18257

MICHIGAN
OCZM GRANT #04-8-M01-334
Subtask 2D

MARINA AND PARK DEVELOPMENT STUDY

VILLAGE OF ELK RAPIDS
ANTRIM COUNTY, MICHIGAN

AUGUST, 1980

SB
483
.A5
M37
1980

PREIN & NEWHOF, P.C.
ENGINEERS-PLANNERS
3000 East Beltline, N.E.
Grand Rapids, Michigan 49505
Project No. 79058

Michigan, Department of Natural Resources

18257

Michigan, Department of Natural Resources
SB453.A5 M5 1980

VILLAGE OF ELK RAPIDS
ANTRIM COUNTY, MICHIGAN

MARINA AND PARK DEVELOPMENT STUDY

AUGUST, 1980

Financial Assistance for this Study has been provided by the Coastal Zone Management Act of 1972 administered by the Office of Coastal Zone Management, National Oceanic and Atmospheric Administration and the Michigan Coastal Management Program, administered by the Department of Natural Resources, Division of Land Resource Programs.

PREIN & NEWHOF, P.C.
Engineers - Planners
Grand Rapids, Michigan

TABLE OF CONTENTS

	Page
INTRODUCTION	1
• Purpose of Report	
• Scope of Study	
SITE DESCRIPTION	3
• General	
• Marina	
• Subsurface Conditions	
• Wave Conditions	
DEVELOPMENT	8
• Park and Waterfront Master Plan	
• Marina Master Plan	
ECONOMICS	16
APPENDICES	19

ILLUSTRATIONS

Location Map	3
Vicinity Plan	4
Wind Rose	7
Shoreline Conditions	9

INTRODUCTION

- PURPOSE OF REPORT

This report is the result of an engineering study which was made to determine the feasibility of expanding the existing marina, re-evaluate Preliminary Engineering Studies done in 1971 and 1976, and provide comprehensive planning of the Village property adjacent to the marina.

- SCOPE OF STUDY

The following objectives were set by the Village of Elk Rapids in accordance with the Michigan Department of Natural Resources, Waterways Commission and Coastal Zone Management Program:

1. Prepare project base maps from aerial photography and field surveys complete with ground contours. Topography identification and supplementary elevations. Maps shall be large scale and include enough of the surrounding area to relate the proposed construction with the immediate environment.
2. Review existing information and previous studies and evaluate with respect to present demands for moorage, current Waterways Commission requirements and construction standards.
3. Establish marina area layout including dockage, launching ramps, parking, utilities and restroom facilities.
4. Study alternate layouts of the marina basin to accomodate maximum number of boats, various boat sizes, service pier location and launching ramp location for evaluation by the Village and the Staff of the Department of Natural Resources, Waterways Commission.
5. Study and compare alternate types of pier construction.
6. Perform additional soundings and soil borings so that accurate volumes of excavation may be determined together with an evaluation of appropriate methods of excavation and disposal of the dredged materials.

7. Prepare cost estimates of the project for budget purposes.

8. Prepare a multi-colored rendering of the project plan for the Village.

9. Prepare a report summarizing findings of the study.

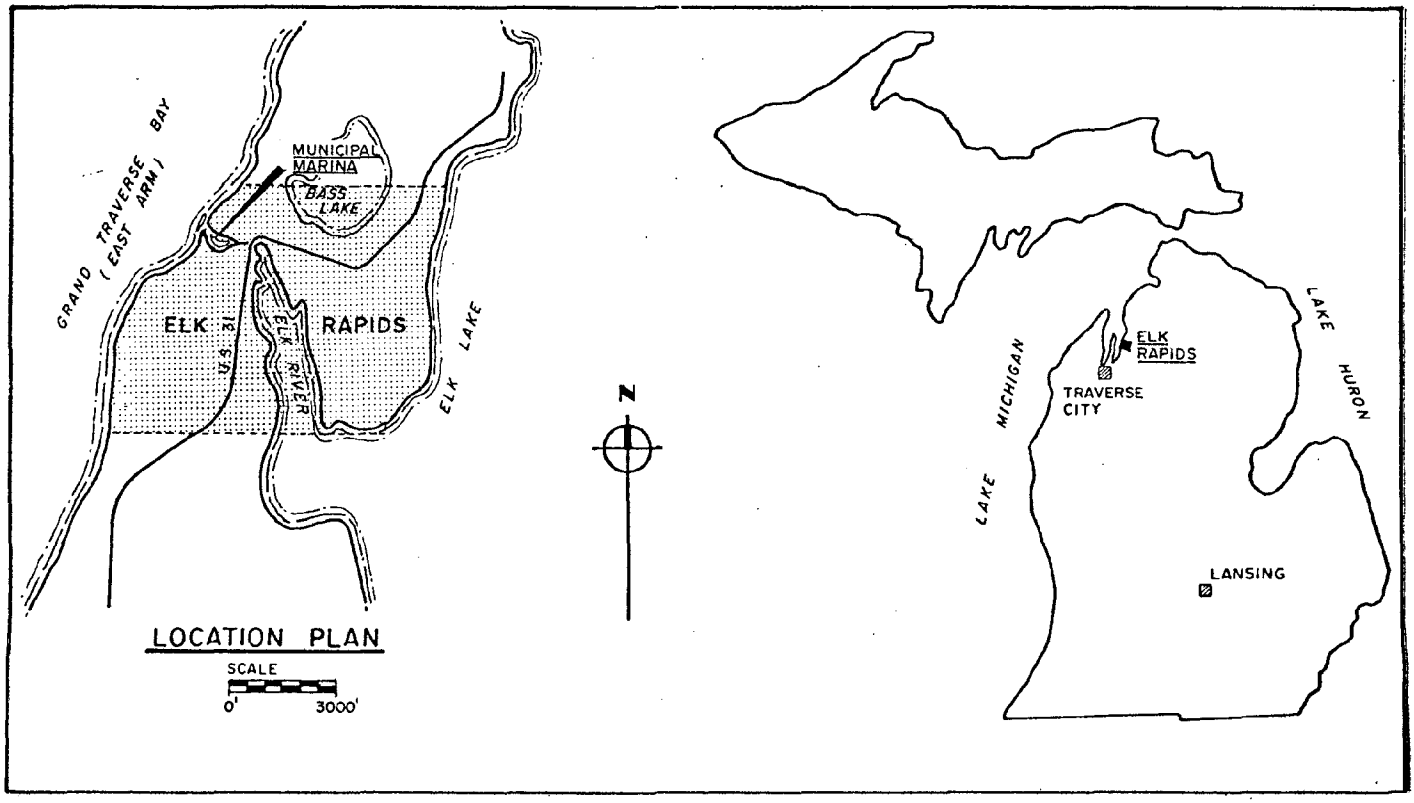
SITE DESCRIPTION

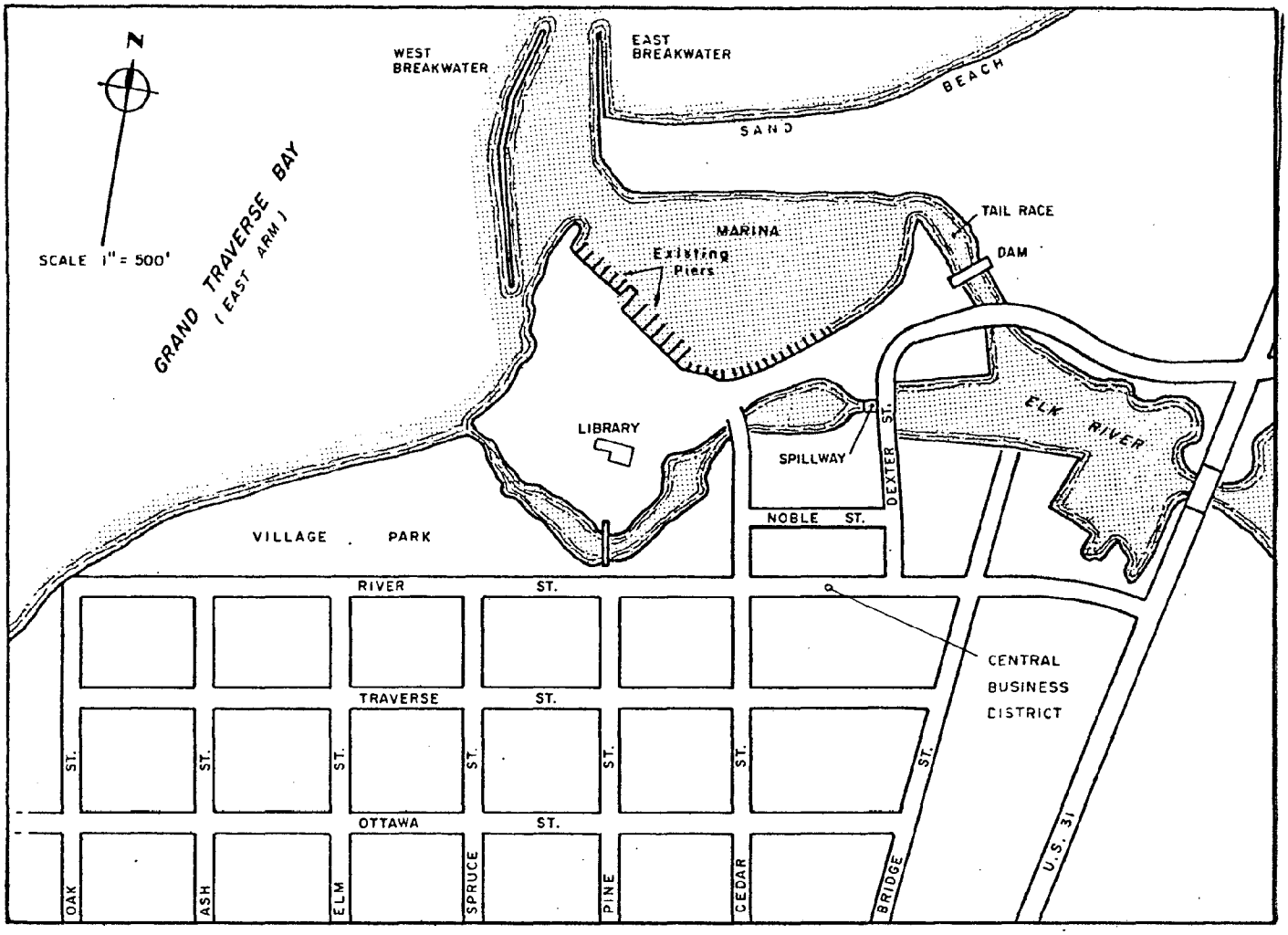
- GENERAL

Elk Rapids is located on the East Shoreline of the East Arm of Grand Traverse Bay in Antrim County, approximately 18 miles northeast of Traverse City. Situated on the Elk River between Elk Lake and Grand Traverse Bay, the waterfrontage offers outstanding opportunities for recreational uses and economic vitality for the Village. The Village maintains a Park, Marina and Village Library on the property between River Street and the Bay, with approximately 3000 feet of Grand Traverse Bay waterfront.

The Village Park Area contains tennis courts, shuffleboard courts, basketball practice courts and a picnic area with some playground equipment. Parking for approximately 40 cars is along River Street. The two existing buildings in the Park house the pumps and controls for the Village water system. The sandy beach is very narrow but fairly protected to the north and south and popular with Village residents for swimming.

LOCATION MAP





VICINITY MAP

The Spillway Channel creates an island where the Village Library and Marina are located. Access to the island is from Cedar or Dexter Street or across the pedestrian bridge from River Street. The Dam and adjacent properties were given to Antrim County by Consumer's Power Company in 1964 and subsequently leased to the Village. The Tail Race below the dam is a popular fishing site and is presently being developed as a public fishing site by Antrim County.

Adjacent to the Village property is the central business district of the Village. Easily acessible from the Marina and Park boaters may shop for goods and services provided by Village merchants. Also located on the Elk River above the dam are several private Marinas with commercial sales which are available to provide service and repairs for boaters in the Municipal Marina below the dam.

- MARINA

The existing Village Marina is located on the mouth of the Elk River below the dam. The original six piers and launching ramp were constructed in 1964 in cooperation with the Michigan State Waterways Commission, Department of Natural Resources and both water and electric service are provided to each slip. Since that time the Village has installed 22 piers of light construction in an attempt to meet the growing demand for mooring space.

The marina basin was formed by construction of a rubble mound breakwater extending west-southwest from the east shore of the tail race. Later the east and west channel breakwaters were constructed to provide entrance protection and additional harbor protection. Construction of the breakwaters out into the Bay has interrupted the littoral drift along the shoreline causing the formation of the sandy beach along the east breakwater and the related deficiency of sand and sediments to the southwest along the Park.

Dredging of the entrance channel and southwest side of the Marina Basin was accomplished in 1964 in conjunction with the original Marina project. The eastern 2/3 of the basin has not been dredged and is navigable only during high lake level conditions. This area is used for open mooring when lake level permit.

- SUBSURFACE CONDITIONS

Soil borings performed by Prein & Newhof, P.C. in June, 1980 were analyzed in conjunction with the boring logs contained in the 1964 Marina Construction Plans as performed by Material Testing Consultants, Inc. in February, 1964. The locations of the five (5) soil borings by Prein & Newhof, P.C., were determined as a result of a preliminary investigation by hand borings.

All borings indicate that the site is underlain by an extensive stiff to hard clay stratum. The depth of the top of this stratum varies as shown on borings 2 through 5 depending on past shoreline and river channel locations. The present river bottom within the Marina basin shows no evidence of sedimentation and all excavation within the harbor will be composed of the hard grey clay mentioned above.

Laboratory analysis of the clay samples recovered indicate that the material is an inorganic, silty clay of low to medium plasticity. (Unified soil classification system - CL) The overconsolidated condition of the stratum is probably due to glacial action. The undrained-unconfined shear strength of the soil was found to be approximately 6.1 K.S.F. and the liquid limit to be 30.

Conversations with persons involved with the dredging accomplished in 1964 indicate that the silty clay bottom of the marina basin is very difficult to excavate using normal marine dredging methods. The original Marina dredging was done with a drag-line crane. It was found to be necessary to scarify the bottom before any significant excavation could be accomplished. Although various techniques were tried, none were found to be very successful at that time. Alternate methods of accomplishing the proposed dredging will be discussed later in this report as it relates to the overall development plan and budget.

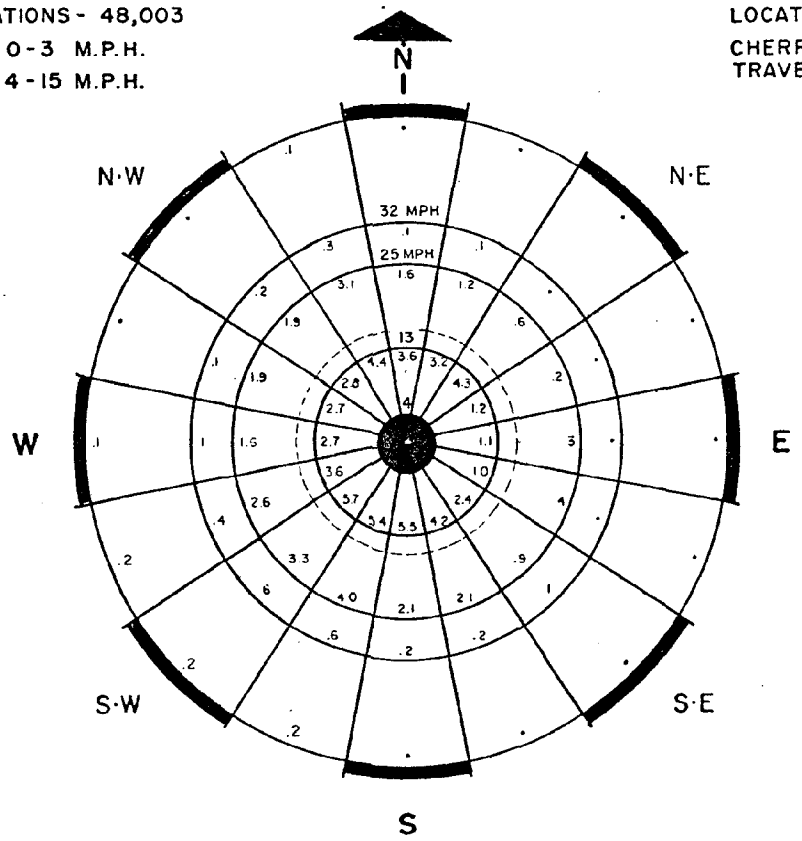
- WAVE CONDITIONS

In order to determine the requirements of any proposed shoreline protection or upgrading of the breakwaters, a wave analysis, based on U.S. Army Coastal Engineering Center methods was performed. Effective fetch distances were calculated and related to wind records as recorded at the Traverse City, Cherry Capitol Airport. This analysis indicates storms from the west-southwest direction may generate waves in the 3 to 4 foot height range and northerly storms may generate waves in the height range of 4 to 6 feet depending on duration times.

During periods of high lake levels the southern end of the west breakwater is nearly submerged, affording marginal protection during southwest storms. Upgrading of the southern 375 feet of this breakwater with an additional layer of heavy stone to elevation 583.0 (I.G.L.D.) minimum is recommended.

NUMBER OF OBSERVATIONS - 48,003
Δ = 14.6% CALMS 0-3 M.P.H.
58.4 % 4-15 M.P.H.

LOCATION :
CHERRY CAPITAL AIRPORT
TRAVERSE CITY , MICHIGAN



WIND ROSE

- PARK AND WATERFRONT MASTER PLAN

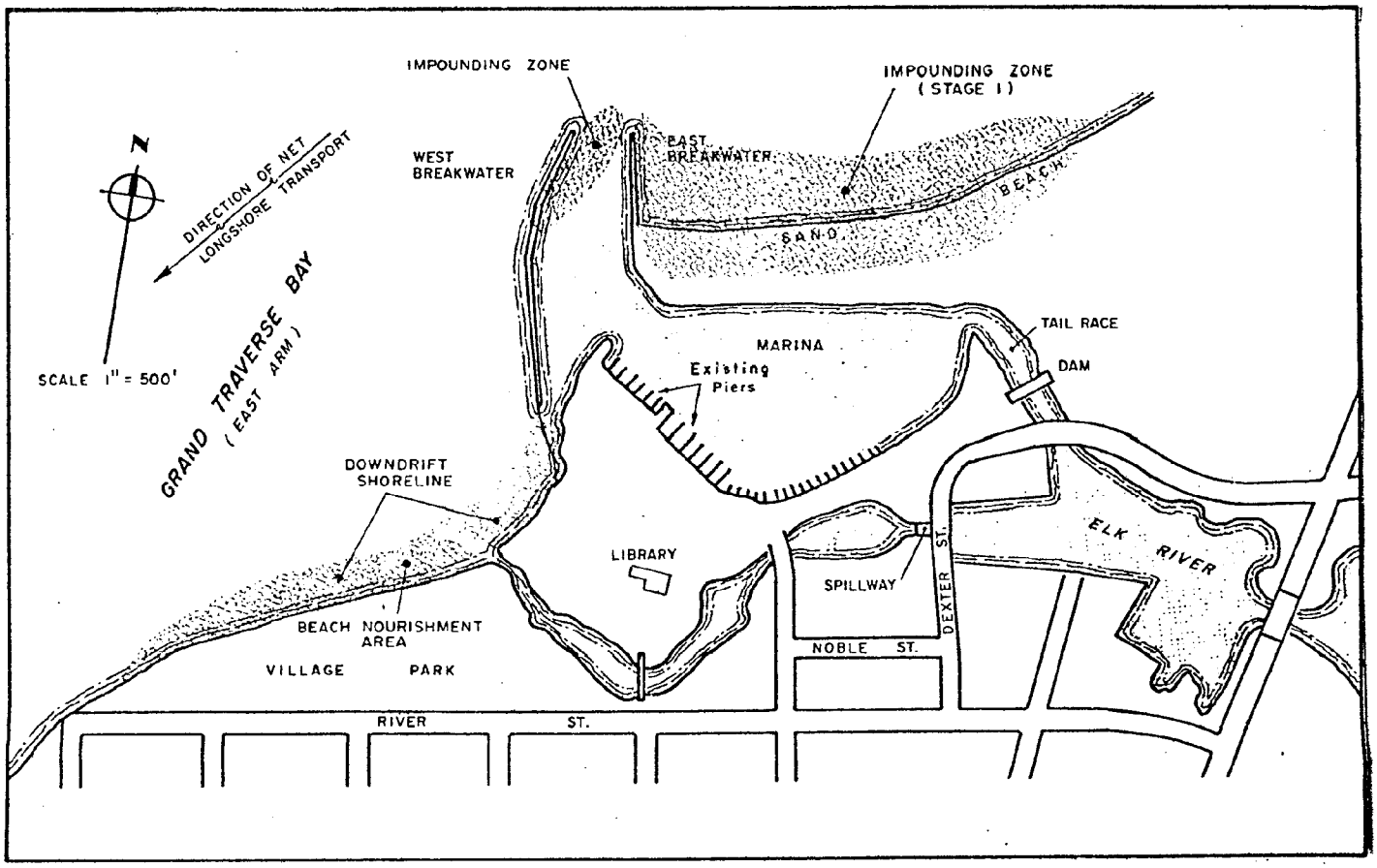
Several meetings with Village Representatives and concerned groups of citizens were held in order to obtain input and planning criteria for the Park and Waterfront Area.

The Proposed Development of the waterfront area attempts to integrate the existing Village Park with the island and spillway channel area by the use of walks and pedestrian bridges. The past nature of the Park has been primarily oriented towards Village residents' needs and usage. Since a fully developed County Park is available less than one mile to the south, no effort has been made to alter the nature of the Park. Instead the proposed development has been related to Village needs, with anticipated usage primarily by Village residents.

The western end of the Park has been left undeveloped except for minor upgrading of the existing parking areas. This end of the Park with its uneven terrain and heavy growth of evergreens acts as a natural buffer to the residentially developed shoreline to the south.

The picnic area and beach occupy the central portion of the Park. A picnic shelter with restrooms and changing facilities has been located so that the view of the bay through the Park is not significantly obstructed. Additional playground equipment is recommended to supplement the existing slide and swings in the playground area. Upgrading of the two original tennis courts by aligning them with the new courts and building the new surface at the same grade as the new courts will allow filling of the existing drainage swale to the beach. This will give the area a more uniform grade and level open play area between the beach and picnic grounds.

A beach nourishment program to rebuild the shoreline along the Park is recommended to replenish the beach and offset the effects of the Harbor breakwaters. The east and west breakwaters constitute a barrier to the natural longshore littoral transport and create impounding zones along the east breakwater and the channel entrance. The acretion along the east breakwater (stage 1 impounding zone) is clearly evident by comparison of 1964 aerial photographs with present conditions. In 1964 there was no sand beach along the east breakwater. Since that time littoral deposition has formed a sand beach approximately 250 feet wide with a corresponding depletion of the downdrift shoreline along the park. Periodic by-passing of sand from the breakwater area to the beach area would accomplish the artificial nourishment of the beach as well as reducing the effect of the impounding zone at the channel entrance. Based upon past conditions, renourishing the beach in this maner should be done every 5 to 7 years depending on the level of Lake Michigan and the severity of winter storms which are predominately from the northwest.



SHORELINE CONDITIONS

The low area between River Street and the spillway channel, just west of the footbridge, is protected from severe weather and has been shown with small special use areas for plantings and flower gardens by local civic groups. Sitting areas here and at various locations along the spillway channel have been planned to allow pedestrians a full appreciation of the serene atmosphere of the area. The additional pedestrian footbridge connecting the park with the west end of the island is optional. The need for this bridge in the future will depend on future demand and the extent of the development on pedestrian walks in the area.

The spillway at Dexter Street is in a state of disrepair. Because of its historical significance in the area, an allowance has been made in the project budget for structural repairs rather than replacement or removal. Stablization of the channel banks downstream has been planned to prevent erosion and to define the channel banks. Placement of stone rip rap along the south bank should be planned as soon as possible since the channel current is causing rapid erosion and endangering the existing plantings and shrubery along the bank.

An additional public restroom building has been located between the spillway and the Village parking lot to accomodate the anticipated increased use of this end of the Village property by the public. This area is quite low and the proposed building would be constructed on fill to facilitate connection to Village Utilities.

Additional landscaping and plantings have been planned to enhance the area aesthetically without interrupting the spectacular view of the bay. Low level planting groups have been used as buffers between specific use areas and between the park and River Street. The pedestrian paths through the park and along the channel have been planned as stone or gravel for easier maintenance and to preserve the natural setting.

- MARINA MASTER PLAN

Development of the existing Marina to a 170 slip full service Marina as shown on the Master Plan entails dredging, upgrading of the west breakwater, slope protection, launching ramp, parking for cars and car-trailer combinations and a new service building with restrooms and a harbor masters office. A new service pier with attendant's shelter, sanitary pump-out service and gasoline and diesel fuel sales has been planned. Also space has been reserved for a boat hoist well and an off-season storage and repair area. Landscaped areas will be used as buffers where appropriate and to integrate the Marina area with the adjoining park, library and public fishing areas. The parking area near the dam will be available for overflow parking for people fishing in the tail race of the dam since the fishing season generally follows the boating season.

The major barrier to expansion of the Marina Facilities in the past has been lack of navigable area within the basin. Due to the nature of the material to be dredged and the difficulties experienced in past dredging projects in the harbor, the proposed dredging work has been extensively investigated. Based upon the soils investigation performed and discussions with persons involved with the original dredging, it is assumed the excavation will be done by means of a bargemounted hydraulic backhoe. The expense involved in this type of operation is reflected in the cost of excavation as shown in the Development Cost Section of this report.

Another possible method of excavating the Marina Basin would involve the placing of temporary cofferdams at the narrowest points upstream and downstream from the area to be excavated and dewatering the entire basin. The volume of water passing through the dam would necessitate construction of a temporary channel through the east breakwater and sand beach. Although the majority of the savings from excavation costs would be offset by the cost of the temporary spillway and cofferdams,

overall construction costs should be lower for any piers and slope protection built in the dry conditions. This alternative appears economically viable on a preliminary basis, however, applicable permits from State and Federal Agencies would be required. The possibility of using a hydraulic dredge with a cutter head was eliminated due to the cost of the necessary disposal area requirements.

As shown on the Master Plan, a small portion of the Marina basin would be filled in so that the proposed service building may be centrally located. Fill would also be placed along the bay shoreline to the west to rebuild the shoreline. Erosion has occurred in this area due to the construction of the breakwaters which have obstructed the natural littoral drift. The proposed fill will reconnect the west breakwater with shore and riprap shore protection would be placed to prevent future shoreline depletion. Also the west breakwater should be upgraded to afford wave protection from the southwest during high water conditions.

Although the rip rap slope protection has been shown extending south from the west breakwater to the spillway channel, the southern 100 feet will not be constructed higher than existing grade. This area will be preserved as a natural area for waterfowl nesting.

Disposal of dredged material not used for on site fill will be on Village owned properties. Specific sites will need to be evaluated during the project design phase.

In cooporation with the Michigan State Waterways Commission, construction of a new four-lane launching ramp is anticipated in 1981. Ramp and skid pier design will be in accordance with Michigan Waterways Commission Standards. Pull-through parking for 62 car/trailer combinations has been provided with space for overflow parking along the shoreline to the west. Although pull-through parking has been

shown on the Master Plan, conventional 45 degree parking spaces minimize the problem of backing out and would allow a greater number of parking spaces with additional planting areas to break up the expansive look of the parking lot.

Determination of the recommended pier layout within the Marina basin has been based upon comparative analysis and review of various layout schemes. Present design criteria recommends allocation of 10% of the available mooring space for 45-60 foot boats; 40% for 30-45 foot boats and 50% for boats up to 30 feet in length. Following this criteria, optimum utilization of the available mooring area was achieved with the following combination of slips.

Slip Size	Number of Slips	Percentage of Total
up to 30 feet	85	50%
30 to 45 feet	68	40%
45 to 60 feet	17*	10%
TOTAL	170	100%

* Includes service slip

The recommended type of dock construction for the Marina has been investigated with respect to the following criteria:

1. Initial cost of fabrication and installation.
2. Durability and life expectancy.
3. Ice conditions within the Marina basin.
4. Local preference.
5. Expansion capabilities for phased construction.

Based on comparison of the various types of dockage available it is recommended that docks be pile supported with wood decking over heavy steel framing. All support and spring piles would be designed to resist ice and mooring loads. Preliminary analysis indicates that piles with a total length of 40 feet will develop the necessary resistance to lateral movement and ice uplift. Floating Pier Systems of U.S. Manfacture have not been found to be acceptable in locations such as Elk

Rapids where moving ice conditions exist, and removal from the water each fall is required. It is recommended however that a re-evaluation of the type of dock construction be made at the time of project design due to the variation of material costs and types of system available.

All piling subject to heavy icing conditions should be protected by a compressed air deicing system, as a precaution against uplift due to sieche action.

The proposed service pier has been located near the launching ramp to facilitate collection of ramp fees by the service pier attendant. Master Controls for the fuel pumps and sanitary pumpout unit will be located in the attendants shelter on the service pier as well as a radio/telephone communications base and controls for new harbor entrance lights. Space for a future boat hoist well has been reserved between the service pier and the launching ramp.

The six finger piers built in 1964 have since been extended by the Village in order to double berth smaller boats on each side. In order to conform to accepted slip widths and lengths, it is recommended that these piers be cut back to the original length of 56 feet.

The existing Marina office does not contain adequate restroom facilities for the size of the Marina proposed and rather than expanding and remodeling the existing building, a new service building is recommended. The proposed service building will contain a small harbormaster's office, men's and women's restrooms and a mechanical room with a storage area for supplies. Each restroom would have three showers, five lavatories, and five toilets in accordance with regulations of the Michigan Department of Health. Also the building must conform to barrier free standards for handicapped persons. The central location of the building reduces the distance to the slips as much as possible and also affords a measure of control

to discourage unauthorized persons from going out on the central head piers for malicious reasons.

Utilities on the site would be upgraded to accomodate the increased size of facility. Each slip would be provided with water and electric service along the main pier or perimeter walk together with low level lighting for nighttime security.

Parking for 73 cars has been provided along the southeast and southwest side of the Marina basin. Although this is less than normally provided, arrangements with the Village for partial use of the Village owned parking lot directly across the spillway channel are possible to alleviate excess parking demands. One way traffic flow has been used in the parking areas to avoid congestion and provide for better traffic flow for car-trailer units. Security lighting in the parking lots must be designed to cast light down rather than out to avoid problems with glare for boaters on the bay and entrance channel. Access to the site by automobile has been limited to Cedar Street for reasons of traffic control. The existing 30 inch diameter culverts should be extended to allow walks four feet wide on each side of the entrance drive. Concrete headwalls have been planned to prevent settlement between the culvert pipes.

- ECONOMICS

The large initial cost of the Harbor and Waterfront Development requires the involvement of public funds for financial feasibility. Due to the funding qualifications and limitations of the various agencies available, phasing of the Marina Construction may be necessary. Specific construction phases should be determined after an initial survey of funding sources has been done in order to ascertain financial feasibility for each phase of the construction.

The following listing of possible funding sources is intended as a guide for initial contact regarding specific programs applicable to the Elk Rapids Project supplemental to Village funds.

Federal - U.S. Army Corps of Engineers

- Land and Water Conservation Fund (Administered by the Michigan Department of Natural Resources)
- Coastal Zone Management Program
- Economic Development Administration
- Farmers Home Administration
- U.S. Soil Conservation Service

State - Michigan Department of Natural Resources - Waterways Commission

- Upper Great Lakes Regional Commission

A meeting with representatives of the various agencies is recommended to discuss the feasibility and implementation of a funding program for the proposed development.

The following costs reflect current construction cost data for 1980. These costs have been increased by 20% to account for contingencies and engineering fees. The costs shown must be appropriately increased, to allow for inflation, for valid construction costs in years other than 1980.

- Park Development

Shelter Building with restrooms and changing area	$ 102,000
Restroom Building	$ 60,000
Tennis Court improvements	$ 31,000
Playground Equipment	$ 18,000
Parking Area improvements	$ 18,000
Footbridge, walks, benches	$ 46,000
Landscaping	$ 48,000
Channel bank stabilization	$ 72,000
Spillway reconditioning	$ 60,000
Sand Bypassing	$ 48,000
TOTAL	$ 503,000

- Marina Development

Dredging	$ 543,000
Earthwork and grading	$ 72,000
Slope protection	$ 245,000
West breakwater improvements	$ 63,000
Launching Ramp	$ 53,000
Dockage	$1,480,000
Service building	$ 180,000
Service pier	$ 59,000
Drives and parking areas	$ 173,000
Utilities	$ 243,000
Landscaping	$ 36,000
TOTAL	$3,183,000

- DEMAND ANALYSIS

Elk Rapids has developed into the major recreational center of the surrounding area as the Village provides the only harbor on the east arm of Grand Traverse Bay. The need for expansion of the existing marina facilities has been shown in previous harbor studies. In addition, the personnel of the Michigan State Waterways Commission prepared a report in 1976 which favorably evaluated the economic impact that expansion of the marina would have on the Village of Elk Rapids.

Population growth and the recent development of the Grand Traverse Hilton complex with approximately 800 new homes and condominiums is causing increased demand for mooring space and the present waiting list for slips in the village marina is extensive. A marina of the size and quality proposed would have little difficulty in obtaining renters for the available seasonal slips.

Aside from the economic factors, there is also a need for better harbor conditions at Elk Rapids as there are no other places on the East Arm where boaters may take refuge during storms. Again the lack of navigable space within the harbor poses additional safety considerations for the boats that seek refuge in the harbor.

TECHNICAL APPENDICES

- Appendix A — Design Criteria — 20 - 21
- Appendix B — Alternate Designs — 22 - 23
- Appendix C — Itemized Marina Cost Summary — 24 - 25
- Appendix D — Soil Boring Logs — 26 - 27

- Drawings

  Existing Site Plan

  Waterfront Development Plan

  Existing Marina Plan

  Marina Master Plan

APPENDIX A Design Criteria

Although this study does not include project design, certain features of the project must be assumed for the purpose of more accurately determining the project cost. The purpose in stating these criteria at this time is for general information and also to form a basis for the project design at a future time.

- MARINA
  - All pier construction is of steel supporting members with 2" x 6" wood decking and 6" x 6" wood fenders. The head piers are 10 feet wide and the finger piers 3 feet wide. All wood decking and fenders are to be pressure preservative treated with a waterborne preservative. (CCA) Design live load for both finger and head piers is 100 psf.
  - Support for the piers is by 12" diameter heavy wall (0.250") steel pipe piles 15' ± on center. Piles may be driven open ended and the top portion filled with concrete or stone. Piling lengths of 40 feet are anticipated based upon 500 psf soil friction and ice uplift loads of 45,000 lbs. (24" ice)
  - Spring piles are 8 x 36 steel H-piling 40 feet long. H-piles have been used to facilitate attachment of wood fenders.
  - Heavy rip rap shore protection consists of 6" granular filter material, plastic filter cloth, 8" of 4" - 6" mattress stone and 12" of heavy rip rap stone.
  - Light shore protection in the harbor consists of 6" granular filter material, filter cloth and 9" of stone filled reno mattresses or their equivalent.
  - Perimeter walks around the marina should be concrete 6" thick with a 30" turned down edge to prevent undermining.
  - The launching ramp construction is of 12' x 6' x 4" thick reinforced concrete slabs bolted together and laid on 6" of filter stone. The total length of the ramp is 56.7 feet with the initial 40' of the ramp

constructed with a 13% slope and the remaining 16.7 feet at 18% slope. The skid piers are 40 feet long and of steel and wood construction.

- The space reserved for the construction of a boat haul-out facility is adequate for a 15 ton boat crane handling boats up to 45 feet in length.
- The parking areas and drives consist of 6" gravel with a 2" bituminous surface. Deep concrete curbing (6" x 24") has been planned.
- Upgrading of the west breakwater consists of placement of a single layer of 18"-24" stone rubble the width of the existing breakwater and extending to 375 feet north of the south end.
- Granular fill material for the project will be obtained from the beach area along the east breakwater.
- The new service building should be of masonary construction to reduce maintenance costs and upkeep. Approximately 1600 square feet of area is required to provide sufficient restroom, office and storage areas.

- PARK
  - The picnic shelter should offer approximately 3200 square feet of sheltered area with partial enclosure of the shelter for restroom facilities. Pre-fabricated shelters are available if desired.

APPENDIX B Alternate Design

Although two major alternate design features were investigated for the Marina Facilities the following discussion will treat both together due to their interdependence. As may be seen from the development costs the two largest costs for the project involve first the dredging of the remainder of the Marina Basin and secondly, the construction and installation of the dockage. As mentioned earlier in the report the possibility of dewatering the entire Marina Basin was considered. Although the additional cost of construction cofferdams and dewatering appears to offset the reduced cost of excavation the following advantages would be realized during construction:

I. Reduction of the time required to do the excavation.

II. Reduced turbidity within the harbor and easier disposal of the excavated material since it would be handled in a much drier condition.

III. Slope protection costs would be lower due to alternate construction methods possible.

IV. Alternate support piling design may be utilized with a possible reduction of the piling lengths required.

V. The steel sheet piling used for the temporary cofferdams could be redriven permanently around the fill area for the proposed service building. This would replace the stone slope protection and create four additional moorage slips.

Additional cost reductions may be realized with the use of less traditional materials for the pier construction. Although heavily dependant on local preference, the use of such materials as precast concrete members in lieu of steel beams and wood decking

is becoming more widespread. In addition to lower costs per square foot of pier area, span lengths may be increased thus reducing the number of support piles required.

Although the possible cost savings discussed above may be quite large, they are largely dependent on the scope of the initial project if construction phasing is necessary. As the dredging and slope protection work is a high cost item for the Marina Development, much of the initial project budget will be used for this work. Many of the possible cost saving alternatives could not be utilized unless the initial project budget is sufficient to allow both the excavation and pier construction while the Marina Basin is dewatered.

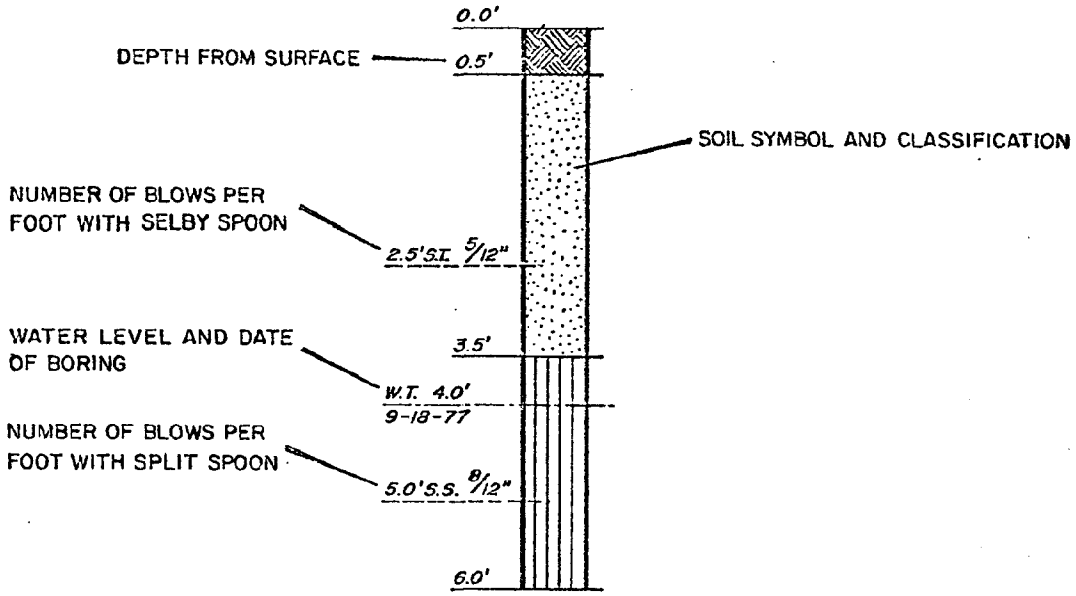
APPENDIX C Itemized Marina Cost Summary

	Item	Quantity	Unit Price	Amount
1.	Dredging	56,560 cys	$ 8.00	$ 453,000
2.	Earthwork and Grading	15,000 cys	4.00	60,000
3.	Rip Rap (Heavy)	900 l.f.	120.00	180,000
4.	Rip Rap (Light)	1,060 l.f.	90.00	95,400
5.	Upgrading West Breakwater	2,100 ton	25.00	52,500
6.	Sand Bypassing	10,000 cys	3.50	35,000
7.	Launching Ramp	1 l.s.	44,000.00	44,000
8.	Head Piers	14,500 sft	25.00	362,500
9.	Finger Piers	8,840 sft	30.00	265,200
10.	Piling	21,640 lft	28.00	605,900
11.	Service Pier			
	Decking	936 sft	25.00	23,400
	Shelter	1 ls	8,000.00	8,000
	Fuel Service	1 ls	15,000.00	15,000
	Pumpout Service	1 ls	3,000.00	3,000
12.	Service Building	1 ls	150,000.00	150,000
13.	Asphalt Drives and Parking	15,620 sys	4.75	74,200
14.	Concrete Walks and Curbs	1 ls	70,000.00	70,000
15.	Mechanical			
	Water Service	1 ls	42,000.00	42,000
	Sewers	1 ls	20,000.00	20,000
	Ice Protection	1 ls	15,000.00	15,000

	Item	Quantity	Unit Price	Amount
16.	Electrical			
	Distribution	1 ls	50,000.00	$ 50,000
	Service Centers	1 ls	42,000.00	42,000
	Lighting	1 ls	15,000.00	15,000
	Breakwater Lights	1 ls	10,000.00	10,000
	Radio and Communications	1 ls	8,000.00	8,000
17.	Landscaping	1 ls	30,000.00	30,000
			SUBTOTAL	$2,653,000
		20% CONTINGENCIES & ENGINEERING		
			TOTAL	$3,183,600

PREIN & NEWHOF
CONSULTING ENGINEERS

LEGEND - SOIL BORING LOG

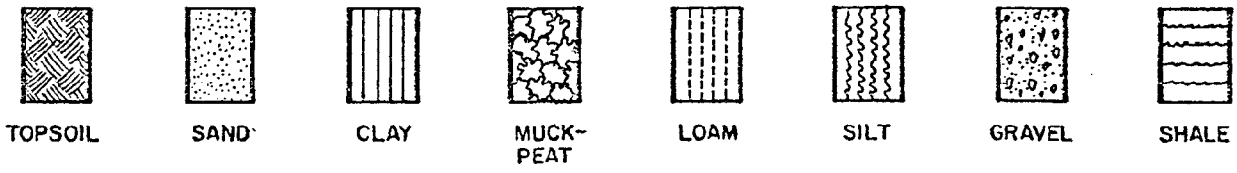


PENETRATION TESTS ARE MADE WITH A 2" DIAMETER SPLIT SPOON, 140 POUND HAMMER WITH 30" FREEFALL UNLESS OTHERLESS NOTED.

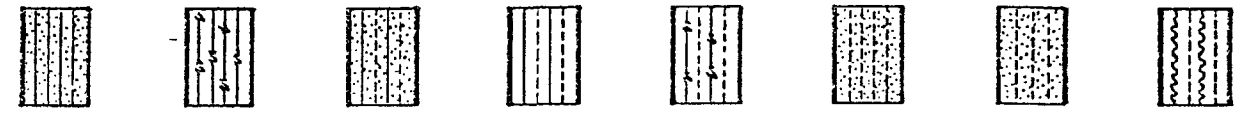
S.S/12" DENOTES TYPE OF SAMPLER AND NUMBER OF BLOWS TO DRIVE SAMPLER 12"

S.S. = SPLIT SPOON
S.T. = SHELBY SPOON

SOIL PROFILE SYMBOLS



TOPSOIL | SAND | CLAY | MUCK-PEAT | LOAM | SILT | GRAVEL | SHALE

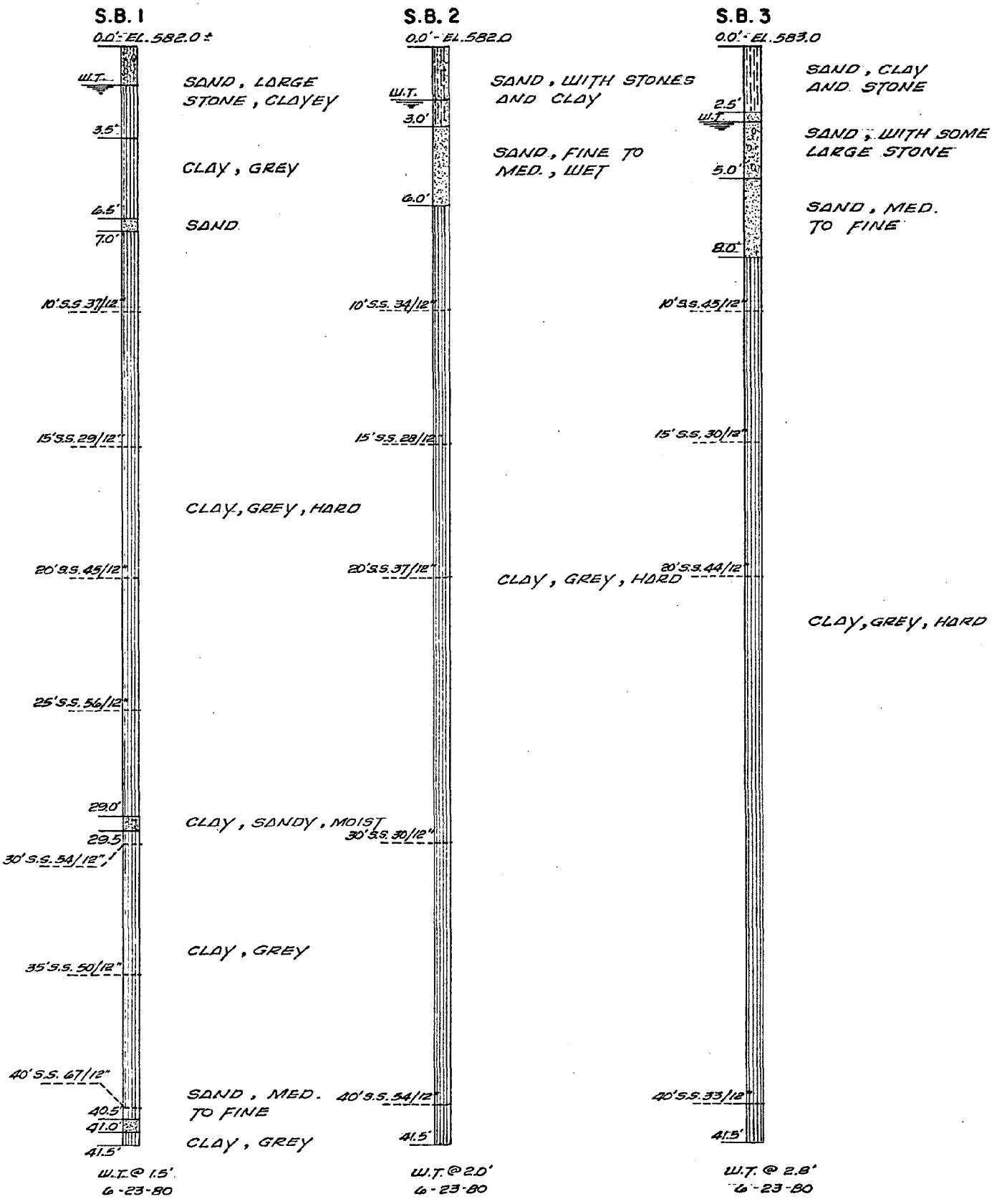


SANDY CLAY | SILTY CLAY | SANDY CLAY LOAM | CLAY LOAM | SILTY CLAY LOAM | SANDY LOAM | LOAMY SAND | SILTY LOAM

CLASSIFICATIONS ARE MADE BY VISUAL INSPECTION. THE WATER LEVELS AS INDICATED ARE THOSE OBSERVED WHEN THE BORING WAS MADE OR AS NOTED.

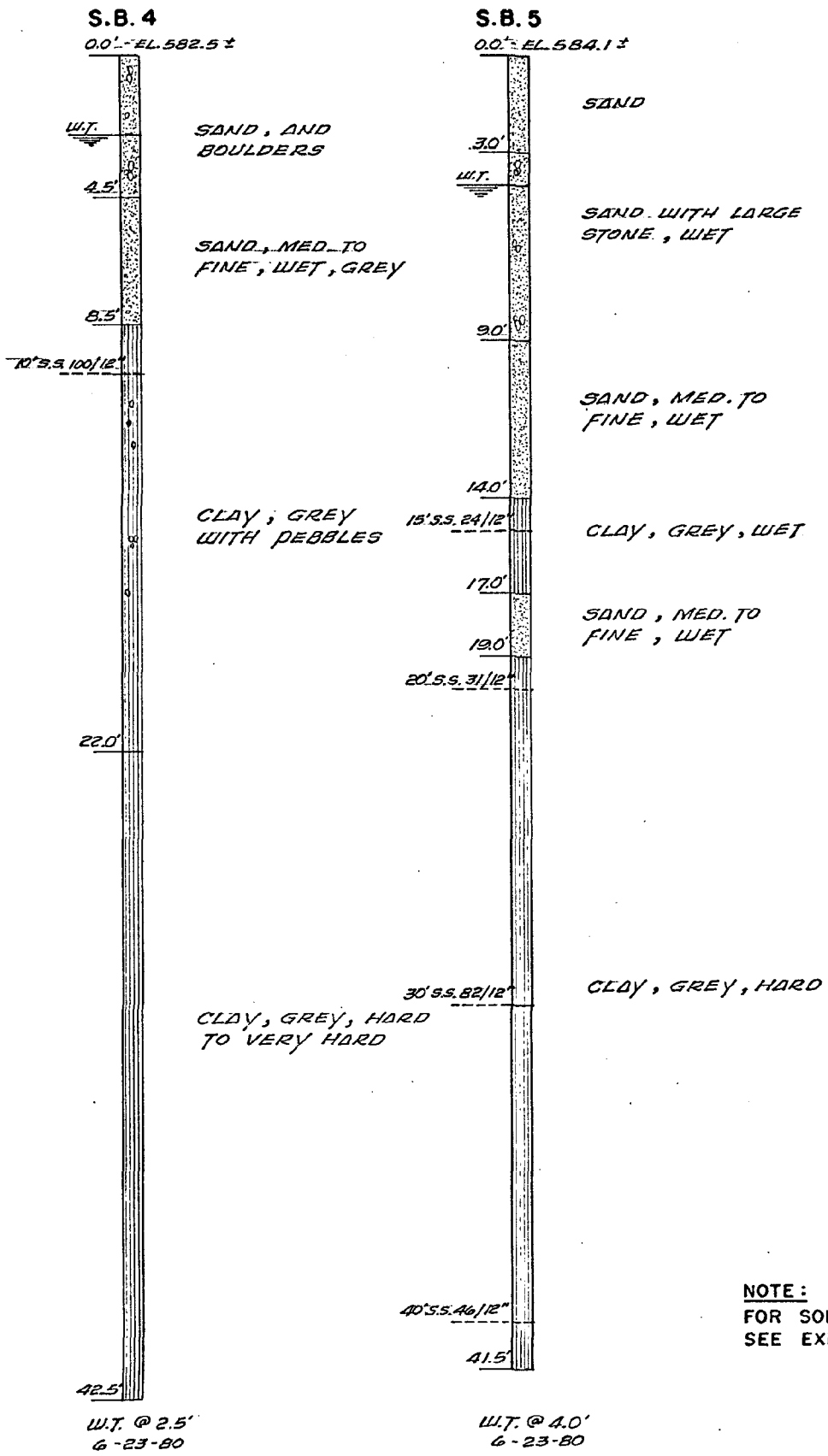
SYMBOLS COMBINED WHEN NECESSARY TO SHOW VARIATIONS.

·SOIL BORINGS·

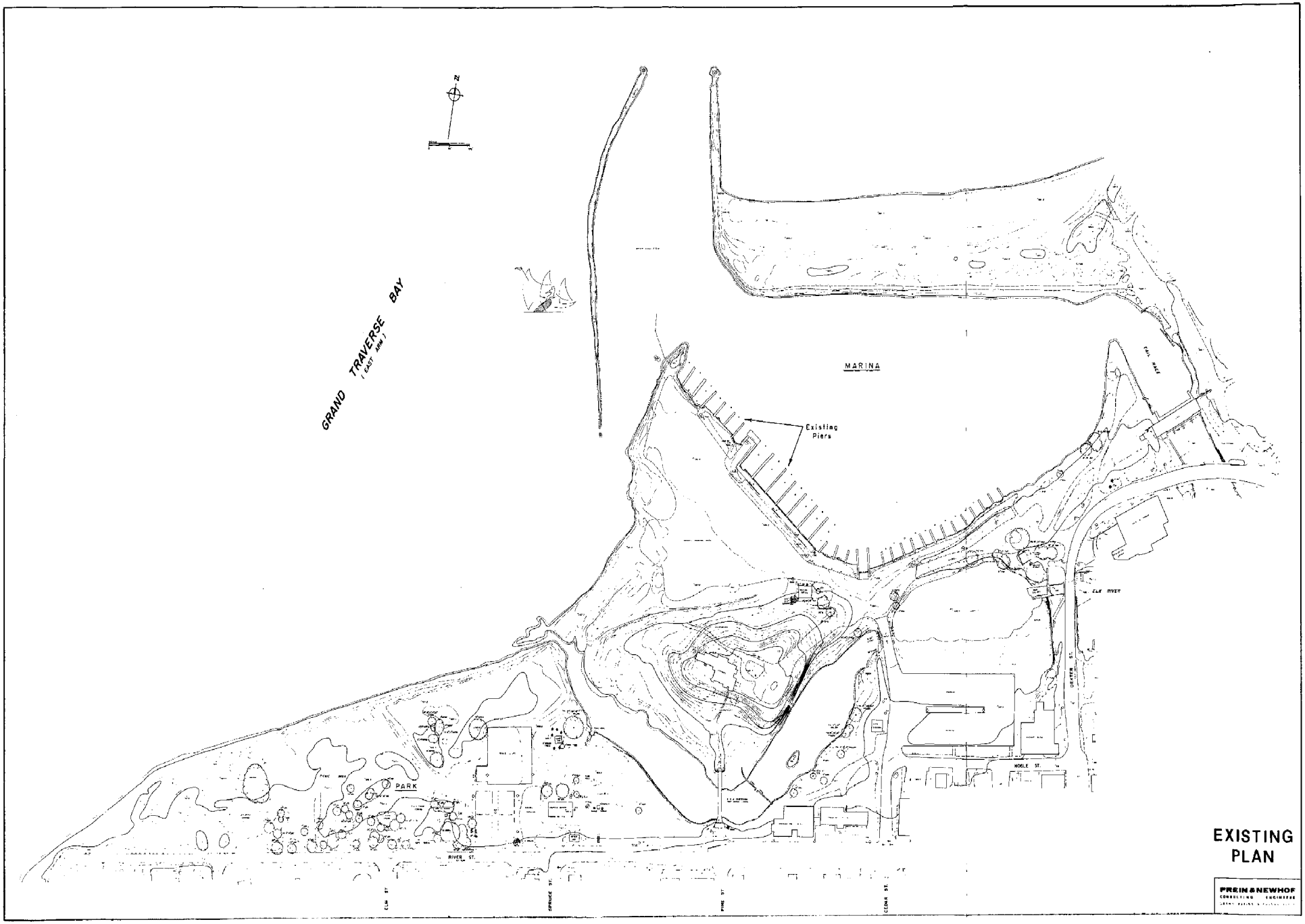


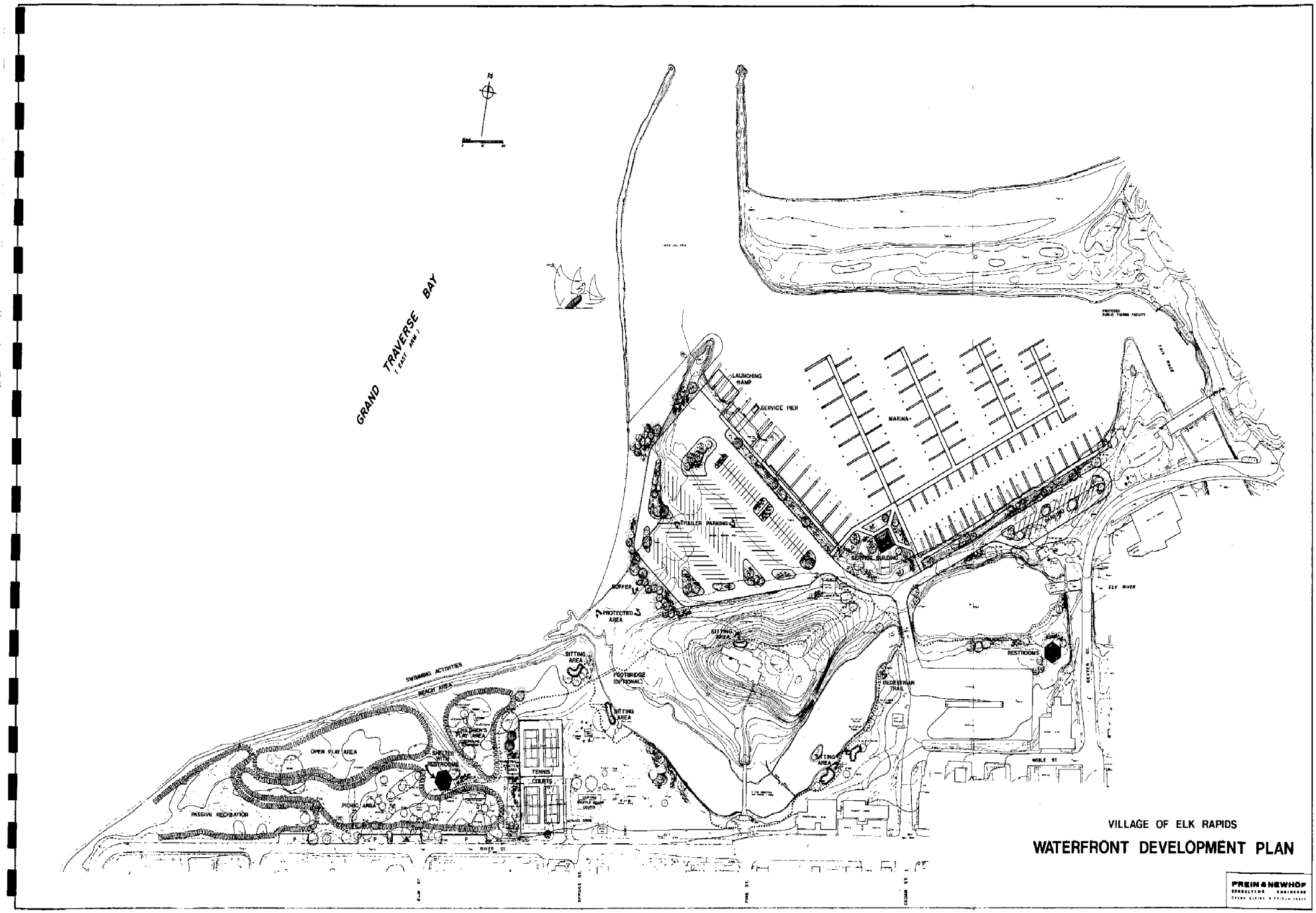
79058

·SOIL BORINGS·



NOTE:
FOR SOIL BORING LOCATIONS SEE EXISTING MARINA PLAN

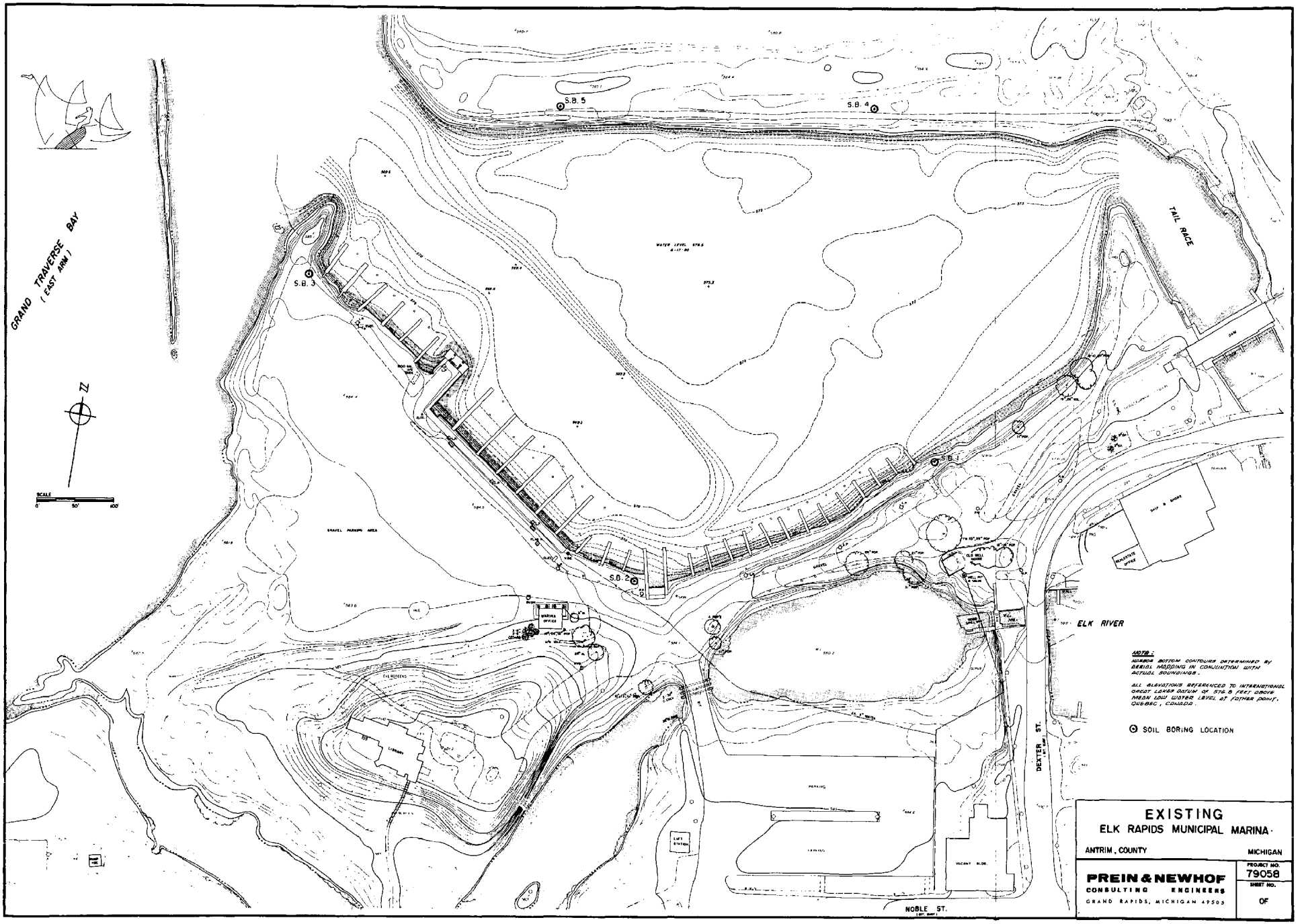

N
GRAND TRAVERSE BAY
(EAST ARM)
MARINA
Existing Piers
PARK
RIVER ST.
ELM ST
SPRUCE ST.
PINE ST
CEDAR ST.
WOBLE ST.
ELM RIVER
EXISTING PLAN
PREIN & NEWHOF
CONSULTING ENGINEERS



VILLAGE OF ELK RAPIDS

WATERFRONT DEVELOPMENT PLAN

PREIN & NEWHOF
CONSULTING ENGINEERS



NOTE :
HARBOR BOTTOM CONTOURS DETERMINED BY AERIAL MAPPING IN CONJUNCTION WITH ACTUAL SOUNDINGS.

ALL ELEVATIONS REFERENCED TO INTERNATIONAL GREAT LAKES DATUM OF 576.8 FEET ABOVE MEAN LOW WATER LEVEL AT FATHER POINT, QUEBEC, CANADA.

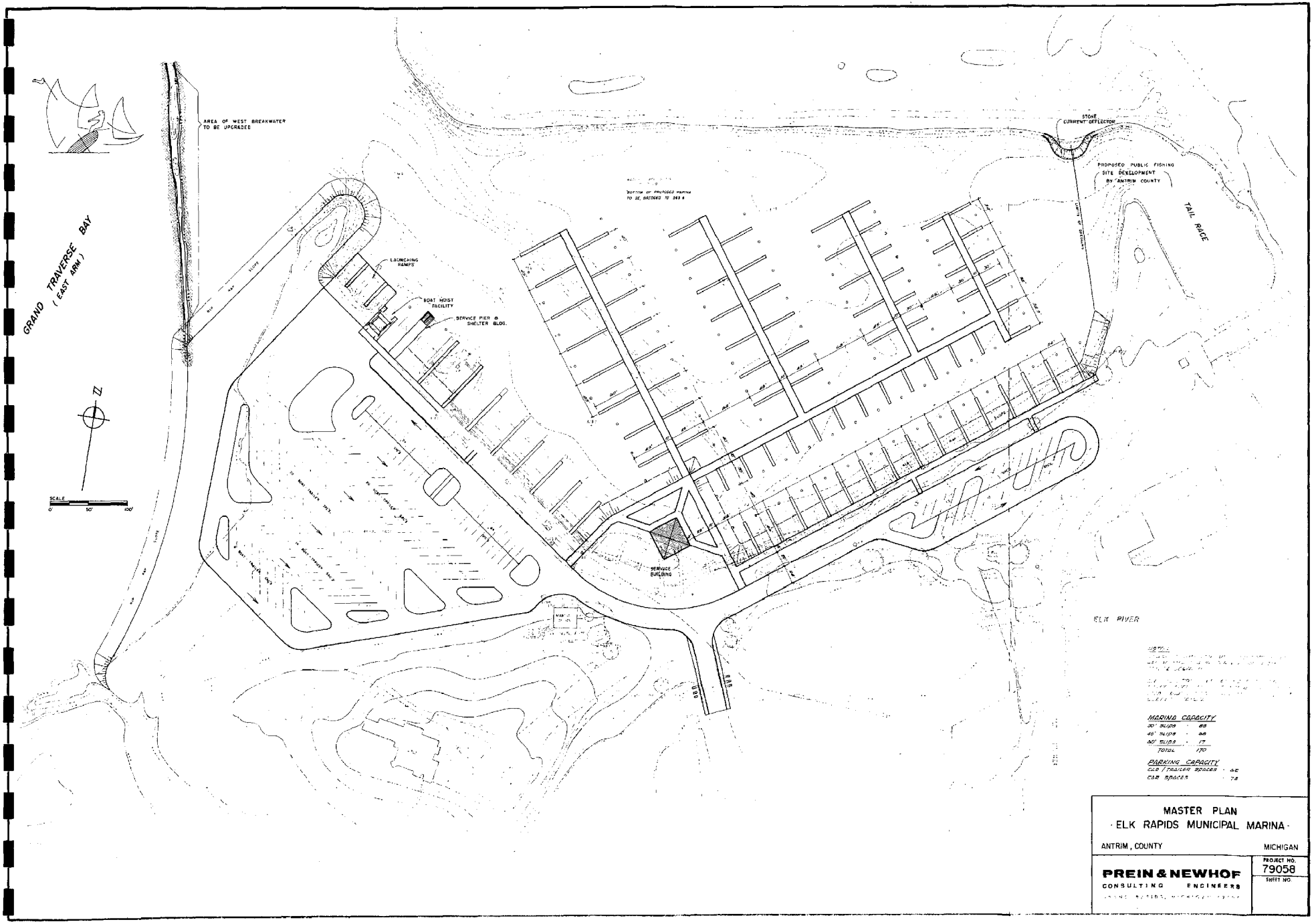
⊙ SOIL BORING LOCATION

EXISTING
ELK RAPIDS MUNICIPAL MARINA

ANTRIM, COUNTY MICHIGAN

PREIN & NEWHOF
CONSULTING ENGINEERS
GRAND RAPIDS, MICHIGAN 49503

PROJECT NO. 79058
SHEET NO. OF



MARINA CAPACITY

30' SLIPS	85
40' SLIPS	68
60' SLIPS	17
TOTAL	170

PARKING CAPACITY

CAR / TRAILER SPACES	62
CAR SPACES	78

MASTER PLAN
- ELK RAPIDS MUNICIPAL MARINA -

ANTRIM, COUNTY — MICHIGAN

PREIN & NEWHOF
CONSULTING ENGINEERS

PROJECT NO. 79058
SHEET NO.

NOAA COASTAL SERVICES CENTER LIBRARY
3 6668 14109 5614