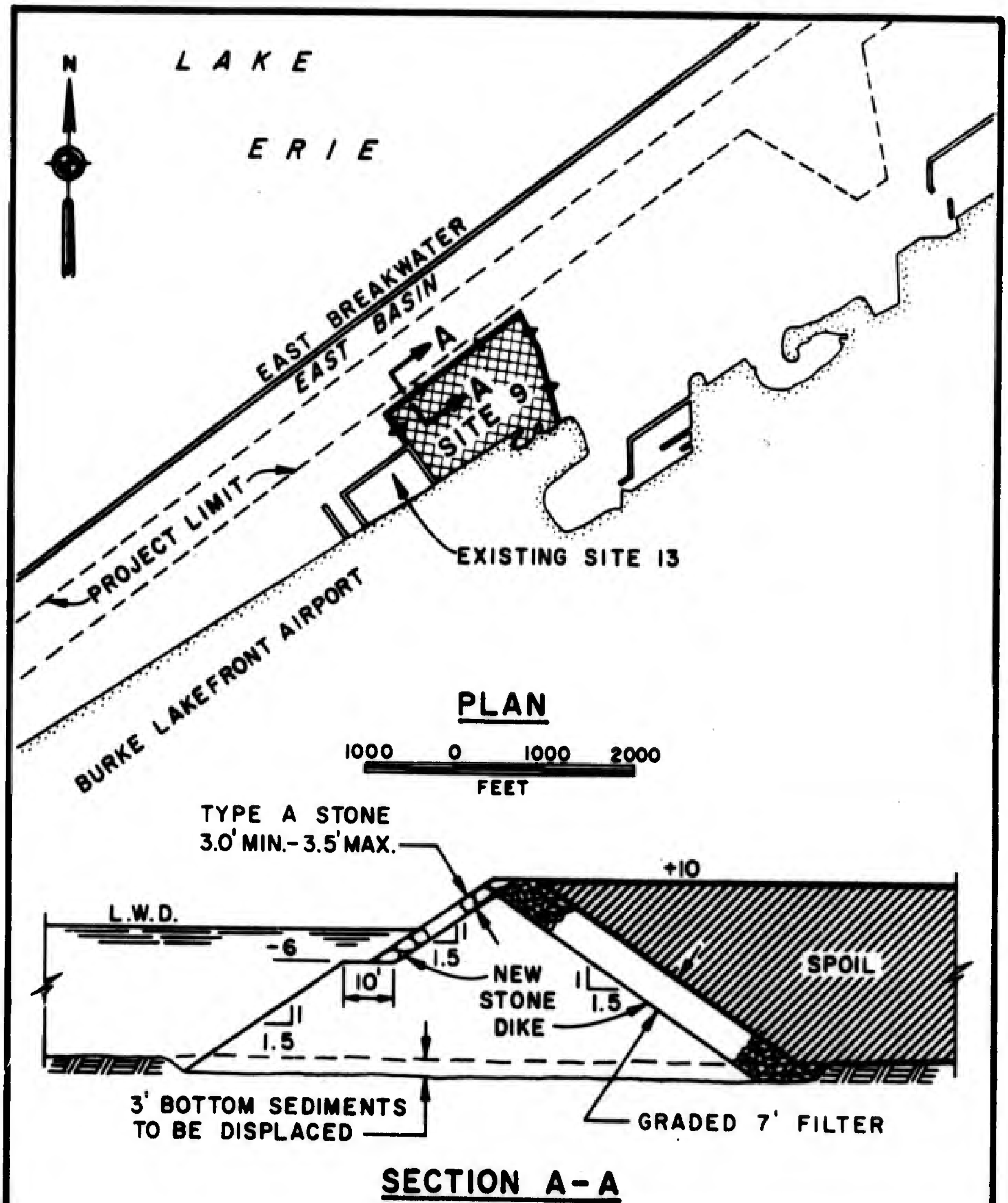

N
HARVARD
AVE.
NEWBURGH
HEIGHTS
CUYAHOGA
RIVER
SITE 8
BALTIMORE
AND
OHIO
R. R.
BRADLEY
RD.
FLOW
CUYAHOGA
HEIGHTS
PLAN
500
0
500
1000
FEET
CLEVELAND HARBOR
OHIO
SITE 8

FIG. K3-12




CLEVELAND HARBOR
OHIO

SITE 9

FIG. K3-13

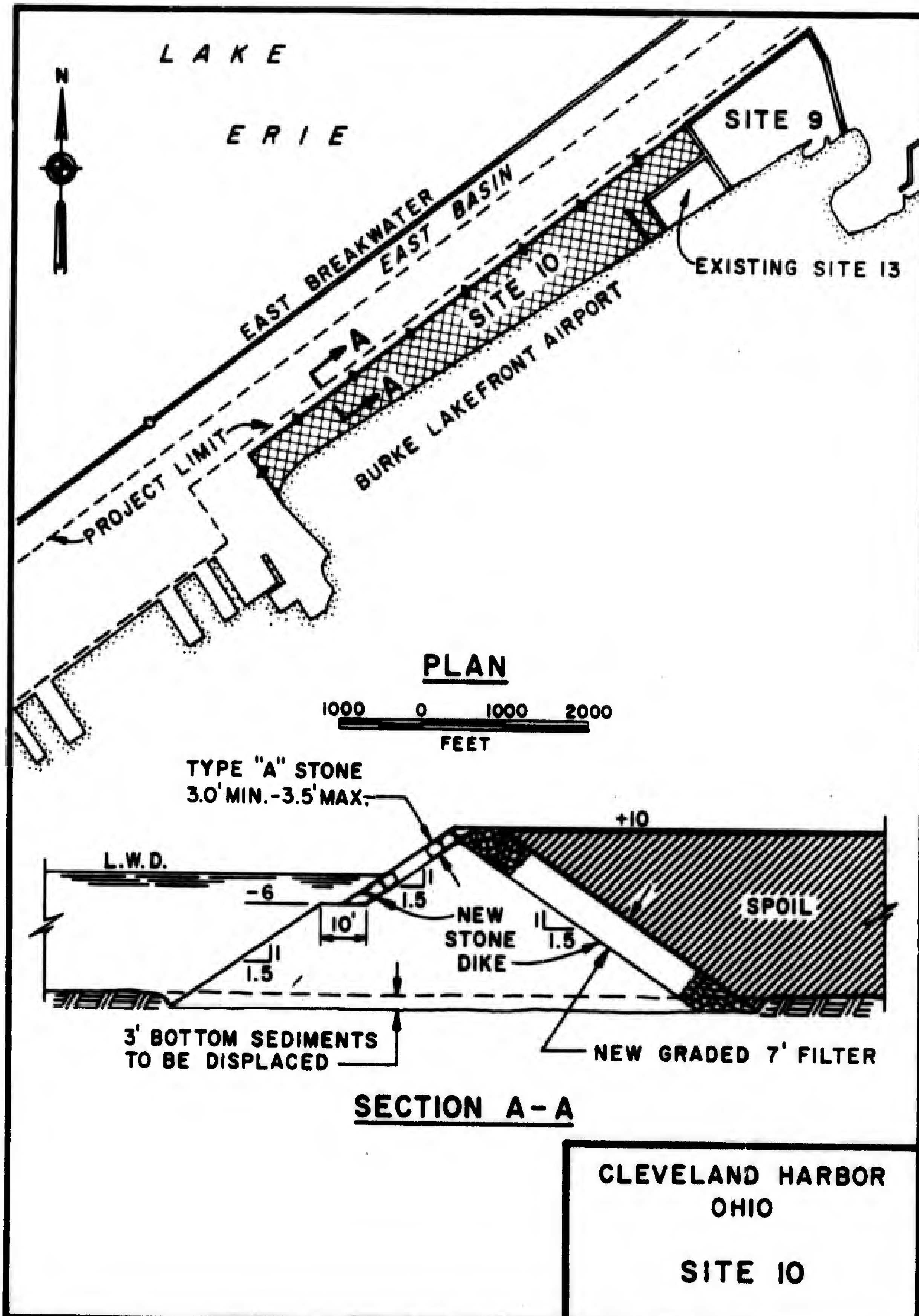
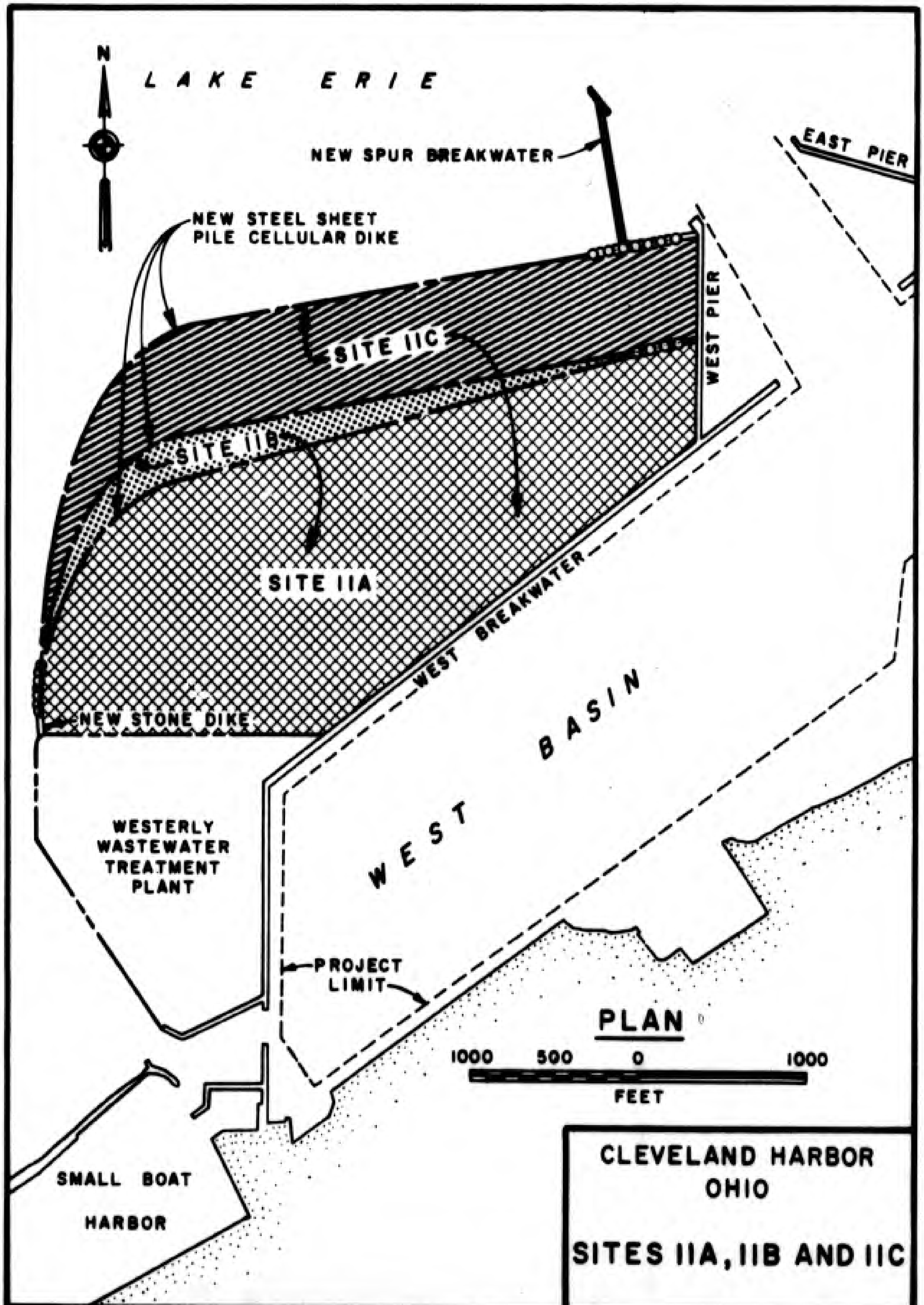
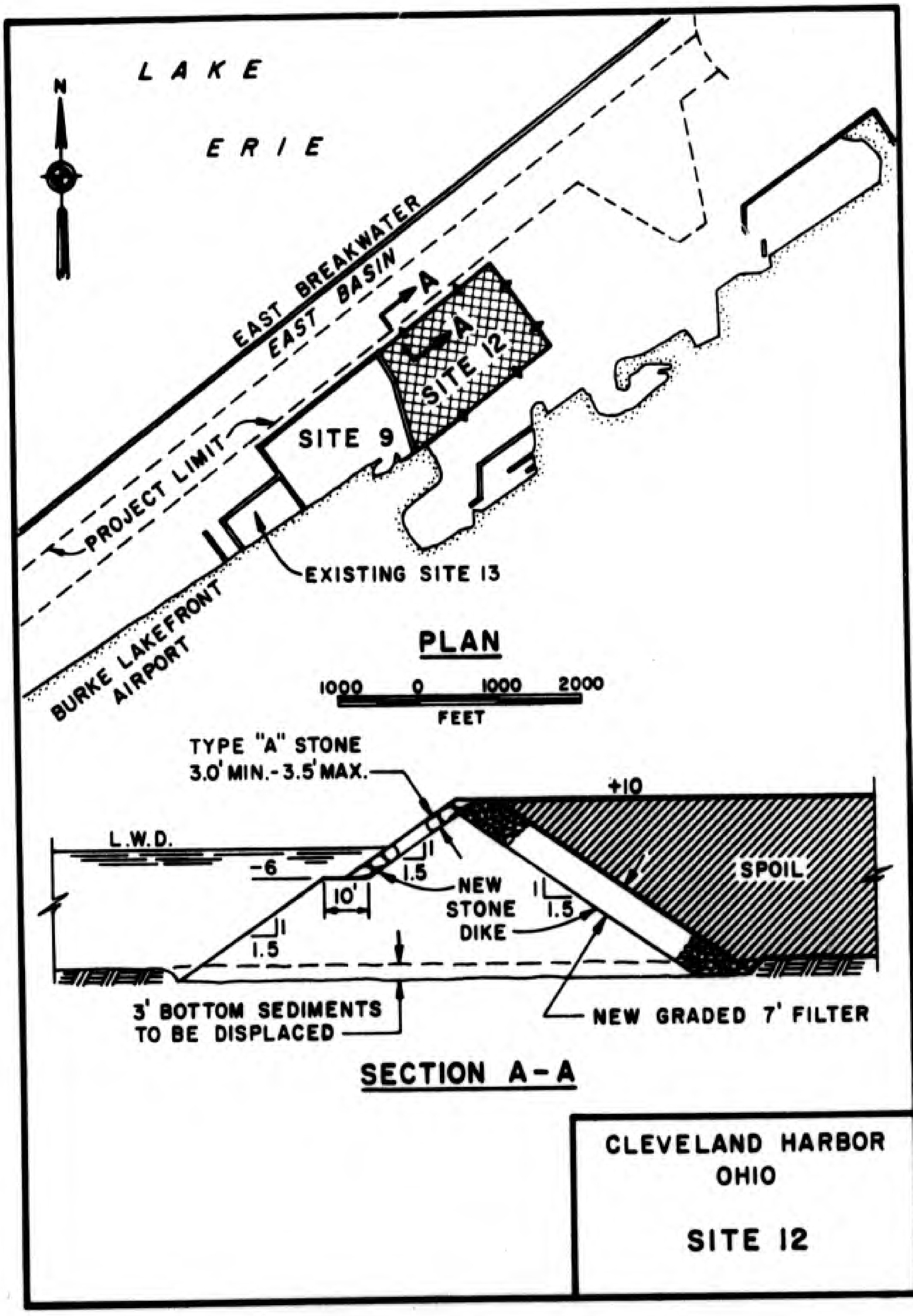

LAKE
ERIE
N
EAST BREAKWATER
EAST BASIN
PROJECT LIMIT
A
A
SITE 10
SITE 9
EXISTING SITE 13
BURKE LAKEFRONT AIRPORT
PLAN
1000 0 1000 2000
FEET
TYPE "A" STONE
3.0' MIN.-3.5' MAX.
+10
L.W.D.
-6
1
1.5
10'
NEW
STONE
DIKE
1
1.5
SPOIL
1
1.5
3' BOTTOM SEDIMENTS
TO BE DISPLACED
NEW GRADED 7' FILTER
SECTION A-A
CLEVELAND HARBOR
OHIO
SITE 10

FIG. K3-14


N
LAKE ERIE
NEW SPUR BREAKWATER
EAST PIER
NEW STEEL SHEET PILE CELLULAR DIKE
WEST PIER
SITE IIC
SITE IIB
SITE IIA
WEST BREAKWATER
NEW STONE DIKE
WEST BASIN
WESTERLY WASTEWATER TREATMENT PLANT
PROJECT LIMIT
PLAN
1000 500 0 1000
FEET
SMALL BOAT HARBOR
CLEVELAND HARBOR OHIO
SITES IIA, IIB AND IIC




CLEVELAND HARBOR
OHIO

SITE 12

FIG. K3-16

APPENDIX K7

STUDY OF

ALTERNATE DISPOSAL AREAS

FOR

LORAIN HARBOR, OHIO

U. S. ARMY ENGINEER DISTRICT, BUFFALO
CORPS OF ENGINEERS
1776 NIAGARA STREET
BUFFALO, NEW YORK 14207

OCTOBER 1968

DREDGING AND WATER QUALITY PROBLEMS
IN
THE GREAT LAKES

APPENDIX K7

STUDY OF ALTERNATE DISPOSAL AREAS
FOR
LORAIN HARBOR, OHIO

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## APPENDIX K7 - LORAIN HARBOR

### LOCATION AND DESCRIPTION

1. Lorain Harbor, Ohio is located at the mouth of Black River, 28 miles west of Cleveland Harbor. The Black River basin encompasses some 467 square miles. Details of the navigation project are shown in fig. K7-1.

2. The harbor is an important commercial port. The total waterborne commerce at Lorain Harbor for 1966 amounted to 6,620,98[illegible] tons and for the 10-year period 1957-1966, inclusive, has averaged 6,164,856 tons. The principal commodities in 1966 were: receipts of 3,491,756 tons of iron ore (53% of total commerce); shipments of 1,631,114 tons of bituminous coal (25%); receipts of 709,865 tons of limestone (11%); and receipts of 513,579 tons of sand and gravel (8%). Future waterborne commerce is expected to average 6,200,000 tons annually.

### EXISTING CORPS OF ENGINEERS PROJECT

3. PROJECT

The existing project was authorized by the 1899, 1907, 1910, 1917, 1930, 1935, 1945, 1960 and 1965 River and Harbor Acts which provide for:

a. An outer breakwater lakeward of harbor entrance, 2,180 feet long.

b. An outer harbor about 60 acres in area formed by converging rubble mound breakwaters with an aggregate length of 8,500 feet and having a clear channel width of 525 feet between lakeward ends.

c. Two piers at the mouth of the river 300 feet apart, west pier 1,004 feet long, and east pier 880 feet long.

d. Lake approach channel with a depth of 29 feet in soft material and 30 feet in hard material, from 525-foot width at entrance in breakwater system flaring to deep water within protection of detached breakwaters.

e. Depth of 28 feet if soft material and 29 feet in hard material for a width of 800 feet through the outer harbor to a point opposite west pier light, then narrowing to a width of about 250 feet at a point 1,000 feet above the west pier light, then a channel of that width to a point 2,200 feet above west pier light.

f. An approach channel 16 feet deep extending from the outer harbor to a municipal pier.

g. Depth of 25 feet in soft material and 26 feet in hard material in remaining portions of outer harbor.

h. Channel in Black River with a depth of 27 feet in soft material and 28 feet in hard material from a point 2,200 feet above west pier light to a point 500 feet below upstream limit of Federal project, and a depth of 24 feet in soft material and 25 feet in hard material in the remaining 500-foot portion of the river channel. A river channel suitably widened at bends and with additional widening through the Norfolk and Western Railway bridge to provide a clear channel width of 200 feet, with no dredging to be done closer than 50 feet to existing and future docks or bulkheads, except at bends.

i. Bank stabilization works at Cut numbered 1 along left bank of river channel above the Erie Avenue Bridge.

j. A lower turning basin 650 feet wide and 20 feet deep in the bend of Black River immediately upstream from the former Baltimore and Ohio Railroad coal dock.

k. An upper turning basin approximately 690 feet wide and 17 feet deep opposite National Tube Company dock with an enlarged portion immediately downstream, 21 feet deep.

l. Replacement of the existing Norfolk and Western Railway swing bridge with a vertical lift bridge to provide a clear horizontal width between fenders of about 205 feet normal to the channel and a vertical clearance of 100 feet above the low-water datum.

4. PROGRESS

The existing project is 62% complete as of 30 June 1968. Government owned plant completed removal of shoals in the lake approach channel on 17 July 1967. For the remainder of the work to be done as authorized by the 1960 and 1965 River and Harbor Acts: preconstruction planning is continuing for the replacement of Norfolk and Western Railway bridge and bank stabilization at cut numbered 1; deepening and widening Black River at cut numbered 2, in the vicinity of N. & W. Railway bridge, will be accomplished upon completion of replacement of the bridge and; dredging of 25-foot wide strips adjacent to the East and the West piers is deferred for restudy.

## PRESENT DREDGING PRACTICES

5. PROCEDURES

All project channels are maintained annually by U.S. hopper dredges. Permit dredging is accomplsihed by the use of clamshell dredges and dump scows.

6. WORK SEASON

The available season for dredging work at Lorain Harbor approximates the navigation season. In recent years the earliest and latest opening and closing of navigation at the harbor were:

| | Opening | Closing |
|---|---|---|
| Earliest date | Mar 15 | Dec 13 |
| Latest date | Apr 7 | Dec 31 |

7. QUANTITY AND TYPE OF MATERIAL

The volume of material dredging in maintaining the project channels has averaged about 200,000 cubic yards during the last ten years. However, project areas and channel depths have recently been increased, as a result of substantial completion of the improvements authorized in 1960. This will increase the volume of material to be removed annually to adequately maintain project channels. It is estimated that about 300,000 cubic yards will be dredged annually in the future. Permit dredging averages about 25,000 cubic yards annually. This is not expected to change significantly in the future. The material dredged in maintenance operations consists primarily of sand and silt which has been deposited since the last dredging.

8. NATURE OF POLLUTION

The nature of pollution in the Black River is duscussed in a report by FWPCA entitled "Lake Erie Report, A Plan for Water Pollution Control," dated August 1968. The report states that toxic materials such as cyanide and chromium, in addition to oil, solids, etc. discharged by industry, divest the Black River of its life-sustaining properties upstream near Elyria. Below Elyria the river is often depleted of oxygen, covered with oil slicks, and multi-colored from industrial and other wastes during low flow. In the lower reaches, wastes from the City of Lorain and local industry add to the already polluted conditions of the river.

## PRESENT DISPOSAL PRACTICE

### 9. METHOD OF DISPOSAL

Material dredged in project maintenance or by permit is disposed of by bottom dumping, from hopper dredges or dump scows, into the established open lake disposal areas in Lake Erie. A small amount of recent new work dredging was truck hauled about five miles to a land disposal area.

### 10. DISPOSAL AREAS

There are two established open lake disposal areas at Lorain Harbor, one for earth and the other for rock. The earth disposal area, used for all material dredged by hopper dredge and earth removed in permit dredging, is rectangular, one mile by 1½ miles, located 3½ miles, N 10° W, from the west breakwater light. At present dredging rates it is estimated that the capacity of the earth disposal area within its existing limits is sufficient to serve for at least 40 years without impeding navigation. The rock disposal area, used for disposal of unclassified material removed in new work dredging and miscellaneous hard materials removed in permit dredging and miscellaneous hard materials removed in permit dredging is one mile square and located 4-3/4 miles, N 8° W, from the east breakwater light. The capacity of the rock disposal area, as now being used, is indefinite. The land disposal area, discussed in paragraph 10, is a 10-acre site located about five miles from the harbor.

11. COST OF DREDGING

The unit cost for harbor maintenance by hopper dredge, with disposal in the earth disposal area in Lake Erie, is $0.42 per cubic yard.

## ALTERNATE DISPOSAL AREAS

12. GENERAL

A survey was made in 1968 to locate sites for diked disposal areas as an alternative to the present open lake disposal for at least a ten-year period. Based on a reconnaissance of the area and discussions with city officials and representatives of the Lorain Port Authority, several sites were selected for further study. Some of these areas were located along the existing Black River channel. Pumping would be required to reach the sites located upstream of the head of navigation. It would also be possible to provide diked disposal areas along the lake front. The City of Lorain has prepared a master plan for filling the lake front area to eventually provide additional harbor facilities and land for commercial development. Although there are no plans for implementing this plan in the immediate future, it is an area where large quantities of fill having suitable strength characteristics could be utilized. The quantity of fill being considered, about 16 million cubic yards, could be obtained from the total volume of annual maintenance dredging from Lorain Harbor over a period of about 50 years. Unfortunately the strength characteristics of this material are unknown and it would probably require testing over a period of years to determine whether or not the material would be suitable, by itself, for this type of development. It has been assumed, however, that some productive use would be found for any land areas created with dredged material. Even land that would not support structures could be utilized for some form of recreational development. The sites selected for further study are shown in fig. K7-2 and discussed individually in the following paragraphs.

13. SITE 1

This is an alongshore site, located in the harbor area between the east breakwater shorearm and the Lorain sewage disposal plant. The disposal area would extend out from the shoreline about 1,200 to 1,900 feet, covering an area of about 25 acres. The capacity of the site when filled to a height of 10 feet above LWD is approximately 1,200,000 cubic yards. This volume is equivalent to about four years of maintenance dredging. A stone or slag dike, about 1,400 feet in length, would be constructed along the northwest sides of the site. The dike design was based on the cross-section used for the pilot study disposal areas at Buffalo and Cleveland. Because the dike is within the harbor area and therefore protected from lake storms, the use of lesser quantities of dike material was considered feasible. Effluent would be discharged into the harbor by seepage through the dike. Details for site 1 are shown in fig. K7-3.

14. Mooring facilities that would incorporate all the necessary equipment for making and handling flexible connections between the dredge and a fixed discharge line, would be required to utilize the disposal area. The discharge line would consist of sections of 18-inch pipe. The mooring facilities would be installed on an existing pier adjacent to the navigation channel. The distance from the outer dredging limit of the harbor approach channel to the mooring site is a little under a mile. The distance from the upstream limit of dredging in the Black River to the mooring site is about three miles. The distances are less than the 3-1/2 to 4-3/4 miles to the open lake disposal area that is currently being used.

15. The existing shoreline along the southern boundary of the site is essentually undeveloped, consisting of a low bluff and a rough narrow beach. A row of houses on the bluff overlook the harbor. Although property owners were not contacted, it is assumed that there would be some opposition to the considered plan. The site was suggested by local officials as part of the plan for future harbor development discussed in paragraph 13.

16. SITE 2

This site is located about two miles upstream, adjacent to the Black River navigation channel. It is a small triangular-shaped site that would hold only about 1½ years of maintenance dredging spoil when filled to a depth of 40 feet above LWD. The site is now being used as a spoil area by a private contractor doing excavation work in the river channel. It is assumed that the site would hold maintenance dredging spoil for one year after being partially filled by the contractor. The site would be inclosed with an earth dike. An overflow structure would be provided to discharge effluent back to the river. Mooring facilities would be provided for the dredge to pump directly to the disposal area. The site is owned by the City of Lorain and the B & O Railroad. Future use of the site would probably be for industrial expansion. Details for site 2 are shown in Fig. K7-4.

17. SITE 3

This is a landfill site, located about one and a half miles east of the upper turning basin in the Black River, near the junction of routes 611 and 301. The capacity of the site when filled to an elevation about 15 feet above the existing ground, is three million cubic yards. This volume is equivalent to ten years of maintenance dredging. To contain the dredged material during the stabilization period, an earth dike about 10,000 feet in length, would be constructed from material excavated at the site. An overflow structure would be provided to drain off the effluent and return it to the river. Details for site 3 are shown in fig. K7-5.

18. Mooring facilities would be constructed in the turning basin near the upstream limit of the navigation project. It would consist of two cellular structures separated by an equipment dock. The necessary equipment for making and handling flexible connections between the dredge and a fixed 18-inch discharge line would be provided on the dock. About 11,000 feet of discharge pipe and three booster pumps would be required to transport the spoil to site 3.

19. Most of the site has been developed for agricultural purposes. The land is generally flat with some undeveloped wooded areas. The property adjacent to the site, along existing highways, is partially developed for residential purposes. Although owners of property in the disposal area were not contacted, it was assumed that rights could be purchased to use the site as a disposal area. The spoil material is expected to be suitable for growing crops after a stabilization period.

20. SITE 4

This site is located a little over two miles east of the upper turning basin in the Black River, between route 301 and Harris Road. The dimensions and capacity of the site are almost identical to site 3. The dikes, mooring facilities and piping system are also similar. An additional 4,000 feet of piping and one additional booster pump would be required to reach the disposal area. Details for site 4 are shown in fig. K7-6.

21. Most of this site has been developed for agricultural purposes. The discussion in paragraph 19 also applies to site 4.

22. SITE 5

This is an offshore site that would be located on the lake side of the east breakwater. The capacity of the site when filled to a height of five feet above LWD would be 2,400,000 cubic yards. It would hold the maintenance dredging spoil for eight years. The site would be inclosed with a 4600-foot cellular sheet pile structure filled with granular material and capped with concrete. The cellular wall would be tied to the rubble mound east breakwater by means of two spur dikes. A seven-foot thick filter blanket would line the breakwater side slope inside the spoil area. Effluent would drain through the filter and breakwater and discharge into the harbor. A mooring facility would be constructed on the harbor side of the breakwater and spoil would be pumped into the disposal area through an 18-inch pipeline. Details of site 5 are shown in fig. K7-7.

23. It has been assumed that any offshore land area created would become the property of the State of Ohio. The land would be accessible only by water unless some modification of the existing breakwater system is made. The land would probably be suitable for some form of recreational development after a stabilization period.

24. SITE 6

This is a landfill site, adjacent to the Black River, about 2,000 feet above the head of navigation. The site would hold about 600,000 cubic yards of spoil which is equivalent to the volume of two years of maintenance dredging. A 4,000-foot earth dike would be constructed along the river to inclose the spoil area. An overflow structure would be provided to discharge effluent back to the river. A mooring facility would be constructed near the head of navigation and spoil would be pumped with a booster pump through an 18-inch pipeline.

25. The existing site is undeveloped marshland located between the river and a 40-foot bluff. Although property owners were not contacted it was assumed that rights to the land could be acquired. Future use of the landfill area would probably be for recreational or agricultural purposes.

## ESTIMATES OF COSTS

26. GENERAL

Costs of the spoil retention structure, mooring facilities and spoil discharge system were estimated for each site. Land costs were included in the estimate for the retention structure. It was assumed that these would be no land costs for site 1, the offshore site. All costs were based on 1968 price levels. Salvage value for a booster pump was credited to the total cost of sites 3, 4 and 6. Salvage value of piping and mooring facilities was considered negligible at all sites. The construction period for site 5 was assumed to be two years. Total investment cost for this site included interest on the first cost over half the construction period at 3-1/4 percent, the current Federal risk-free interest rate. The other sites could be constructed in less than one year. Total investment was therefore equal to total first costs for these sites. Future land use benefits were not evaluated because of the unknown strength characteristics of the land fill areas.

27. Annual costs for each site included interest at 3-1/4 percent on the total investment. The investment was amortized over the filling period for sites 1, 2 and 5. The investment less salvage was amortized for the other three sites. Other annual charges included the cost of dredging 300,000 cubic yards of spoil material and disposal at the designated mooring site. The unit cost would vary with the distance to the disposal area and the method of disposal.

28. It was assumed that maintenance of the stone dike, for site 1, would probably be required for some unknown period after filling. Wave action is expected to cause periodic damage to the dikes. Repairs should be effected as pollution abatement measure until such time as the fill has stabilized. It was assumed that maintenance would be required for 10 years after the site is filled. The annual maintenance over the total maintenance period was converted to a present worth value and amortized over the filling period. Cost estimates for individual sites are shown in the following paragraphs.

29. SITE 1

a. First Costs

| | |
|---|---|
| Spoil retention structures | $ 842,000 (1) |
| Mooring facilities | 33,000 |
| Spoil discharge system | 55,000 |
| Total Investment Cost | $ 930,000 |

b. Annual Costs

| | |
|---|---|
| Interest, $930,000 @ .0325 | $ 30,000 |
| Amortization, 4 yrs., $930,000 @ .2381 | 221,000 |
| Maintenance dredging, 300,000 c.y. @ $0.68 | 204,000 |
| Operation and maintenance | 21,000 (2) |
| Total Annual Cost | $ 476,000 |
| Cost per Cubic Yard | $ 1.59 |

(1) Includes land costs.

(2) Includes $4,000 annually for 14 years for maintenance of the dike, which is equivalent to $12,000 annually for 4 years. ($4,000 X 11.106 X.2706)

30. SITE 2

a. First Costs

| | | |
|---|---|---|
| Spoil retention structures | $ | 501,000 |
| Mooring facilities | | 89,000 |
| Spoil discharge system | | 40,000 |
| Total Investment Cost | $ | 630,000 |

b. Annual Costs

| | | |
|---|---|---|
| Interest, $630,000 @ .0325 | $ | 20,000 |
| Amortization, 1 yrs., $630,000 @ 1.000 | | 630,000 |
| Maintenance dredging, 300,000 c.y. @ $0.50 | | 150,000 |
| Operation and maintenance | | 5,000 |
| Total Annual Cost | $ | 805,000 |
| Cost per Cubic Yard | $ | 2.68 |

31. SITE 3

a. First Costs

| | |
|---|---|
| Spoil retention structures | $ 791,000[1] |
| Mooring facilities | 78,000 |
| Spoil discharge system | 1,096,000 |
| Total Investment Cost | $1,965,000 |
| Salvage value | -112,000 |
| Investment less Salvage | $1,853,000 |

b. Annual Costs

| | |
|---|---|
| Interest, $1,965,000 @ .0325 | $ 64,000 |
| Amortization, 10 yrs., $1,853,000 @ .0862 | 160,000 |
| Maintenance dredging, 300,000 c.y. @ $0.60 | 180,000 |
| Operation and maintenance | 55,000 |
| Total Annual Cost | $ 459,000 |
| Cost per Cubic Yard | $ 1.53 |

(1) Includes land costs.

32. SITE 4

a. First Costs

| | |
|---|---|
| Spoil retention structures | \$ 742,000[1] |
| Mooring facilities | 78,000 |
| Spoil discharge system | 1,447,000 |
| Total Investment Cost | \$ 2,267,000 |
| Salvage value | -150,000 |
| Investment less Salvage | \$ 2,117,000 |

b. Annual Costs

| | |
|---|---|
| Interest, \$2,267,000 @ .0325 | \$ 74,000 |
| Amortization, 10 yrs., \$2,117,000 @ .0862 | 182,000 |
| Maintenance dredging, 300,000 c.y. @ \$0.60 | 180,000 |
| Operation and maintenance | 66,000 |
| Total Annual Cost | \$ 502,000 |
| Cost per Cubic Yard | \$ 1.67 |

(1) Includes land costs.

33. SITE 5

a. First Costs

| | |
|---|---|
| Spoil retention structures | $ 7,470,000 |
| Mooring facilities | 140,000 |
| Spoil discharge system | 40,000 |
| Total First Cost | $ 7,650,000 |
| Interest during construction | 250,000 |
| Total Investment Cost | $ 7,900,000 |

b. Annual Costs

| | |
|---|---|
| Interest, $7,900,000 @ .0325 | $ 257,000 |
| Amortization, 8 yrs., $7,900,000 @ .1115 | 881,000 |
| Maintenance dredging, 300,000 c.y. @ $0.76 | 228,000 |
| Operation and maintenance | 7,000 |
| Total Annual Cost | $ 1,373,000 |
| Cost per Cubic Yard | $ 4.58 |

34. SITE 6

a. First Costs

| | |
|---|---|
| Spoil retention structures | $ 467,000[1] |
| Mooring facilities | 81,700 |
| Spoil discharge system | 341,300 |
| Total Investment Cost | $ 890,000 |
| Salvage value | -150,000 |
| Investment less Salvage | $ 740,000 |

b. Annual Costs

| | |
|---|---|
| Interest, $890,000 @ .0325 | $ 29,000 |
| Amortization, 2 yrs., $740,000 @ .4920 | 364,000 |
| Maintenance dredging, 300,000 c.y. @ $0.60 | 180,000 |
| Operation and maintenance | 38,000 |
| Total Annual Cost | $ 611,000 |
| Cost per Cubic Yard | $ 2.04 |

(1) Includes land costs.

35. COST COMPARISONS

A summary of costs for each of the six considered alternate disposal areas are shown below in tabular form. The cost of open lake disposal is given for comparison with the more expensive alternate methods.

| Site | Capacity Cu. yds. | Capacity Years | Cost per Cu. Yd. ($) |
|---|---|---|---|
| Open lake | -- | 40+ | 0.42 |
| 3 | 3,000,000 | 10 | 1.53 |
| 1 | 1,200,000 | 4 | 1.59 |
| 4 | 3,000,000 | 10 | 1.67 |
| 6 | 600,000 | 2 | 2.04 |
| 2 | 300,000 | 1 | 2.68 |
| 5 | 2,400,000 | 8 | 4.58 |

DISCUSSION

36. The considered alternate disposal sites were sized to handle the estimated future volume of maintenance spoil only, 300,000 cubic yards annually. It was assumed that permit dredging, estimated at 25,000 cubic yards annually, could be disposed of at the same sites if necessary. Since costs per cubic yard are being compared, this analysis is considered adequate.

37. The least costly alternatives at Lorain would utilize landfill sites with the spoil pumped from the dredge to the site through a piping system. Site 3 was the least costly 10-year site. The property required is currently used for agricultural purposes.

38. An informal meeting was held in Lorain on 20 January 1969 to discuss the considered sites with public officials, community planners, and principle property owners. Representatives from the Lorain Port Authority requested that Site 1 be used for disposal of dredged materials. The created land areas would be used for future development of the waterfront area. They felt that the land would have a very real value, possibly $10,000 to $20,000 per acre, which should be considered in the economic analysis of considered sites at Lorain. The general reaction of local interest was that created land areas could be used for future development even though it was pointed out that the fill might have questionable strength characteristics. There is a possibility that the City will have a solid waste disposal problem when they add an incinerator to the sewage treatment plant facilities in about 2½ years. It might be possible to include storage in the considered sites for the incinerator wastes. Some form of cost sharing could be worked out for such a plan. None of the property owners in Site 3, the least costly site, were present at the meeting. Public officials surmised that there might be some objection to the use of this site by adjacent property owners.

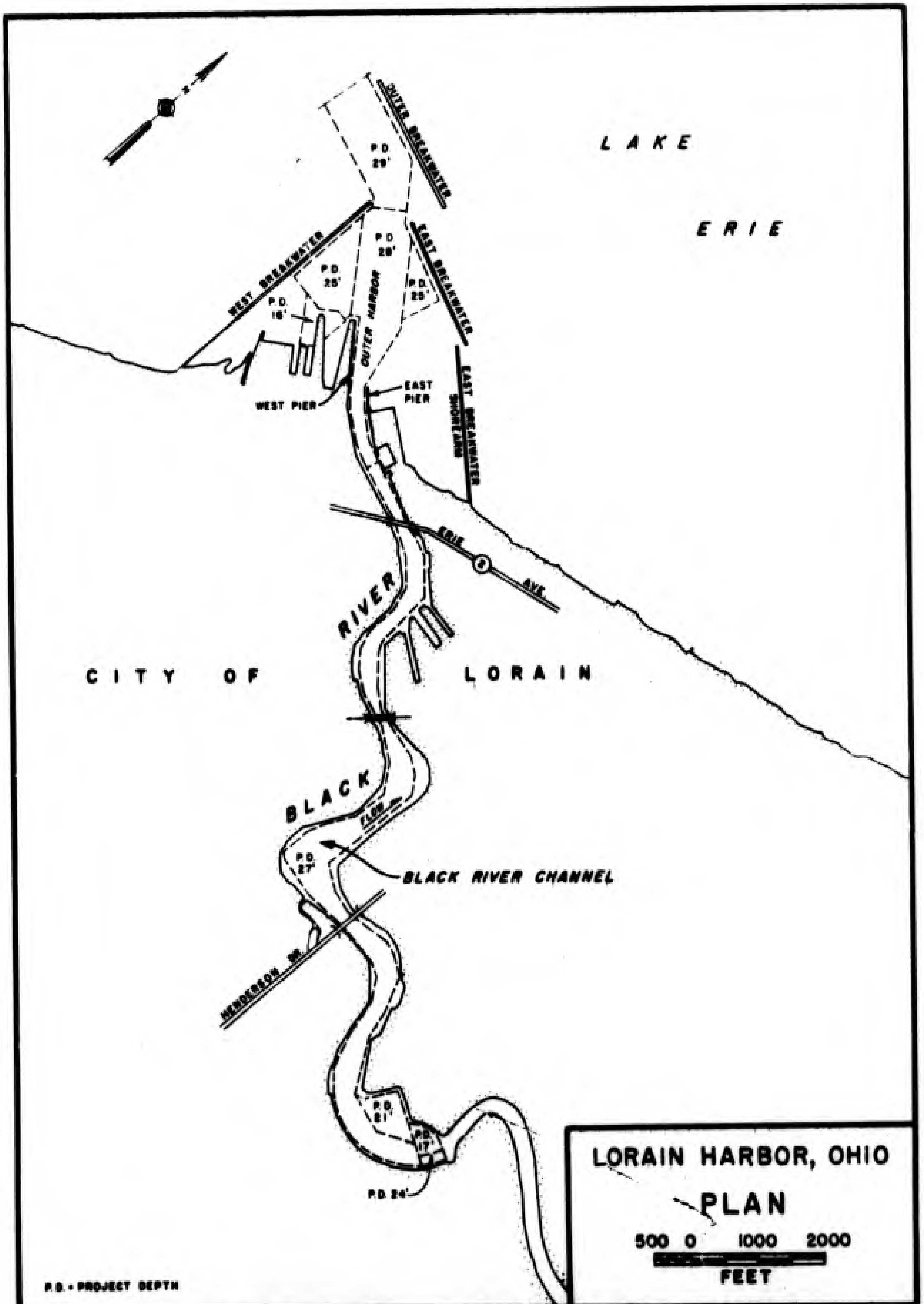
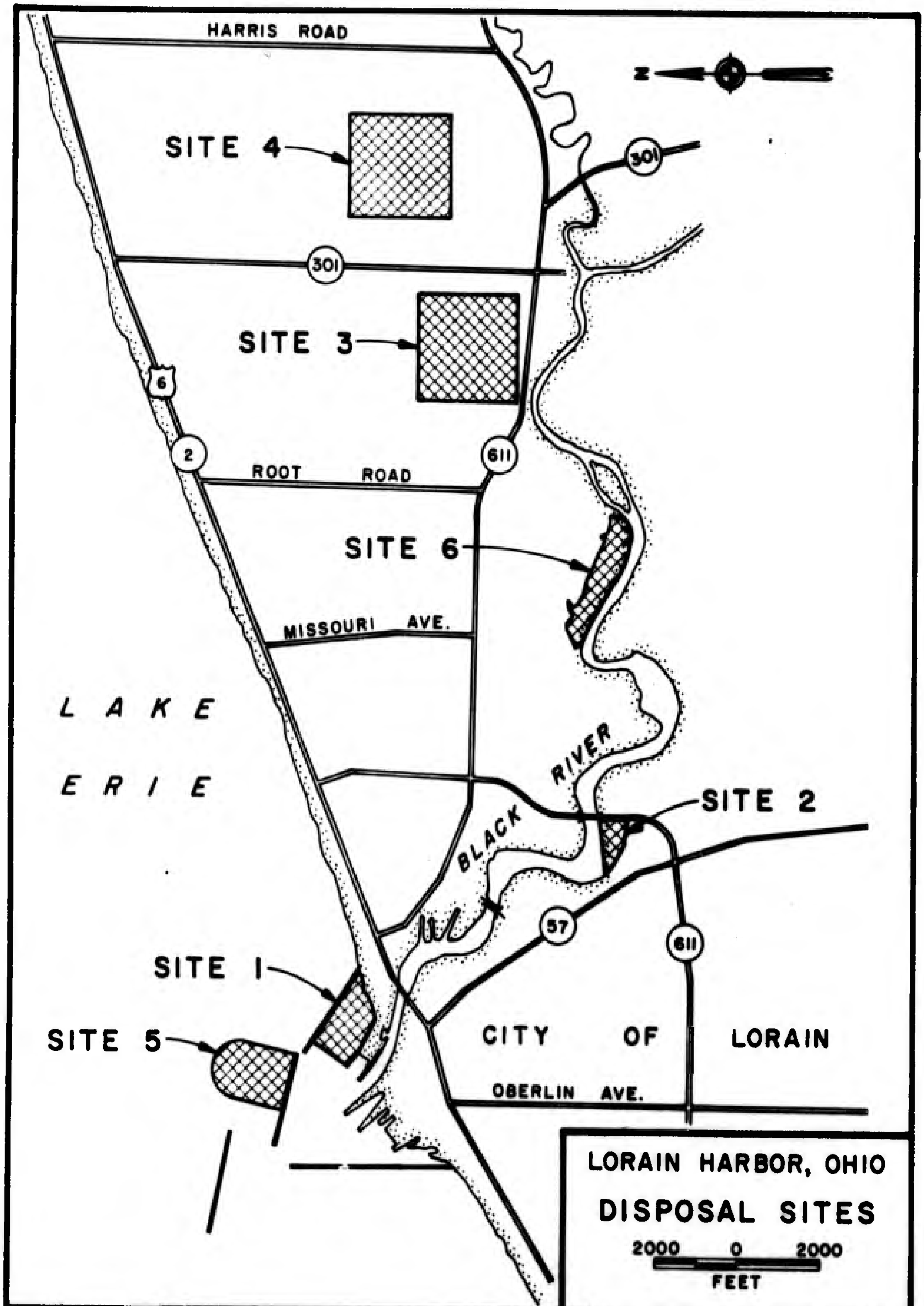

LAKE
ERIE
OUTER BREAKWATER
P.D. 29'
WEST BREAKWATER
EAST BREAKWATER
P.D. 28'
P.D. 25'
P.D. 25'
P.D. 16'
OUTER HARBOR
WEST PIER
EAST PIER
EAST BREAKWATER SHOREARM
ERIE AVE
CITY OF LORAIN
RIVER
BLACK
FLOW
P.D. 27'
BLACK RIVER CHANNEL
HENDERSON DR.
P.D. 21'
P.D. 17'
P.D. 24'
P.D. = PROJECT DEPTH
LORAIN HARBOR, OHIO
PLAN
500 0 1000 2000
FEET

FIG. K7-1



HARRIS ROAD
SITE 4
301
SITE 3
6
2
611
ROOT ROAD
SITE 6
MISSOURI AVE.
LAKE
ERIE
BLACK RIVER
SITE 2
57
611
SITE 1
SITE 5
CITY OF LORAIN
OBERLIN AVE.
LORAIN HARBOR, OHIO
DISPOSAL SITES
2000 0 2000
FEET


FIG. K7-2

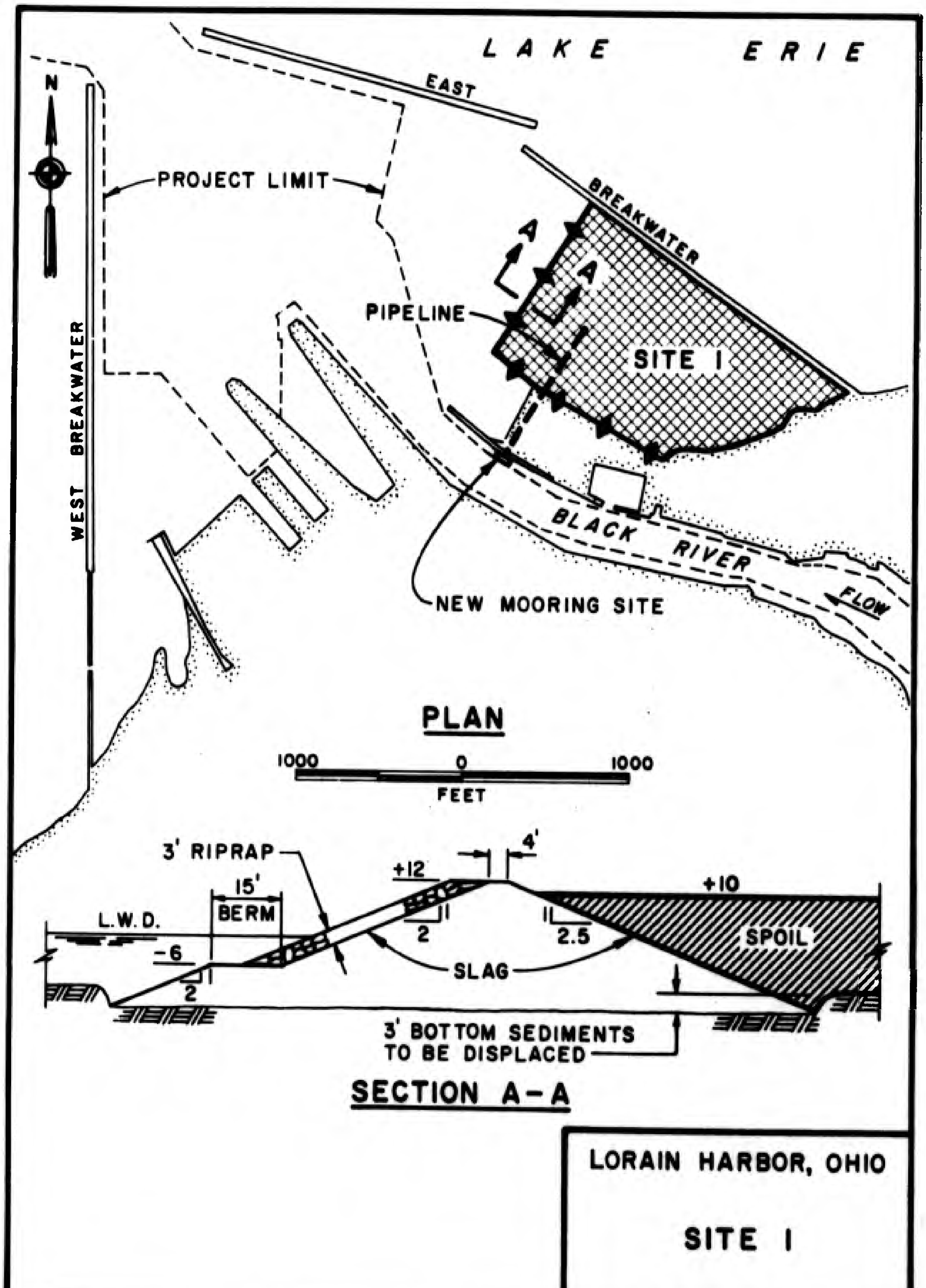
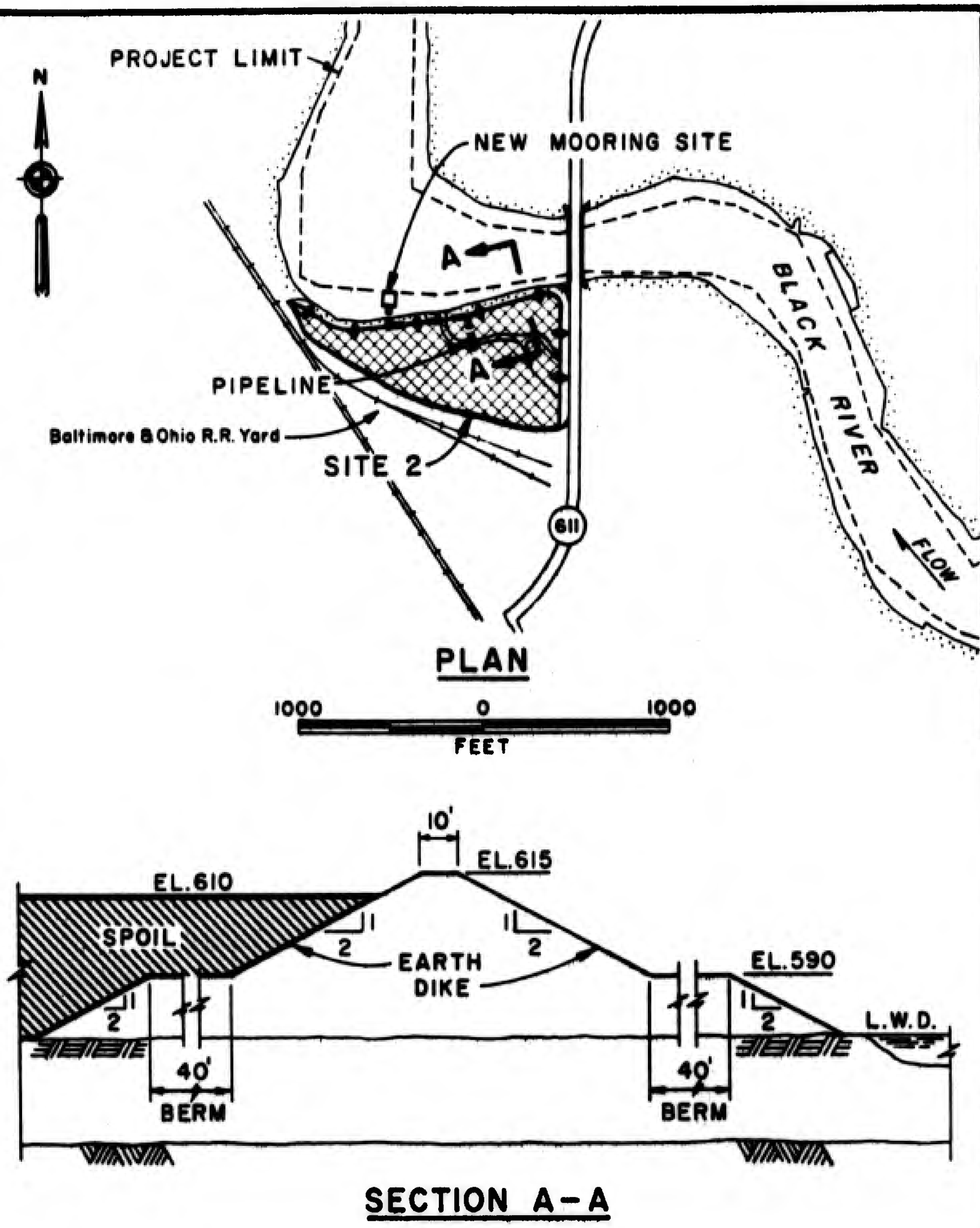

LAKE ERIE
N
EAST
BREAKWATER
PROJECT LIMIT
WEST BREAKWATER
A
A
PIPELINE
SITE I
BLACK RIVER
FLOW
NEW MOORING SITE
PLAN
1000
0
1000
FEET
3' RIPRAP
4'
+12
+10
15'
BERM
L.W.D.
1
2
1
2.5
SPOIL
-6
SLAG
2
3' BOTTOM SEDIMENTS
TO BE DISPLACED
SECTION A-A
LORAIN HARBOR, OHIO
SITE I

FIG. K7-3




LORAIN HARBOR, OHIO

SITE 2

FIG. K7-4

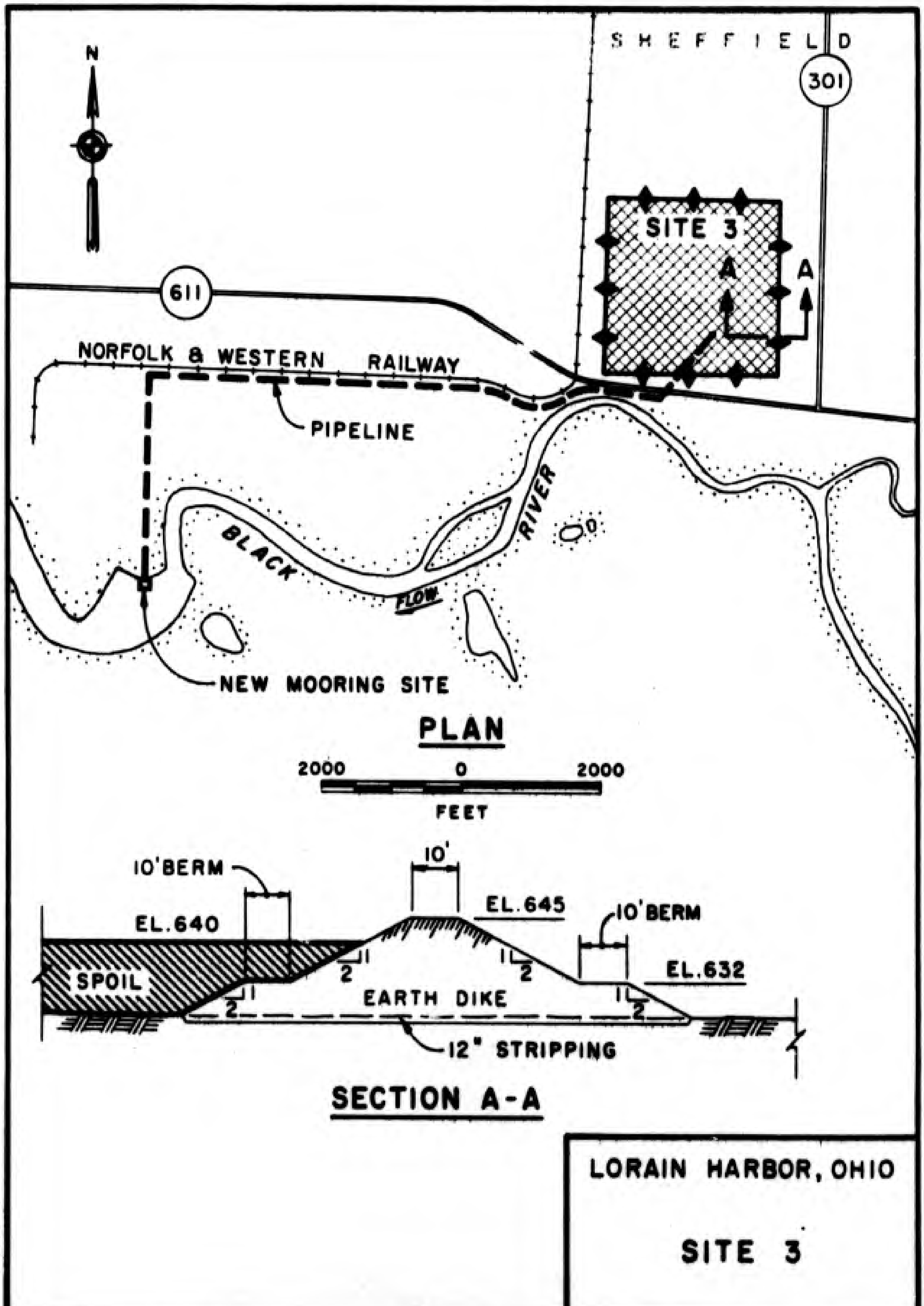

SHEFFIELD
301
N
SITE 3
A
A
611
NORFOLK & WESTERN RAILWAY
PIPELINE
BLACK RIVER
FLOW
NEW MOORING SITE
PLAN
2000 0 2000
FEET
10'BERM
10'
EL.640
EL.645
10'BERM
EL.632
SPOIL
2
1
EARTH DIKE
12" STRIPPING
SECTION A-A
LORAIN HARBOR, OHIO
SITE 3

FIG K7-5

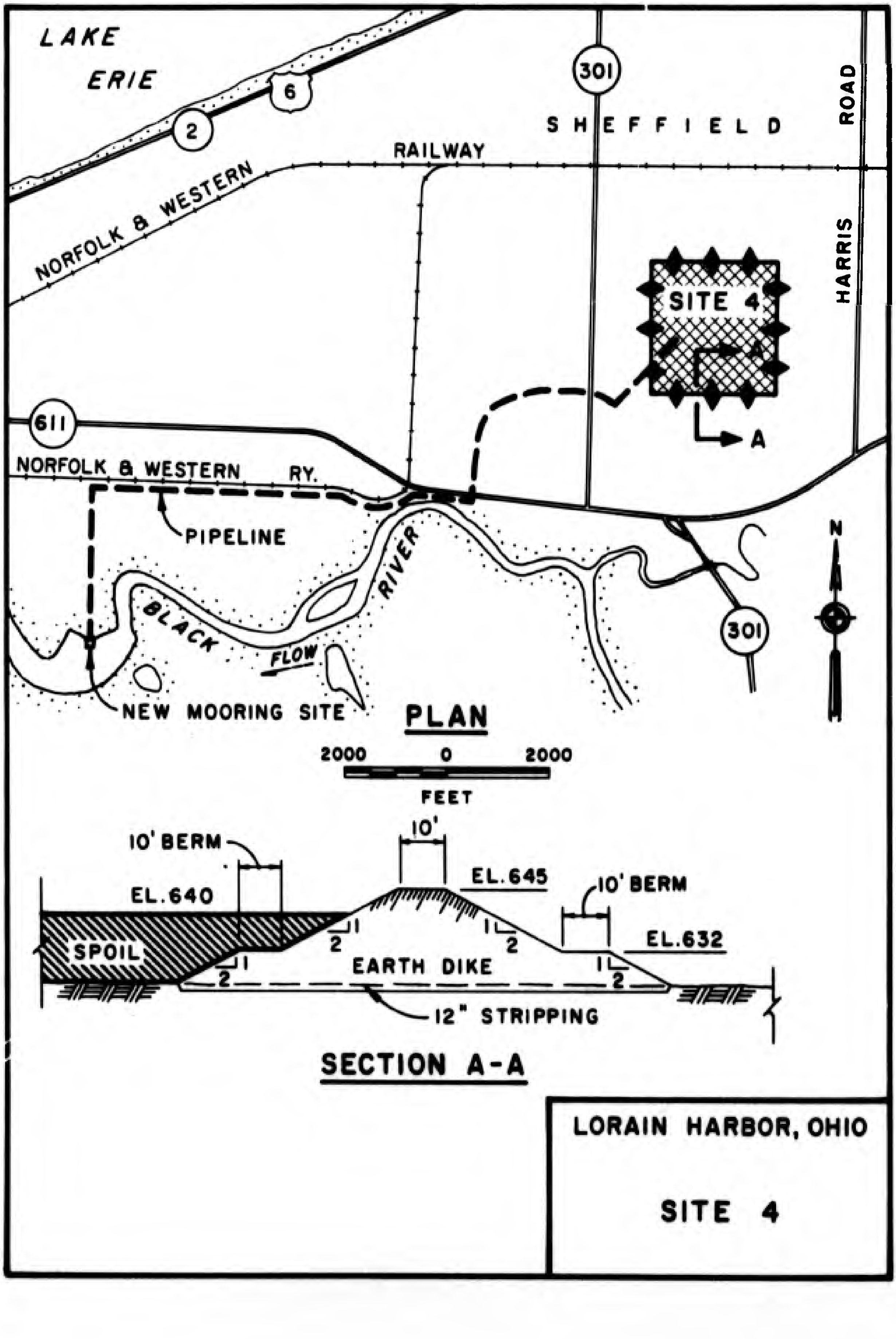
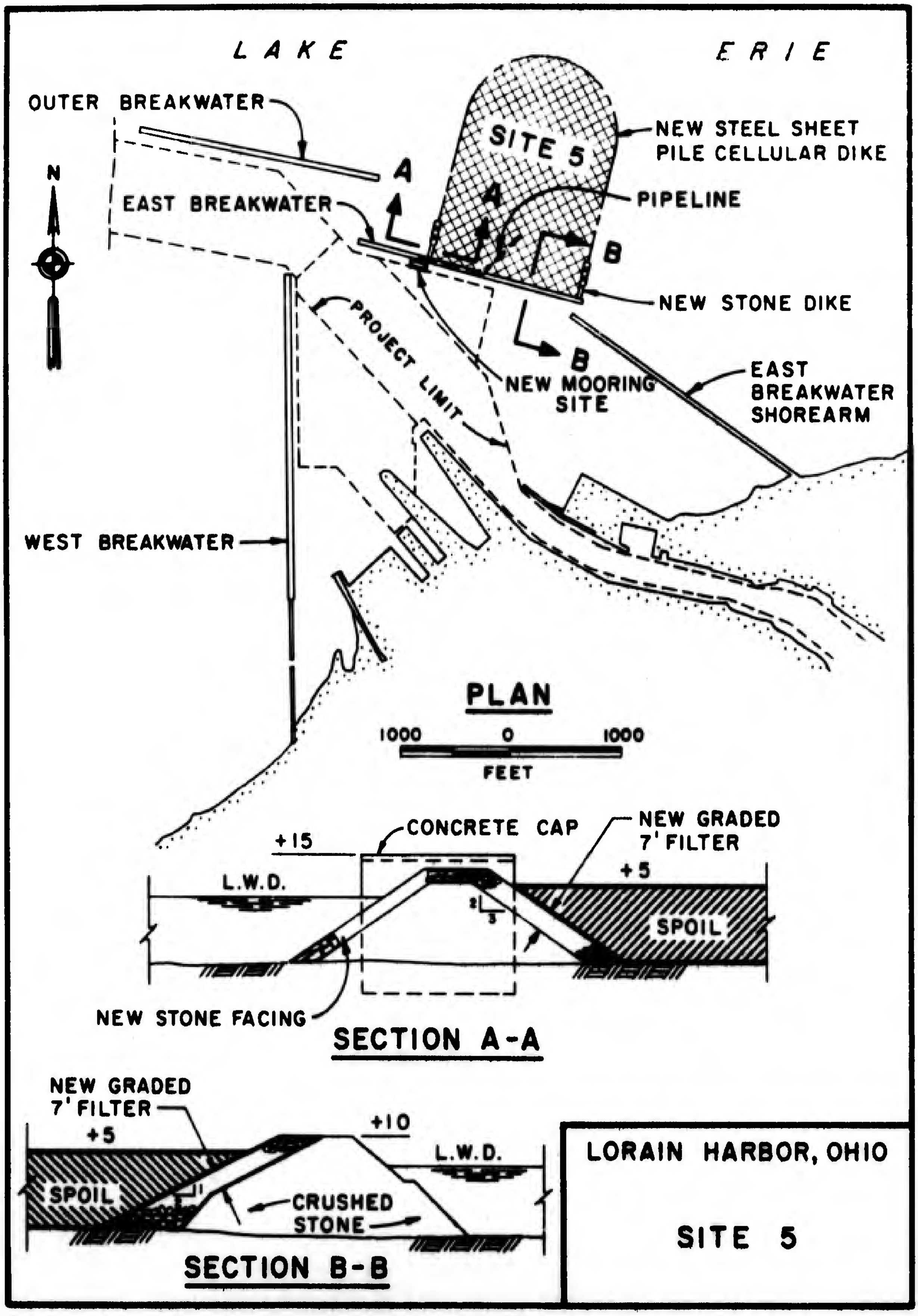
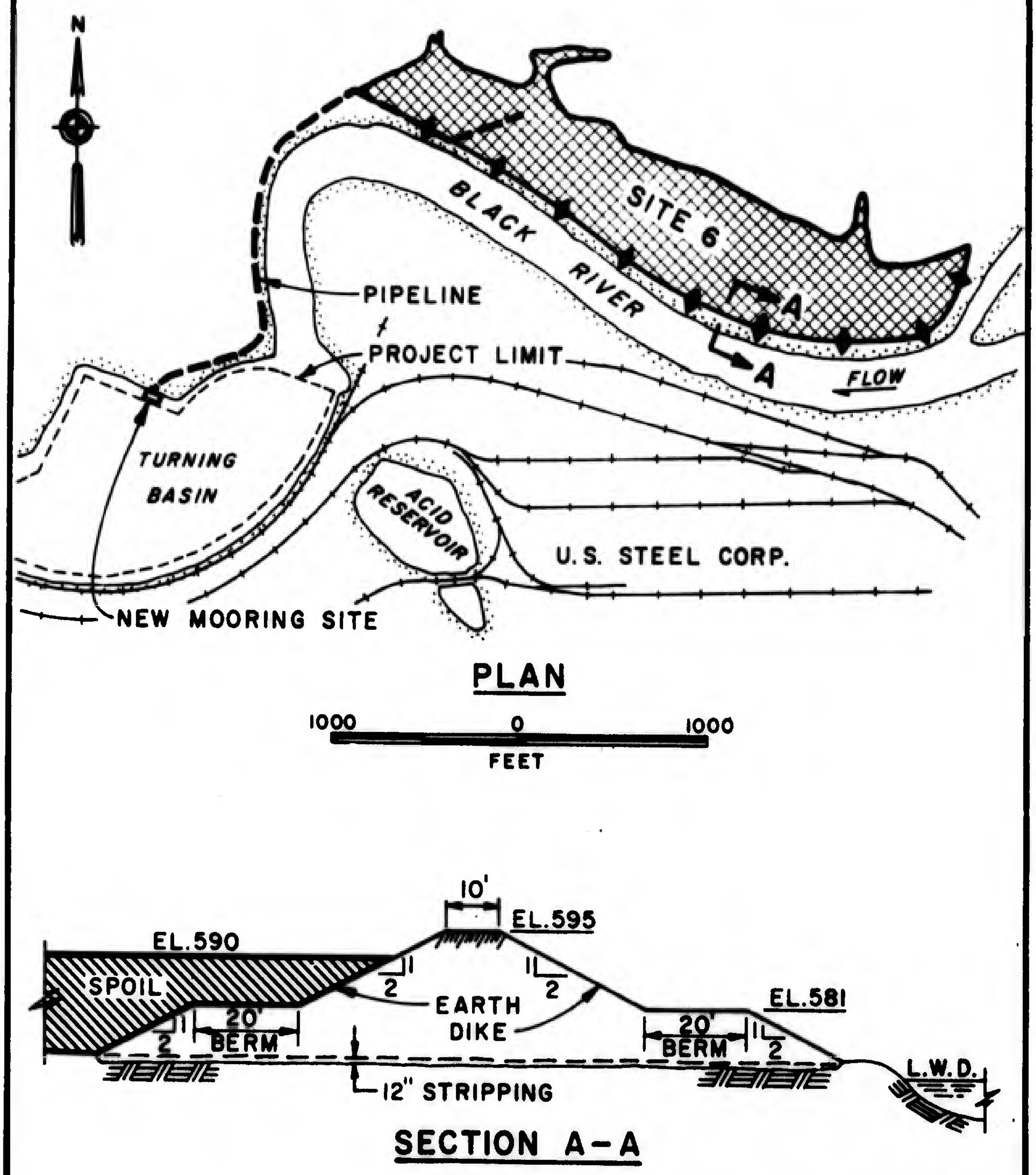

LAKE
ERIE
6
2
301
SHEFFIELD
ROAD
RAILWAY
NORFOLK & WESTERN
HARRIS
SITE 4
A
611
NORFOLK & WESTERN
RY.
PIPELINE
RIVER
BLACK
FLOW
301
N
NEW MOORING SITE
PLAN
2000
0
2000
FEET
10'
10' BERM
EL. 640
EL. 645
10' BERM
EL. 632
SPOIL
EARTH DIKE
12" STRIPPING
SECTION A-A
LORAIN HARBOR, OHIO
SITE 4

FIG. K7-6



LAKE ERIE
OUTER BREAKWATER
SITE 5
NEW STEEL SHEET PILE CELLULAR DIKE
N
EAST BREAKWATER
A
PIPELINE
B
NEW STONE DIKE
PROJECT LIMIT
NEW MOORING SITE
EAST BREAKWATER SHOREARM
WEST BREAKWATER
PLAN
1000 0 1000
FEET
CONCRETE CAP
NEW GRADED 7' FILTER
+15
+5
L.W.D.
SPOIL
NEW STONE FACING
SECTION A-A
NEW GRADED 7' FILTER
+5
+10
L.W.D.
SPOIL
CRUSHED STONE
SECTION B-B
LORAIN HARBOR, OHIO
SITE 5


FIG. K7-7




LORAIN HARBOR, OHIO

SITE 6

FIG. K7-8

APPENDIX K8

# STUDY OF ALTERNATE DISPOSAL AREAS FOR SANDUSKY HARBOR, OHIO

U. S. ARMY ENGINEER DISTRICT, BUFFALO
CORPS OF ENGINEERS
1776 NIAGARA STREET
BUFFALO, NEW YORK 14207

JANUARY 1969

DREDGING AND WATER QUALITY PROBLEMS
IN
THE GREAT LAKES

APPENDIX K8

STUDY OF ALTERNATE DISPOSAL AREAS
FOR
SANDUSKY HARBOR, OHIO

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# APPENDIX K8 - SANDUSKY HARBOR

## LOCATION AND DESCRIPTION

1. Sandusky Harbor, Ohio is located in Sandusky Bay, 55 miles west of Cleveland. The Sandusky River basin which drains to the bay encompasses some 1,420 square miles. Details of Sandusky Harbor navigation project are shown in fig. K8-1.

2. The harbor is a deep-draft commercial port. The total waterborne commerce for 1966 amounted to 3,805,129 tons and for the 10-year period, 1957-1966, inclusive, has averaged 4,862,964 tons. The principal commodity handled is bituminous coal, shipments of which comprise about 96 percent of the total commerce,

## EXISTING CORPS OF ENGINEERS PROJECT

3. PROJECT

The existing project was authorized by the 1899, 1902, 1919, 1927, 1935, 1945, and 1960 River and Harbor Acts which provide for:

a. Mosley channel 400 feet wide and 26 feet deep from deep water in Lake Erie to the outer (northerly) end of the Straight channel, a total distance of 2.1 miles, with widening at the junction of the Moseley and Straight channels.

b. Straight channel 400 feet wide and 25 feet deep from its junction with the Moseley channel to its junction with the Bay channel, a distance of one mile; thence 400 feet wide and 21 feet deep to its terminus at the dock channel adjacent to the City waterfront docks, a distance of 4,300 feet.

c. Dock channel along the waterfront 5,700 feet long, 300 feet wide and 22 feet deep ending at the easterly limit of the turning basin.

d. A rock dike, 3,355 feet long, on the north side of the dock channel.

e. Turning basin, irregularly shaped about 46 acres in area, 24 feet deep in soft material and 25 feet deep in hard material.

f. Bay channel extending 1,300 feet northward along the Pennsylvania Railroad coal wharf from the northerly limit of the turning basin, 350 feet wide, 24 feet deep in soft material and 25 feet in hard material, thence 25 feet feep, 400 feet wide for 1,100 feet, thence turning northeastward through Sandusky Bay for 7,950 feet to a junction with the Straight channel, 300 feet wide and 25 feet deep.

g. Protection works consisting of a stone jetty on the easterly side of the channel, extending northeasterly from Cedar Point, a distance of 6,000 feet, with suitable pierhead; a short stone spur at Cedar Point; and revetment of the slope adjacent to the channel in the vicinity of the inner front light, with a brush-and-stone mattress.

The project was completed in 1965.

## PRESENT DREDGING PRACTICES

### 4. PROCEDURES

All project channels are maintained annually by U.S. hopper dredges. Permit dredging is accomplished by clamshell dredges and dump scows.

5. WORKING SEASON

The available season for dredging Sandusky Harbor approximates the navigation season. In recent years the earliest and latest opening and closing of navigation at the harbor were:

| | Opening | Closing |
|---|---|---|
| Earliest date | Mar 9 | Nov 17 |
| Latest date | Apr 13 | Dec 18 |

6. QUANTITY AND TYPE OF MATERIAL

During the past 10 years the volume of material removed annually by hopper dredge in maintaining the project was about 395,000 cubic yards. This reflects some reduction in maintenance efforts during the period while new work authorized by the 1960 Act was in progress. Now with this new work completed, the major channels are several feet deeper and the Moseley channel extends farther into the lake. Consequently, it is estimated that, in the future, an average of 600,000 cubic yards will be dredged annually. Permit dredging is required to maintain dockside areas. Annual permit dredging requirement is estimated at 10,000 cubic yards. Material removed from the inner channels is predominately silt with some sand. A large share of the maintenance effort is concentrated in the inner channels. Material removed from the Moseley channel is predominately sand.

7. NATURE OF POLLUTION

The nature of pollution in the vicinity of Sandusky is discussed in a report by FWPCA entitled "Lake Erie Report, A Plan for Water Pollution Control," dated August 1968. The report states that gross pollution with bacterial contamination, scum, profuse algal growth, and septic sludge and muck exist in a number of small tributaries. In the Sandusky, Amherst, and Sheffield-Avon areas this gross pollution and potential health hazard is particularly evident.

## PRESENT DISPOSAL PRACTICE

### 8. METHOD OF DISPOSAL

Dredged material from the harbor is disposed of by bottom dumping, from hopper dredges or dump scows, into an established open lake disposal area in Lake Erie.

### 9. DISPOSAL AREA

The established open lake disposal area for maintenance material is one mile square, located in Lake Erie 3¼ miles, N 11° 15' E, from the pierhead light. With the anticipated rate of maintenance dredging it is estimated that the capacity of the disposal area within its existing limits is sufficient to serve for about 10-15 years without impeding navigation. Surrounding depths of water are such, however, that additional capacity can be obtained by enlargement of the limits.

### 10. COST OF DREDGING

The unit cost for harbor maintenance by hopper dredge, with disposal in the open lake, is $0.30 per cubic yard.

## ALTERNATE DISPOSAL AREAS

11. GENERAL

A survey was made in 1968 to locate alternate disposal sites in the Sandusky area to contain the maintenance dredgings for at least a 10-year period. City officials, State officials and some property owners were questioned regarding the availability of specific sites. Consideration was given to pumping the dredgings through pipelines to landfill sites. In addition, offshore sites were considered where the material could be pumped directly to the disposal area. In some cases, a 10-year plan for alternate disposal would use more than one site. A brief description of each considered disposal area is given in the following paragraphs. The general location of each is shown in fig. K8-2.

12. SITE 1

This is a 323-acre offshore site that would inclose most of the shallow water area within the Sandusky Bay channel loop bounded by the Straight Channel, Bay Channel and Dock Channel. The site would be inclosed with about 14,000 feet of rubblemound dike, constructed on an alignment that would utilize existing dike and breakwater structures. About 3,600 feet of the existing structures would be reconstructed in order to increase their height and provide for adequate filtration. A five-foot thick graded filter would be placed within the new and reconstructed dikes. Effluent would drain through the filter and dike, returning to the harbor. The site would have a capacity of about six million cubic yards when filled to a depth three feet above Low Water Datum (LWD). This is expected to be the total volume of maintenance dredgings for a 10-year period. Two mooring facilities would be constructed to incorporate the necessary equipment for making and handling flexible connections between the hopper dredge and the fixed discharge line leading to the disposal area. The considered plan would also require the extension of an existing sewer line near the southwest corner of the inclosure dike and replacement of the outfall structure. The site is shown in fig. K8-3.

13. If Site 1 were filled, the created land would probably become the property of either the State of Ohio or the City of Sandusky. It has been assumed that the land could be used for recreational purposes after a stabilization period. Although the site is apparently available for disposal of dredgings, local interests are not particularly interested in having it used for this purpose. The site would not be accessible to the mainland unless an expensive high-level bridge were constructed. There appears to be an ample supply of land within a few miles of the city that could be developed to meet the future recreational needs of the area.

14. SITE 2

This is a small, seven-acre alongshore site that was investigated at the request of City officials. The site would be inclosed with 1,700 feet of rubblemound dike. A seven-foot thick graded filter would be placed along the inside side slopes of the new dike. Effluent would drain through the filter and dike, discharging into the harbor. Site 2 would be 1,250 feet long, extending to within 50 feet of the harbor line. The site would have a capacity for about 100,000 cubic yards of material which is only a small portion of the volume of dredged material removed in one year. An existing pier on the west side of the site could probably be used for mooring the dredge and construction of the spoil discharge equipment. It may be necessary to deepen the dock area next to the pier to accomodate the dredge. The site is shown in fig. K8-4.

15. The City would like to have Site 2 filled so that the created land could be used to provide a parking lot to serve the downtown area. This would be part of a proposed renewal project for the City's business district. City officials have indicated their willingness to provide the dikes if the Corps of Engineers would fill the site.

16. SITE 3A

This is a 116-acre alongshore site located near the eastern limit of the City of Sandusky. About 7,000 feet of stone dike would inclose the area. A five-foot thick graded filter would be placed along the inside side slope of the new dike. Effluent would drain through the filter and dike, discharging into the bay. When filled to a depth six and one-half feet above LWD, the site would contain 750,000 cubic yards of material, which is slightly more than the expected volume of future maintenance dredgings for one year. A mooring facility would be constructed near the navigation channel and the dredgings would be pumped to the site. About 2½ miles of pipeline and three booster pumps would be required. The site is shown in fig. K8-5.

17. The existing site is primarily marsh land, most of which is owned by the MHD Corporation, developers of mobile housing communities. They would like to have the area filled for their future development. Representatives of the corporation have indicated that they would be willing to provide the spoil area without cost and possibly share in the cost of the dike if this area were filled. The State of Ohio, Department of Natural Resources is opposed to the use of this site because it would be detrimental to existing wildlife.

18. SITE 3B

This is a 544-acre site located east of Site 3A in Huron Township. It could be used by extending the pipeline for Site 3A about two more miles and adding two additional booster pumps. The site would be inclosed with 14,500 feet of stone dike similar in design to the dike for Site 3A. When filled to a depth six and one-half feet above LWD, the site would contain the future maintenance dredgings for about nine years. The site could be enlarged to hold the dredgings for 10 years by extending the northwestern boundary of the site about 1,100 feet. Ten-year plans could be developed using Sites 3A and 3B, or using Site 3B alone. A channel would be left open between the Cedar Point Chaussee, a narrow strip of land lined with expensive homes, and the outer dike so that small boat navigation would not be interrupted. Part of the inner dike, parallel to the shore, would not be connected to the mainland because existing streams in the area drain into the bay. The site is shown in fig. K8-5.

19. Most of the site is owned by the East Bay Development Corporation. Much of the existing land is under about two to four feet of water. The corporation would be interested in having the area filled. The State of Ohio, Department of Natural Resources would prefer not to have the area filled because of Wildlife considerations. Property owners on the Cedar Point Chausee were not contacted.

20. OTHER SITES INVESTIGATED

Three other sites were considered for disposal of dredgings but studies were terminated for various reasons after preliminary investigations. Each is discussed below and shown in fig. K8-2.

21. Site 4 is located east of Site 3 and is separated by a highway constructed on a landfill. The site would contain the maintenance dredgings for about three years. The principle property owner, East Bay Development Corporation, would be interested in having part of the area filled for possible future development. Site 4 would be more expensive than Site 3 because it is smaller and further away from the navigation project.

22. Site 5 is a 410-acre landfill site located about five miles west of Sandusky. The area is primarily marshland. The site would hold the maintenance dredgings for 10 years if filled to an average depth of nine feet. The State of Ohio, Department of Natural Resources would prefer not to have this area used because of wildlife considerations. There are also some complex drainage problems, in connection with the existing State Highway No. 2, that would have to be studied before serious consideration could be given to this site.

23. An area in the vicinity of Site 6 was suggested by State officials. The existing fisherman parking lots, adjacent to the "Old Bay Bridge" that crosses Sandusky Bay, are heavily utilized. Parking lots and additional bank fishing space could be provided by using Site 6 for disposal of dredgings. It appears that the site would hold less than one-year's dredgings and the cost for such a small area would be very high. A five mile discharge pipeline with booster pumps would be required to utilize Site 6 for disposal of dredgings.

## ESTIMATES OF COST

24. GENERAL

Cost estimates were prepared for three possible 10-year plans that would provide for diked disposal of the total maintenance dredgings for 10 years. In addition, an estimate was prepared for Site 2 because of the interest shown by City officials. This site could be used to hold the dredgings from the Dock channel and the Straight channel for about one year. The dredgings in these areas are probably the most polluted. An estimate was also prepared for Site 3A alone. This site could be used to hold these lesser quantities of dredgings for the remaining nine years in the event that it is decided that the remaining materials can continue to be disposed of in the open lake.

25. The 10-year plans for alternate disposal of all maintenance dredgings would require two-year construction periods. Interest on the first cost for one year at the current Federal risk-free interest rate was included in the total investment cost for these plans. For those sites that would require booster pumps in the spoil discharge system, the salvage value of the pumps would be subtracted from the total investment. All costs are based on 1968 price levels.

26. Annual costs include interest and amortization over the assumed filling period, dredging costs with disposal at a specified mooring facility, and operation and maintenance costs. It was assumed that the stone dikes would require periodic maintenance for a 10-year period after the site has been filled. This would cover possible damages to the dikes from wave action in the bay during the period in which the spoil material may not be fully

consolidated. Annual costs were divided by the estimated future dredging quantities to determine the cost per cubic yard. The costs estimates are shown in the following paragraphs.

27. SITE 1

a. First Costs

| | |
|---|---|
| Spoil retention structures | $5,510,000 |
| Mooring facilities | 512,000 |
| Spoil discharge system | 495,000 |
| Total First Cost | $6,517,000 |
| Interest during construction | 212,000 |
| Total Investment Cost | $6,729,000 |

b. Annual Costs

| | |
|---|---|
| Interest, $6,729,000 @ .0325 | $ 219,000 |
| Amortization, 10 years, $6,729,000 @ .0862 | 580,000 |
| Maintenance dredging, 600,000 c.y. @ $0.24 | 144,000 |
| Operation and maintenance | 78,000 (1) |
| Total Annual Cost | $1,021,000 |
| Cost per Cubic Yard | $1.70 |

(1) Includes $22,800 annually for 20 years for maintenance of the stone dike, which is equivalent to $39,000 annually for 10 years ($22,800 x 14.539 x .1187).

28. SITE 3A (1 year) and SITE 3B (9 years)

a. First Costs

| | |
|---|---|
| Spoil retention structures | $3,214,000 (1) |
| Mooring facilities | 260,000 |
| Spoil discharge system | 3,090,000 |
| Total First Cost | $6,564,000 |
| Interest during construction | 213,000 |
| Total Investment Cost | $6,777,000 |
| Salvage value | - 260,000 |
| Investment less salvage | $6,517,000 |

b. Annual Costs

| | |
|---|---|
| Interest, $6,777,000 @ .0325 | $ 220,000 |
| Amortization, 10 yrs., $6,517,000 @ .0862 | 562,000 |
| Maintenance dredging, 600,000 c.y. @ $0.25 | 150,000 |
| Operation and maintenance | 213,000 (2) |
| Total Annual Cost | $1,145,000 |
| Cost per Cubic Yard | $1.91 |

(1) Includes land acquistion cost.

(2) Includes $45,000 annually for 20 years for maintenance of the stone dike, which is equivalent to $78,000 annually for 10 years ($45,000 x 14.539 x .1187).

29. SITE 3B

a. First Costs

| | |
|---|---|
| Spoil retention structure | \$2,588,000 (1) |
| Mooring facilities | 260,000 |
| Spoil discharge system | 3,030,000 |
| Total First Cost | \$5,878,000 |
| Interest during construction | 191,000 |
| Total Investment Cost | \$6,069,000 |
| Salvage Value | - 260,000 |
| Investment less Salvage | \$5,809,000 |

b. Annual Costs

| | |
|---|---|
| Interest, \$6,069,000 @ .0325 | \$ 197,000 |
| Amortization, 10 years, \$5,809,000 @ .0862 | 501,000 |
| Maintenance dredging, 600,000 c.y. @ \$0.25 | 150,000 |
| Operation and maintenance | 200,000 (2) |
| Total Annual Cost | \$1,048,000 |
| Cost per Cubic Yard | \$1.75 |

(1) Includes land acquisition cost.

(2) Includes \$35,000 annually for 20 years for maintenance of the stone dike, which is equivalent to \$60,000 annually for 10 years (\$35,000 x 14.539 x .1187).

30. SITE 2

a. First Costs

| | |
|---|---|
| Spoil retention structure | $450,000 |
| Mooring facilities | 44,000 |
| Spoil discharge system | 26,000 |
| Total Investment Cost | $520,000 |

b. Annual Costs

| | |
|---|---|
| Interest, $520,000 @ .0325 | $ 17,000 |
| Amortization, 1 year, $520,000 @ 1.000 | 520,000 |
| Maintenance dredging, 100,000 c.y. @ $0.47 | 47,000 |
| Operation and maintenance | 39,000(1) |
| Total Annual Cost | $ 623,000 |
| Cost per Cubic Yard | $6.23 |

(1) Includes $3,500 annually for 11 years for maintenance of the stone dike, which is equivalent to $33,000 for one year ($3,500 x 9.126 x 1.0325)

31. SITE 3A

a. First Costs

| | |
|---|---|
| Spoil retention structure | $ 921,000[1] |
| Mooring facilities | 260,000 |
| Spoil discharge system | 1,940,000 |
| Total Investment Cost | $3,121,000 |
| Salvage value | - 160,000 |
| Investment less Salvage | $2,961,000 |

b. Annual Costs

| | |
|---|---|
| Interest, $3,121,000 @ .0325 | $ 101,000 |
| Amortization, 9 yrs., $2,961,000 @ .0974 | 288,000 |
| Maintenance dredging, 100,000 c.y. @ $0.47 | 47,000 |
| Operation and Maintenance | 92,000 |
| Total Annual Cost | $ 528,000 |
| Cost per Cubic Yard | $5.28 |

(1) Includes land acquisition cost.

(2) Includes $15,000 annually for 19 years for maintenance of the stone dike, which is equivalent to $27,000 annually for 9 years ($15,000 x 14.012 x .1299).

NOTE: Costs shown are for a capacity of 750,000 cubic yards. The site could be enlarged to hold 900,000 cubic yards at little or no extra cost.

32. COST COMPARISONS

A summary of costs for considered alternate disposal areas is shown below. The cost of disposal in the open lake is shown for comparison purposes.

| Site | Capacity Cu. Yds. | Capacity Years | Cost per Cubic Yard $ |
|---|---|---|---|
| Open lake | --- | --- | 0.30 |
| 1 | 6,000,000 | 10 | 1.70 |
| 3B | 6,000,000 | 10 | 1.75 |
| 3A and 3B | 6,000,000 | 10 | 1.91 |
| 3A | 900,000(1) | 9 | 5.28 |
| 2 | 100,000(1) | 1 | 6.23 |

(1) Dock and Straight Channels only.

## DISCUSSION

33. The considered alternate disposal sites were sized to handle the estimated future volume of maintenance dredging spoil only, 600,000 cubic yards annually. It was assumed that permit dredging estimated at 10,000 cubic yards annually, could be disposed of at the same sites if necessary. Since costs per cubic yard are being compared this analysis is considered adequate.

34. The least costly plan for alternate disposal of all maintenance dredgings for 10 years would use Site 1 for the entire period. This is an offshore site that would be constructed inside the loop formed by the navigation channels. A landfill area, Site 3B, could be substituted for Site 1 with very little increase in cost. City officials would like to have a small area, Site 2, filled with a portion of one-year's dredgings. In the event that it is decided that only a portion of the maintenance dredgings are sufficiently polluted to warrant dike disposal, Site 2 could be used in connection with such a plan. No matter what action, if any, is taken regarding diked disposal, Site 2 could be filled with dredgings if local interests are willing to provide the necessary dikes and facilities.

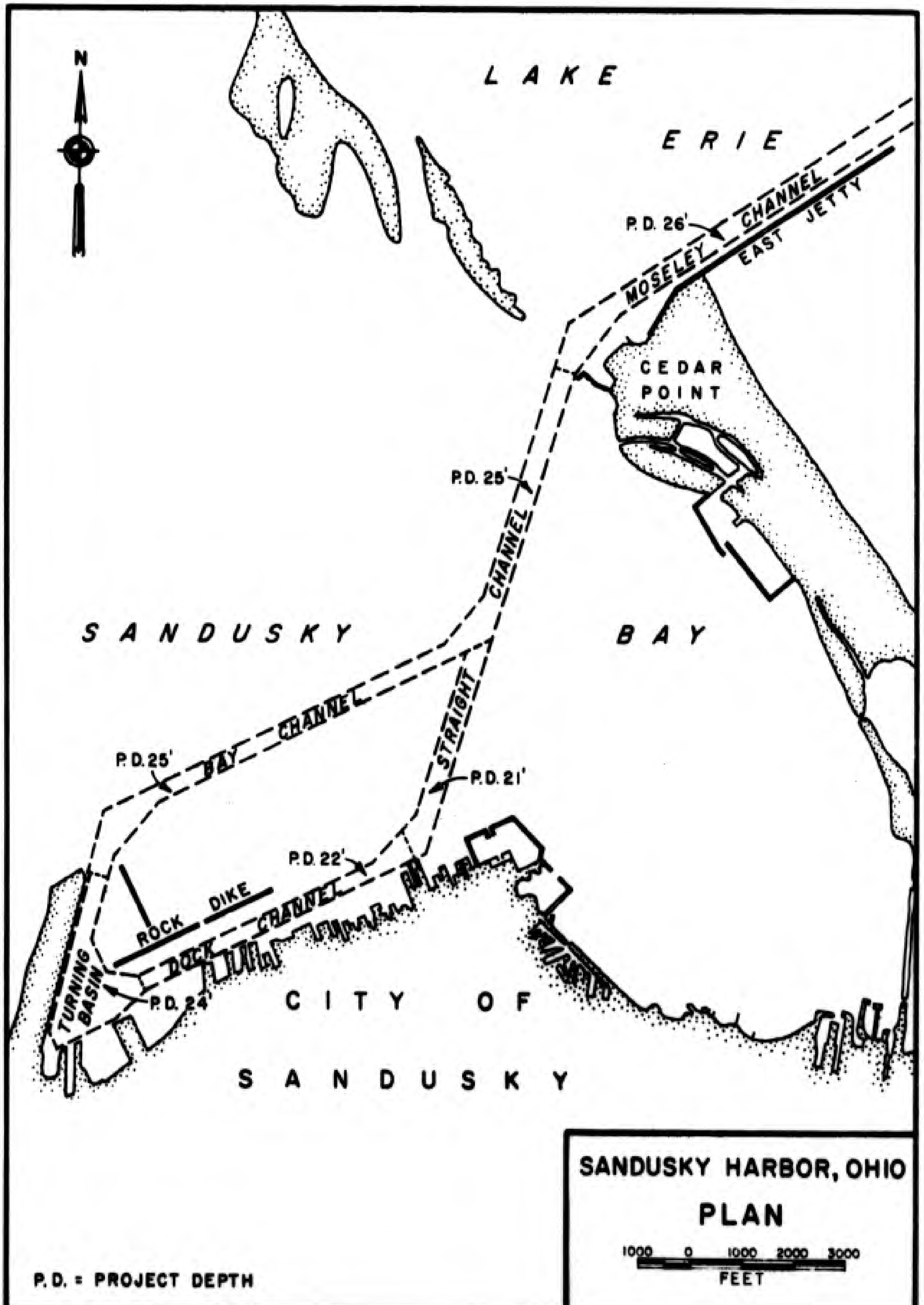
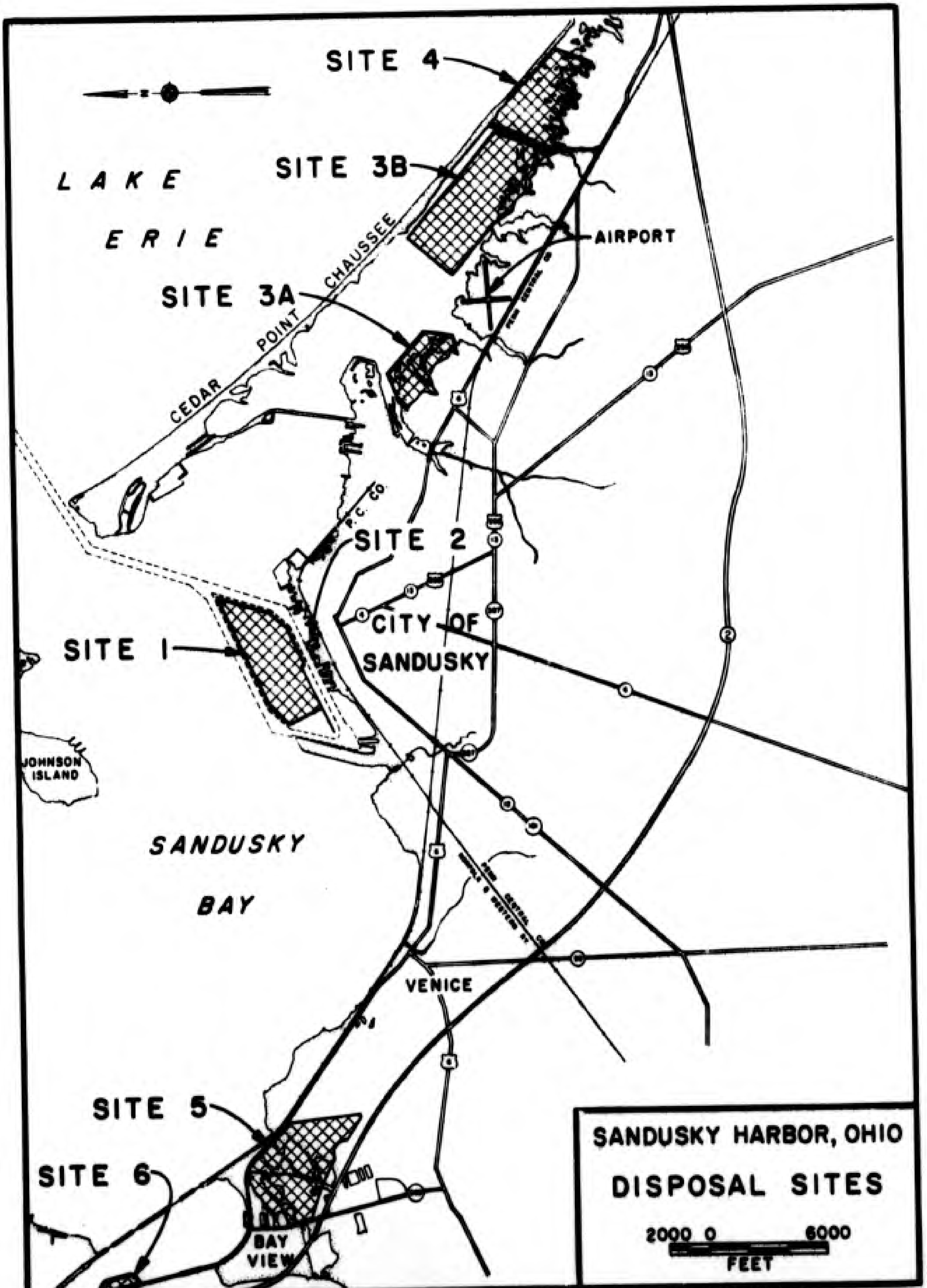

LAKE
ERIE
N
P. D. 26'
MOSELEY CHANNEL
EAST JETTY
CEDAR
POINT
P.D. 25'
STRAIGHT CHANNEL
SANDUSKY
BAY
BAY CHANNEL
P.D. 25'
P.D. 21'
P.D. 22'
ROCK DIKE
DOCK CHANNEL
TURNING BASIN
P.D. 24'
CITY OF
SANDUSKY
SANDUSKY HARBOR, OHIO
PLAN
1000 0 1000 2000 3000
FEET
P. D. = PROJECT DEPTH

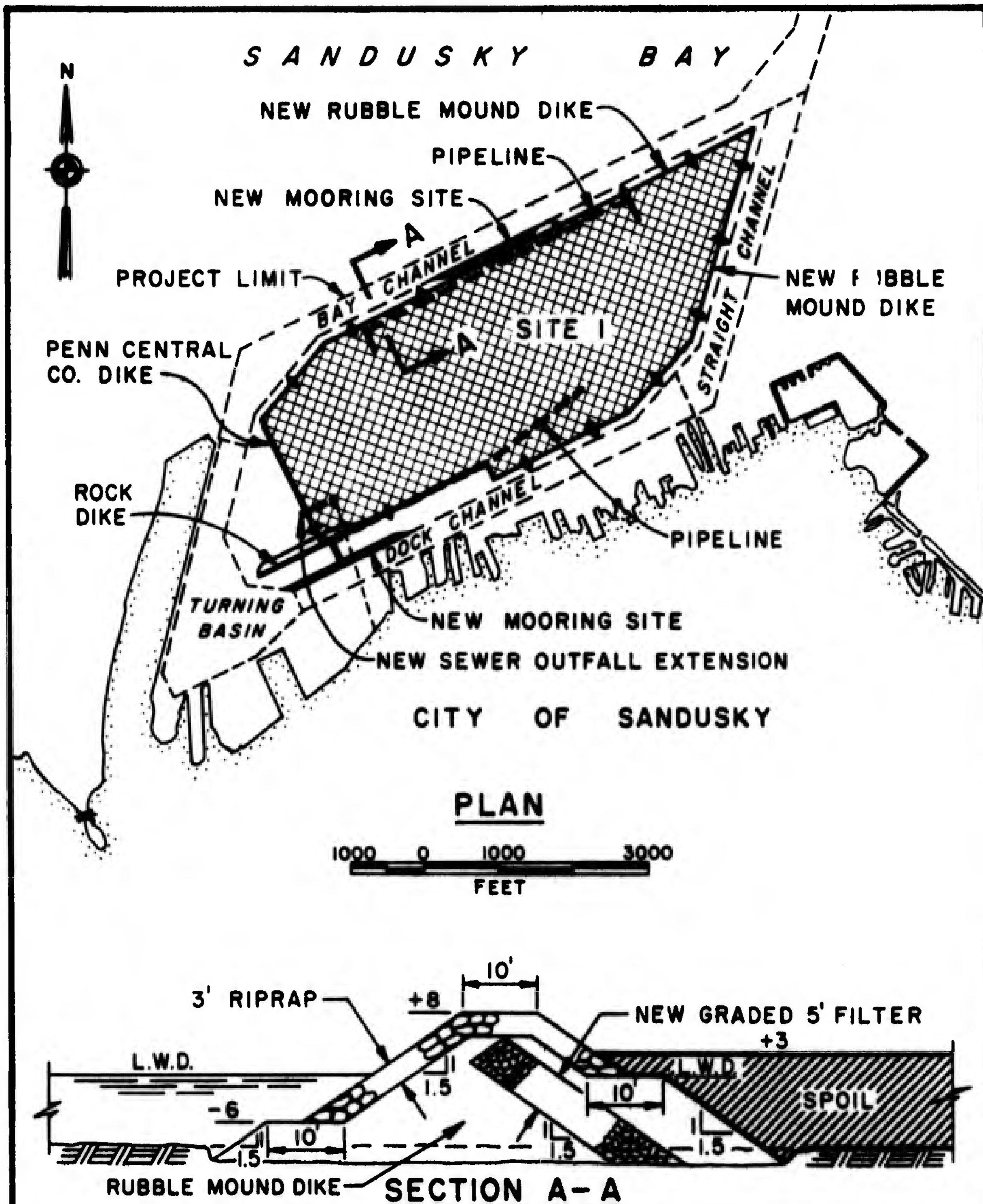
FIG. K8-1




SANDUSKY HARBOR, OHIO

DISPOSAL SITES

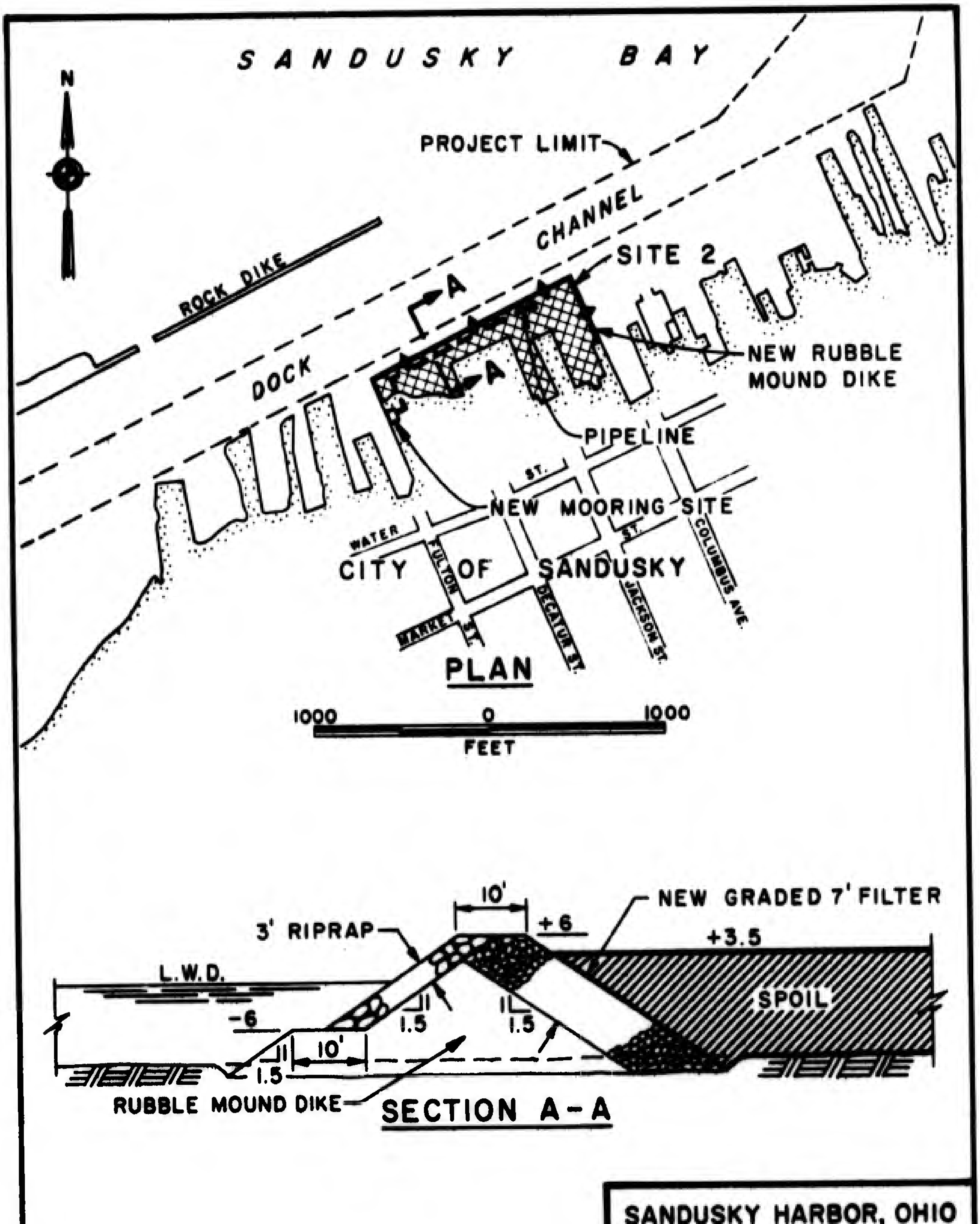
FIG. K8-2




SANDUSKY HARBOR, OHIO

SITE I

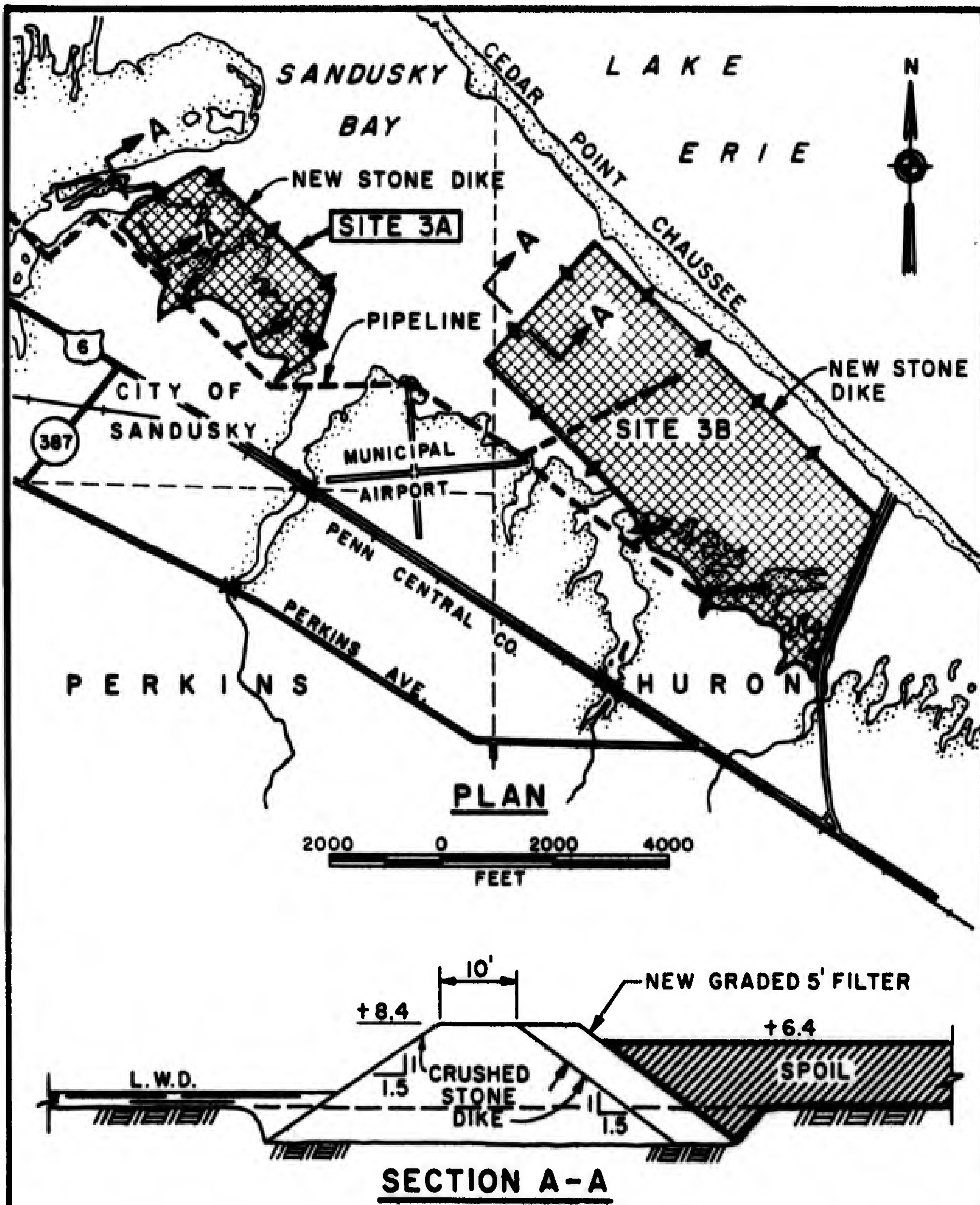
FIG. K8-3




SANDUSKY HARBOR, OHIO

SITE 2

FIG. K8-4




NOTE:
THE AREA SHOWN FOR SITE 3B WOULD PROVIDE A NINE YEAR CAPACITY

SANDUSKY HARBOR, OHIO

SITE 3

FIG. K8-5

APPENDIX K9

STUDY OF

ALTERNATE DISPOSAL AREAS

FOR

ROCHESTER HARBOR, NEW YORK

U. S. ARMY ENGINEER DISTRICT, BUFFALO
CORPS OF ENGINEERS
1776 NIAGARA STREET
BUFFALO, NEW YORK 14207

OCTOBER 1968

DREDGING AND WATER QUALITY PROBLEMS
IN
THE GREAT LAKES

APPENDIX K9

STUDY OF ALTERNATE DISPOSAL AREAS
FOR
ROCHESTER HARBOR, NEW YORK

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## APPENDIX K9 - ROCHESTER HARBOR

### LOCATION AND DESCRIPTION

1. Rochester Harbor, New York is centrally located on the south shore of Lake Ontario at the mouth of Genesee River, about 80 miles easterly of the mouth of Niagara River. The Genesee River basin encompasses about 2,500 square miles. Details of the existing Federal navigation project are shown in fig. K9-1.

2. The harbor is an important commercial port. The total waterborne commerce at Rochester Harbor for 1966 amounted to 839,502 tons and for the 10-year period, 1957-1966 inclusive, has averaged 492,622 tons. The principal commodities in 1966 were: Canadian and overseas export of 568,977 tons of bituminous coal (68% of total commerce); Canadian import of 150,117 tons of building cement (18%); Canadian import and lakewise receipts of 63,369 tons of nonmetallic minerals (8%); Canadian import of 16,606 tons of newsprint paper (2%); lakewise receipt of 10,559 tons of gasoline (1%); and overseas export of 8, 541 tons of wood veneer (1%).

### EXISTING CORPS OF ENGINEERS PROJECT

3. PROJECT

The existing project was authorized by the 1829, 1882, 1920, 1935, 1945 and 1960 River and Harbor Acts which provide for:

a. An approach channel 24 feet deep, 300 feet wide, from deep water in the lake to opposite the outer end of the west pier, about 1,900 feet long.

b. An entrance channel 23 feet deep, 200 feet wide between the piers flaring to a turning basin on the same depth, 600 feet in width, opposite the Rochester-Monroe County Port Authority dock, thence reducing to 270 feet in width to the downstream side of the Penn-Central Railroad bridge.

c. A channel in Genesee River 21 feet deep suitably widened at bends, varying in width from 270 to 150 feet, except 300 feet wide adjacent to the upper turning basin, from the downstream side of the Penn-Central Railroad bridge to the upstream Federal project limit, a distance of about 11,800 feet.

d. An upper turning basin, adjacent to the river channel, 21 feet deep, irregularly shaped, 650 feet wide and about 10 acres in area.

e. Two mooring dolphins located at the angle points on the south side of the upstream turning basin.

f. Parallel piers at the mouth of Genesee River, about 450 feet apart, the west pier 3,036 feet long and the east pier 2,699 feet long.

The existing project was completed in 1963.

## PRESENT DREDGING PRACTICES

### 4. PROCEDURES

The project channels are maintained annually by U. S. hopper dredge. Permit dredging is accomplished by clamshell dredge and dump scows.

### 5. WORKING SEASON

The available season for dredging Rochester Harbor approximates the navigation season. In recent years the earliest and latest opening and closing of navigation at the harbor were:

| | Opening | Closing |
|---|---|---|
| Earliest date | Mar 16 | Nov 18 |
| Latest date | Apr 27 | Dec 18 |

### 6. QUANTITY AND TYPE OF MATERIAL

During the past 10 years the volume of material removed annually by hopper dredge in maintaining the project is 330,000 cubic yards, bin measure. However, project depths have been increased during this period in accordance with the improvement authorized by the 1960 Act. Future estimated annual dredging requirements to adequately maintain the project are 360,000 cubic yards. Annual permit dredging requirements are about 10,000 cubic yards. This is not expected to change significantly in the future. The material dredged in maintenance operations consists primarily of sand and silt deposited since the last dredging.

7. NATURE OF POLLUTION

The nature of pollution in Rochester Harbor is discussed in detail in "Statement on Pollution in Lake Ontario Basin, Prepared for the Natural Resources and Power Subcommittee of the House Committee on Government Operations", July 1966, by the Department of the Interior. FWPCA cites the lower 12 miles of the Genesee River as being grossly polluted. It is indicated that, despite good primary treatment, the Eastman Kodak Company is the main polluter, discharging large waste flows from a paper plant, a gelatin plant, and a chemical processing works. In addition to the organic loadings therefrom, their effluent has been found to include high concentrations of chromium, copper, cyanides and phenols. Rochester Gas and Electric Company is cited as discharging tons of fly ash to the river. Also, as the river traverses the City of Rochester, overflows from 30 combined sewers discharge into it: at some locations continuously, at the others periodically, during times of high run-off. FWPCA indicates the river recovers somewhat after it mixes with Lake Ontario water; however, an obvious demarcation between river outflows and the main body of the lake, due to the discoloration of the former with its floating and suspended solids, is generally visable on the lake surface off the harbor entrance and downdrift for the very considerable distances.

## PRESENT DISPOSAL PRACTICES

8. METHOD OF DISPOSAL

Dredged material from the harbor is disposed of by bottom dumping, from hopper dredges or dump scows, into an established open lake disposal area in Lake Ontario.

9. DISPOSAL AREA

All material is dumped in an area ½ mile square, the center of which is located 1-½ miles, N 60° E, from the west pierhead light. At present dredging rates it is estimated that the capacity of this disposal area is sufficient to serve at least 15 years without impeding navigation. Adjacent depths of water are such that indefinite capacity can be obtained by enlargement of the area lakeward.

10. COST OF DREDGING

The unit cost for harbor maintenance by hopper dredge with disposal in the open lake is $0.45 per cubic yard.

## ALTERNATE DISPOSAL AREAS

11. GENERAL

A survey was made in 1968 to locate diked disposal areas as an alternative to the present open lake disposal practice for at least a 10-year period. Possible sites were discussed with City officials, County officials, State Conservation Department officials, and some property owners. Preliminary studies indicated that the wetlands along the lake shore, east and west of Rochester, would provide desirable landfill sites for spoil disposal. If these sites are not available, offshore sites could be developed.

12. The considered sites west of Rochester are inundated with lake water thus forming Round, Buck, Long and Cranberry Ponds, along with Braddock Bay. All have relatively large surface areas and shallow depths with extensive marsh lands adjacent to the ponds. Any one of these ponds could easily be modified with the necessary dikes and drainage culverts to hold the maintenance dredging spoil for a 10-year period. The majority of the land surrounding these ponds, including the Ontario Parkway which passes nearby, is owned by the Genesee State Park Commission. The State Conservation Department objects to the use of these areas for spoil disposal because it would conflict with their future plans.

13. The shoreline east of Rochester is dominated by Durand Eastman Park and Irondequoit Bay. The Park fronts on the Lake and consists of highly gullied terrain with many ridge lines and small drainage streams. The major land area of the park has been developed into a golf course with the small ponds and adjoining swamps left unimproved. The City is in the process of acquiring property adjoining the southern limit of the present park in order to expand their recreational facilities. Some of the remaining undeveloped valleys

could be modified with a dike across the valley's mouth and diversion of the existing stream so that dredging could be pumped directly into the impounded area. The City of Rochester's Bureau of Planning rejected this considered plan because the property in question was donated to the city with the understanding that it would be left in its natural state for the enjoyment of the public.

14. The mouth of Irondequoit Bay is almost entirely cut off from Lake Ontario by a sand bar with a small channel opening through the bar. The large Bay area immediately behind the sand bar is relatively shallow with the water only two or three feet deep. Either the the east side or the southern end of the Bay could be diked off and used for spoil disposal. The State Conservation Department objects to the use of these sites because of possible damage to existing fish and wildlife habitat.

15. Most of the land near the existing channel in the lower reaches of the Genesee River has been developed for residential or industrial purposes. Consideration was given to a landfill site on the east side of the river, about three miles above the mouth, and an offshore site near the harbor entrance. The location of all sites considered are shown in fig. K9-2. They are discussed individually in the following paragraphs.

16. SITE 1

This is an offshore site that would be formed by construction of a cellular steel pile wall on a quadrangular alignment, confining a 115-acre area just east of the existing stone breakwater. The cellular structure would be designed for a depth of about 15 feet below LWD and would extend to a height of 15 feet above LWD to protedt the spoil area from lake storms. The mooring facility would incorporate the necessary equipment to tie up floating plant and to make pipeline connections between the plant to be pumped out and fixed discharge lines installed along the top of the existing breakwall. The capacity of the disposal area is about 3,600,000 cubic yards, sufficient to contain the maintenance dredging spoil from the Rochester area for a 10-year period. Details of Site 1 are shown in figs. K9-3 and K9-4.

17. Since the diked disposal area is situated lakeward of the east breakwater, the site does not consitute an obstruction to navigation channels and would be available for spoil disposal. It is assumed that the land area created by this plan would become the property of the State of New York. Future use of the property would probably be limited to some form of recreational development because of the unknown strength characteristics of the spoil material.

18. An apartment complex, Harbor Square Apartments, is the only development near the existing shoreline. There are a number of private homes set back from the lake front at least 300 feet. Most of the shorefront property is undeveloped, sloping down to a narrow sandy beach. Public bathing is not permitted because of the polluted condition of the water. One of the owners of the apartment complex indicated a desire to develop the lake front for recreational boating facilities. Other property owners were not contacted.

19. SITE 2

This landfill site is located about 3 miles west of the Genesee River channel and it is bordered on the north by Buck Pond and on the south by the Ontario State Parkway. This low marshy area is roughly crescent shaped, about 1 mile long and 1/3 mile wide. The existing ground elevation is approximately the LWD of Lake Ontario.

20. The capacity of Site 2 when filled to an average depth of 10 feet above LWD is 3,600,000 cubic yards. This would accomodate the Rochester Harbor

maintenance dredging material for the entire 10-year period. An earth dike, approximately one mile long, would have to be constructed around the northern portion of the site to contain the spoil and prevent it from contaminating Buck Pond and Lake Ontario.

21. The spoil would be pumped about 3½ miles, through an 18-inch pipeline, from a mooring facility in the navigation channel of the Genesee River to the disposal site. Four booster pumps, stationed approximately 4,000 feet apart, would be required. Details of Site 2 are shown in fig. K9-5.

22. The State Parks Commission purchased the high ground surrounding this site when the right-of-way for the Ontario Parkway was acquired, and the State Conservation Department has jurisdiction over all the wetlands and underwater property. In a letter from the Regional Supervisor of the New York State Conservation Department, Division of Fish and Game, dated 26 November 1968, it was stated that their Department would have to oppose the filling of an area such as Site 2 described above. The Conservation Department feels that a substantial amount of high value wetlands would be destroyed by the considered plan.

23. SITE 3

This is an alongshore site, known locally as Durand Eastman Beach, that comprises an undeveloped reach of the shoreline about 2½ miles east of the harbor entrance. A cellular sheet pile wall would inclose the semicircular area. The site would have an area of 130 acres with a beach frontage of 3/4 of a mile. The site would contain approximately 3,600,000 cubic yards when filled to an elevation 12 feet above LWD. It would contain the maintenance dredging material for a 10-year period. The elevation of onshore property is about 25 feet above LWD. The shoreline is unoccupied, undeveloped, and unattended. The spoil would be pumped through an 18-inch pipeline from a mooring facility in the navigation channel of the Genesee River. The distance from the considered mooring facility to Site 3 is about 3/4 of a mile more than the distance to the open lake disposal area.

24. The existing shoreline needed for Site 3 is owned by the City of Rochester. They would like to develop this general area for recreational boating. The protected harbor needed for this type of development would not be compatible with spoil disposal. If the site were used for spoil disposal, it could probably be developed by the city for a park or other recreational facilities. The general location of the site is shown in fig. K9-2.

25. SITE 4

This landfill site is located 1,000 feet east of Site 2 between Round Pond on the north and the Ontario State Parkway on the south. The low marshy area would be partially inclosed with earth dikes extending to high ground. The 300-acre site would contain 3,600,000 cubic yards of spoil when filled to an average depth of 10 feet. This is the estimated maintenance dredging volume for a 10-year period. The dredged materials would be pumped through an 18-inch pipeline from the Genesee River to the disposal site, a distance of 13,600 feet. Three booster pump installations would be required.

26. This land is under title to a private owner but this claim is being contested by the State Conservation Department. The State opposes the use of this site for spoil disposal because it would destroy a substantial amount of high value wetlands. The general location of the site is shown in fig. K9-2.

27. SITES 5 and 6

These landfill sites are both located east of the Genesee River Channel in the Township of Irondequoit. Site 5 is located 1,000 feet east of the river, just upstream of the head of navigation. It consists of an open field covering an area of approximately 100 acres. It would be inclosed with earth dikes. When filled to an average depth of 10 feet, it would hold 5 years volume or approximately 1,800,000 cubic yards of maintenance dredging spoil.

28. Site 6 is located 2 miles east of the river channel and it is bounded on the north by Lake Ontario shoreline in Durand Eastman Park which is owned by the City of Rochester. This 100-acre site would be produced by building an earth dike 15 feet high across the steam bed and filling the gully behind the dike. The existing channel would be relocated. Portions of an existing golf course would be in the site. Site 6 would hold 5 years volume or 1,800,000 cubic yards of maintenance dredging spoil. An 18-inch pipeline, 2¼ miles long, would be needed to pump the spoil from the river channel to Site 6 and a shorter piepline would be needed to pump the spoil to Site 5. The general locations of these sites are shown in fig. K9-2.

29. Site 5 is surrounded by residential development. Although property owners were not contacted, it appears likely that there would be objections to the use of this site because it might delay future development of the area and temporarily reduce adjacent land values. The City of Rochester has objected to the use of Site 6 because it would not be compatible with their plans for future recreational development.

30. SITES 7 and 8

These sites are located on Irondequoit Bay in the shallow waters at both the north and south ends. The northern site, Site 7, covers an area of approximately 190 acres, would require 2,640 feet of earth dike, and when filled to a depth of 12 feet it would hold 3,600,000 cubic yards or 10 years volume of maintenance dredging spoil. The southern site, Site 8, would require an earth dike 3,170 feet long to form a 300-acre impoundment which would have the same capacity when filled to an average depth of 8 feet. An 18-inch pipeline approximately 4½ miles long, would be needed to pump the spoil from the Rochester Harbor entrance, along Lake Ontario shoreline, to the north end of Irondequoit Bay. An additional 4 miles of pipeline would be needed to pump the spoil to Site 8. The general locations of these sites are shown in fig. K9-2.

31. The wetlands of Irondequoit Bay are protected by the New York State Conservation Department. Recently the State prevented a private individual from filling in the south end of the Bay. The local population is interested in removing the causes of water pollution in the Bay and using this body of water for recreational purposes. There seems to be a great demand for small boat harbors and bathing beach facilities. Because of opposition to the use of Site 7 and 8 for spoil disposal, consideration of these sites was terminated after preliminary studies.

ESTIMATE OF COST

32. GENERAL

Cost estimates have been prepared for Sites 1 and 2 only. The cost for other offshore sites, such as Site 3, would be similar to the estimate for Site 1. The cost for other landfill sites near the lake, such as Site 4, would be similar to the estimate for Site 2. It has been assumed that the construction period for an offshore site would be two years and that the landfill sites could be constructed in one year. Interest during construction, over half the construction period, at the current Federal risk-free interest rate, was included in the investment cost for Site 1. The salvage value of booster pumps used in the spoil discharge system for the landfill sites was subtracted from the investment cost for Site 2. Land costs were excluded from the investment cost for Site 2 because the property required is owned by the State and they apparently are not interested in providing the land for spoil disposal. The present value of the property as wetlands for fish and wildlife purposes is largely intangible. All costs are based on 1968 price levels.

33. Annual costs include interest and amortization over an assumed 10-year period, dredging costs with disposal at a specified mooring facility, and operation and maintenance costs. Total annual costs were divided by the expected future annual maintenance dredging volume, 360,000 cubic yards, to obtain a cost per cubic yard. Cost estimates for Sites 1 and 2 are shown in the following paragraphs.

34. SITE 1

a. First Costs

| | |
|---|---|
| Spoil retention structure | $ 7,470,000 |
| East Pier modification | 800,000 (1) |
| Spoil discharge system | 100,000 |
| Total First Cost | 8,370,000 |
| Interest during construction | 270,000 |
| Total Investment Cost | $ 8,640,000 |

b. Annual Costs

| | |
|---|---|
| Interest and amortization, 10 yrs @ .1187 | $ 1,026,000 |
| Maintenance dredging 360,000 c.y. @ $0.57 | 205,000 |
| Operation and maintenance | 23,000 |
| Total Annual Cost | $ 1,254,000 |
| Cost per Cubic Yard | $3.48 |

(1) An additional $1,100,000 in advance maintenance, not chargeable to the project, would be required. Without the project this maintenance work could be spread over an estimated 15-year period.

35. SITE 2

a. First Costs

| | |
|---|---|
| Spoil retention structure | $1,090,000 |
| Mooring facilities | 30,000 |
| Spoil discharge system | 1,320,000 |
| Total Investment Cost | $2,440,000 |
| Salvage Value | - 150,000 |
| Investment less Salvage | $2,290,000 |

b. Annual Costs

| | |
|---|---|
| Interest, 2,440,000 @ .0325 | $ 79,000 |
| Amortization, 10 yrs., 2,290,000 @ .0862 | 198,000 |
| Maintenance dredging, 360,000 C. Y. @ 0.57 | 205,000 |
| Operation and Maintenance | 227,000 |
| Total Annual Cost | $ 709,000 |
| Cost per Cubic Yard | $1.97 |

36. Cost Comparisons

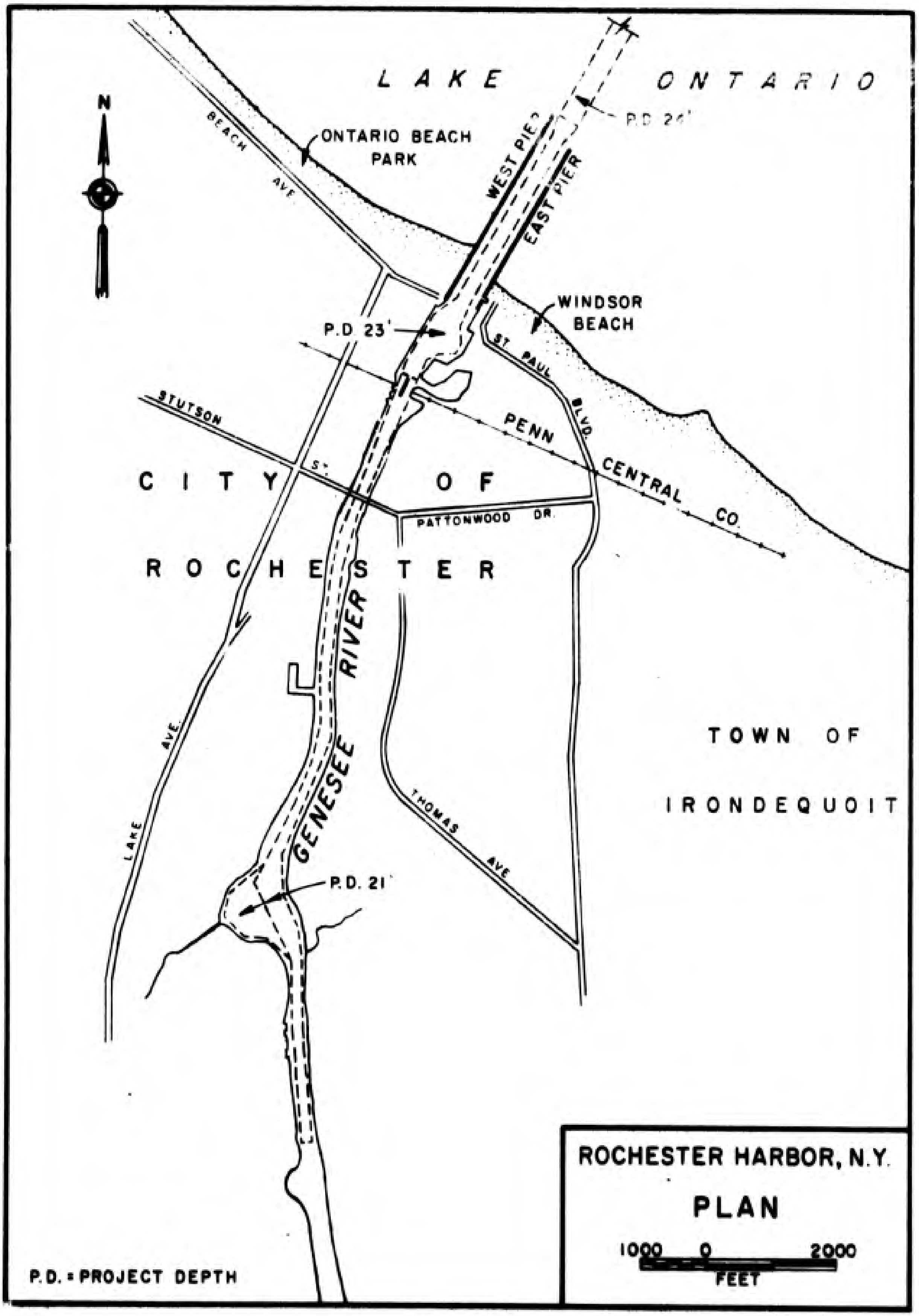
A summary of costs for Sites 1 and 2 are shown below for comparison with the cost for open lake disposal of maintenance dredging material.

| Site | Capacity cu. yds. | Capacity years | Cost per cu. yd. |
|---|---|---|---|
| Open lake | - | 15+ | 0.45 |
| 1 | 3,600,000 | 10 | 3.48 |
| 2 | 3,600,000 | 10 | 1.97 |

## DISCUSSION

37. The considered alternate disposal sites were sized to handle the estimated future volume of maintenance dredging spoil only, 360,000 cubic yards annually. It was assumed that future permit dredging, estimated at 10,000 cubic yards annually, could be disposed of at the same sites if necessary. Since costs per cubic yard are being compared, this analysis is considered adequate.

38. The least costly alternate disposal site at Rochester Harbor would be a landfill site west of the Genesee River, such as Site 2. However, the State Conservation Department is opposed to the use of these areas because it would destroy wetlands for fish and wildlife purposes. It appears that there is similar opposition to the use of all landfill sites of sufficient size in the Rochester area. The alternative would be to use a more expensive offshore site, such as site 1, in the event that diked disposal is necessary.



LAKE ONTARIO
N
ONTARIO BEACH PARK
BEACH AVE
WEST PIER
EAST PIER
P.D. 23'
WINDSOR BEACH
ST PAUL BLVD.
STUTSON ST.
PENN CENTRAL CO.
CITY OF ROCHESTER
PATTONWOOD DR.
GENESEE RIVER
LAKE AVE.
THOMAS AVE
TOWN OF IRONDEQUOIT
P.D. 21'
ROCHESTER HARBOR, N.Y.
PLAN
1000 0 2000
FEET
P.D. = PROJECT DEPTH


FIG. K9-1

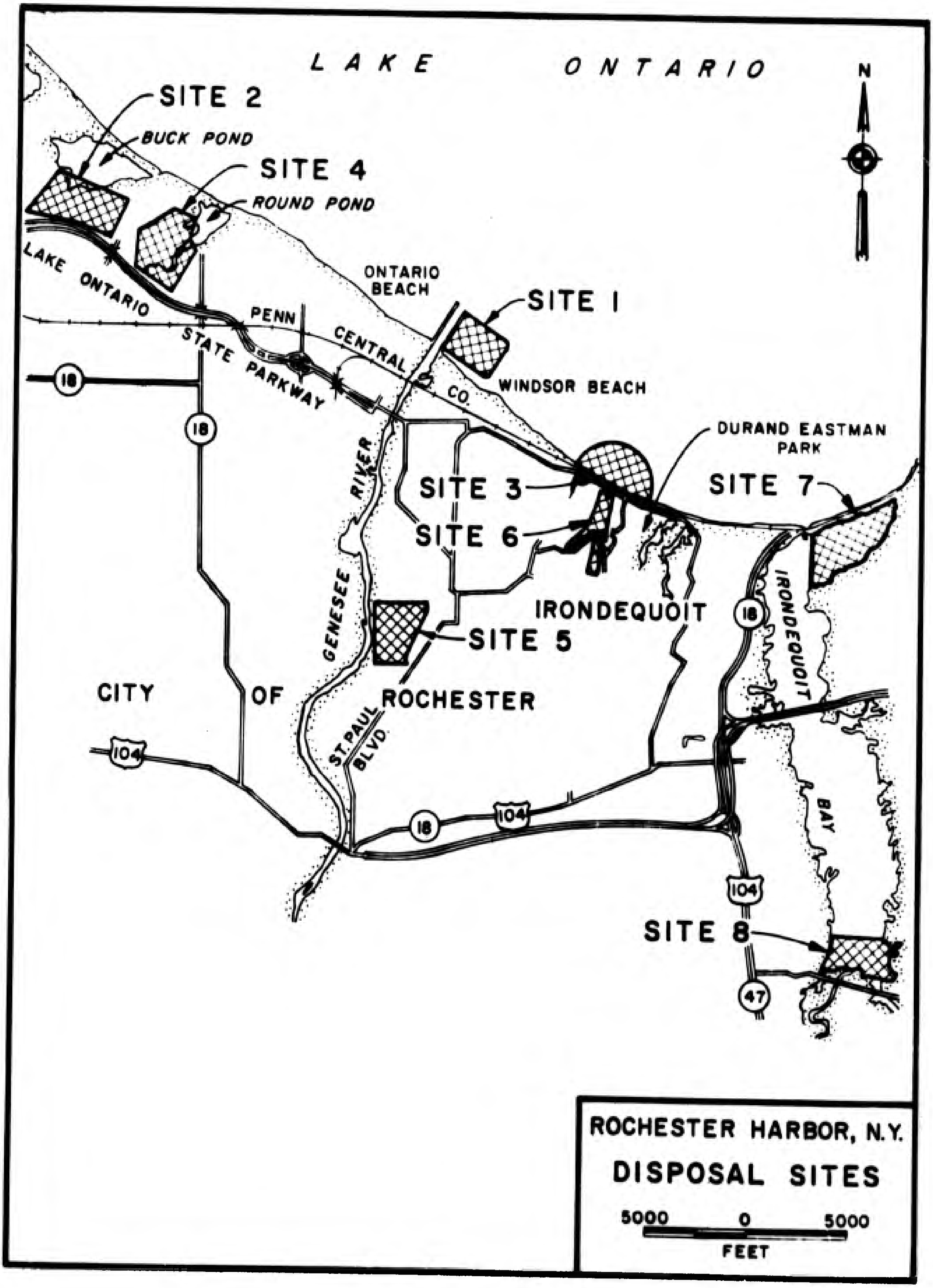
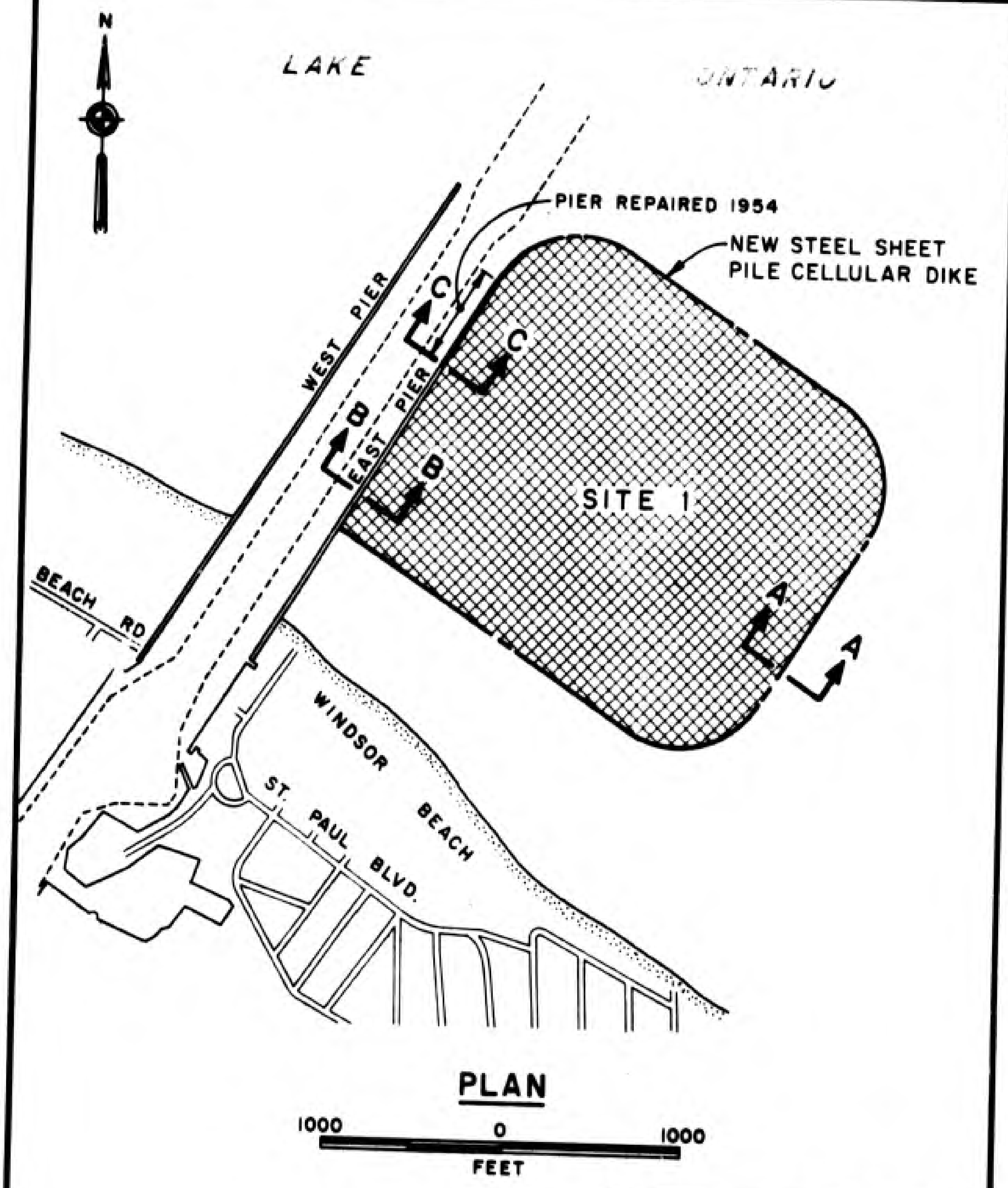

LAKE ONTARIO
N
SITE 2
BUCK POND
SITE 4
ROUND POND
LAKE ONTARIO STATE PARKWAY
PENN CENTRAL CO.
ONTARIO BEACH
SITE 1
WINDSOR BEACH
DURAND EASTMAN PARK
SITE 3
SITE 7
SITE 6
GENESEE RIVER
IRONDEQUOIT
SITE 5
CITY OF ROCHESTER
ST. PAUL BLVD
IRONDEQUOIT BAY
18
104
47
SITE 8
ROCHESTER HARBOR, N.Y.
DISPOSAL SITES
5000 0 5000
FEET

FIG. K9-2




ROCHESTER HARBOR, N.Y.

SITE 1

FIG. K9-3

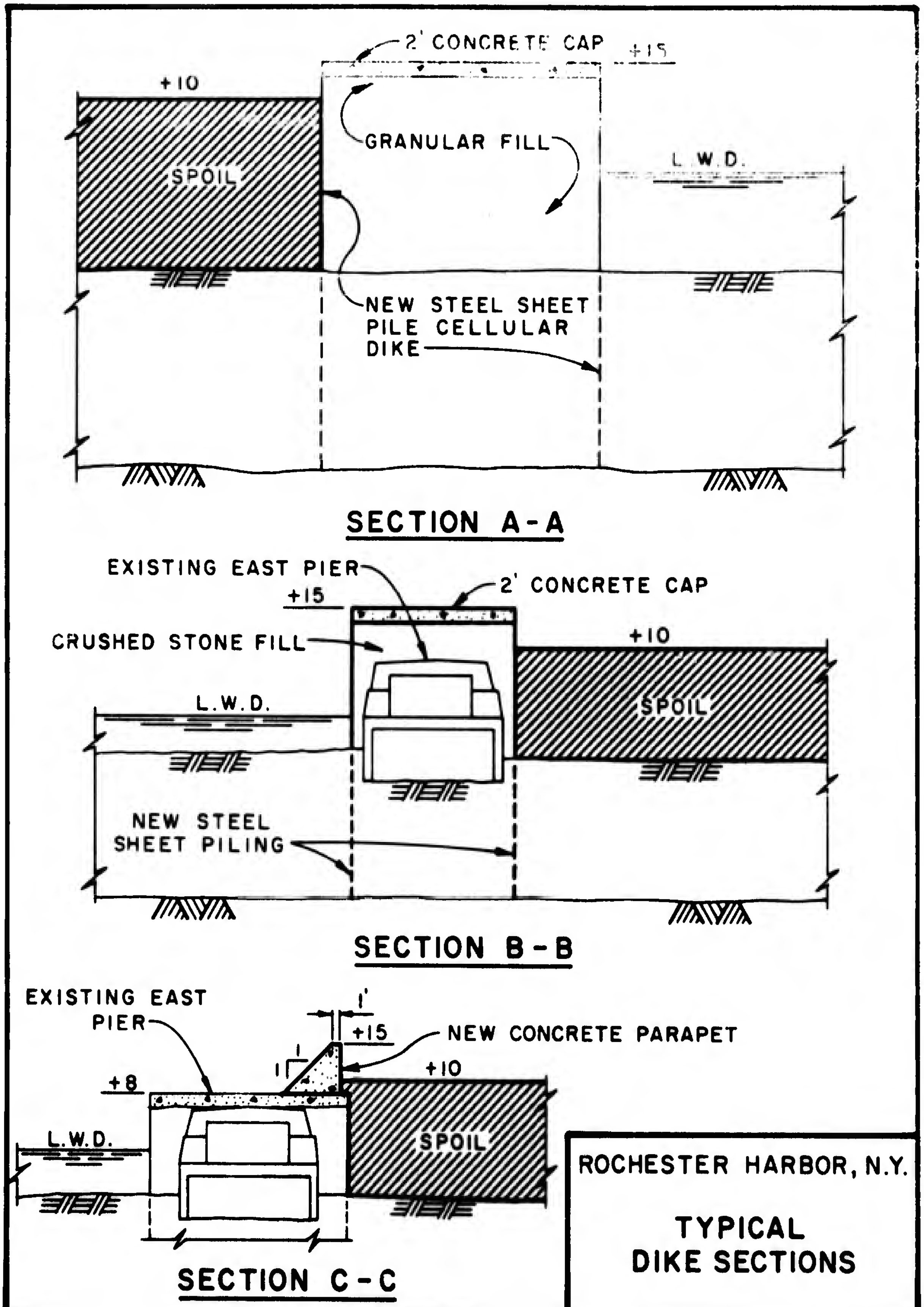
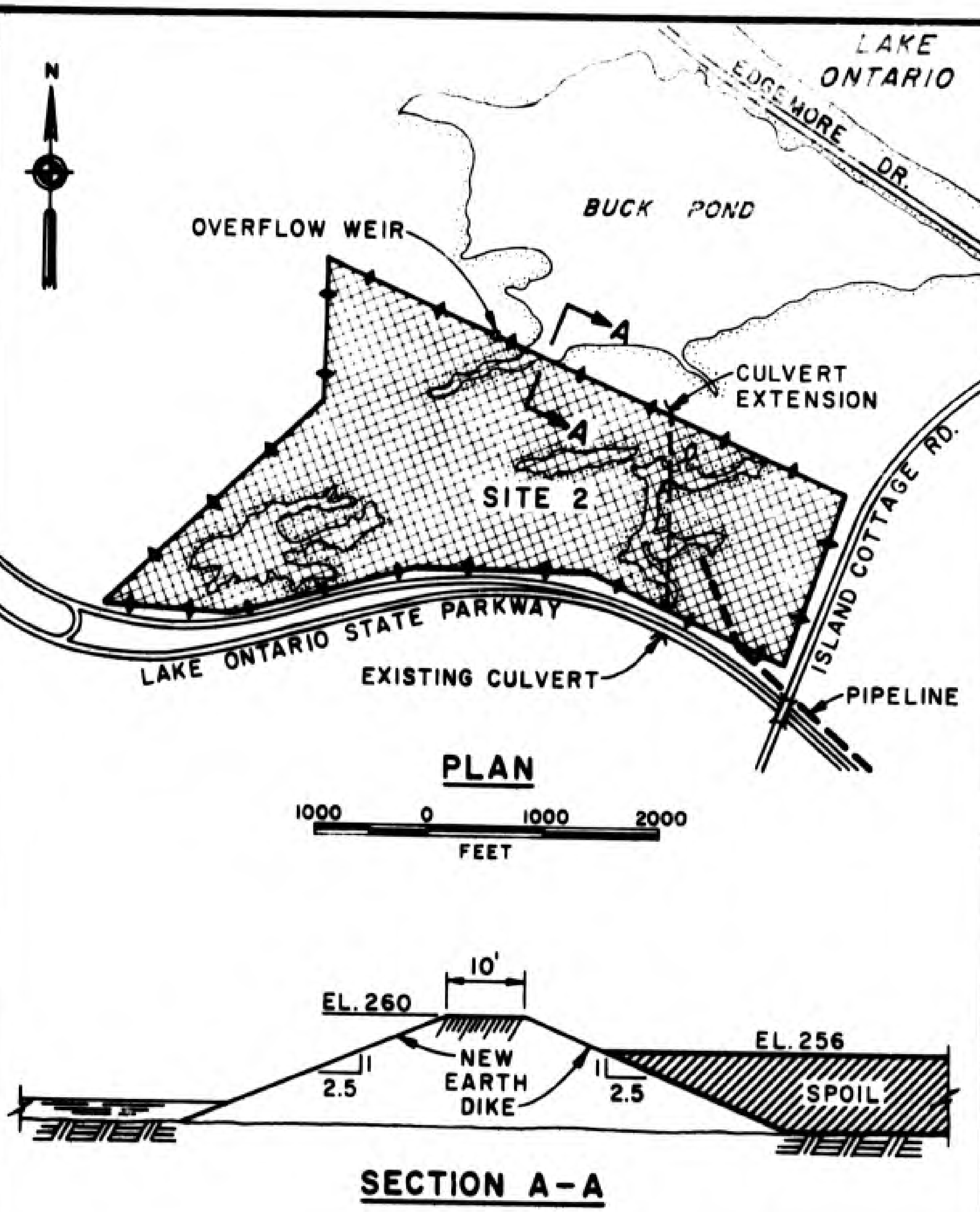

2' CONCRETE CAP
+15
+10
SPOIL
GRANULAR FILL
L. W. D.
NEW STEEL SHEET PILE CELLULAR DIKE
SECTION A-A
EXISTING EAST PIER
2' CONCRETE CAP
+15
CRUSHED STONE FILL
+10
L.W.D.
SPOIL
NEW STEEL SHEET PILING
SECTION B-B
EXISTING EAST PIER
1'
+15
NEW CONCRETE PARAPET
1
1
+10
+8
L.W.D.
SPOIL
SECTION C-C
ROCHESTER HARBOR, N.Y.
TYPICAL DIKE SECTIONS

FIG. K9-4




ROCHESTER HARBOR, N.Y.

SITE 2

FIG. K9-5

APPENDIX K10 & K11

OSWEGO HARBOR, NEW YORK

AND

HURON HARBOR, OHIO

TO BE SUBMITTED LATER

# APPENDIX K10

# STUDY OF
# ALTERNATE DISPOSAL AREAS
# FOR
# OSWEGO HARBOR, NEW YORK

U. S. ARMY ENGINEER DISTRICT, BUFFALO
CORPS OF ENGINEERS
1776 NIAGARA STREET
BUFFALO, NEW YORK 14207

JANUARY 1969

DREDGING AND WATER QUALITY PROBLEMS
IN
THE GREAT LAKES

APPENDIX K10

STUDY OF ALTERNATE DISPOSAL AREAS
FOR
OSWEGO HARBOR, NEW YORK

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APPENDIX K10 - OSWEGO HARBOR

LOCATION AND DESCRIPTION

1. Oswego Harbor, New York is located near the easterly end of the south shore of Lake Ontario, at the mouth of Oswego River. It is about 57 miles easterly of Rochester Harbor, New York, and about 45 miles south of the head of the St. Lawrence River near Cape Vincent, New York. Details of the Federal navigation project are shown in fig. K10-1.

2. The harbor is an improtant commercial port. Tht total waterborne commerce at Oswego Harbor for 1966 amounted to 449,154 tons and for the 10-year period, 1957-1966 inclosure, has averaged 945,964 tons. The principal commodities in 1966 were: Canadian import and lakewise receipt of 166,504 tons of building cement (37% of total commerce); lakewise receipts and internal shipment of 136,595 tons of wheat (30%); lakewise and internal receipt of 48,135 tons of residual fuel oil (11%); Canadian import of 24,874 tons of fertilizer materials (6%); lakewise receipt of 22,436 tons of barley and rye (5%); lakewise receipt of 21,931 tons of bituminous coal (5%); and Canadian export of 11,753 tons of basic chemicals (3%).

EXISTING CORPS OF ENGINEERS PROJECT

3. PROJECT

The existing project was authorized by the 1870, 1907, 1930, 1935, 1940, 1948, 1954 and 1962 River and Harbor Acts which provide for:

a. An outer harbor, about 280 acres in area, formed by a system of breakwaters comprising an outer west breakwater 4,515 feet long connected with the shore; a west arrowhead breakwater 2,700 feet long; an east arrowhead breakwater about 2,200 feet long.

b. A depth of 27 feet in the lake approach channel from deep water in the lake to the entrance gap in the arrowhead breakwaters.

c. A depth of 25 feet in channel 800 feet wide through the outer harbor from the entrance gap, terminating in a turning basin 25 feet deep, about 750 feet by 1,100 feet in size at the mouth of the Oswego River.

d. A depth of 21 feet in the remainder of the outer harbor between the arrowhead breakwaters and in the west outer harbor east of the Erie - Lackawanna Railroad Coal dock.

e. A depth of 21 feet in soft material and 22 feet in hard material in the west outer harbor west of the east side of the Erie-Lackawanna Railroad coal dock.

f. A depth of 24 feet in earth and 25 feet in hard material in a channel in the river from turning basin to the upstream end of the Port of Oswego Authority's east side terminal, a distance of about 1,600 feet.

g. A depth of 21 feet in a channel in the river between the upstream end of the Port of Oswego Authority's east side terminal and the upstream limit of the Federal project, at the north line of West Seneca Street.

h. No dredging is to be done within 100 feet of the breakwaters and 50 feet of the established harbor lines in the outer and west harbor areas. In the river channel the dredging limits are established parallel to and 50 feet channelward of the established harbor lines.

i. A detached breakwater 850 feet long at the harbor entrance and the removal of shoals to a depth of 25 feet below low - water datum in the approach to the entrance.

4. STATUS OF PROJECT

The project is 73% complete. The work remaining to be done to complete the project consists of: deepening to 22 feet a 150-foot wide strip along the harbor line in the west outer harbor west of the Erie-Lackawanna coal dock as authorized by the 1960 Act. Deepening of the 200-foot strip along the harbor line east of the mouth of the Oswego River, as authroized by the 1930 Act, is classified inactive.

## PRESENT DREDGING PRACTICE

5. PROCEDURES

The lake approach channel, outer harbor and Oswego River channel are maintained annually by U. S. hopper dredges. Clamshell dredge and dump scows are used for permit dredging.

6. WORKING SEASON

The available season for dredging work at Oswego Harbor corresponds generally with navigation season. In recent years the earliest and latest openings and closings of navigation at the harbor were:

| | Opening | Closing |
|---|---|---|
| Earliest date | Apr. 17 | Nov. 26 |
| Latest date | Apr. 29 | Dec. 3 |

7. QUANTITY AND TYPE OF MATERIAL

About 80,000 cubic yards are removed annually in maintaining the project based on records of the last 10 years. Annual permit dredging to maintain dockside areas is estimated at 10,000 cubic yards of earth. No changes in maintenance requirements are anticipated in the future. The materials removed in annual project maintenance and by permit are predominately sand and sandy mixtures in the entrance channel and outer harbor and silts in the river channel.

8. NATURE OF POLLUTION

The nature of pollution in the Oswego River is discussed in a report by FWPCA entitled "Water Pollution Problems and Improvement Needs, Lake Ontario and St. Lawrence River Basins", dated June 1968. The report states that the Oswego River from Three Rivers to Lake Ontario is a pollution-laden stream. The river is high in dissolved and suspended organics at its headwaters and receives untreated domestic sewage from three communities and untreated industrial wastes from six large and many small industries. Before entering Lake Ontario the river receives raw waste discharge from the City of Oswego, which has nearly 31,000 people.

9. METHOD OF DISPOSAL

Dredged material from the harbor is disposed of by bottom dumping, from hopper dredges or dump scows, into an established open lake disposal area in Lake Ontario. The disposal area is one-half mile square, located 1½ miles, N22° W, from the west pierhead light. At present dredging rates it is estimated that the capacity of this area is sufficient to serve for at least 25 years without impeding navigation.

10. COST OF DREDGING

The unit cost of harbor maintenance dredging by hopper dredge, with disposal in the open lake disposal area, is $0.33 per cubic yard. Considered alternate disposal areas discussed in this appendix would require maintenance dredging with disposal at a nearby mooring facility. The estimated cost would be $0.50 per cubic yard. There would, of course, be additional costs for the diked inclosures. These costs are discussed later in the appendix.

## ALTERNATE DISPOSAL AREAS

### 11. GENERAL

A survey was made in 1968 to locate sites for diked disposal areas as an alternative to open lake disposal of maintenance dredgings for at least a 10-year period. Possible sites were discussed with officials from the City of Oswego and the Port Authority. As a result of these discussions, three sites were selected for further study. The location of each site is shown in figure K10-2 and discussed individually in the following paragraphs.

12. SITE 1

This is an onshore disposal area located about two miles northeast of the harbor. It encompasses about 240 acres of low swampland separated from Lake Ontario by a natural sand and gravel bar. The site extends along the shore of Lake Ontario for a little over a mile and is about two-thirds of a mile at its widest point. When filled to an average depth of about two feet, this site would hold the volume from about ten years of maintenance dredging. Dikes would not be required because the site is bordered on all sides by high ground. The Effluent from pumping operations would be discharged into Lake Ontario by means of waste weirs. Mooring facilities would be constructed in the harbor alongside the east arrowhead breakwater, consisting of two mooring cells and an equipment dock supported on bearing piles. The necessary equipment for making and handling connections between the dredge and a fixed 18-inch discharge line would be provided on the dock. About 17,000 feet of discharge pipe and three booster pumps would be required to transport the spoil to the disposal area. The pipeline would be located along the right-of-way for an existing railroad track. Details for Site 1 are shown in figure K10-3.

13. The land adjacent to, and surrounding the disposal site is mostly unused farm land except for an area to the east which has recently been developed for industrial purposes by the Alcan Aluminum Company. The considered site is owned in part by the Port of Oswego Authority and the remainder is owned by a number of private interests. Although individual owners were not contacted, the Port Director would have no objection to the use of this site for disposal of dredged material. The spoil material is expected to be suitable for growing crops or for recreational purposes after a stabilization period.

14. SITE 2

This is an alongshore site located on the lake side of the east arrowhead breakwater. The breakwater and a new extension dike extending to the shore form one side of the three-sided disposal area. The other two sides would be formed by the existing shoreline and a new 2,500 foot cellular sheet pile dike, constructed in a circular arc from the breakwater to the existing shore. The capacity of the site when filled to a height of six feet above LWD is 800,000 cubic yards which is equivalent to the volume from ten years of maintenance dredging. The cellular structure would be filled with granular material and capped with concrete. The east breakwater extension dike would be a rubblemound type structure with a seven-foot thick filter blanket on the inclosed side slope. A similar filter would be placed along the inside side slope of the existing breakwater. Effluent would drain through this filter and the breakwater and discharge into the harbor. The mooring facility would be similar to that used for Site 1 and would be located in the same place. Details for Site 2 are shown in fig. K10-4.

15. It is assumed that this underwater disposal site is owned by the State of New York and that any land areas created by filling would be turned over to the State. The land would probably be suitable for some form of recreational development after the fill has become stabilized.

16. SITE 3

This is an alongshore site inside the breakwaters, on the east side of the protected harbor. The site is about 1,700 feet in length and extends out from shore about 250 feet at the western end and 600 feet at the east breakwater. When filled to an average depth of 8½ feet above LWD, the 19-acre site would have a capacity of about 560,000 cubic yards. This is equivalent to about seven years volume of maintenance dredgings. The offshore boundary of the site would be inclosed with a rubblemound dike. A similar structure exists along the shoreline boundary of the site. A 250-foot section of the existing east breakwater would be raised three feet and breakwater extended to shore, inclosing the east side of the site. A seven-foot thick graded filter would be placed along the inside side slopes of the new dikes. Effluent would drain through the filter and dikes during filling operations. Mooring facilities would be constructed in the harbor adjacent to the new dike and would be similar to the facilities provided for Site 1. Details for Site 3 are shown in fig. K10-5.

17. The possible use of Site 3 was suggested by City officials. The existing shoreline of the site is not now being used for any purpose and a landfill area might eventually be suitable for expanding the port facilities. There are no known objections to the use of this site for disposal of dredged materials.

18. OTHER SITES

Three other potential disposal areas were discussed with City officials. They were eliminated from further consideration for various reasons. Two of the areas, Sites 4 and 5 are in the vicinity of the harbor and the third, Site 6, is about four miles southwest of the mouth of the Oswego River on the shore of Lake Ontario. The general location of each is shown in fig. K10-2.

19. Site 4 is an abandoned hydraulic power canal that lies just east of and parallel to the New York State Barge Canal. It extends upstream from Bridge Street to the downstream end of Lock No. 8. The City Engineer indicated that they expect to use the canal as a route for a new interceptor sewer that will supply a proposed new sewage treatment plant. Because of this planned use, the City would not be in favor of using this site for disposal of dredged material. Even if the site were available, it would have very limited capacity and be of little use as a disposal site.

20. Site 5 is located on the west side of the Erie-Lackawanna Railroad pier. The area has the capacity to hold only about one year's volume of dredged material. The shoreline in this area is dotted with boat-houses, boat-ramps and several marinas. Because of this, the City is not in favor of using the site for disposal of dredged material.

21. Site 6 is separated from Lake Ontario by a low sand and gravel bar and encompasses about 122 acres of low swampy ground. When filled to an average depth of four feet, the site would hold the volume from ten years of maintenance dredging. There are, however, a number of problems connected

with this site, which would make it considerably more expensive than others that appear to be available. One factor is the distance from the harbor. The dredge would probably moor in the western end of the harbor, 3½ miles from the site. A pipeline with at least four booster pumps would be required to transport the material from the dredge to the disposal area. It appears that there are no acceptable routes on which to lay the discharge pipeline. A shoreline route would cross the Oswego State University campus and a public beach. To go further inland would mean crossing many streets and private properties. The alternative would be to provide a protected anchorage, at considerable expense, near the disposal area and pump directly to the site. Offshore structures would be needed to protect the mooring facility during lake storms and there would be extra costs for operating the dredge to and from the site. Finally the site itself is divided by a highway which would have to be either raised or relocated at considerable expense.

## ESTIMATES OF COST

### 22. GENERAL

Cost estimates were prepared for Sites 1, 2 and 3 only. The salvage value of booster pumps used in the spoil discharge system for Site 1 was subtracted from the investment cost for that site. It was assumed that the construction period for Site 2 would be two years. Interest during construction, over half the construction period, at the current Federal risk-free interest rate, was included in the investment cost for the site. It was assumed that required structures for the other sites could be constructed in one year and interest during construction was not included in the total investment.

23. Annual costs include interest and amortization over the assumed filling period, dredging costs with disposal at a specified mooring facility, and operation and maintenance costs. For Site 3, it was assumed that the stone dike would require periodic maintenance for a 10-year period after the site has been filled. Maintenance costs would cover possible damages to the dike from lake storms during the period in which the spoil material may not be fully consolidated. Similar costs were included for the stone dike structures required for Site 2. Cost estimates for Site 1, 2 and 3 are shown in the following paragraphs.

24. SITE 1

a. First Costs

| | |
|---|---|
| Mooring facilities | $ 145,000 |
| Spoil discharge system | 1,190,000 |
| Land acquisition | 350,000 |
| Creek diversion | 50,000 |
| Total Investment Cost | $1,730,000 |
| Salvage Value | 113,000 |
| Investment less Salvage | $1,617,000 |

b. Annual Costs

| | |
|---|---|
| Interest, $1,730,000 @ .0325 | $ 56,000 |
| Amortization, 10 yrs., $1,617,000 @ .0862 | 140,000 |
| Maintenance dredging, 80,000 c.y. @ $0.50 | 40,000 |
| Operation and maintenance | 35,000 |
| Total Annual Cost | $ 271,000 |
| | |
| Cost per Cubic Yard | $ 3.39 |

25. SITE 2

a. First Costs

| | |
|---|---|
| Spoil retention structures | $ 2,890,000 |
| Mooring facilities | 140,000 |
| Spoil discharge system | 60,000 |
| Total First Cost | $ 3,090,000 |
| Interest during construction | 100,000 |
| Total Investment Cost | $ 3,190,000 |

b. Annual Costs

| | | |
|---|---|---|
| Interest, $3,090,000 @ .0325 | = | $ 100,000 |
| Amortization, 10 years $3,190,000 @ .0862 | = | 275,000 |
| Maintenance dredging, 80,000 c.y. @ $0.50 | = | 40,000 |
| Operation and maintenance | = | 12,000 (1) |
| Total Annual Cost | | $ 427,000 |
| Cost per Cubic Yard | | $ 5.34 |

(1) Includes $3,000 annually for 20 years for maintenance of stone dikes, which is equivalent to $5,000 annually for 10 years. ($3,000 x 14.539 x .1187)

26. SITE 3

a. First Costs

| | |
|---|---|
| Spoil retention structure | $ 1,510,000 |
| Mooring facilities | 140,000 |
| Spoil discharge system | 50,000 |
| Total First Cost | $ 1,700,000 |

b. Annual Costs

| | | |
|---|---|---|
| Interest, $1,700,000 @ .0325 | = | $ 55,000 |
| Amortization, 7 yrs, $1,700,000 @ .1295 | = | 220,000 |
| Maintenance dredging 80,000 c.y. @ $0.50 | = | 40,000 |
| Operation and maintenance | = | 21,000(1) |
| Total Annual Cost | | $ 336,000 |
| Cost per Cubic Yard | | $ 4.20 |

(1) Includes $8,000 annually for stone dike maintenance for 17 years which is equivalent to $17,000 annually for 7 years. ($8,000 x 12.905 x .1620)

27. COST COMPARISONS

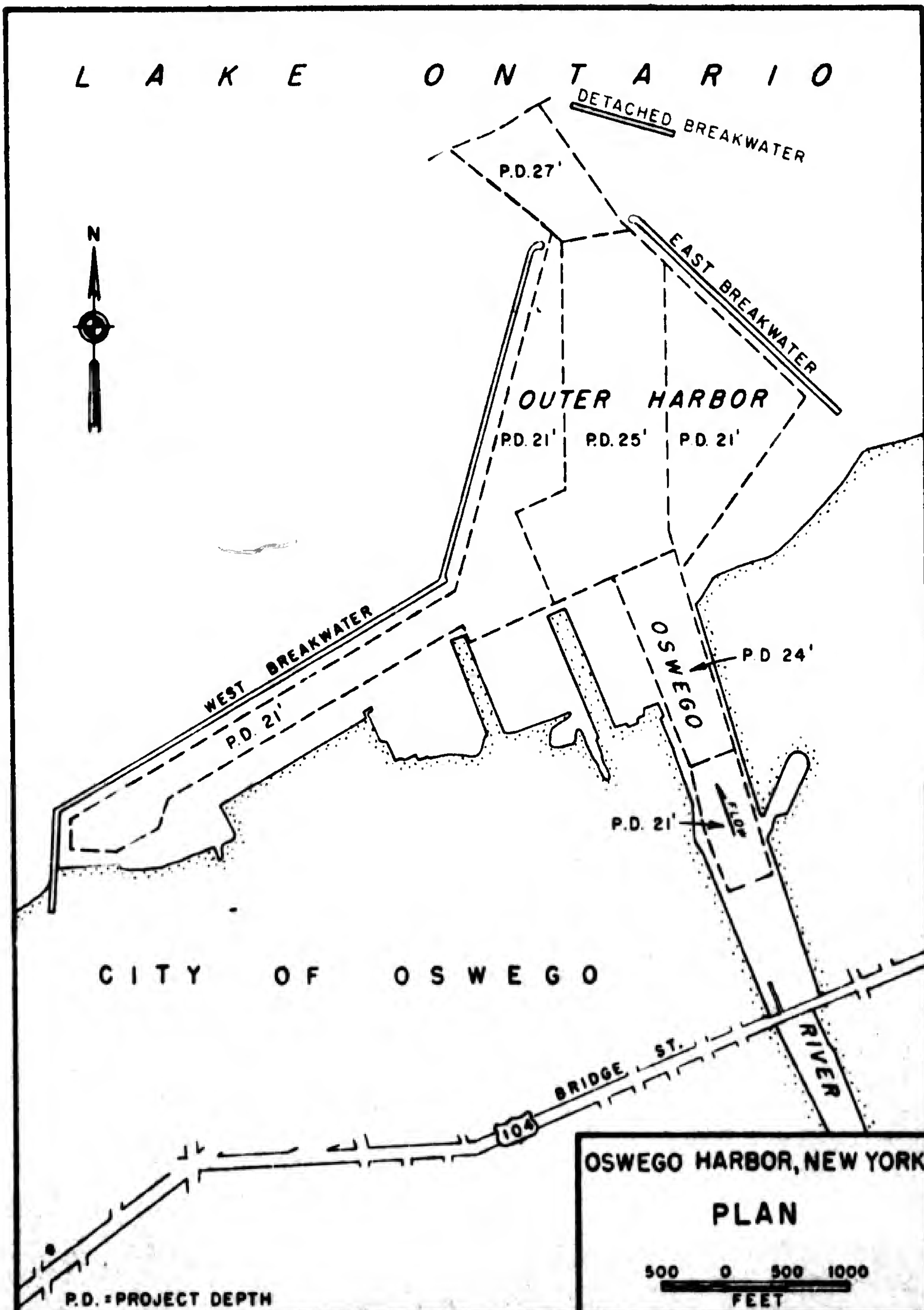
A summary of costs for three alternate disposal sites is shown below in tabular form. The cost of open lake disposal is shown for comparison.

| Site | Capacity Cu. yds. | Capacity Years | Cost per cubic yard |
|---|---|---|---|
| Open lake | - | 25+ | $ 0.33 |
| 1 | 800,000 | 10 | 3.39 |
| 3 | 560,000 | 7 | 4.20 |
| 2 | 800,000 | 10 | 5.34 |

## DISCUSSION

28. The considered alternate disposal sites were sized to handle the estimated future maintenance dredging spoil only, 80,000 cubic yards annually. It was assumed that future permit dredgings, estimated at 10,000 cubic yards annually, could be disposed of at the same sites if necessary. Since costs per cubic yard are being compared, this analysis is considered adequate.

29. The least costly alternative to open lake disposal at Oswego Harbor would be a landfill site east of the Oswego River, referred to as Site 1. These dredgings would be pumped from a mooring facility located in Oswego Harbor, through a pipeline, to the site. The property required is undeveloped and there are no known objections to the use of this site.



LAKE ONTARIO
DETACHED BREAKWATER
P.D. 27'
N
EAST BREAKWATER
OUTER HARBOR
P.D. 21'
P.D. 25'
P.D. 21'
WEST BREAKWATER
P.D. 21'
OSWEGO
P.D 24'
P.D. 21'
FLOW
CITY OF OSWEGO
RIVER
BRIDGE ST.
104
P.D. = PROJECT DEPTH
OSWEGO HARBOR, NEW YORK
PLAN
500 0 500 1000
FEET


FIG. K10-1

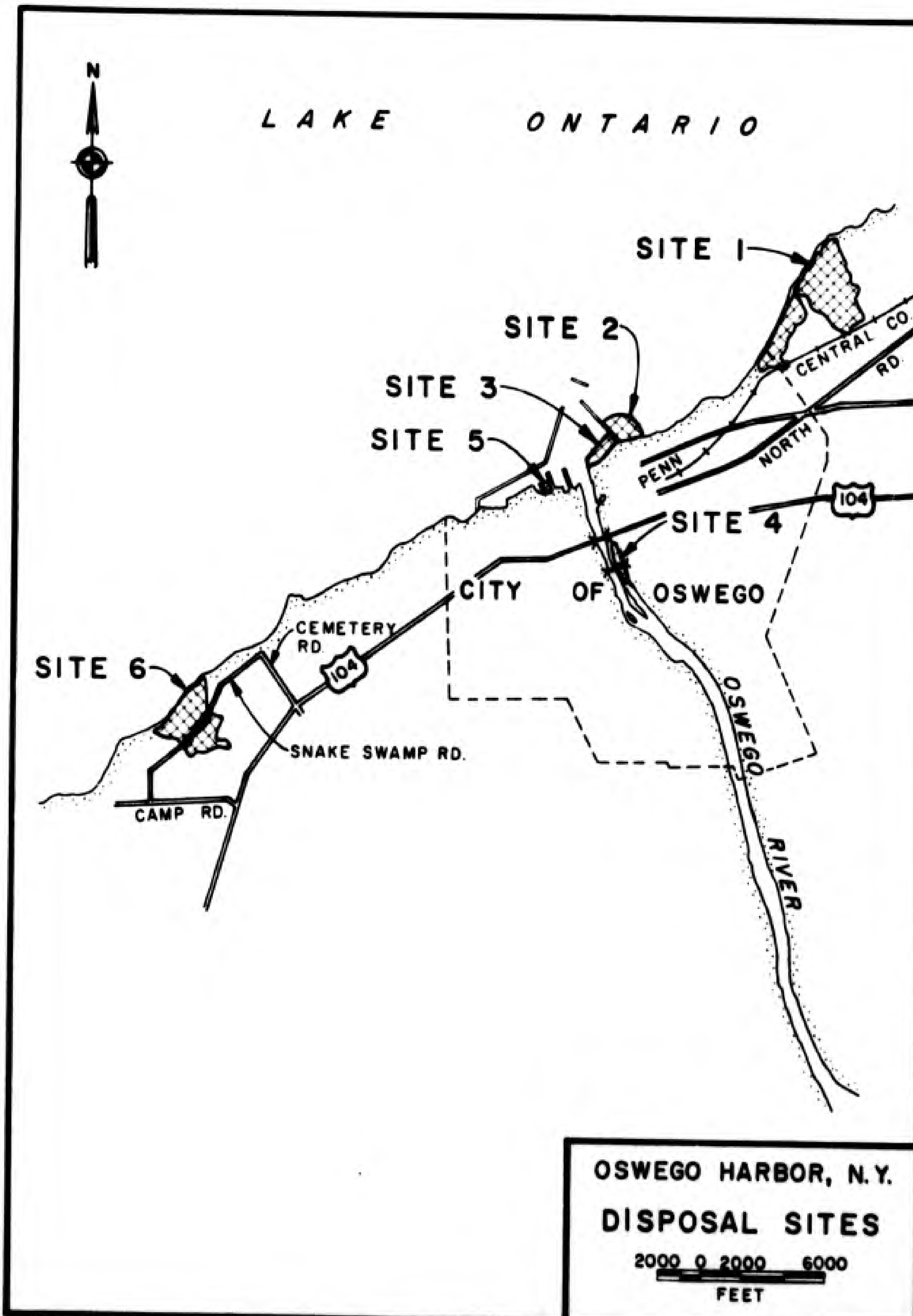
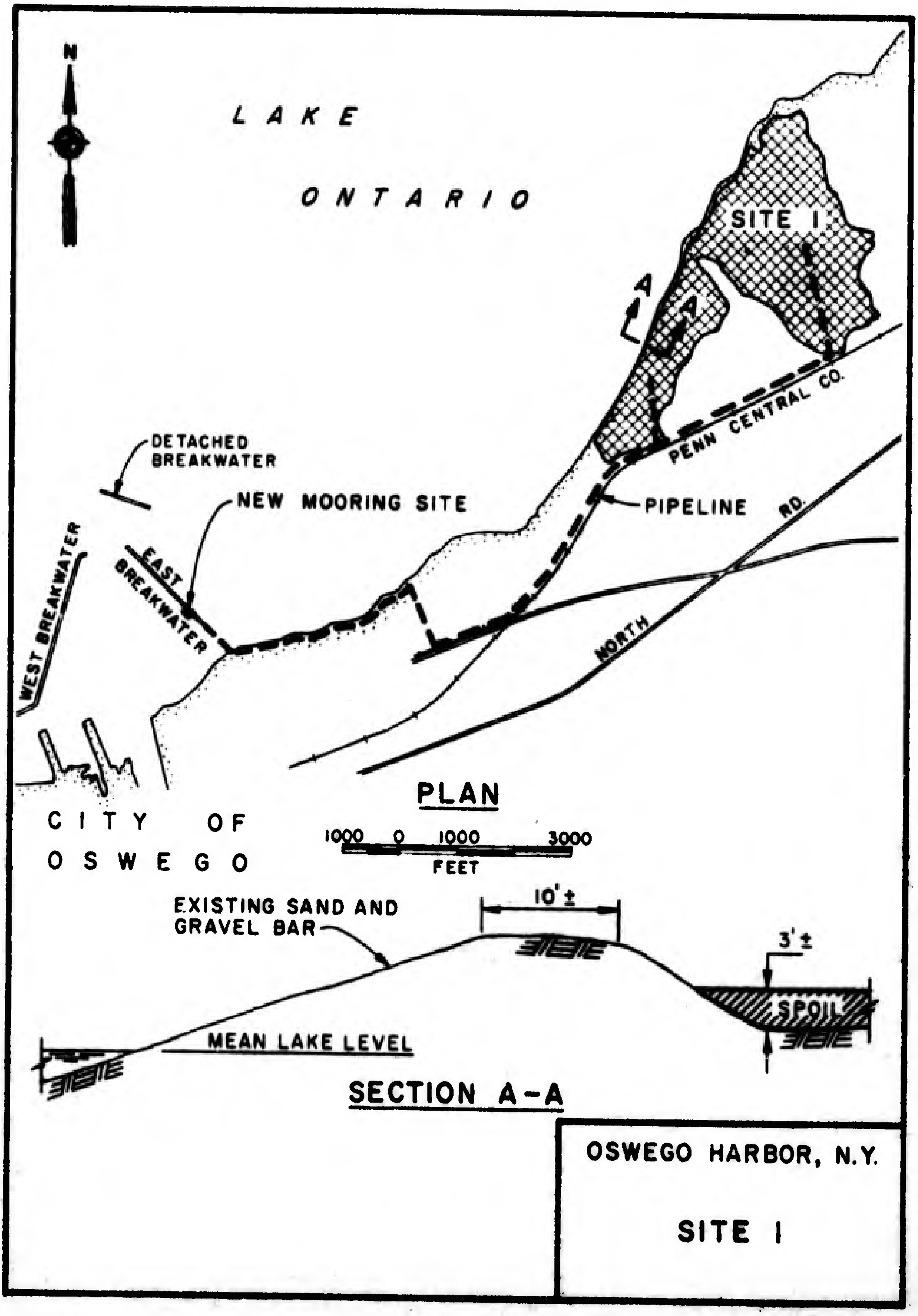
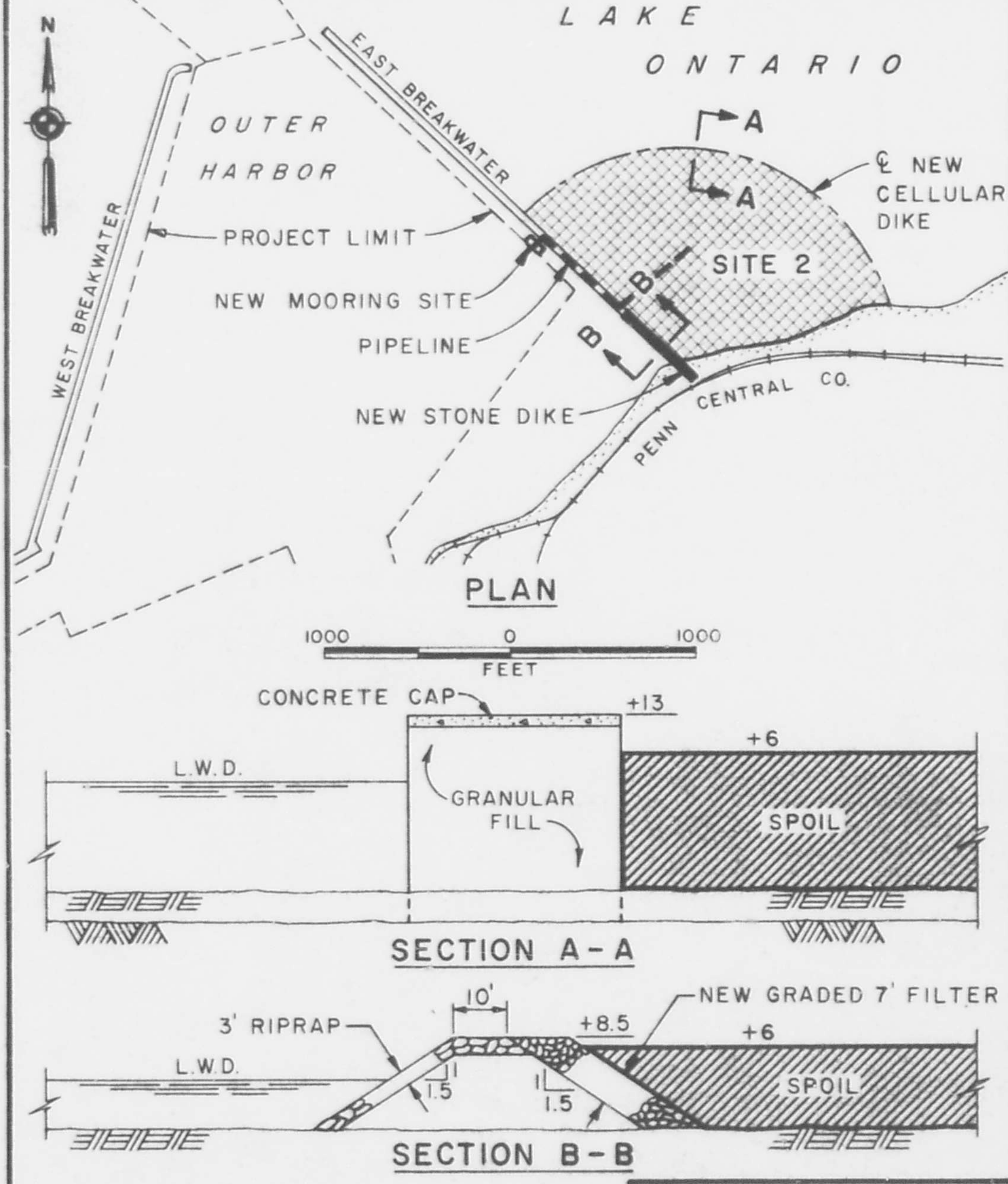

N
LAKE ONTARIO
SITE 1
SITE 2
SITE 3
SITE 5
SITE 4
SITE 6
CENTRAL CO
PENN
NORTH
RD
104
CITY OF OSWEGO
CEMETERY RD.
SNAKE SWAMP RD.
CAMP RD.
OSWEGO RIVER
OSWEGO HARBOR, N.Y.
DISPOSAL SITES
2000 0 2000 6000
FEET

FIG. K10-2



N
LAKE
ONTARIO
SITE I
A
A
DETACHED BREAKWATER
NEW MOORING SITE
PENN CENTRAL CO.
PIPELINE
RD.
NORTH
WEST BREAKWATER
EAST BREAKWATER
CITY OF OSWEGO
PLAN
1000 0 1000 3000
FEET
EXISTING SAND AND GRAVEL BAR
10' ±
3' ±
SPOIL
MEAN LAKE LEVEL
SECTION A-A
OSWEGO HARBOR, N.Y.
SITE I


FIG. K10-3




OSWEGO HARBOR, N.Y.

SITE 2

FIG. K10-4

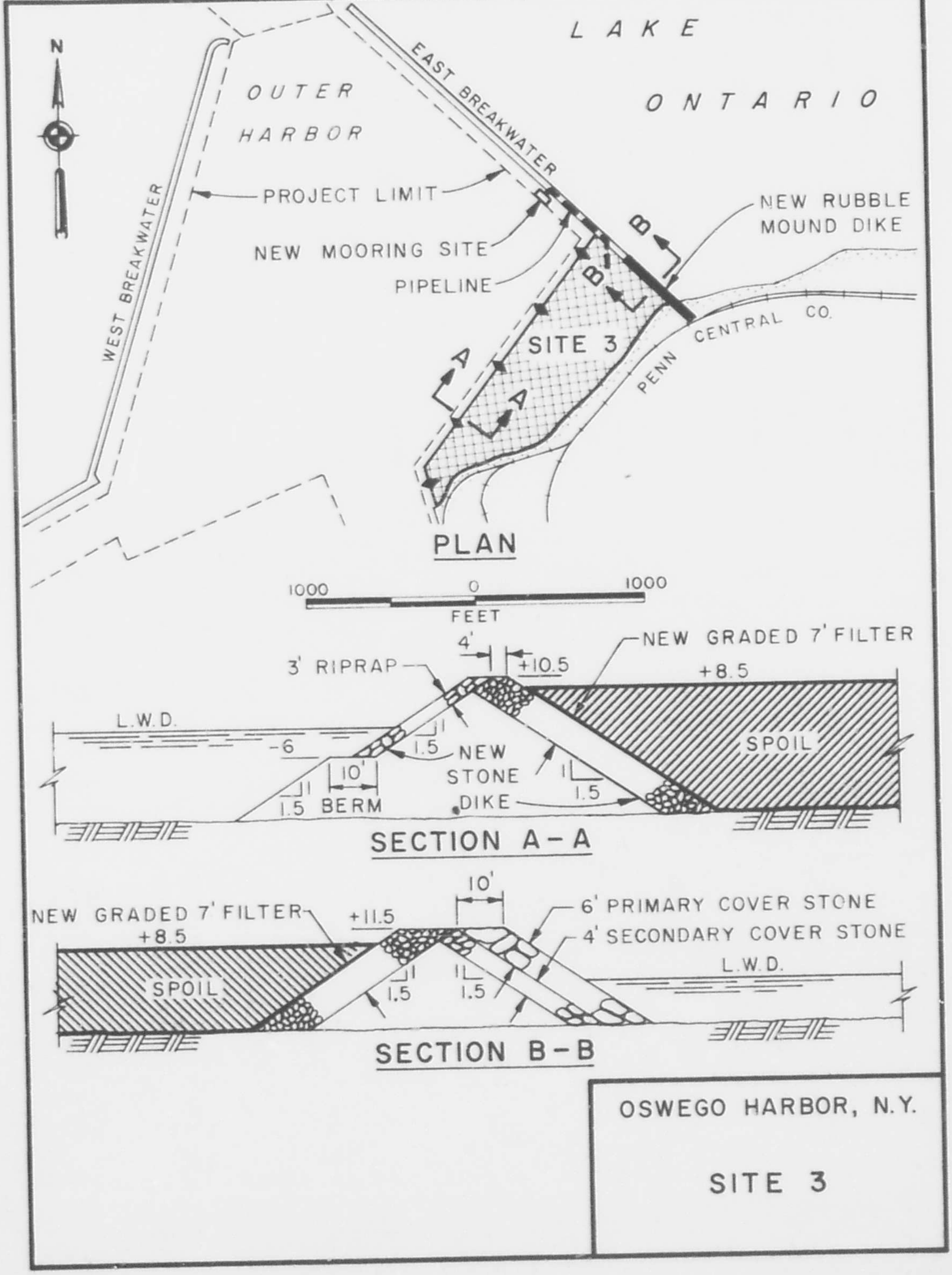

LAKE
ONTARIO
OUTER
HARBOR
N
EAST BREAKWATER
WEST BREAKWATER
PROJECT LIMIT
NEW MOORING SITE
PIPELINE
NEW RUBBLE
MOUND DIKE
B
SITE 3
A
PENN CENTRAL CO.
PLAN
1000 0 1000
FEET
4'
+10.5
NEW GRADED 7' FILTER
3' RIPRAP
+8.5
L.W.D.
-6
1
1.5
NEW
STONE
DIKE
10'
BERM
SPOIL
SECTION A-A
10'
NEW GRADED 7' FILTER
+11.5
+8.5
6' PRIMARY COVER STONE
4' SECONDARY COVER STONE
L.W.D.
SPOIL
SECTION B-B
OSWEGO HARBOR, N.Y.
SITE 3

FIG. K10-5

APPENDIX K11

# STUDY OF

# ALTERNATE DISPOSAL AREAS

# FOR

# HURON HARBOR, OHIO

U. S. ARMY ENGINEER DISTRICT, BUFFALO
CORPS OF ENGINEERS
1776 NIAGARA STREET
BUFFALO, NEW YORK 14207

JANUARY 1969

DREDGING AND WATER QUALITY PROBLEMS
IN
THE GREAT LAKES

APPENDIX K11

STUDY OF ALTERNATE DISPOSAL AREAS
FOR
HURON HARBOR, OHIO

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## APPENDIX K11 - HURON HARBOR

### LOCATION AND DESCRIPTION

1. Huron Harbor, Ohio is located at the mouth of Huron River, 47 miles west of Cleveland. The Huron River basin encompasses some 403 square miles. Details of the existing navigation project are shown in fig. K11-1.

2. The harbor is a deep draft commercial port. The total waterborne commerce for 1966 amounted to 1,306,000 tons and for the 10-year period, 1957-1966 inclusive, has averaged 1,752,000 tons. The only significant commodity in 1966 was iron ore. The shipment of coal was discontinued in 1965.

### EXISTING CORPS OF ENGINEERS PROJECT

3. PROJECT

The existing project was authorized by the 1905, 1919, 1935, and 1962 River and Harbor Acts which provide for:

a. Detached breakwater 1,575 feet in length approximately 2,000 feet lakeward of the outer end of the west pier.

b. West pier 3,523 feet long.

c. Steel-sheet pile shore protection extending 200 feet westerly from near the shoreward end of the west pier.

d. East breakwater 1,450 feet long.

e. Lake approach channel 29 feet deep varying in width from 400 feet at the outer end to 300 feet at the inner end, about 6,500 feet long from deep water in the lake to a point opposite the outer end of east breakwater.

f. Entrance channel 1,900 feet long, 28 feet deep in soft material and 29 feet in hard material, 300 feet wide at its junction with the approach channel and 150 feet wide at its junction with the river channel.

g. River channel 1,500 feet long, 27 feet deep in soft material and 28 feet in hard material, varying in width from 120 feet at the entrance channel to 350 feet at the inner end adjacent to the turning basin.

h. Turning basin in Huron River at the upstream limit of deep-draft navigation with a least width of 750 feet, and a depth, westerly of the river channel of 21 feet in soft, and 22 feet in hard material.

4. PROGRESS

The work remaining to be done to complete the project consists of deepening lake approach, entrance and river channels, enlarging the turning basin and construction of a new detached breakwater, all as authorized by the 1962 Act.

PRESENT DREDGING PRACTICE

5. PROCEDURES

The entrance channel and lake approach are maintained by U. S. hopper dredges. The inner harbor areas have been maintained by the dock operators. Clamshell dredges and dump scows have been used for permit dredging.

6. The new work dredging authorized by the 1962 Act is considered pertinent to this report. There is a reasonable liklihood that the work might be done in the 10-year period during which alternate disposal practices would be in effect. It would be essentually virgin material that is not expected to be polluted. It has been assumed that the material could be deposited in open lake disposal areas without

adversely affecting the water quality of the lake.

7. WORKING SEASON

The available season for dredging work at Huron Harbor corresponds generally with the navigation season. In recent years the earliest and latest openings and closings of navigation at the harbor were:

| | Opening | Closing |
|---|---|---|
| Earliest date | Mar 22 | Nov 18 |
| Latest date | May 1 | Dec 19 |

8. QUANTITY

The volume of material removed annually by the hopper dredges maintaining the project is about 200,000 cubic yards, based on records for the last 10 years. No change in maintenance requirements is anticipated pending completion of remaining new work whereby the project channels will be deepened and enlarged to include the inner harbor areas. Permit dredging by the dock operators to maintain the inner harbor areas has averaged about 15,000 cubic yards annually.

9. After completion of the remaining new work much of the inner harbor will be maintained by the Government and private maintenance dredging will be reduced. The estimated volume of material to be removed in accomplishing the new work dredging is 836,000 cubic yards; 767,000 cubic yards of earth and 69,000 cubic yards of rock. Local interests are expected to accomplish related dockside deepening removing an estimated 40,000 cubic yards of earth and 25,000 cubic yards of rock.

10. TYPES OF MATERIALS

The materials removed in annual project maintenance and by permit are sand and silt. The former material predominates in the outer channels and the latter in the vicinity of the inner harbor. New work dredging would require the removal of a layer of similiar material overlying undisturbed earth and some bedrock.

11. NATURE OF POLLUTION

The nature of pollution in the north central Ohio area is discussed in a report by FWPCA entitled "Lake Erie Report, A Plan for Water Pollution Control," dated August 1968. The report states that nutrients and low dissolved oxygen concentrations are the major causes of water quality problems within the north central Ohio area that includes Huron. Phosphates, nitrates, and other nutrients cause luxuriant growths of floating and attached algae which in places produce taste and odors in raw water supplies. Fish kills are prevalent and waterfowl kills from oil continue. Dissolved oxygen depletions are common below many waste outfalls.

12. METHOD OF DISPOSAL

Dredged material from the harbor is disposed of by bottom dumping, from hopper dredges or dump scows, into an established open lake disposal area in Lake Erie.

13. DISPOSAL AREAS

All dredged material is now dumped in either of two established disposal areas in Lake Erie, one for earth and the other for rock. The earth disposal area is one mile square, located 3½ miles due north from the harbor light. The rock disposal area is also one mile square, located 13½ miles, N 27$^{\circ}$E, from the harbor light. The capacity of the earth disposal area, within existing limits, is sufficient for about 4 years without impeding navigation. Surrounding depths of water are such, however, that additional capacity can be obtained by enlargement of the limits. The capacity of the rock site is indefinite.

## 14. COST OF DREDGING

The unit cost for harbor maintenance by hopper dredge with disposal in the earth disposal area is $0.22 per cubic yard. The estimated composite unit cost for accomplishment of the new work by contract, with disposal of most of the earth in the earth disposal area and the balance of materials in the rock disposal area is $3.56 per cubic yard ($2.50/c.y. for earth; $15.55/c.y. for rock). The estimated composite unit cost for the related non-Federal dockside dredging is $11.35 per cubic yard ($2.37/c.y. for earth; $25.75/c.y. for rock). The estimated cost of dredging and disposal at a designated mooring facility, required as part of the considered alternate disposal plans discussed in this appendix, varies from $0.52 to $0.55 per cubic yard.

# ALTERNATE DISPOSAL SITES

## 15. GENERAL

A survey was made in 1968 to locate sites for diked disposal areas as an alternative to open lake disposal of maintenance dredgings for at least a 10-year period. The overall dredging disposal problem and the need for alternate disposal areas was discussed with City officials, representatives of the Huron Port Authority and shipping interests. Consideration was given to landfill areas that would use a pumping system to transport the dredgings to the site and offshore sites where the material could be pumped in directly. Designs and cost estimates were prepared for the more promising sites. The sites are shown in fig. K11-2 and discussed individually in the following paragraphs.

16. SITE 1

This is a 63-acre offshore site located on the lake side of the west pier. A cellular sheet pile structure, filled with granular material and capped with concrete, would be constructed on a semicircular alignment, with a radius of about 1,100 feet. When filled to a depth of seven feet above Low Water Datum (LWD), the site would have a capacity of two million cubic yards. This is equivalent to the future maintenance dredging volume for about 10 years. The existing piers would be raised to an elevation 15 feet above LWD, the elevation of the new cellular structure, to provide adequate freeboard and protection against lake storms. A mooring facility, incorporating the necessary equipment for making and handling flexible connections between the dredge and the discharge piping system, would be constructed on the harbor side of the west pier. A graded filter would be placed on the inside side slope of a 1,200-foot section of the west pier. Effluent from the disposal area would drain through the filter and stone dike, discharging into the harbor. Site 1 is shown in fig. K11-3.

17. It has been assumed the offshore area could be used for recreational purposes following a stabilization period after the site is filled. It would be accessible from shore by walking along the west pier. There were no specific requests by local interests to have this site filled.

18. SITE 2

This is a 33-acre offshore site located in the general vicinity of a detached breakwater, authorized by the 1962 River and Harbor Act, but not constructed. This site would, in effect, be a dual purpose project that combines the authorized breakwater with a diked disposal area. The authorized breakwater would be a cellular sheet pile structure, filled with granular material, capped with concrete, having a total length of 1,575 feet. A similar structure would be constructed on a semicircular alignment, with a radius of about 800 feet on the lake side of the breakwater. When filled to a depth 13 feet above LWD, the site would hold two million cubic yards of material, the estimated future maintenance dredging volume for a 10-year period. An adjustable overflow weir would be constructed between two cells on the north side of the site to drain effluent back to the lake. Mooring facilities would be constructed at two locations to provide a protected berth for the dredge to discharge the dredgings directly to the site. The facility to be used would depend on the direction of prevailing winds. Site 2 is shown in fig. K11-4.

19. It has been assumed that the offshore land area that would be created by this plan could be developed for recreational purposes after a stabilization period. The area would be located about 4,000 feet from the mainland.

20. SITE 3

This is a 42-acre landfill site located on the right bank of Huron River about one mile above the head of navigation. The existing area is mostly undeveloped marshland that is subject to flooding. Since the site would remove land from the floodplain, the river channel would be widened in the vicinity of the site. When filled to an average depth of nine feet, the site would contain 600,000 cubic yards, the estimated future maintenance dredgings for three years. The site would be inclosed with about 4,200 feet of stone dike. A graded filter would be placed on the inside side slope of the dike so that effluent would drain through the filter and dike, discharging back to the river. Dredgings would be pumped from a mooring facility in the navigation channel, through a 6,000-foot pipeline to the disposal area. One booster pump would be required in the spoil discharge system. The site is shown in fig. K11-5.

21. Local officials suggested this site as a disposal area. It is expected that the filled area could eventually be developed for light industry. Rail transportation is readily available east of the site. Property owners of the existing land were not contacted.

22. SITE 4

This is a 72-acre landfill site located about 2½ miles east of the City. The existing land is marshland and other underwater property, adjacent to Old Woman Creek. The site would be inclosed with a 4,100-foot stone dike with a graded filter on the inside side slope, similar to the design for Site 3. It could be filled to an average depth of 12 feet to contain the expected future maintenance dredgings for seven years or it could be filled to about 17.5 feet to hold the dredgings for 10 years. Ten-year plans could be developed using Site 4 after Site 3 is filled or using Site 4 alone. Nearly three miles of pipeline and three booster pumps would be required to pump the material from a mooring site located in the navigation channel. The pipeline would be placed along an existing railroad embankment. The site is shown in fig. K11-6.

23. This site was also suggested by local officials. The surrounding area is developed primarily for agricultural purposes. It is assumed that Site 4 would also be used for this purpose. State officials and property owners were not contacted regarding the availability of the area.

24. SITE 5

This is an 89-acre alongshore site that would be located on the west side of the existing west pier. About 4,000 feet of cellular sheet pile dike would inclose the site. About 970 feet of the existing pier would be raised to an elevation of 15 feet above LWD, the elevation of the new cellular structure, to provide adequate protection against lake storms. When filled to a depth six feet above LWD, the site would hold about two million cubic yards of dredgings, the estimated future maintenance dredging volume for a 10-year period. A mooring facility, incorporating the necessary equipment for making and handling flexible connections between the dredge and the discharge piping system, would be constructed on the harbor side of the west pier. An adjustable overflow weir would be constructed between two cells on the north side of the site to drain effluent back to the lake. The site is shown in fig. K11-7.

25. The Park Board of the City of Huron asked that consideration be given to filling this general area in order to develop the land for recreational purposes. It is expected that there might be some opposition to the use of this site by property owners in the area who have homes overlooking the lakefront.

26. SITES 6, 7 and 8

These are three considered landfill areas located about three miles west of the City. The largest site would have an area of about 22 acres. They are shallow borrow pits that were used to provide fill for recent highway construction. Consideration of these sites was discontinued after preliminary studies showed that they would have limited capacity. It was assumed that a larger area could be found closer to the navigation channel in the event that a landfill site was needed for disposal of dredgings.

## ESTIMATE OF COSTS

27. GENERAL

Cost estimates were prepared for Sites 1 through 5. The estimates for Sites 3 and 4 were combined to show the cost of a 10-year plan, for comparison with other sites that have this capacity. An estimate was prepared for Site 3 alone, having 3 years capacity, in the event that a small area is needed before a 10-year plan is implemented. Sites 1, 2, and 5 would require two-year construction periods. Interest during construction for one year, at the current Federal risk-free interest rate, was included in the investment costs for these sites. Sites 3 and 4 could be constructed in a single year and interest during construction was neglected. The salvage value of booster pumps used in the spoil discharge system for the landfill sites was subtracted from the investment cost. All costs are based on 1968 price levels.

28. Annual costs include interest and amortization over the assumed filling period, dredging costs with disposal at a specified mooring facility, and operation and maintenance costs. It was assumed that maintenance of stone dikes would continue for a 10-year period following the filling period. This would be necessary to maintain the structural integrity of the area before the fill is fully consolidated. Total annual costs were divided by 200,000 cubic yards to obtain a cost per cubic yard. Cost estimates for each site are shown in the following paragraph.

29. SITE 1

a. First Costs

| | |
|---|---|
| Spoil retention structures | $4,390,000 |
| Mooring facilities | 31,000 |
| Spoil discharge system | 69,000 |
| Total First Cost | $4,490,000 |
| Interest during construction | 146,000 |
| Total Investment Cost | $4,636,000 |

b. Annual Costs

| | |
|---|---|
| Interest, $4,636,000 @ .0325 | $ 151,000 |
| Amortization, 10 yrs., $4,636,000 @ .0862 | 400,000 |
| Maintenance dredging, 200,000 c.y. @ $0.52 | 104,000 |
| Operation and maintenance | 18,000(1) |
| Total Annual Cost | $ 673,000 |
| Cost per Cubic Yard | $3.37 |

(1) Includes $3,000 annually for 20 years for maintenance of the stone dike, which is equivalent to $5,000 annually for 10 years ($3000 x 14.539 x .1187).

30. SITE 2

a. First Costs

| | |
|---|---|
| Spoil retention structure | $7,320,000 |
| Mooring facilities | 62,000 |
| Spoil discharge system | 69,000 |
| Total First Cost | $7,451,000 |
| Interest during construction | 242,000 |
| Total Investment Cost | $7,693,000 |

b. Annual Costs

| | |
|---|---|
| Interest, $7,693,000 @ .0325 | $ 250,000 |
| Amortization, 10 yrs., $7,693,000 @ .0862 | 663,000 |
| Maintenance dredging, 200,000 c.y. @ $0.55 | 110,000 |
| Operation and maintenance | 8,000 |
| Total Annual Cost | $1,031,000 |
| Cost per Cubic Yard | $5.16 (1) |

(1) Deducting the value of the authorized detached breakwater, estimated at $2,390,000, would reduce this cost to $3.69 per cubic yard.

31. SITE 3 (3 yrs.)

a. First Costs

| | |
|---|---|
| Spoil retention structure | $1,169,000 (1) |
| Mooring facilities | 31,000 |
| Spoil discharge system | 419,000 |
| Total First Cost | $1,619,000 |
| Salvage Value | - 130,000 |
| Investment less Salvage | $1,489,000 |

b. Annual Costs

| | |
|---|---|
| Interest, $1,619,000 @ .0325 | $ 53,000 |
| Amortization, 3 yrs., $1,489,000 @ .3227 | 481,000 |
| Maintenance dredging, 200,000 c.y. @ $0.55 | 110,000 |
| Operation and maintenance | 85,000 (2) |
| Total Annual Cost | $ 729,000 |
| Cost per Cubic Yard | $3.65 |

(1) Includes land acquisition cost
(2) Includes $8,000 annually for 13 years for maintenance of the stone dike, which is equivalent to $30,000 annually for 3 years ($8000 x 10.467 x .3552)

32. SITE 3 (3 Yrs.) and SITE 4 (7 Yrs.)

a. First Cost

| | | |
|---|---|---|
| Retention structure, Site 3 | $1,169,000 | (1) |
| Retention structure, Site 4 | 1,408,000 | (1) |
| Mooring facilities | 31,000 | |
| Spoil discharge system | 1,074,000 | |
| Total First Cost | $3,682,000 | |
| Salvage Value | - 112,000 | |
| Investment less Salvage | $3,570,000 | |

b. Annual Costs

| | | |
|---|---|---|
| Interest, $3,682,000 @ .0325 | $ 120,000 | |
| Amortization, 10 yrs. $3,570,000 @ .0862 | 308,000 | |
| Maintenance dredging, 200,000 c.y. @ $0.55 | 110,000 | |
| Operation and maintenance | 106,000 | (2) |
| Total Annual Cost | $ 644,000 | |
| Cost per Cubic Yard | $3.22 | |

(1) Includes land acquisition cost
(2) Includes $16,000 annually for 20 years for maintenance of stone dikes, which is equivalent to $28,000 annually for 10 years ($16000 x 14.539 x .1187)

33. SITE 4 (10 Yrs.)

a. First Costs

| | |
|---|---|
| Spoil retention structure | $2,044,000 (1) |
| Mooring facilities | 31,000 |
| Spoil discharge system | 1,059,000 |
| Total First Cost | $3,134,000 |
| Salvage value | - 112,000 |
| Investment less Salvage | $3,022,000 |

b. Annual Costs

| | |
|---|---|
| Interest, $3,134,000 @ .0325 | $ 102,000 |
| Amortization, 10 yrs., $3,022,000 @ .0862 | 260,000 |
| Maintenance dredging, 200,000 c.y. @ $0.55 | 110,000 |
| Operation and maintenance | 100,000 (2) |
| Total Annual Cost | $ 572,000 |
| Cost per Cubic Yard | $2.86 |

(1) Includes land acquisition cost
(2) Includes $8000 annually for 20 years for maintenance of the stone dike, which is equivalent to $14,000 annually for 10 years ($8000 x 14.529 x .1187)

## 34. SITE 5

### a. First Costs

| | |
|---|---|
| Spoil retention structures | $3,880,000 (1) |
| Mooring facilities | 22,000 |
| Spoil discharge system | 58,000 |
| Total First Cost | $3,960,000 |
| Interest during construction | 129,000 |
| Total Investment Cost | $4,089,000 |

### b. Annual Costs

| | |
|---|---|
| Interest, $4,089,000 @ .0325 | $ 133,000 |
| Amortization, 10 yrs., $4,089,000 @ .0862 | 352,000 |
| Maintenance dredging, 200,000 c.y. @ $0.52 | 104,000 |
| Operation and maintenance | 14,000 (2) |
| Total Annual Cost | $ 603,000 |
| Cost per Cubic Yard | $3.02 |

(1) Includes land acquisition cost
(2) Includes $600 annually for 20 years for maintenance of the stone rehabilitation to the existing timber crib wall, which is equivalent to $1,000 annually for 10 years ($600 x 14.539 x .1187).

## 35. COST COMPARISONS

A summary of costs for various sites and combinations of sites are shown below for comparison with the cost of open lake disposal of maintenance dredging material.

| Site | Capacity Cu. Yds. | Capacity Years | Cost per Cu. Yd. |
|---|---|---|---|
| open lake | - | - | $0.22 |
| 1 | 2,000,000 | 10 | 3.37 |
| 2 | 2,000,000 | 10 | 5.16 |
| 3 | 600,000 | 3 | 3.65 |
| 3 & 4 | 2,000,000 | 10 | 3.32 |
| 4 | 2,000,000 | 10 | 2.86 |
| 5 | 2,000,000 | 10 | 3.02 |

DISCUSSION

36. The considered alternate disposal sites were sized to handle the estimated future maintenance dredging spoil only, 200,000 cubic yards annually. It was assumed that future permit dredgings, estimated at 15,000 cubic yards annually, could be disposed of at the same sites if necessary. Since costs per cubic yard are being compared, this analysis is considered adequate.

37. The least costly alternative to open lake disposal at Huron Harbor would be to use Site 4, a landfill site east of the City, adjacent to Old Woman Creek, for the entire 10-year period. The dredgings would be pumped from a mooring facility located in the Harbor, through a pipeline, to the site. State officials and property owners were not contacted regarding the availability of the site.

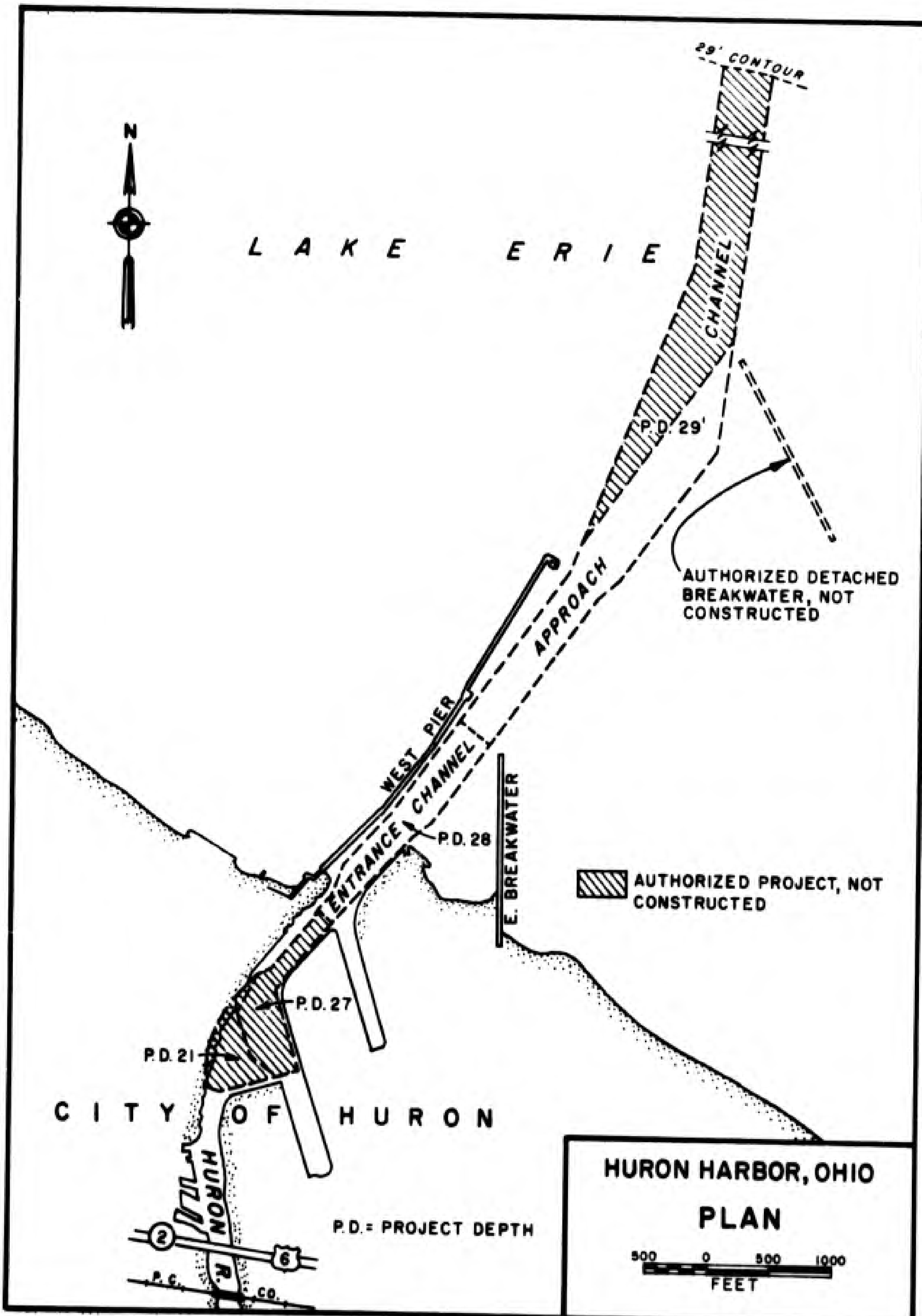

29' CONTOUR
N
LAKE ERIE
CHANNEL
P.D. 29'
AUTHORIZED DETACHED BREAKWATER, NOT CONSTRUCTED
APPROACH
WEST PIER
ENTRANCE CHANNEL
P.D. 28
E. BREAKWATER
AUTHORIZED PROJECT, NOT CONSTRUCTED
P.D. 27
P.D. 21
CITY OF HURON
HURON R.
2
6
P.C. CO.
P.D. = PROJECT DEPTH
HURON HARBOR, OHIO
PLAN
500 0 500 1000
FEET

FIG. KII-1

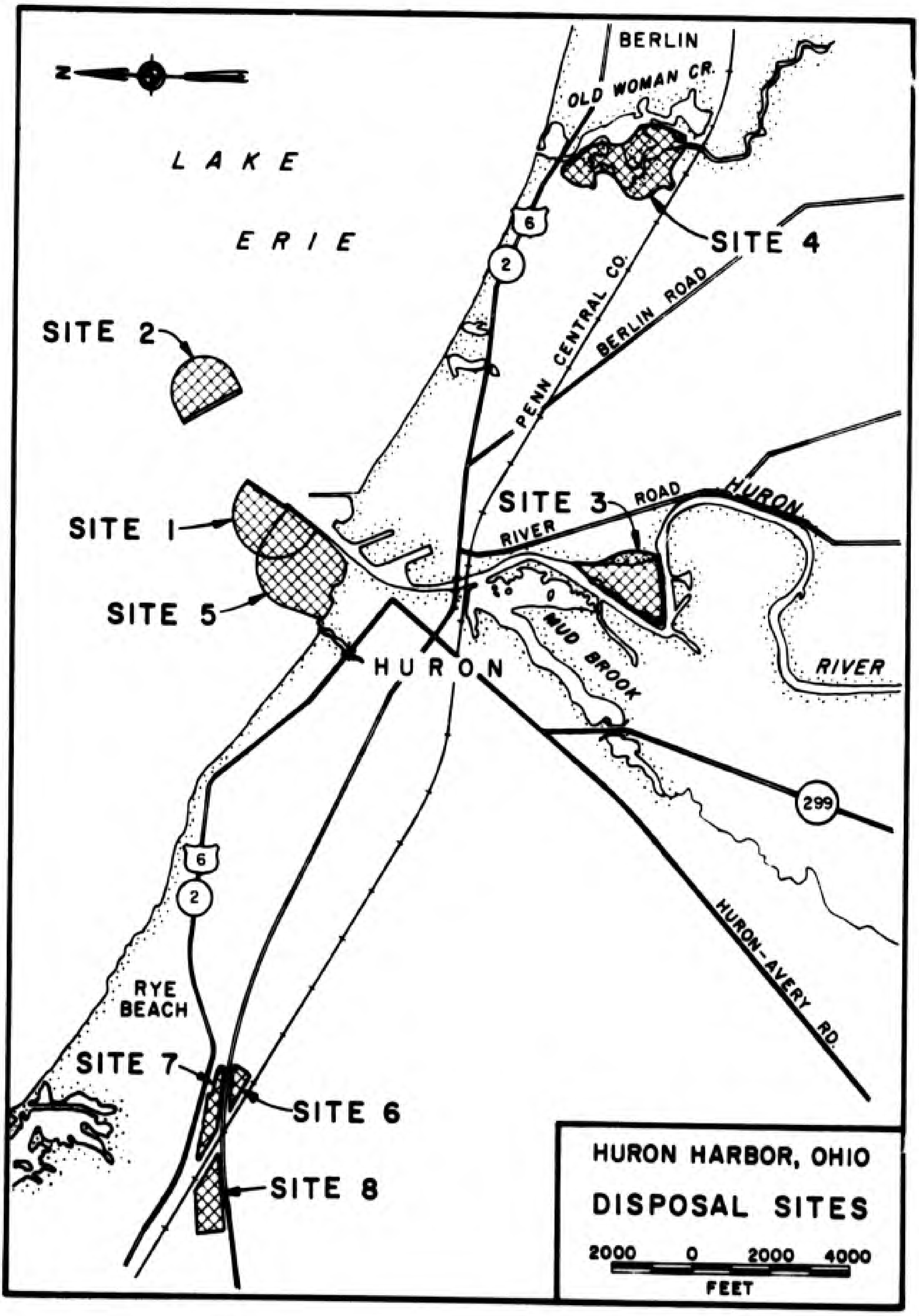

BERLIN
OLD WOMAN CR.
LAKE
ERIE
SITE 4
PENN CENTRAL CO.
BERLIN ROAD
SITE 2
SITE 1
SITE 3
ROAD
RIVER
HURON
SITE 5
MUD BROOK
HURON
RIVER
299
HURON-AVERY RD.
RYE
BEACH
SITE 7
SITE 6
SITE 8
6
2
HURON HARBOR, OHIO
DISPOSAL SITES
2000 0 2000 4000
FEET

FIG. K11-2

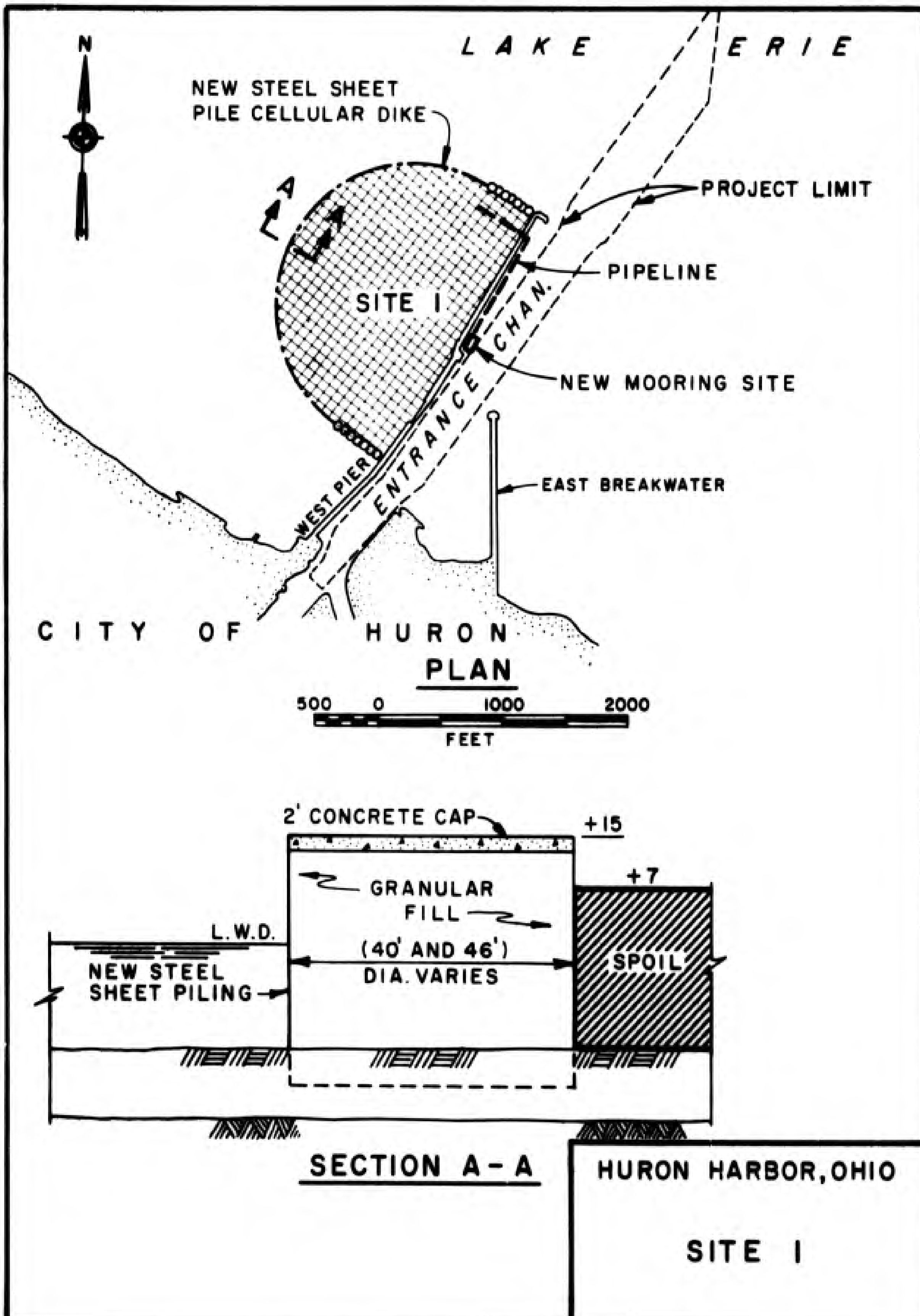
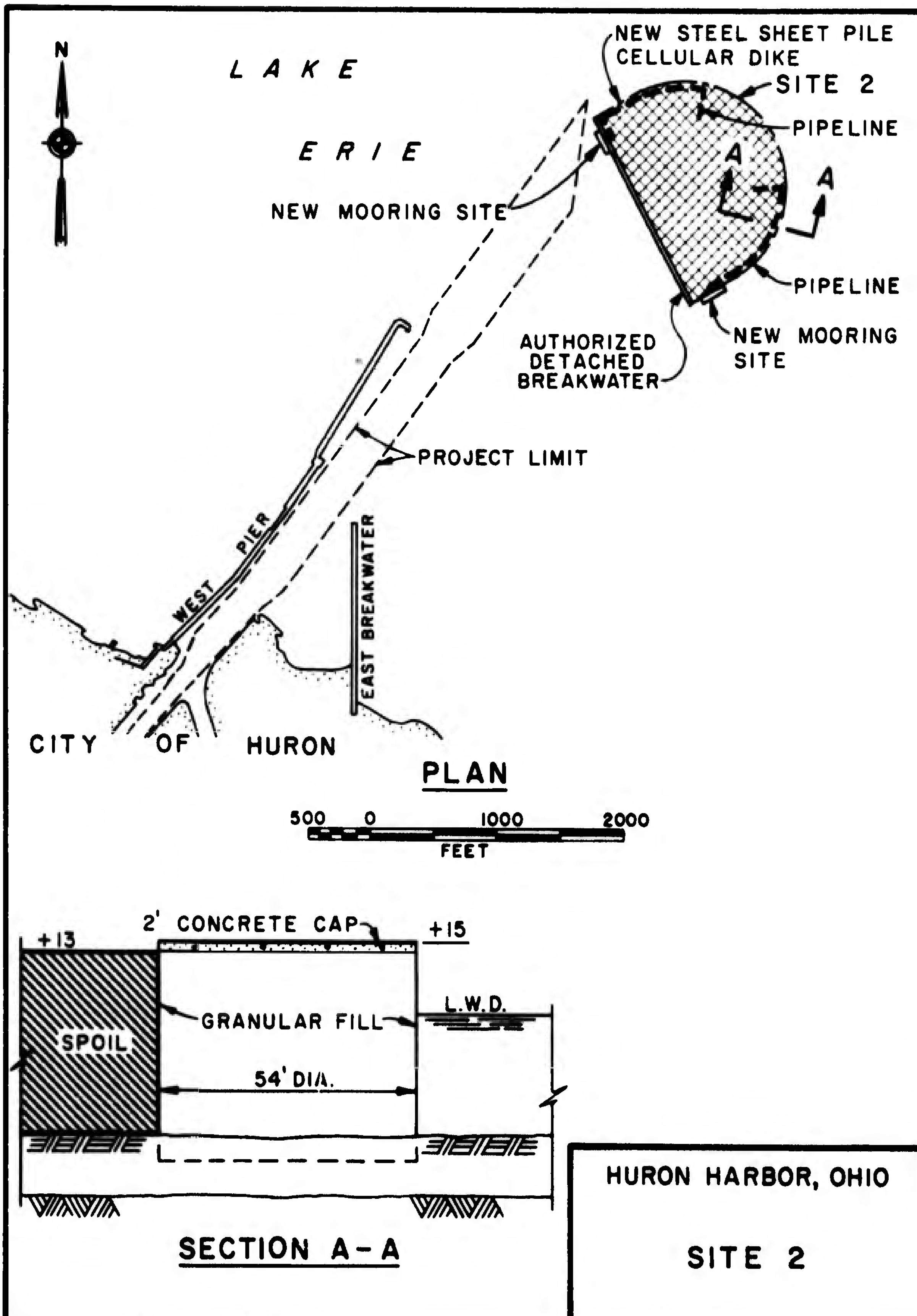

N
LAKE ERIE
NEW STEEL SHEET PILE CELLULAR DIKE
A
PROJECT LIMIT
PIPELINE
SITE I
ENTRANCE CHAN.
NEW MOORING SITE
WEST PIER
EAST BREAKWATER
CITY OF HURON
PLAN
500 0 1000 2000
FEET
2' CONCRETE CAP
+15
+7
GRANULAR FILL
L.W.D.
NEW STEEL SHEET PILING
(40' AND 46') DIA. VARIES
SPOIL
SECTION A - A
HURON HARBOR, OHIO
SITE I

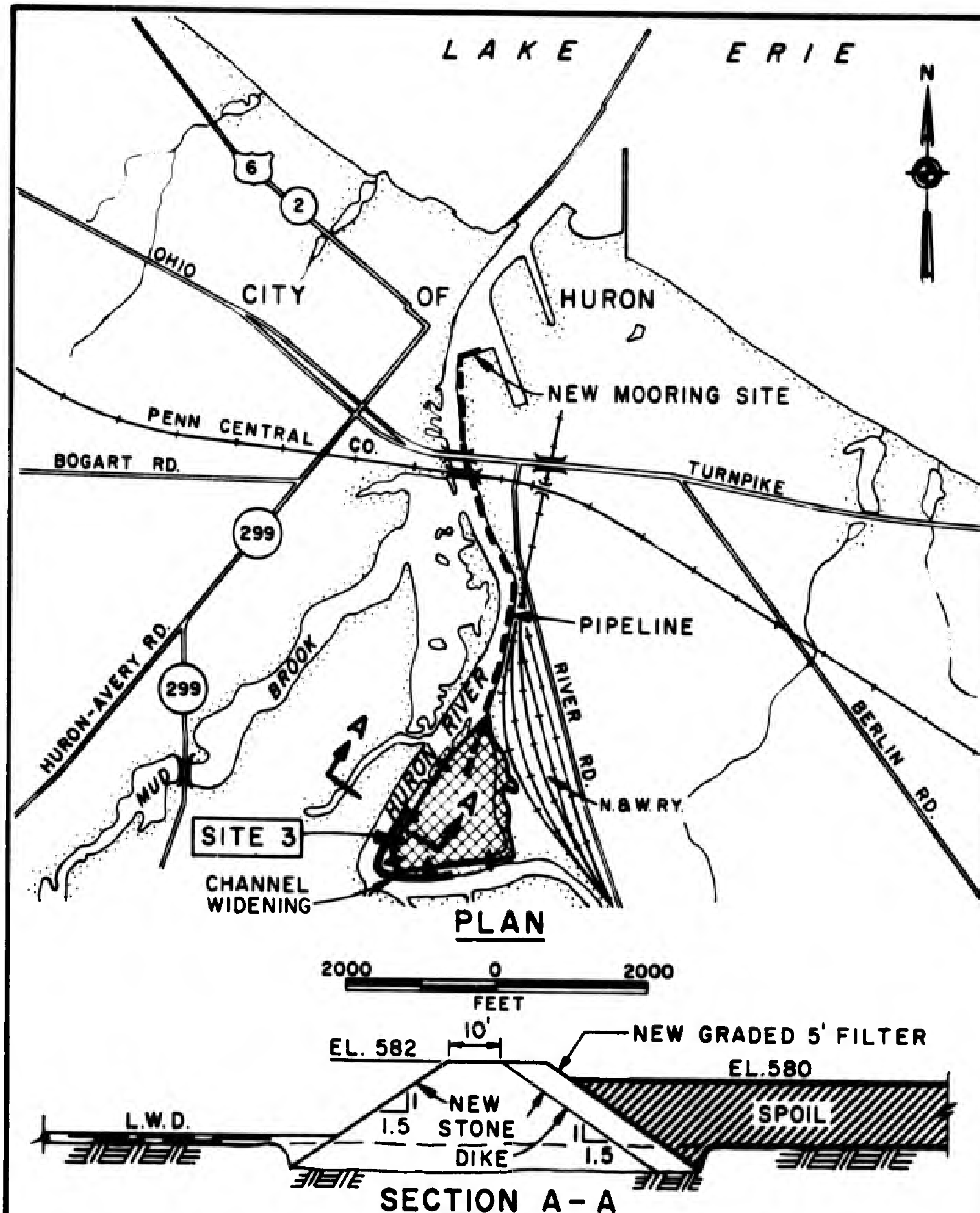
FIG. KII-3




HURON HARBOR, OHIO

SITE 2

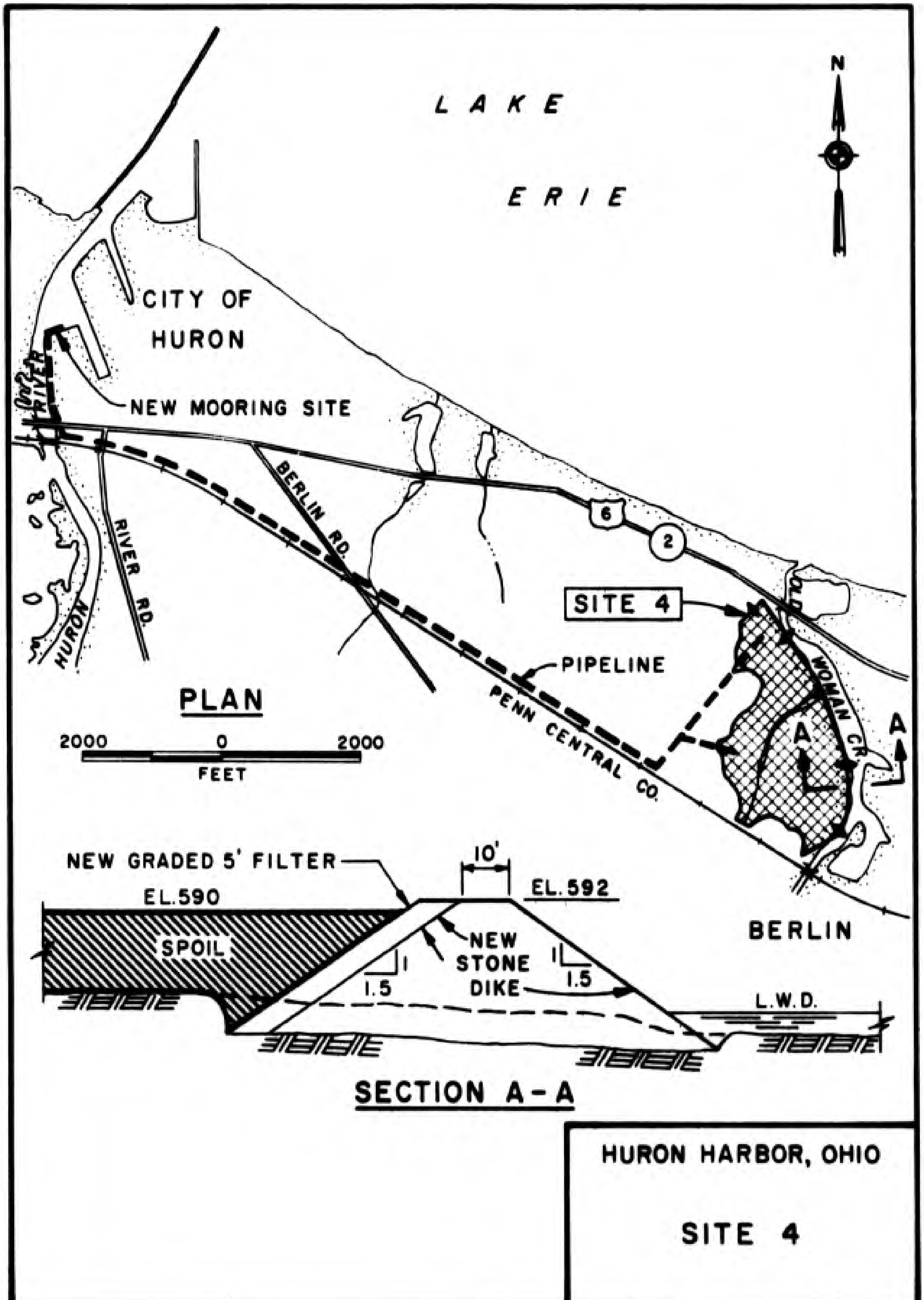
FIG. KII-4




HURON HARBOR, OHIO

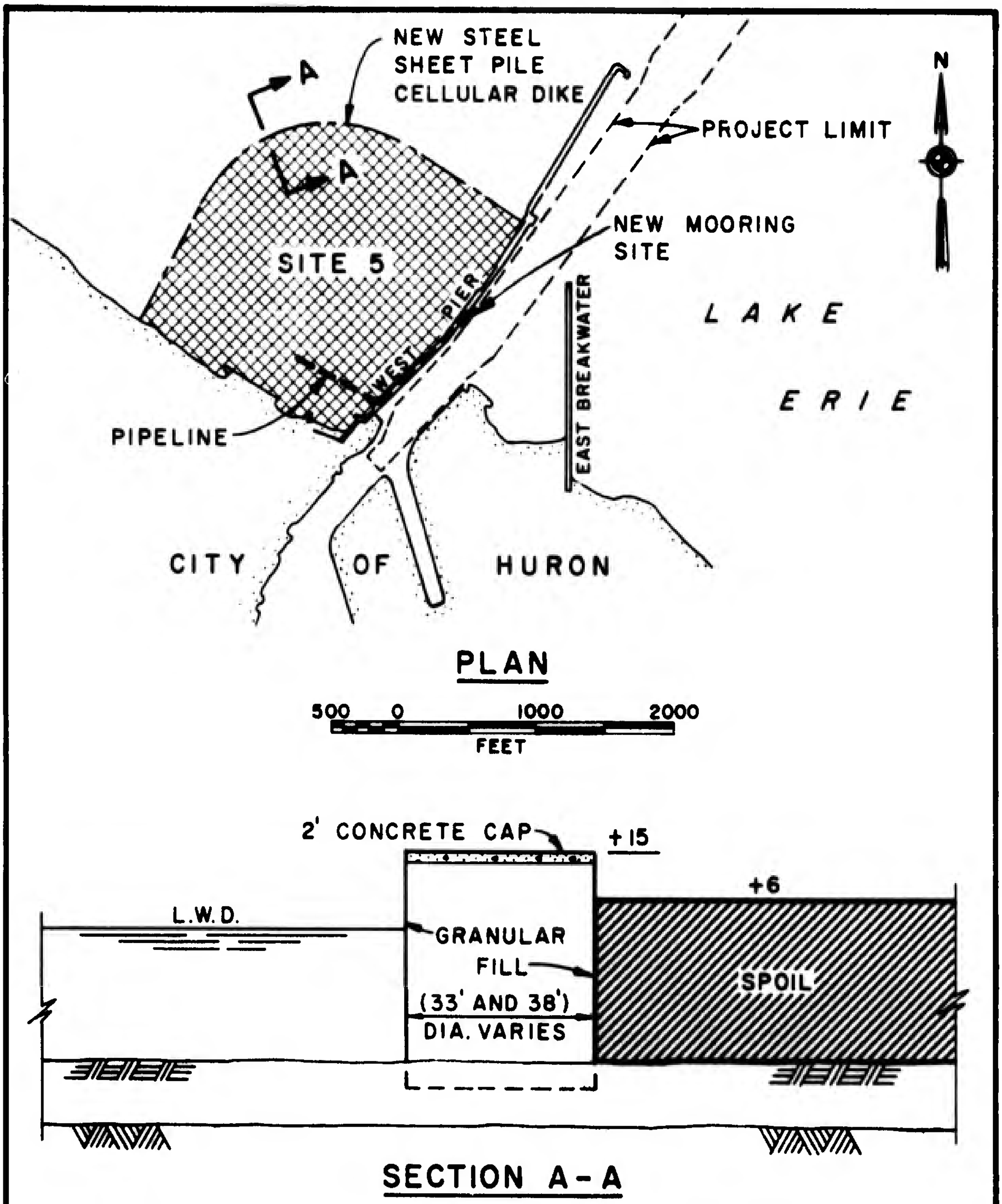
SITE 3

FIG. KII-5



LAKE
ERIE
N
CITY OF HURON
NEW MOORING SITE
RIVER
HURON
RIVER RD.
BERLIN RD.
6
2
SITE 4
OLD WOMAN CR.
PIPELINE
PENN CENTRAL CO.
A
A
BERLIN
PLAN
2000
0
2000
FEET
NEW GRADED 5' FILTER
10'
EL.590
EL.592
SPOIL
NEW STONE DIKE
1
1.5
1
1.5
L.W.D.
SECTION A-A
HURON HARBOR, OHIO
SITE 4


FIG. K11-6




HURON HARBOR, OHIO

SITE 5

FIG. KII-7