

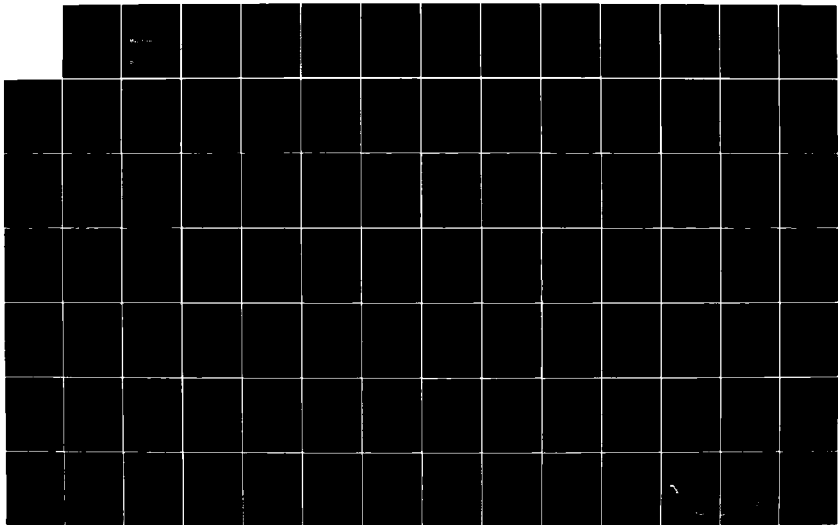
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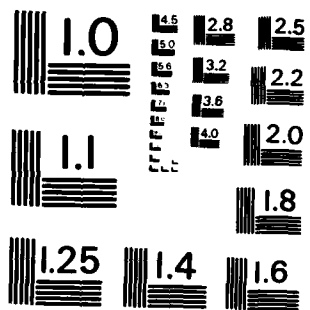
CHESAPEAKE BAY LOW FRESHWATER INFLOW STUDY PHASE II
BIOTA ASSESSMENT MAP..(U) WESTERN ECO-SYSTEMS
TECHNOLOGY INC BOTHELL WA G B MACKIERNAN ET AL. MAY 82
DACW31-79-C-0056

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May 1982

**Chesapeake Bay Low Freshwater Inflow Study
Phase II Biota Assessment**

Map Folio

AD A 1 200 1 5 1



**US Army Corps
of Engineers**
Baltimore District

by Western Eco-Systems Techn

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r Inflow Study

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Prepared for U.S. Army Engineer District Baltimore
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4. TITLE (and Subtitle) CHESAPEAKE BAY LOW FRESHWATER INFLOW STUDY BIOTA ASSESSMENT PHASE II: FINAL REPORT MAP FOLIO		5. TYPE OF REPORT & PERIOD COVERED FINAL
7. AUTHOR(s) Report: Gail B. Mackiernan, David F. Bleil, G. Bradford Shea Map Folio: Joellyn Shea, Judith McFarland		6. PERFORMING ORG. REPORT NUMBER
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19. KEY WORDS (Continue on reverse side if necessary and identify by block number) Chesapeake Bay, Biology, Salinity, Habitat, Estuary		
20. ABSTRACT (Continue on reverse side if necessary and identify by block number) -An assessment of the effects of low freshwater inflow conditions on the biota of Chesapeake Bay was conducted through use of data output from the U.S. Army Corps of Engineers' Chesapeake Bay Hydraulic Model. Four sets of test conditions (scenarios) were used which simulated effects of drought and effects of future consumptive water withdrawal and use as deviations from present average flow conditions. Changes in habitat of over 50 biological organisms were predicted and mapped based on salinity and other variables. Changes in habitat,		

which were used to determine tolerances, and interchange was found to

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which were used to delineate the amount of impact from low flow, were found to include increases and decreases depending on the species, its lifecycle, tolerances, and interactions with other organisms. The magnitude of habitat change was found to generally increase as salinity changes increased.

limited.

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Estuary

(Stock number)

water inflow conditions on the biota of data output from the U.S. Army Ecological Model. Four sets of test conducted effects of drought and effects of salinity as deviations from present average salinity for 50 biological organisms were pre-selected variables. Changes in habitat,



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INTRODUCTION

This folio is a principal product of the Biota Assessment portion of the Corps of Engineers' Chesapeake Bay Low Freshwater Inflow Study. The purpose of the mapping is to portray habitat for selected Chesapeake Bay species under a variety of freshwater inflow conditions. They are based on the results of tests done on the Chesapeake Bay Hydraulic Model simulating four freshwater inflow conditions. These were:

- 1) Base Average -- average freshwater inflow conditions.
- 2) Future Average -- reflective of average inflow conditions reduced by increased water consumption projected for the year 2020.
- 3) Base Drought -- simulating an actual drought in the 1960's.
- 4) Future Drought -- simulated 1960's drought inflows, reduced by increased water consumption projected for the year 2020.

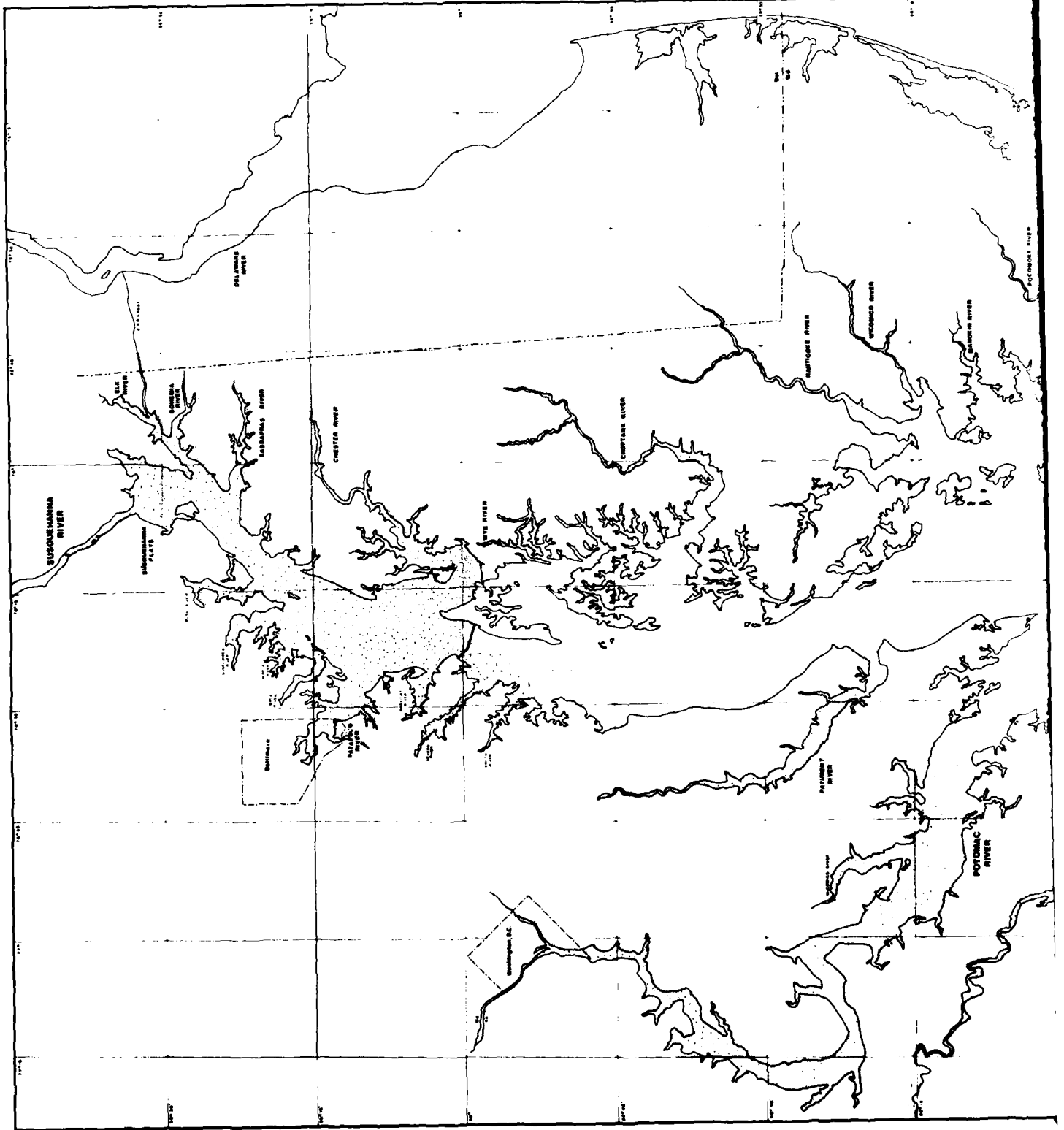
Data from the hydraulic model tests were subsequently used to generate seasonal average salinities at various depths from the mouth of the Bay to the head of tide in each tributary. These salinity data, in conjunction with data on depth, substrate, and dependence on other organisms, was used to create the maps of habitat portrayed in this volume. For further discussion of the information presented herein, the reader is referenced to the Chesapeake Bay Low Freshwater Inflow Study Biota Assessment, Phase II; Final Report, May 1982.

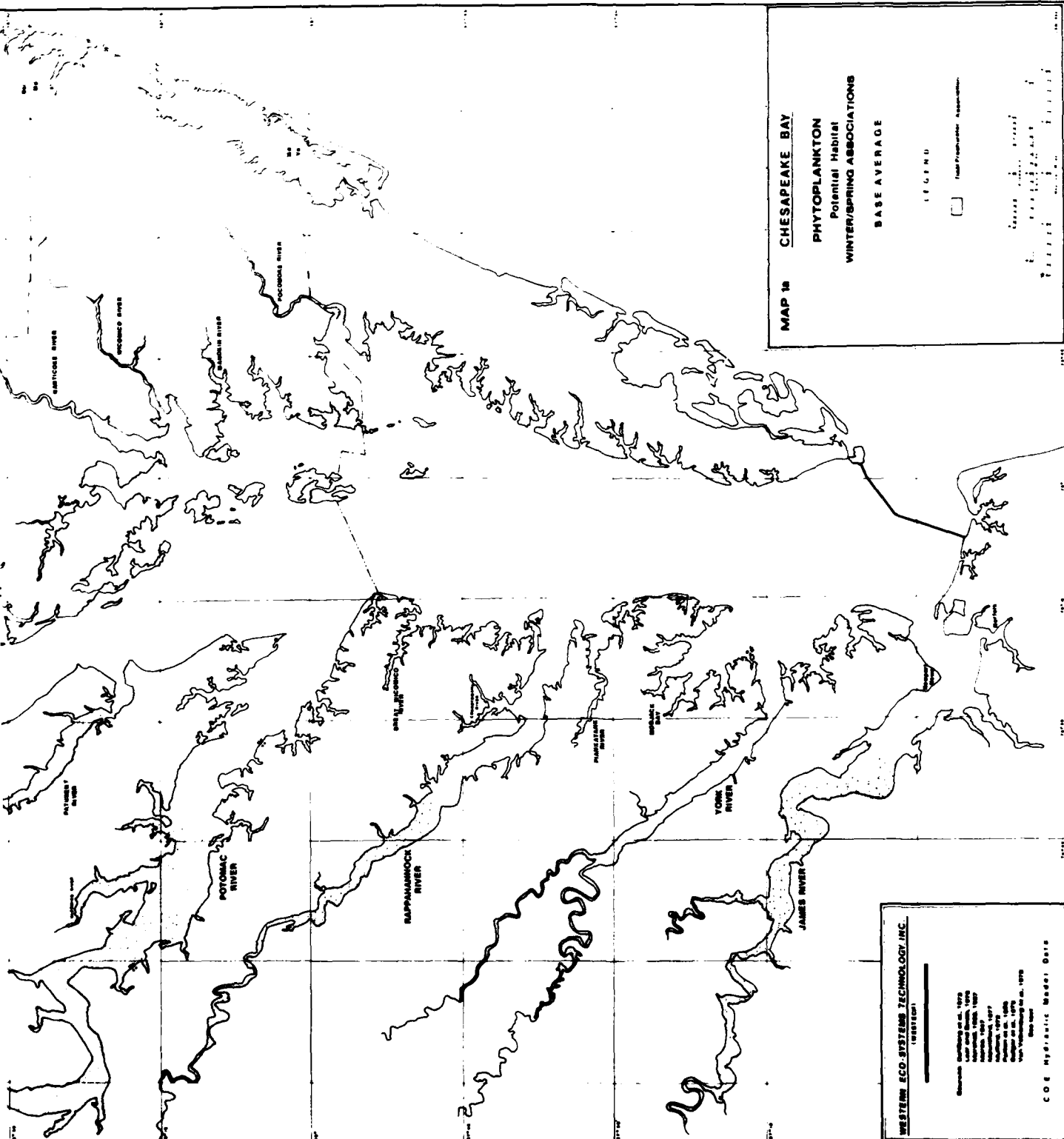
TABLE OF CONTENTS

TITLE	Plate No.	TITLE
Base Average		
Tidal Fresh Phytoplankton, Winter/Spring	1	Anchoa mit
Oligo-Low Mesohaline Phytoplankton, Winter/Spring	2	Leiostomus
Mesohaline Phytoplankton, Winter/Spring	3	Morone sax
Polyhaline Phytoplankton, Summer/Fall	4	Aythya val
Tidal Fresh Phytoplankton, Summer/Fall	5	
Oligo-Low Mesohaline Phytoplankton, Summer/Fall	6	Future Average
Mesohaline Phytoplankton, Summer/Fall	7	Potamogeto
Prorocentrum minimum (Dinoflagellate)	8	Potamogeto
Ceratophyllum demersum (Coontail)	9	Chrysaora
Ruppia maritima (Widgeon Grass)	10	Eurytemora
Zostera marina (Eelgrass)	11	Urosalpinx
Zannichellia palustris (Horned Pondweed)	12	Crassostre
Emergent Aquatic Vegetation (Coastal Fresh Marsh)	13	Macoma bal
Mnemiopsis leidyi Summer (Ctenophore - Sea Walnut)	14	Mercenaria
Mnemiopsis leidyi Winter (Ctenophore - Sea Walnut)	15	Mya arenar
Brachionis calyciflorus (Rotifer)	16	Callinecte
Acartia clausi (Copepod)	17	Callinecte
Acartia tonsa (Copepod)	18	Alosa sapi
Scottolana canadensis (Copepod)	19	Brevoortia
Bosmina longirostris (Cladoceran)	20	Anchoa mit
Evadne tergestina (Cladoceran)	21	Leiostomus
Podon polyphemoides (Cladoceran)	22	Morone sax
Limnodrilus hoffmeisteri (Oligochaete Worm)	23	Aythya val
Heteromastus filiformis (Polychaete Worm)	24	
Pectinaria gouldii (Polychaete Worm)	25	Base Drought (M
Scolecoplepides viridis (Polychaete Worm)	26	Potamogeto
Streblospio benedicti (Polychaete Worm)	27	Potamogeto
Mulinia lateralis (Coot Clam)	28	Chrysaora
Rangia cuneata (Brackish Water Clam)	29	Eurytemora
Ampelisca abdita (Amphipod)	30	Urosalpinx
Balanus improvisus (Acorn Barnacle)	31	Crassostre
Cyathura polita (Isopod)	32	Macoma bal
Gammarus daiberi (Amphipod)	33	Mercenaria
Leptocheirus plumulosus (Amphipod)	34	Mya arenar
Palaemonetes pugio (Grass Shrimp)	35	Callinecte
Alosa pseudoharengus (Alewife - Eggs & Larvae)	36	Callinecte
Alosa pseudoharengus (Alewife - Juveniles)	37	Alosa sapi
Micropogonias undulatus (Atlantic Croaker)	38	Brevoortia
Menidia menidia (Atlantic Silverside)	39	Anchoa mit
Morone americana (White Perch)	40	Leiostomus
Perca flavescens (Yellow Perch)	41	Morone sax
		Aythya val
Base Average (Major 15 Species)		
Potamogeton pectinatus (Sago Pondweed)	42	Future Drought
Potamogeton perfoliatus (Redhead Grass)	42	Potamogeto
Chrysaora quinquecirrha (Sea Nettle)	43	Potamogeto
Eurytemora affinis (Copepod)	44	Chrysaora
Urosalpinx cinerea (Oyster Drill)	45	Eurytemora
Crassostrea virginica (American Oyster)	46	Urosalpinx
Macoma balthica (Baltic Macoma)	47	Crassostre
Mercenaria mercenaria (Hard Clam)	48	Macoma bal
Mya arenaria (Soft Clam)	49	Mercenaria
Callinectes sapidus (Blue Crab - Summer males)	50	Mya arenar
Callinectes sapidus (Blue Crab - Summer females)	51	Callinecte
Alosa sapidissima (American Shad)	52	Callinecte
Brevoortia tyrannus (Menhaden)	53	Alosa sapi

TABLE OF CONTENTS (Cont'd)

<u>ate No.</u>	<u>TITLE</u>	<u>Plate No.</u>
1	<u>Anchoa mitchilli</u> (Bay Anchovy)	54
2	<u>Leiostomus xanthurus</u> (Spot)	55
3	<u>Morone saxatilis</u> (Striped Bass)	56
4	<u>Aythya valisineria</u> (Canvasback Duck)	57
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14	<u>Mercenaria mercenaria</u> (HardClam, Quahog)	64
15	<u>Mya arenaria</u> (Soft-Shell Clam)	65
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50	<u>Mya arenaria</u> (Soft-Shell Clam)	97
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52	<u>Callinectes sapidus</u> (Blue Crab - summer females)	99
53	<u>Alosa sapidissima</u> (American Shad)	100





MAP 14 CHESAPEAKE BAY
PHYTOPLANKTON
Potential Habitat
WINTER/SPRING ASSOCIATIONS
BASE AVERAGE

LEGEND

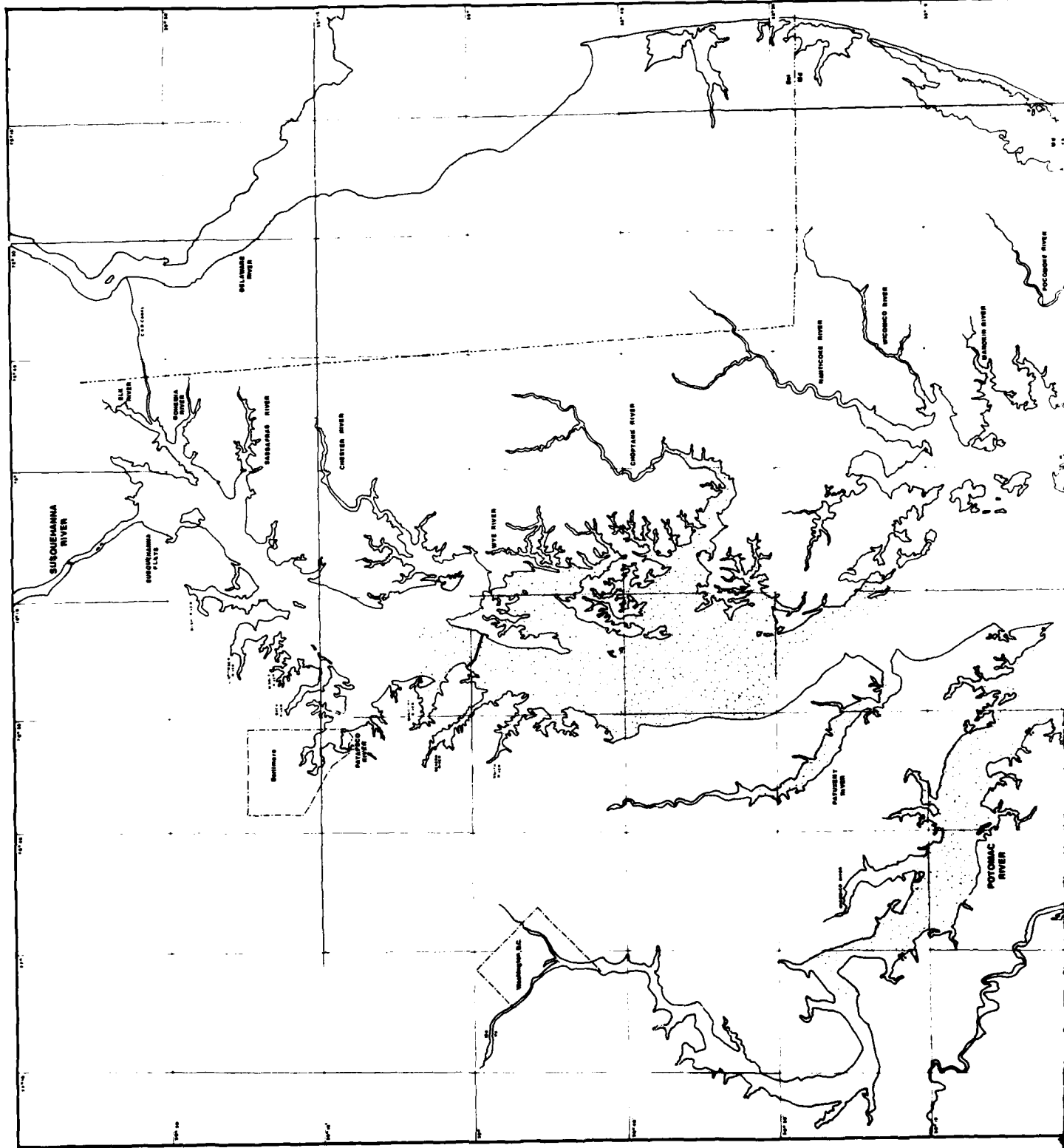
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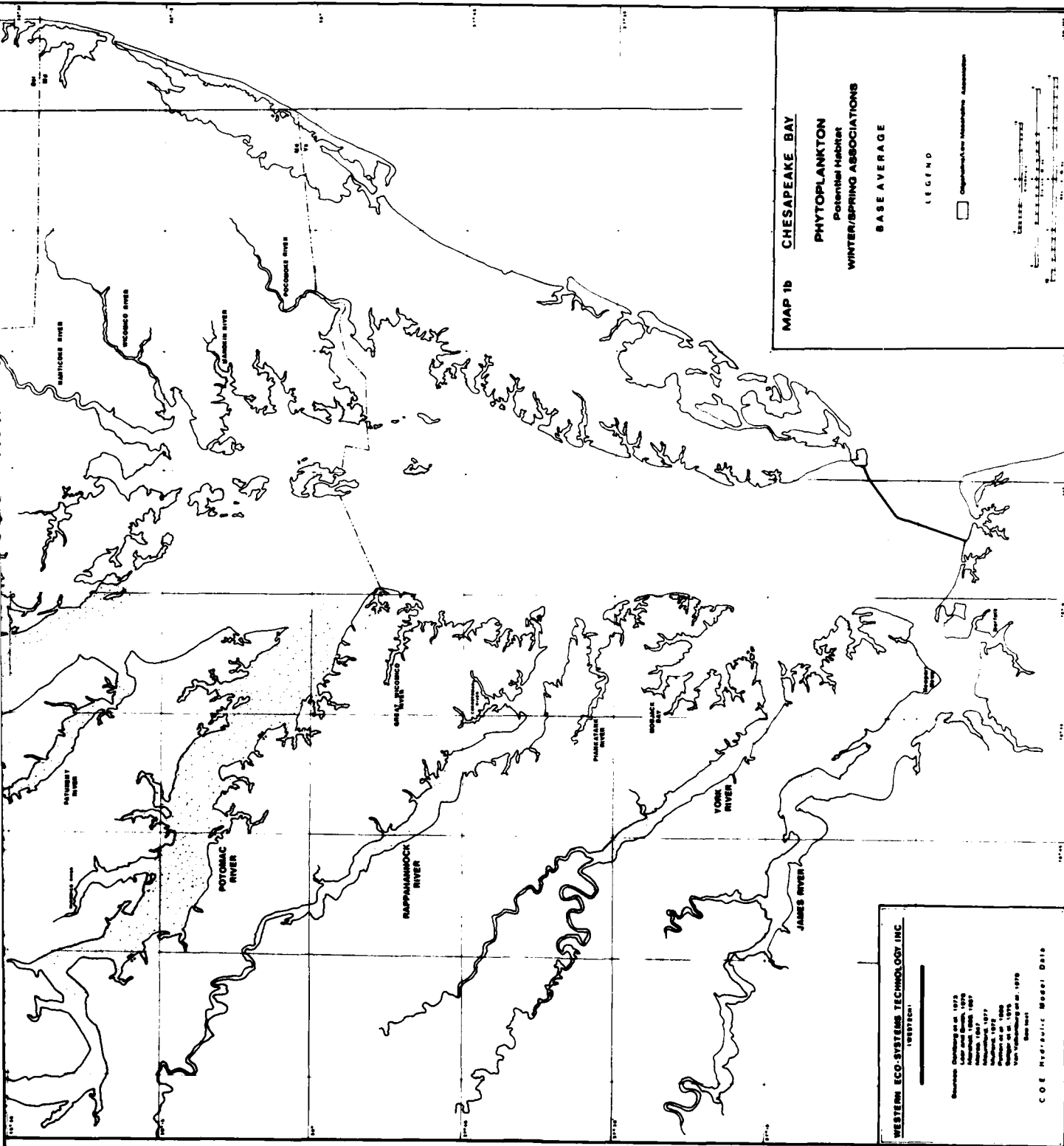
Winter/Spring Association

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Developed by:
L. J. Breyer, Ph.D., 1990
L. J. Breyer, Ph.D., 1989
L. J. Breyer, Ph.D., 1988
L. J. Breyer, Ph.D., 1987
L. J. Breyer, Ph.D., 1986
L. J. Breyer, Ph.D., 1985
L. J. Breyer, Ph.D., 1984
L. J. Breyer, Ph.D., 1983
L. J. Breyer, Ph.D., 1982
L. J. Breyer, Ph.D., 1981
L. J. Breyer, Ph.D., 1980

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MAP ID CHESAPEAKE BAY

PHYTOPLANKTON
Potential Habitat
WINTER/SPRING ASSOCIATIONS

BASE AVERAGE

LEGEND

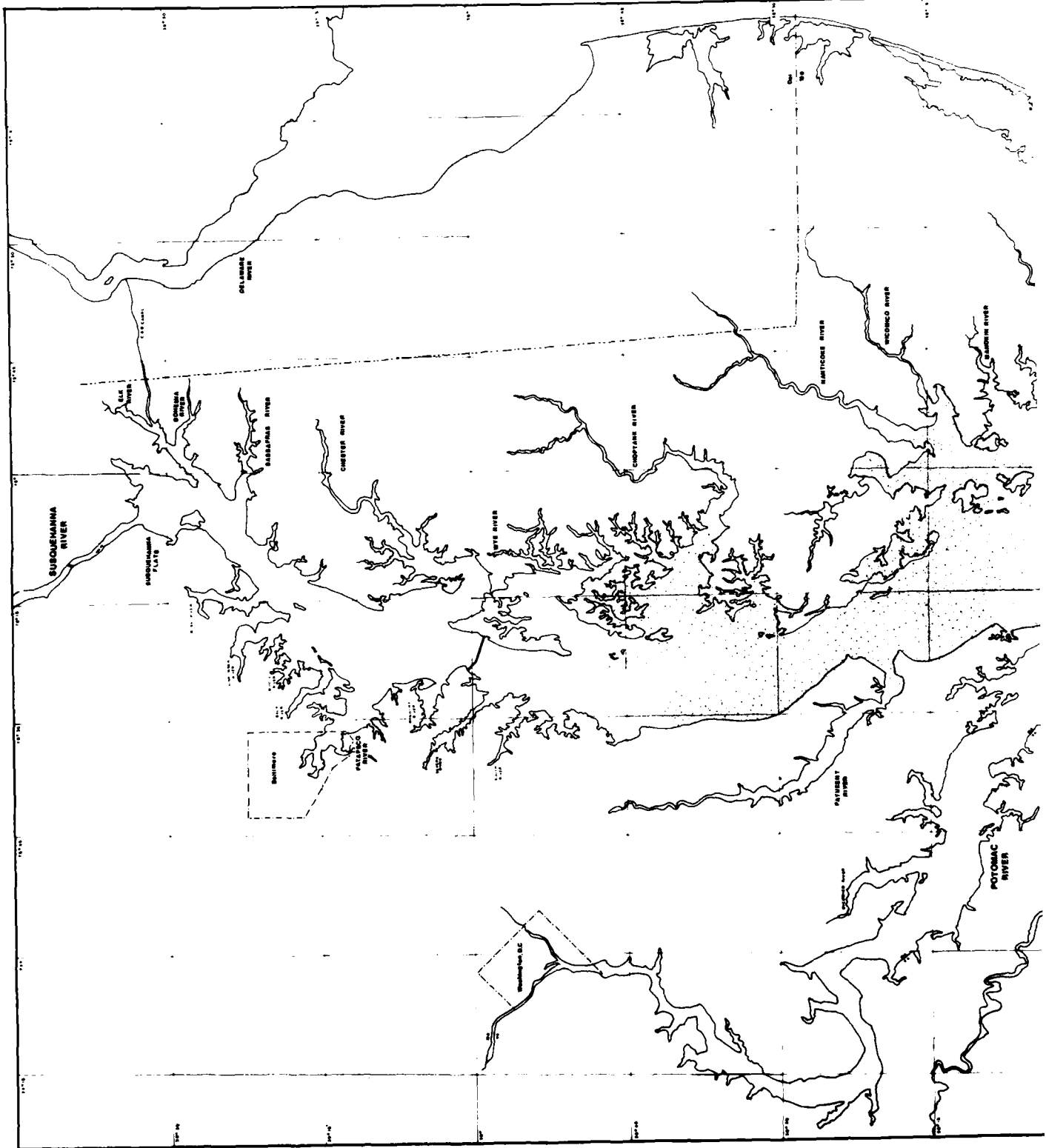
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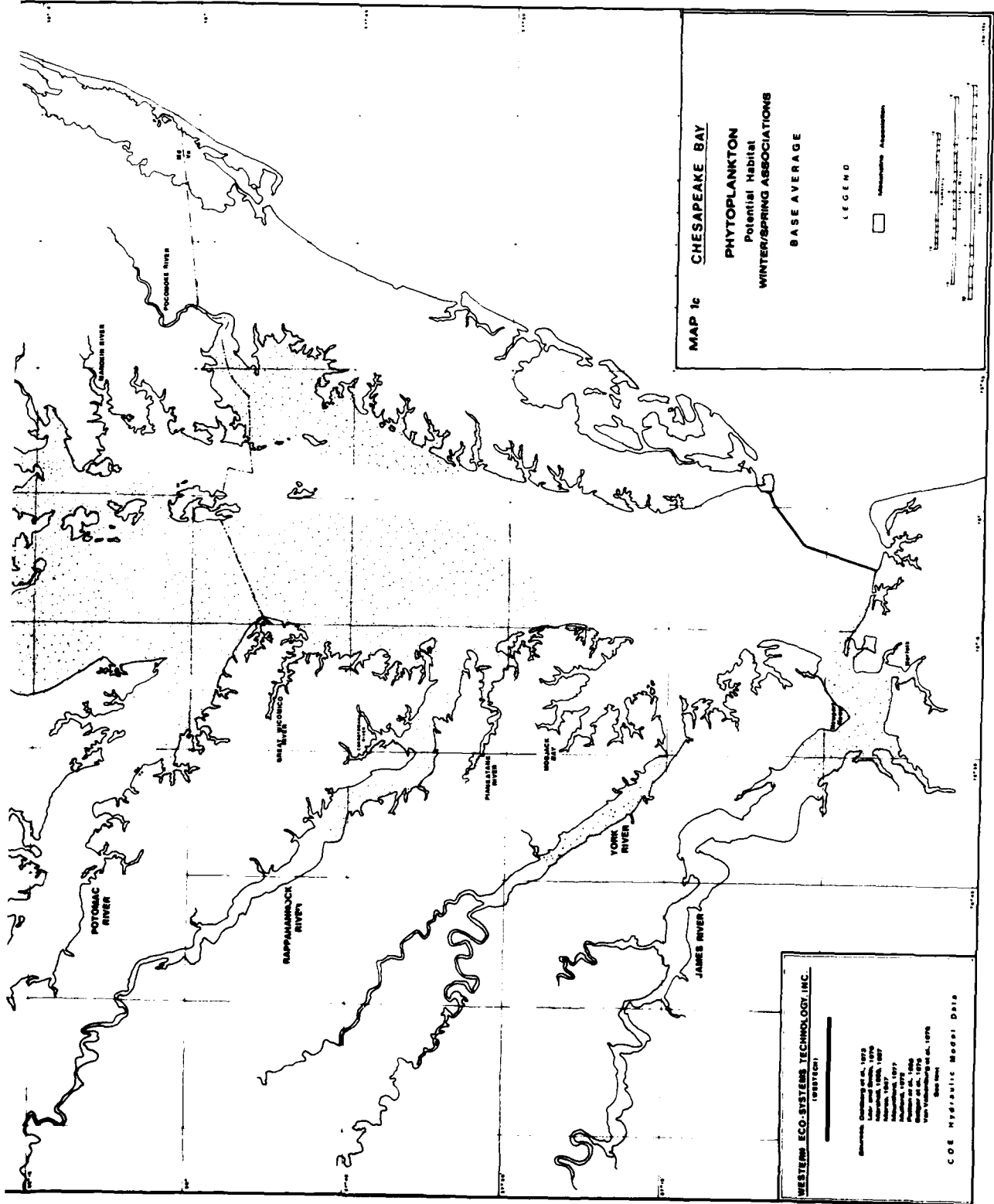
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Lutz and Smith 1979
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Hutchinson 1977
Hutchinson 1977
Hutchinson et al. 1979
Van Vleet et al. 1979
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MAP 1c CHESAPEAKE BAY

PHYTOPLANKTON
 Potential Habitat
 WINTER/SPRING ASSOCIATIONS
 BASE AVERAGE

LEGEND

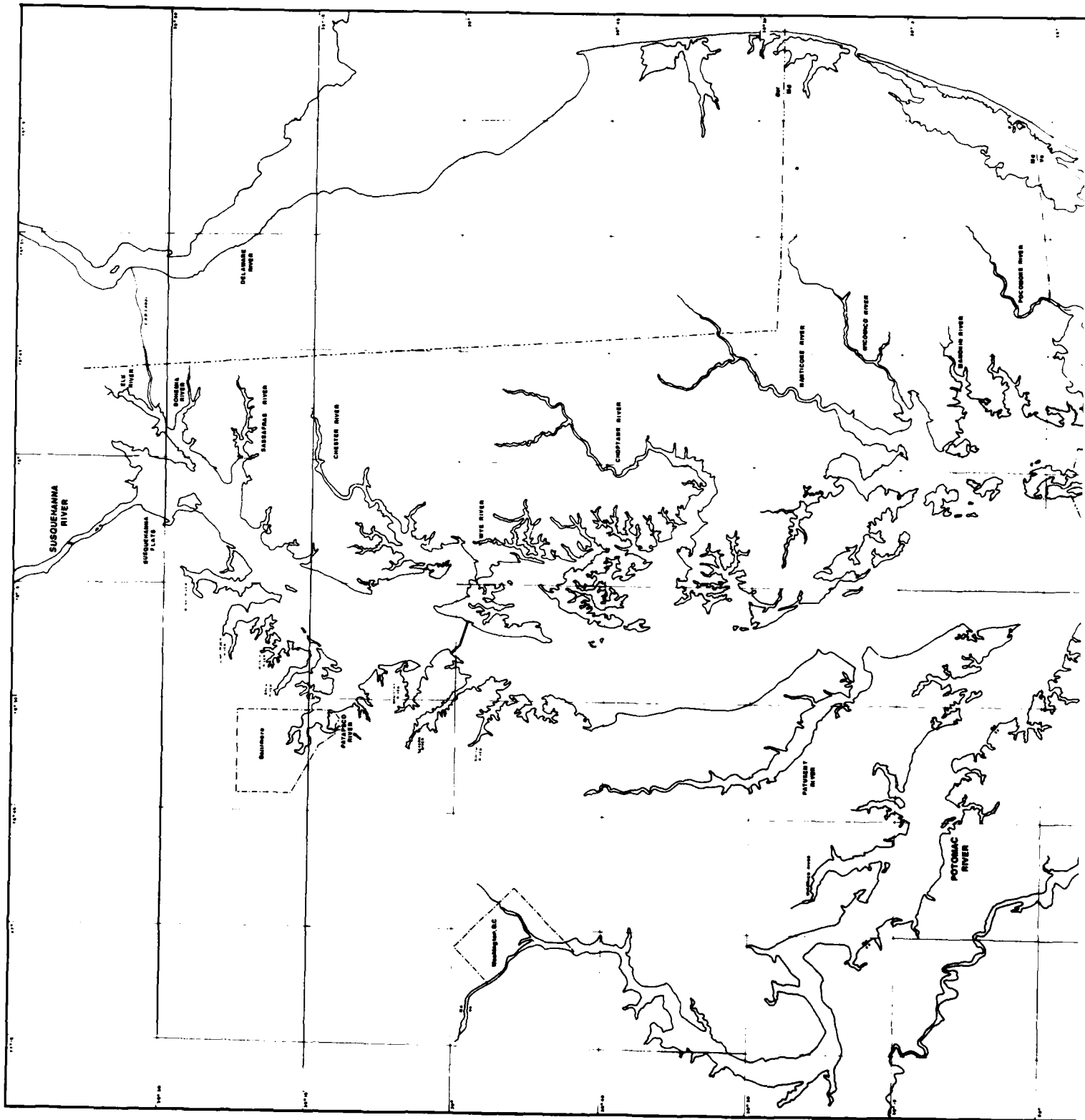
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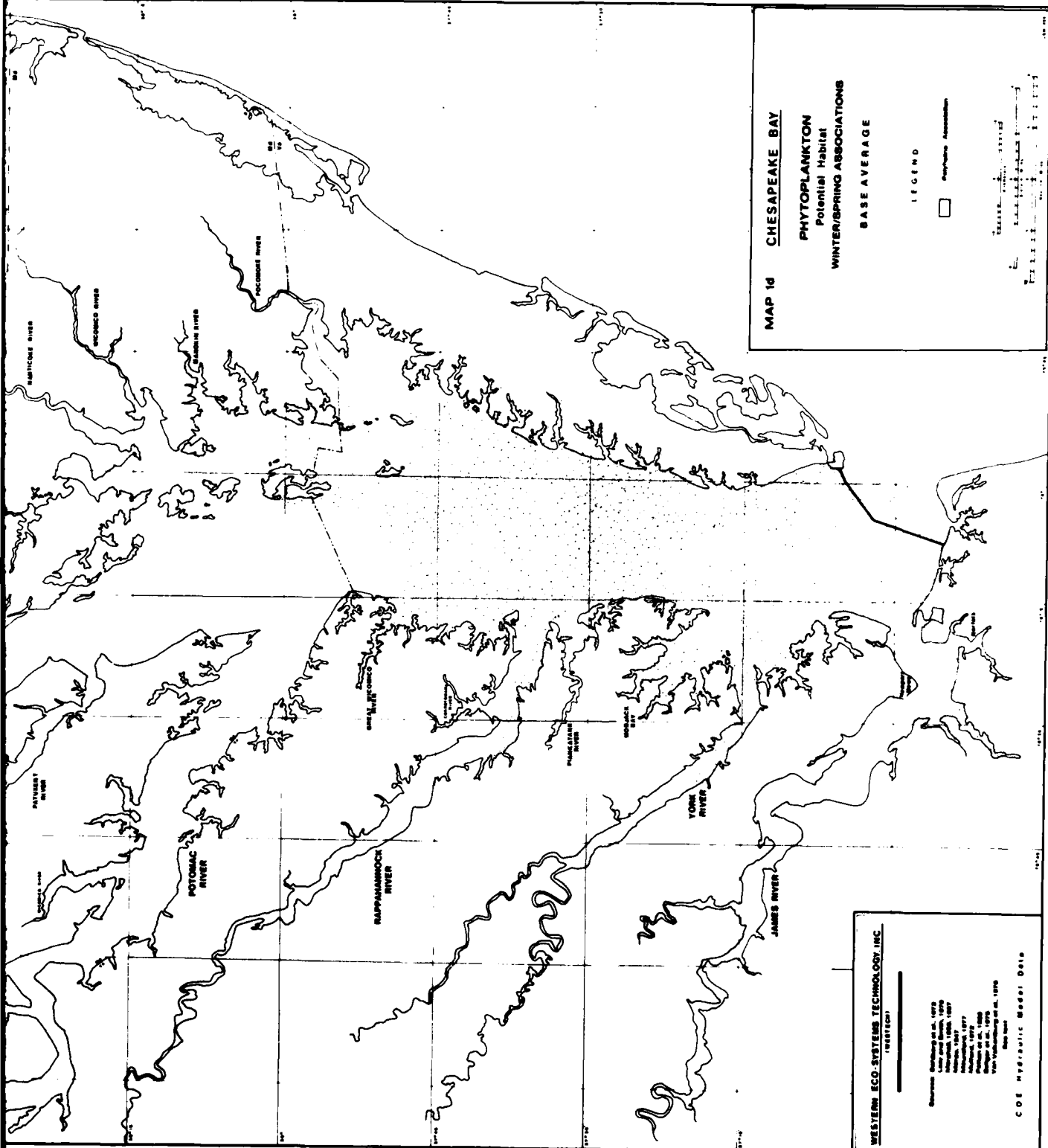
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 Lee and Smith, 1979
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 Johnson et al., 1977
 Johnson, 1979
 Johnson et al., 1978
 Johnson et al., 1979
 Johnson et al., 1979

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MAP 10 CHESAPEAKE BAY
PHYTOPLANKTON
 Potential Habitat
WINTER/SPRING ASSOCIATIONS
 BASE AVERAGE

LEGEND

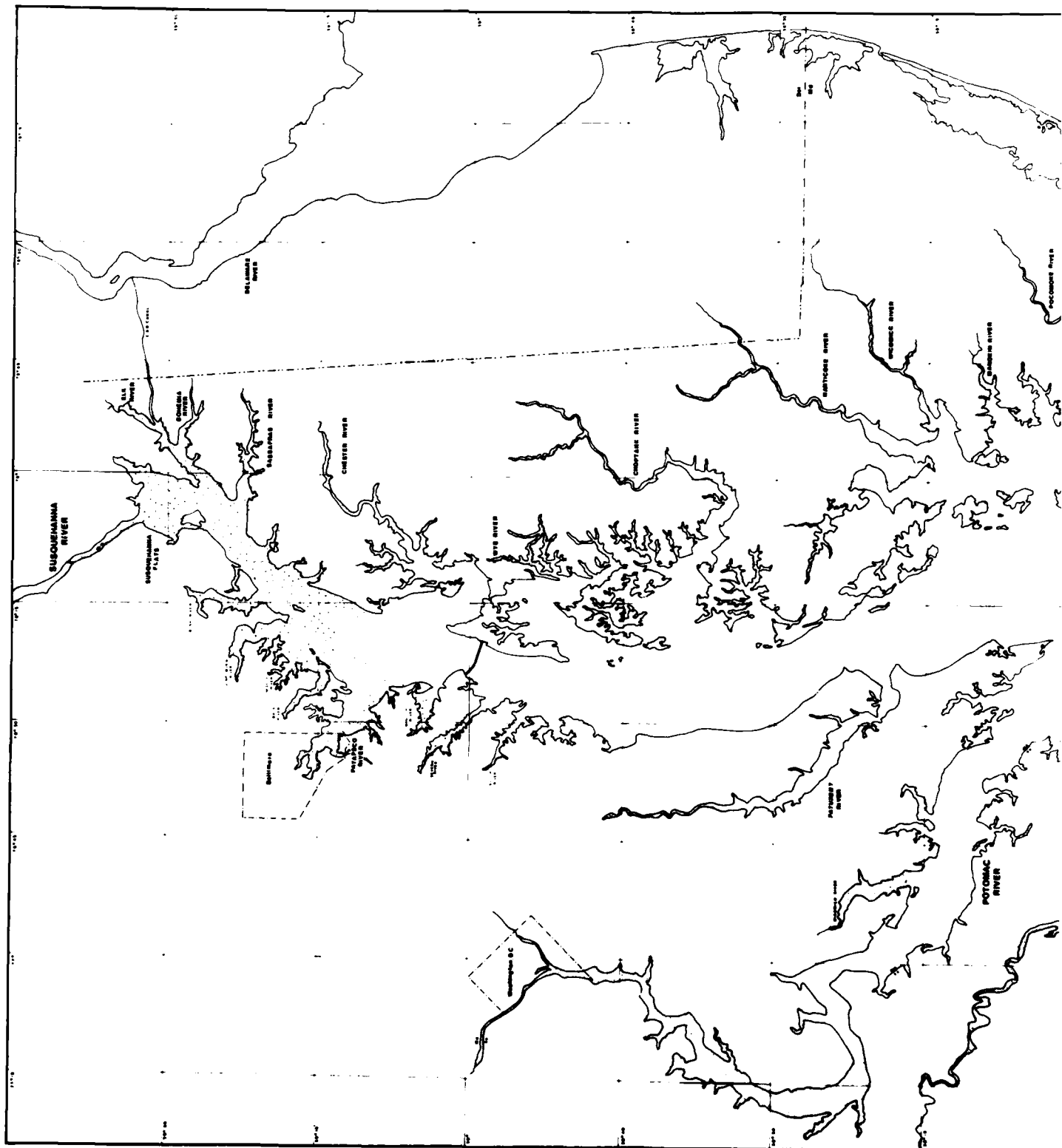
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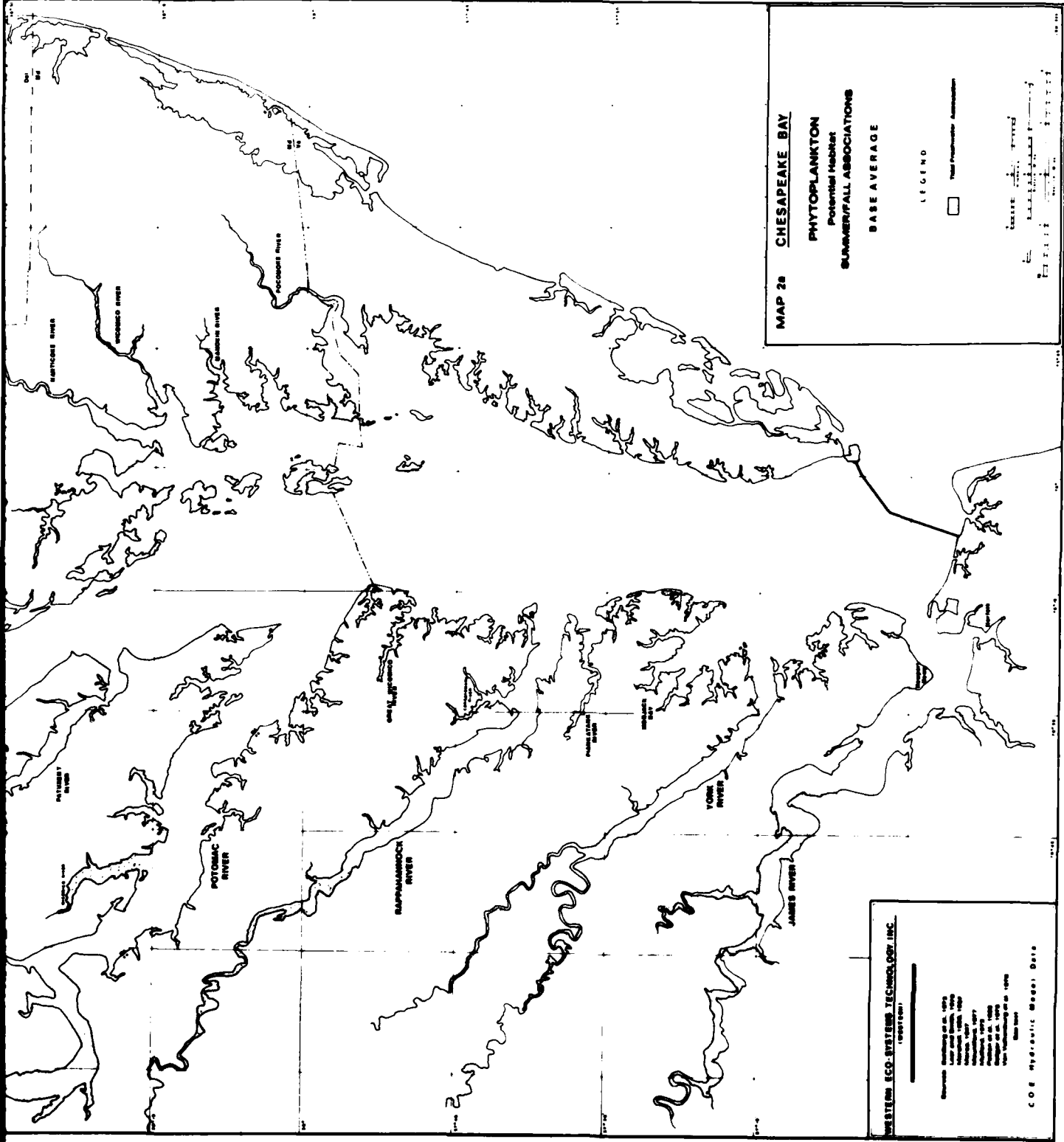
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 2016-2017
 2018-2019
 2020-2021
 2022-2023
 2024-2025

COE HYDROLOGIC MODEL DATA





MAP 2b CHESAPEAKE BAY
 PHYTOPLANKTON
 Potential Habitat
 SUMMER/FALL ASSOCIATIONS
 BASE AVERAGE

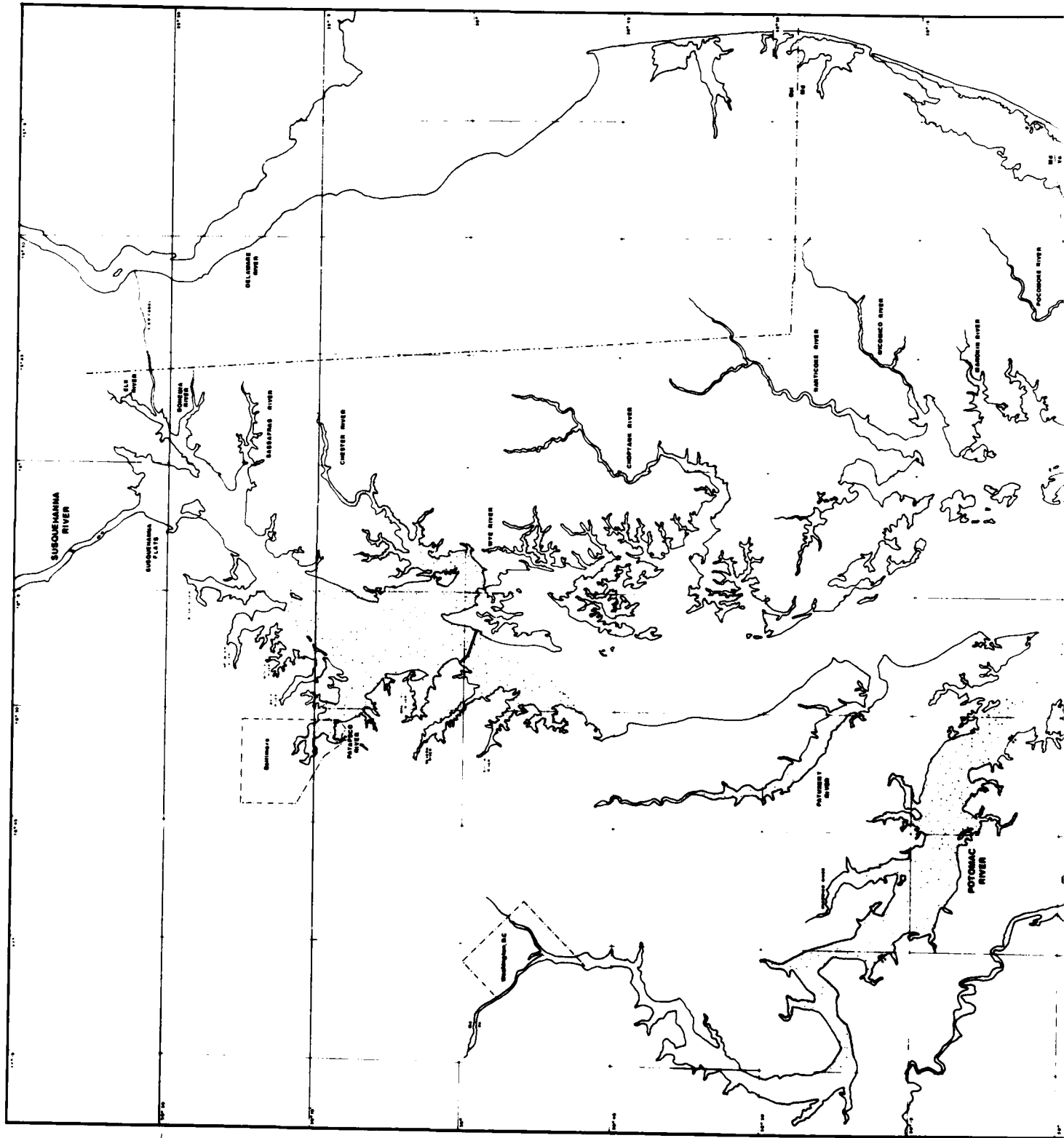
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 □ Total Phytoplankton Association

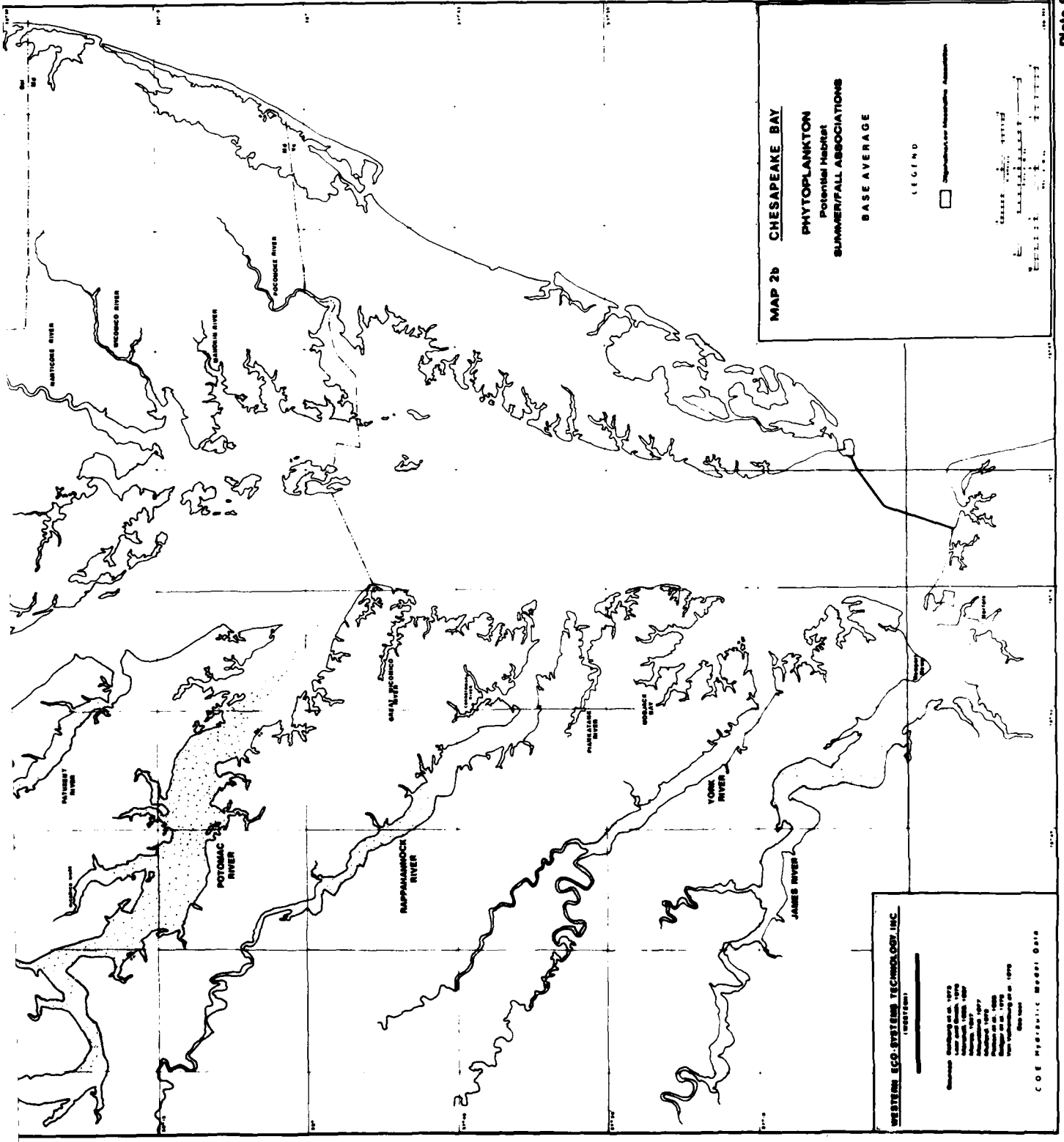
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 0 1 2 3 4 5 Kilometers

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 Project: [illegible]
 Client: [illegible]
 Title: [illegible]

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MAP 2b CHESAPEAKE BAY
PHYTOPLANKTON
 Potential Habitat
 SUMMER/FALL ASSOCIATIONS
 BASE AVERAGE

LEGEND

□ Organismal Association

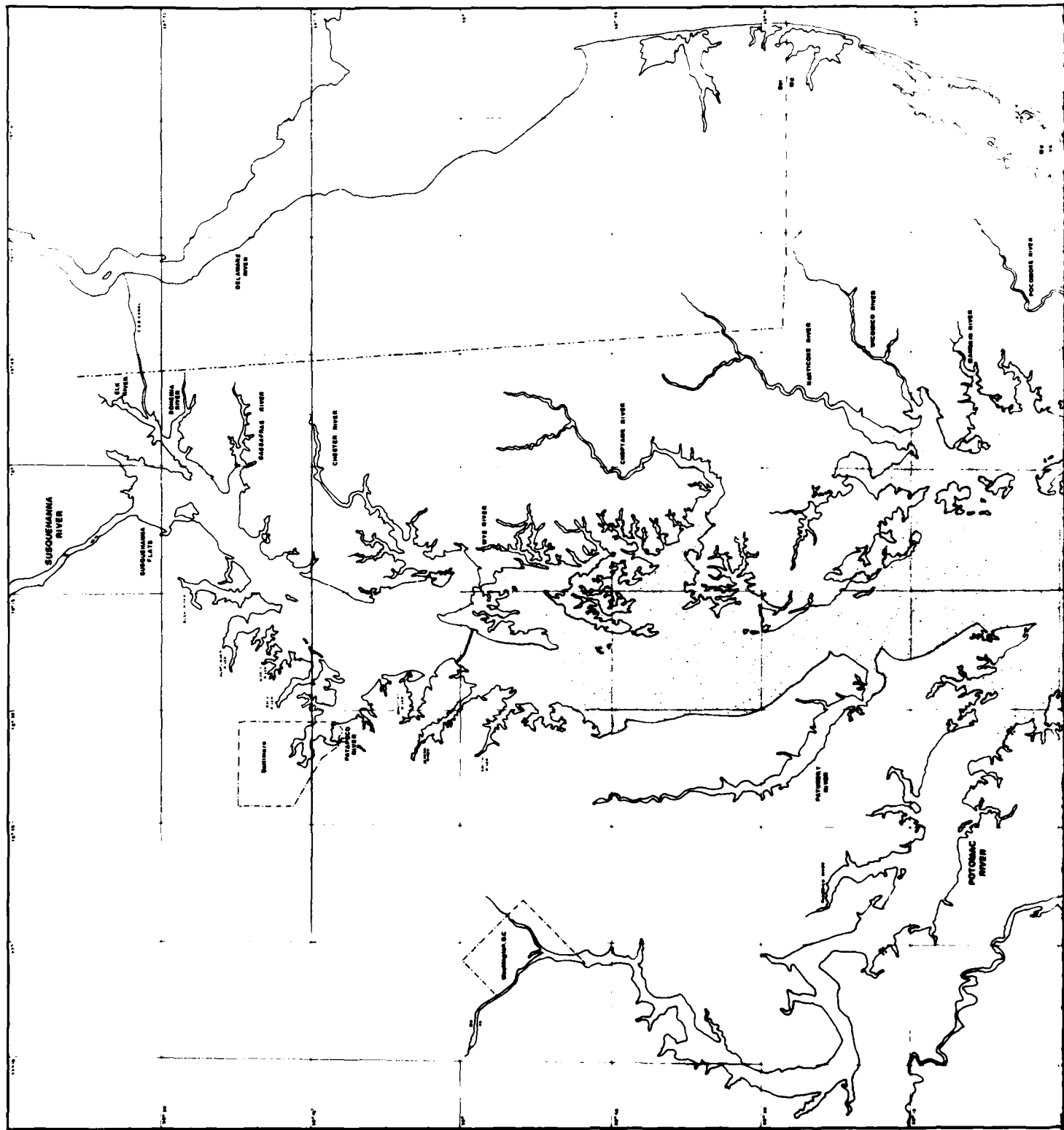
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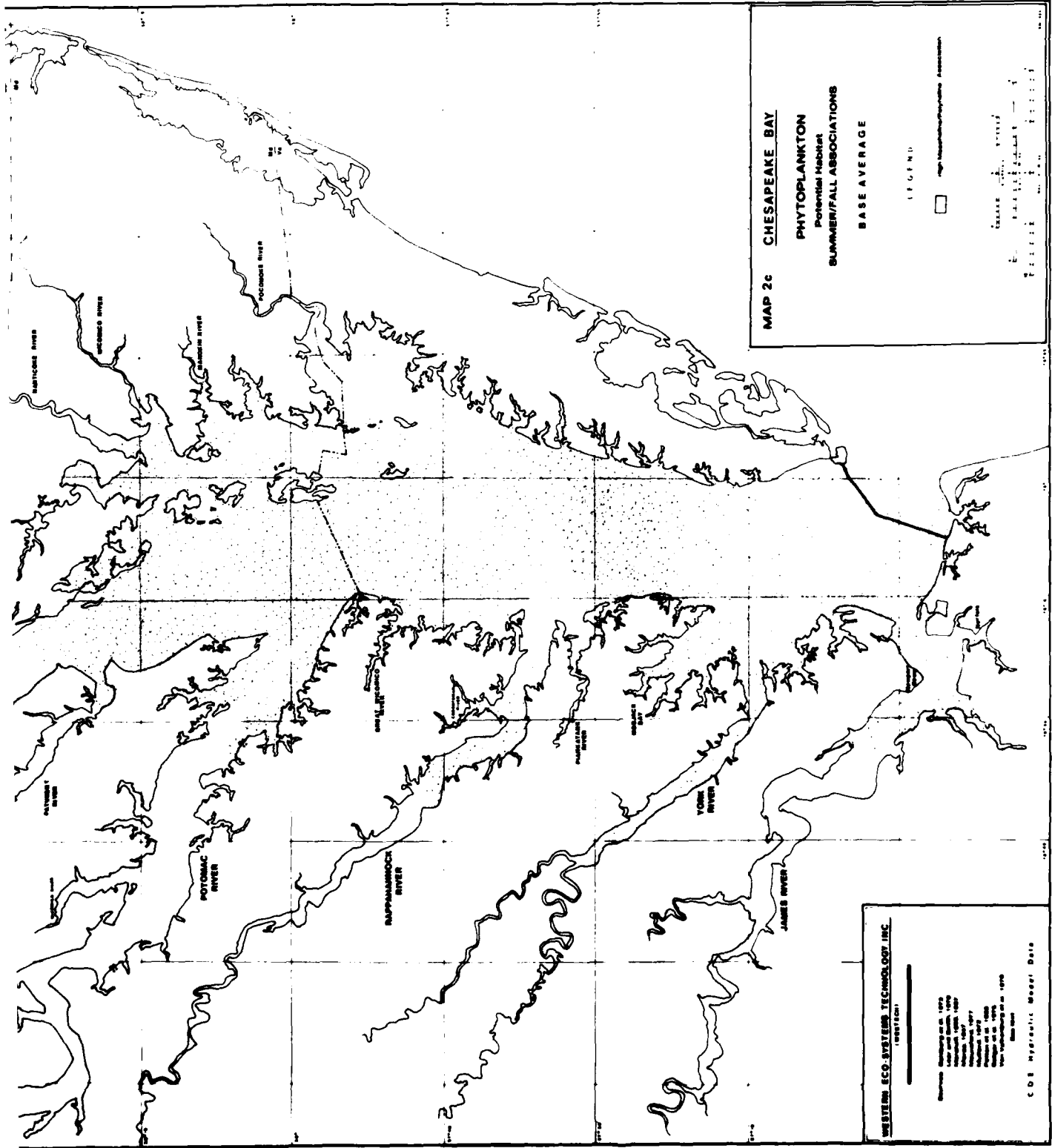
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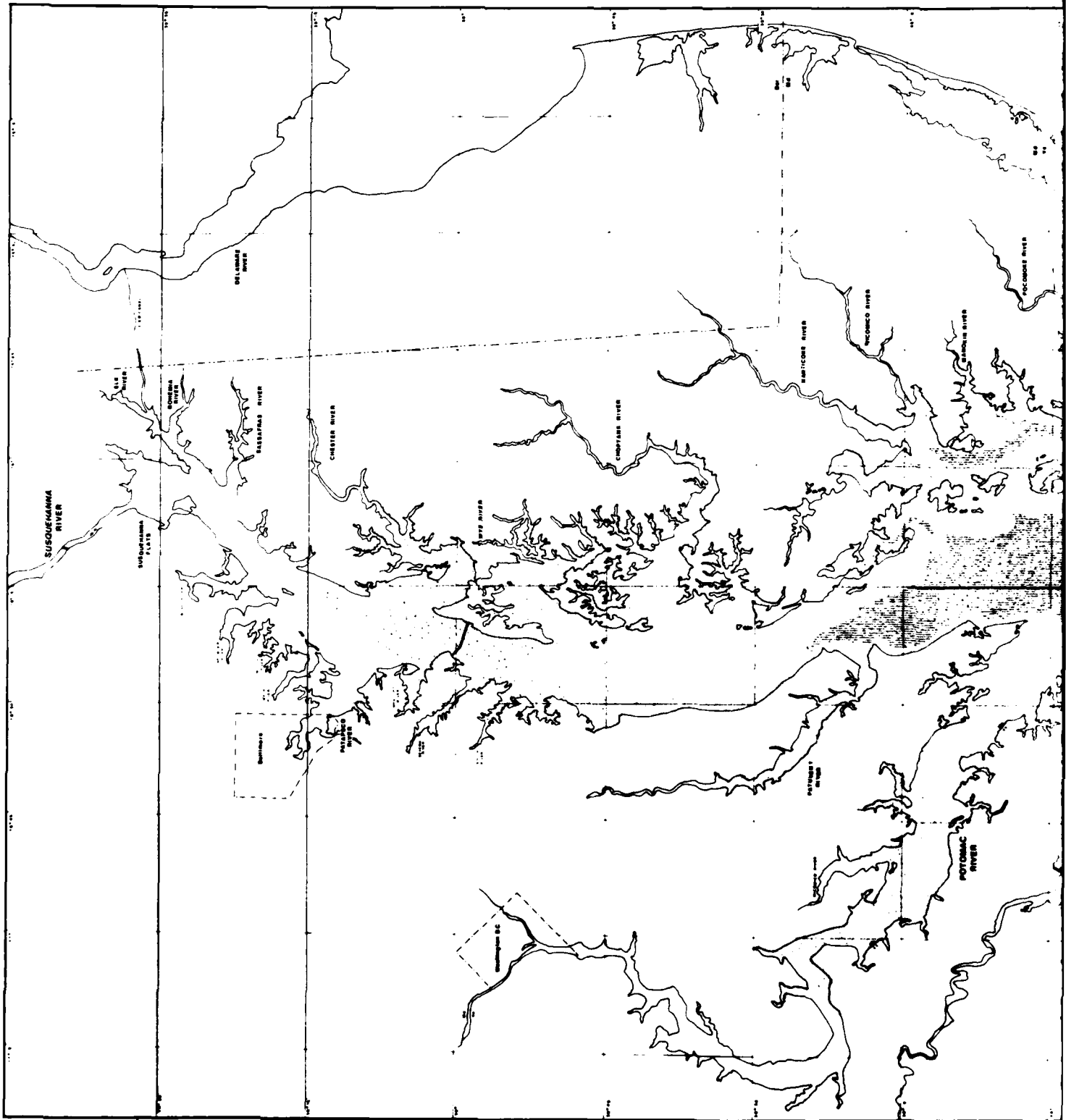
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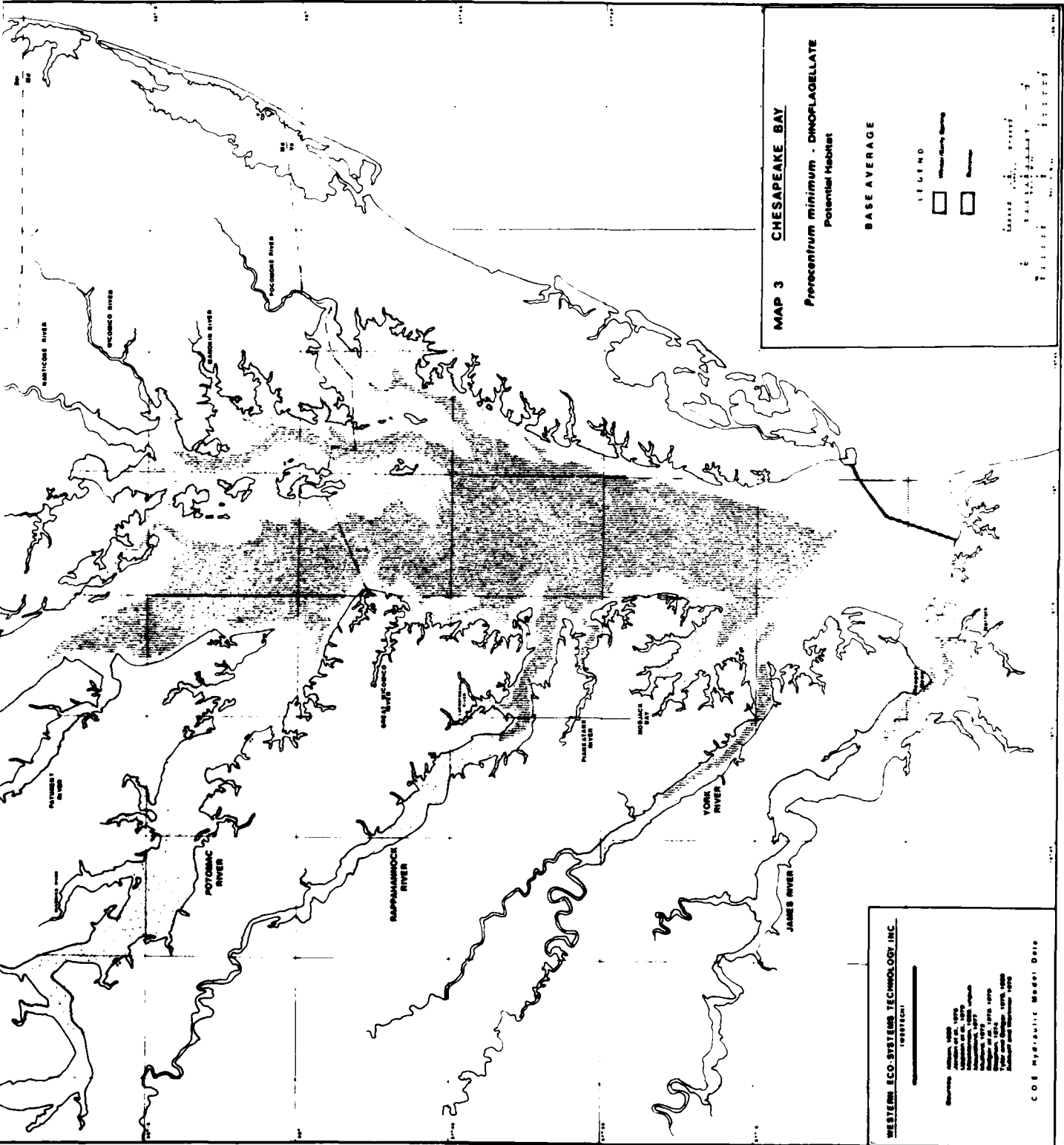
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 Contract No.: W91279-87-1-0001
 Project: Chesapeake Bay
 Date: 1987
 Prepared by: W. J. G. B. & Associates
 Date: 1987
 Project No.: W91279-87-1-0001
 Scale: 1:50,000
 Date: 1987

COE HYDRAULIC MODEL DATA









MAP 3 CHESAPEAKE BAY

Procentrum minimum - Dinoflagellate Potential Habitat

BASE AVERAGE

LEGEND

- Procentrum Minimum
- Base Average

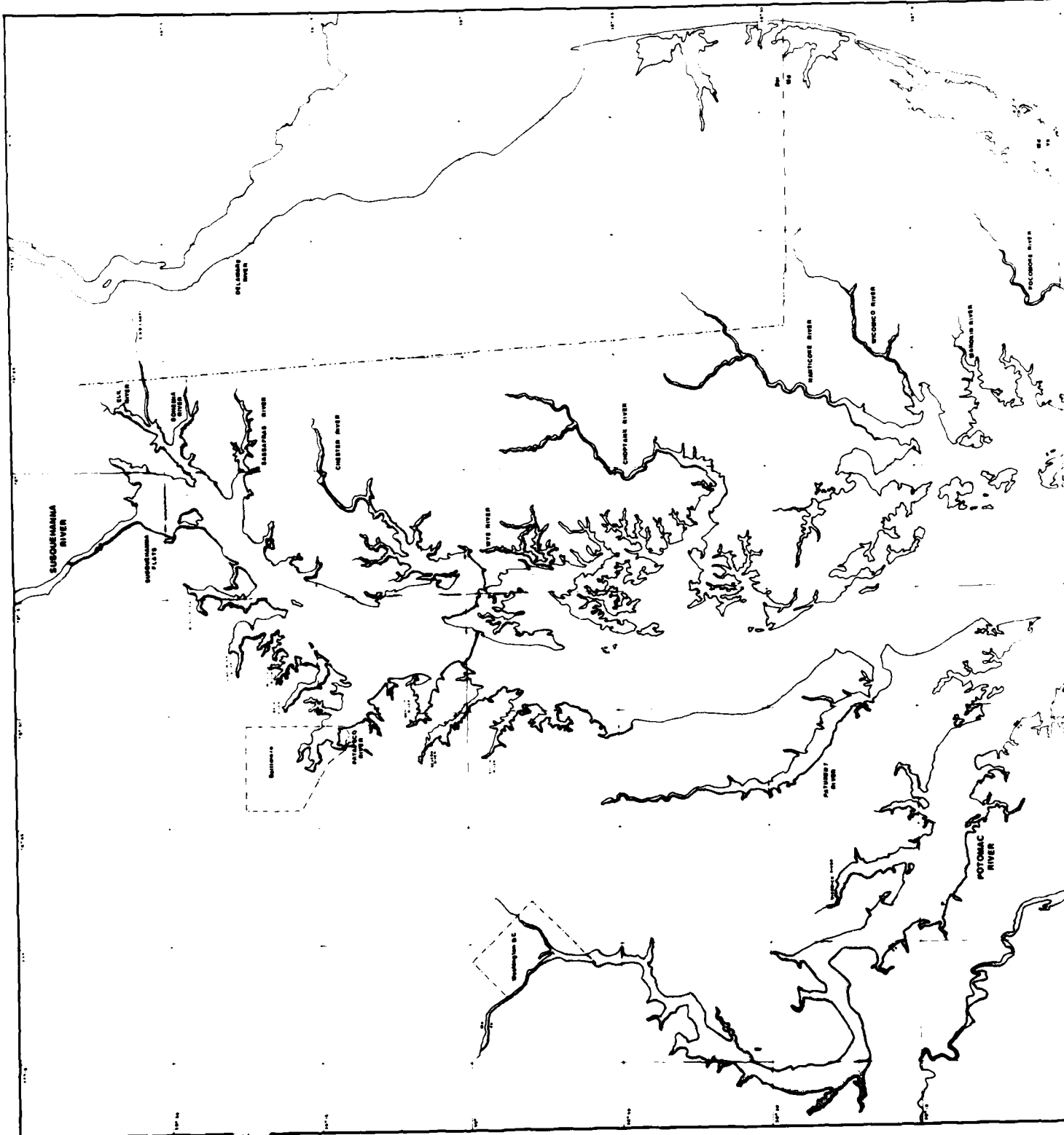
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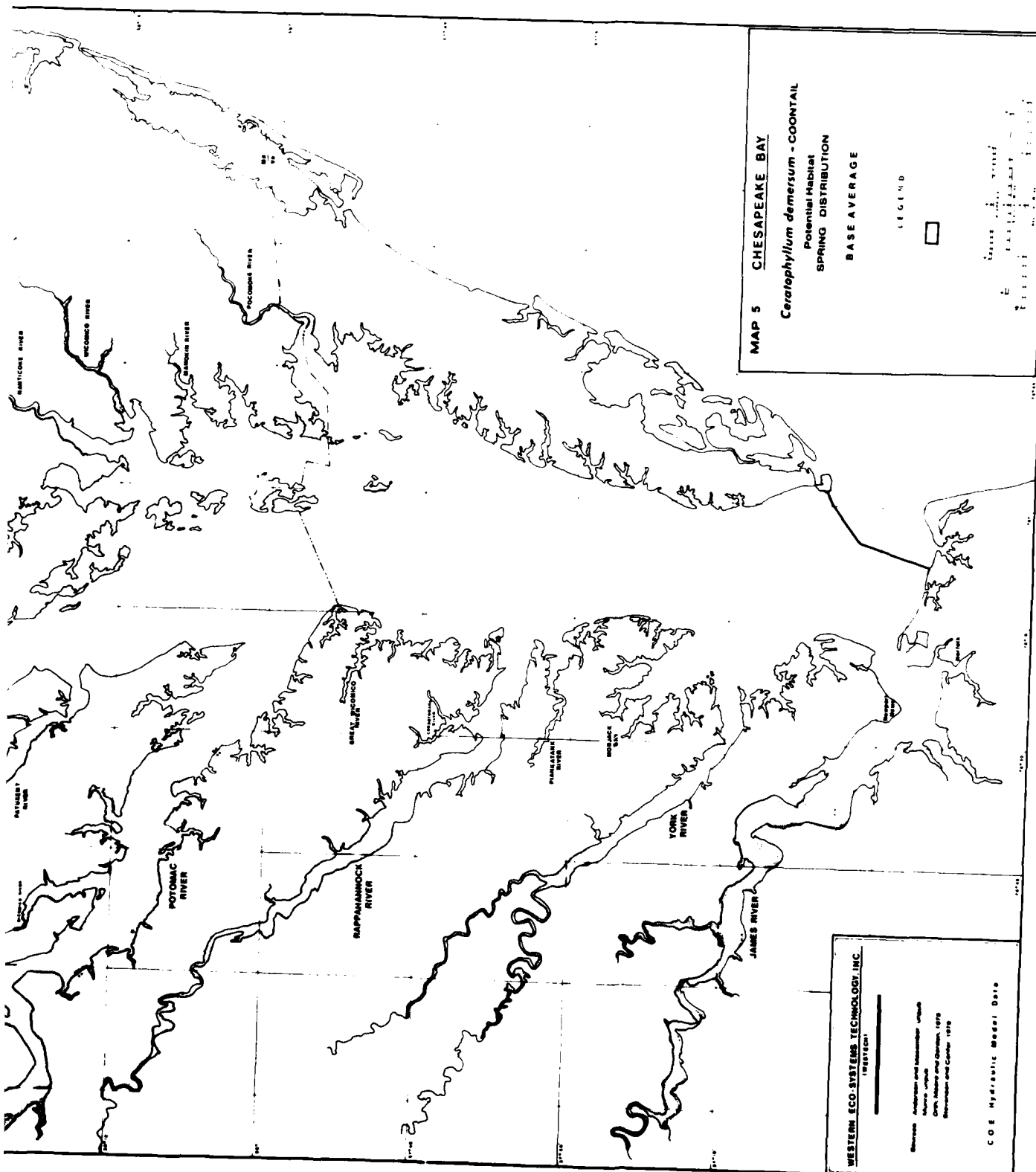
North Arrow

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MAP 5 CHESAPEAKE BAY
Ceratophyllum demersum - COONTAL
 Potential Habitat
 SPRING DISTRIBUTION
 BASE AVERAGE

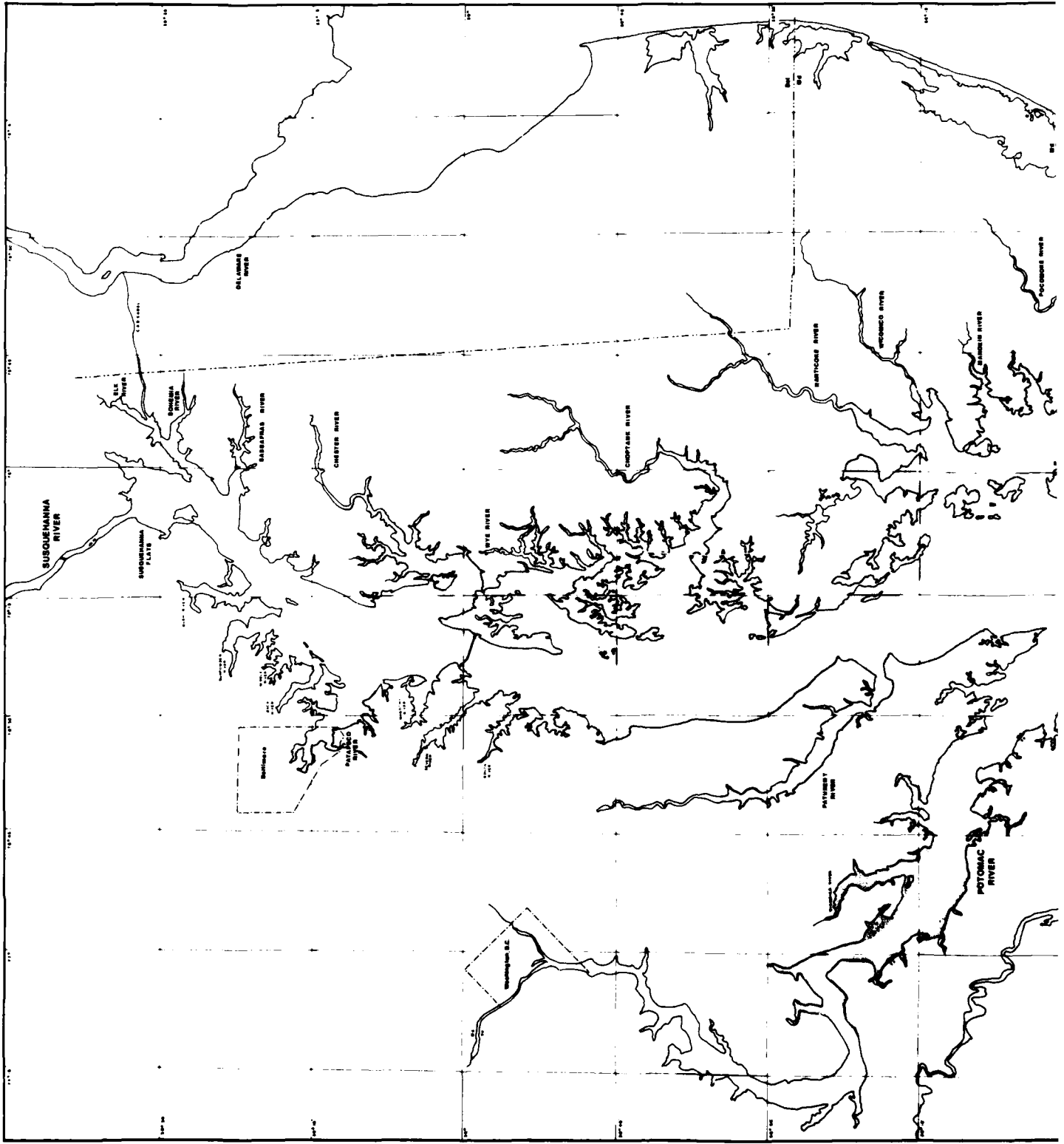
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 Project: Chesapeake Bay
 File: 11/11/79

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 Denver, Colorado 80231, USA
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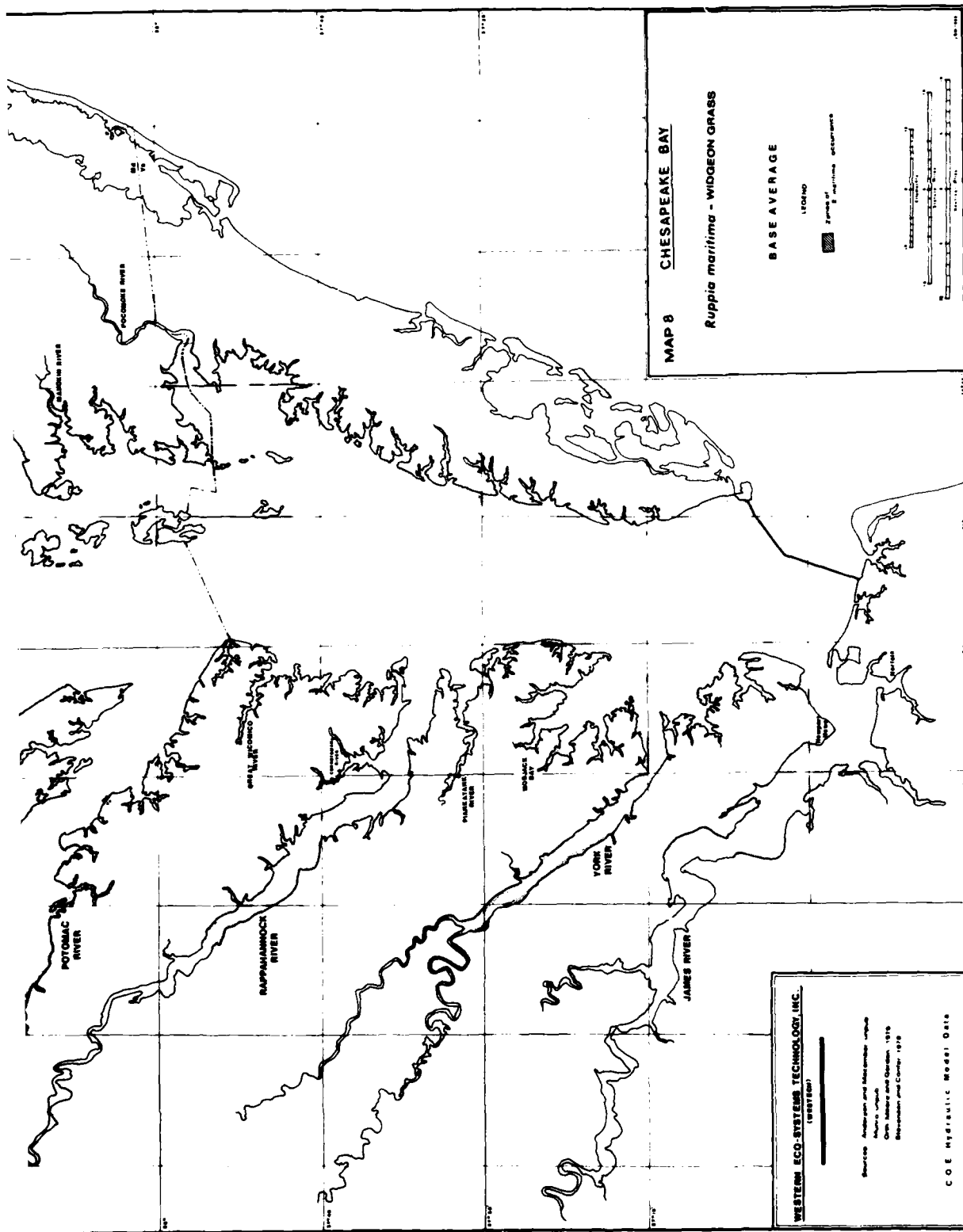
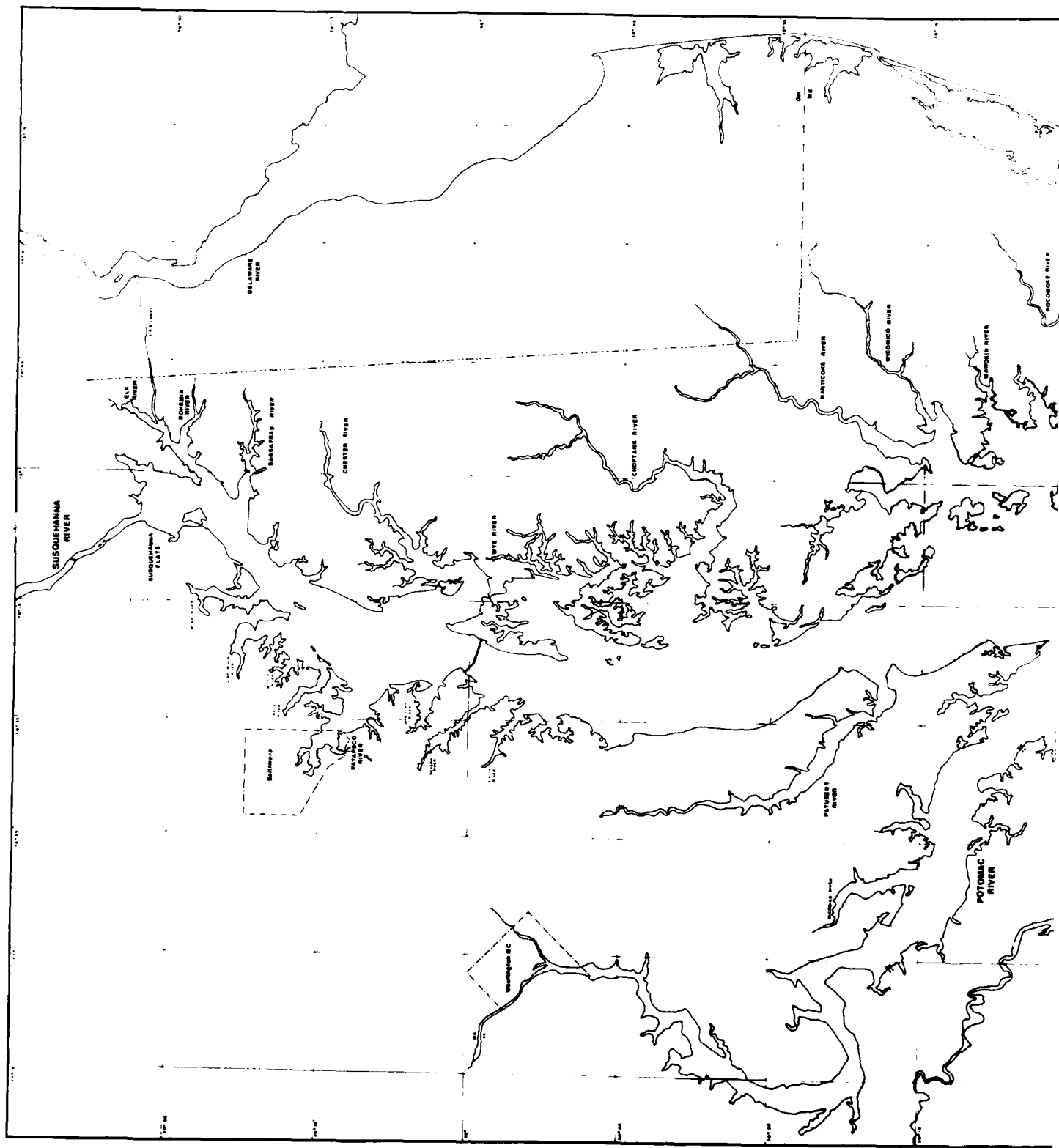
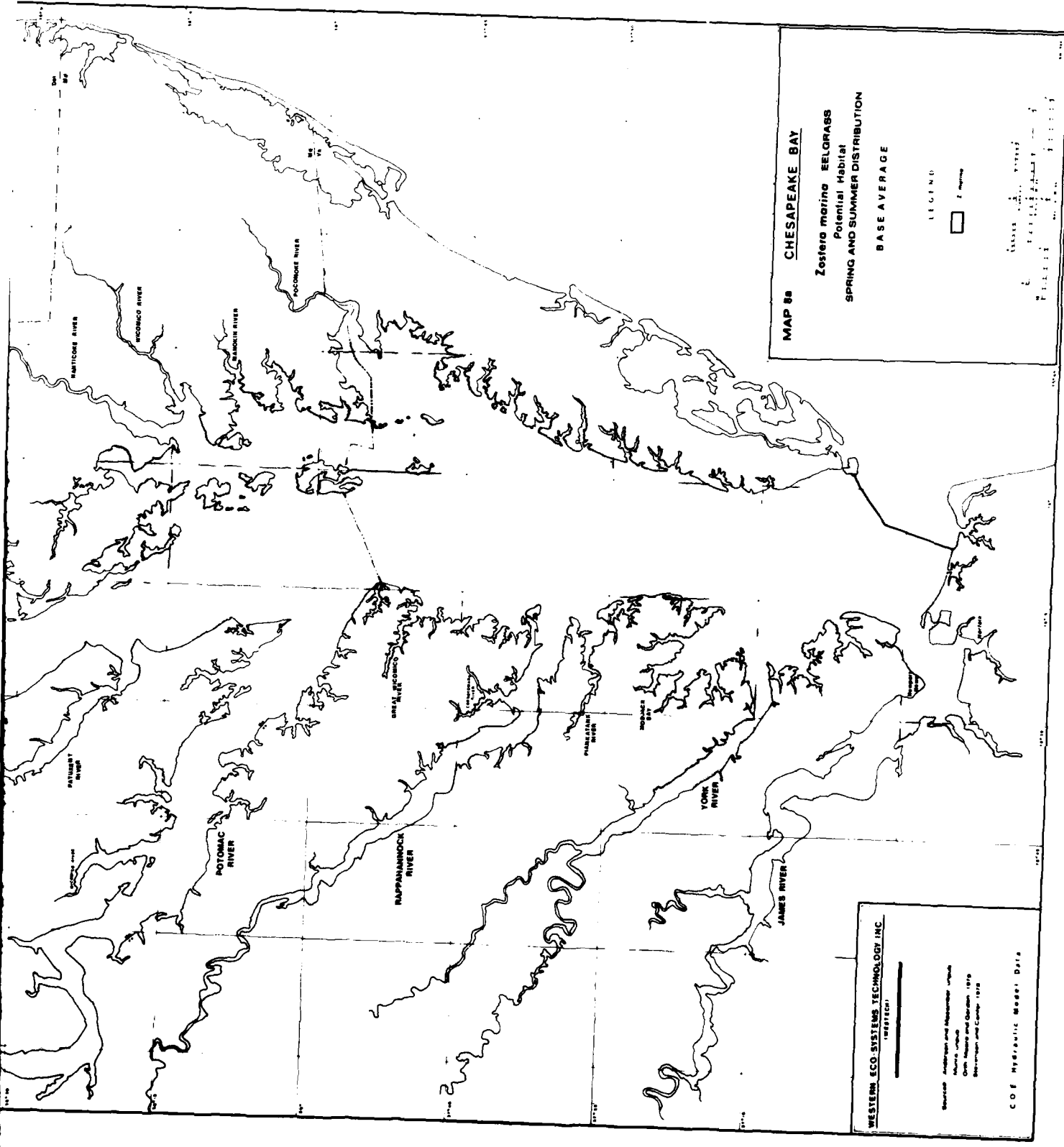


Plate 10





MAP 86 CHESAPEAKE BAY
Zostera mering EELGRASS
 Potential Habitat
 SPRING AND SUMMER DISTRIBUTION
 BASE AVERAGE

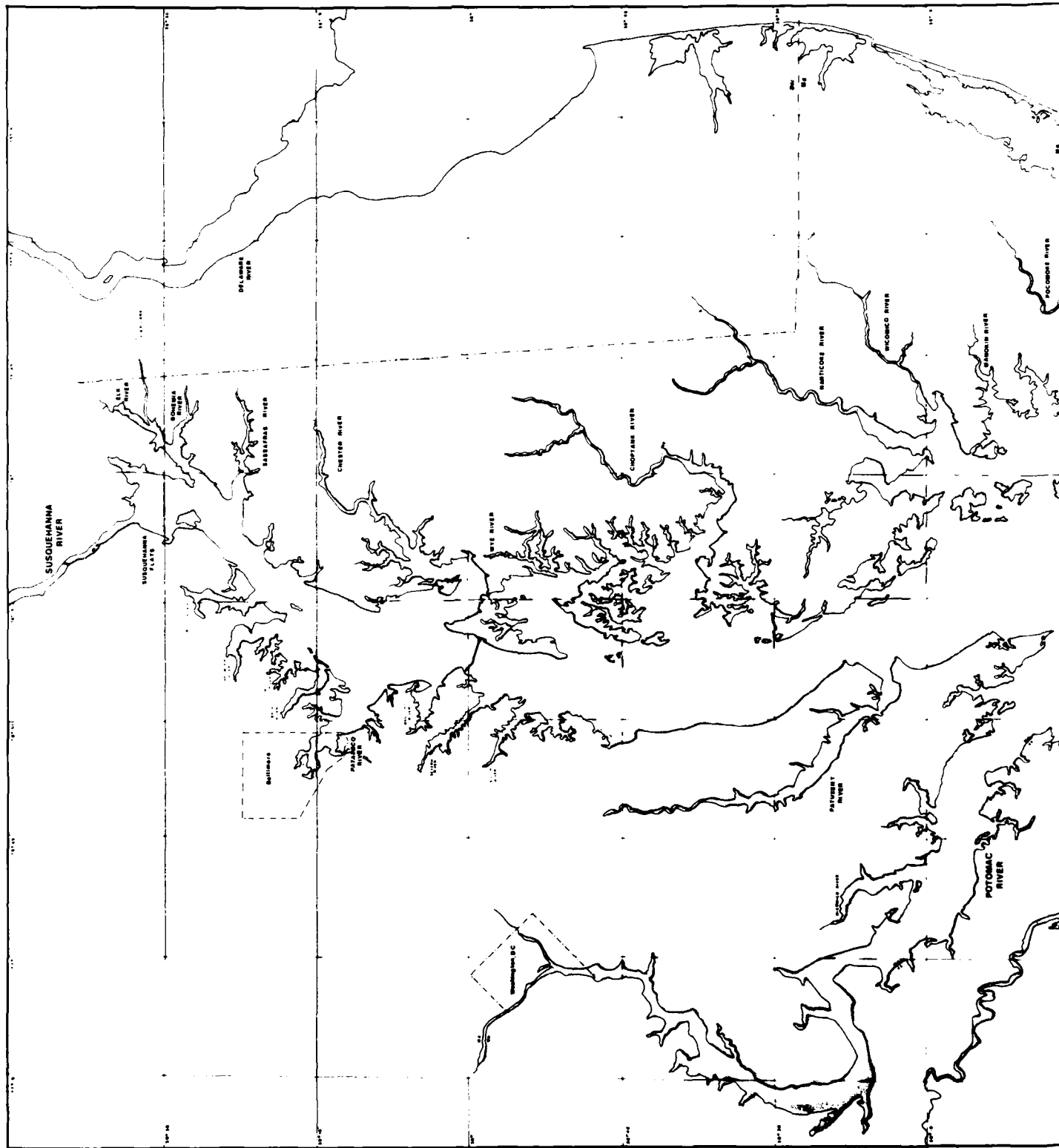
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 [White Box] Base Average

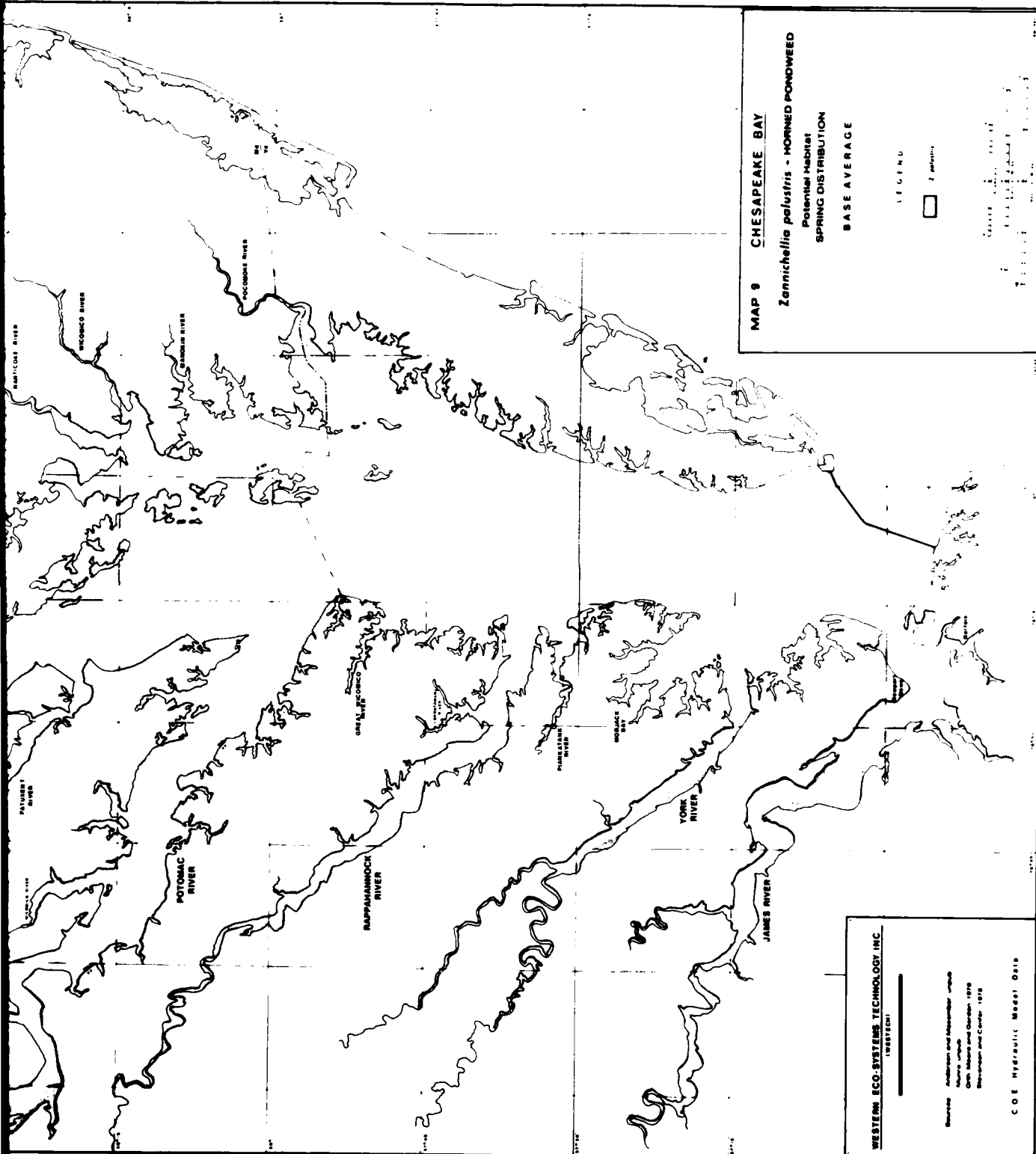
DATE: 10/15/86
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 CHECKED BY: J. J. [unclear]

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Source: Analysis and Interpretation of
 Hydrographic Data
 Data: 1970 and 1971
 Sources: [unclear] and [unclear]

COE HYDRAULIC MODEL DATA





MAP 9 CHESAPEAKE BAY
Zennichellio palustris - HORNED PONDWEED
 Potential Habitat
 SPRING DISTRIBUTION
 BASE AVERAGE

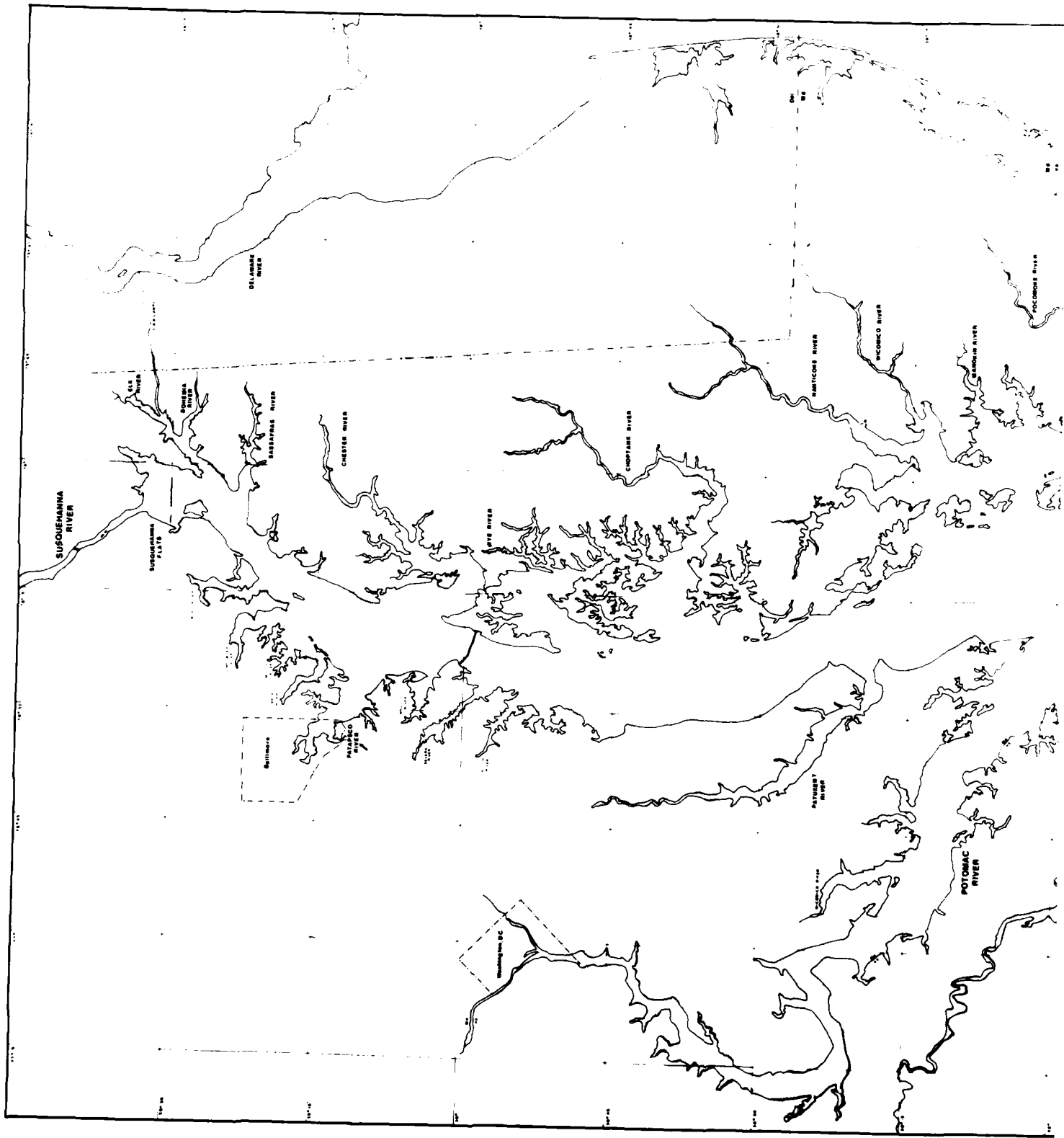
LEGEND
 1 mile

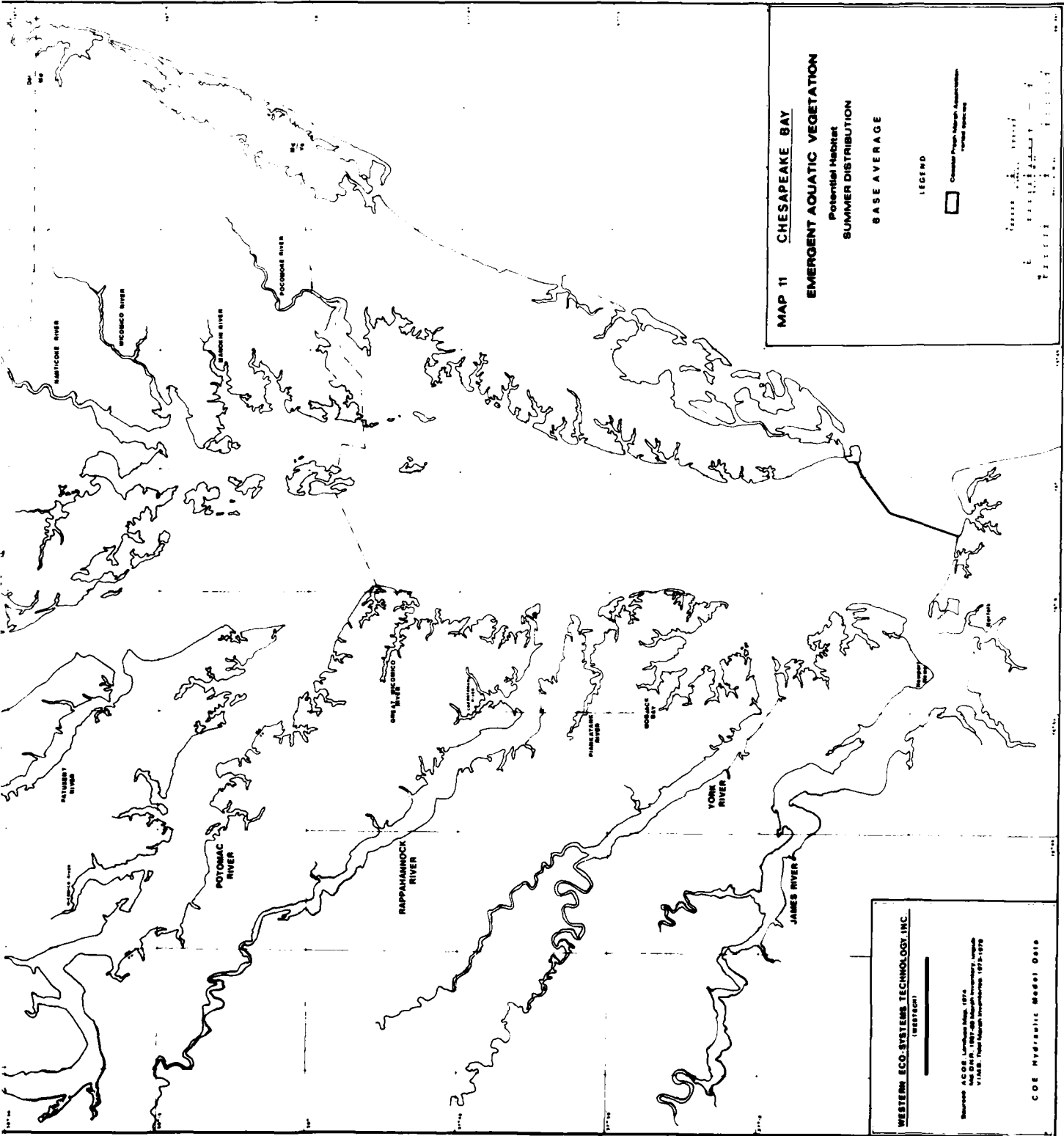
WESTERN ECO-SYSTEMS TECHNOLOGY, INC.
 (WESTECH)

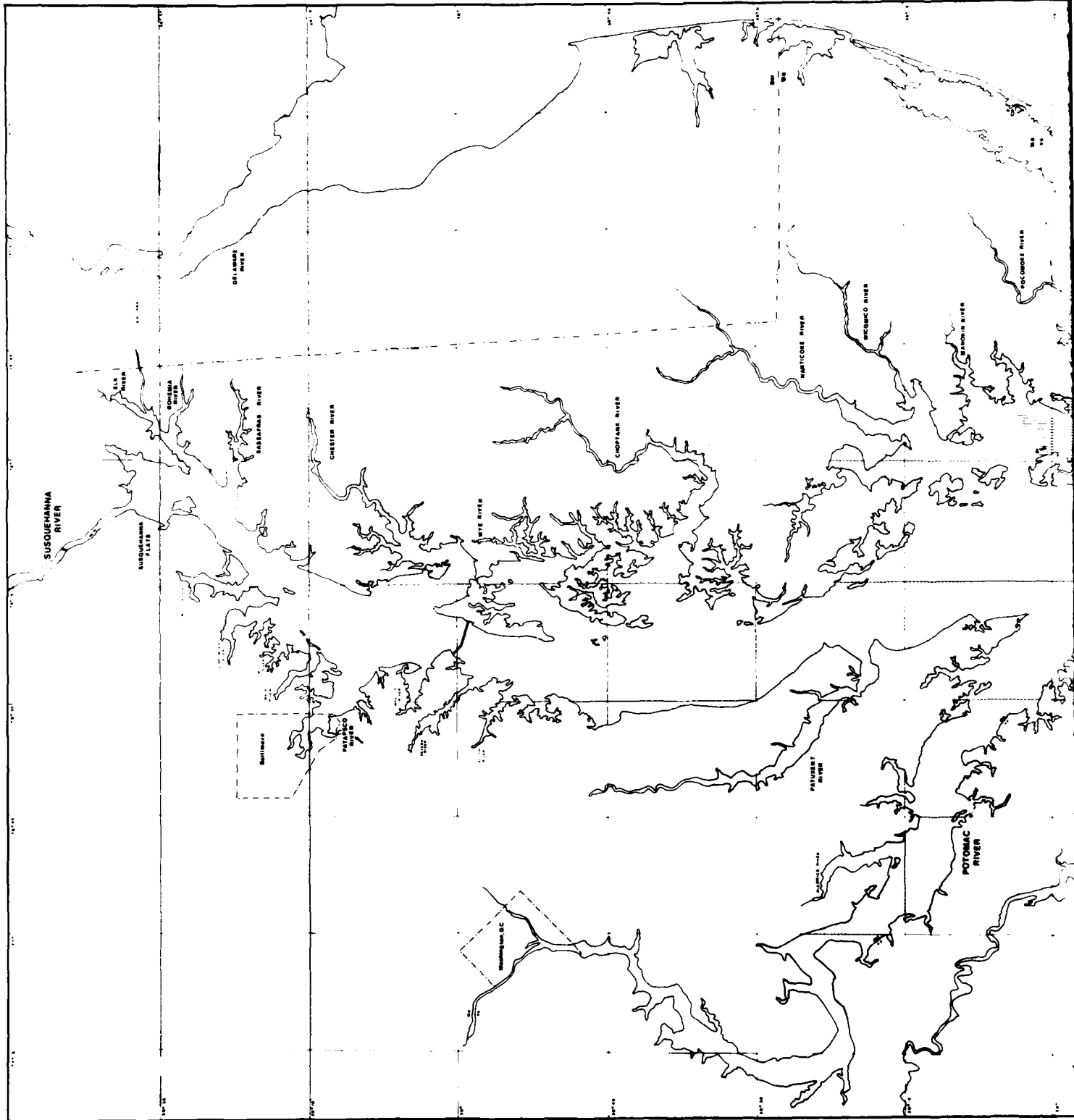
Source: Anderson and Macomber, 1976
 Nature Link
 Data: Johnson and Gierke, 1976
 Distribution and Correlation, 1976

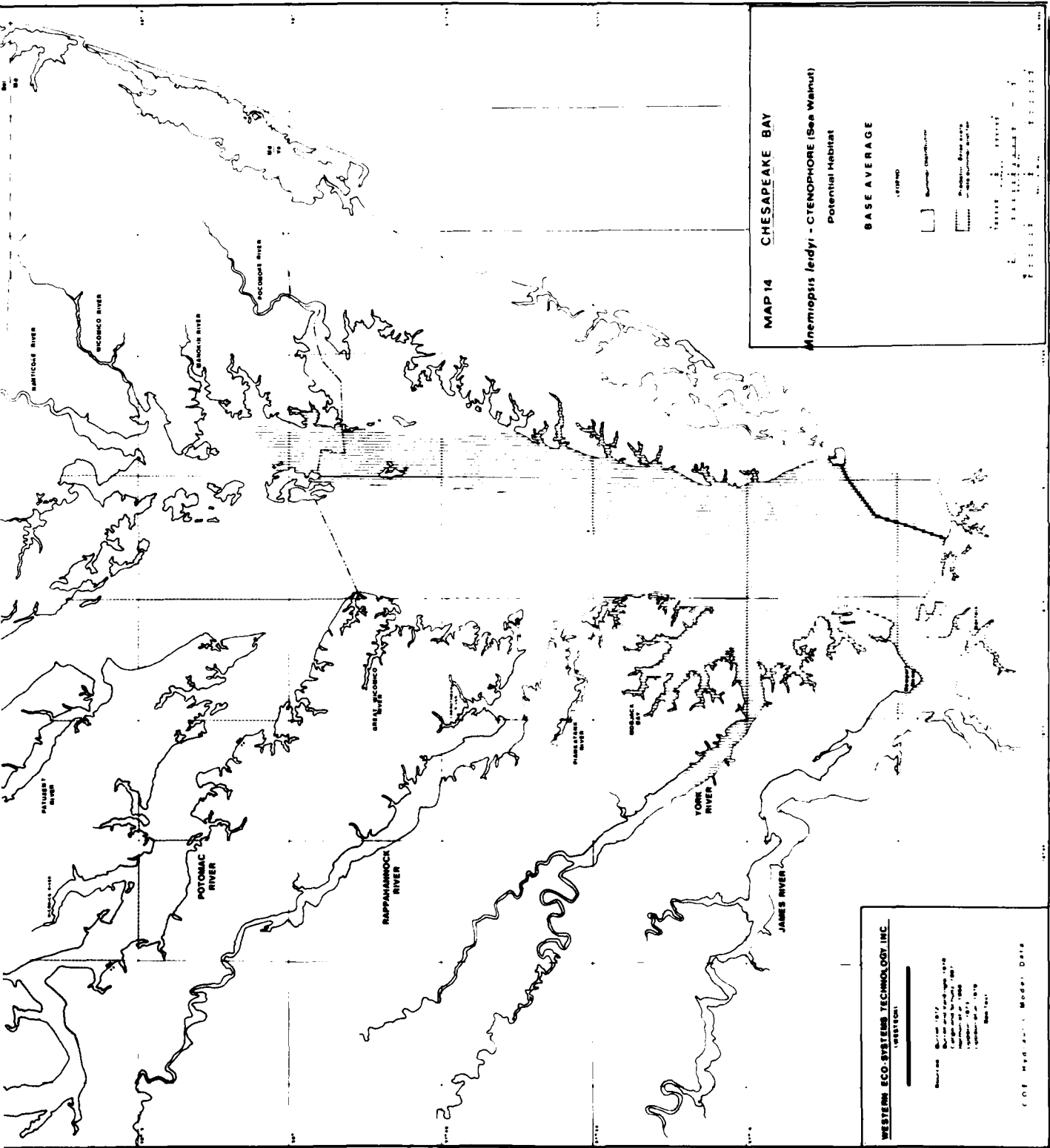
COE Hydraulic Model Data

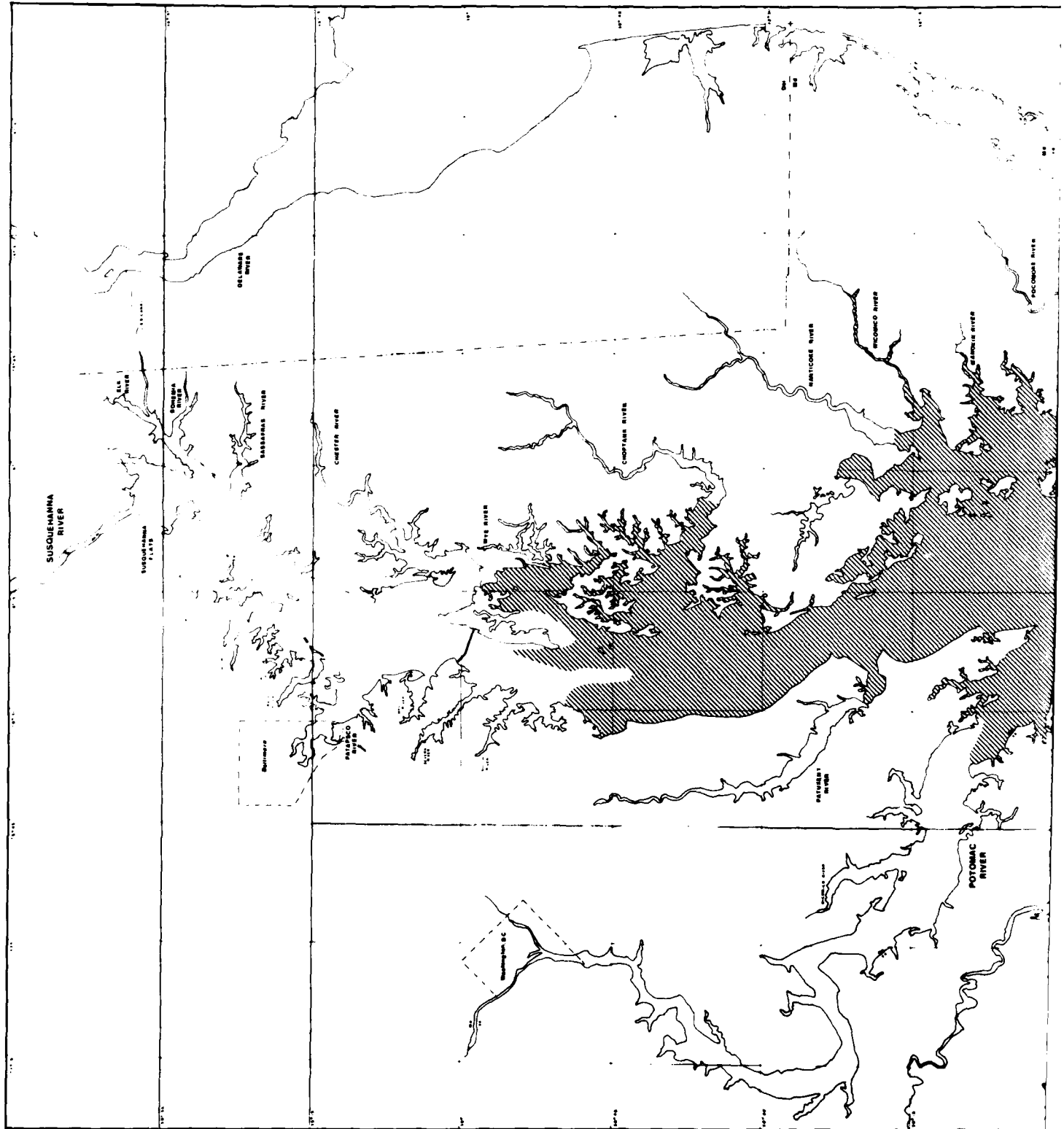
Plate 12

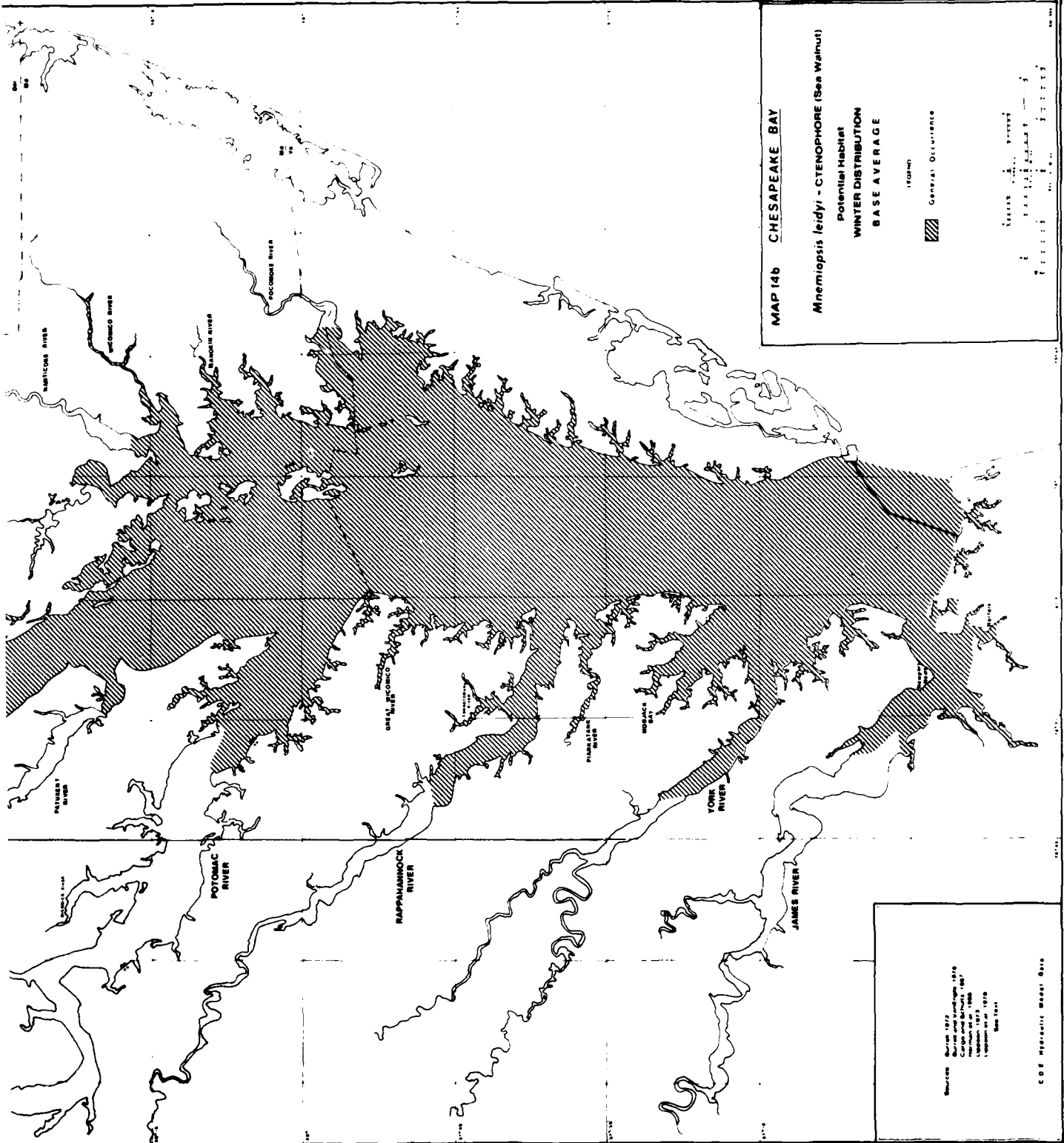












MAP 14b CHESAPEAKE BAY

Mnemiopsis leidyi - CYENOPHORE (Sea Walnut)

Potential Habitat
WINTER DISTRIBUTION
BASE AVERAGE

LEGEND

▨ General Occurrence

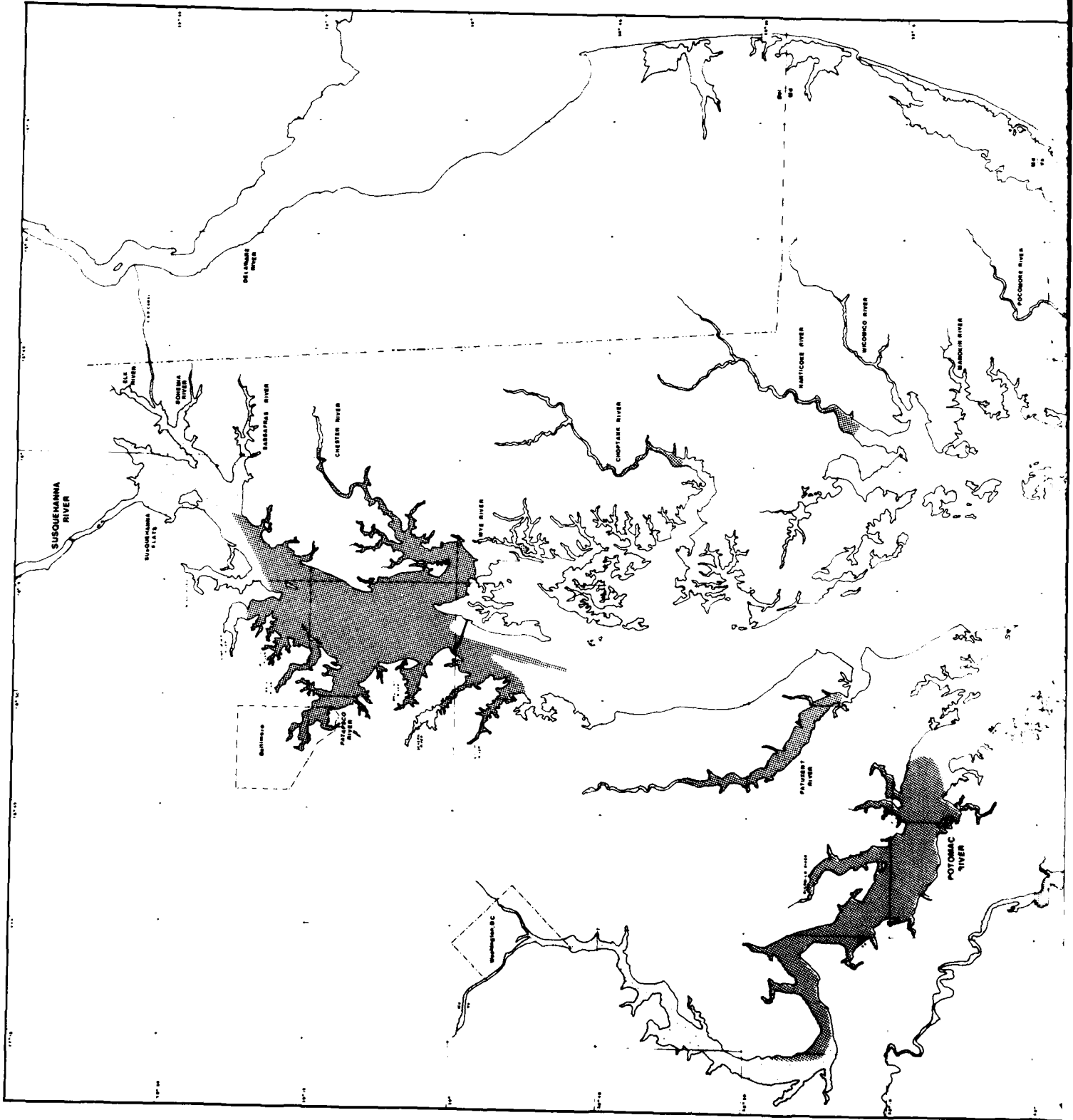
Scale: 1:100,000

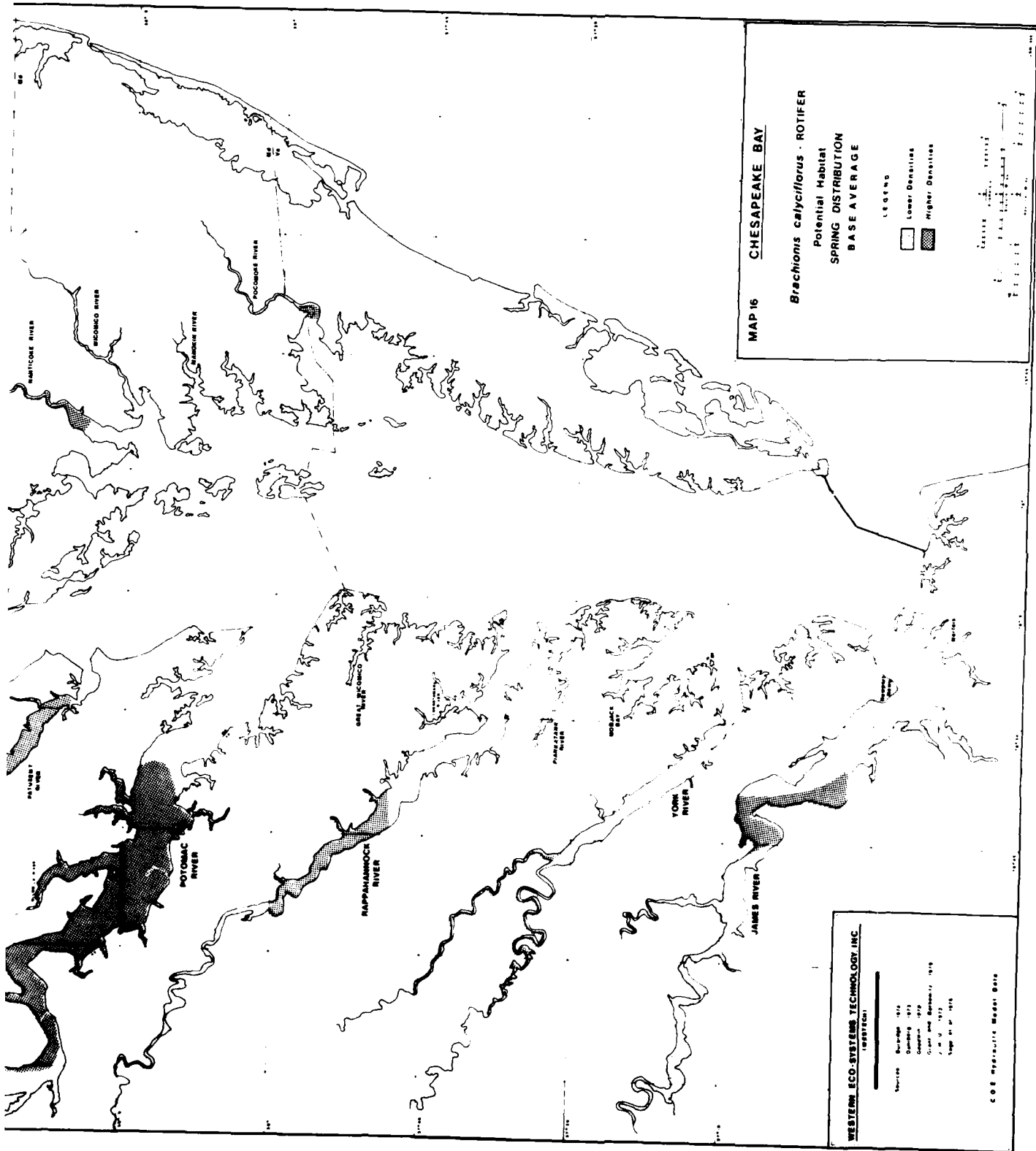
0 1 2 3 4 5 6 7 8 9 10

0 1 2 3 4 5 6 7 8 9 10

Source: Smith, 1977
 Smith and Lindgren, 1979
 Cople and Smith, 1981
 Cople and Smith, 1982
 Cople and Smith, 1983
 Smith, 1984

C. D. F. HERRICK, MARSH, DELE.





MAP 16 CHESAPEAKE BAY

Brachionis calyciflorus - ROTIFER
 Potential Habitat
 SPRING DISTRIBUTION
 BASE AVERAGE

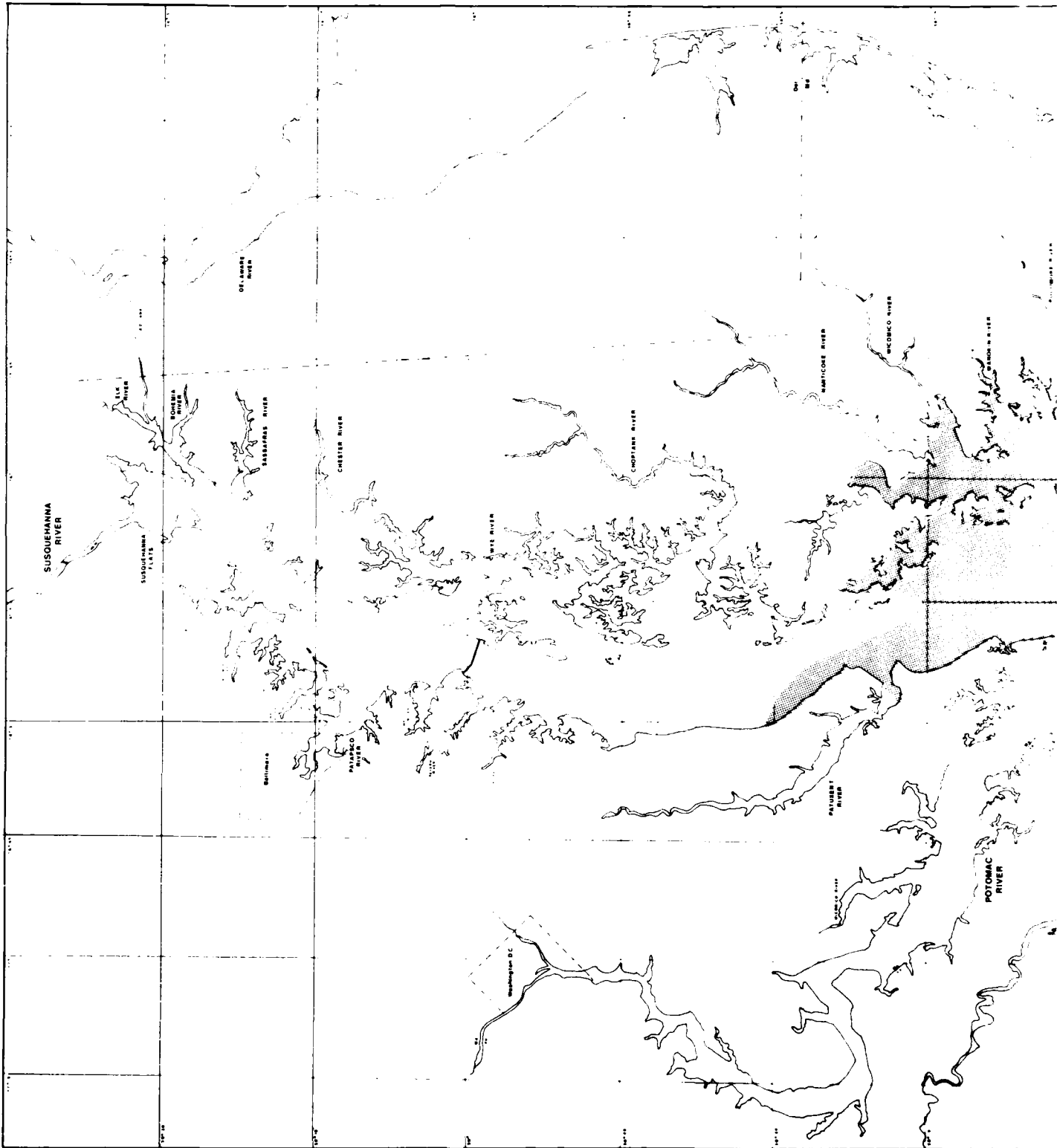
LEGEND
 Lower Densities
 Higher Densities

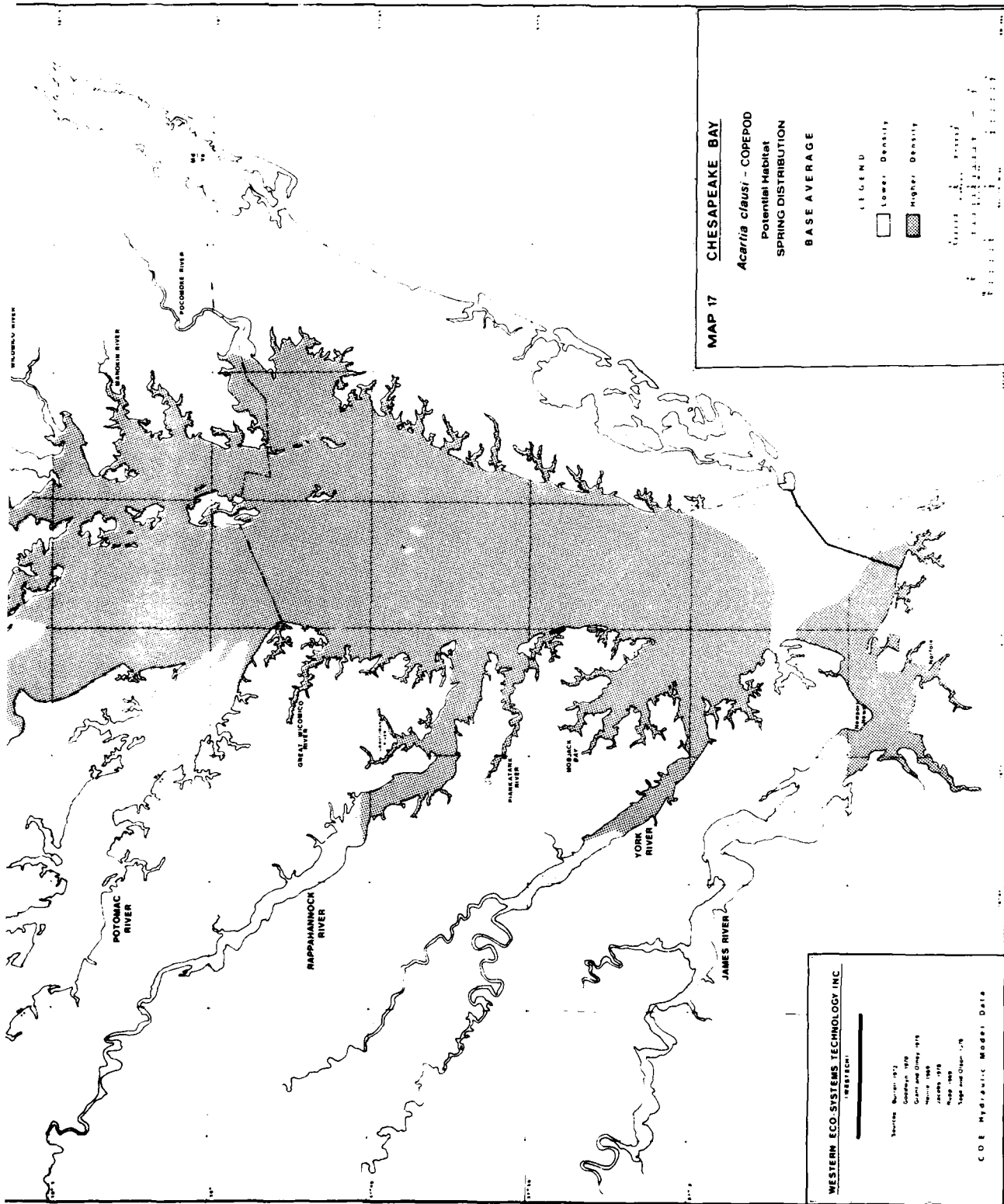


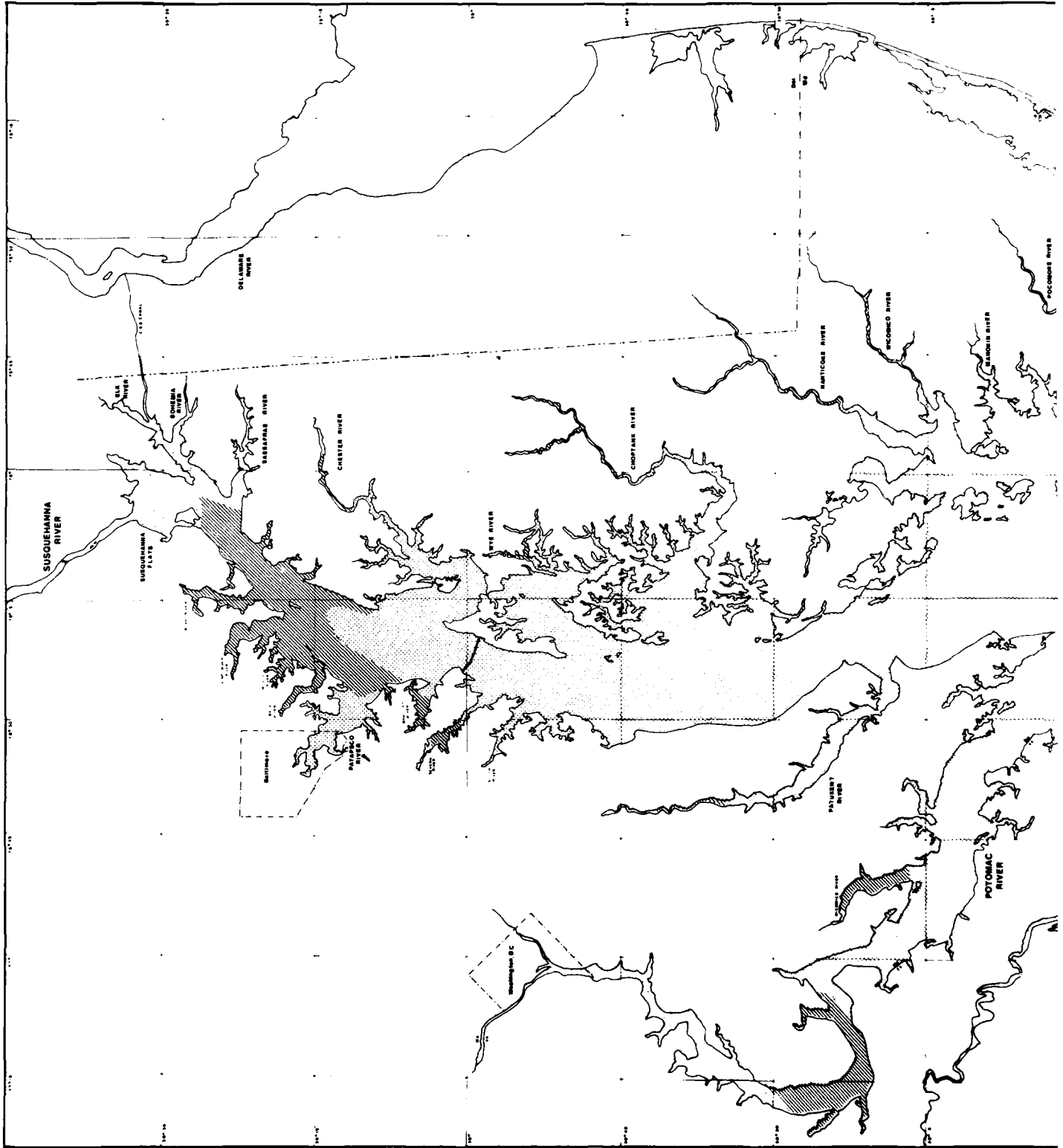
WESTERN ECO-SYSTEMS TECHNOLOGY, INC.
 (8575252)

Source: Burchard 1971
 Cushing 1971
 Cushing 1972
 Grant and Burchard 1979
 J. M. J. 1973
 Voge et al 1976

COE Hydrologic Basin Data



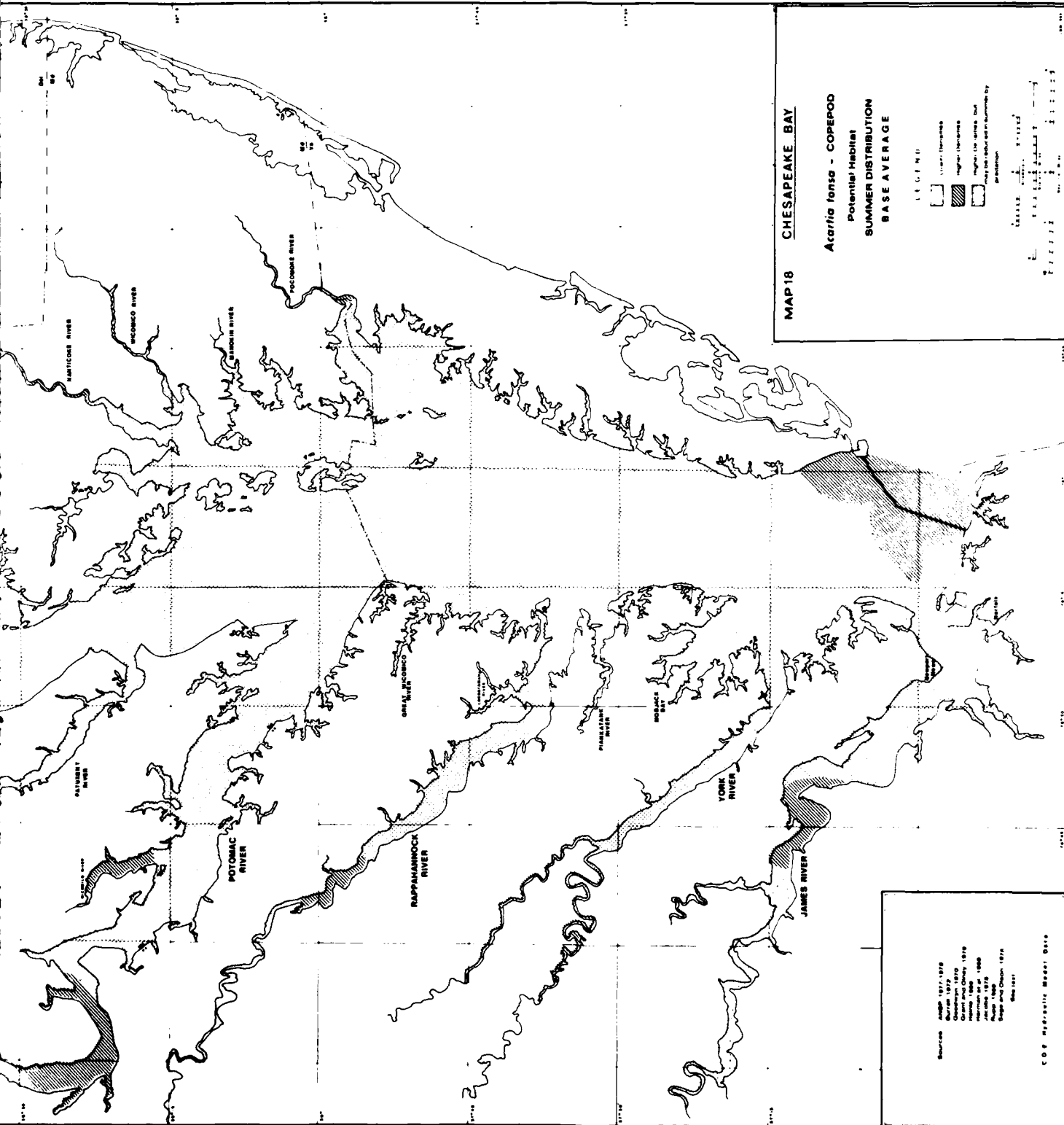




MAP 18 CHESAPEAKE BAY

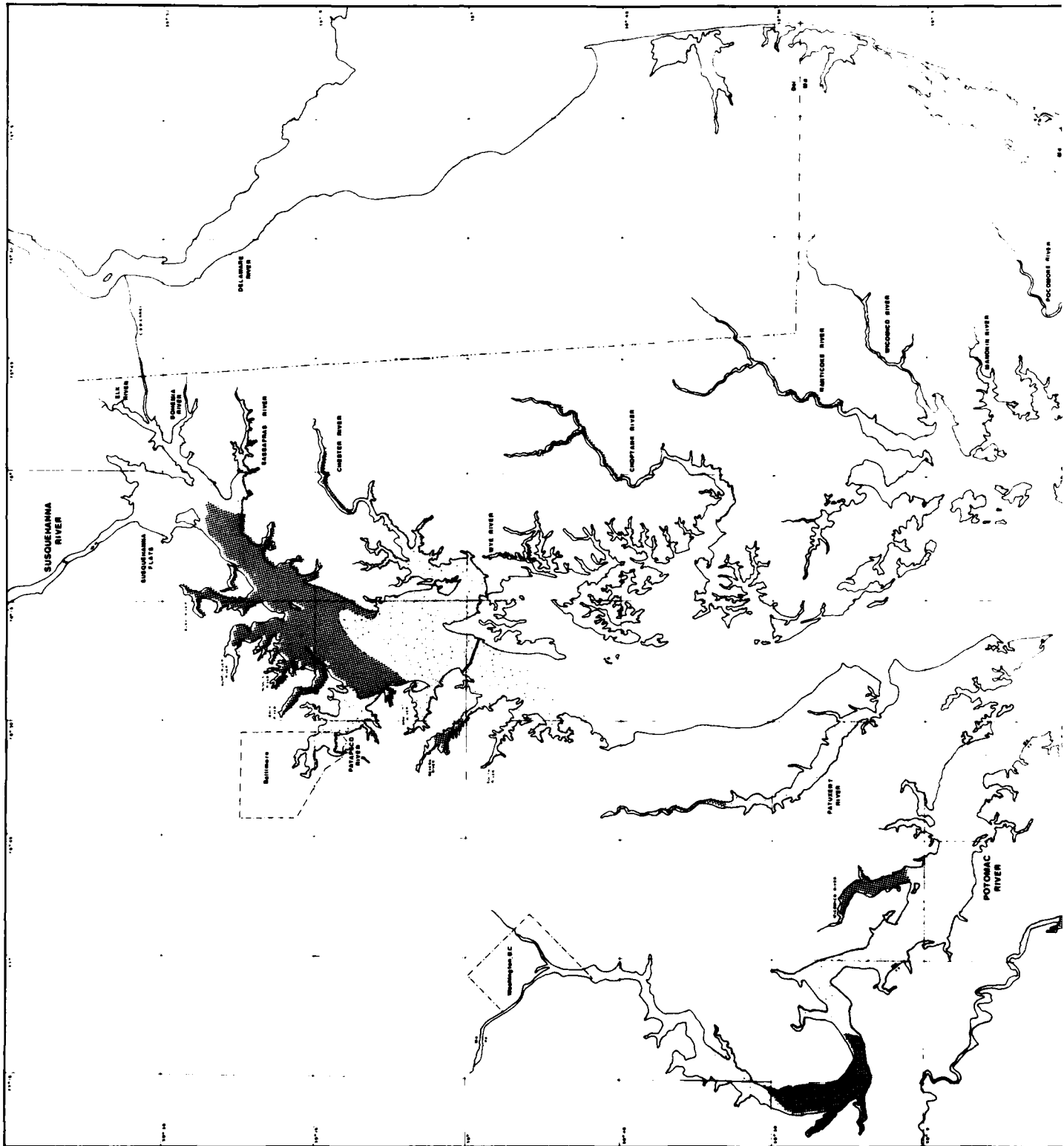
Acartia tonsa - COPEPOD
Potential Habitat
SUMMER DISTRIBUTION
BASE AVERAGE

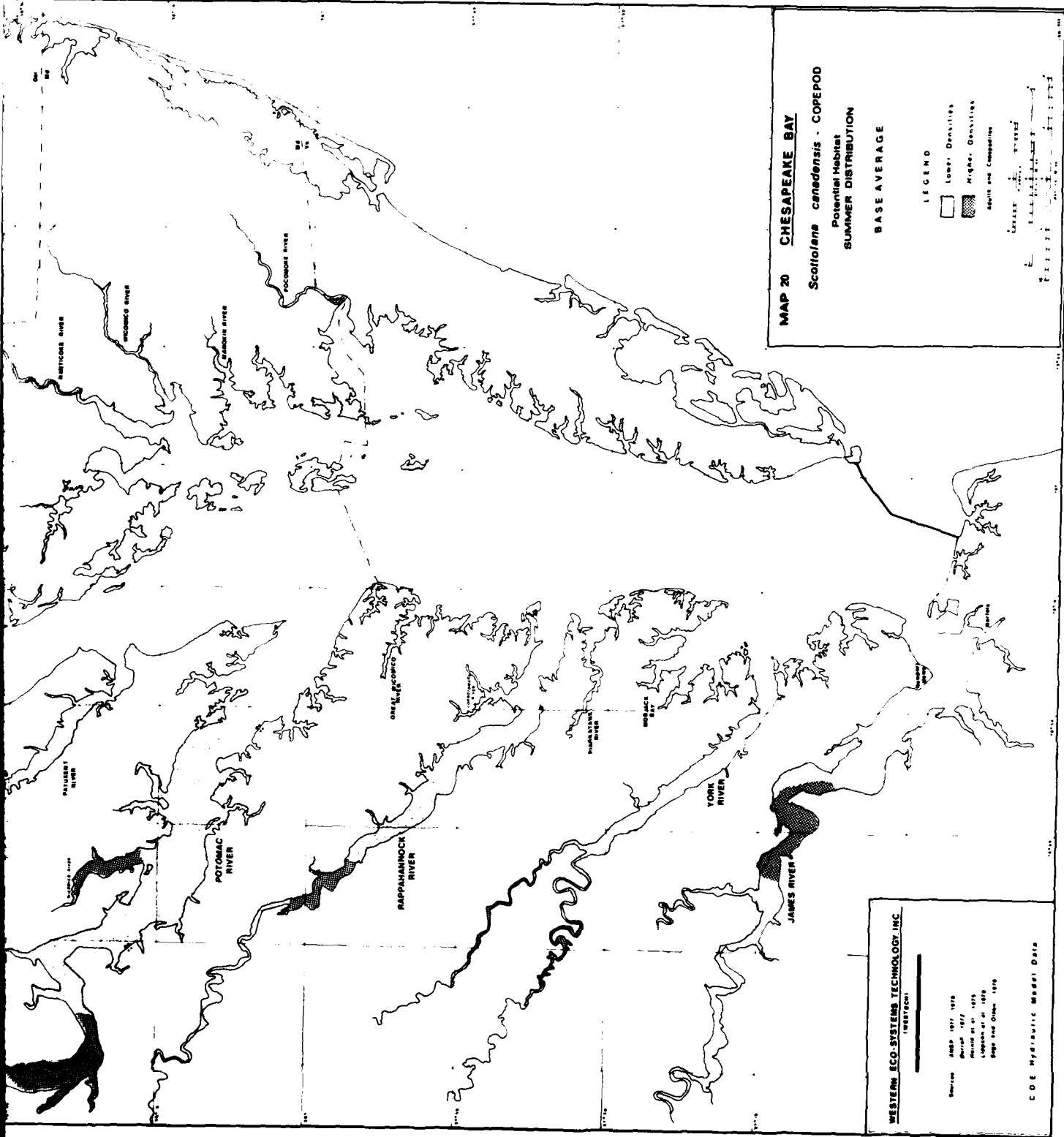
- LEGEND
- Higher Abundance
 - Lower Abundance
 - Areas Not Surveyed by Institution



Sources: Auld, 1937, 1978
 Boyer, 1975
 Boyer and Boyer, 1976
 Chittenden, 1974
 Chittenden and Boyer, 1978
 Hargrave, 1966
 Hargrave and Boyer, 1966
 Jorgensen, 1974
 Pappas, 1966
 Sage and Chittenden, 1974
 See text

COPY REPRODUCED FROM ORIGIN





MAP 20 CHESAPEAKE BAY
Scofolana canadensis - COPEPOD
 Potential Habitat
 SUMMER DISTRIBUTION
 BASE AVERAGE

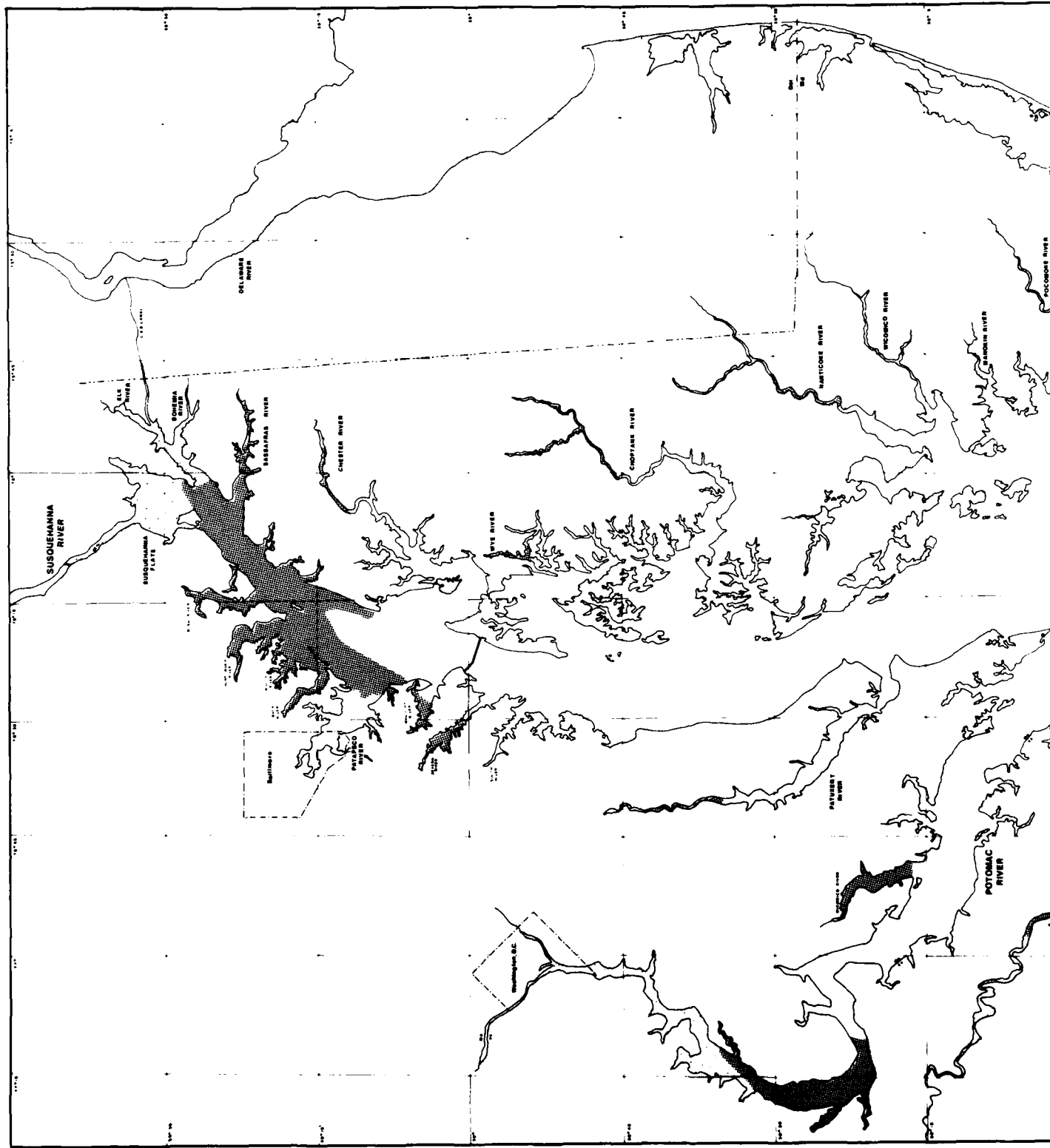
LEGEND
 Lower Densities
 Higher Densities
 Base Average

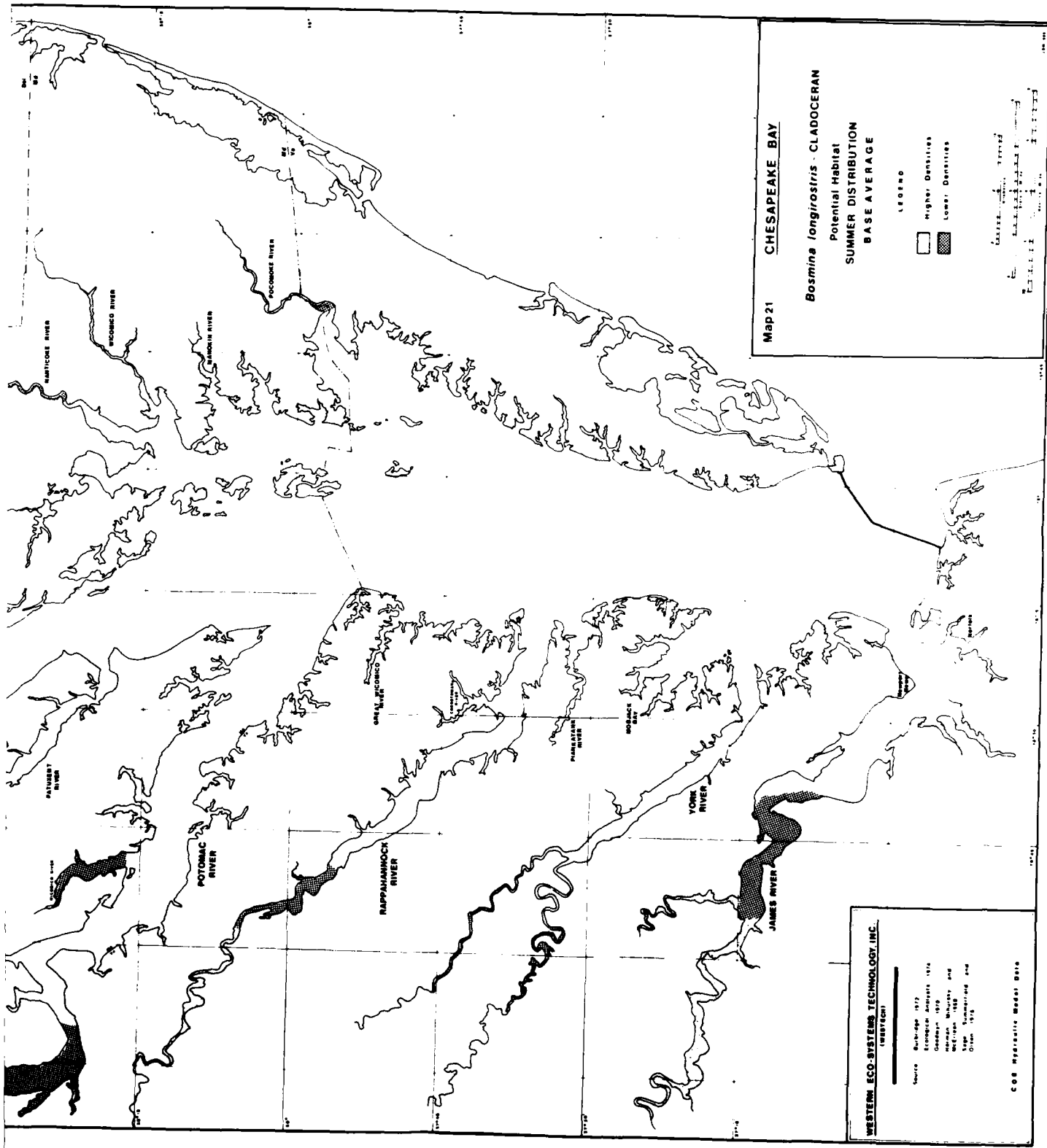
Scale: 1:50,000
 0 1 2 3 4 5 6 7 8 9 10 Miles
 0 1 2 3 4 5 6 7 8 9 10 Kilometers

WESTERN ECO-SYSTEMS TECHNOLOGY, INC.
 WESTECH

Source: JMSB 1977, 1979
 Smith 1977, 1978
 Lyman et al. 1979
 SPOB and Other 1979

CDE Hydraulic Model Data





Map 21 **CHESAPEAKE BAY**

Bosmina longirostris - CLADOCERAN
Potential Habitat
SUMMER DISTRIBUTION
BASE AVERAGE

LEGEND

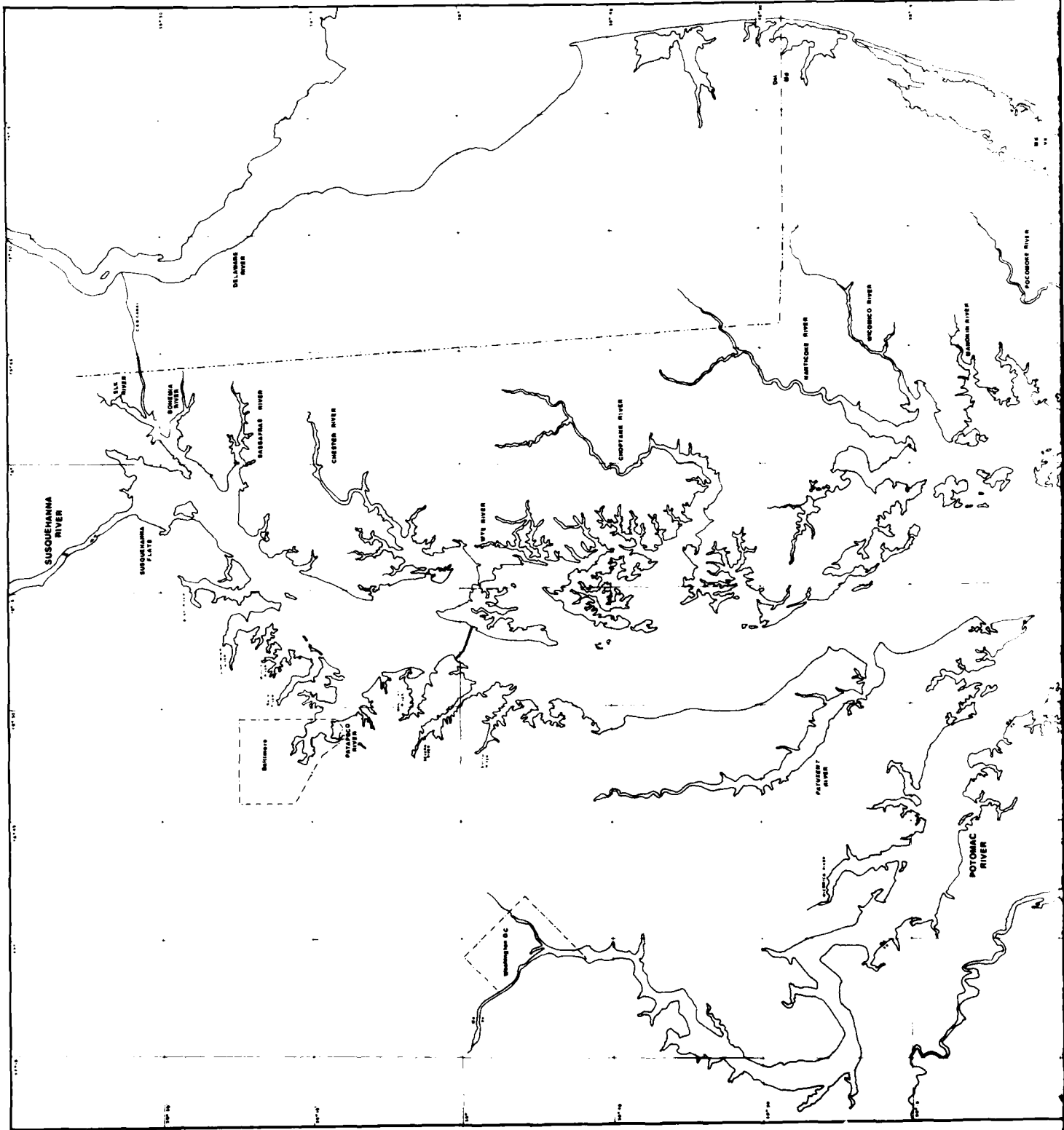
Higher Densities
Lower Densities

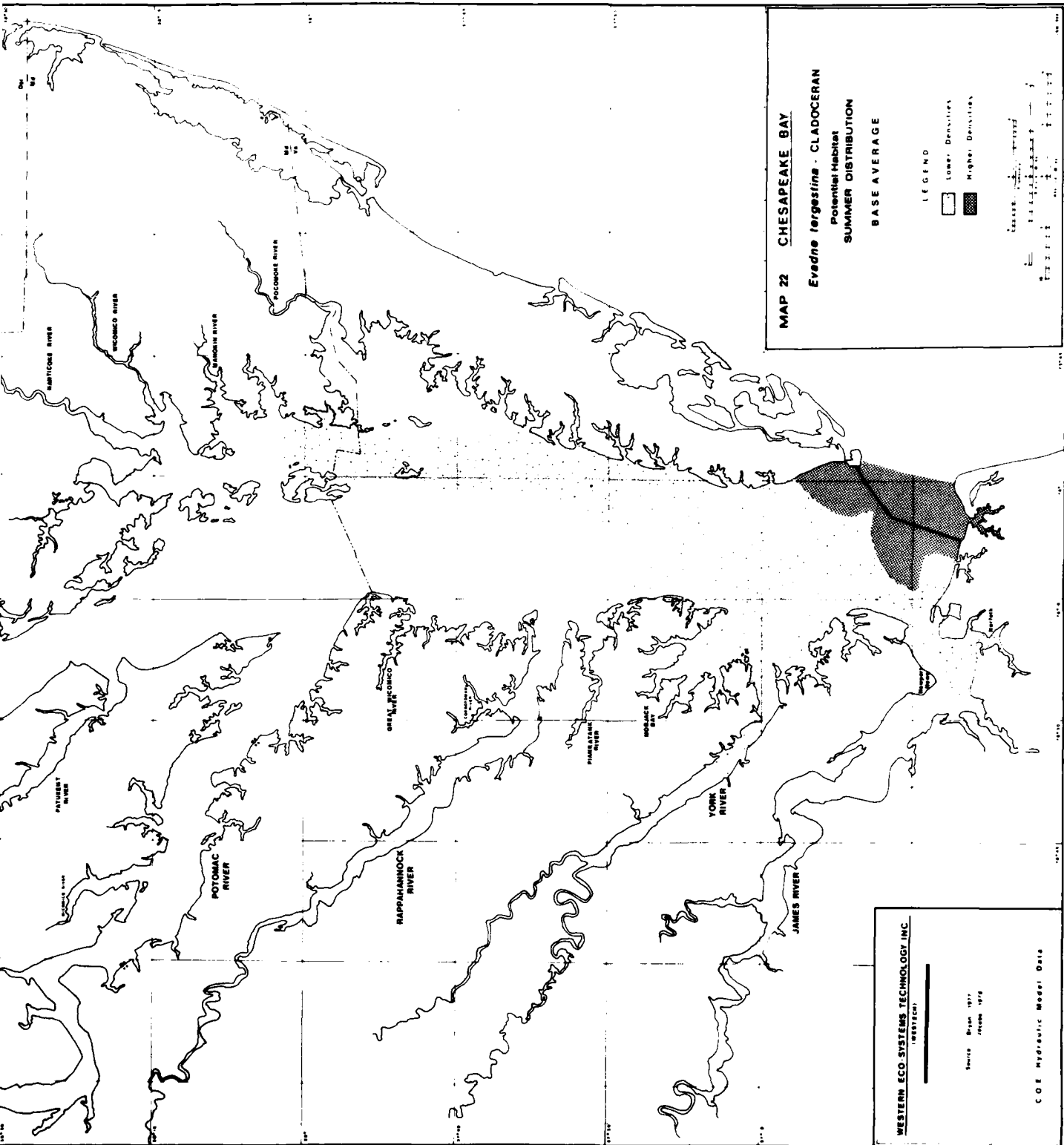
Scale: 1:50,000
NAD 83
Datum: North American Datum of 1983
Units: Feet

WESTERN ECO-SYSTEMS TECHNOLOGY, INC.
WESTVICT

Source: Sub-App 1972
Economic Analysis 1974
Gordon 1979
Marion, Whittely and
Simpson 1980
State Sub-App 1981 and
Other 1978

COB Hydrologic Model Data

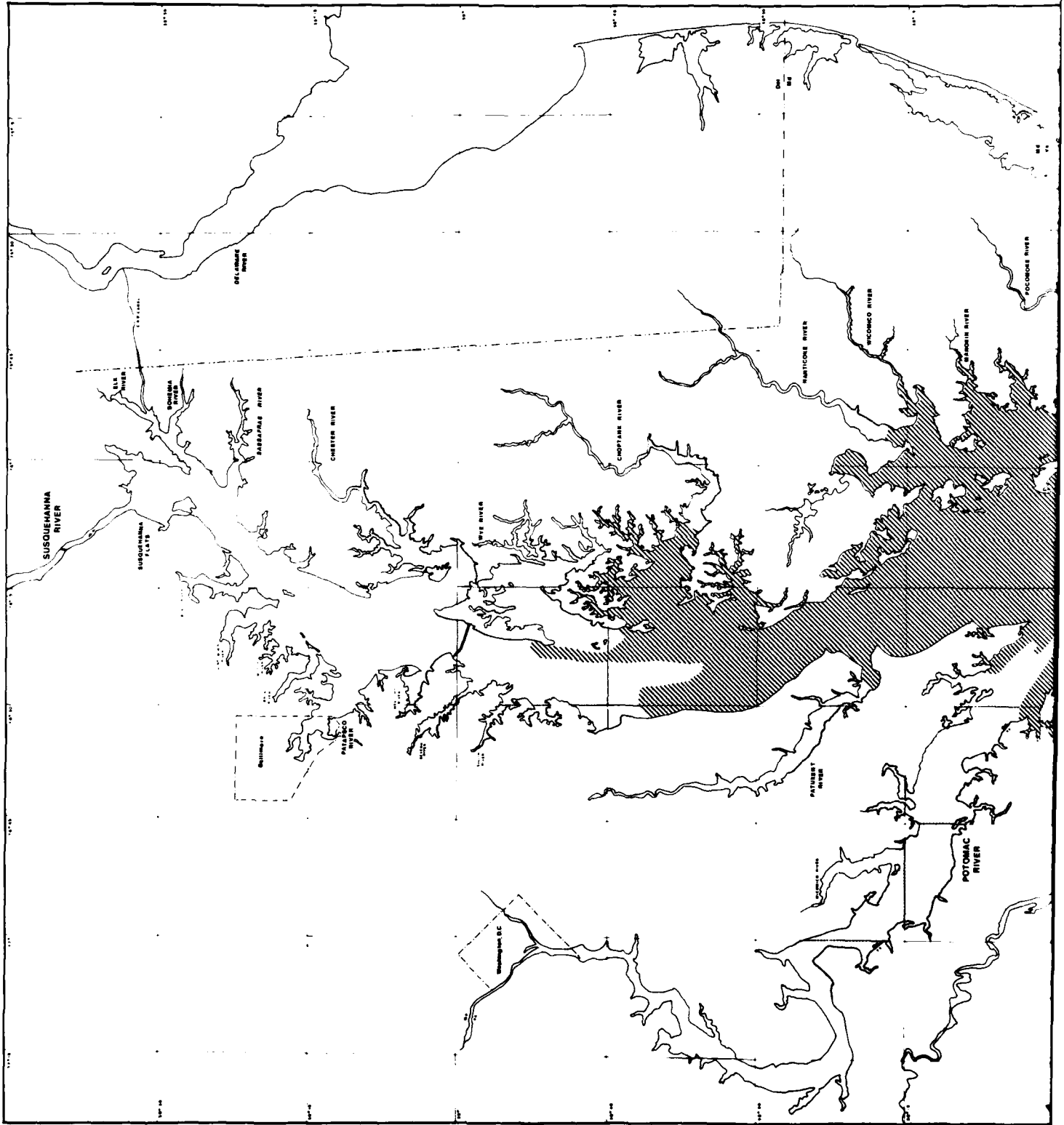


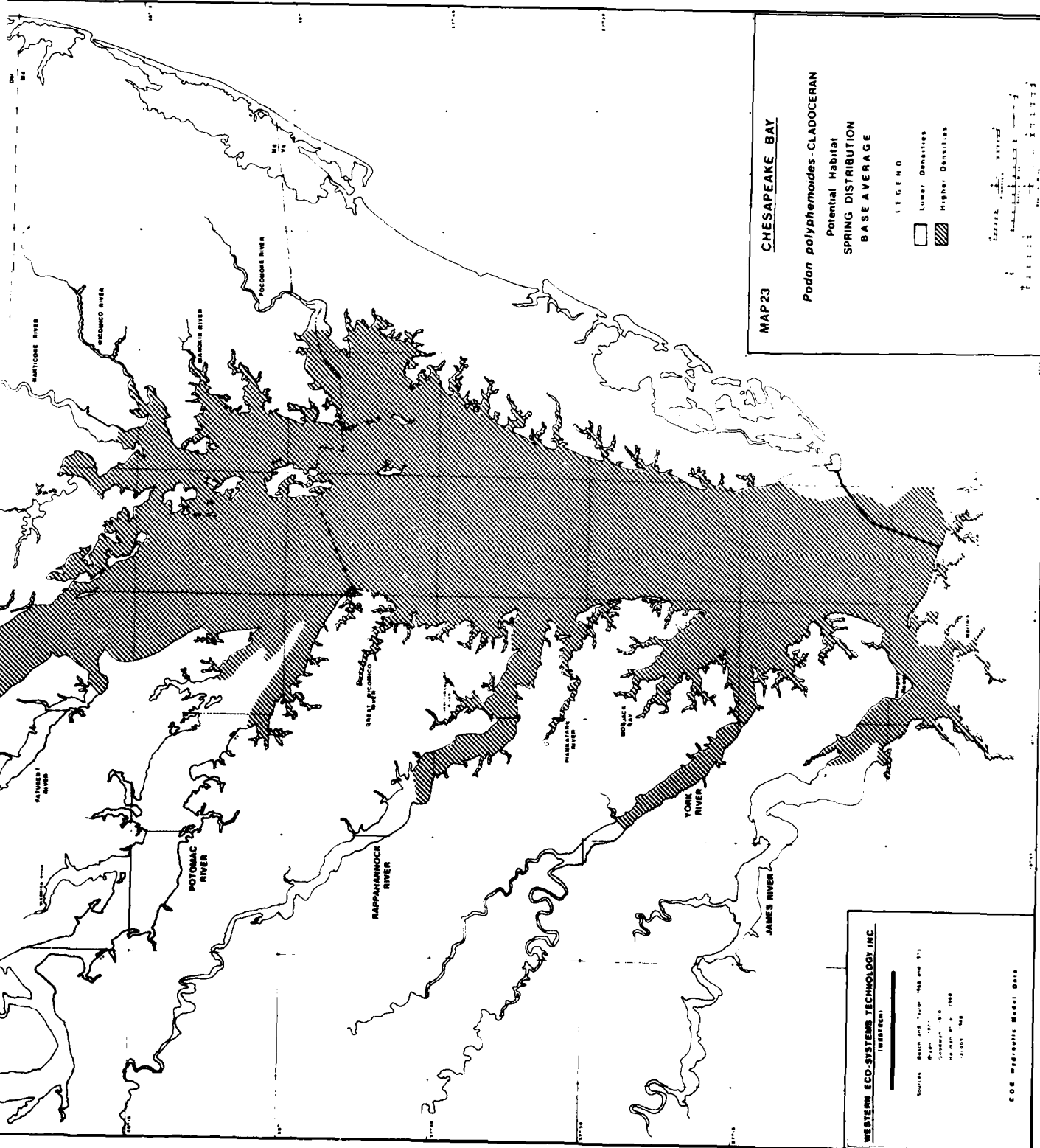


MAP 22 CHESAPEAKE BAY
Evedne tergestina - CLADOCERAN
 Potential Habitat
 SUMMER DISTRIBUTION
 BASE AVERAGE

LEGEND
 Lower Density
 Higher Density

WESTERN ECO-SYSTEMS TECHNOLOGY INC.
 WESTTECH
 SOURCE: BROWN 1977
 JUNE 1978
 COE HYDRAULIC MODEL DATA





MAP 23 CHESAPEAKE BAY

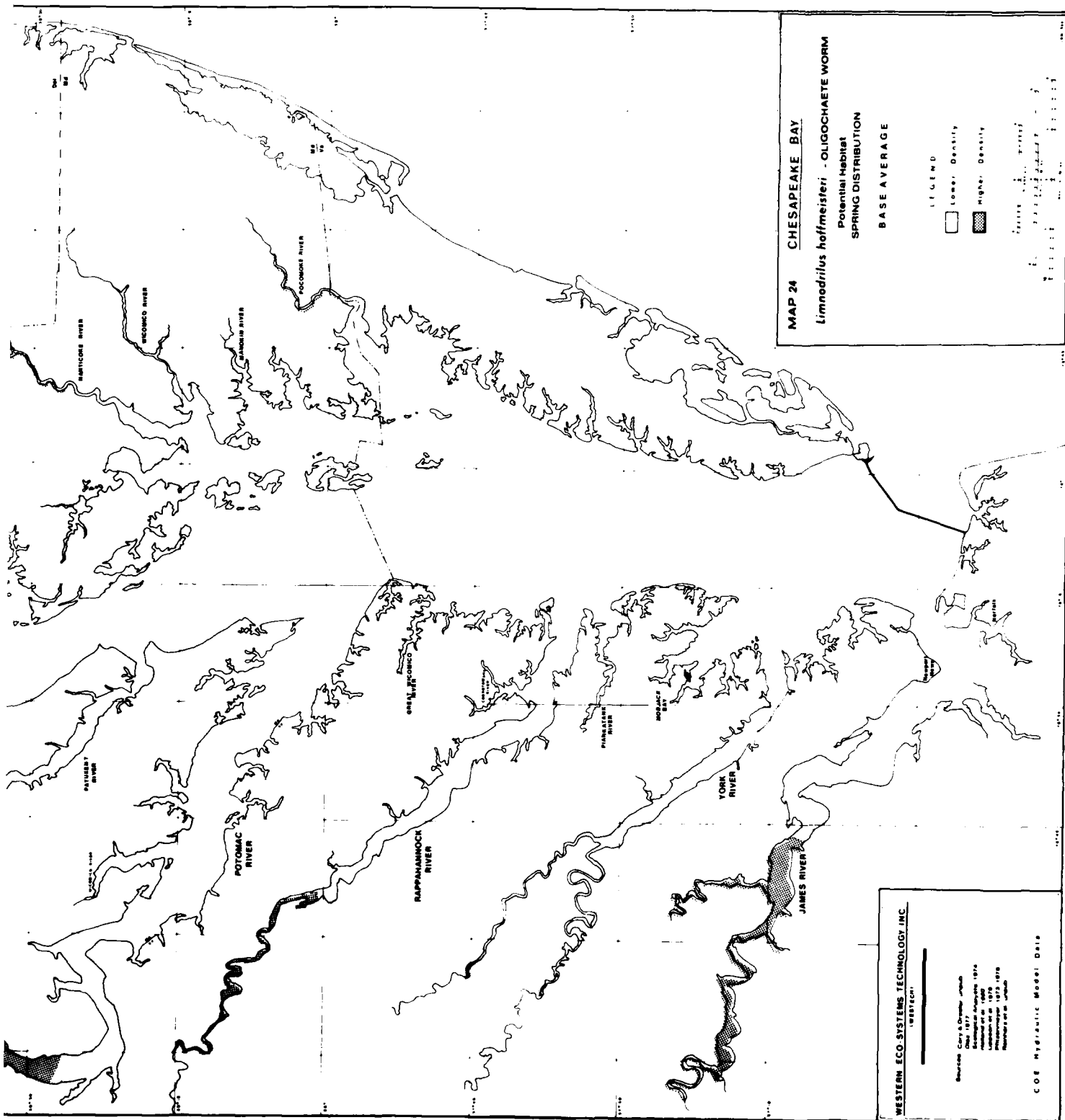
Podon polyphemoides-cladoceran
 Potential Habitat
 SPRING DISTRIBUTION
 BASE AVERAGE

LEGEND
 Lower Densities
 Higher Densities



WESTERN ECO-SYSTEMS TECHNOLOGY, INC.
 WESTECOL
 Sources: Brien and Taylor 1988 and 1973
 Brien et al. 1975
 Hargrave et al. 1988
 1985-1988
 COE Hydrologic Model Data



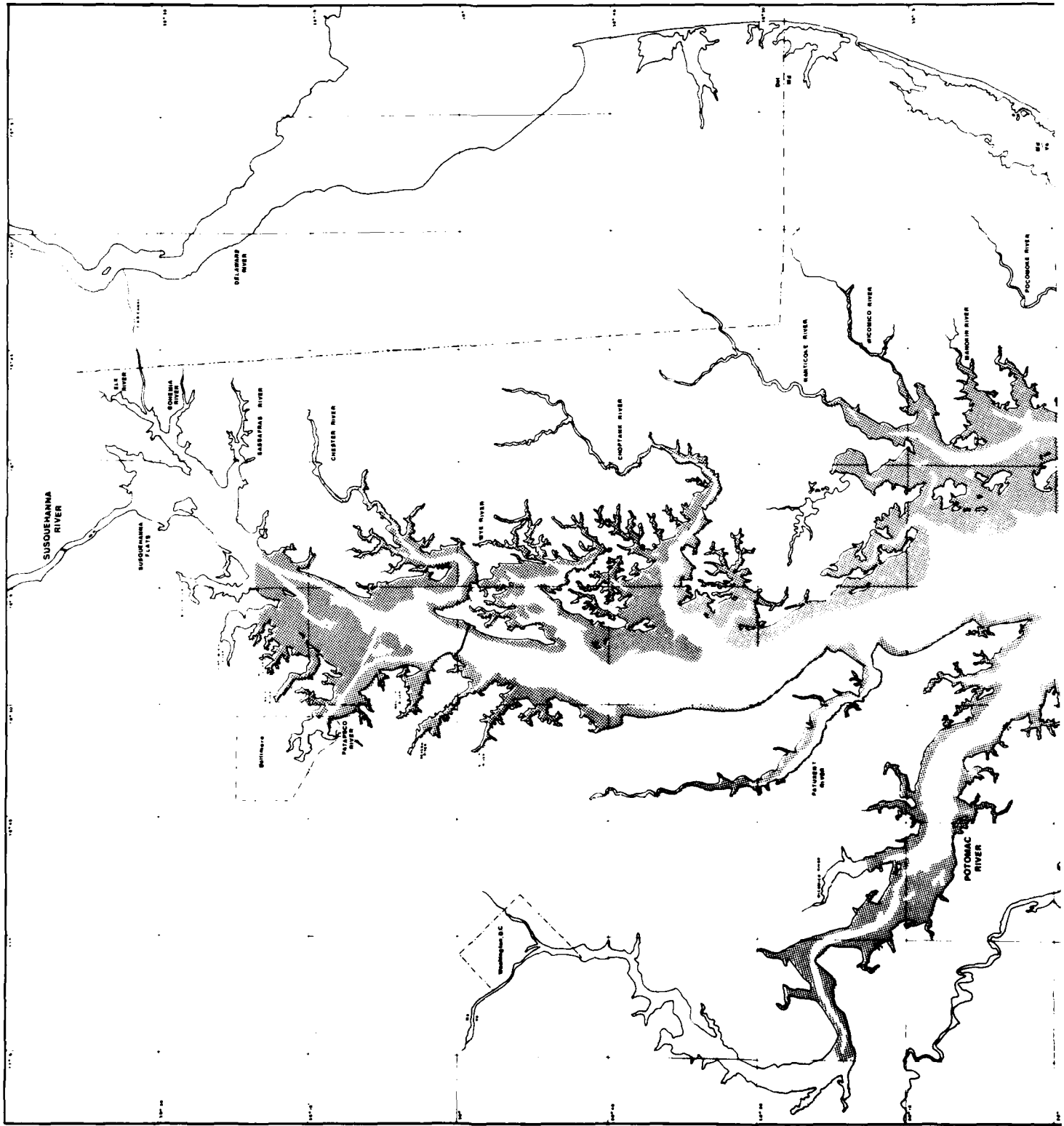


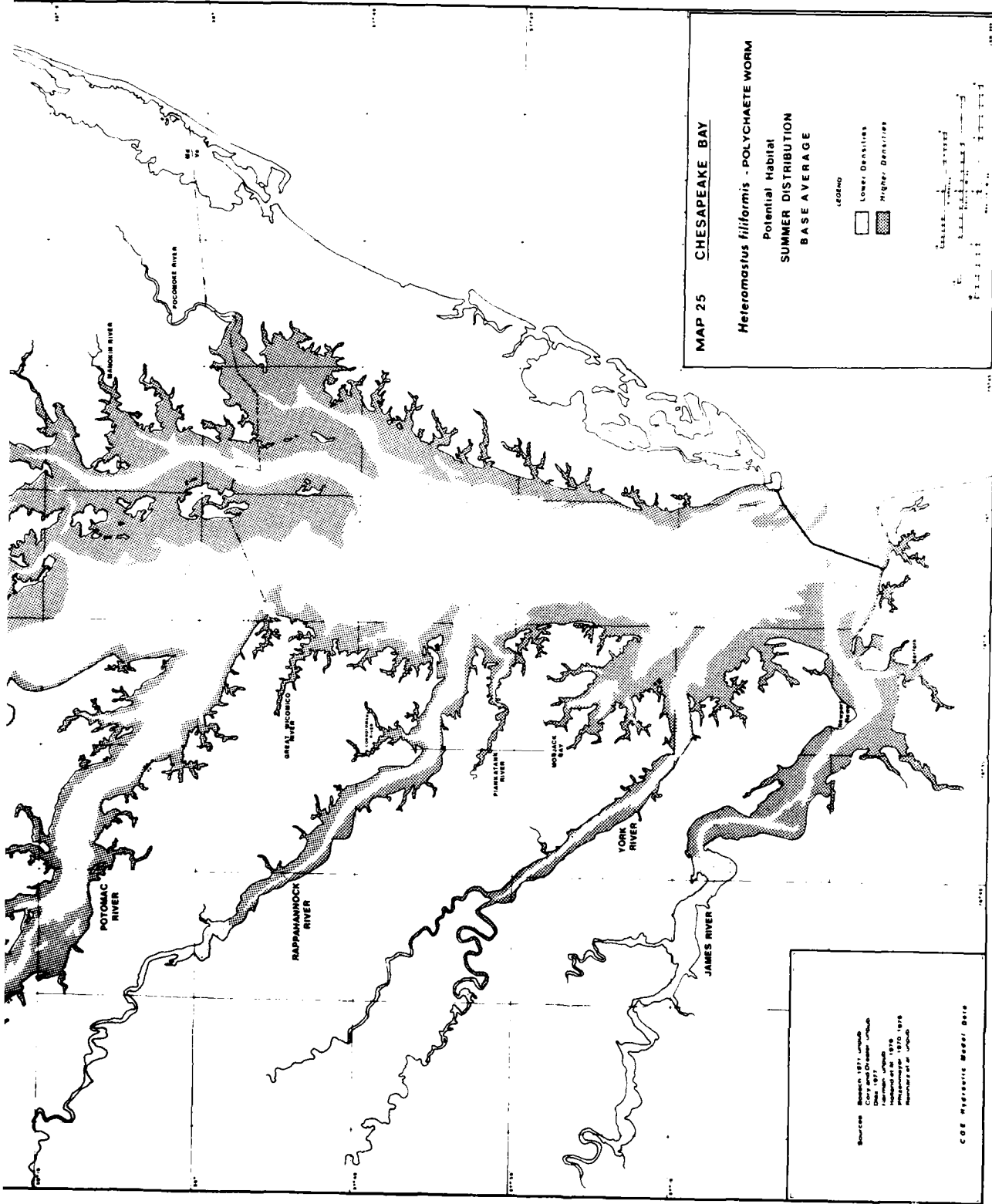
MAP 24 CHESAPEAKE BAY
Limnodrilus hoffmeisteri - OLIGOCHAETE WORM
 Potential Habitat
 SPRING DISTRIBUTION
 BASE AVERAGE

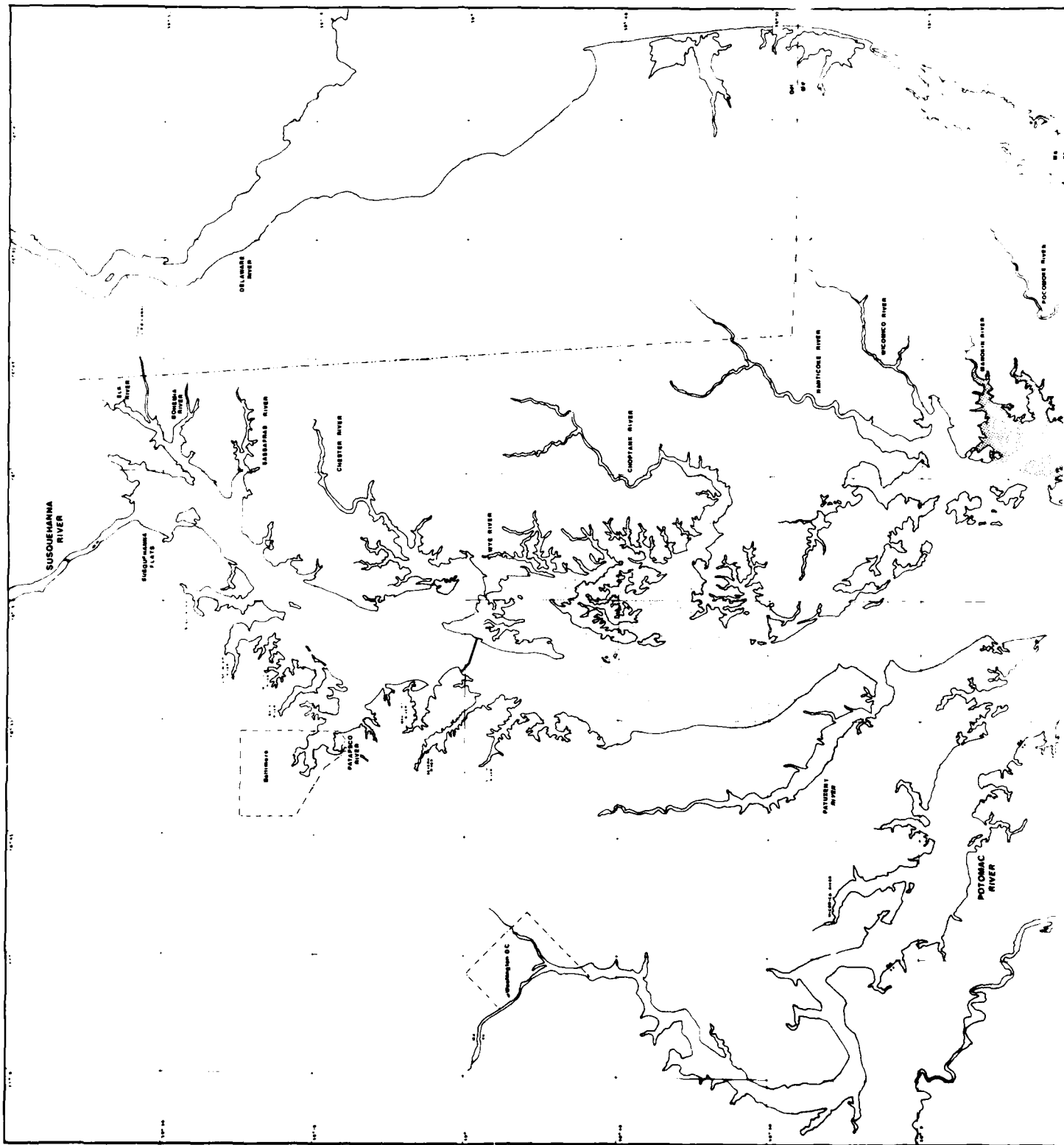
LEGEND
 Low Density [unshaded box]
 High Density [shaded box]

WESTERN ECO-SYSTEMS TECHNOLOGY INC.
 (WESTECH)
 Authors: Gary A. Dwyer, Joseph
 L. H. Smith, and
 Kenneth L. Johnson
 Published in 1979
 Reprinted in 1983
 Reprinted in 1985
 Reprinted in 1987

COE HYDRAULIC MODEL DATA







MAP 26 CHESAPEAKE BAY

Pectinaria gouldii - POLYCHAETE WORM

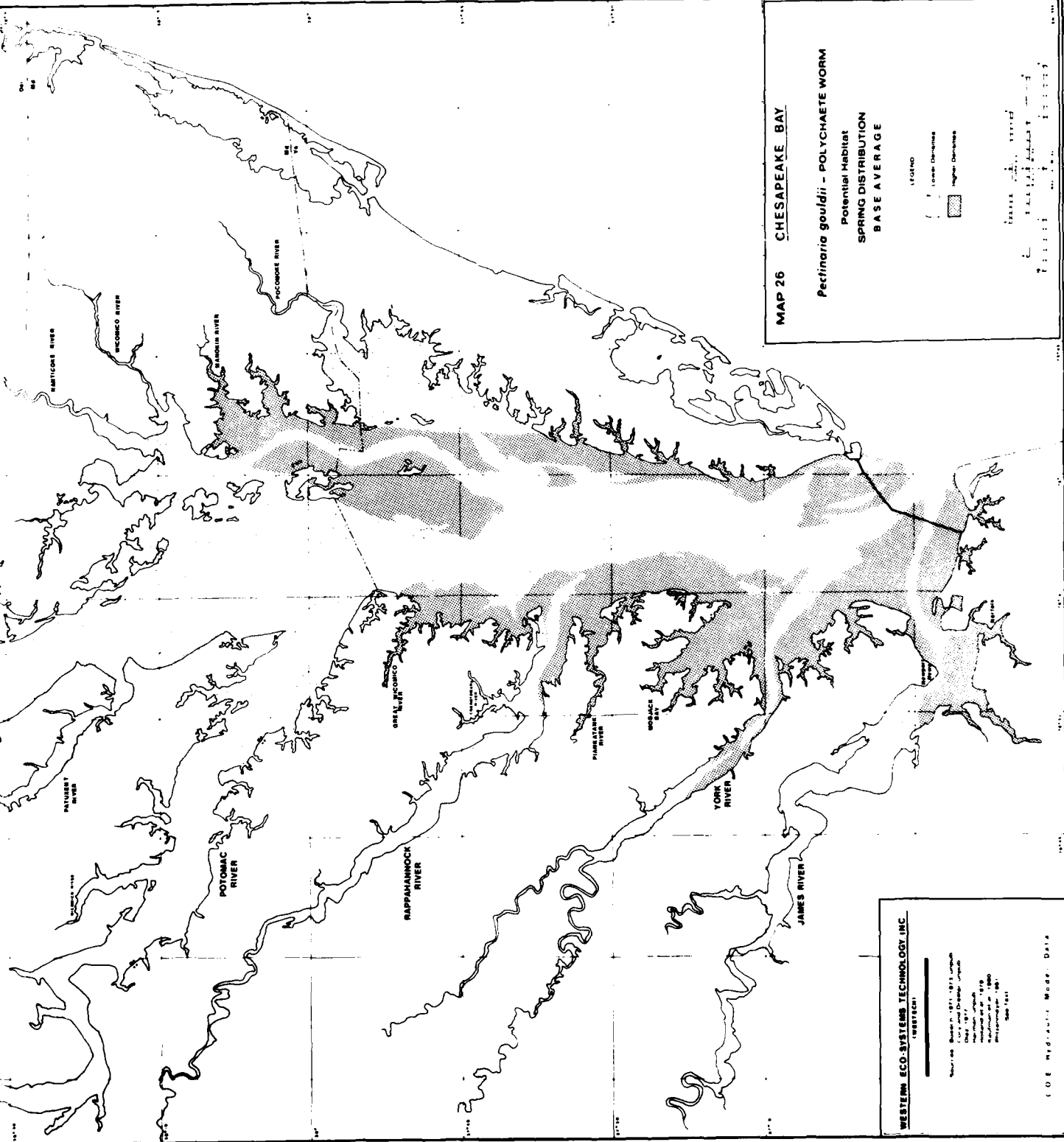
Potential Habitat
 SPRING DISTRIBUTION
 BASE AVERAGE

LEGEND

- Lower Distribution
- Higher Distribution

Scale: 1:50,000

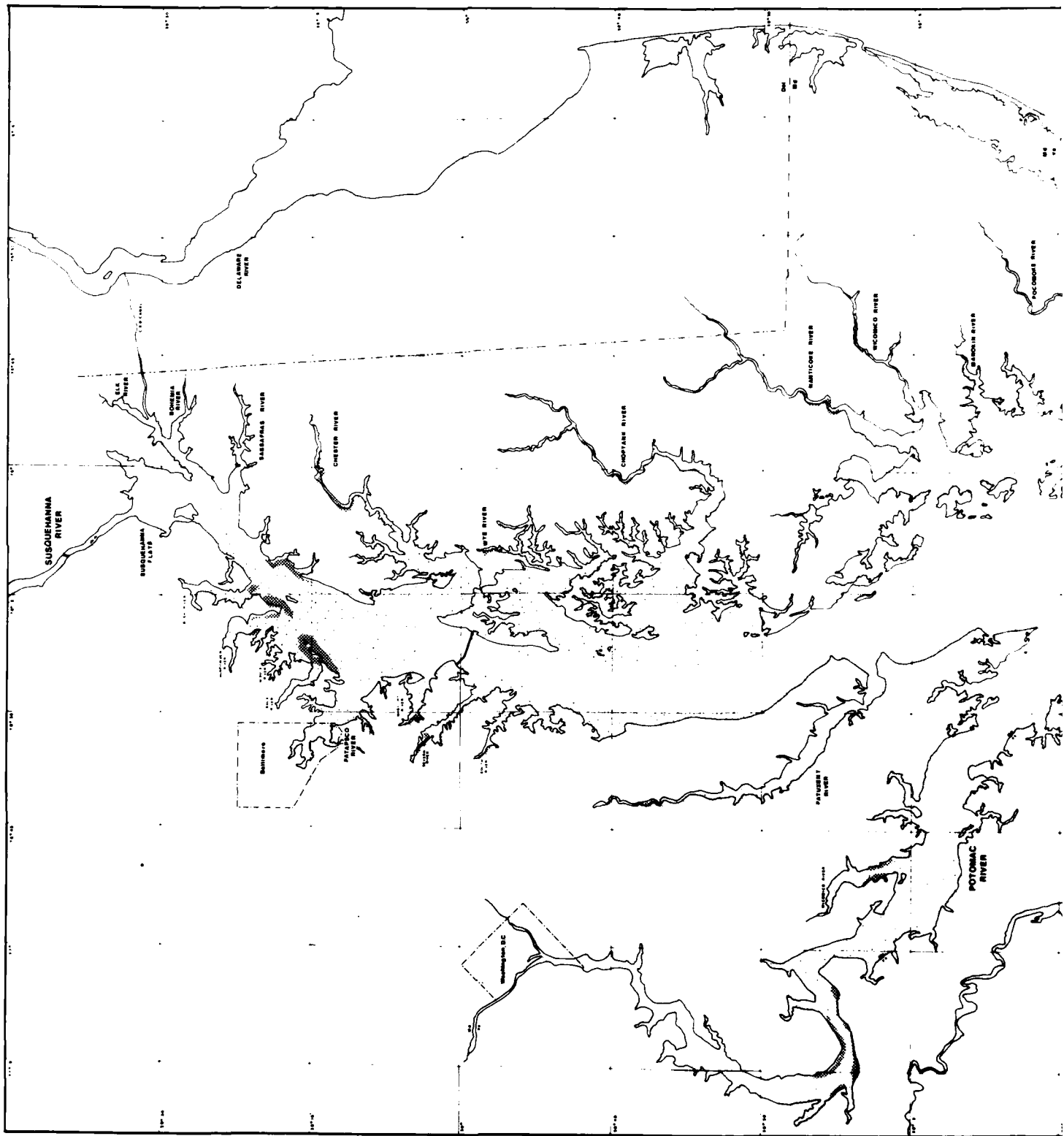
North Arrow

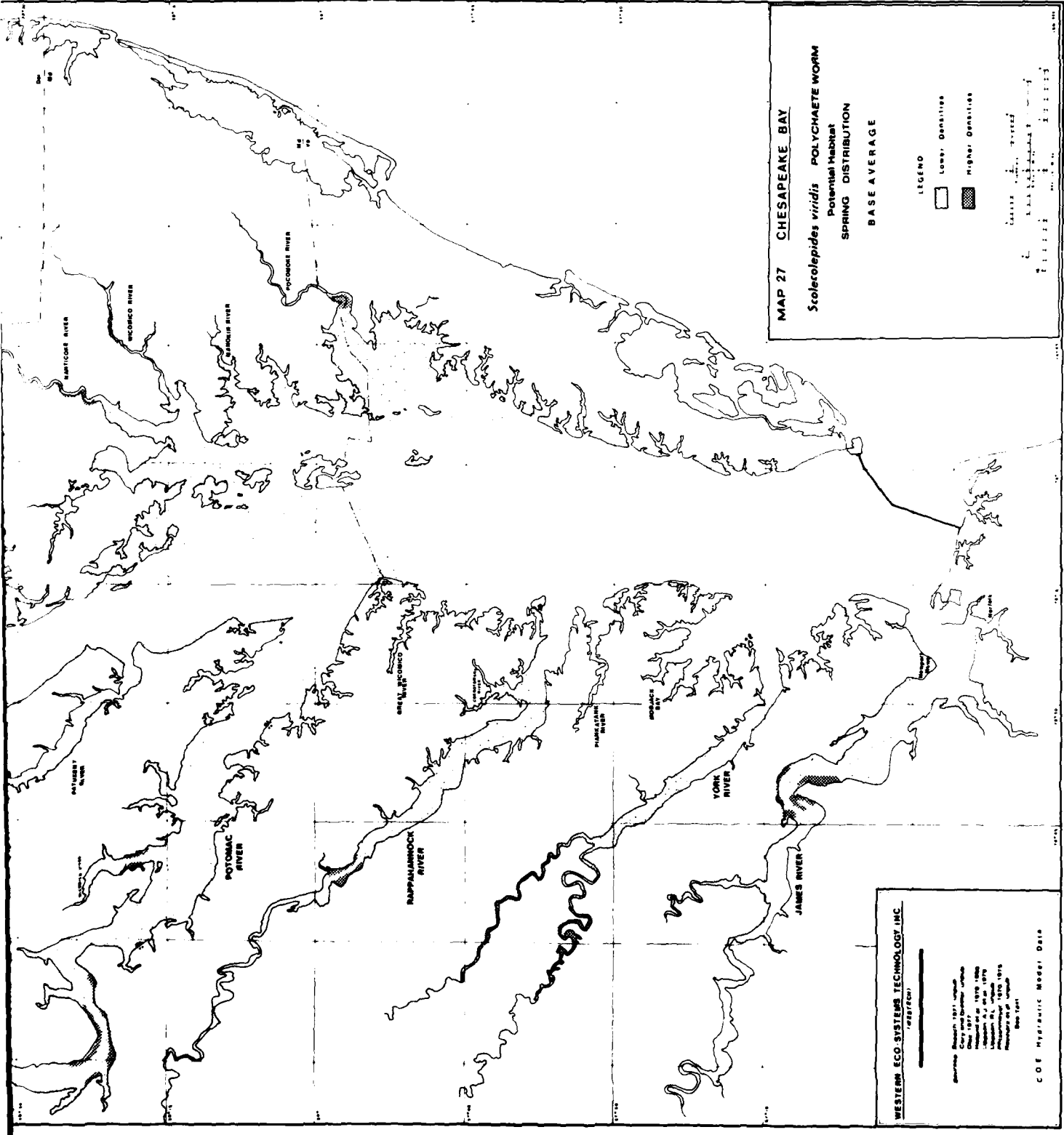


WESTERN ECO-SYSTEMS TECHNOLOGY, INC.
 (WESTECO)

Map and Model: 1971, 1973, 1974
 Data and Design: 1974
 Date: 1977
 Version: 1.0
 Project: Chesapeake Bay
 Scale: 1:50,000

COE Hydraulic Model Data





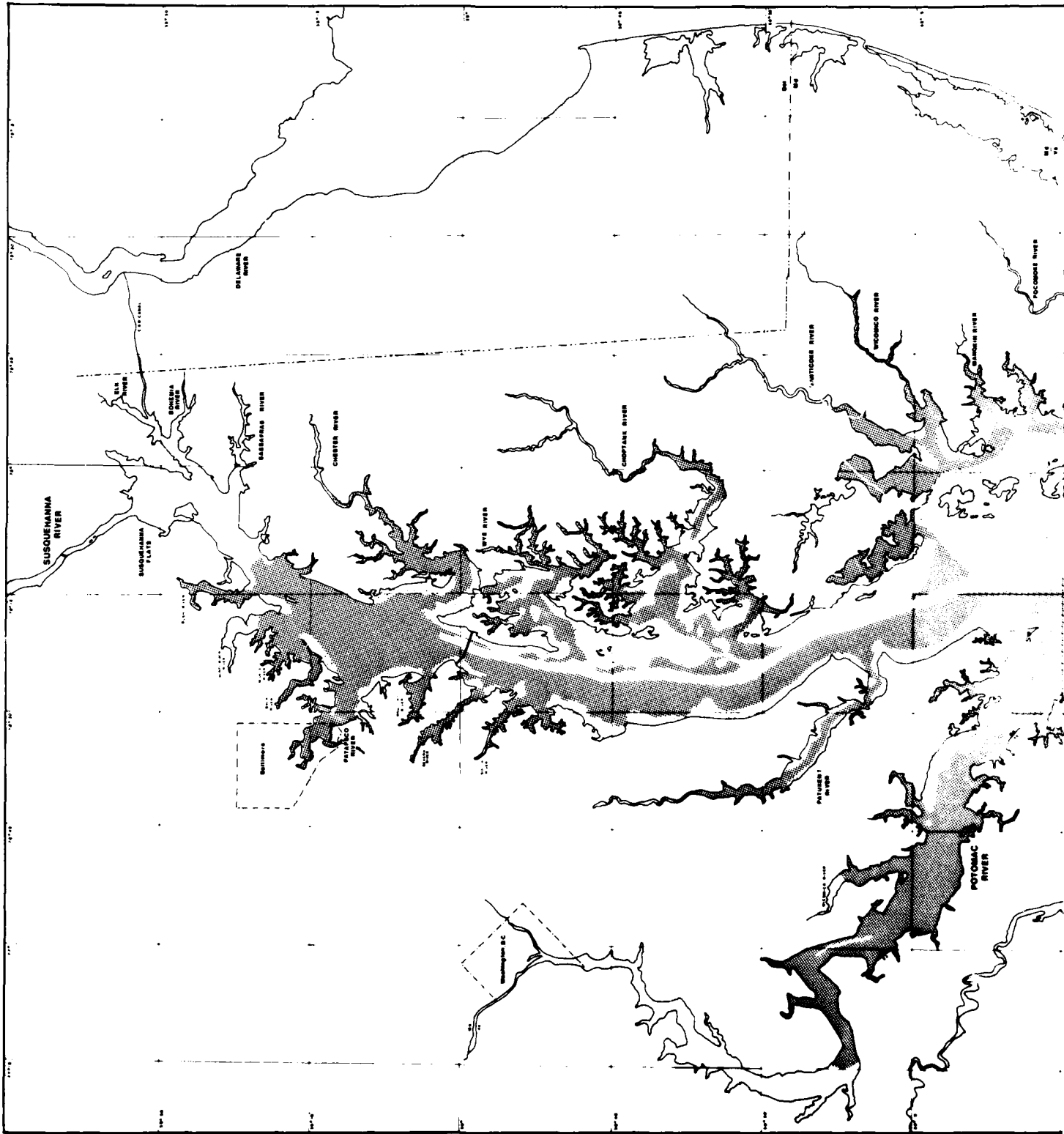
MAP 27 CHESAPEAKE BAY
Scolerolepides viridis POLYCHAETE WORM
 Potential Habitat
 SPRING DISTRIBUTION
 BASE AVERAGE

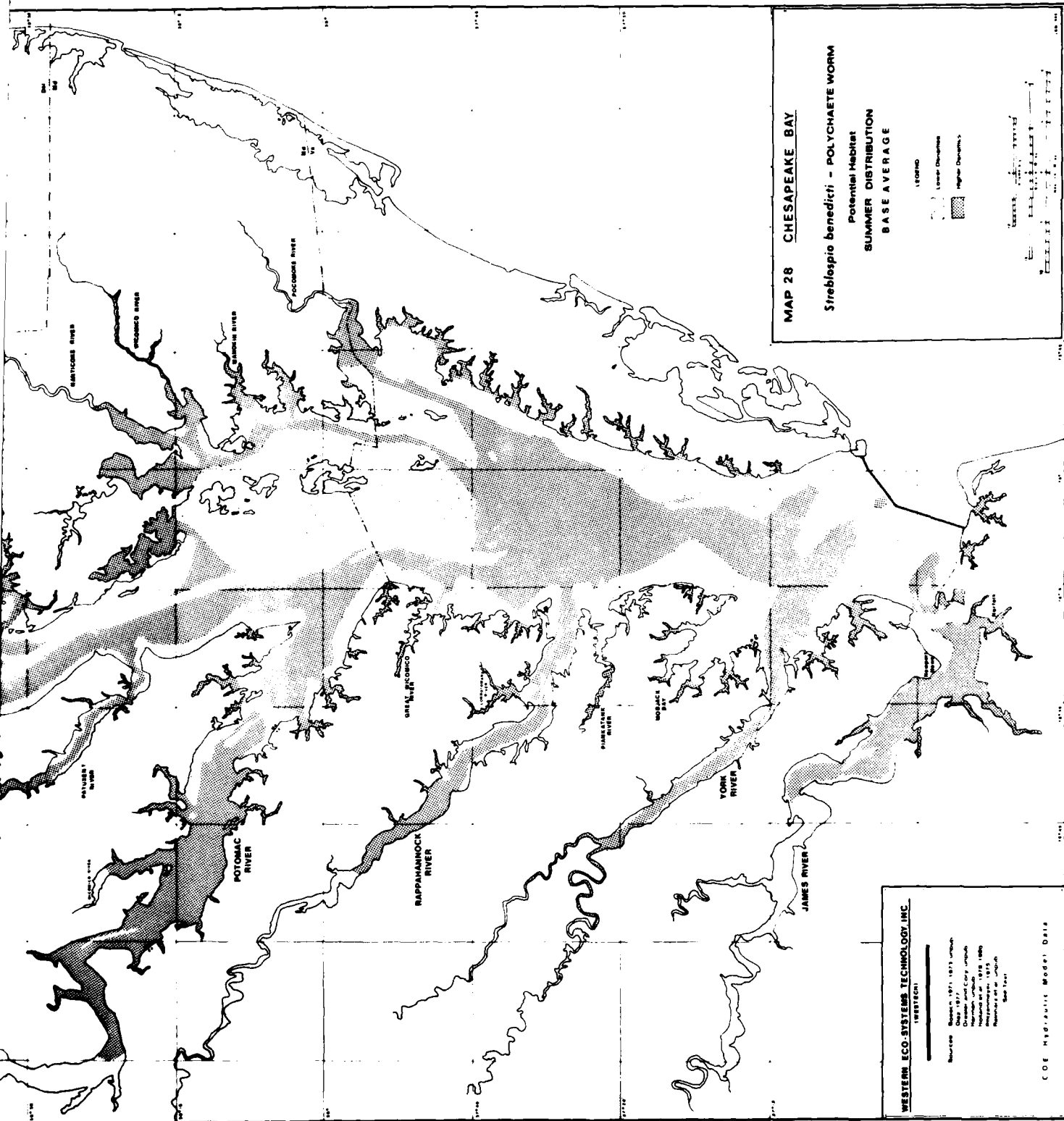
LEGEND
 [Unshaded Box] Lower Densities
 [Shaded Box] Higher Densities

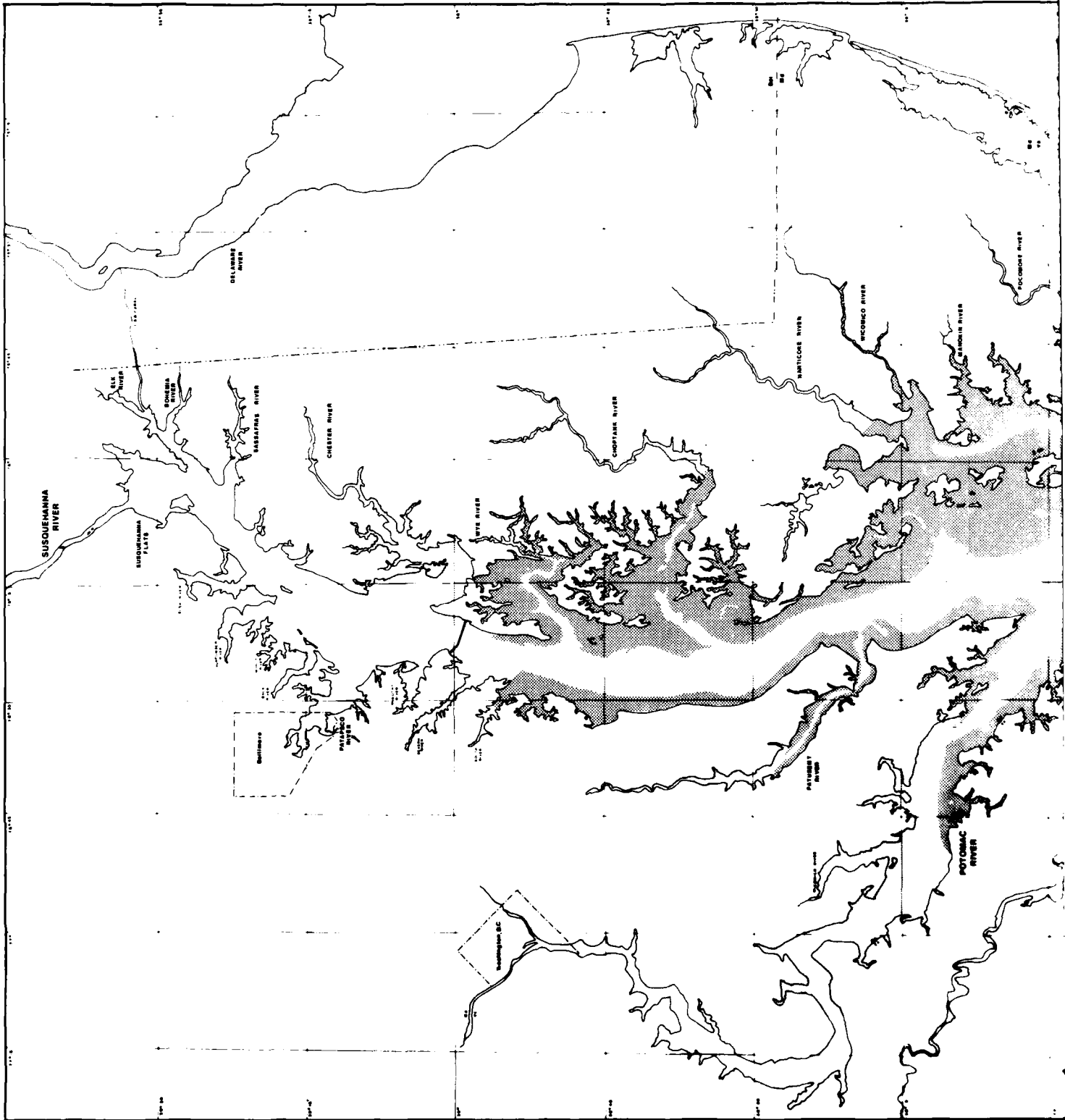
Scale: 1:100,000
 0 1 2 3 4 5 Miles
 0 1 2 3 4 5 Kilometers

WESTERN ECO-SYSTEMS TECHNOLOGY, INC.
 (A Division of)
 American Republics, 1231 Avenue
 C, Suite 200, Silver Spring, Maryland
 20910-4201
 Telephone: (301) 590-1800
 Telex: 540000
 Fax: (301) 590-1800
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COE Hydraulic Model Data
 May 1981



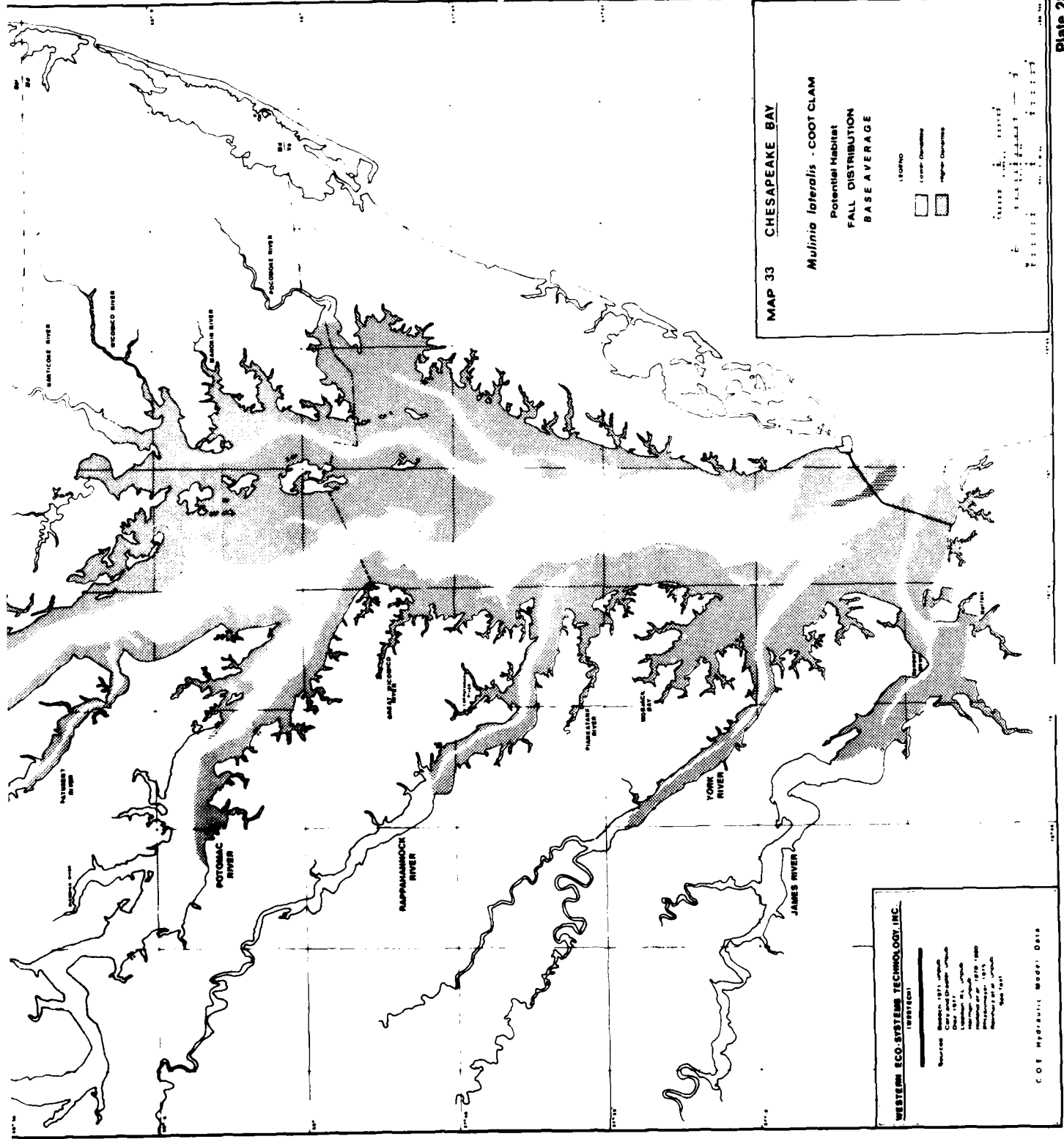
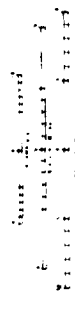




MAP 33 CHESAPEAKE BAY

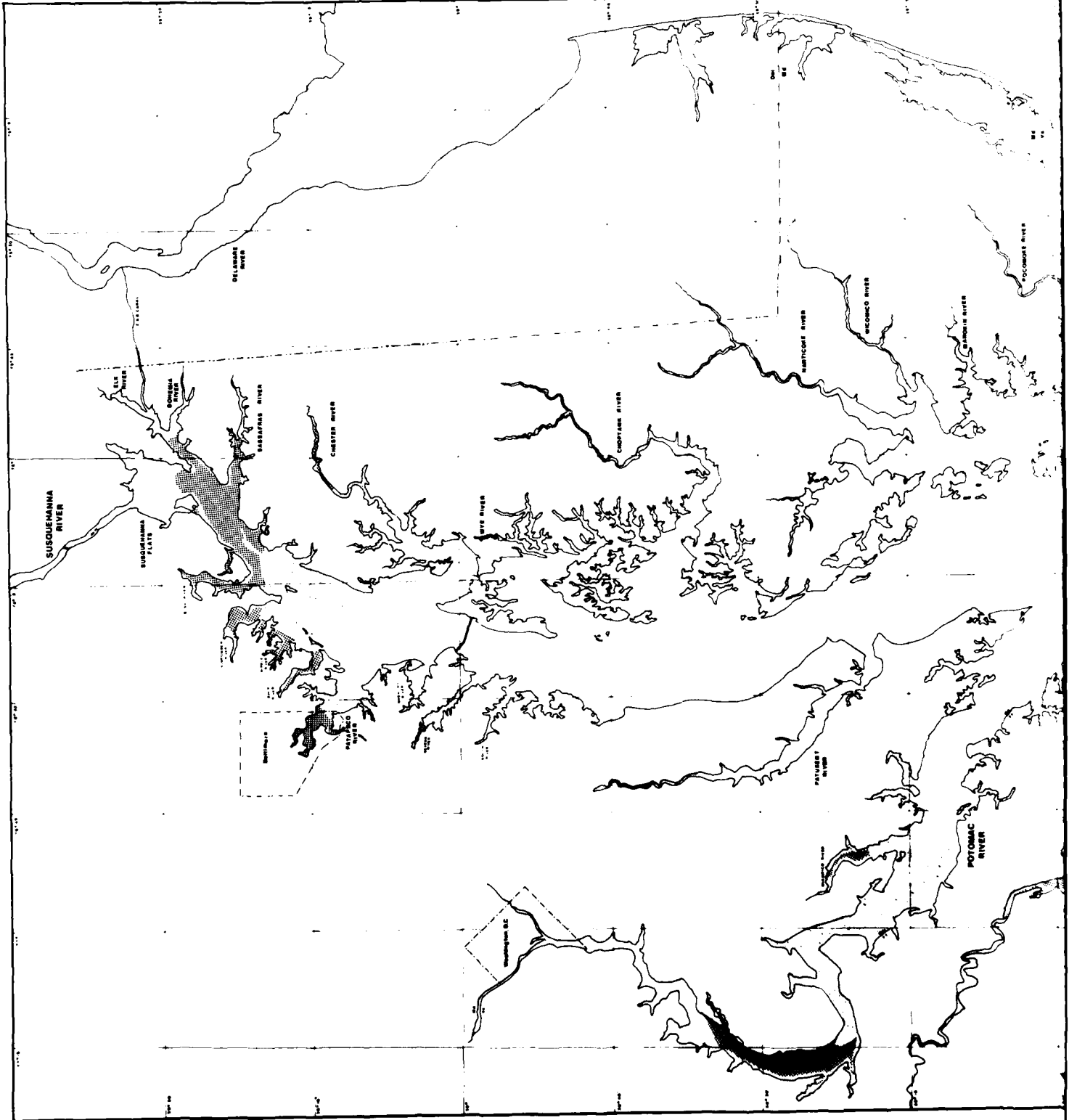
Mulinia lateralis - COOT CLAM
Potential Habitat
FALL DISTRIBUTION
BASE AVERAGE

LEGEND
Lower Distribution
Higher Distribution



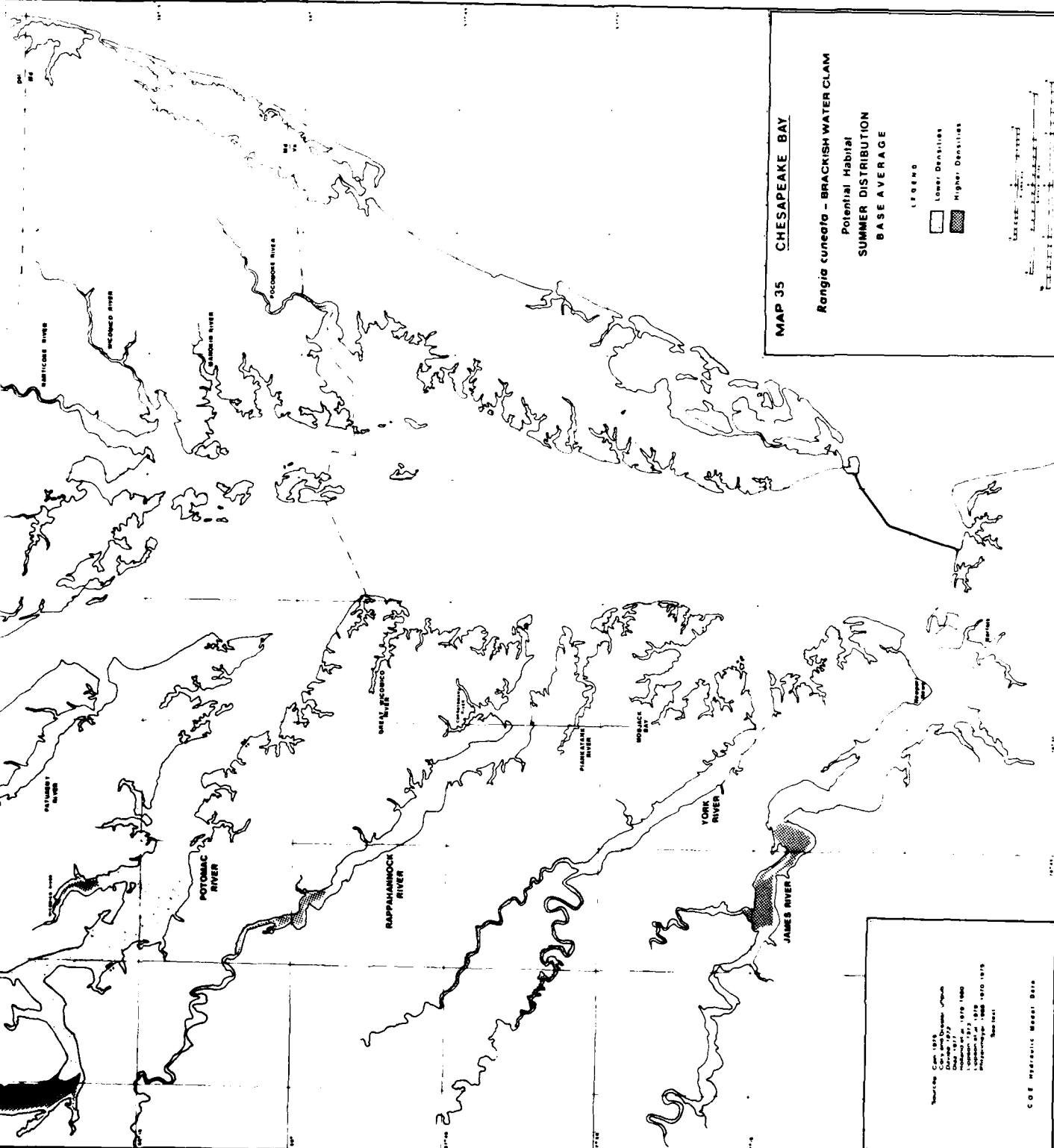
WESTERN ECO-SYSTEMS TECHNOLOGY, INC.
INVESTMENT
Source: Boush, 1971, unpub.
Data: 1977, unpub. (Pilot)
Lambert, R., unpub.
Published as of 1979, 1980
Revised/Updated: 1981
Scale: 1:50,000

COT HYDRAULIC MODEL D218



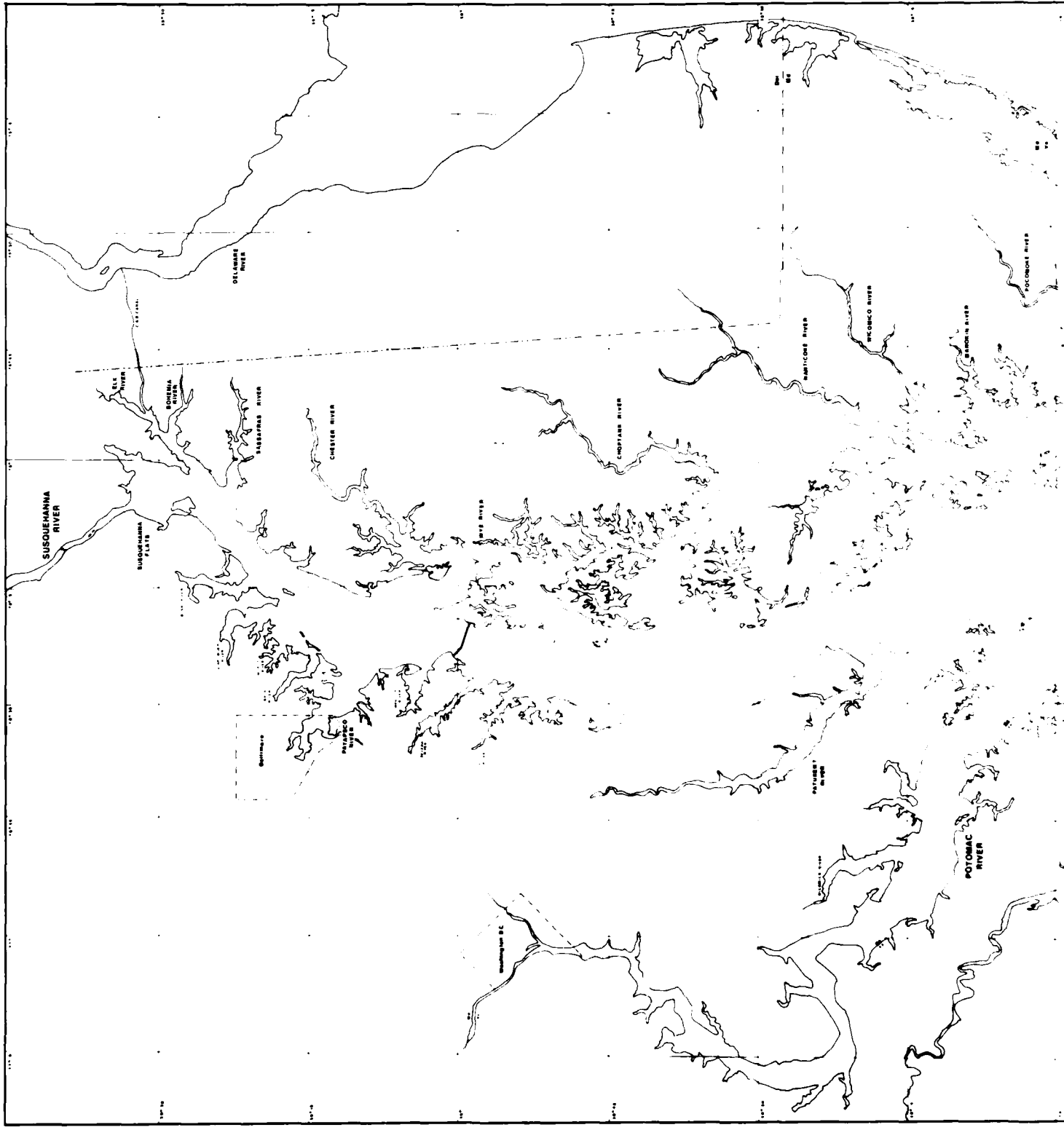
MAP 35 CHESAPEAKE BAY
Rangia cuneata - BRACKISH WATER CLAM
 Potential Habitat
 SUMMER DISTRIBUTION
 BASE AVERAGE

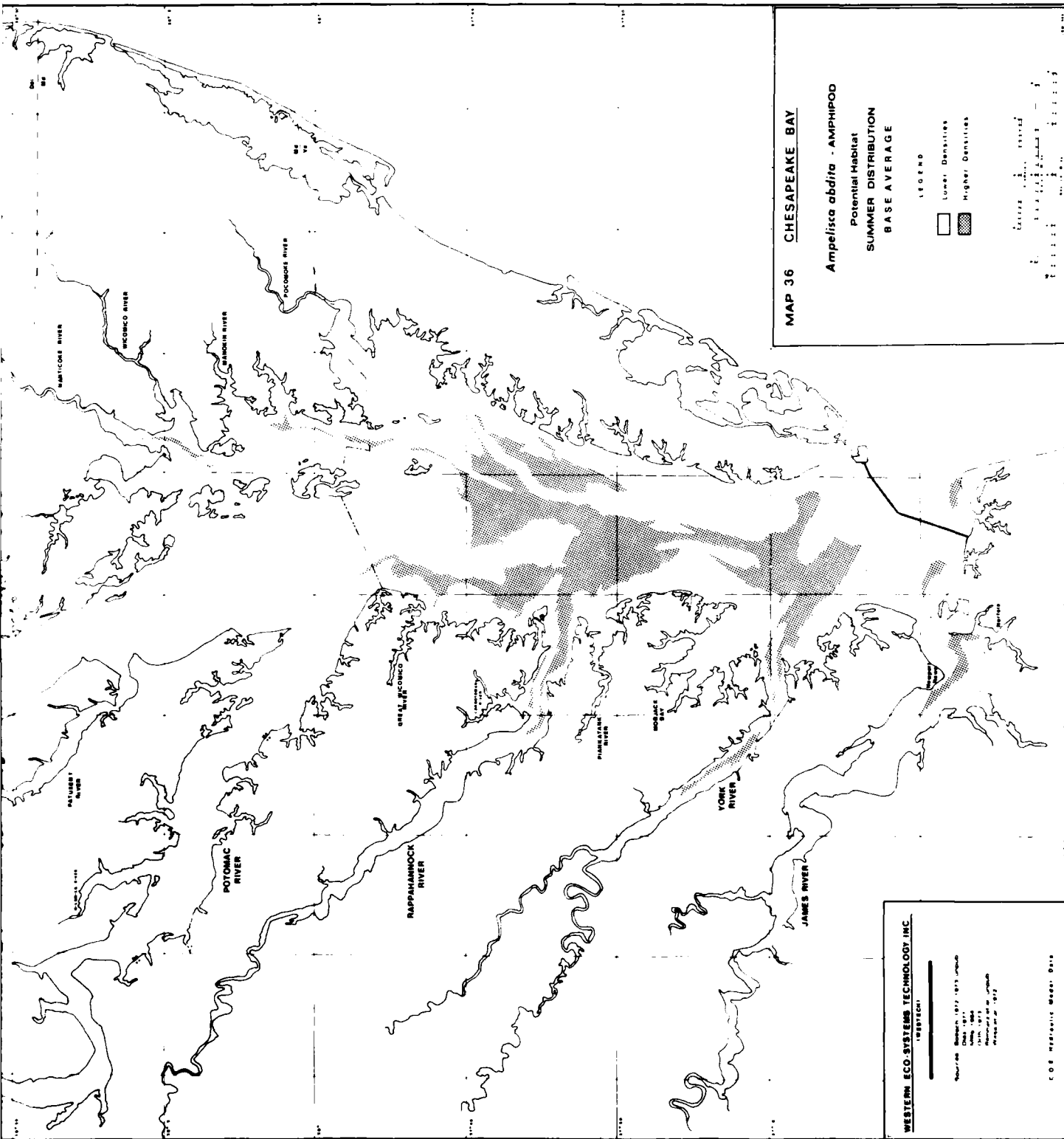
LEGEND
 Lower Densities
 Higher Densities



Source: Con 1978
 Data from: Con 1978
 Date: 1978
 Distribution: 1978-1980
 Collection: 1978
 Photographs: 1978-1979
 Base Data

COE HYDROLOGIC MAPS: DATA





MAP 36 CHESAPEAKE BAY

Ampelisca abdita - AMPHIPOD
 Potential Habitat
 SUMMER DISTRIBUTION
 BASE AVERAGE

LEGEND

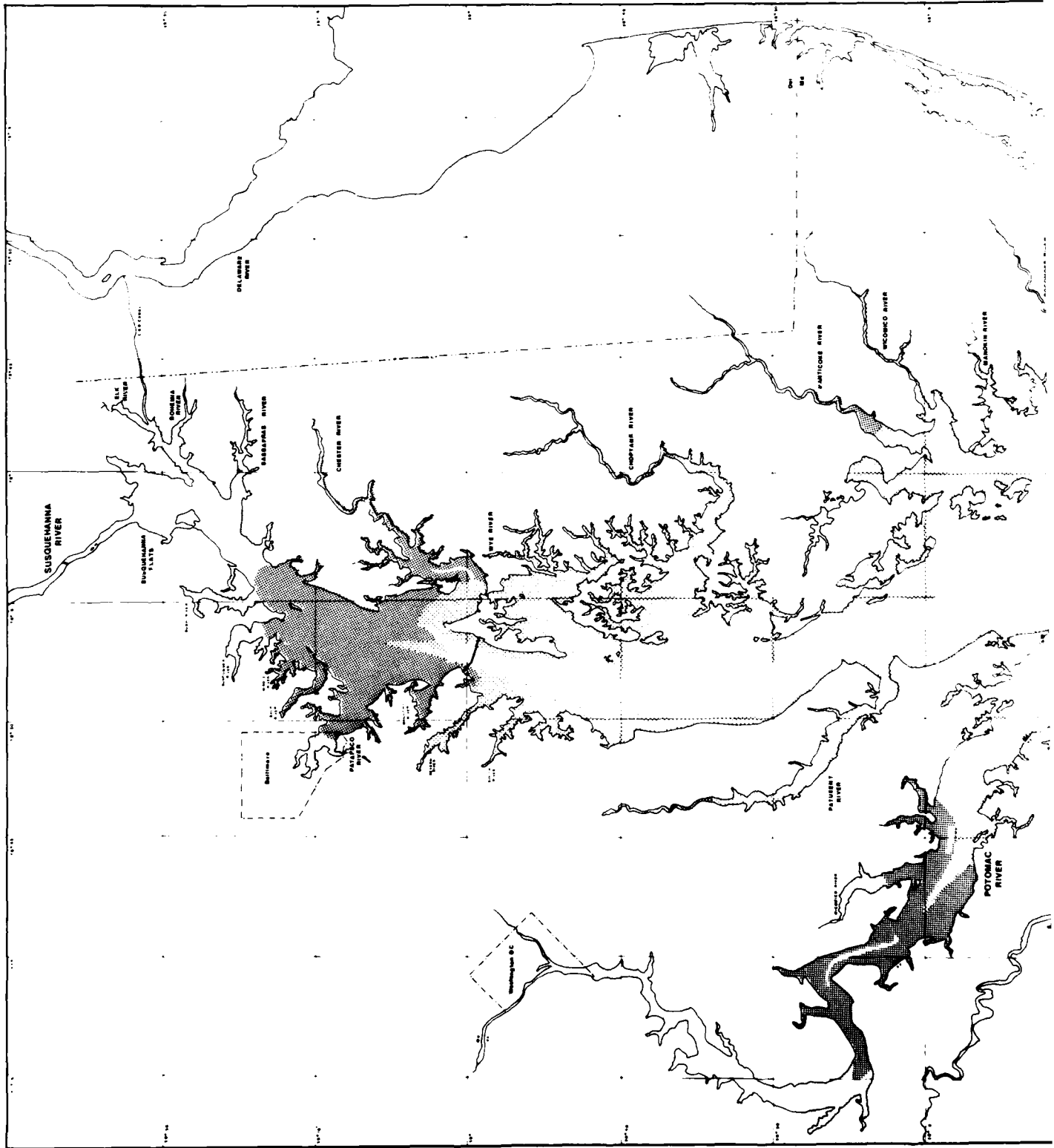
□ Lower Densities
 ▨ Higher Densities

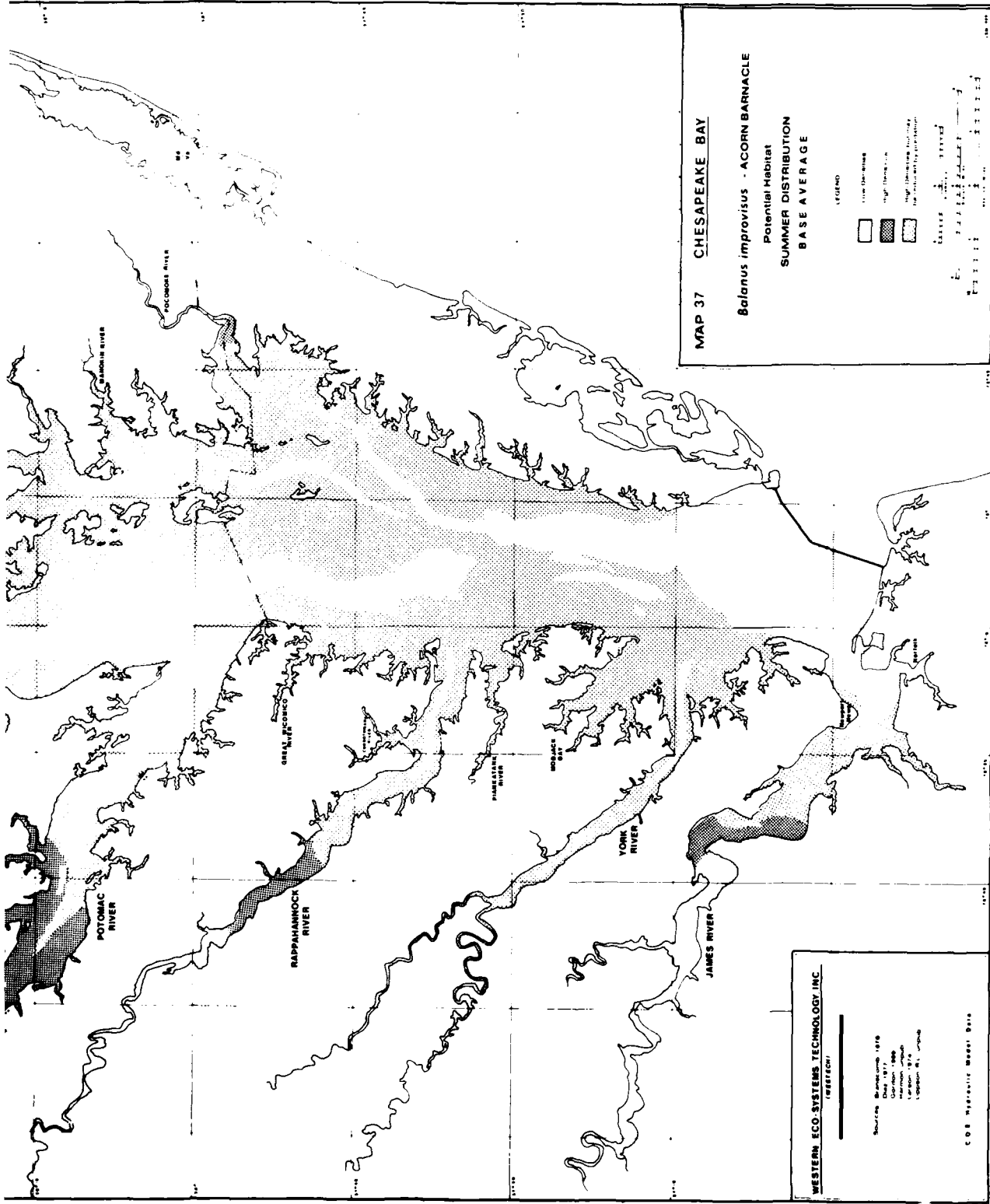
Scale: 1:50,000
 0 1 2 3 4 5 6 7 8 9 10 Miles
 0 1 2 3 4 5 6 7 8 9 10 Kilometers

WESTERN ECO-SYSTEMS TECHNOLOGY, INC.
 (PUBLISHED)

Map No. WET-107 (87) (1987)
 Date: 1987
 Scale: 1:50,000
 Project No. 107

C O S WESTERN MARKS, 0110





MAP 37 CHESAPEAKE BAY

Bolanus improvisus - ACORN BARNACLE

Potential Habitat

SUMMER DISTRIBUTION

BASE AVERAGE

LEGEND

- Low Distribution
- ▨ High Distribution
- ▩ High Distribution (Base Average)
- ▧ High Distribution (Base Average)

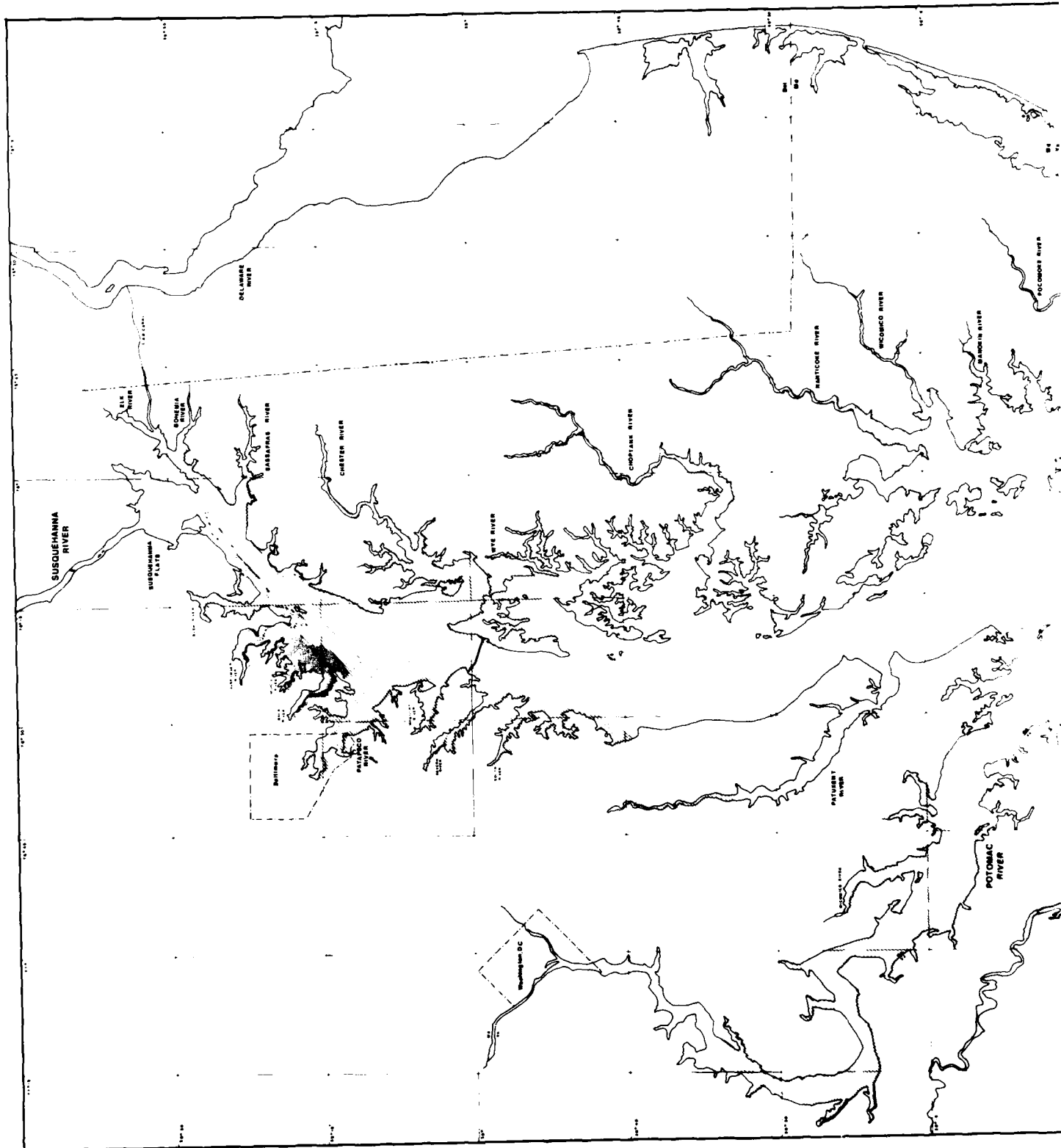
Scale: 1:50,000

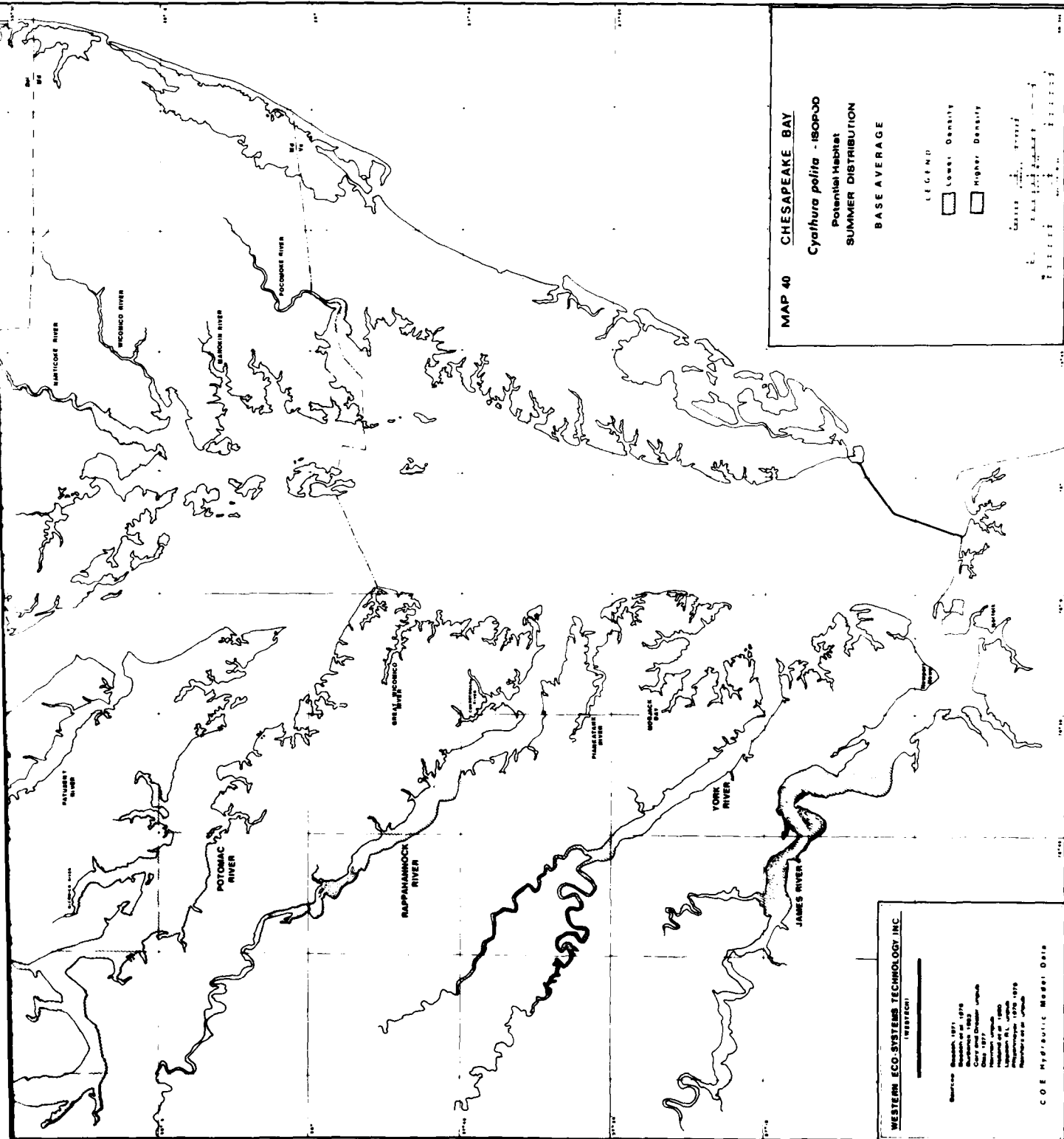
North Arrow

WESTERN ECO-SYSTEMS TECHNOLOGY INC.
(WESTECH)

Source: Based on 1978
Data 1977-1980
Map 1981
Version 1.0
Copyright © 1981

COE Reproductive Market Data





MAP 40 CHESAPEAKE BAY
Cyathura polita - 1980
 Potential Habitat
 SUMMER DISTRIBUTION
 BASE AVERAGE

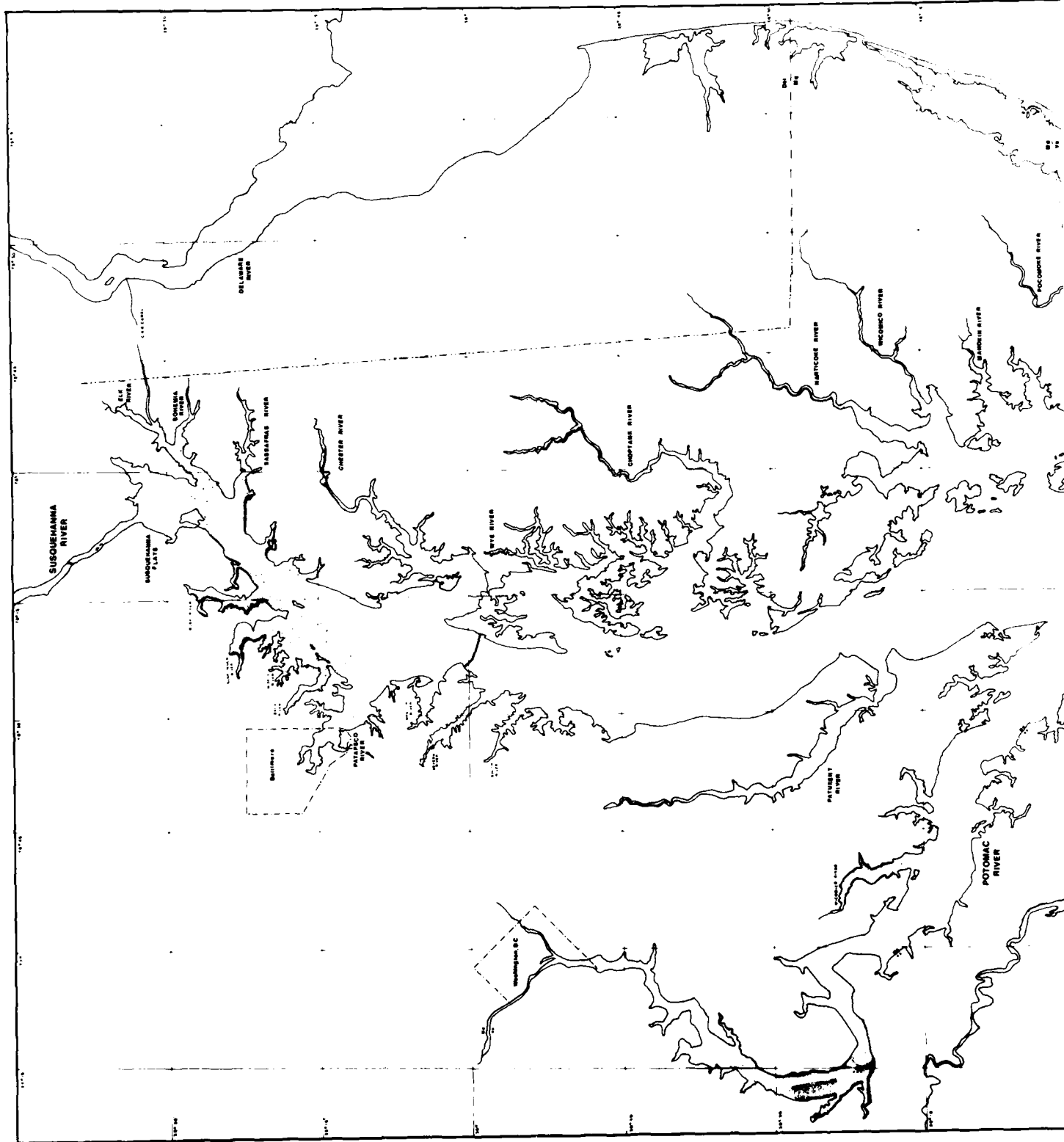
LEGEND
 Lower Density
 Higher Density

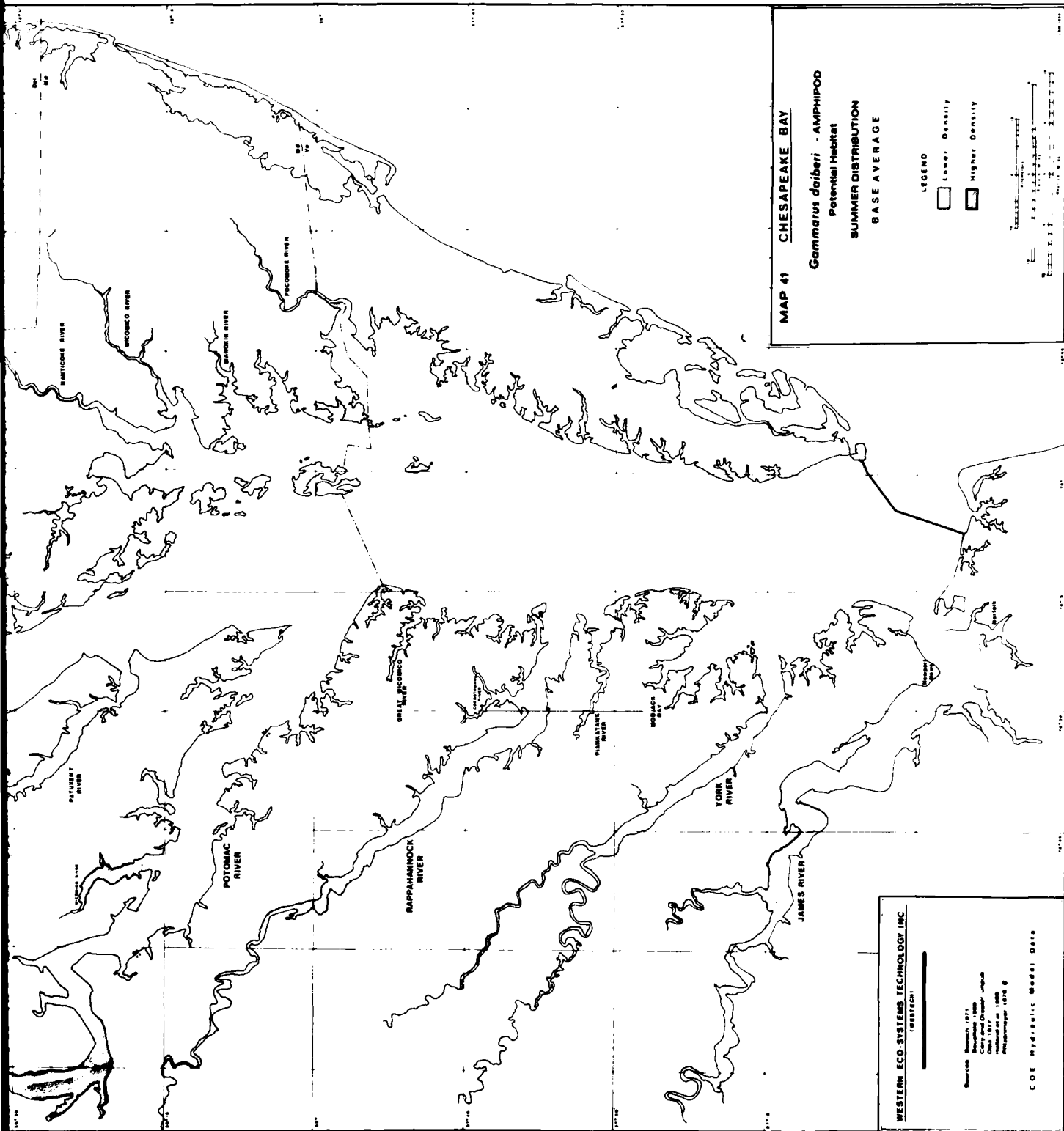
Scale: 1:50,000
 North Arrow

WESTERN ECO-SYSTEMS TECHNOLOGY INC.
 TRESTON

Contract: August, 1977
 Revision: 10/1978
 Date: 1978
 Date: 1977
 Date: 1977
 Date: 1977
 Date: 1977
 Date: 1977
 Date: 1977

COE HYDRAULIC MODEL DATA





MAP 41 CHESAPEAKE BAY
Gammarus duebeni - AMPHIPOD
 Potential Habitat
 SUMMER DISTRIBUTION
 BASE AVERAGE

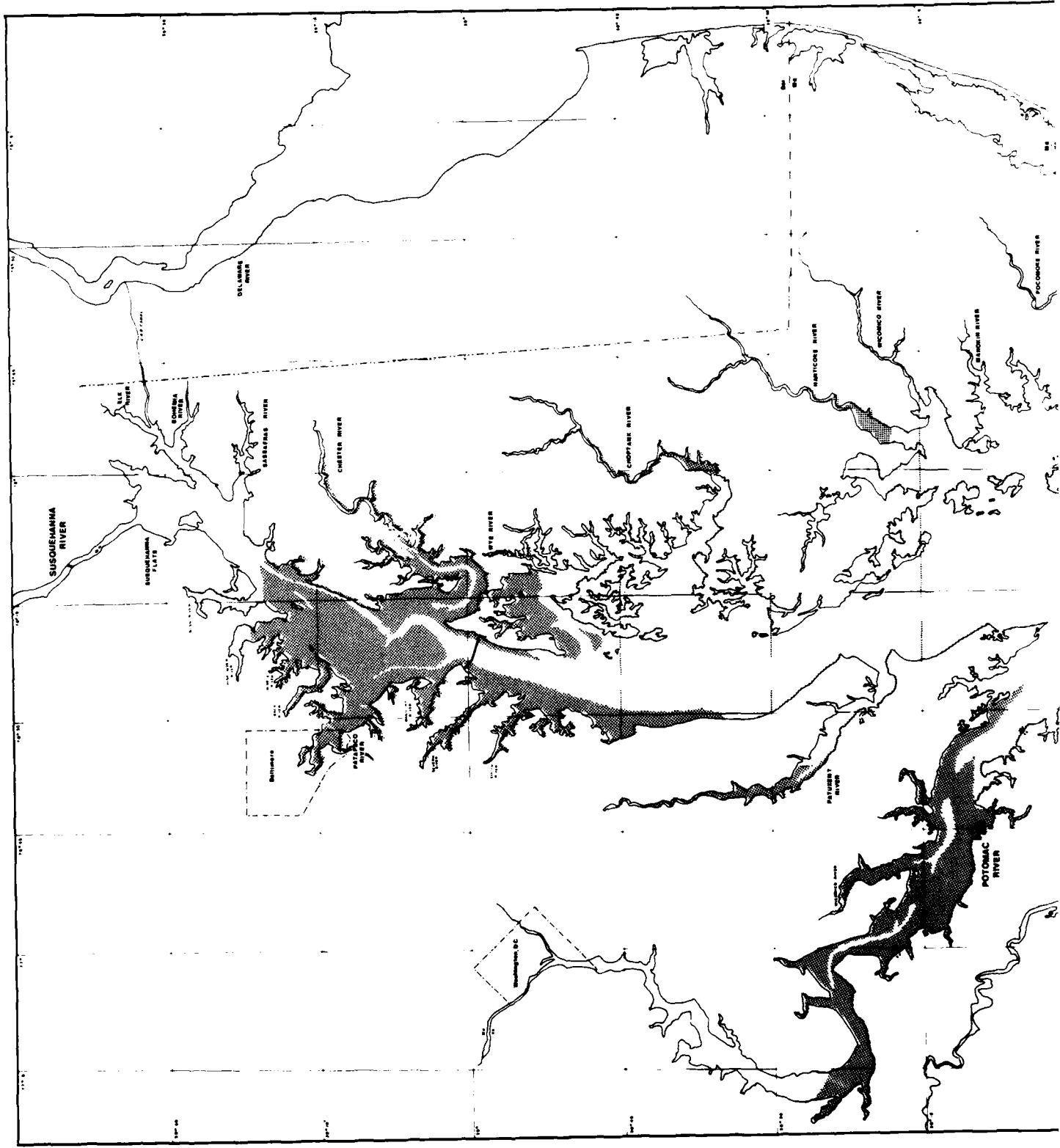
LEGEND
 □ Lower Density
 ■ Higher Density

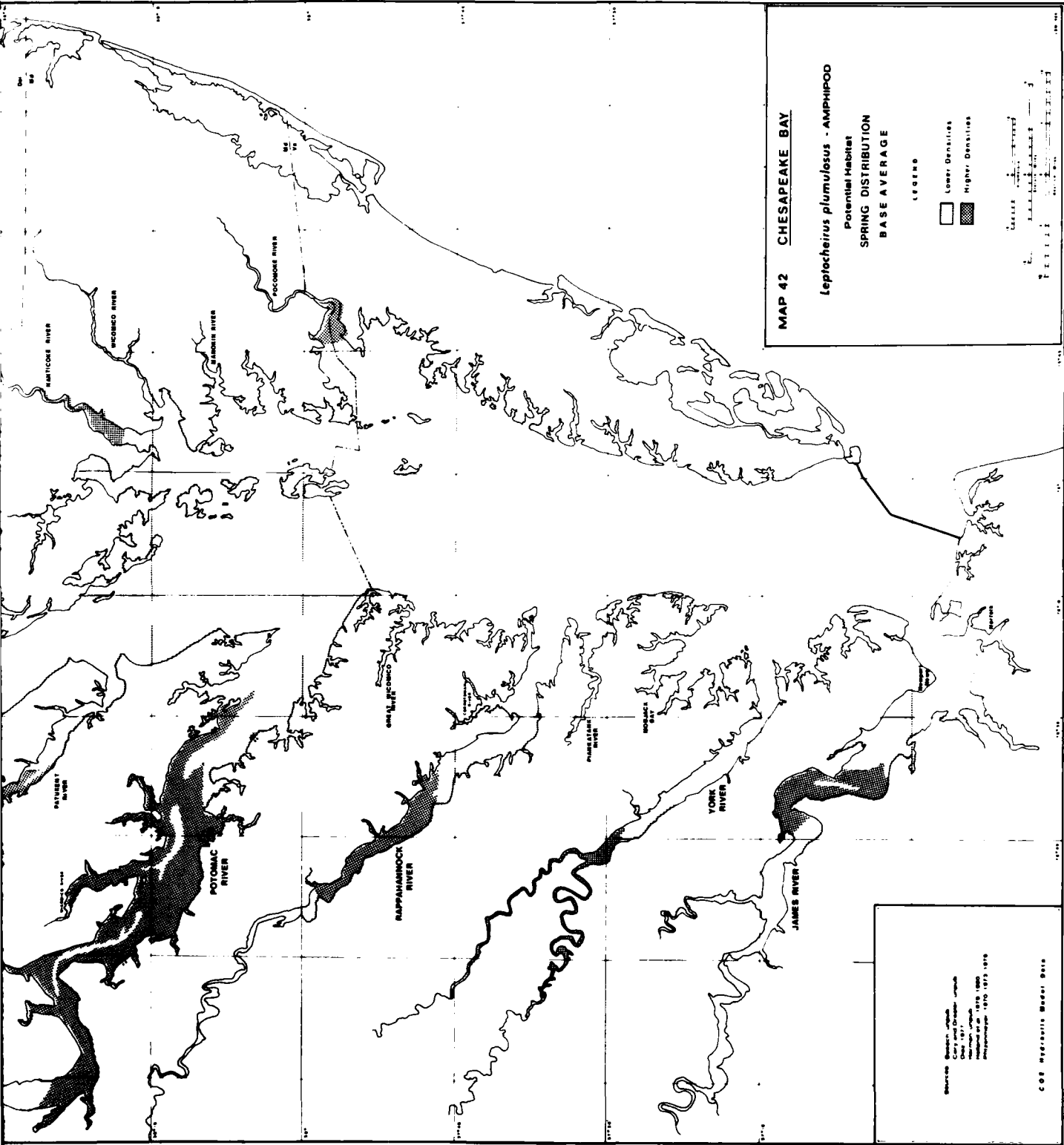
Scale: 1:50,000
 0 1 2 3 4 5 6 7 8 9 10 Miles
 0 1 2 3 4 5 6 7 8 9 10 Kilometers

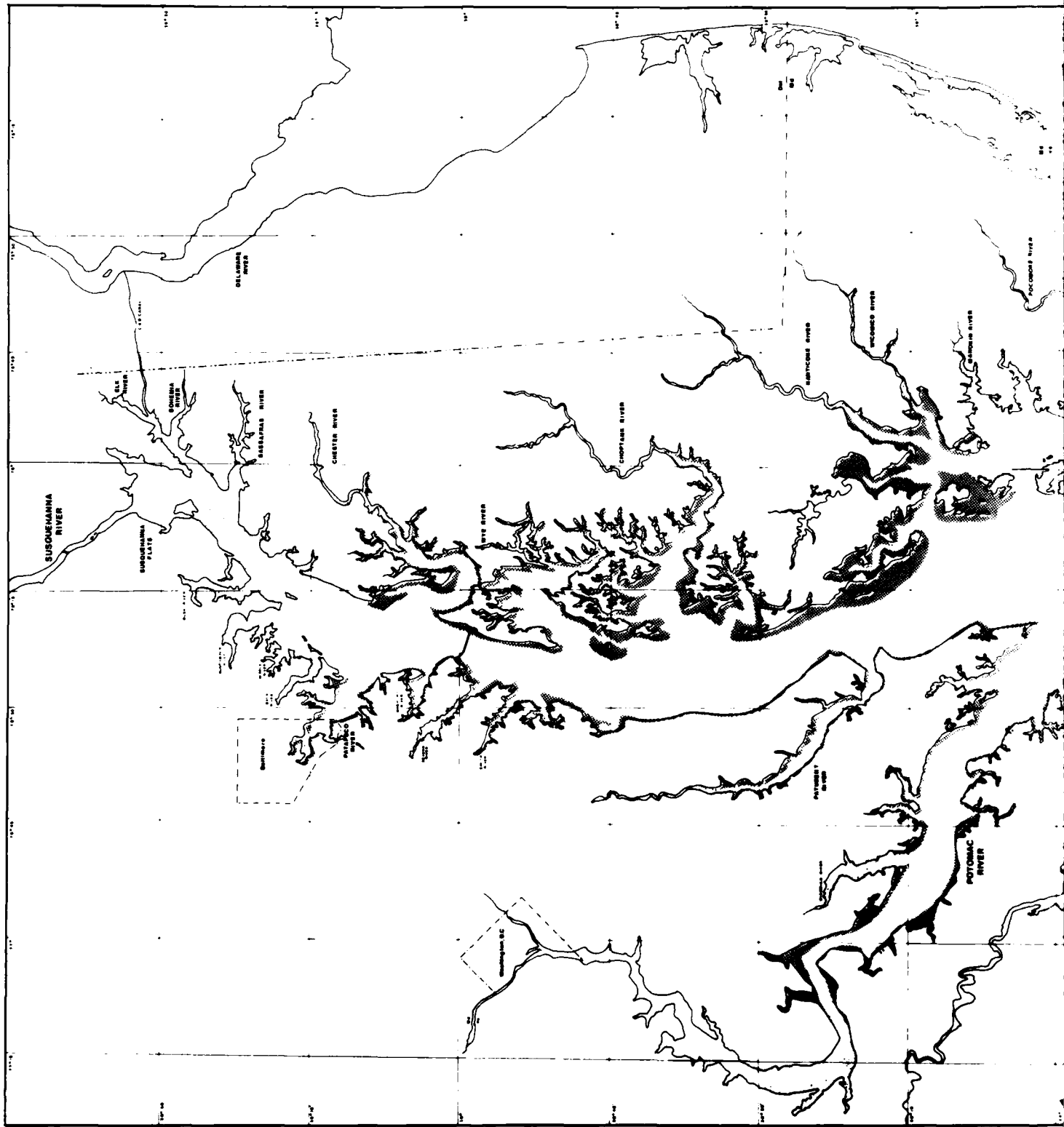
WESTERN ECO-SYSTEMS TECHNOLOGY INC.
 WESTECH

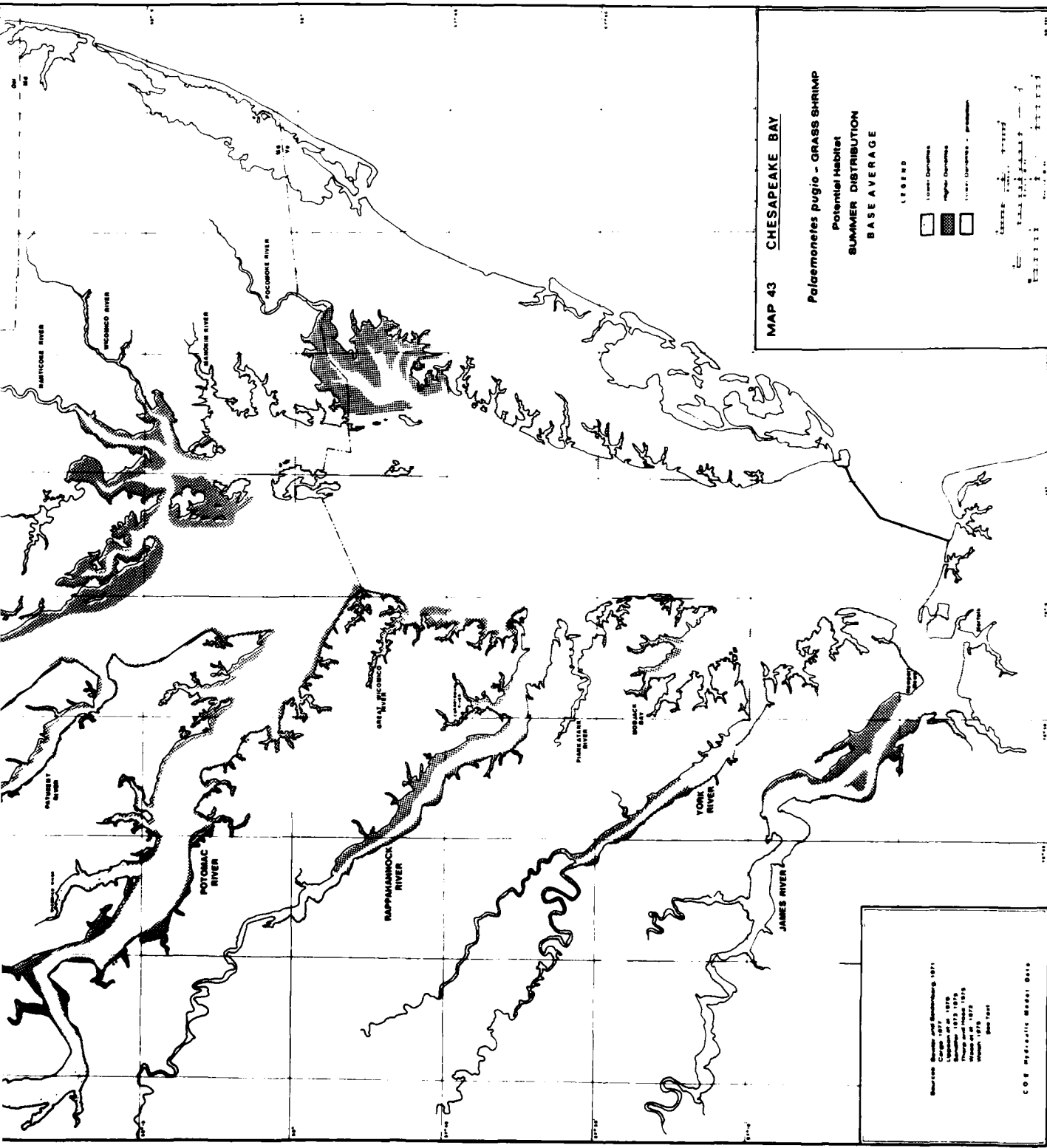
Source: Bennett, 1971
 Distribution 1980
 Distribution 1981
 Data 1977
 Distribution 1980
 Distribution 1978

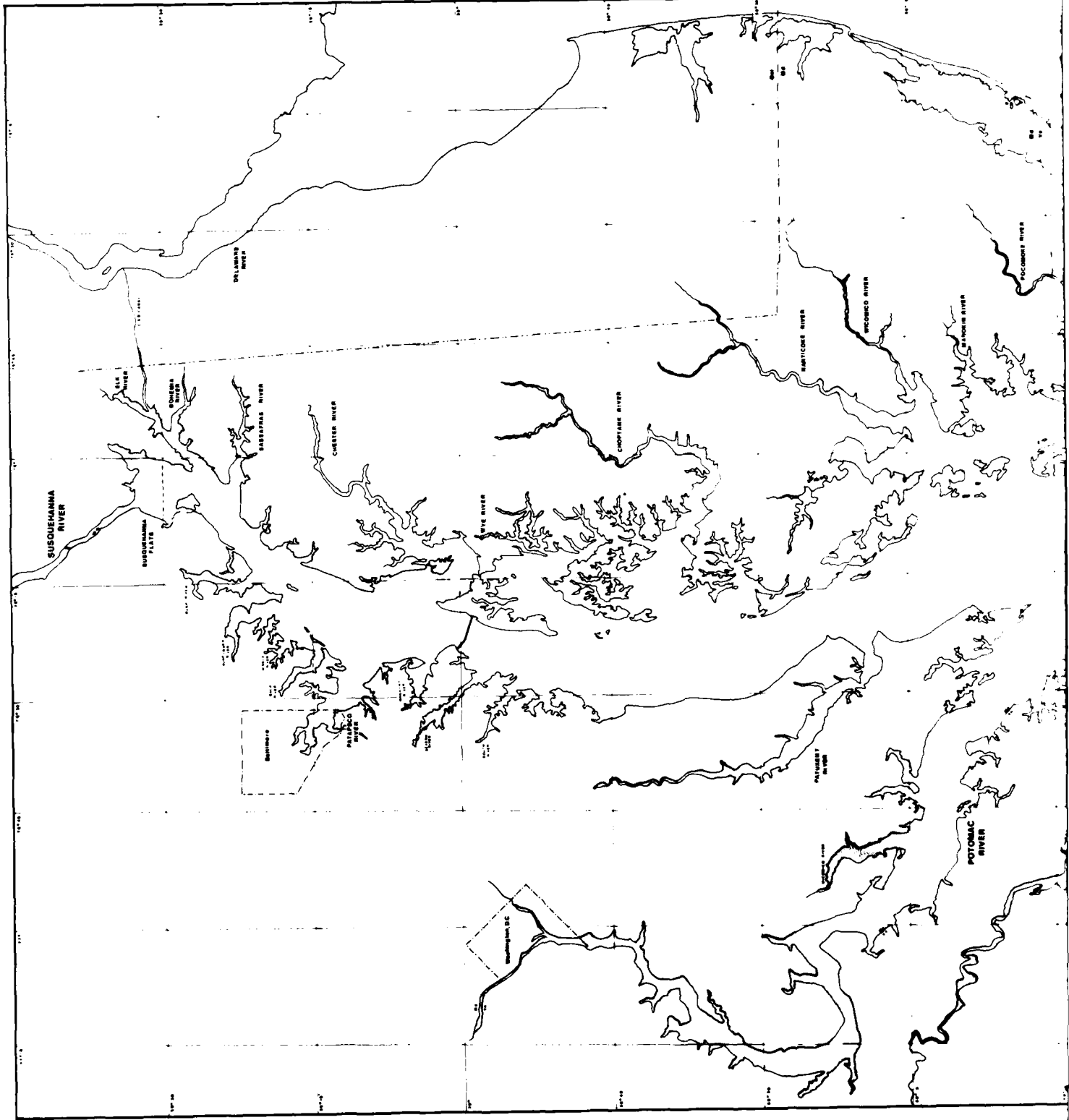
COE Hydraulic Model Data

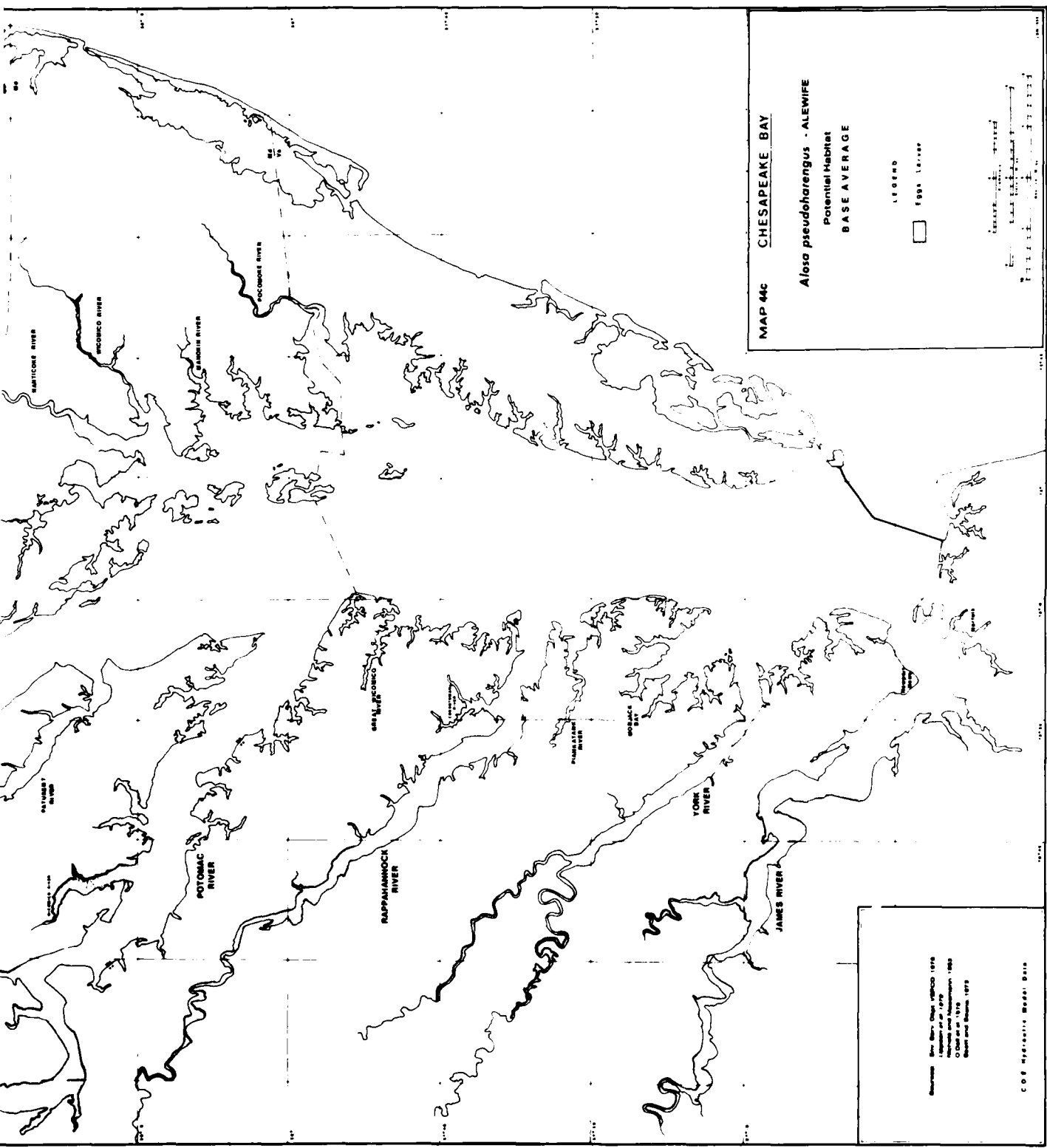






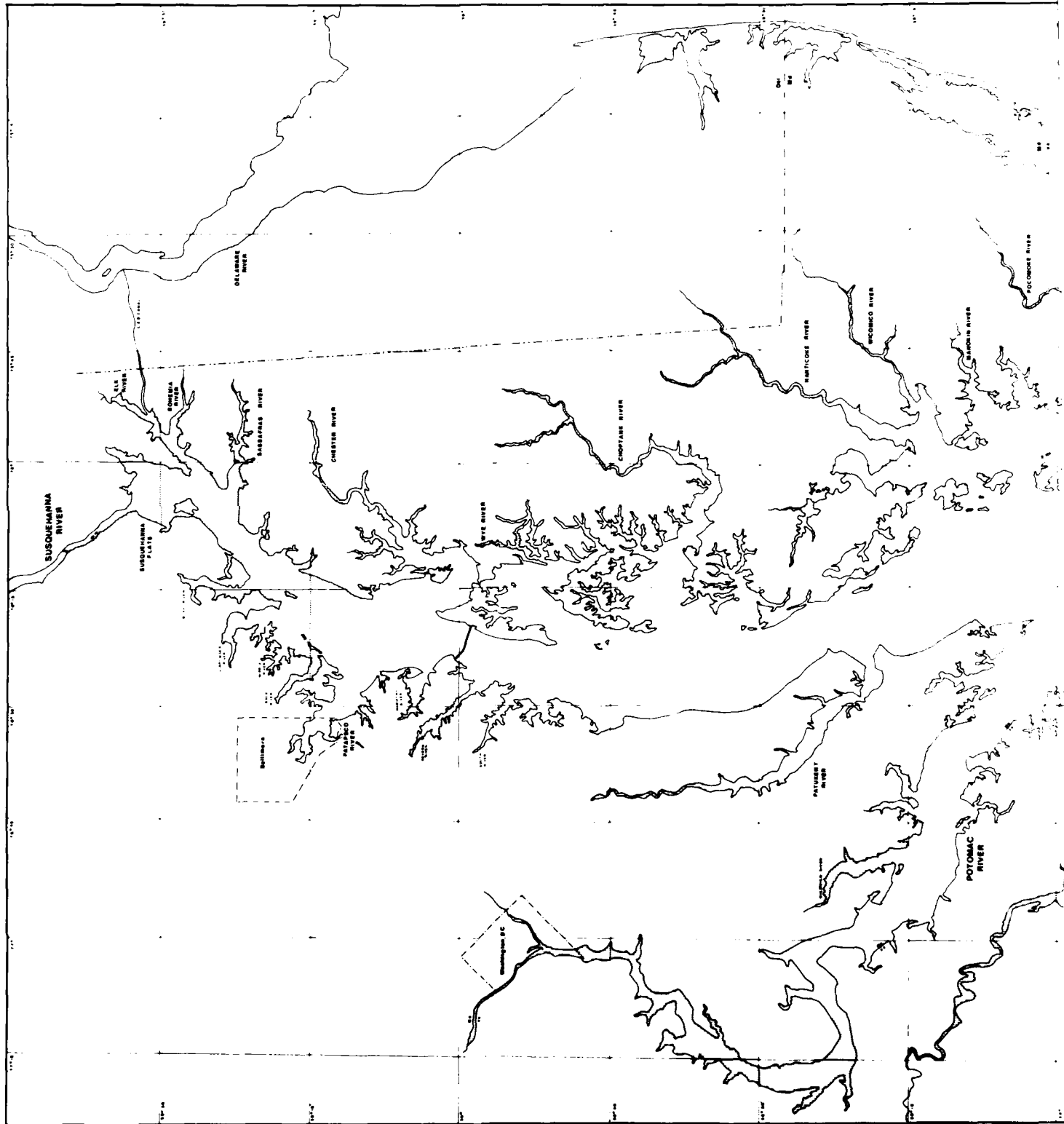


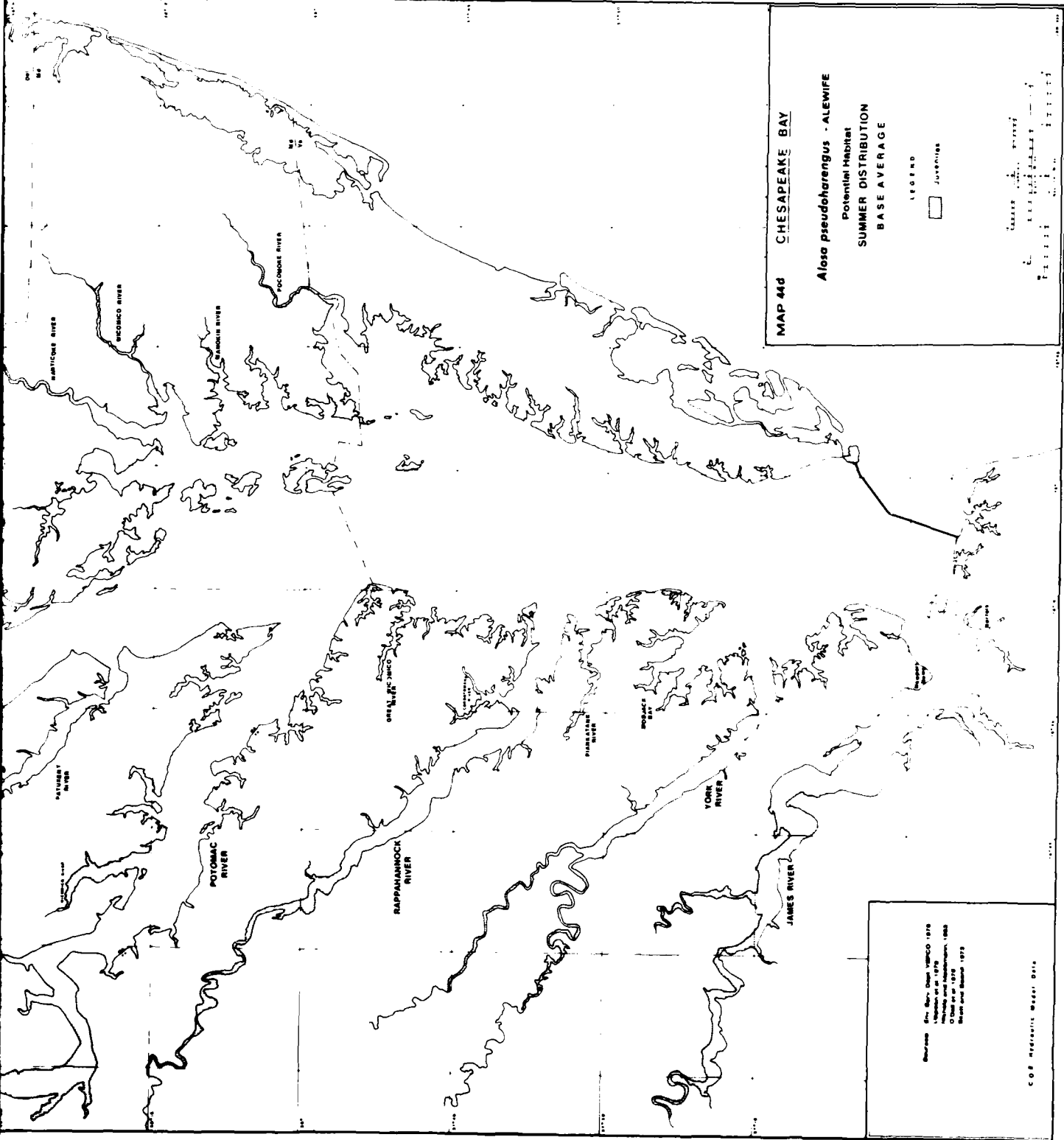




Chesapeake Bay Study, 1974-1975
 A. J. Threlkeld, Jr., 1979
 Potomac and Rappahannock Rivers
 O. J. Threlkeld, Jr., 1979
 York and James Rivers, 1979

C. S. HERRICK'S BAY, 1875





MAP 44d CHESAPEAKE BAY

Alosa pseudoharengus - ALEWIFE
 Potential Habitat
 SUMMER DISTRIBUTION
 BASE AVERAGE

LEGEND

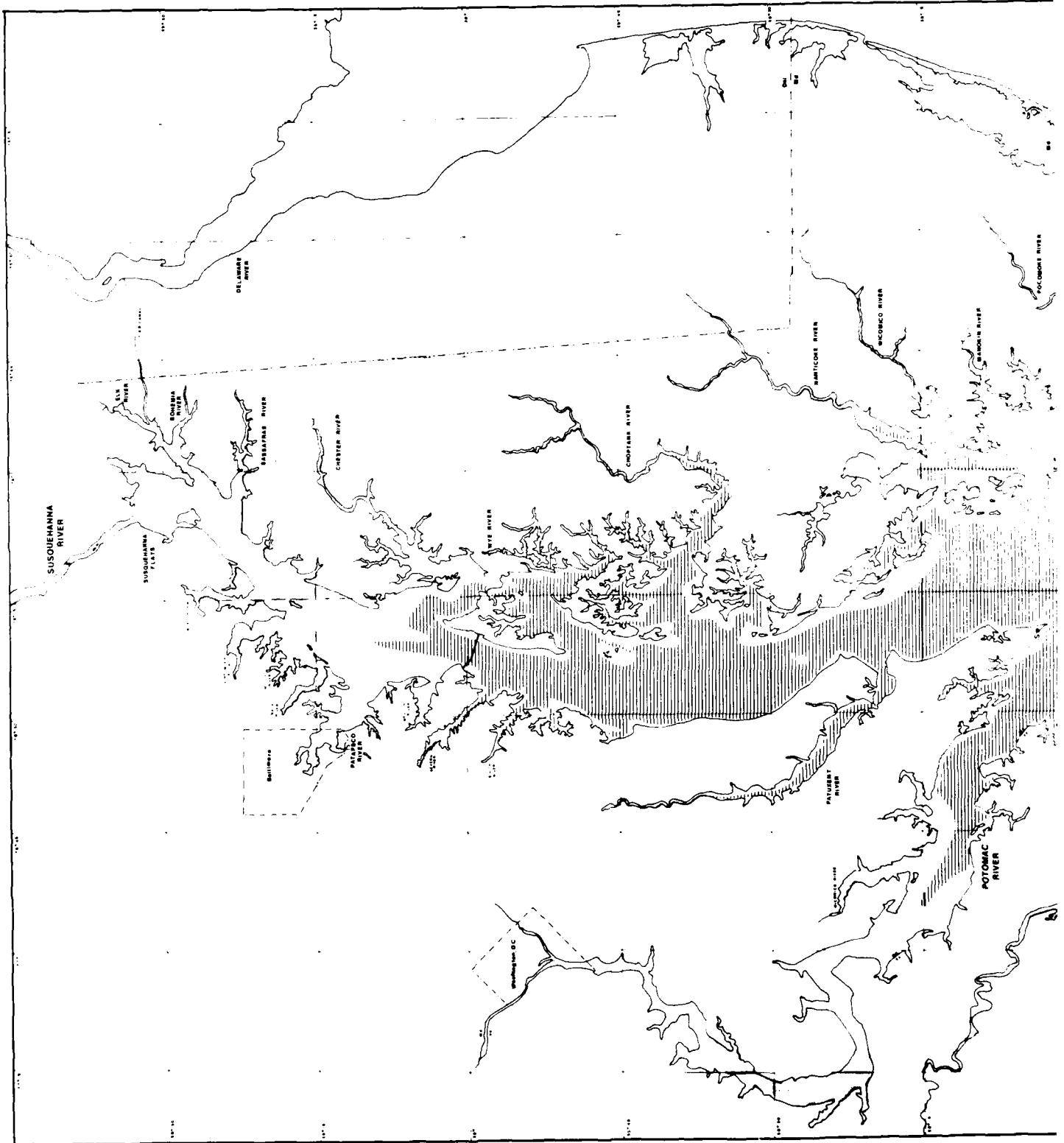
☐ JUVENILES

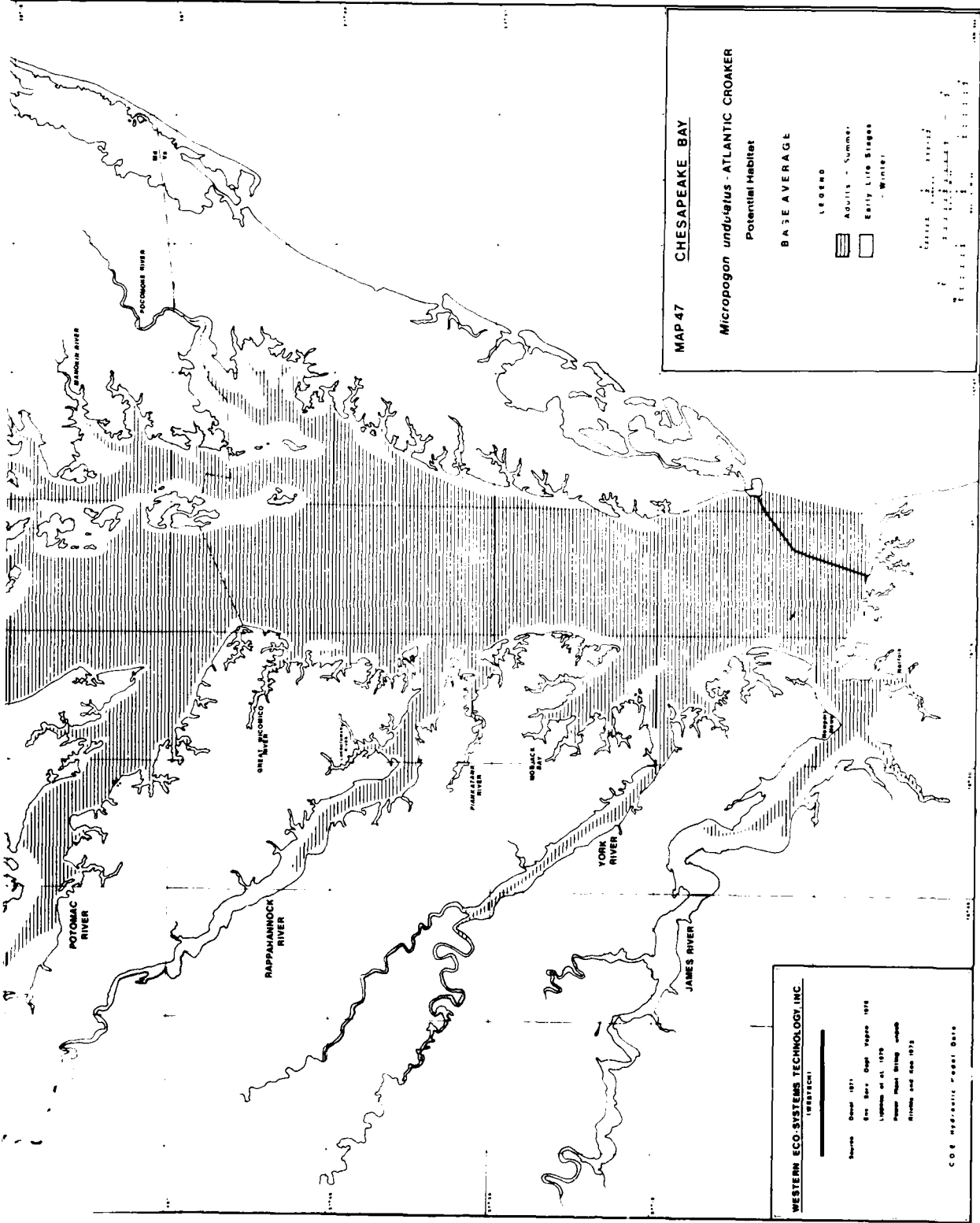
Scale: 1:50,000

Scale bar showing 0 to 10 miles.

Source: Dr. John D. Squires, 1976
 Modified by Dr. J. D. Squires, 1978
 Modified by Dr. J. D. Squires, 1988
 Modified by Dr. J. D. Squires, 1993
 Modified by Dr. J. D. Squires, 1995

COR. NANTUCKET BAY, 1976





MAP 47 CHESAPEAKE BAY

***Micropogon undulatus* - ATLANTIC CROAKER**

Potential Habitat

BASE AVERAGE

LEGEND

Adults - Summer

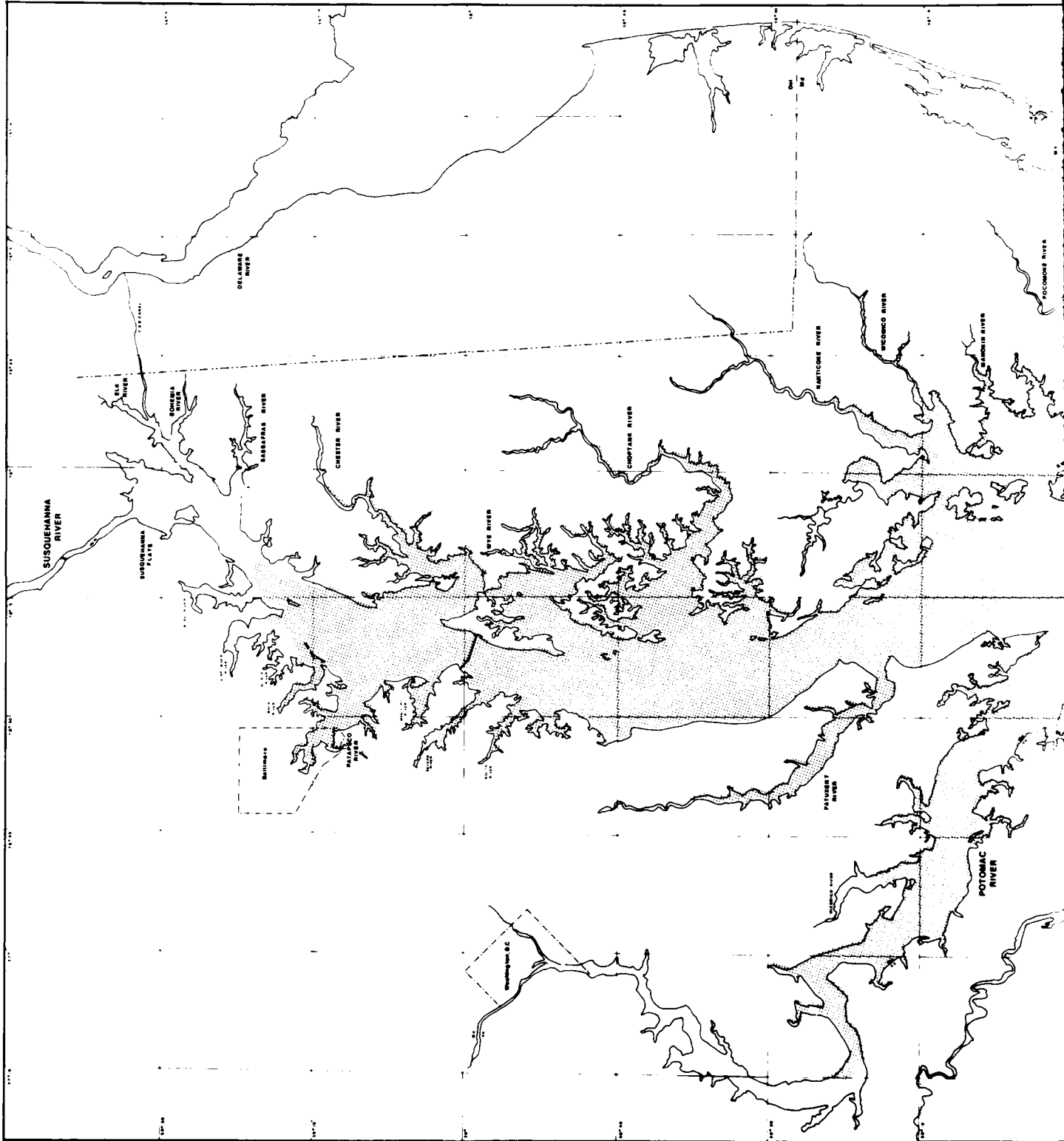
Early Life Stages

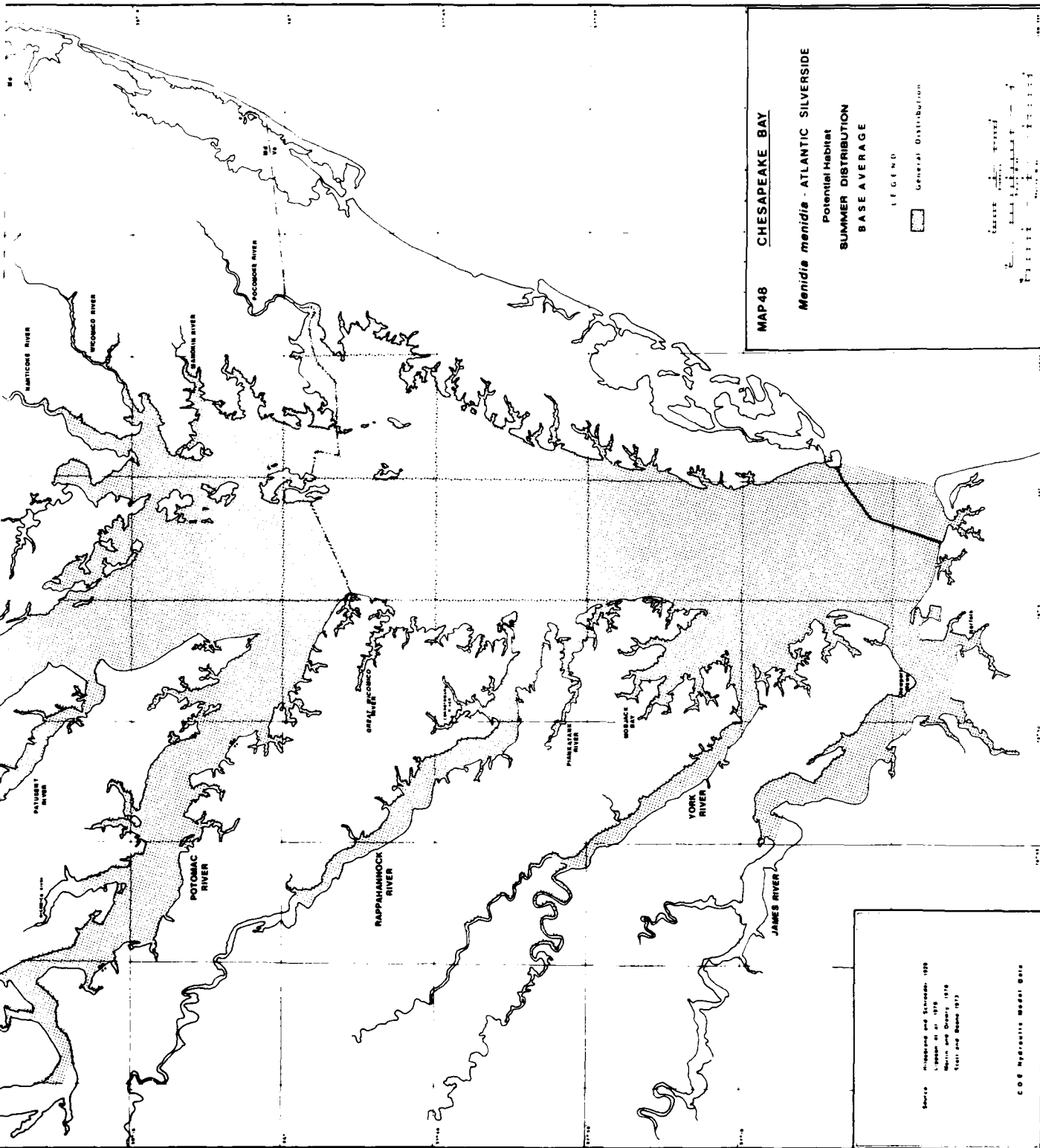
Winter

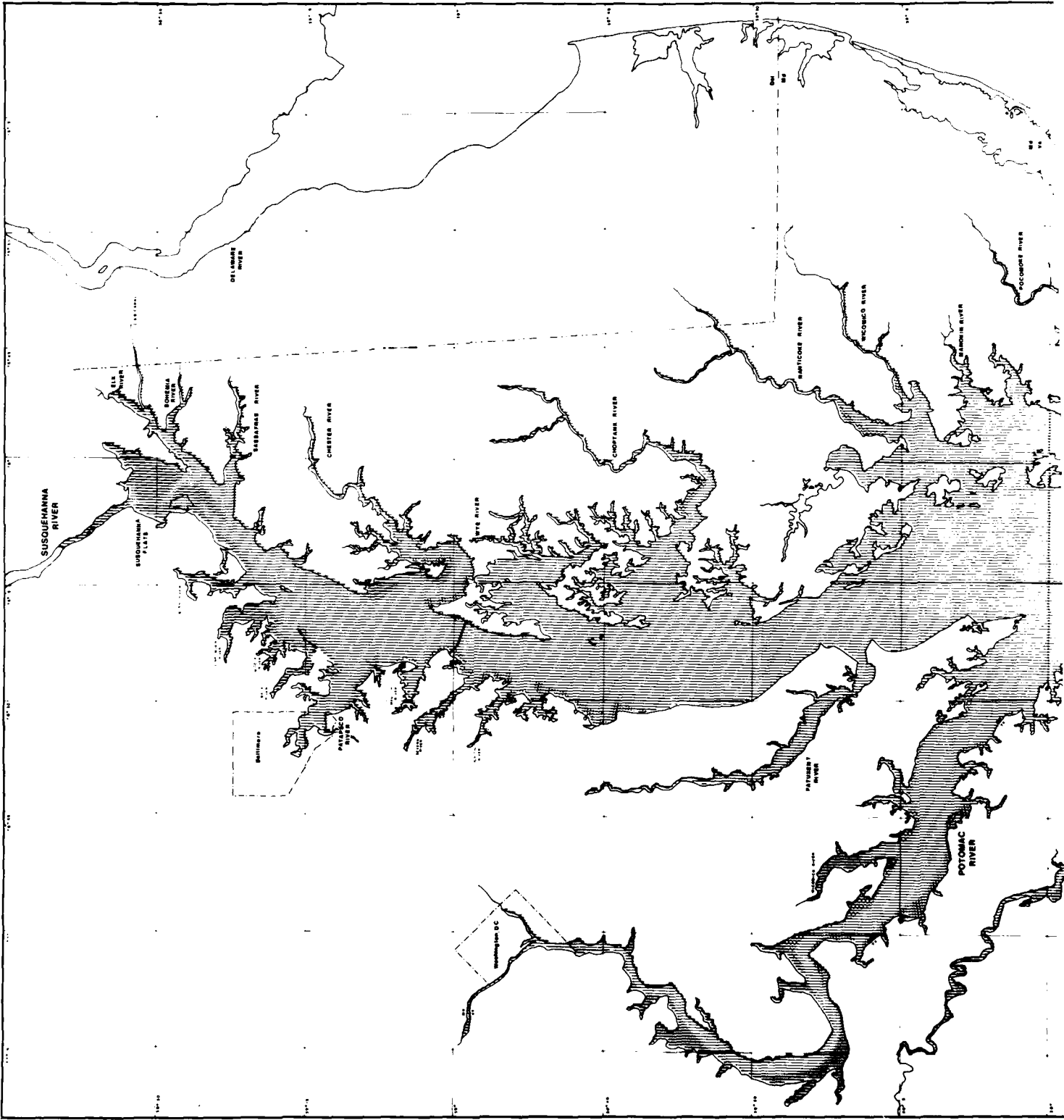
WESTERN ECO-SYSTEMS TECHNOLOGY, INC.
 (WESTTECH)

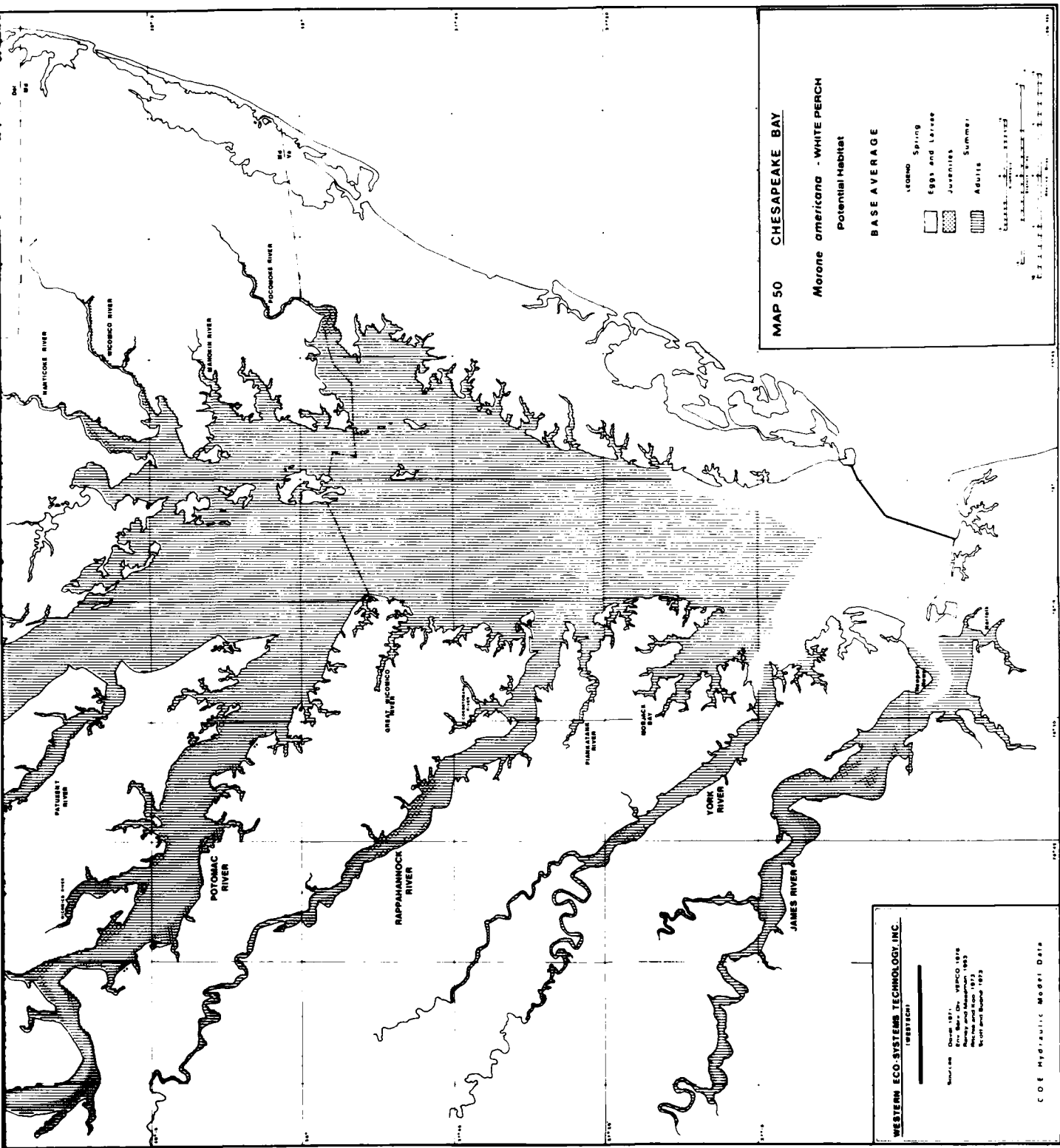
Source: Based 1971
 Data Base: Dept. of the Interior
 Fisheries at 1970
 Power Plant Siting studies
 1970 and 1972

COE HYDRAULIC MODEL DATA









MAP 50 CHESAPEAKE BAY

Morone americana - WHITE PERCH

Potential Habitat

BASE AVERAGE

Legend Spring

Eggs and Larvae

Juveniles

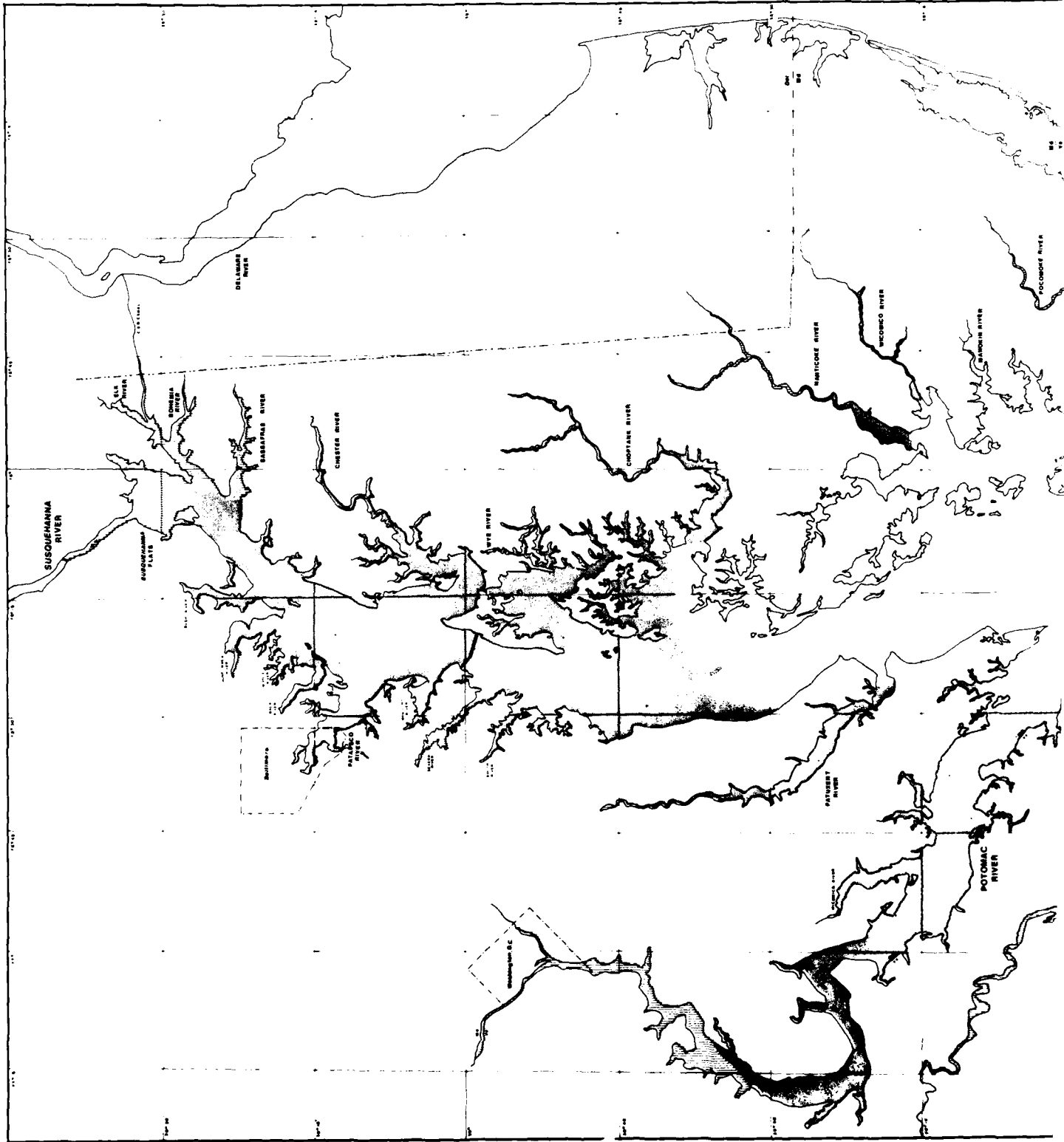
Adults

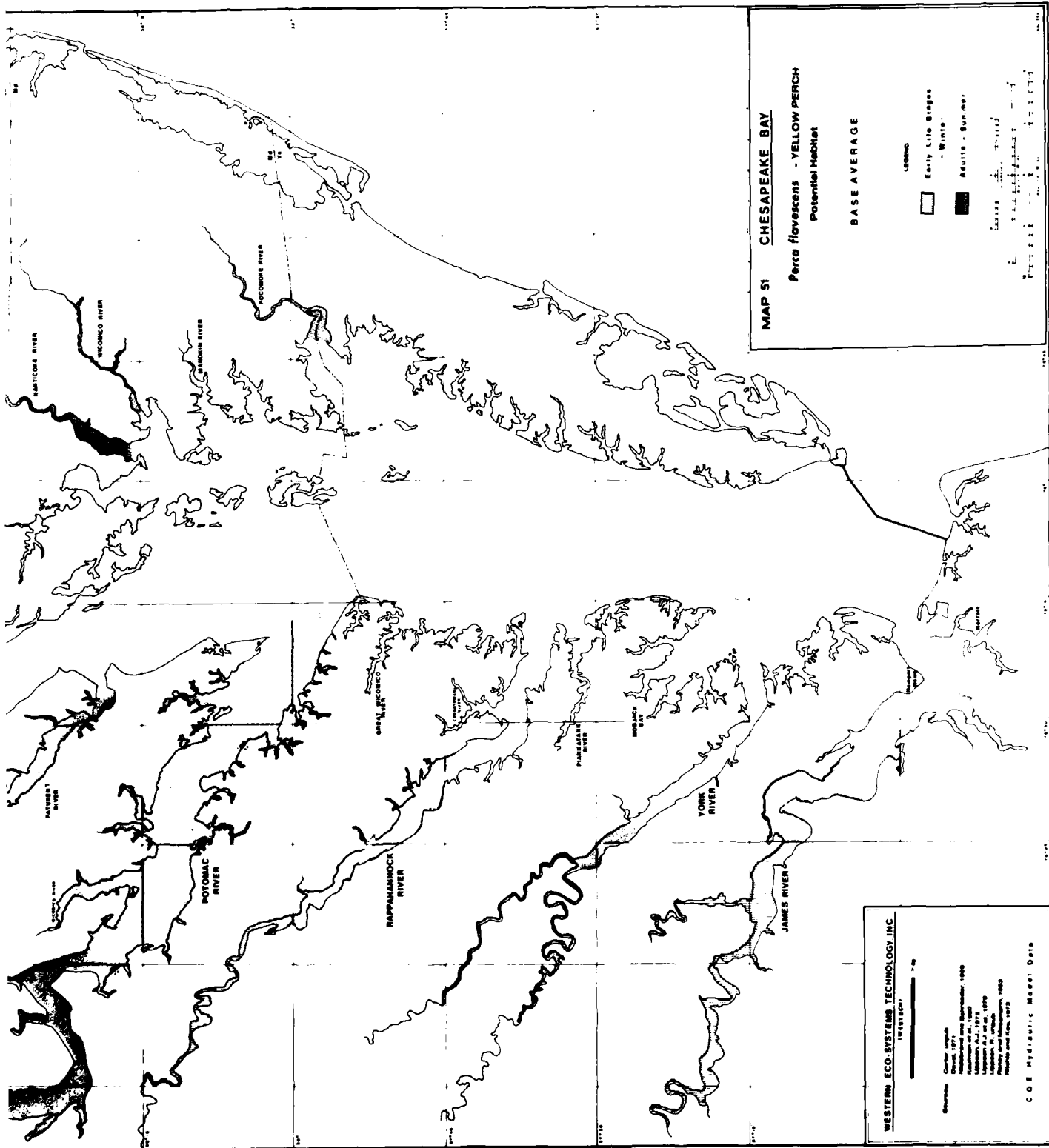
Scale: 1:50,000

WESTERN ECO-SYSTEMS TECHNOLOGY, INC.
 FORT WORTH, TEXAS

Source: Data 1971
 From Basin Div. WPCO 1976
 WPCO 1976
 WPCO 1976
 WPCO 1976

COE Hydraulic Model Data

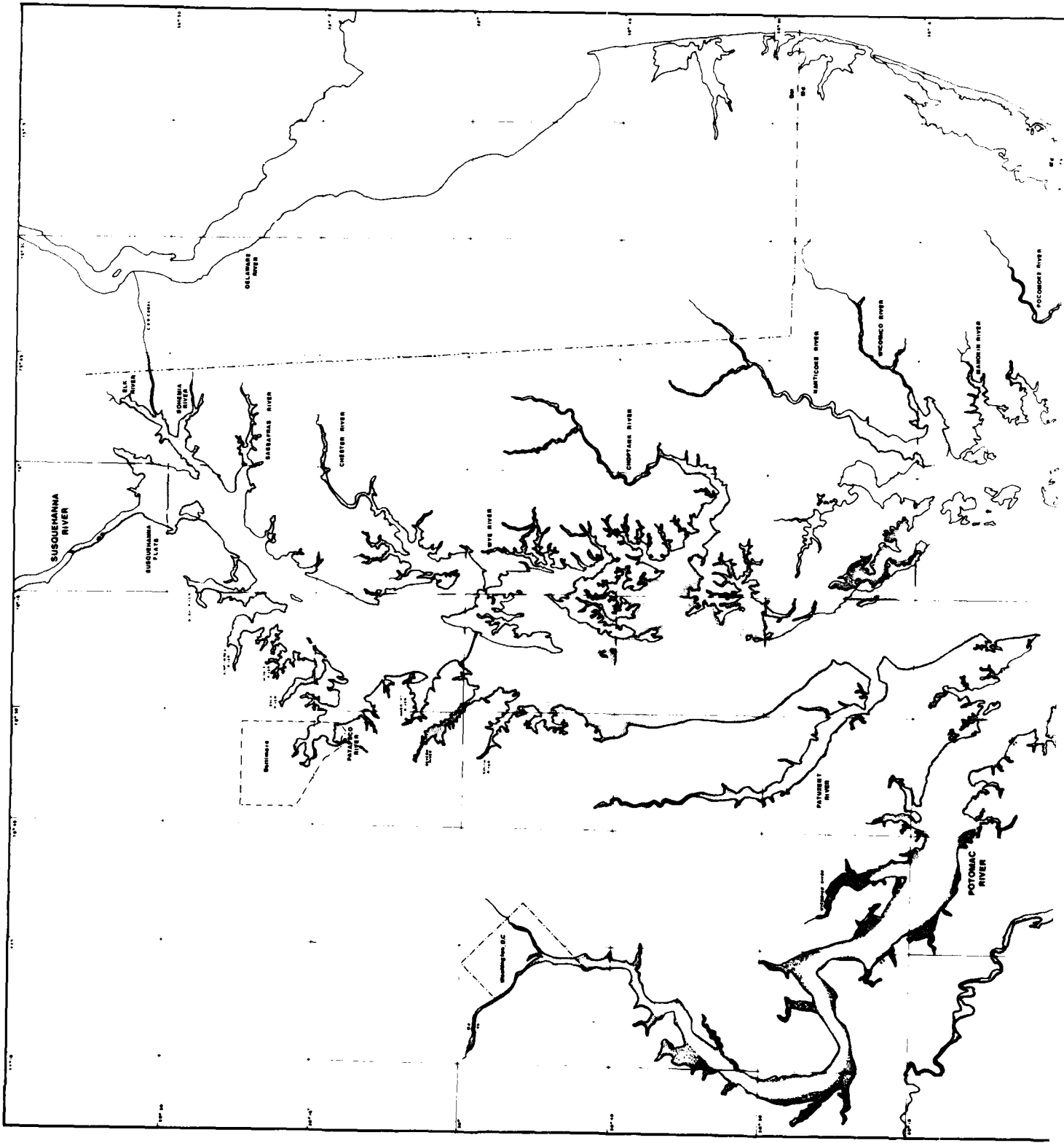


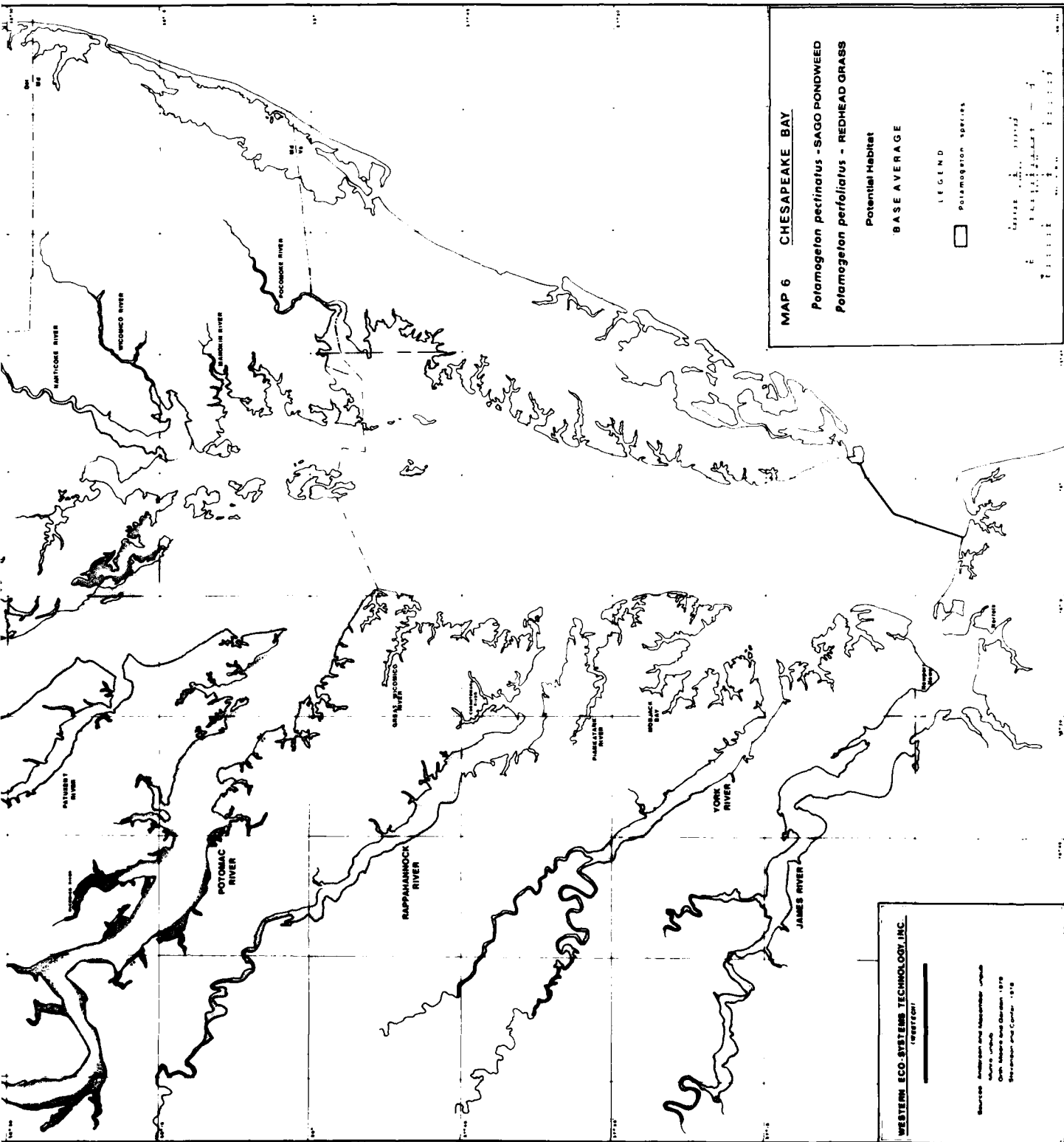


WESTERN ECO-SYSTEMS TECHNOLOGY, INC.
 WESTECH

Source: Coyle, 1974
 Oriskany, 1974
 Proceedings of the Symposium, 1980
 "Perch and Yellow Perch"
 American Fisheries Society, 1979
 Vannote et al., 1979
 Watershed Assessment, 1980
 Watershed Study, 1975

COE Hydraulic Model Data





MAP 6 CHESAPEAKE BAY

Potamogeton pectinatus - SAGO PONDWEED
Potamogeton perfoliatus - REDHEAD GRASS

Potential Habitat
 BASE AVERAGE

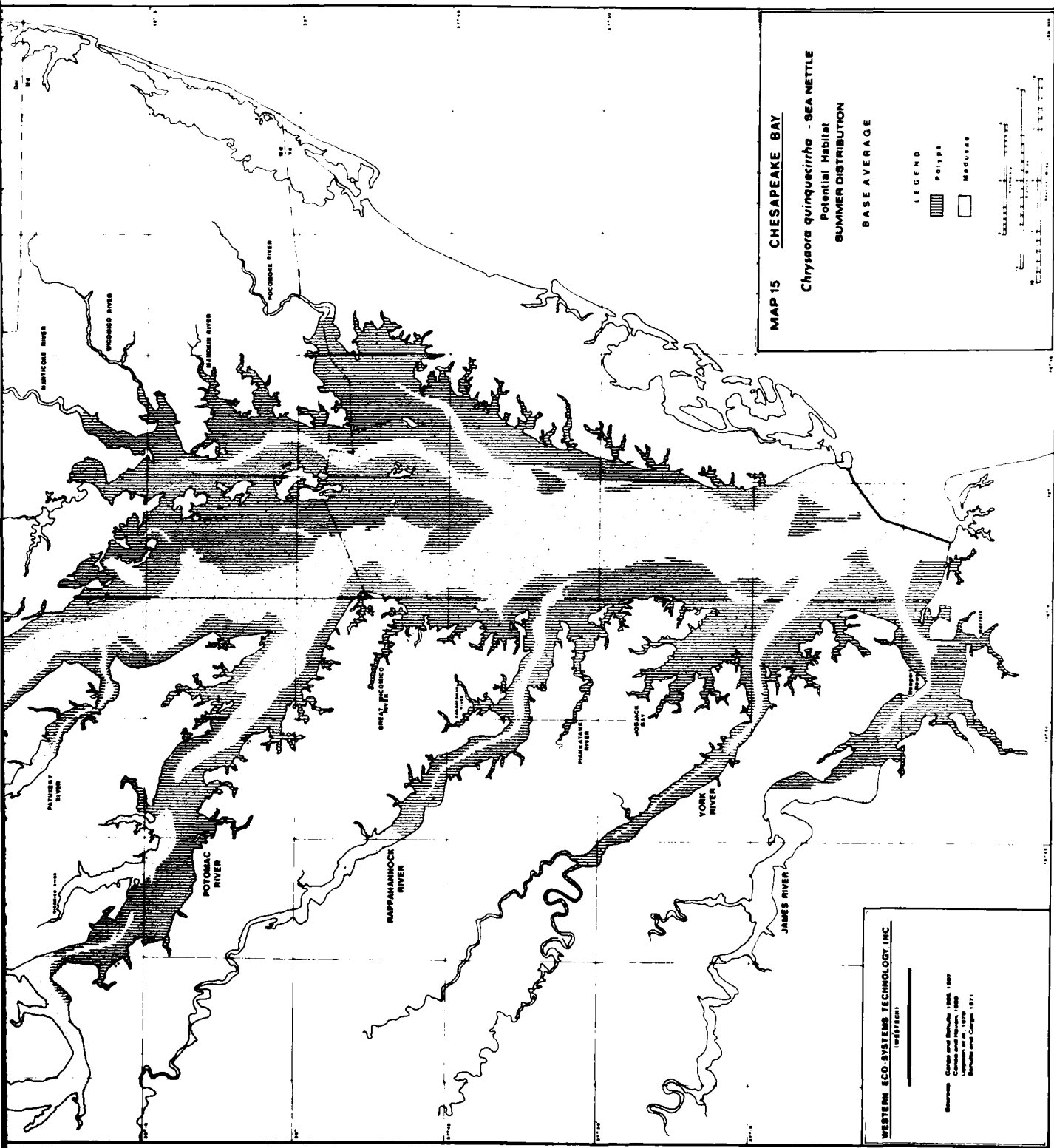
LEGEND
 □ Potamogeton species

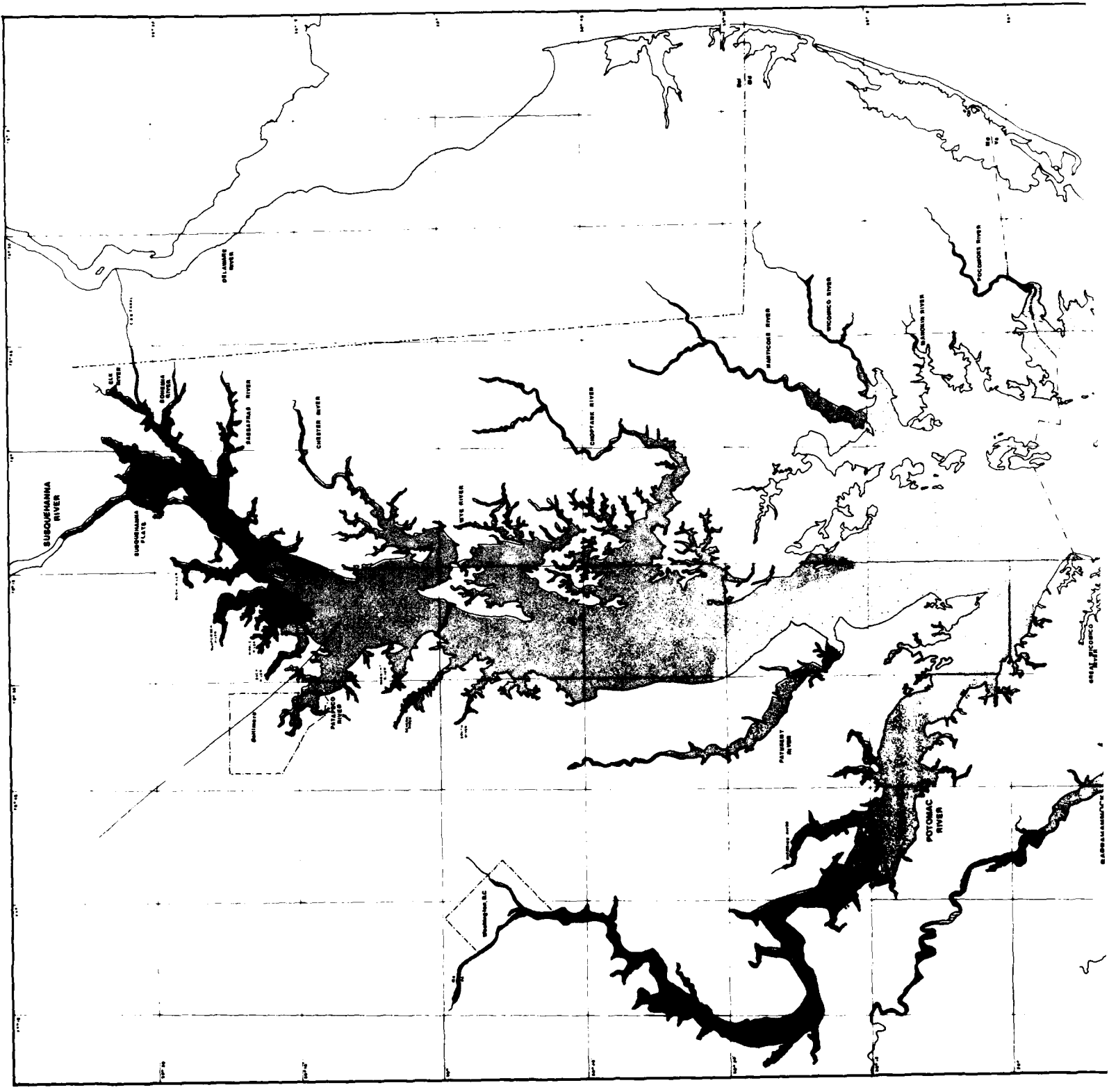
Scale: 1:50,000
 Date: 1978
 Project: Chesapeake Bay

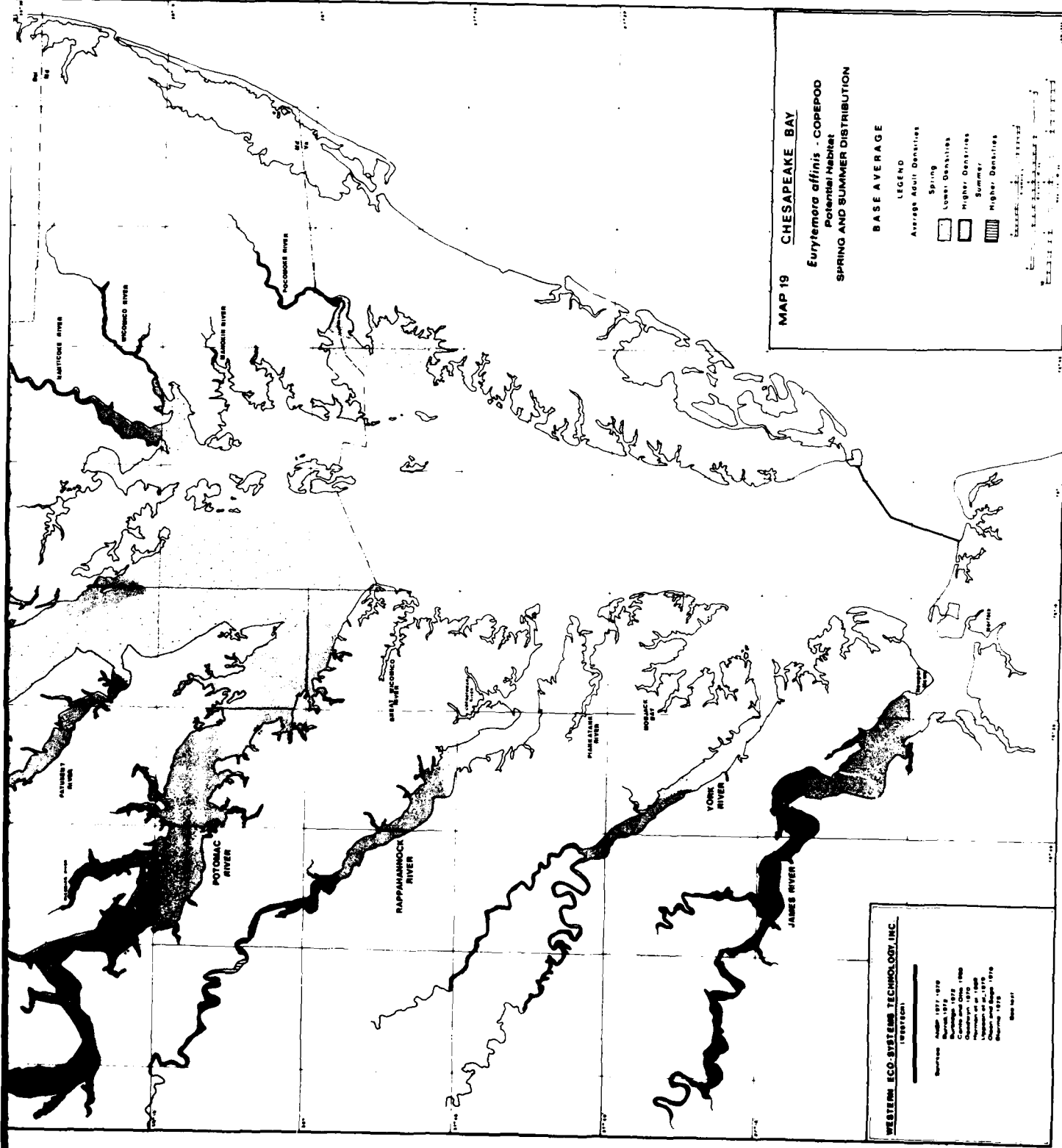
WESTERN ECO-SYSTEMS TECHNOLOGY, INC.
 (WESTTECH)

Services: Assessment and Management, Land Use Planning, Wetlands, Data Analysis and Collection, Database and Cartography









MAP 19 CHESAPEAKE BAY
Eurytemora affinis - COPEPOD
 Potential Habitat
 SPRING AND SUMMER DISTRIBUTION

BASE AVERAGE

LEGEND
 Average Adult Densities

Spring
 Lower Densities
 Higher Densities

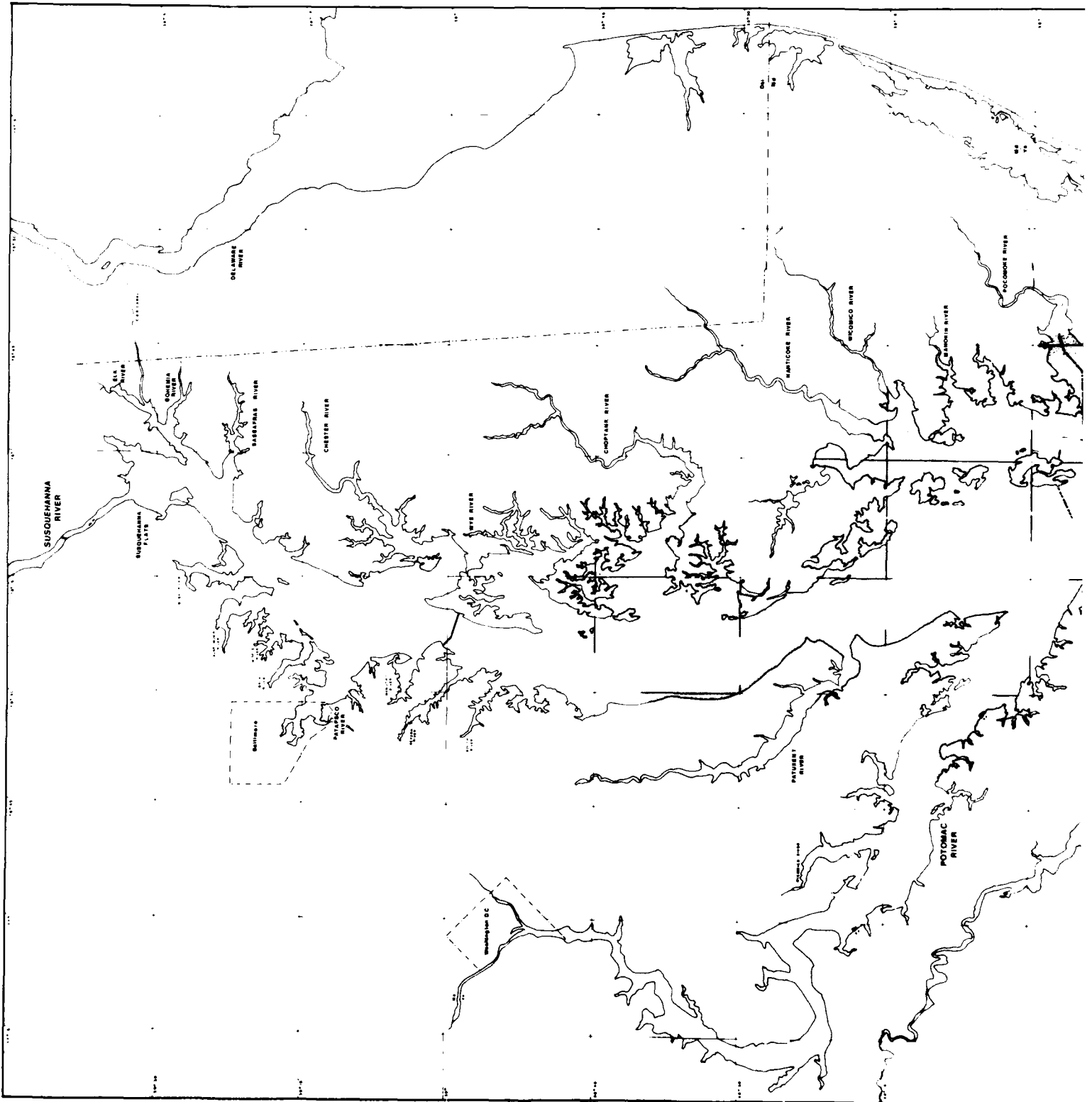
Summer
 Lower Densities
 Higher Densities

Scale: 1:100,000
 North Arrow

WESTERN ECO-SYSTEMS TECHNOLOGY, INC.
 (WESTECH)

Developed
 August 1977-1979
 December 1979
 Revised 1982
 Carter and Oles 1980
 November 1981
 November 1981
 November 1981
 November 1981
 November 1981

Map No. 21



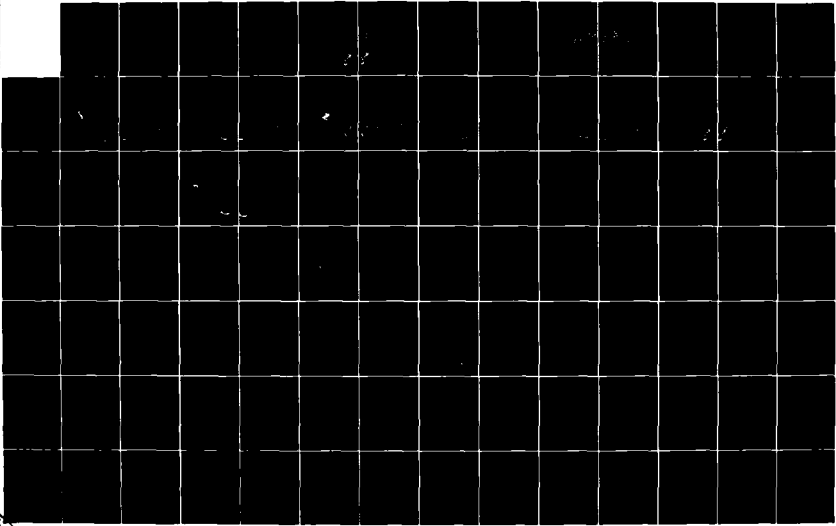
AD-A125 154

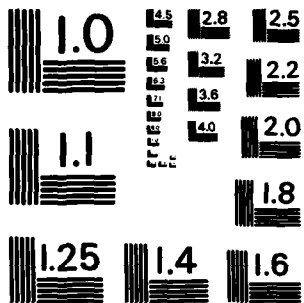
CHESAPEAKE BAY LOW FRESHWATER INFLOW STUDY PHASE II
BIOTA ASSESSMENT MAP.. (U) WESTERN ECO-SYSTEMS
TECHNOLOGY INC BOTHELL WA G B MACKIERNAN ET AL. MAY 82
DACW31-79-C-0056 F/G 6/6

22

UNCLASSIFIED

NL


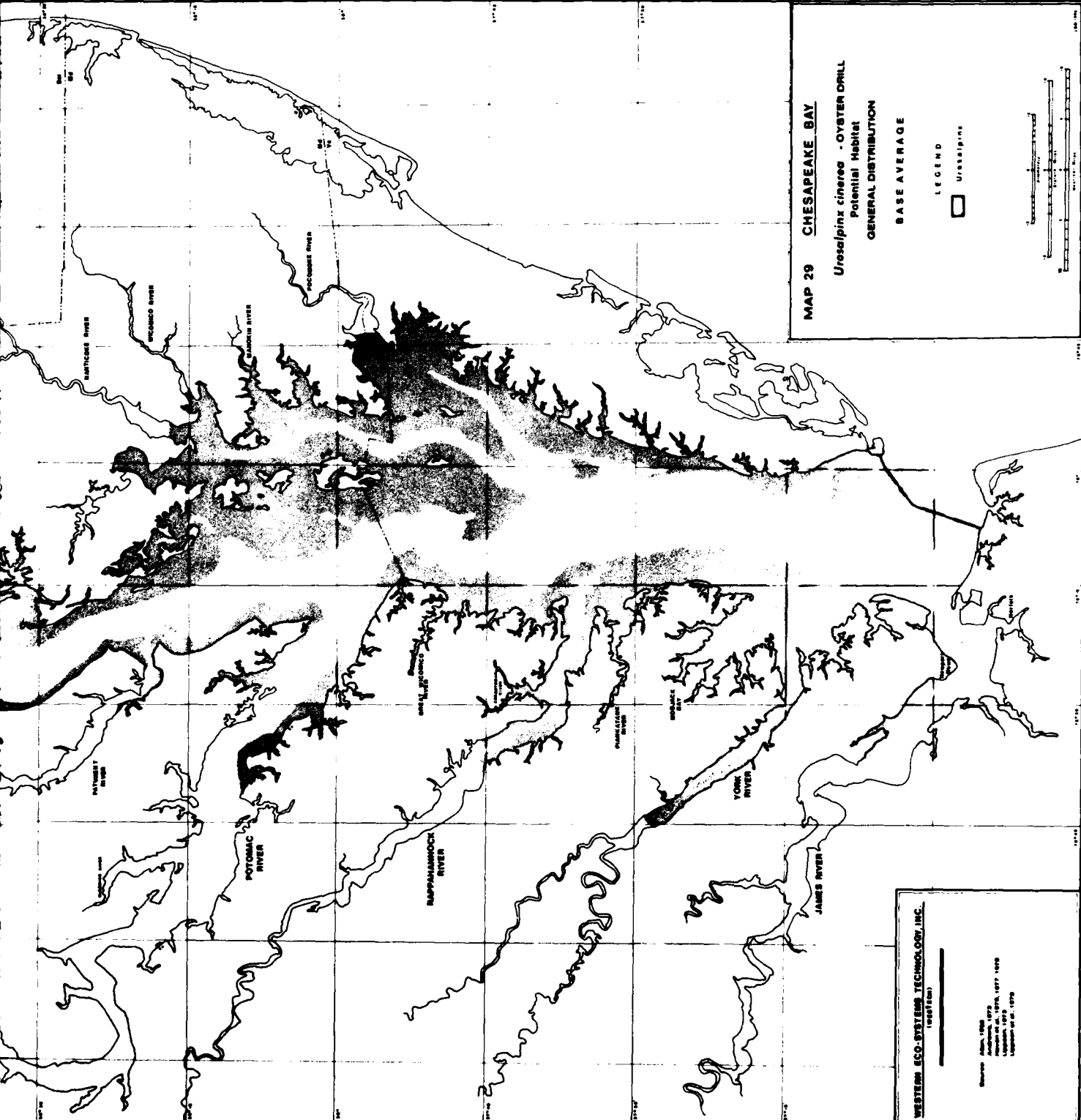




MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

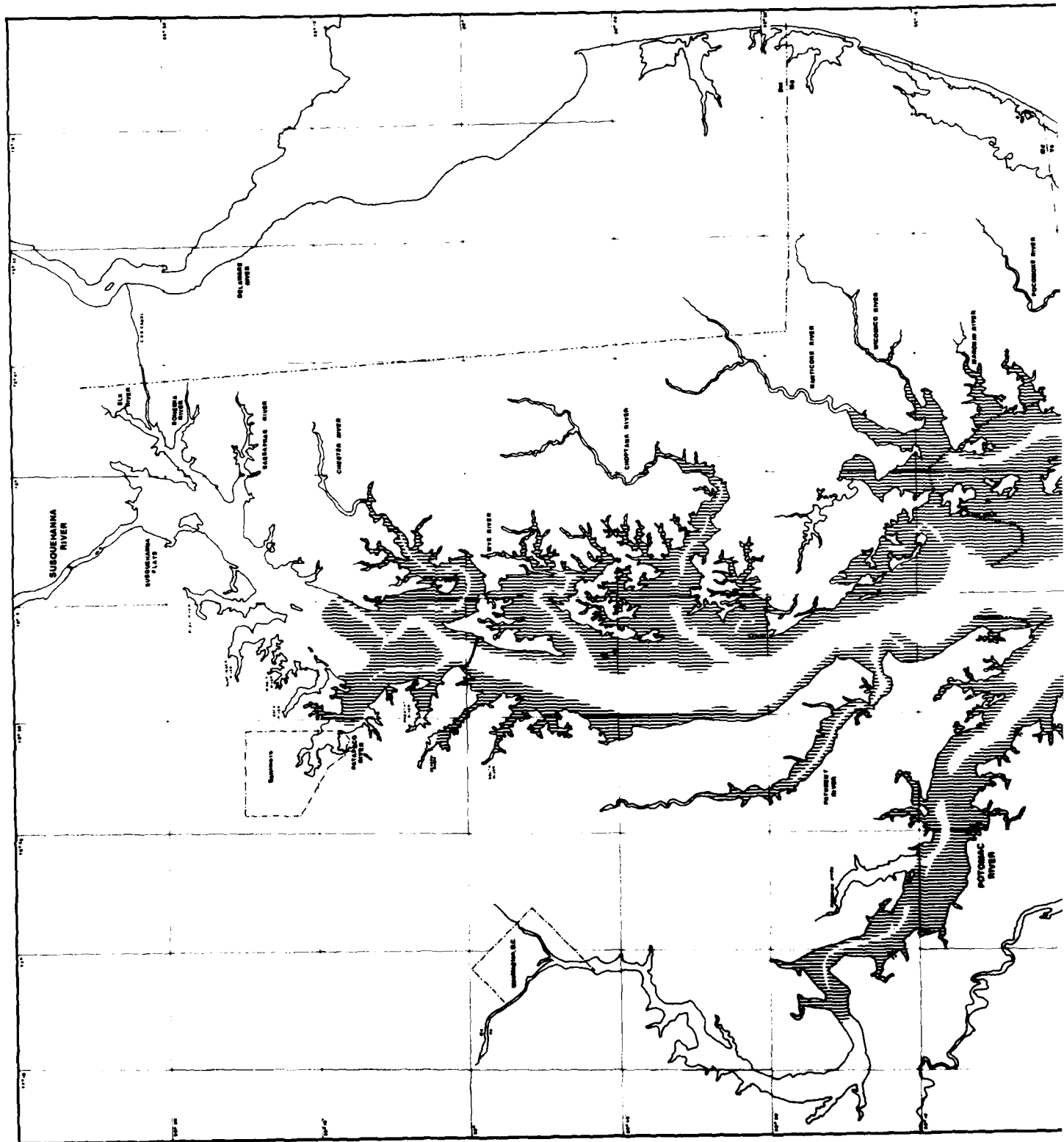
MAP 29 CHESAPEAKE BAY
Urosalpinx cinerea - OYSTER DRILL
 Potential Habitat
 GENERAL DISTRIBUTION
 BASE AVERAGE

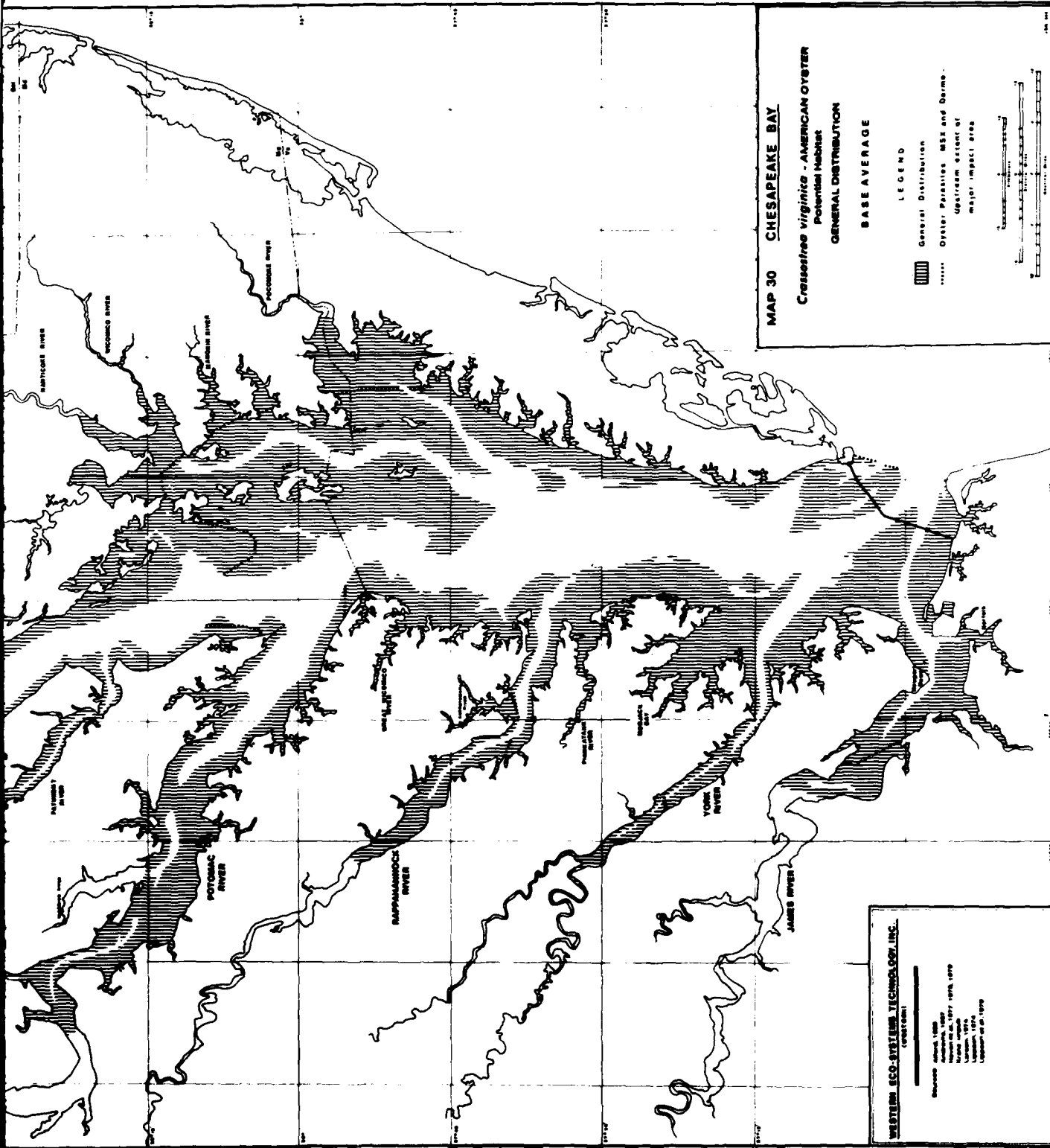
LEGEND
 □ *Urosalpinx*

WESTERN GEO-SYSTEMS TECHNOLOGY, INC.
 (1988) (10)

Source: Jahn, 1982
 Anderson, 1972
 Peterson et al., 1976, 1987, 1979
 Chapman et al., 1979





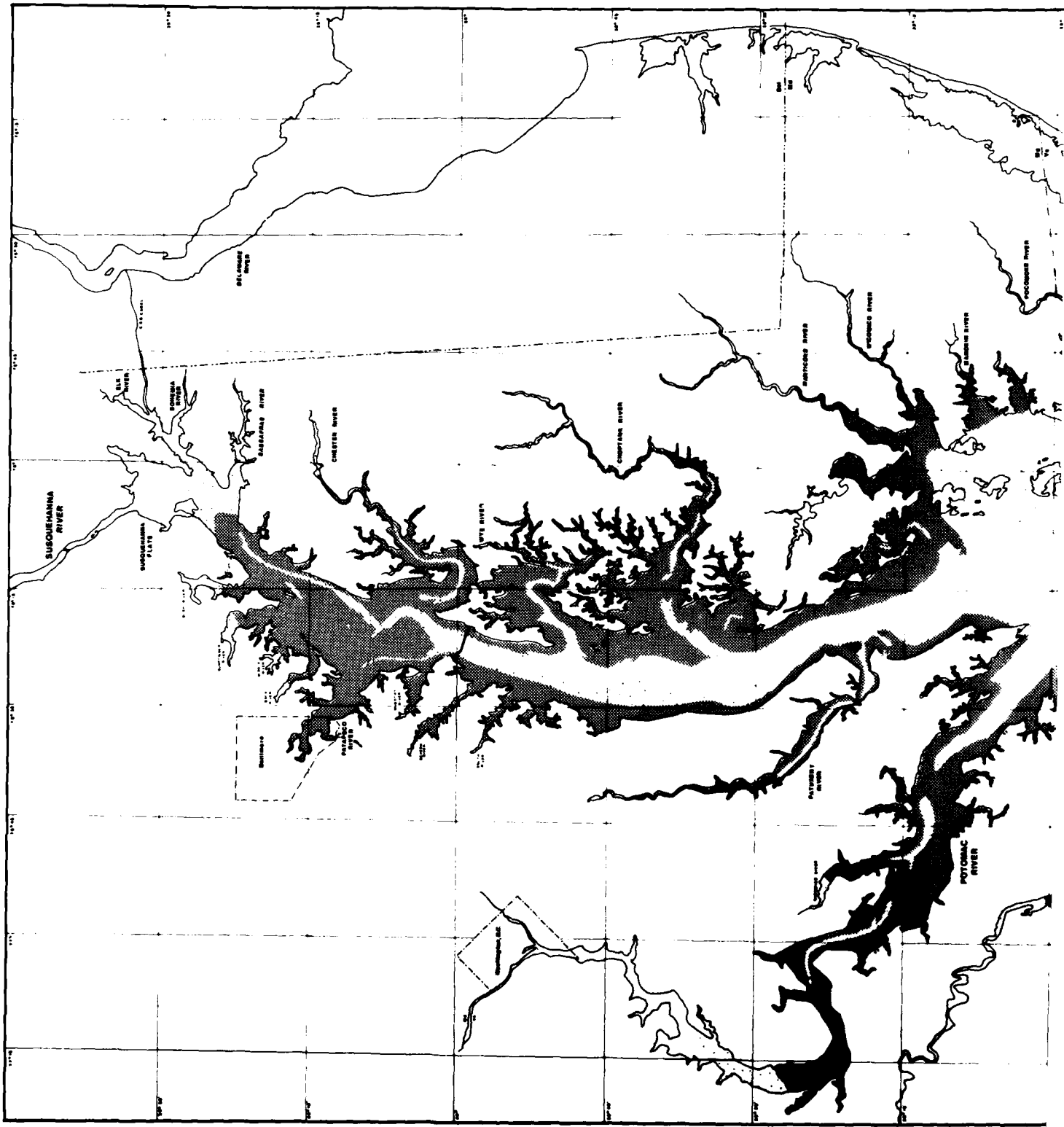
MAP 30 CHESAPEAKE BAY
Crassostrea virginica - AMERICAN OYSTER
 Potential Habitat
 GENERAL DISTRIBUTION
 BASE AVERAGE

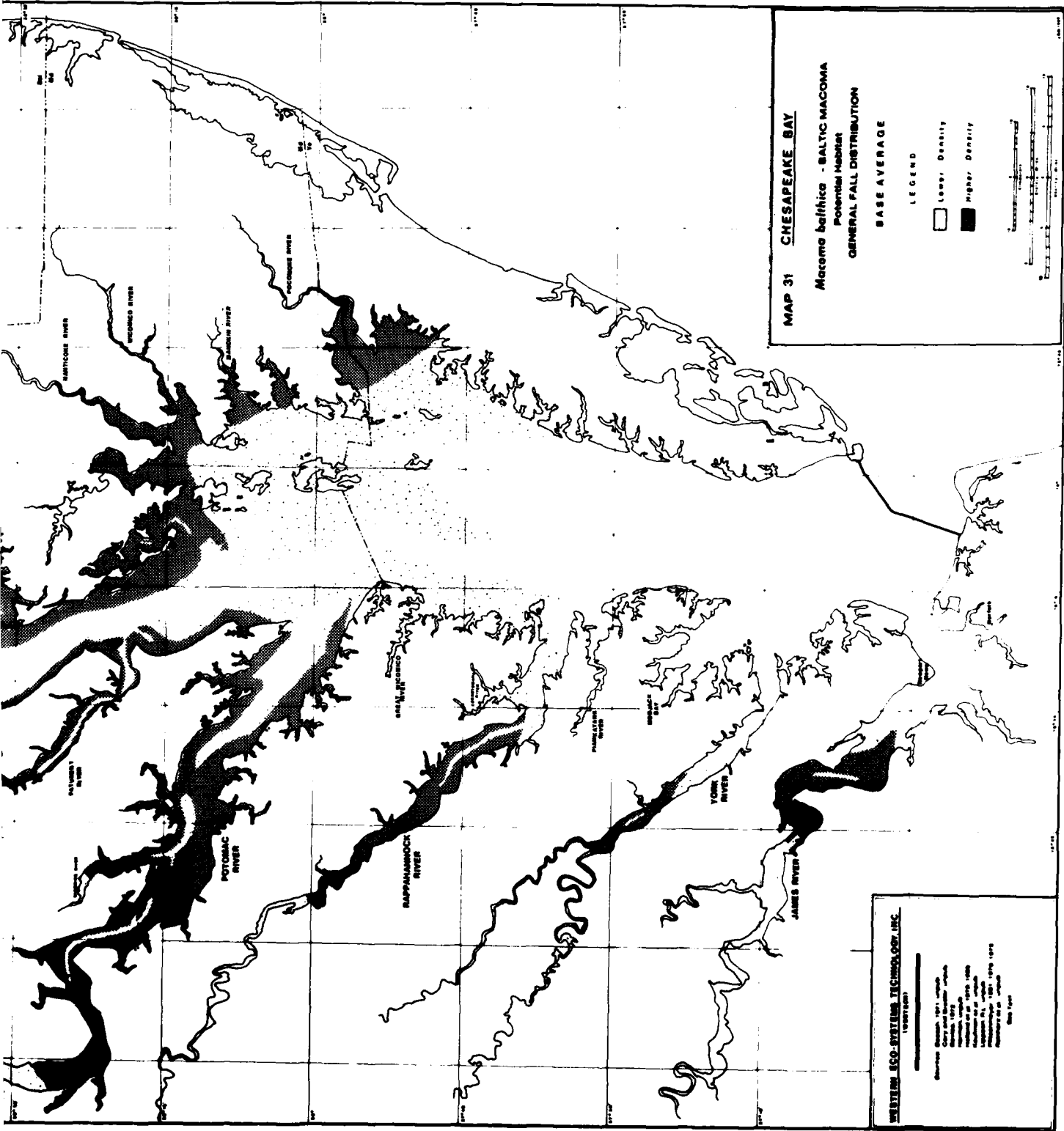
LEGEND
 General Distribution
 Upstream extent of major impact area

Scale: 1:50,000

WESTERN ECO-SYSTEMS TECHNOLOGY, INC.
 CONSULTANTS

Bethesda, MD
 Alexandria, VA
 Washington, DC
 Fairfax, VA
 Columbia, SC
 Columbia, MS
 Columbia, MO
 Columbia, TN
 Columbia, SC
 Columbia, MS
 Columbia, MO
 Columbia, TN





MAP 31 CHESAPEAKE BAY

Macoma balthica - BALTIC MACOMA
 Potential Habitat
 GENERAL FALL DISTRIBUTION
 BASE AVERAGE

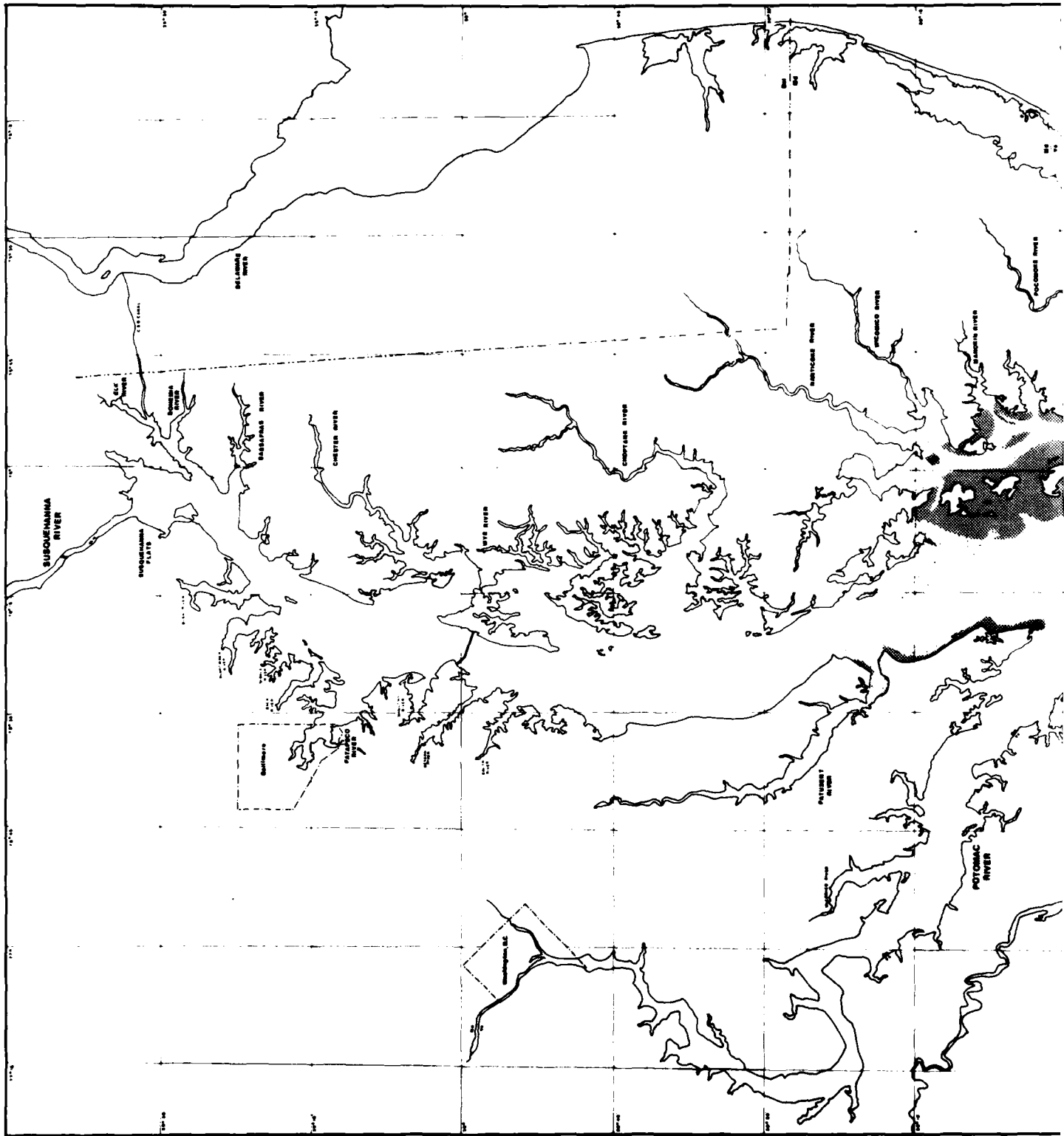
LEGEND

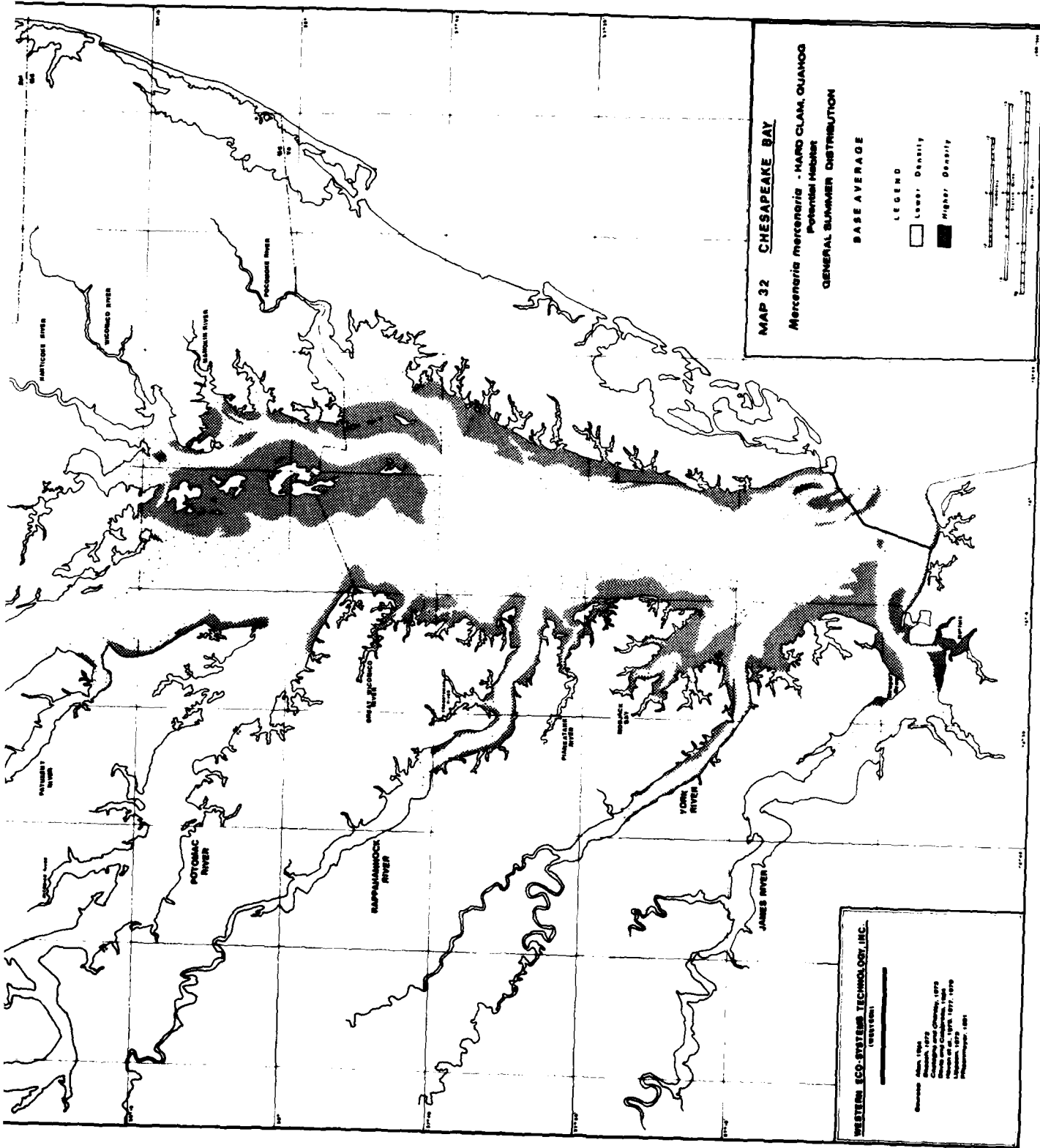
□ Lower Density
 ■ Higher Density

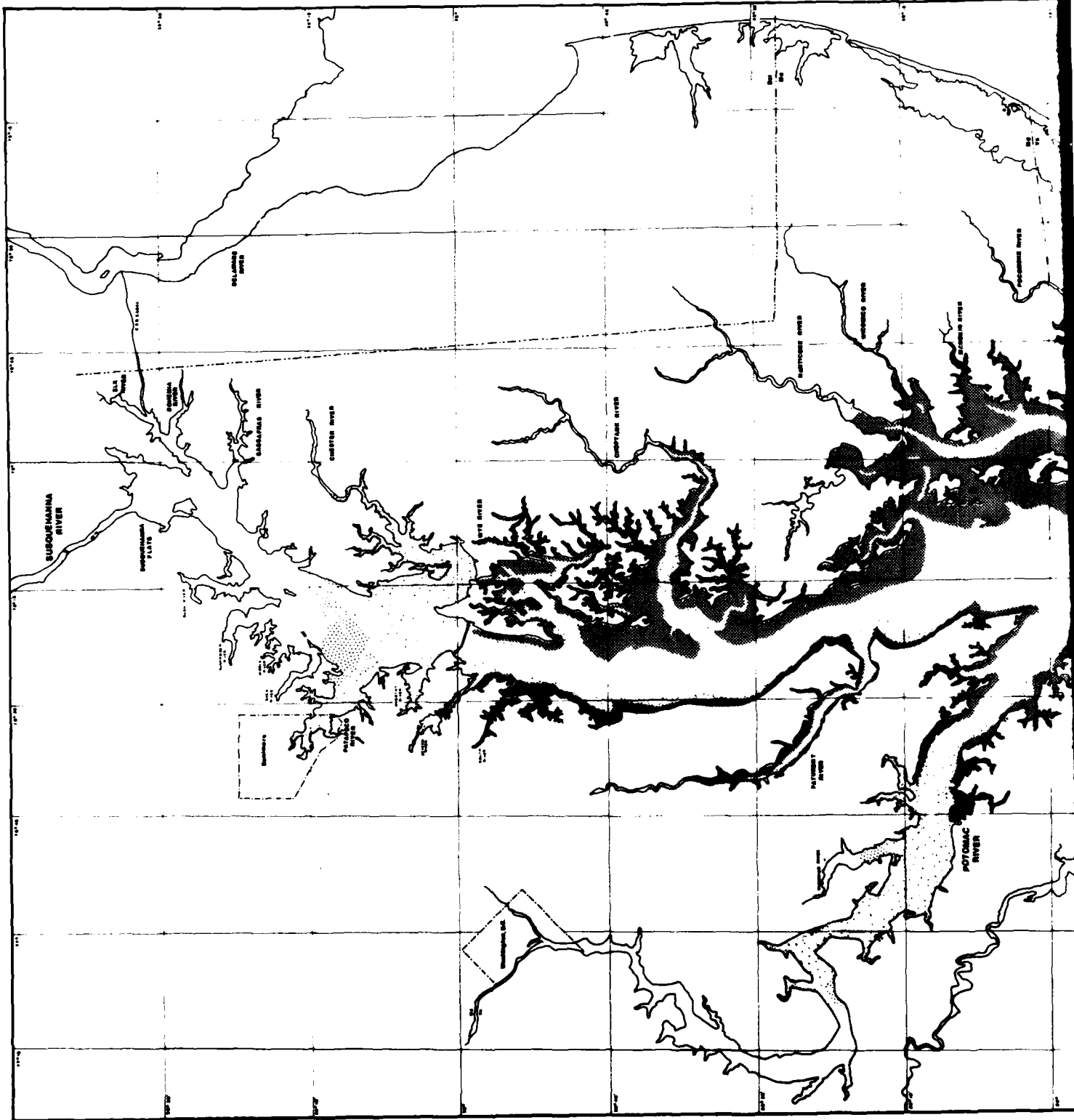
Scale: 0 10 20 30 40 50 Miles
 0 10 20 30 40 50 Kilometers

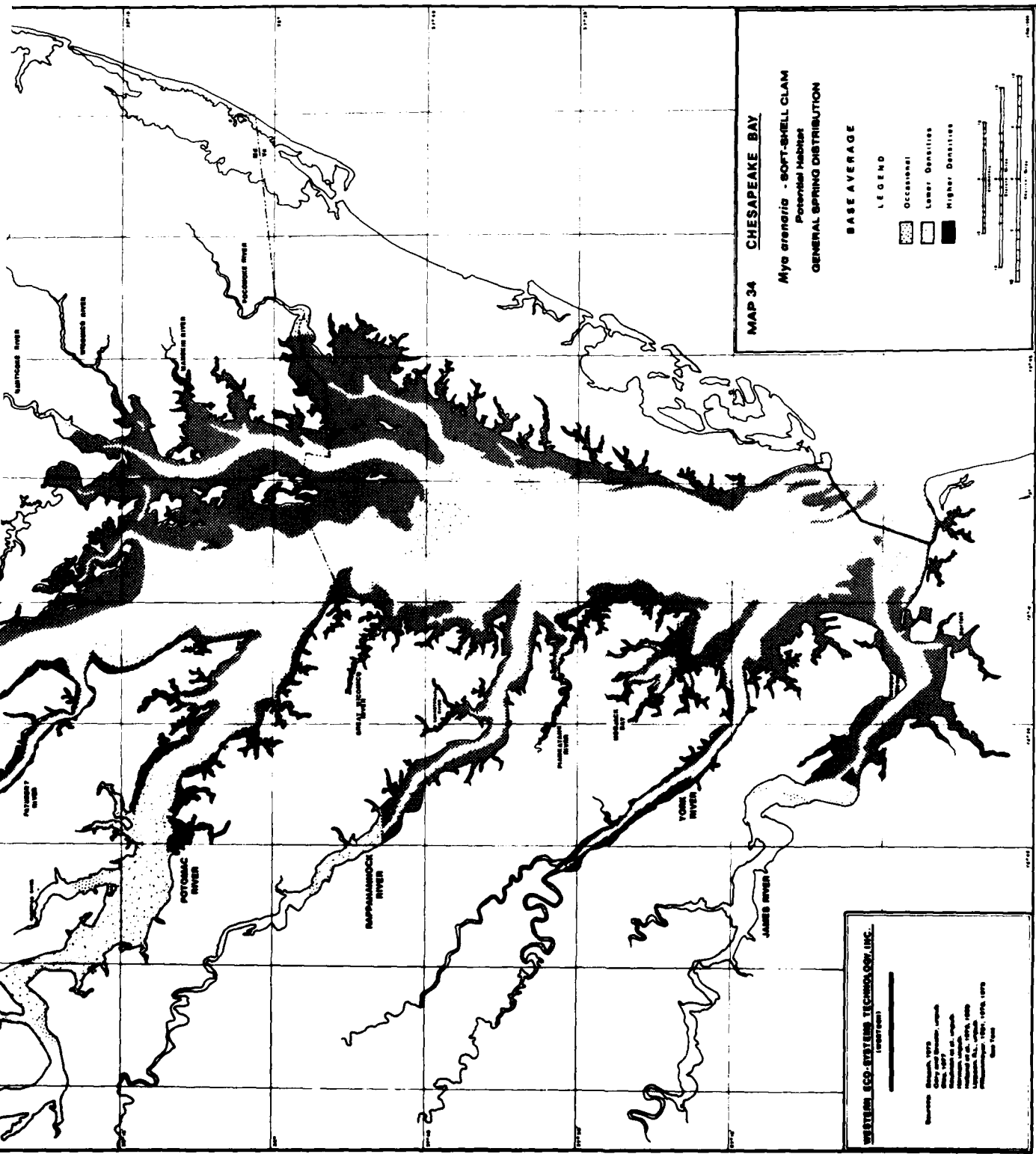
WESTINGHOUSE SYSTEMS TECHNOLOGY, INC.
 (continued)

Contract: N00014-77-0-0000
 Office: Naval Facilities Engineering Command
 Station: 3195
 Building: 3195-100
 Room: 3195-100-100
 Alexandria, VA 22304
 Date: 1978









MAP 34 CHESAPEAKE BAY
Mya arenaria - SOFT-SHELL CLAM
 Potential Habitat
 GENERAL SPRING DISTRIBUTION

BASE AVERAGE

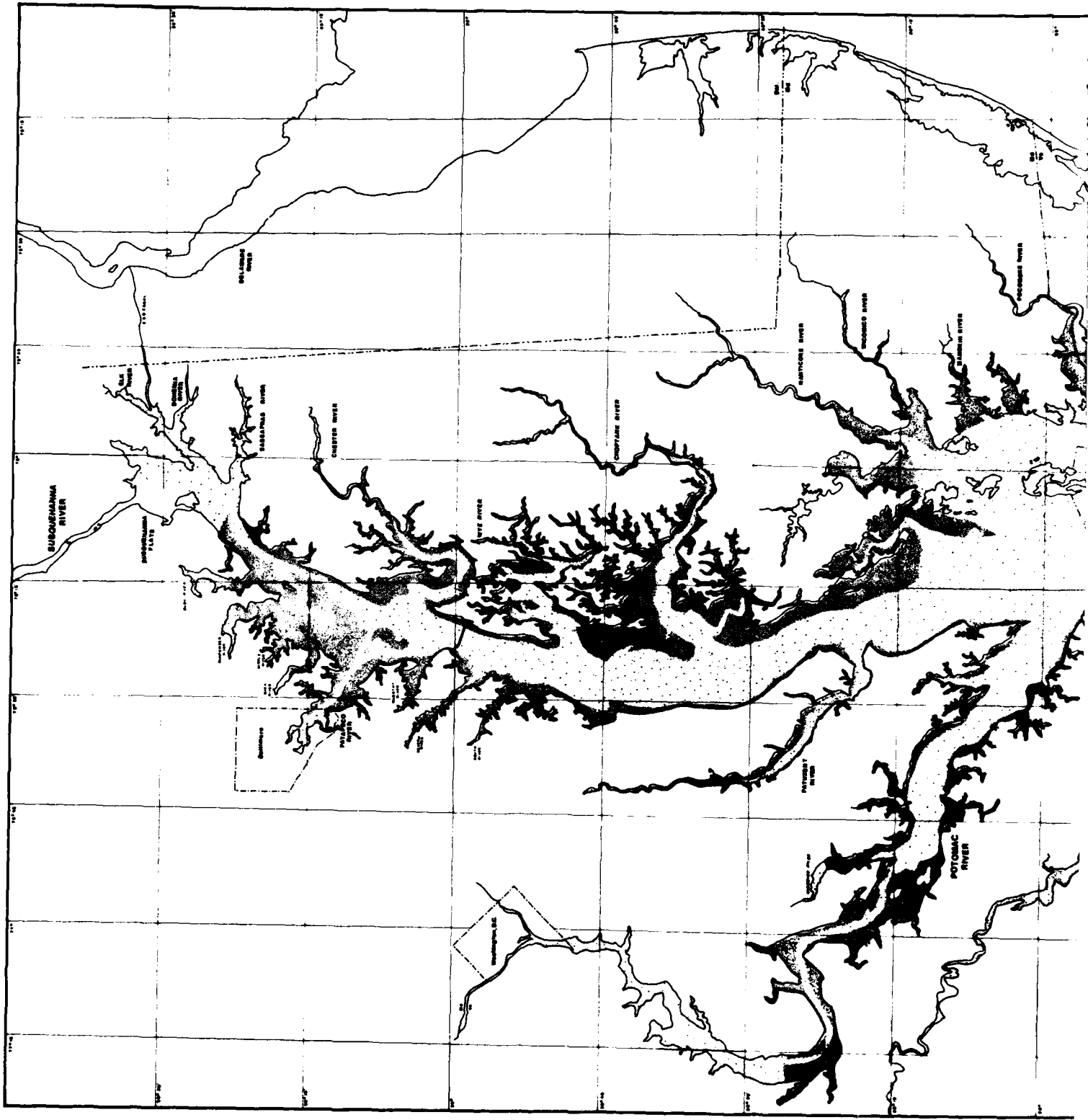
LEGEND

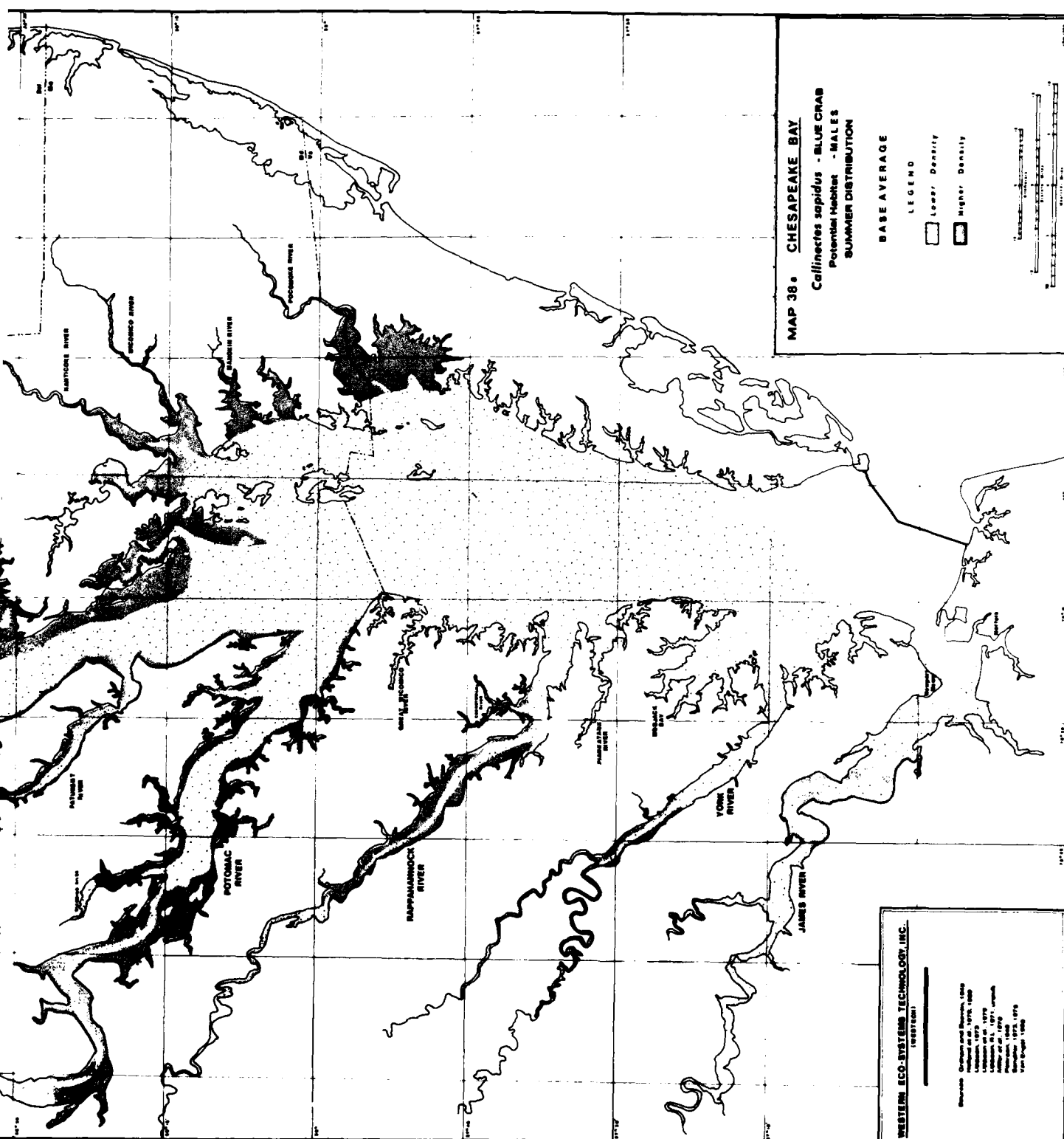
- Occasional
- Lower Densities
- Higher Densities

Scale: 0 1000 2000 Feet
 0 100 200 Meters

WESTERN GEO. SYSTEMS TECHNOLOGY, INC.
 (1987/88)

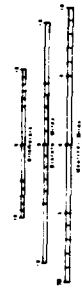
Chesapeake Bay
 York River
 James River
 Rappahannock River
 Potomac River
 Annapolis River
 Magothy River
 Susquehanna River
 Date: 1987, 1988



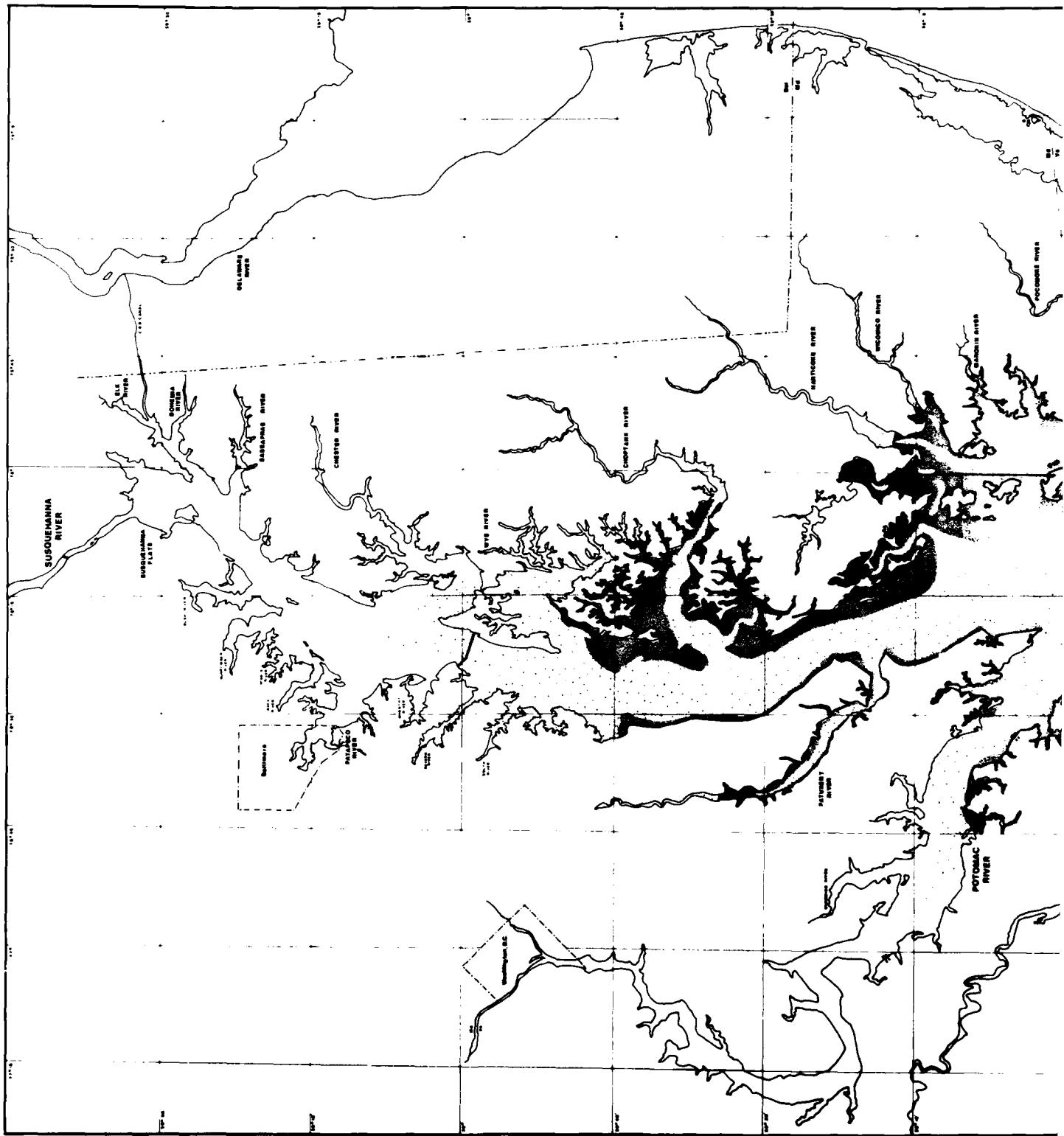


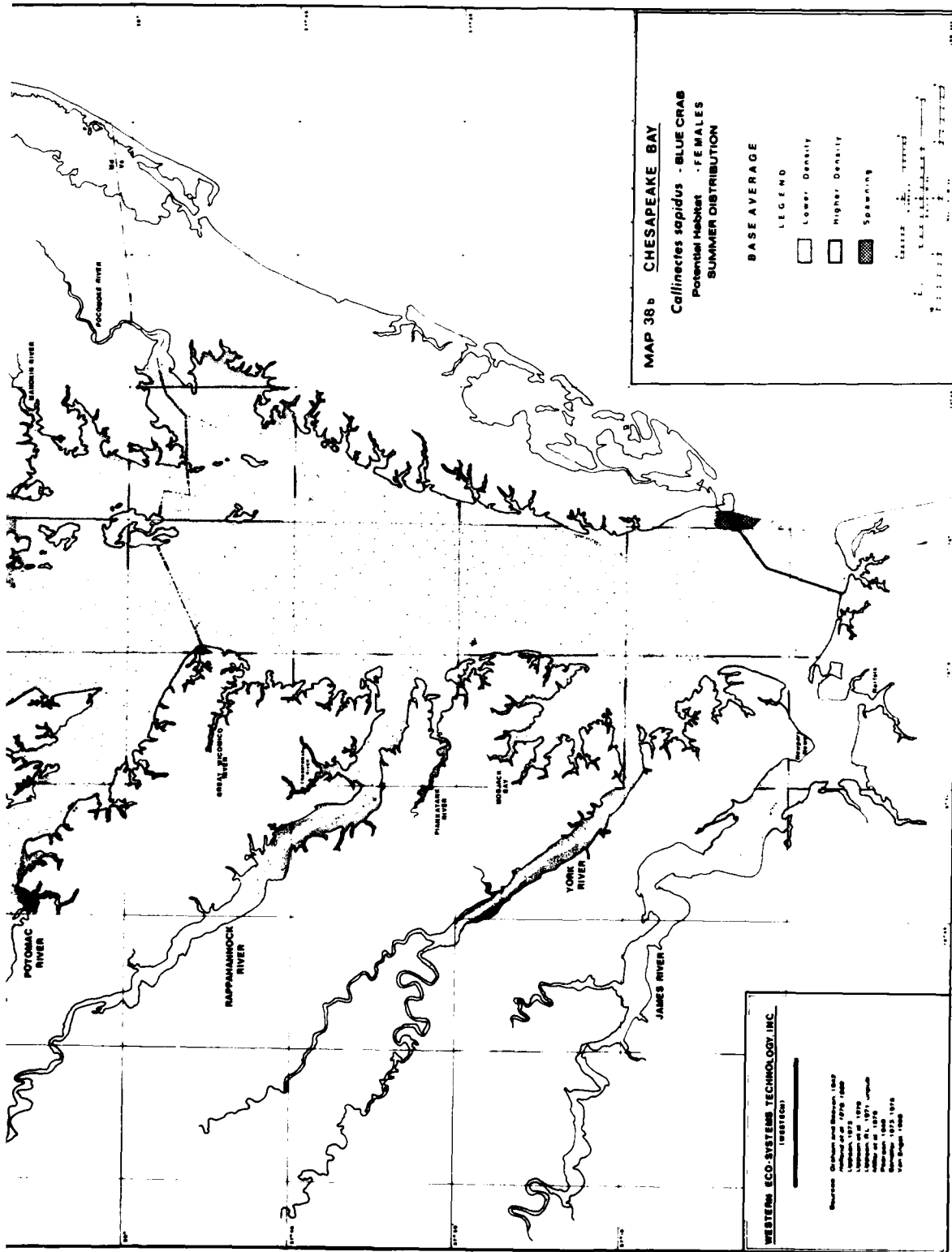
MAP 38. CHESAPEAKE BAY
Callinectes sapidus - BLUE CRAB
 Potential Habitat - MALES
 SUMMER DISTRIBUTION

BASE AVERAGE
LEGEND
 Lower Density
 Higher Density



WESTERN ECO-SYSTEMS TECHNOLOGY, INC.
 (WESTERN)
 Research, Collection and Reports, 1989
 Collection of 1975, 1989
 Collection of 1975, 1989
 Collection of 1975, 1989
 Collection of 1975, 1989
 Collection of 1975, 1989
 Collection of 1975, 1989





MAP 38 b CHESAPEAKE BAY
Callinectes sapidus - BLUE CRAB
 Potential Habitat - FEMALE
 SUMMER DISTRIBUTION

BASE AVERAGE

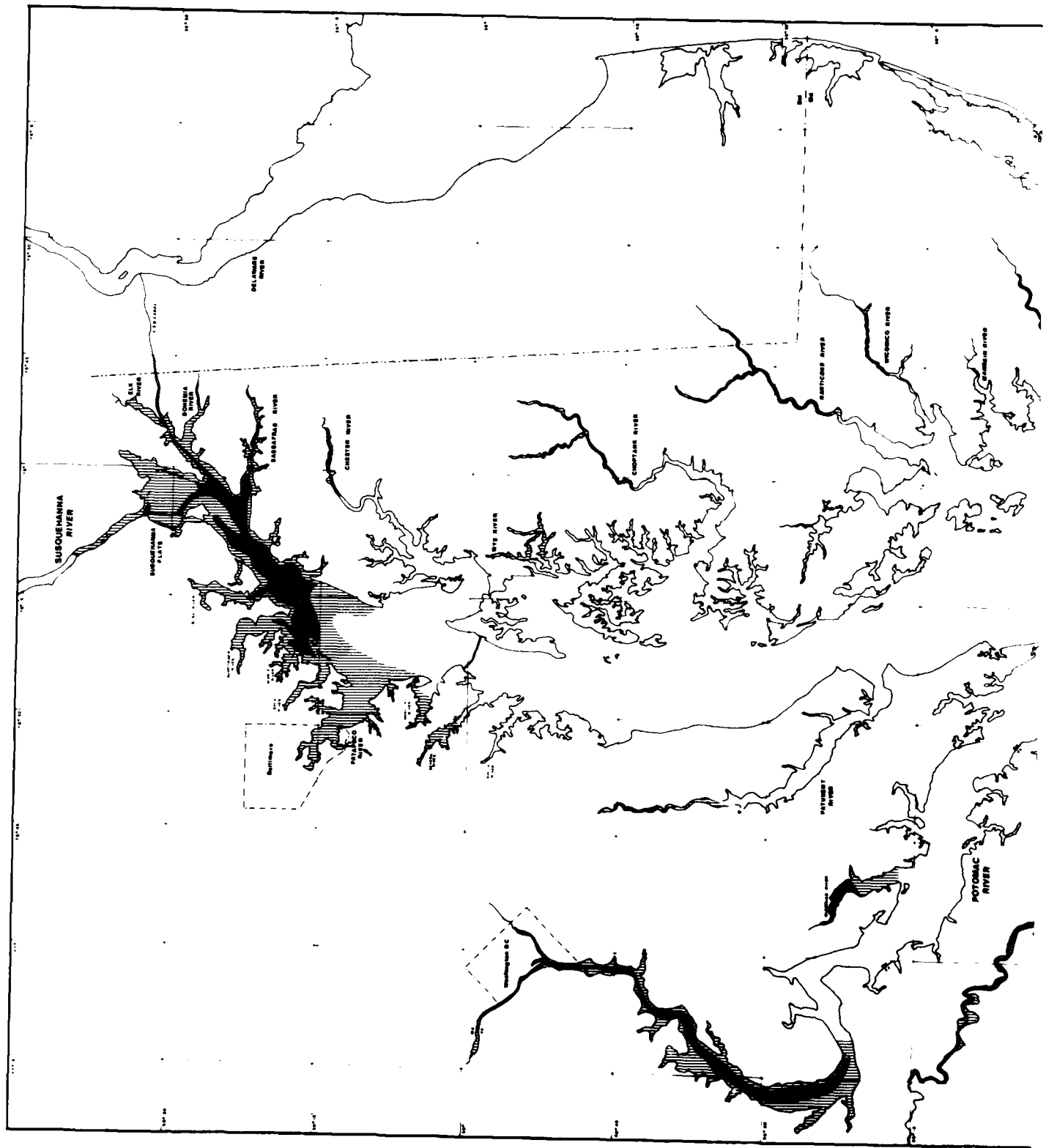
LEGEND

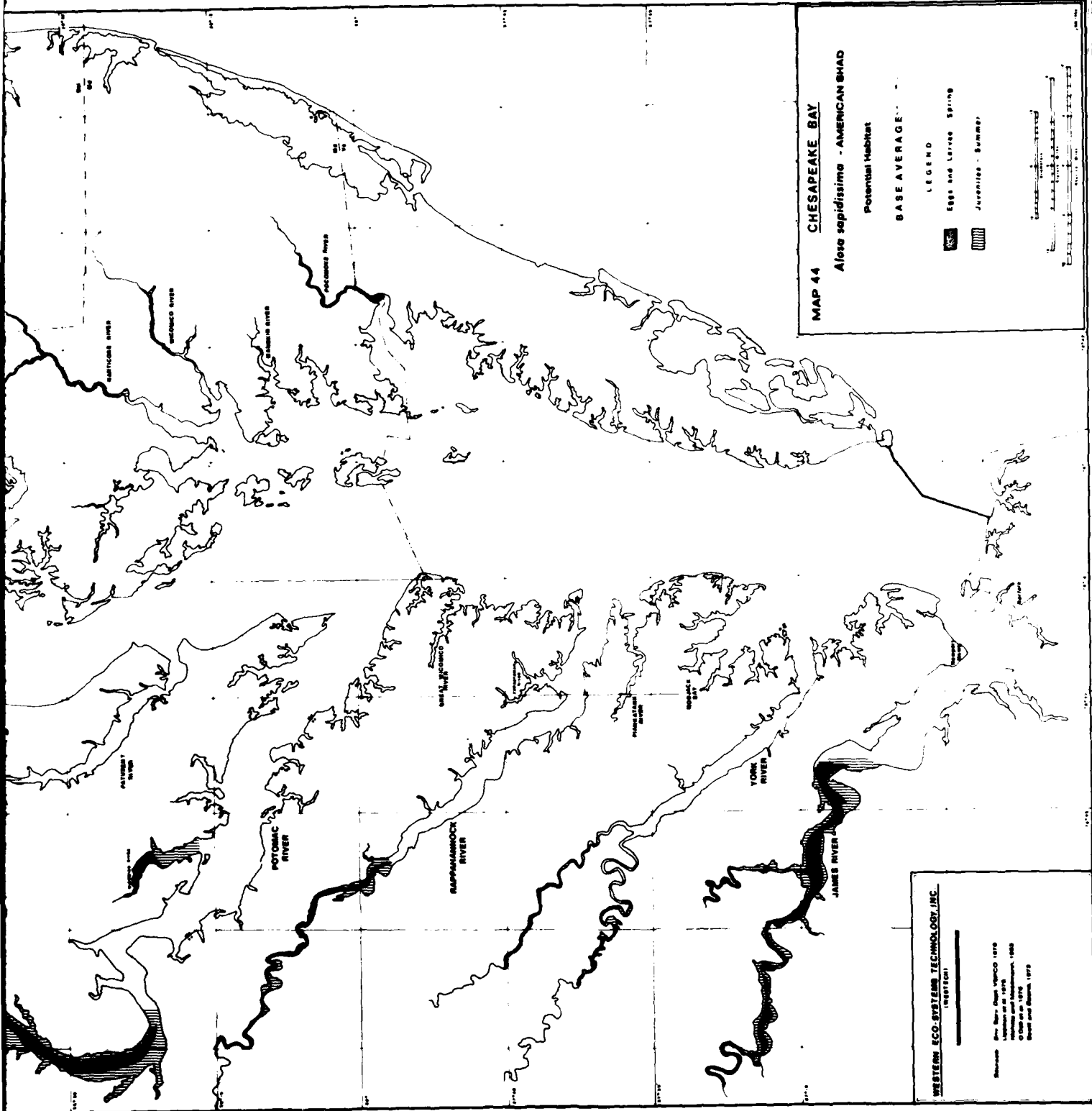
- Lower Density
- Higher Density
- Spawning

Scale: 1:50,000
 0 1 2 3 4 5 6 7 8 9 10 Miles

WESTERN ECO-SYSTEMS TECHNOLOGY, INC.
 INSTITUTE

Source: Graham and Bishop, 1982
 Published at 1970, 1980
 Updated 1971
 Modified 21, 1971, 1976
 Revised 1975
 Rechecked 1975, 1976
 Year Single 1980





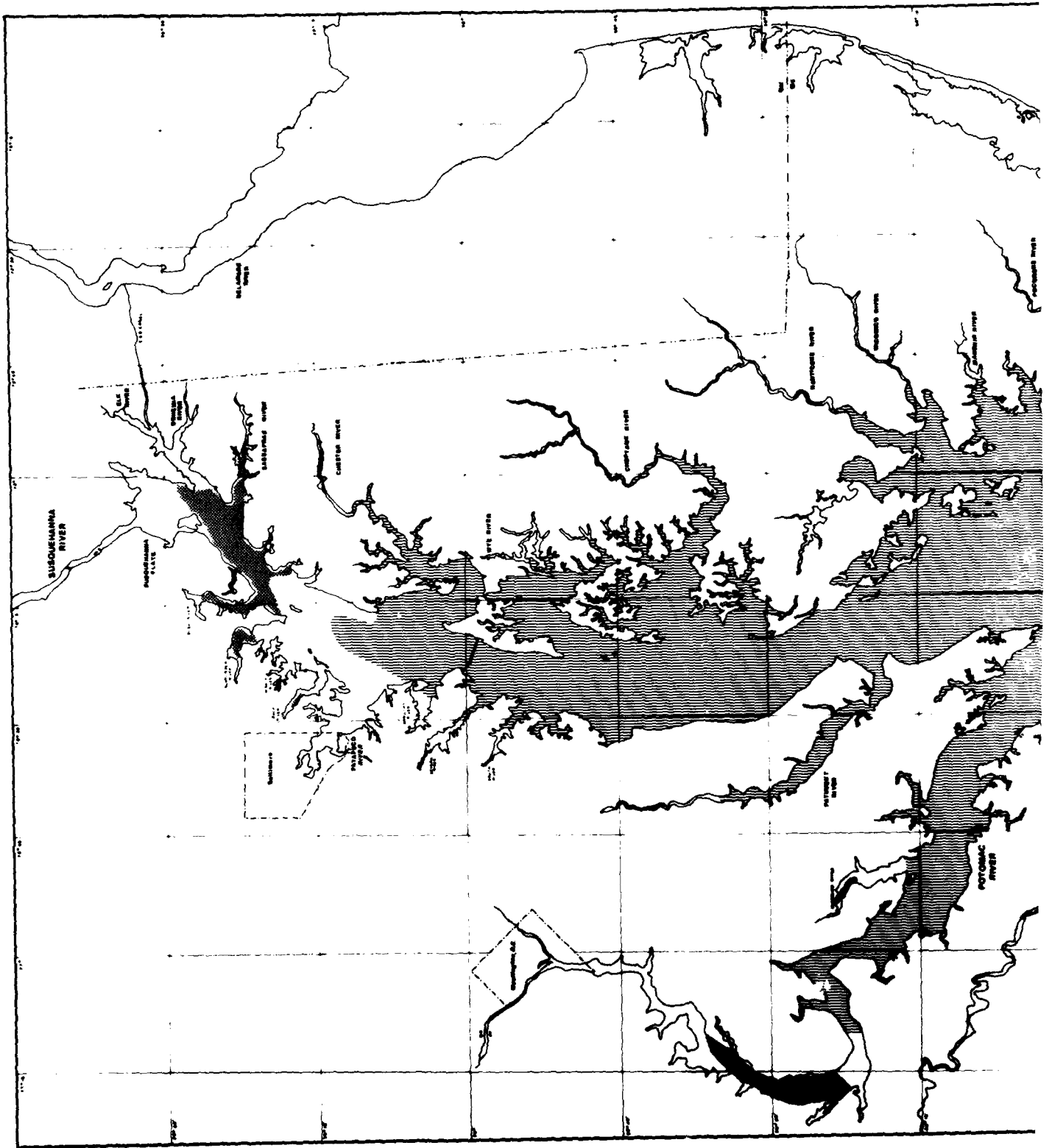
MAP 44 CHESAPEAKE BAY
Alosa sapidissima - AMERICAN SHAD
 Potential Habitat
 BASE AVERAGE: -

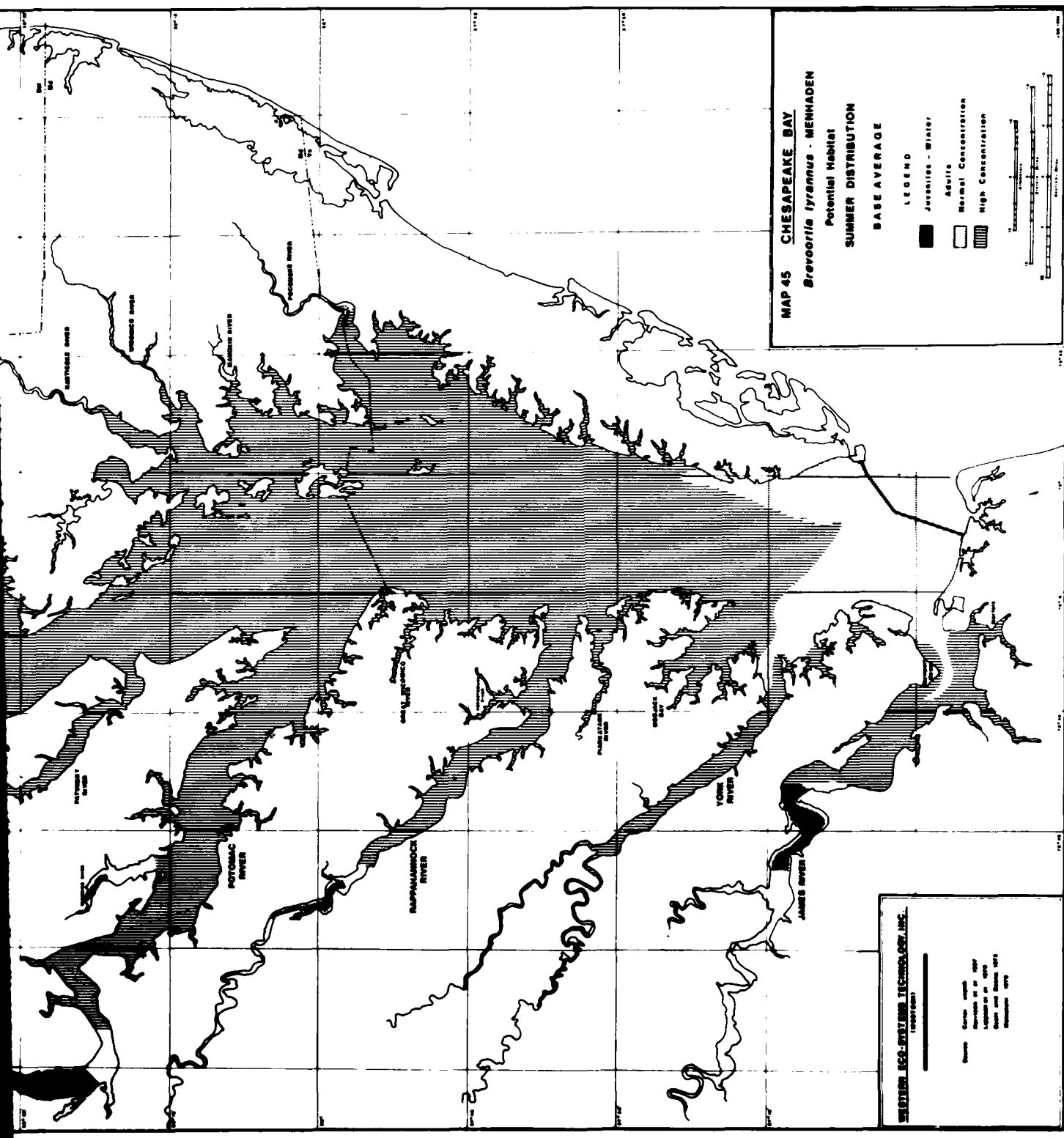
LEGEND
 Eggs and Larvae - Spring
 Juveniles - Summer

Scale: 1:50,000
 0 1 2 3 4 5 6 7 8 9 10 Miles
 0 1 2 3 4 5 6 7 8 9 10 Kilometers

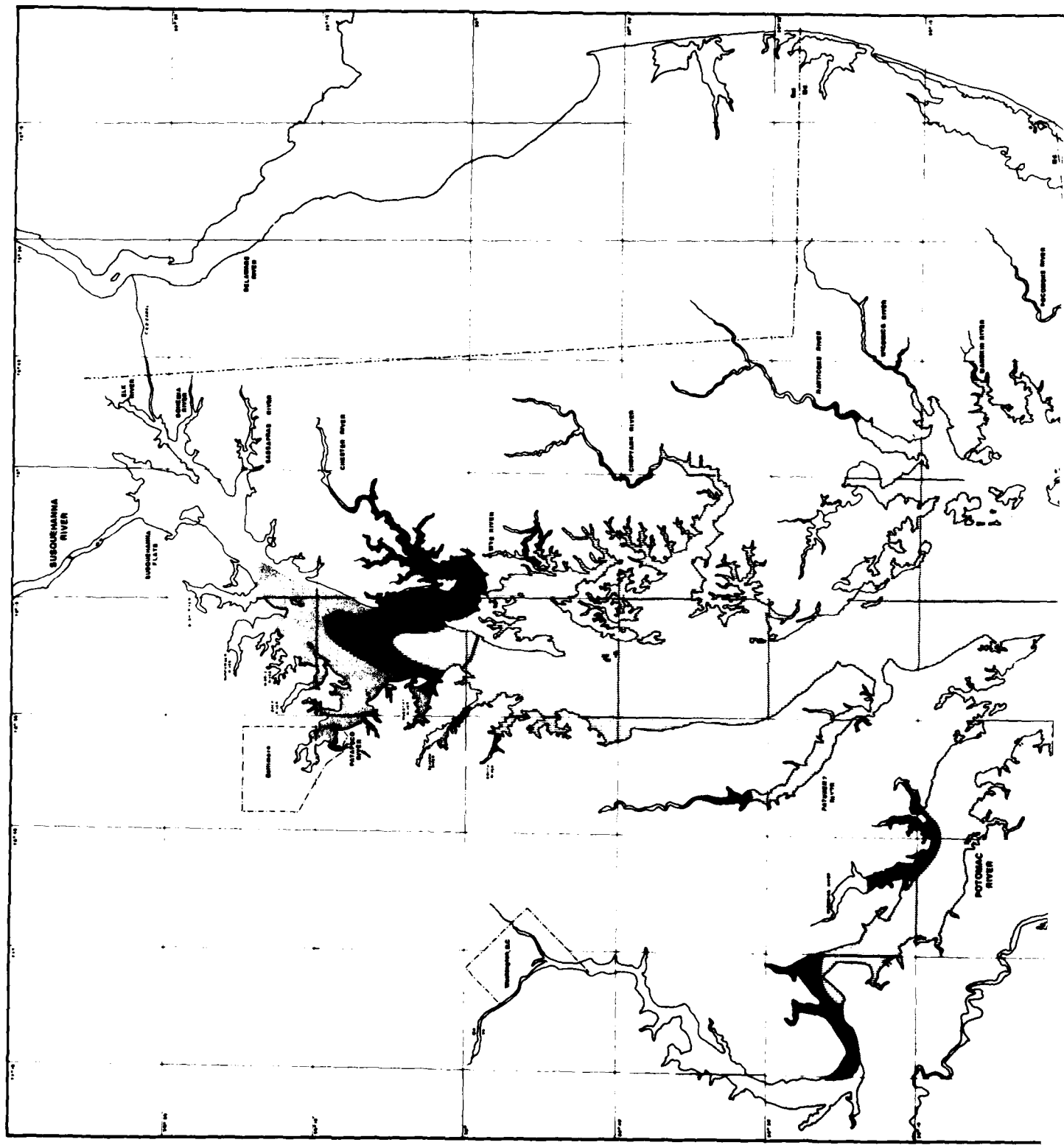
WESTERN ECO-SYSTEMS TECHNOLOGY, INC.
 INSTITUTION

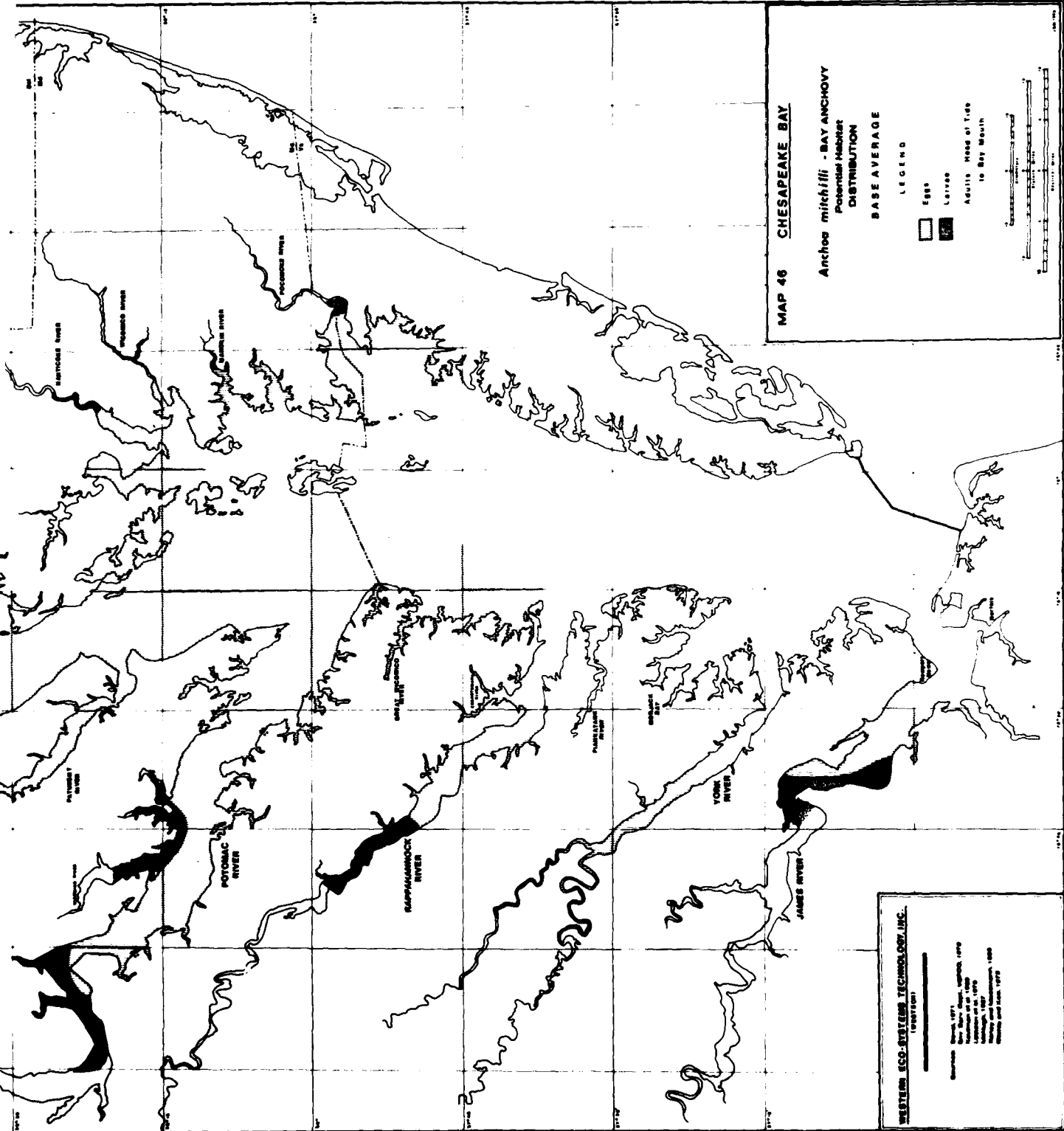
Contract No. DA-36-069-AMC-0001-1978
 Location No. 1978
 Station and Measurement No. 1988
 Date of Report: 1979

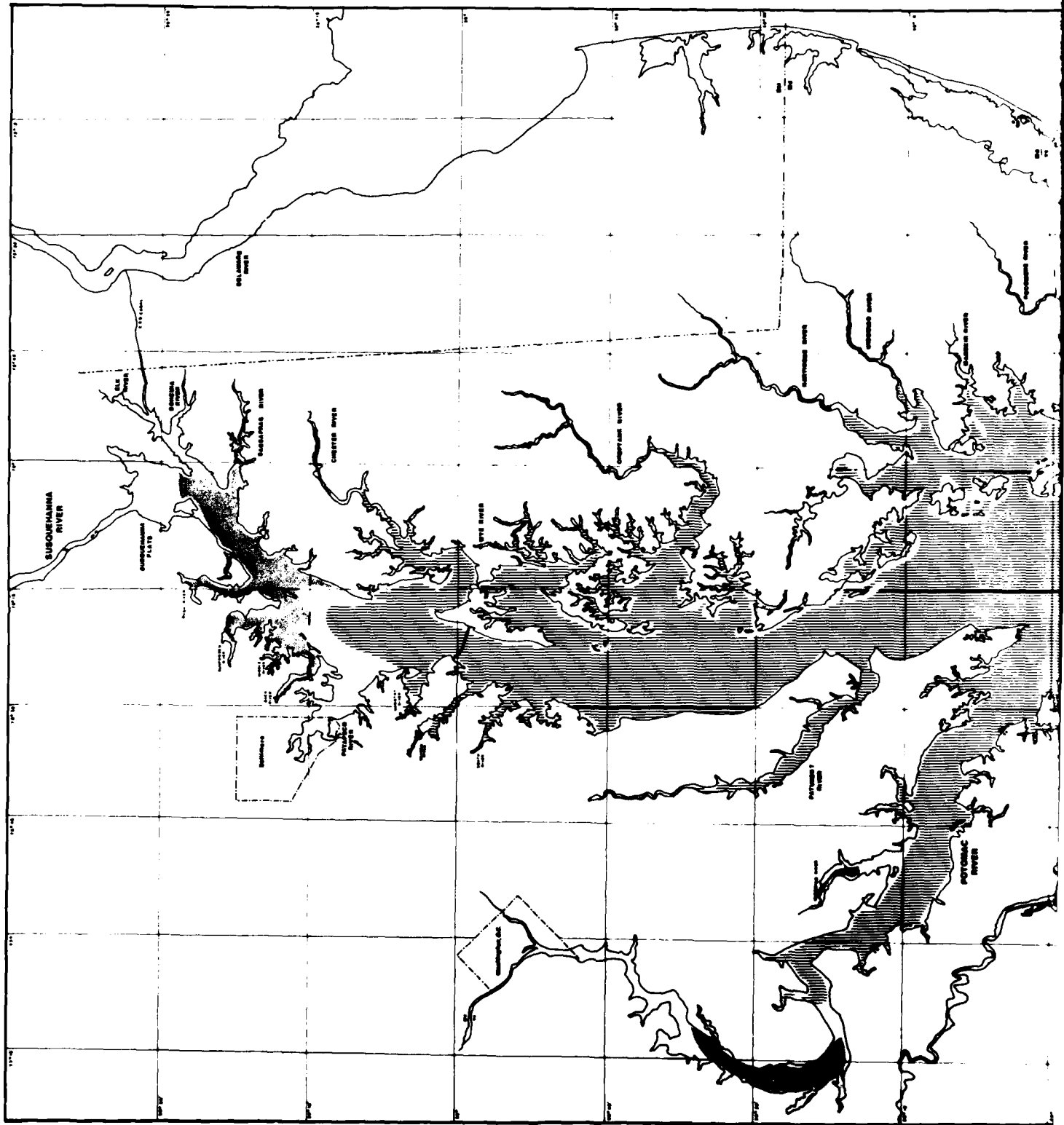


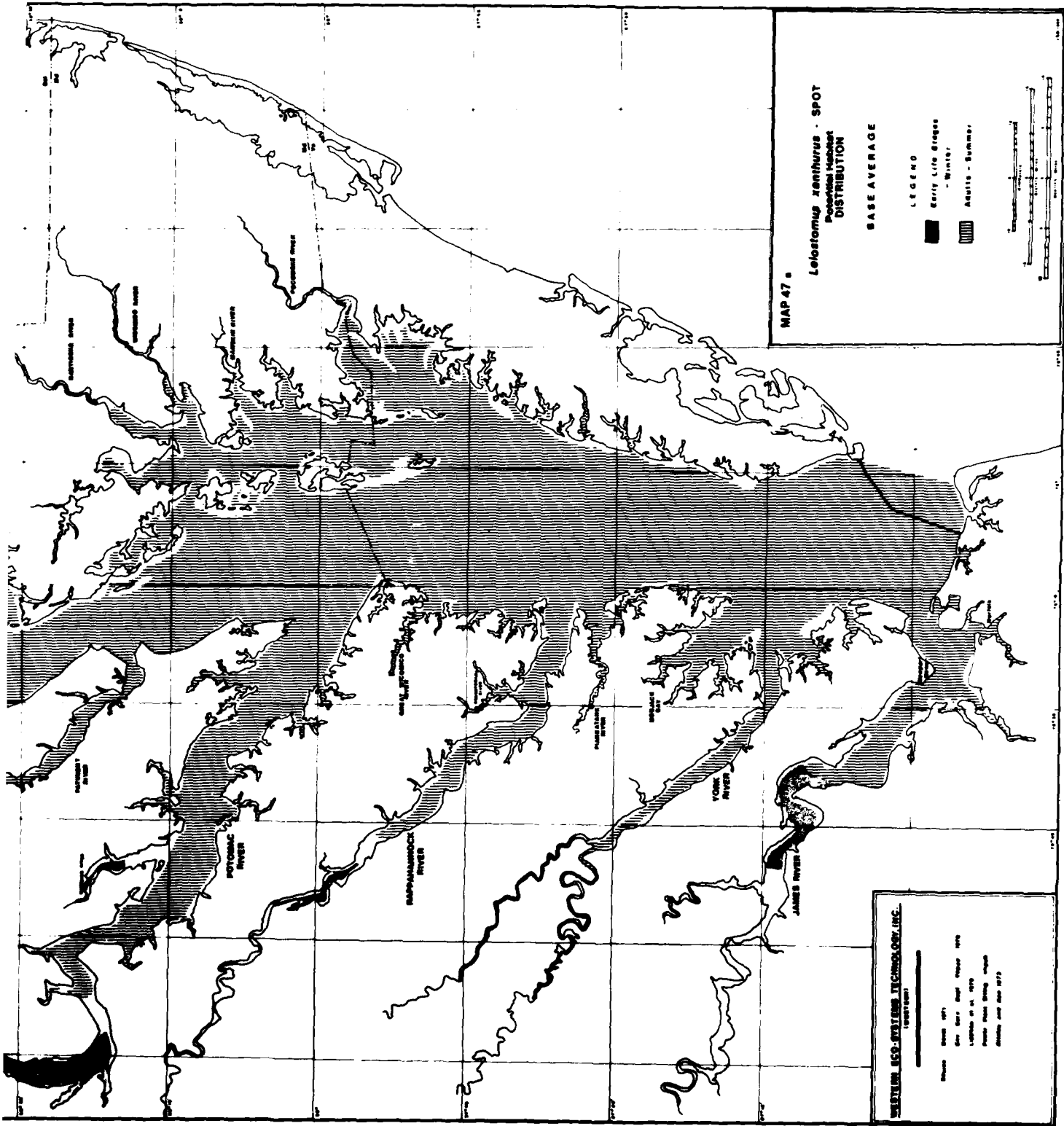


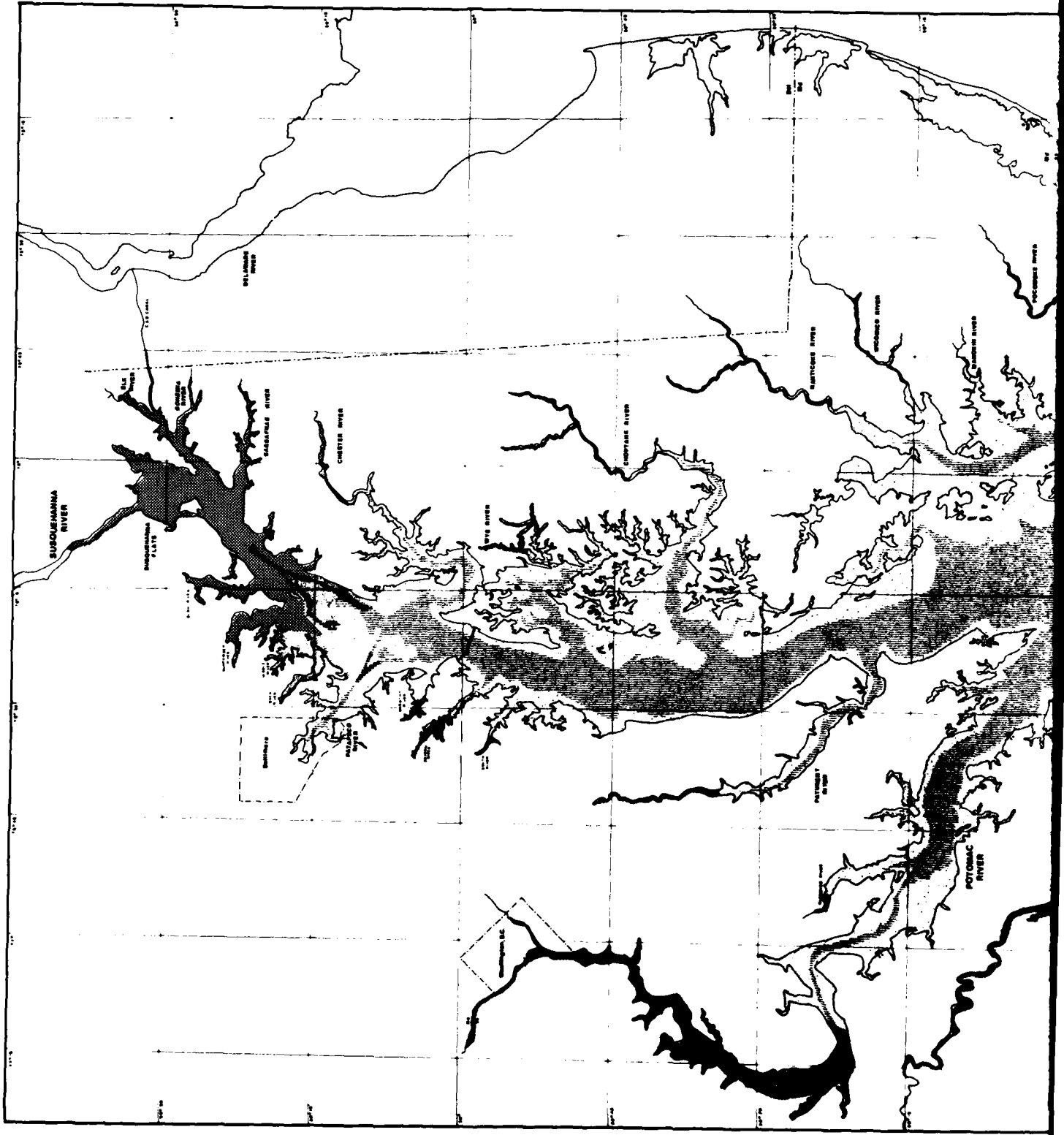
WESTERN ECO-SYSTEMS TECHNOLOGY, INC.
 Copyright © 1987
 Printed in the U.S.A.
 Date of Issue: 1987

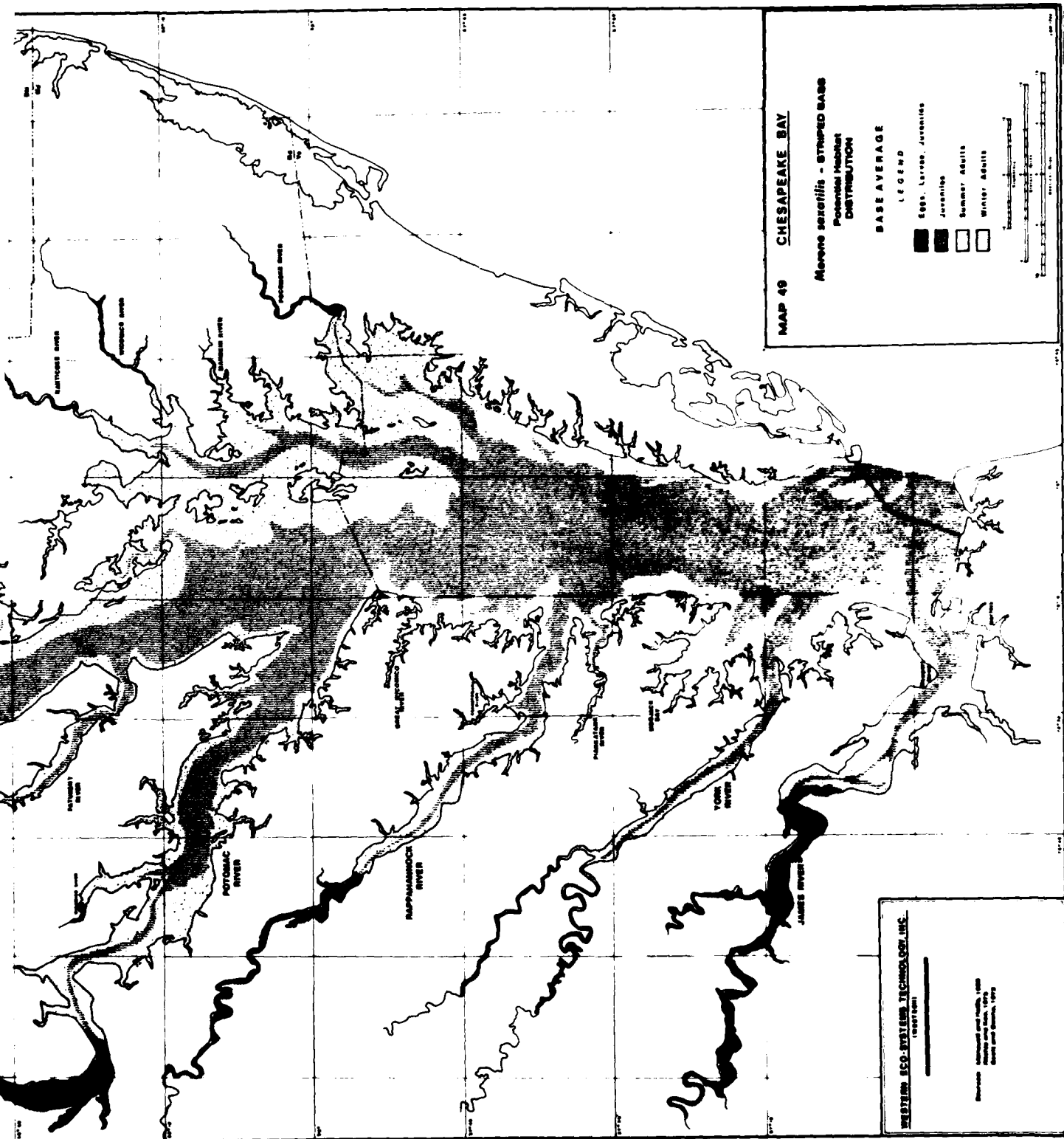












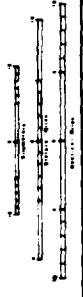
MAP 49 CHESAPEAKE BAY

Morone saxatilis - STRIPED BASS
 Present/ Absent
 DISTRIBUTION

BASE AVERAGE

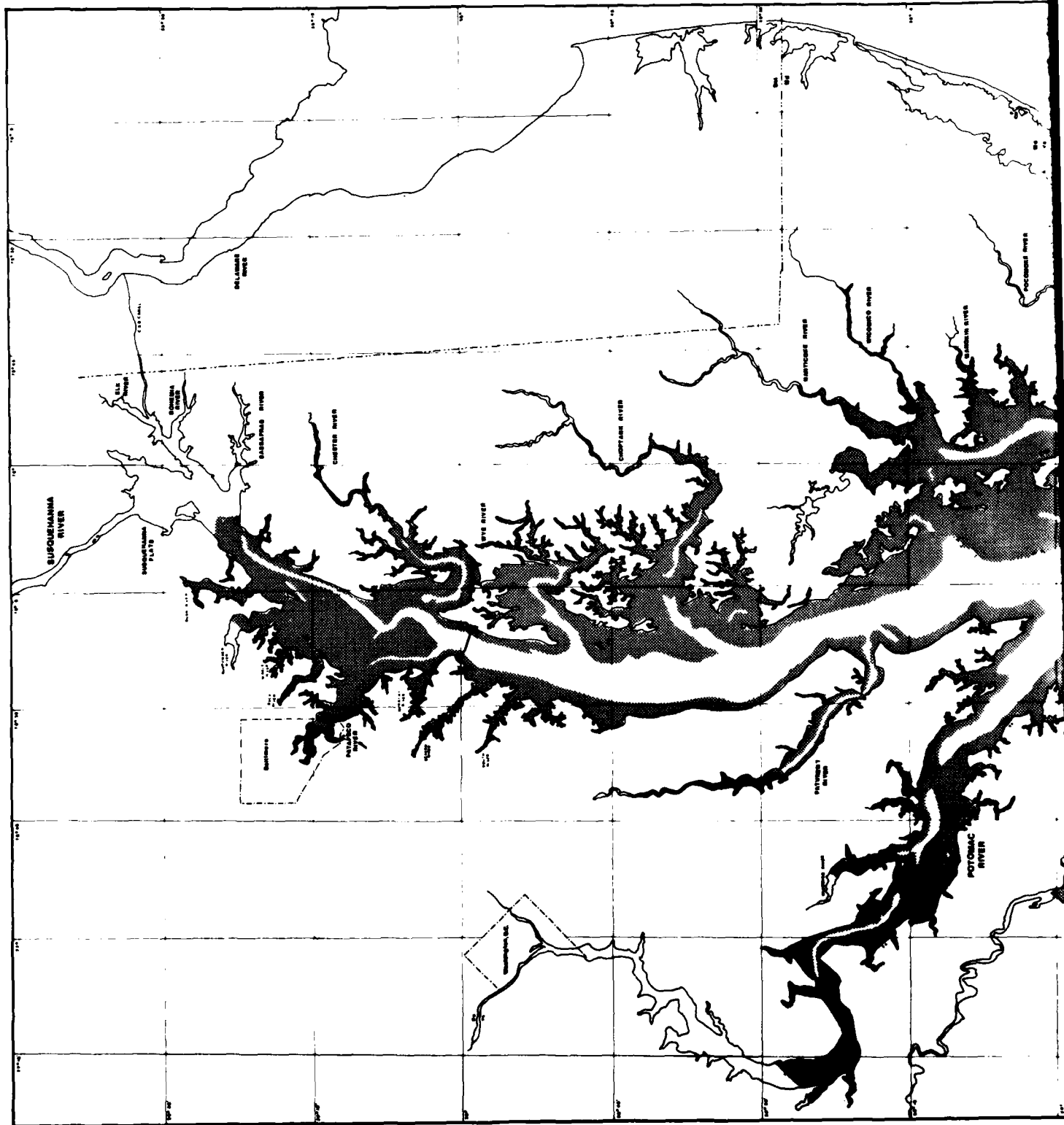
LEGEND

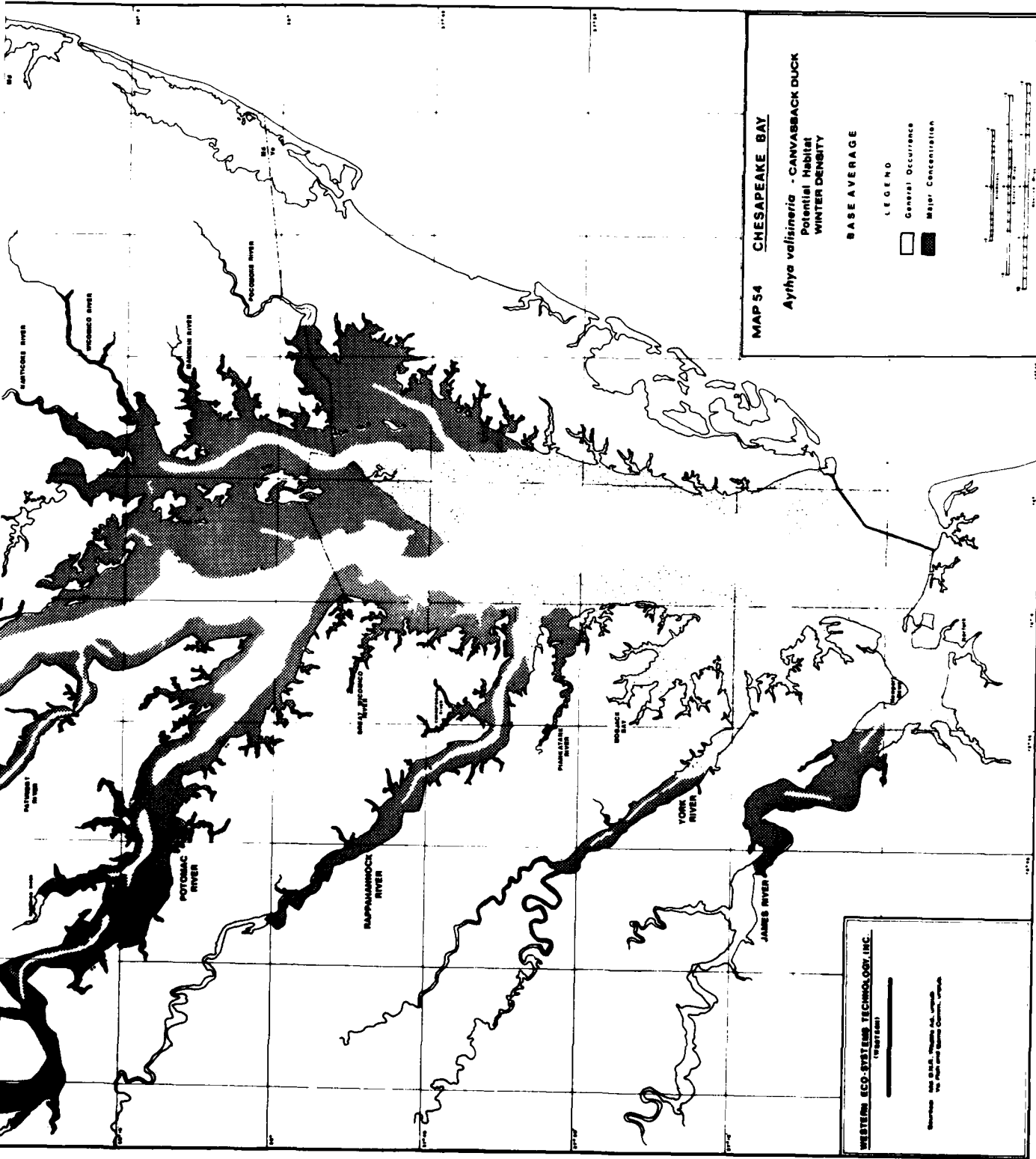
- EGGS, LARVAE, JUVENILES
- JUVENILES
- SUMMER ADULTS
- WINTER ADULTS



WESTERN GEO-SYSTEMS TECHNOLOGY, INC.
 1980-1981

Revised: 1980-1981 and 1982, 1983
 Original: 1974
 Revised and Reprinted, 1982





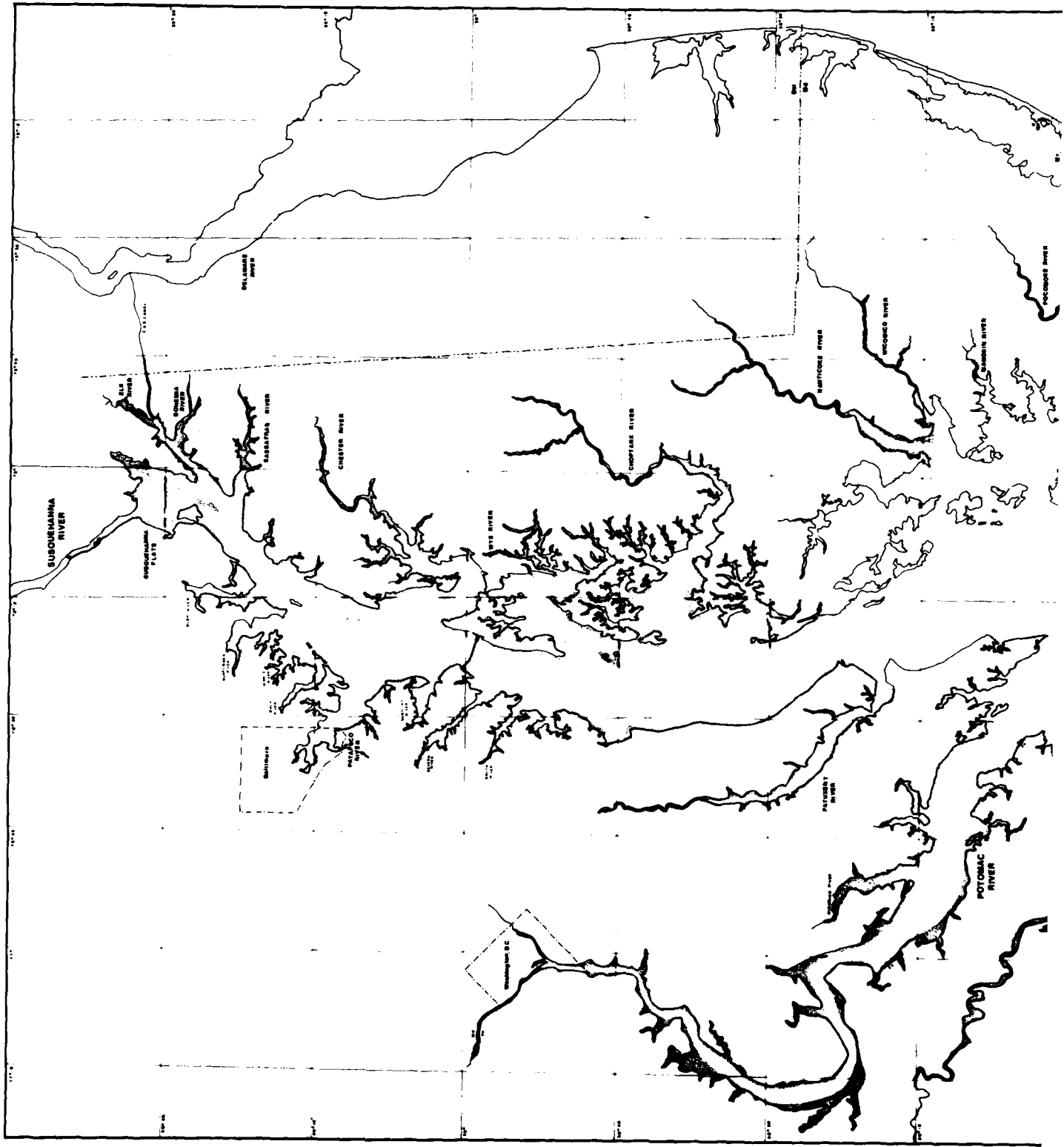
MAP 54 CHESAPEAKE BAY
Aythya valisineria - CANVASSACK DUCK
 Potential Habitat
 WINTER DENSITY
 BASE AVERAGE

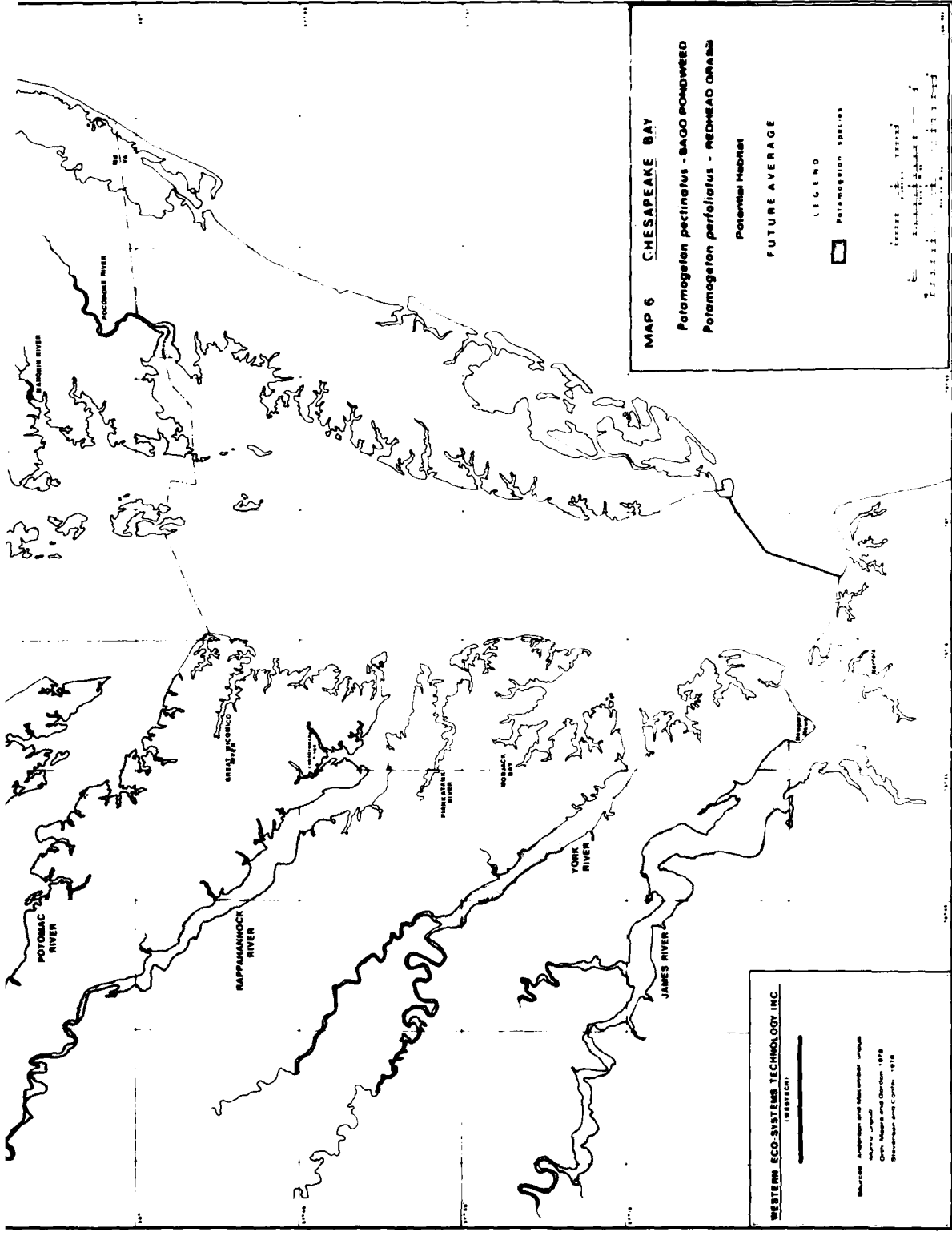
LEGEND
 General Occurrence
 Major Concentration

Scale: 1:50,000
 0 1 2 3 4 5 6 7 8 9 10 Miles
 0 1 2 3 4 5 6 7 8 9 10 Kilometers

WESTERN ECO-SYSTEMS TECHNOLOGY, INC.
 (1987)

Developed by D.R. Thibault, A.C. Smith,
 W. P. and others, Coastal, Virginia





MAP 6 CHESAPEAKE BAY

Potamogeton pectinatus - SAGO PONDWEED
 Potamogeton perfoliatus - REDHEAD GRASS

Potential Habitat
 FUTURE AVERAGE

LEGEND

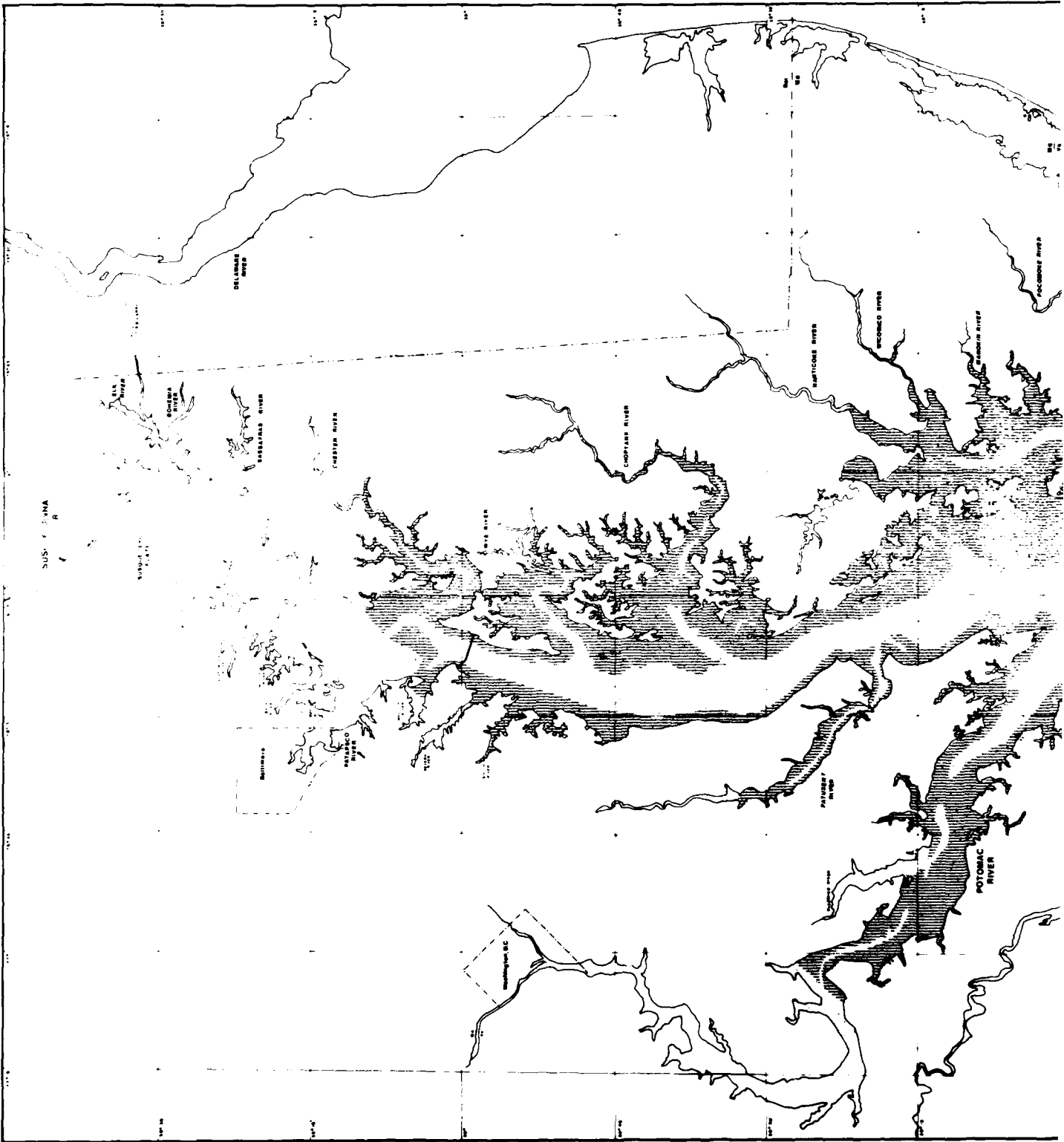
□ Potamogeton species

Scale: 1:50,000

North Arrow

WESTERN ECO-SYSTEMS TECHNOLOGY, INC.
 (ESTECH)

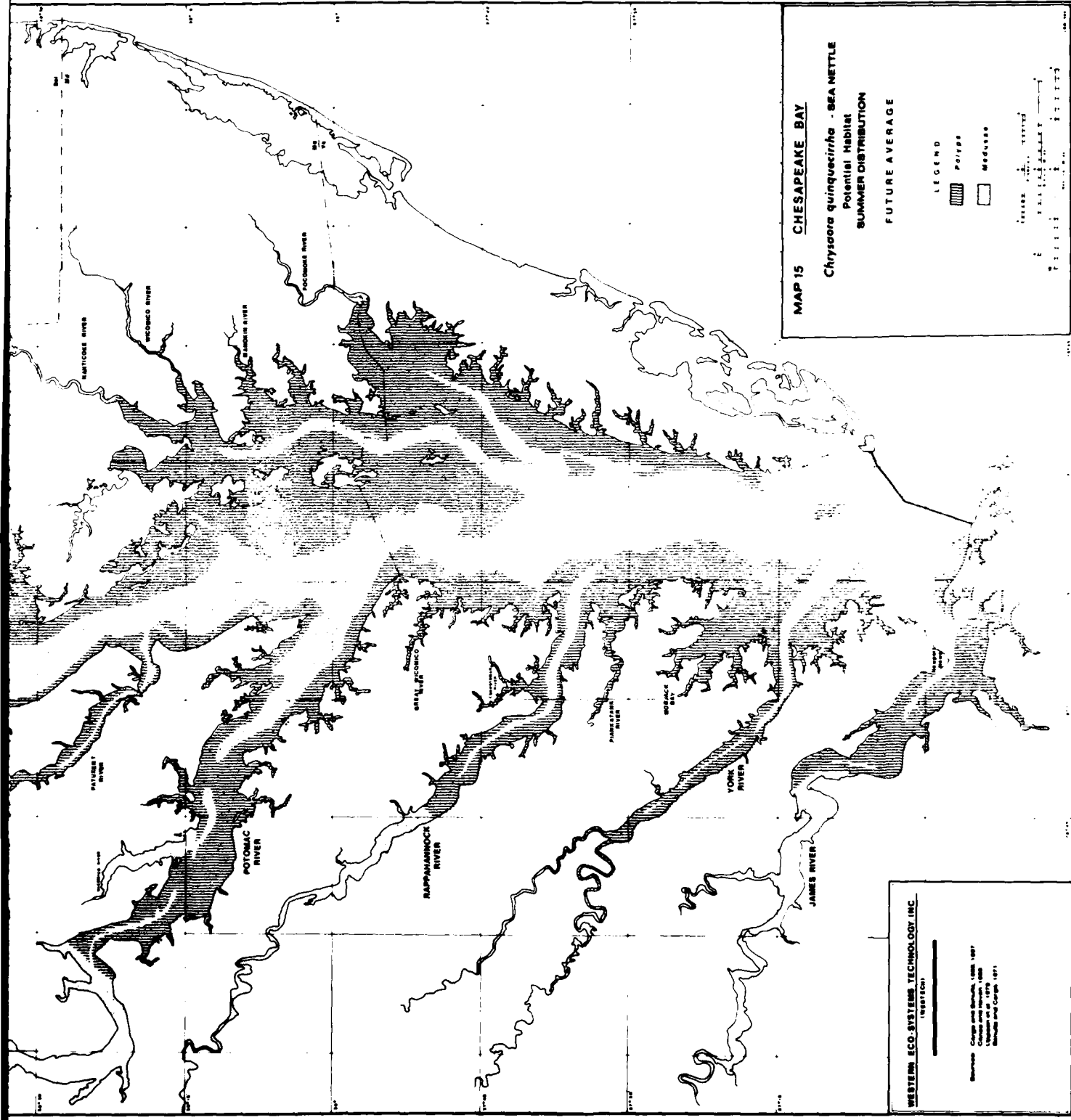
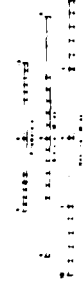
Shelton Anderson and Associates, Inc.
 Delta, Utah
 Gary Meyer and Gordon, 1979
 Shearman and Sterling, 1978



MAP 15 CHESAPEAKE BAY

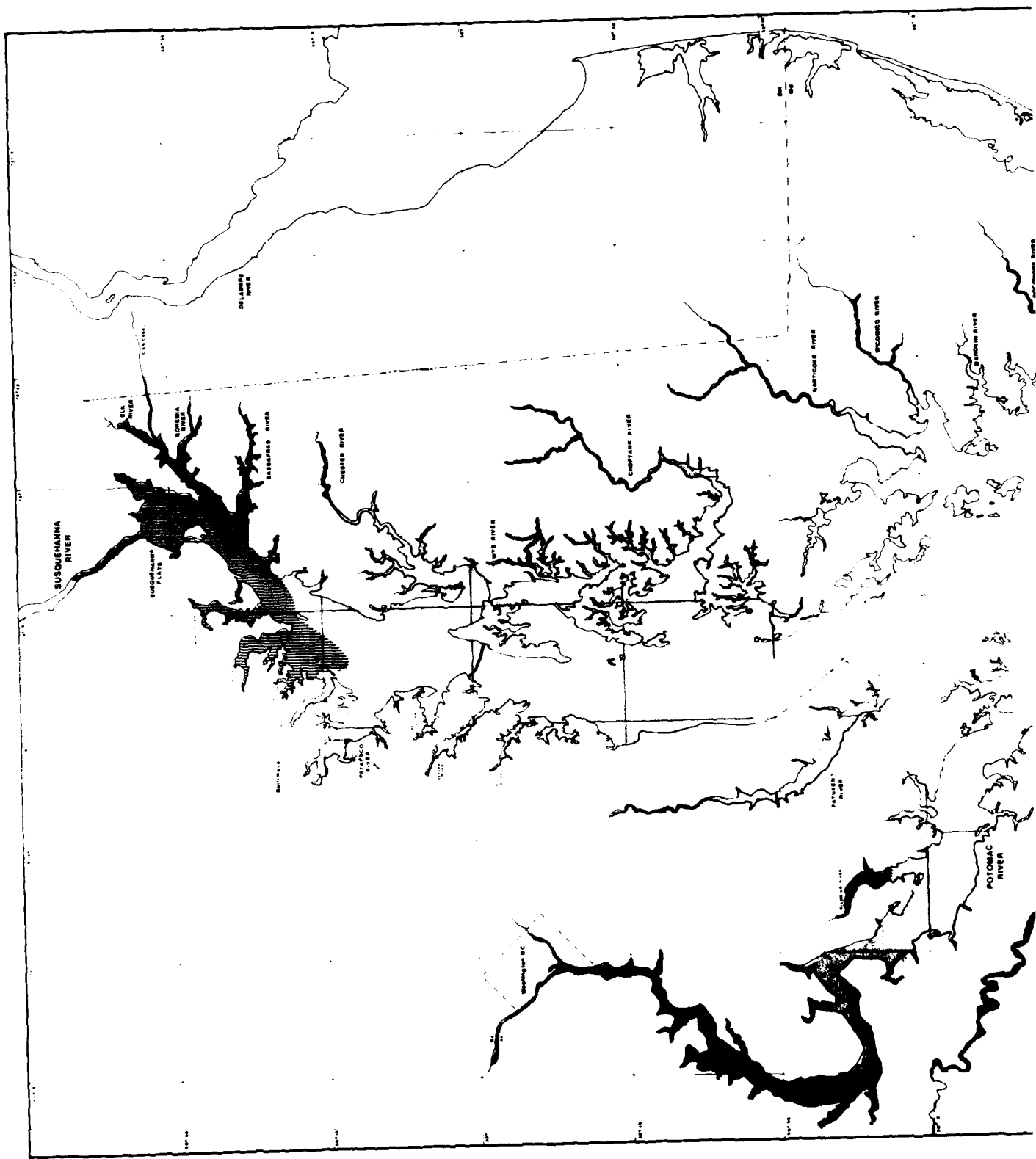
Chrysaora quinquecirrha - SEA NETTLE
Potential Habitat
SUMMER DISTRIBUTION
FUTURE AVERAGE

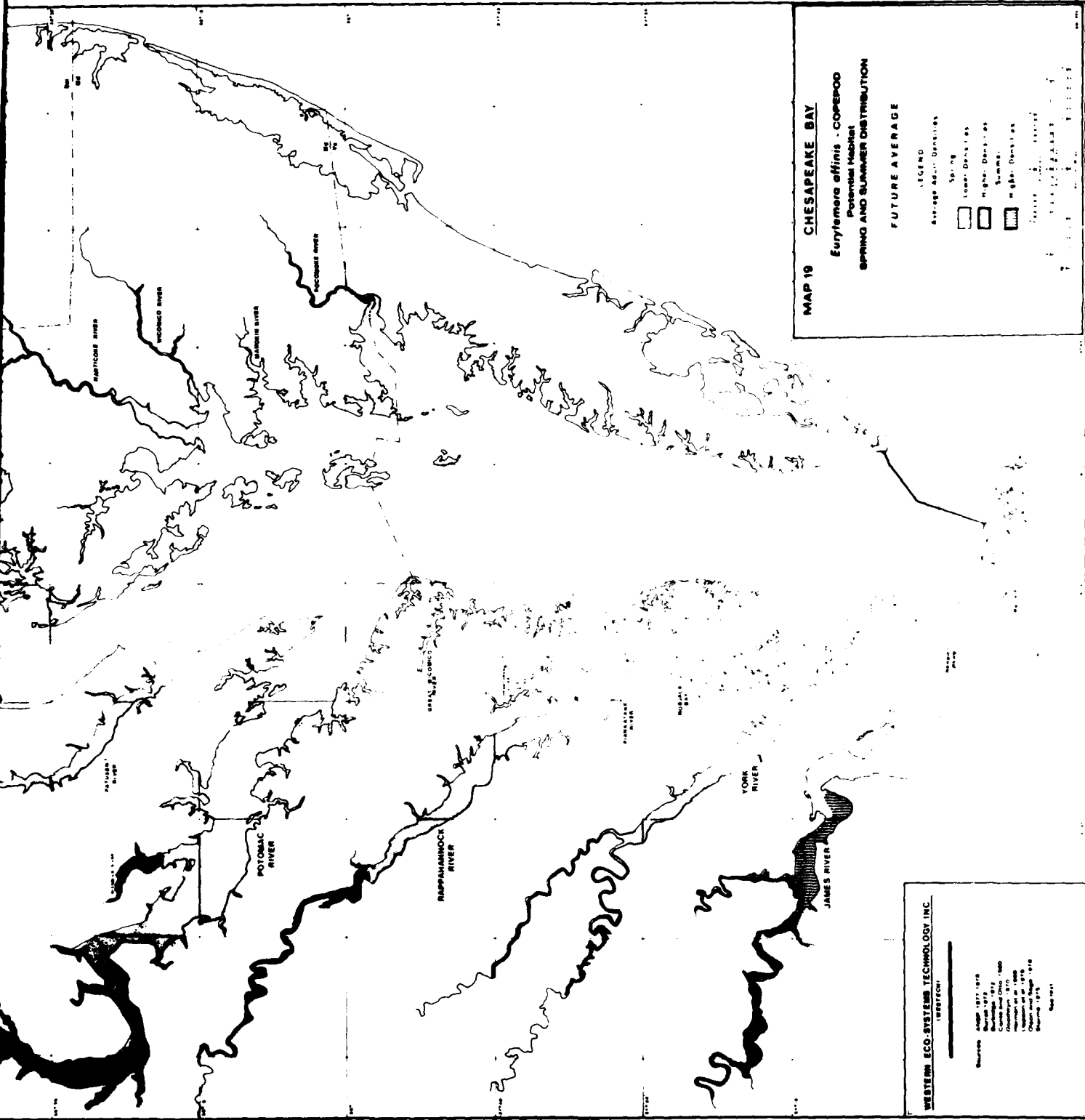
LEGEND
[Hatched Box] Present
[White Box] Future Average



WESTERN ECO-SYSTEMS TECHNOLOGY, INC.
(800) 551-1011

Reviewed: Clark and Burckle, 1988, 1997
Checked and Approved: 1988
Updated on: 1979
Maple and Corley, 1971





MAP 19 CHESAPEAKE BAY
Eurytemora affinis - COREPOD
 Potential Habitat
 SPRING AND SUMMER DISTRIBUTION

FUTURE AVERAGE

LEGEND

Average Adult Densities

- Spring
- Summer

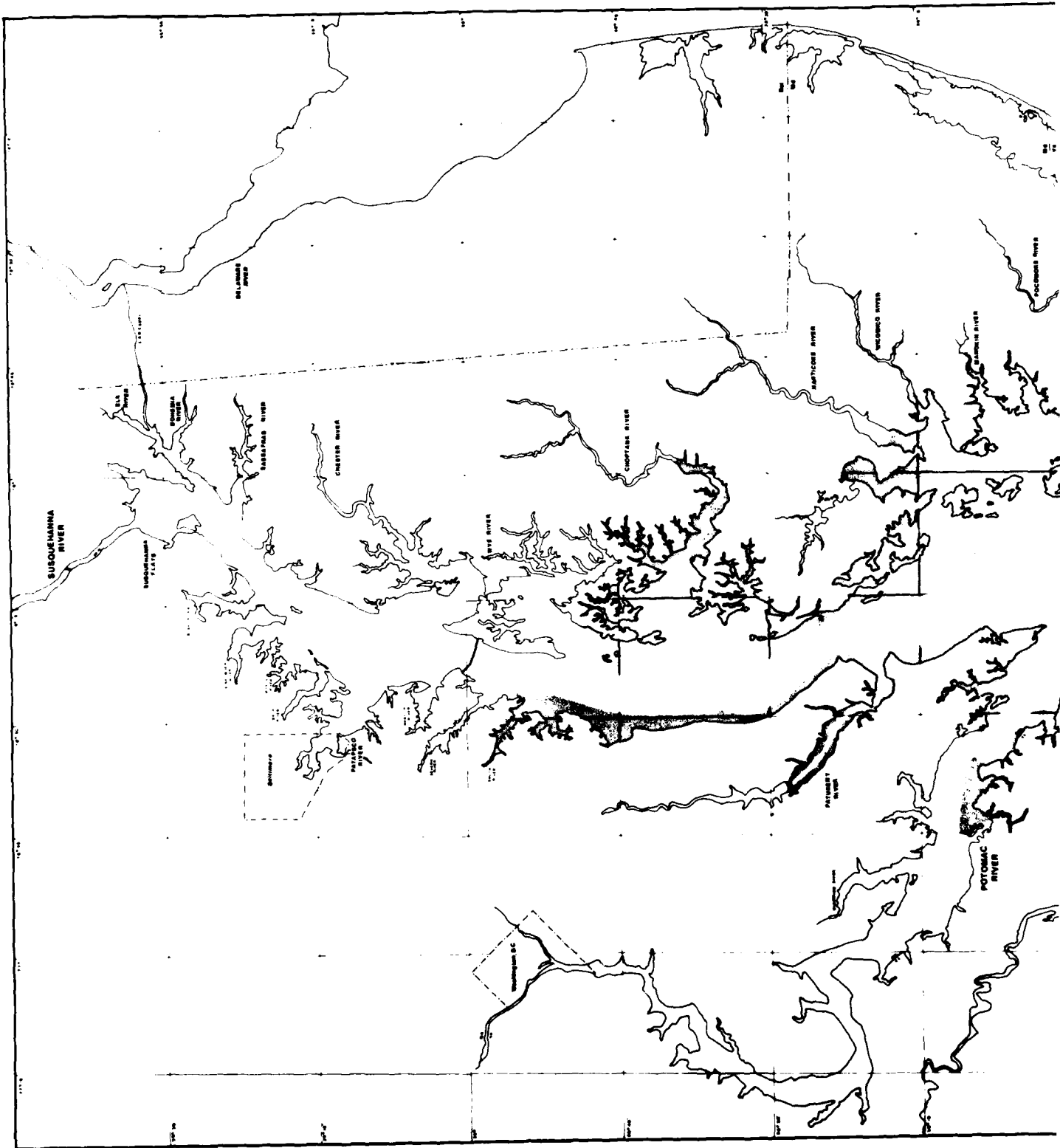
Lower Densities

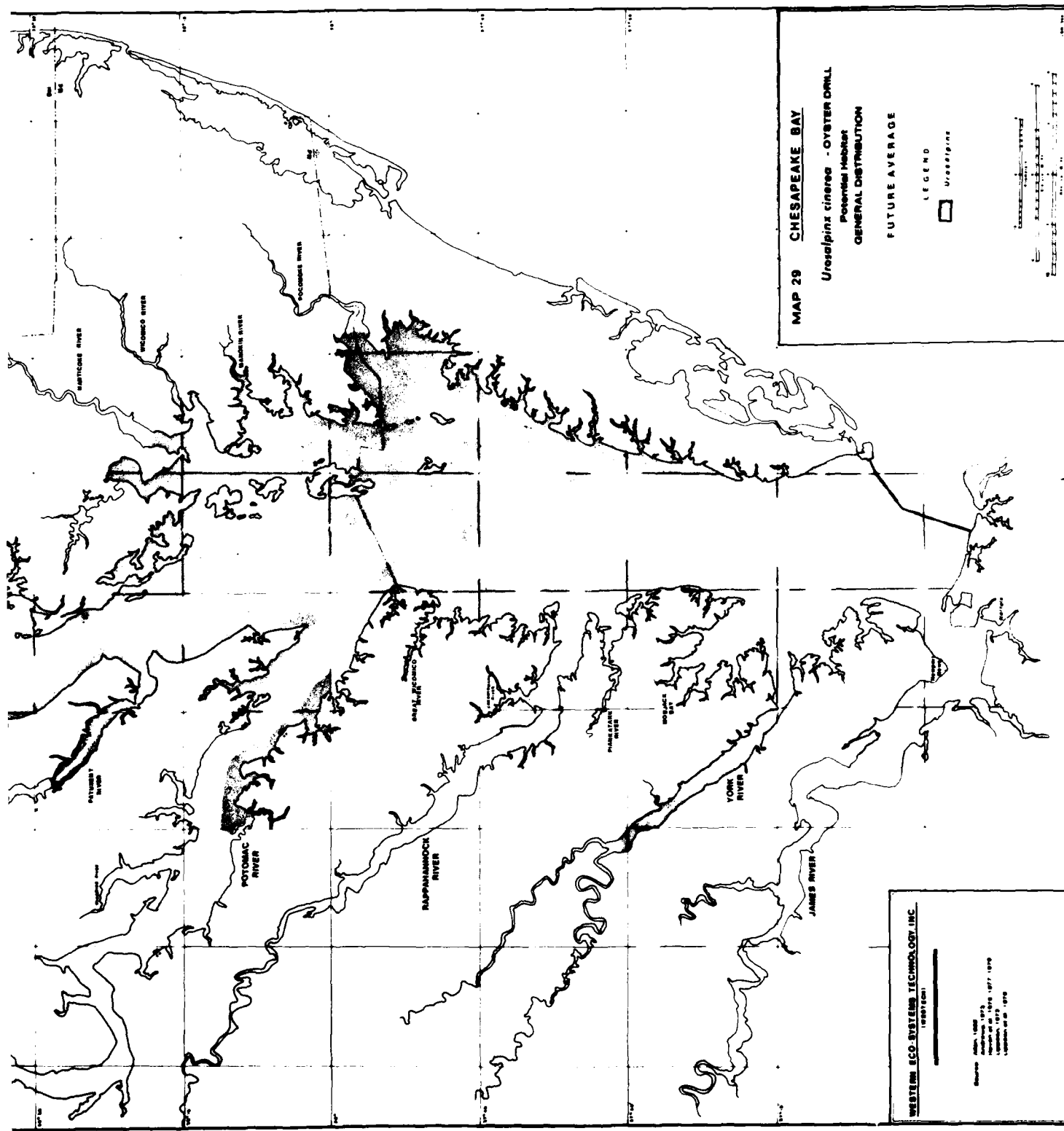
Higher Densities

Very High Densities

WESTERN ECO-SYSTEMS TECHNOLOGY, INC.
 WESTFIELD, MASSACHUSETTS

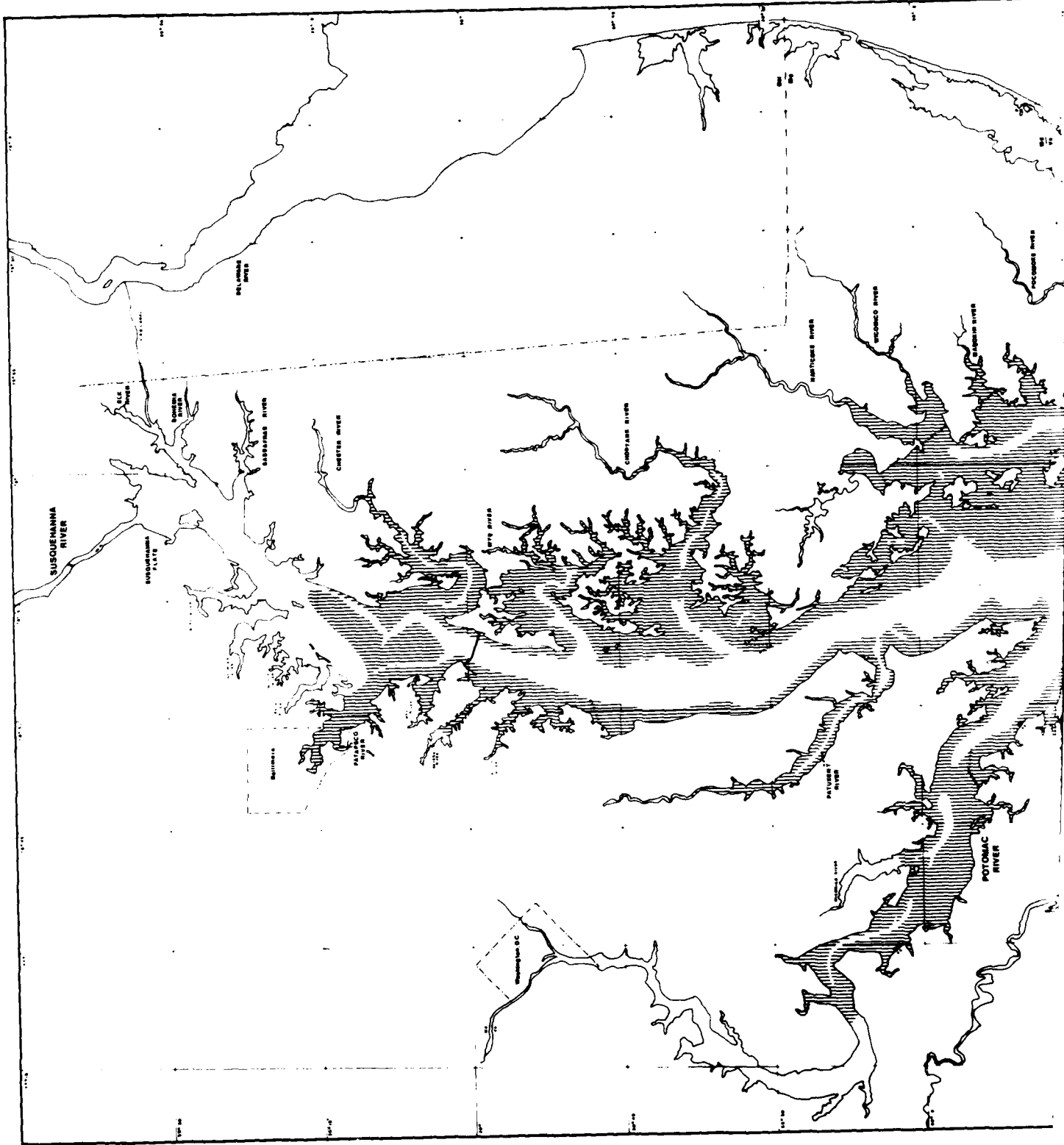
August 1972, 1974
 March 1975
 March 1976
 October 1976
 February 1977
 October 1977
 March 1978
 November 1978
 May 1979

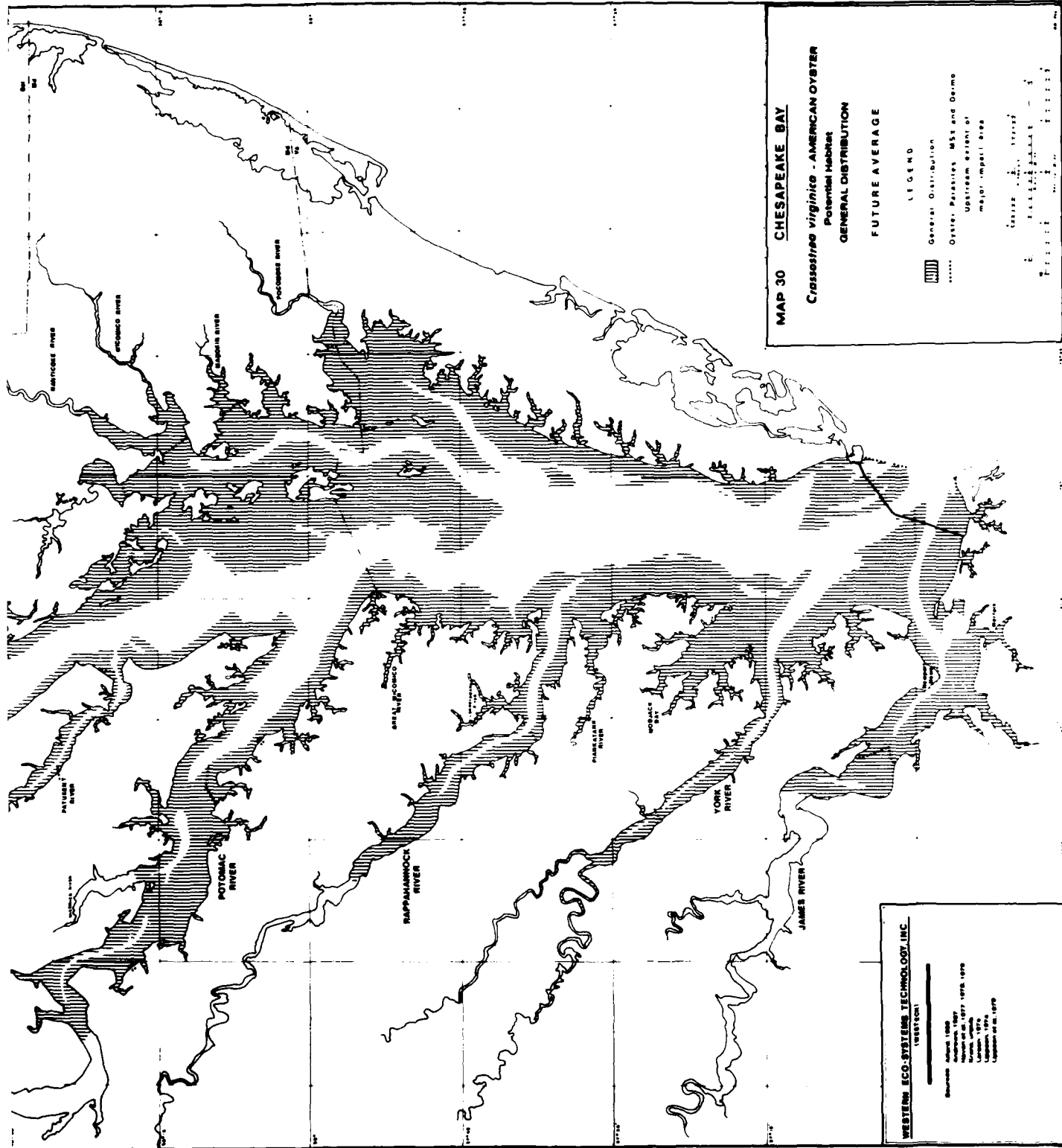




MAP 29 CHESAPEAKE BAY
Urosalpinx cinerea - OYSTER DRILL
 Potential Habitat
GENERAL DISTRIBUTION
FUTURE AVERAGE
 LEGEND
 □ *Urosalpinx*

WESTERN ECO-SYSTEMS TECHNOLOGY, INC.
 189970001
 REPORT NO. 1006
 JANUARY 1979
 CONTRACT NO. DAH-107-1079
 PROJECT NO. 1073
 VERSION NO. 1079





MAP 30 CHESAPEAKE BAY

Crassostrea virginica - AMERICAN OYSTER
Potential Habitat

GENERAL DISTRIBUTION

FUTURE AVERAGE

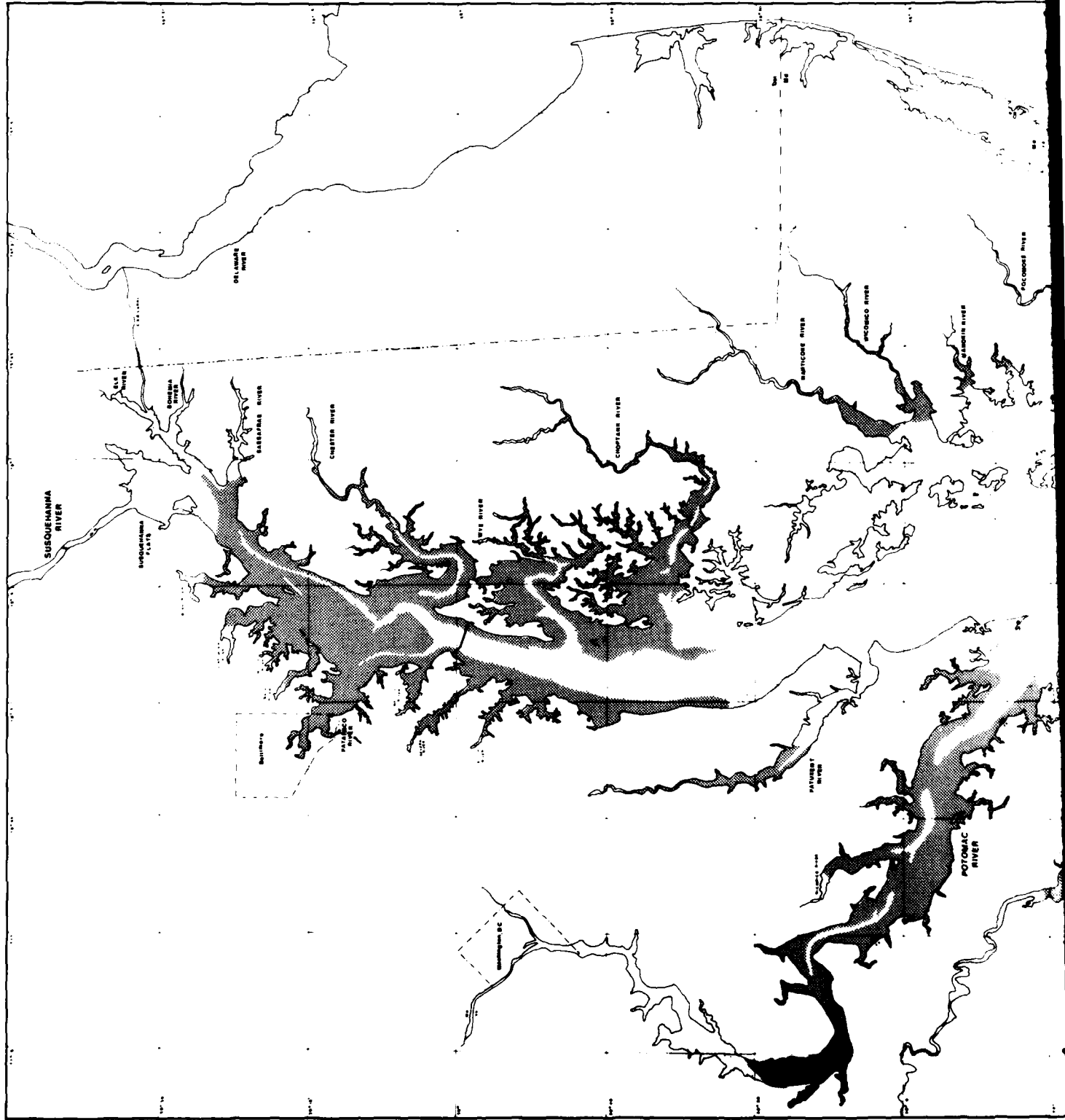
LEGEND

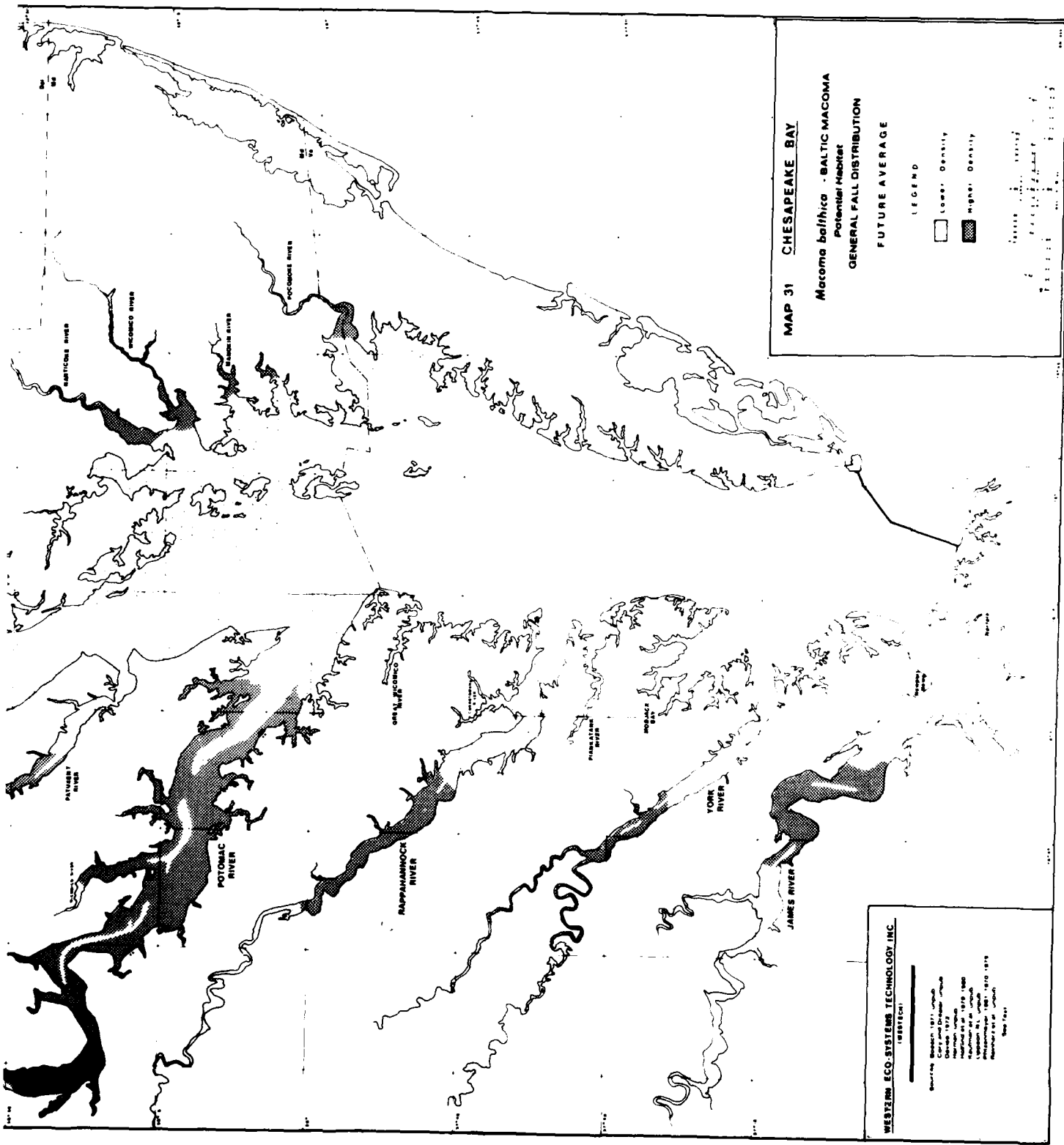
- ▨ General Distribution
- Oyster Parasites, MSA and Dermo
- Upstream extent of major impact area

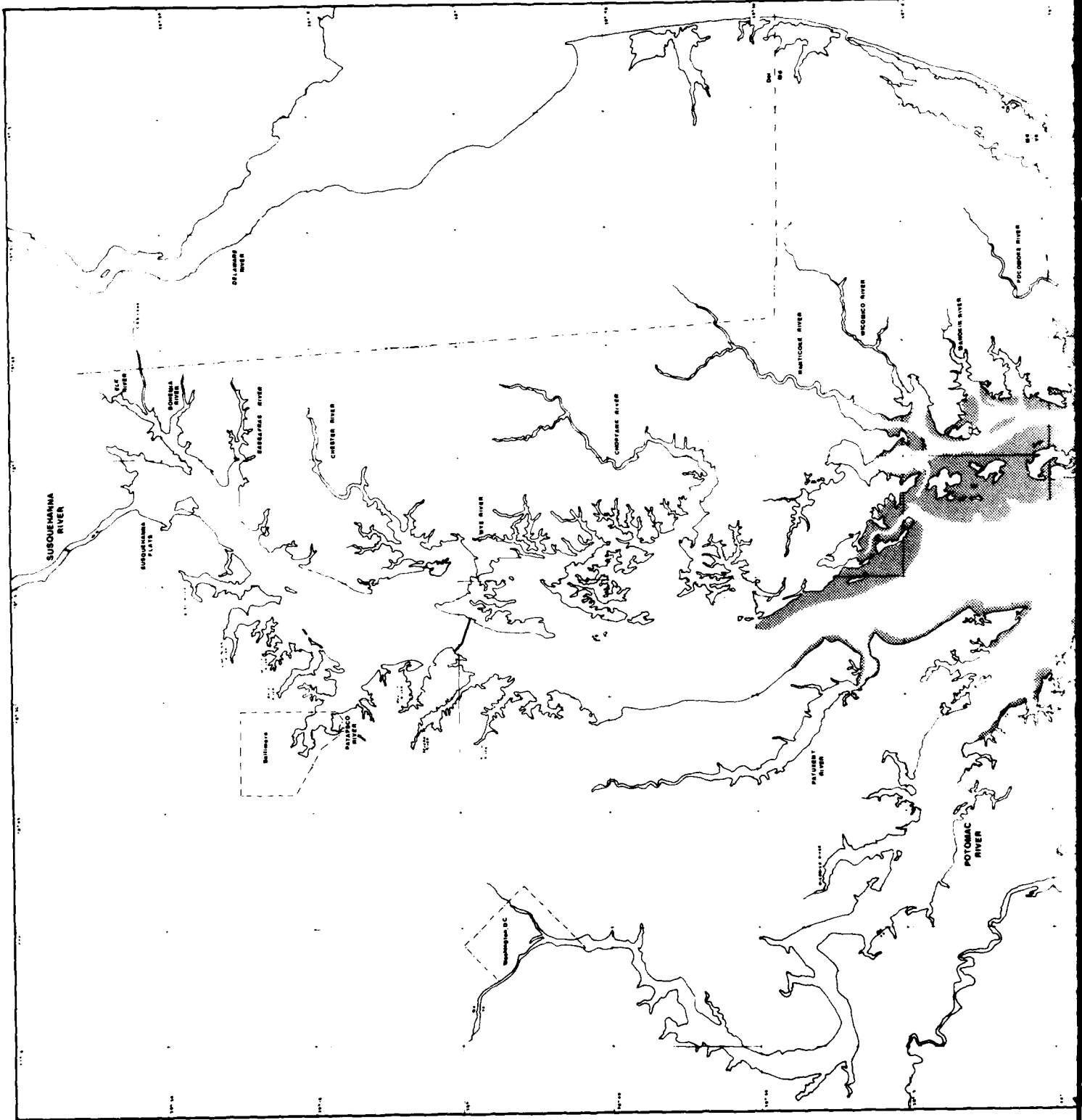
1987
 1988
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 2014
 2015
 2016
 2017
 2018
 2019
 2020

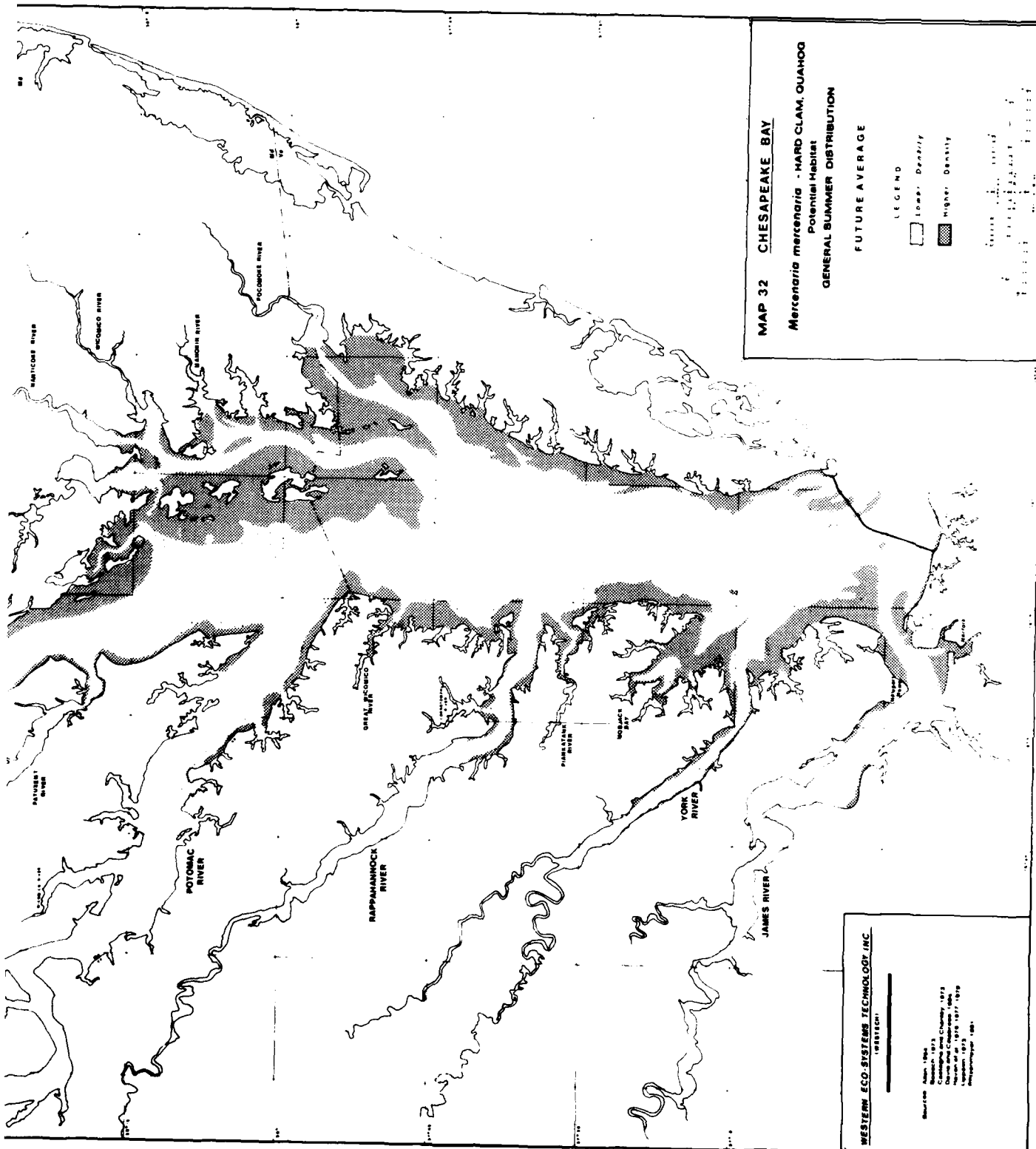
WESTERN ECO-SYSTEMS TECHNOLOGY, INC.
(ESTABLISHED)

Established: 1986
 Headquarters: 1807
 1807 West 10th Street
 Lincoln, NE 68506
 Telephone: (402) 479-1111
 Fax: (402) 479-1112
 Copyright © 1999









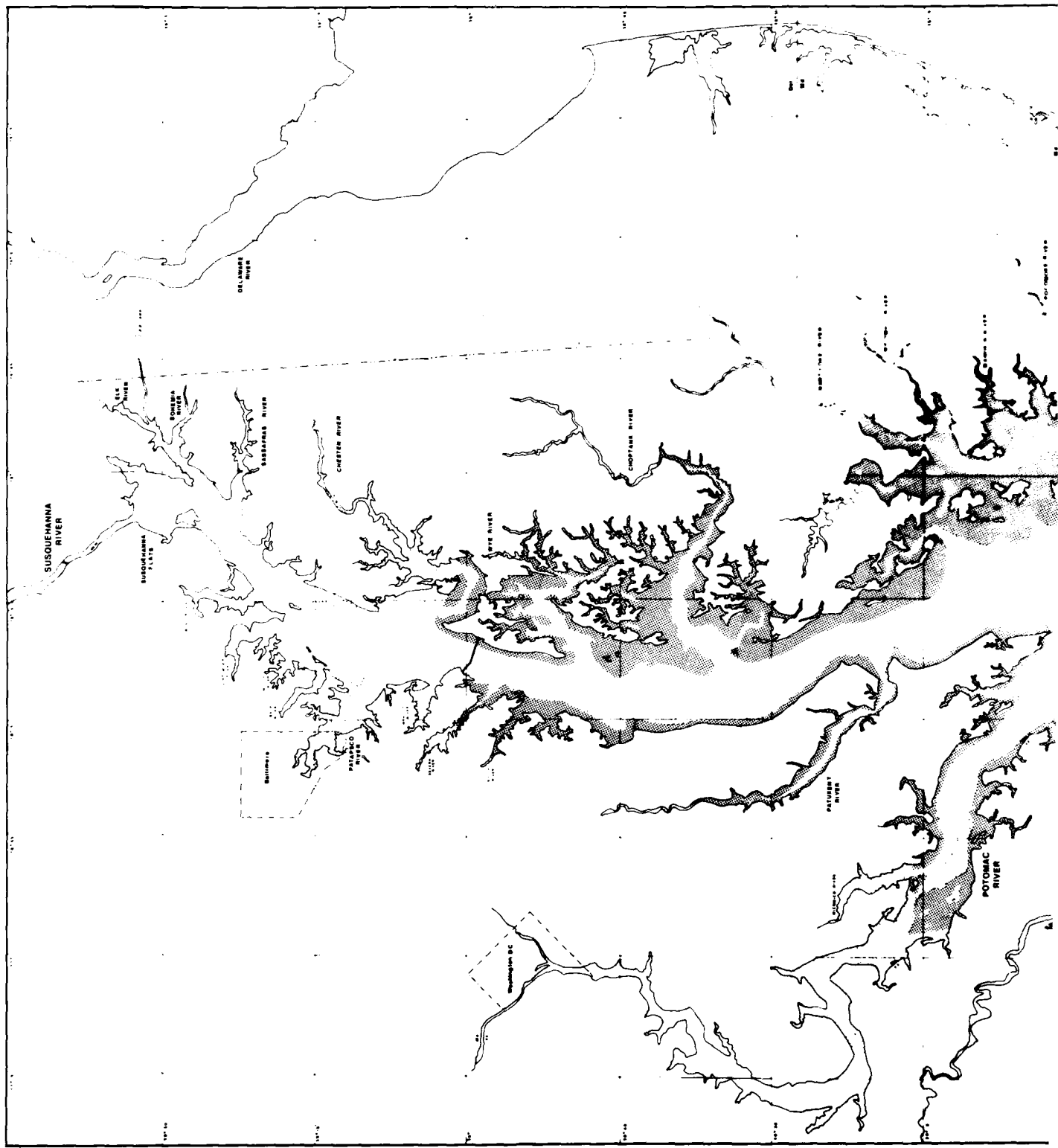
MAP 32 CHESAPEAKE BAY
Mercenaria mercenaria - HARD CLAM, OYAHOG
 Potential Habitat
 GENERAL SUMMER DISTRIBUTION
 FUTURE AVERAGE

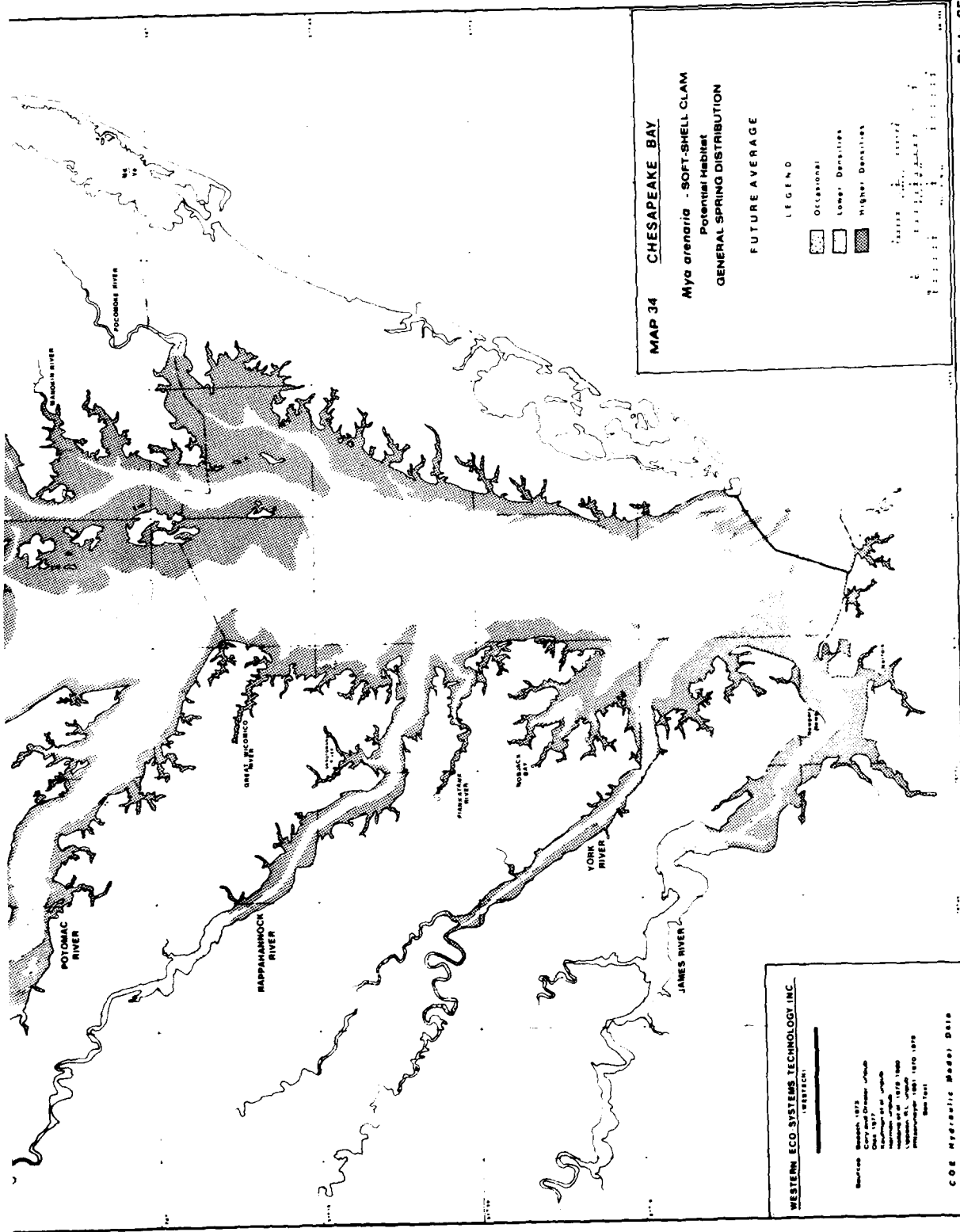
LEGEND
 [Light Stippling] Lower Density
 [Dark Stippling] Higher Density

Scale: 1:50,000
 0 1 2 3 4 5 Miles
 0 1 2 3 4 5 Kilometers

WESTERN ECO-SYSTEMS TECHNOLOGY, INC.
 WESTTECH

Source:
 Allen, 1961
 Chesapeake Bay
 Chesapeake Bay Chapter, 1974
 Chesapeake Bay Chapter, 1986
 Chesapeake Bay Chapter, 1974-1977-1979
 Chesapeake Bay Chapter, 1981





MAP 34 CHESAPEAKE BAY
***Mya arenaria* - SOFT-SHELL CLAM**
 Potential Habitat
GENERAL SPRING DISTRIBUTION
 FUTURE AVERAGE

LEGEND

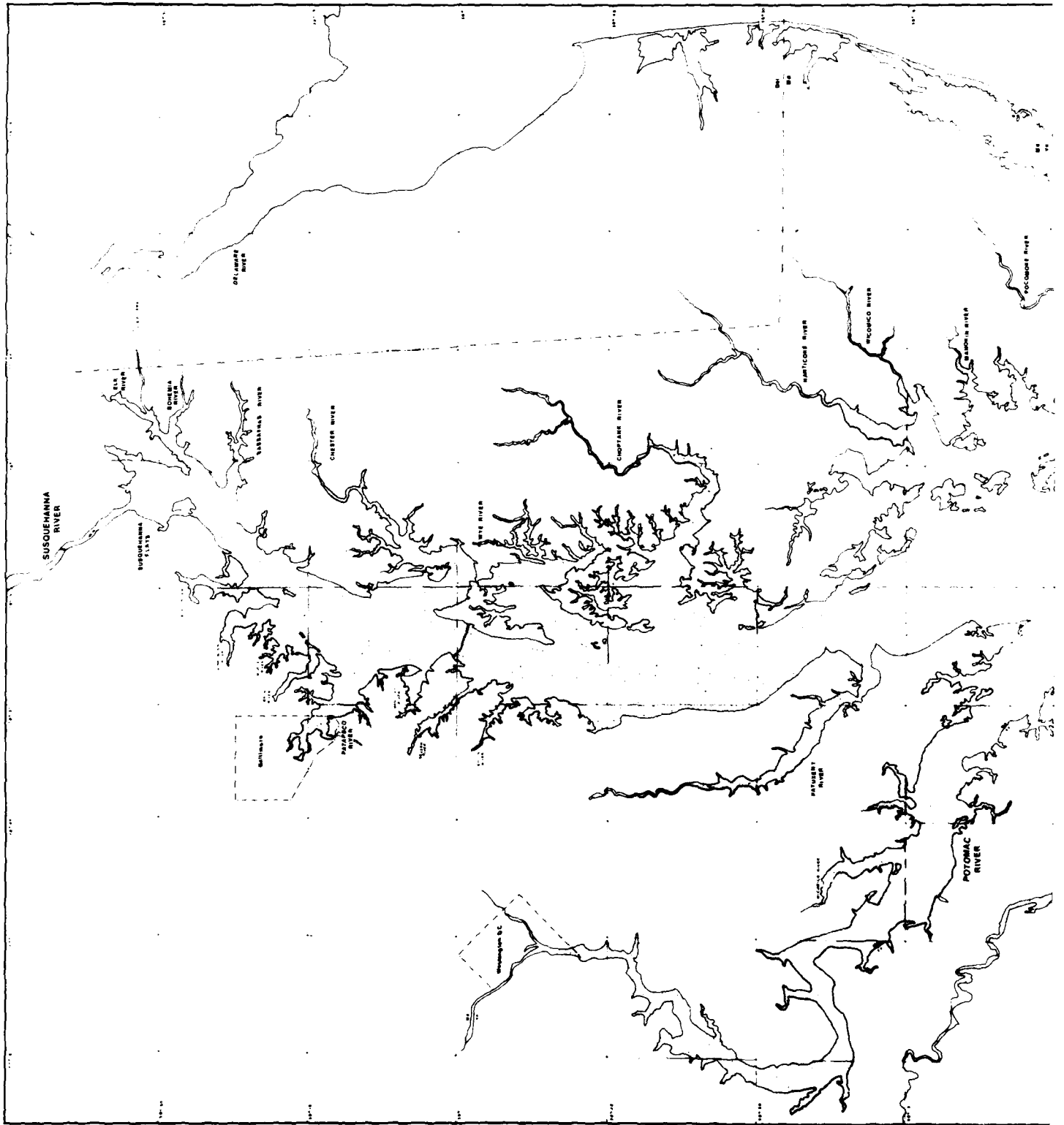
- Occasional
- Lower Densities
- Higher Densities

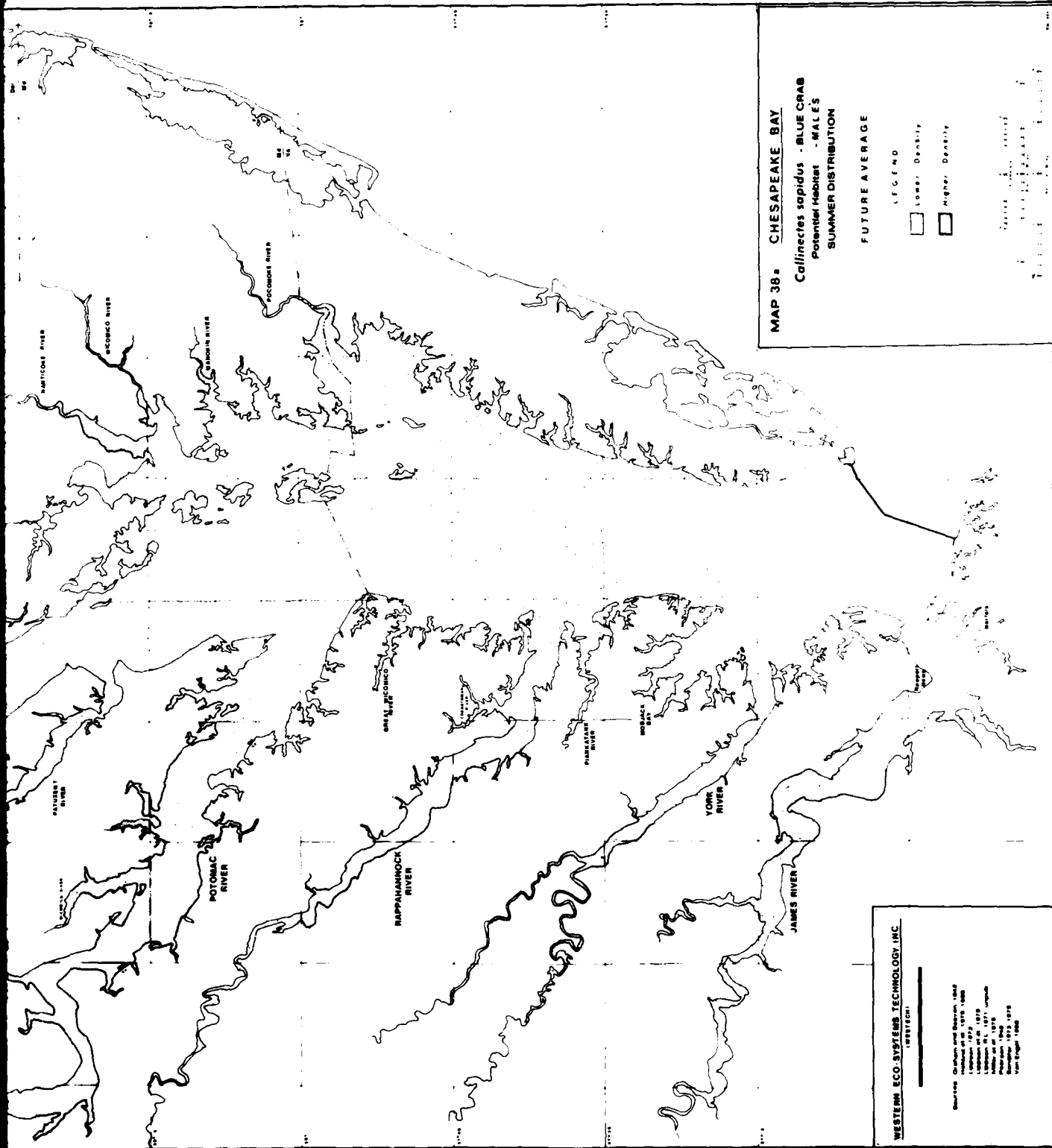
Scale: 1:50,000
 North Arrow

WESTERN ECO SYSTEMS TECHNOLOGY INC.
 DIVISION

Source: *Mya arenaria* 1975
 Coastal Ocean Atlas
 Data 1977
 Hydrographic Survey
 Hydrographic 1979-1980
 Hydrographic 1981-1970 1979
 Data Text

COE Hydrologic Model Data

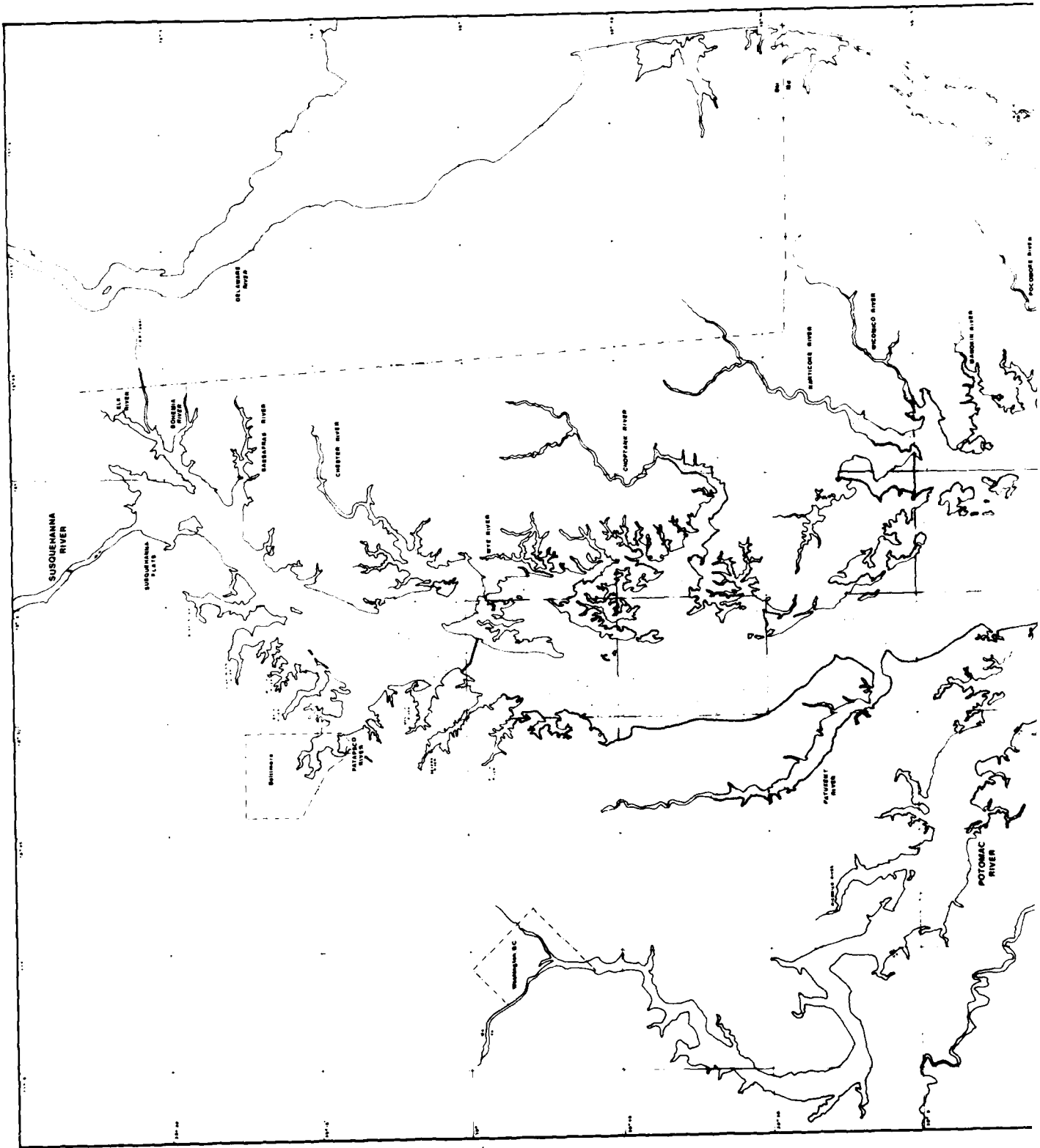


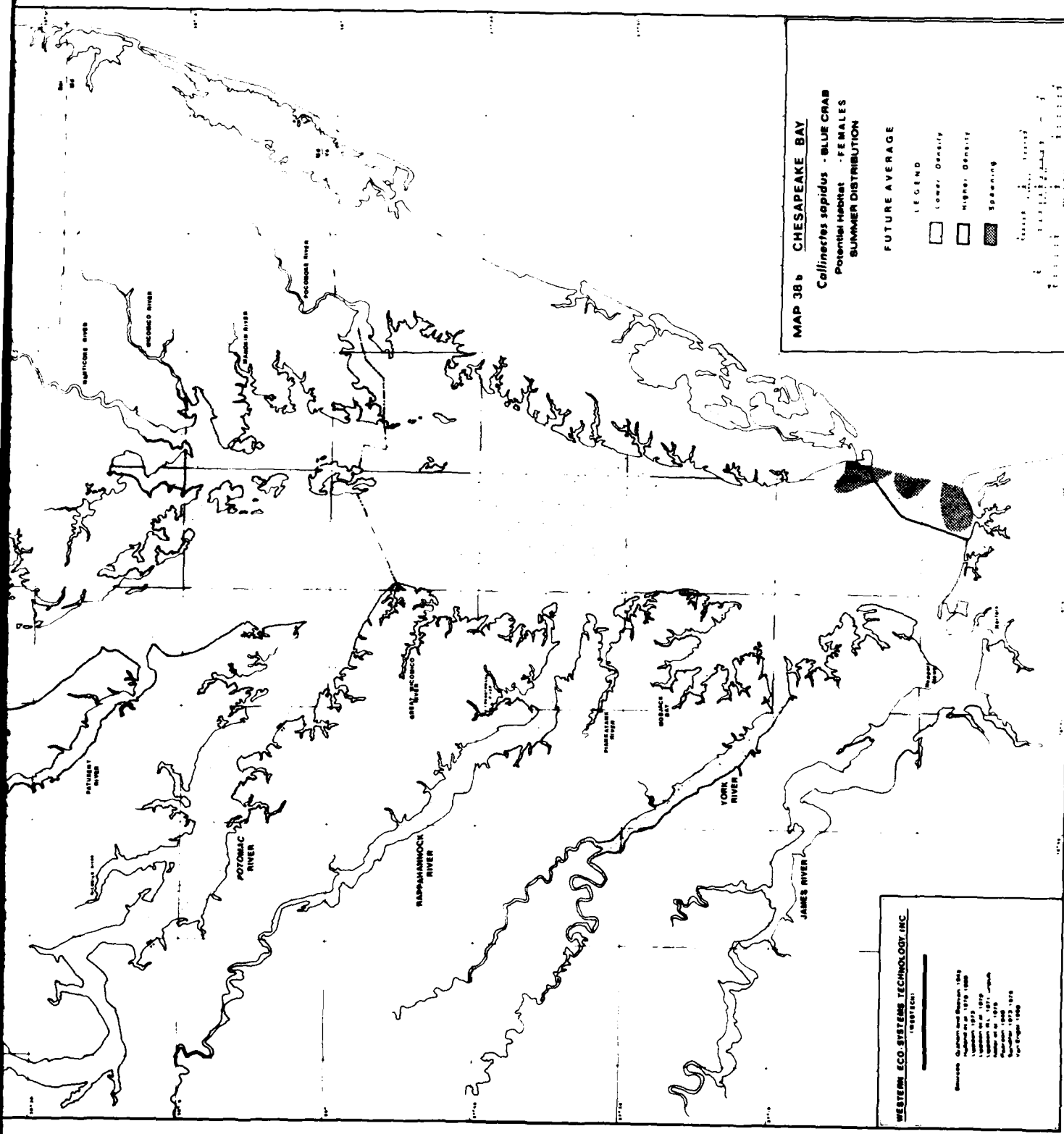


MAP 38. CHESAPEAKE BAY
Callinectes sapidus - BLUE CRAB
 Potential Habitat - MALES
 SUMMER DISTRIBUTION
 FUTURE AVERAGE

LEGEND
 Low Density
 High Density

WESTERN ECO-SYSTEMS TECHNOLOGY, INC.
 (WESTECH)
 Sources: Graham and Brown, 1982
 Johnson, 1979
 Johnson et al., 1979
 Johnson et al., 1979
 Johnson et al., 1979
 Johnson et al., 1979
 Johnson et al., 1979





MAP 38 b CHESAPEAKE BAY
Callinectes sapidus - BLUE CRAB
 Potential Habitat - FEMALE
 SUMMER DISTRIBUTION

FUTURE AVERAGE

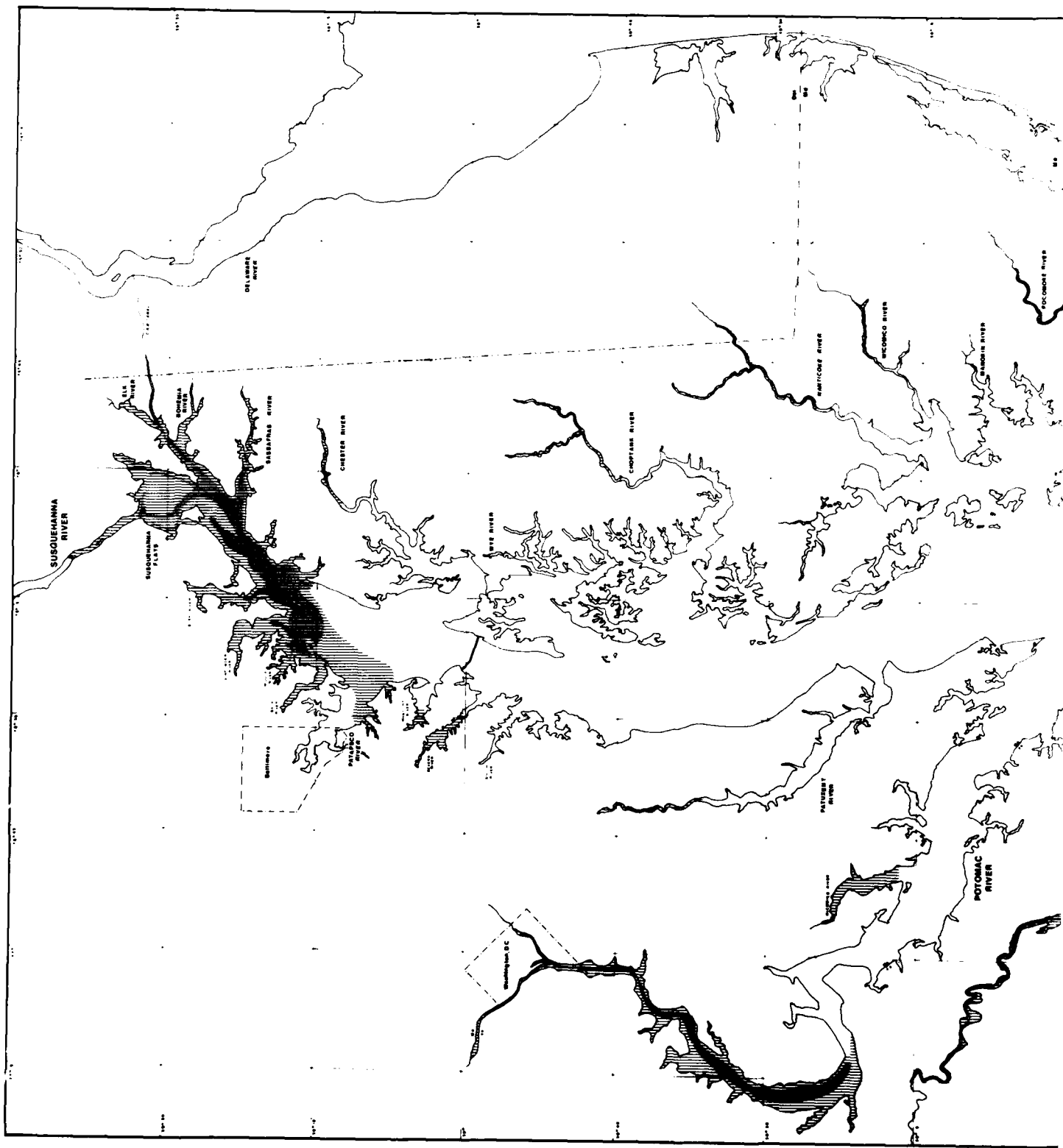
LEGEND

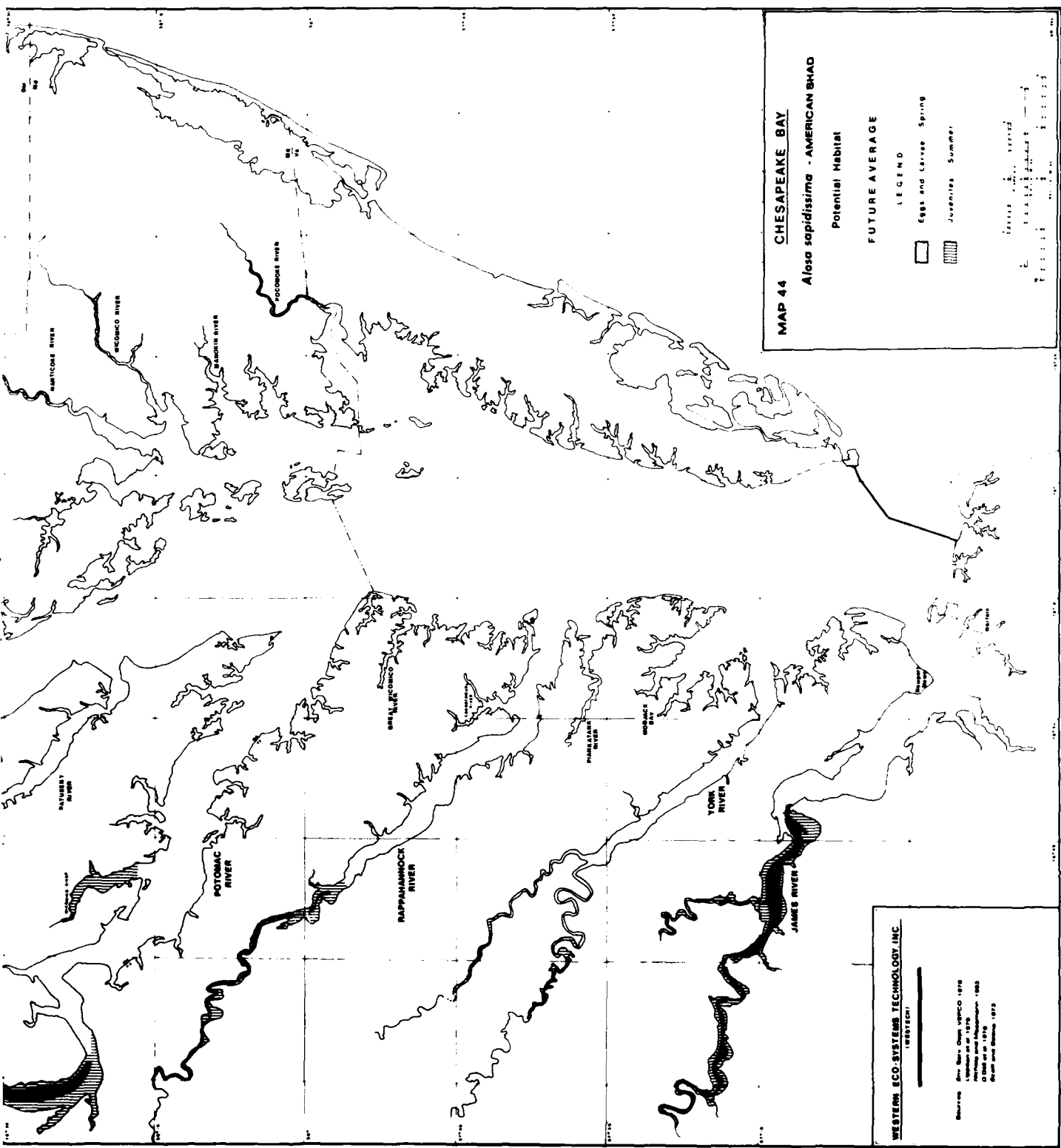
- Lower Density
- ▨ Higher Density
- ▩ Spawning

Scale: 1:50,000
 Date: 1978
 Project: Chesapeake Bay

WESTERN ECO-SYSTEMS TECHNOLOGY, INC.
 WESTTEC

Company: 2000 West 10th Street, Suite 100
 Portland, Oregon 97201
 Telephone: (503) 251-1000
 Telex: 251100
 Fax: (503) 251-1000
 Copyright: 1978-1979
 Van Enger 1989





MAP 44 CHESAPEAKE BAY

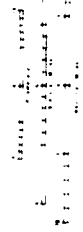
Alosa sapidissima - AMERICAN SHAD

Potential Habitat

FUTURE AVERAGE

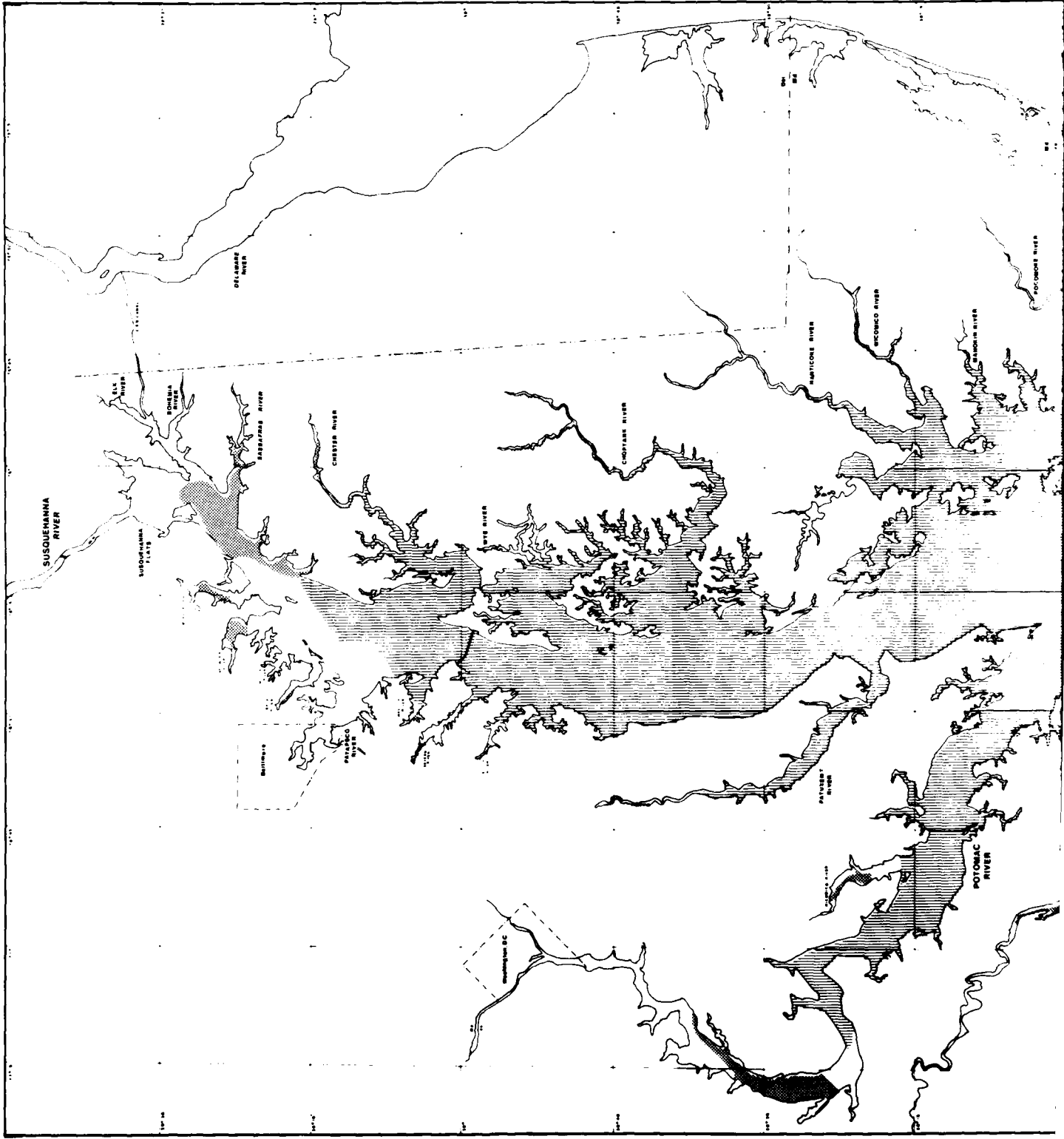
LEGEND

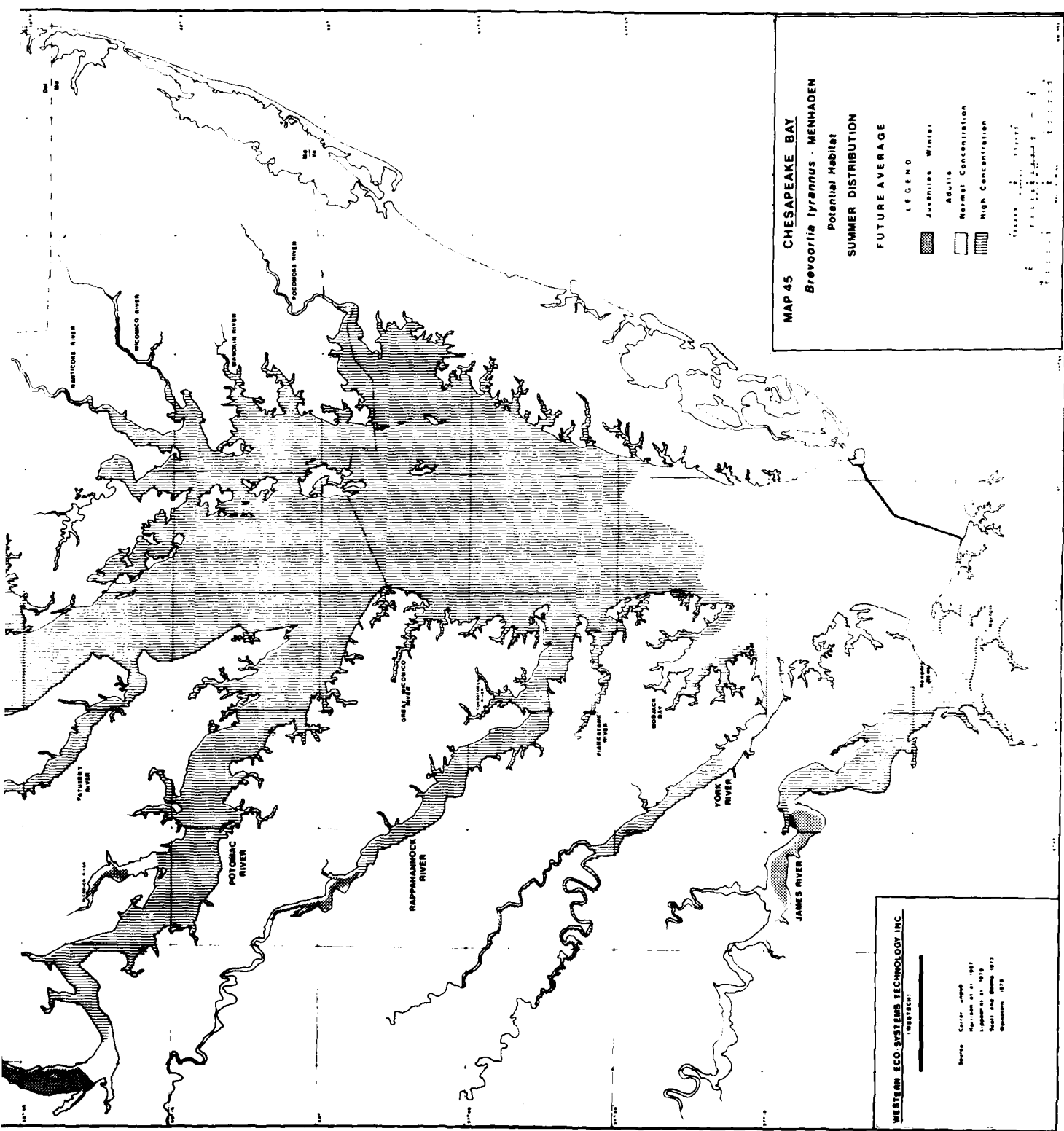
- Eggs and Larvae Spring
- ▨ Juveniles Summer



WESTERN ECO-SYSTEMS TECHNOLOGY, INC.
19851201

Source: See Also: USFWS 1978
 Fisheries and Wildlife
 O 200 as of 1978
 Second and Third 1979





MAP 45 CHESAPEAKE BAY
Brevortia tyrannus - MENHADEN
 Potential Habitat
 SUMMER DISTRIBUTION
 FUTURE AVERAGE

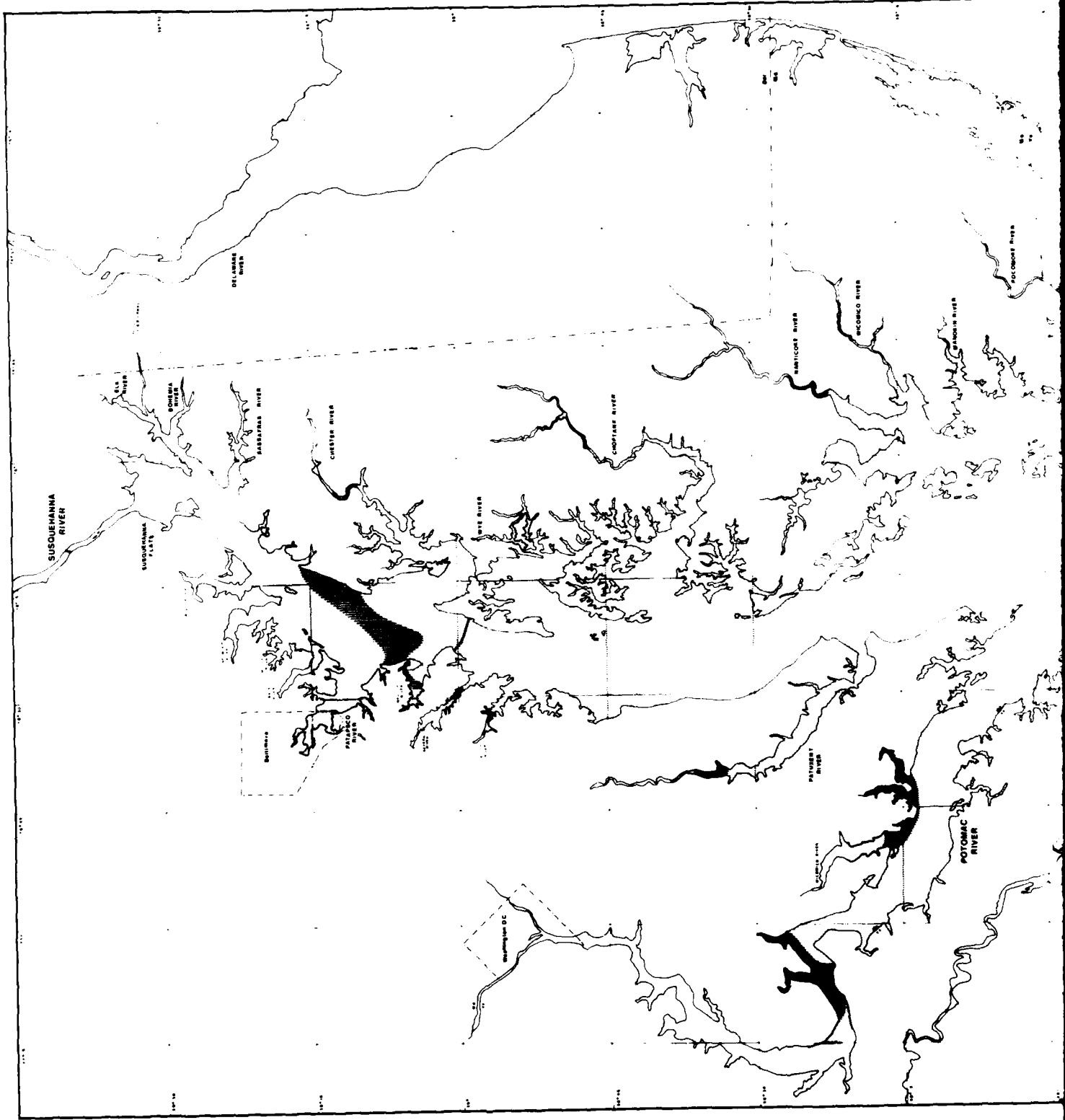
LEGEND

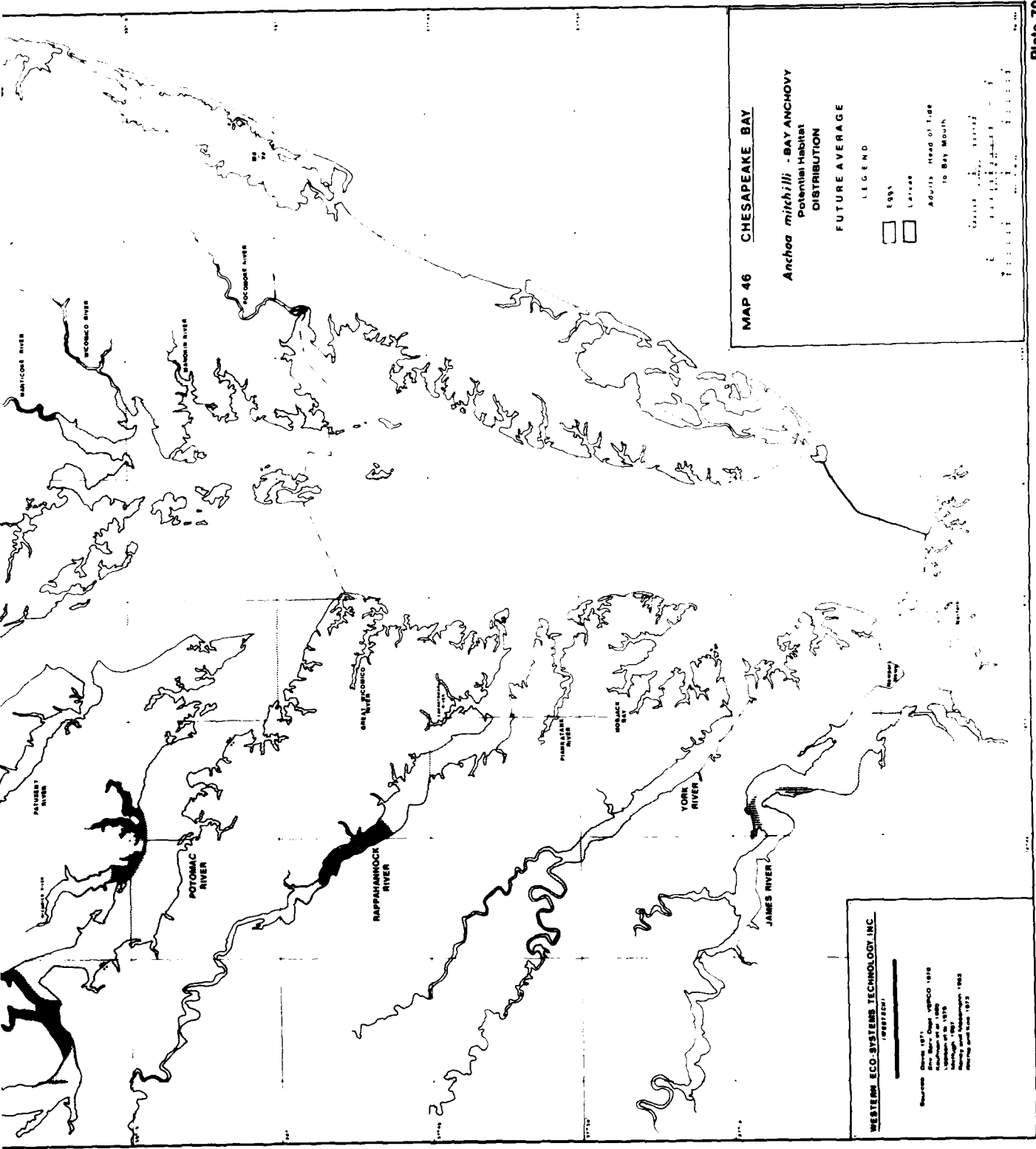
- Juveniles - Normal Concentration
- Juveniles - High Concentration
- Adults - Normal Concentration
- Adults - High Concentration

Scale: 1:50,000
 Date: 1978

WESTERN ECO-SYSTEMS TECHNOLOGY INC.
 (WESTECH)

Source: Carter, 1968
 Morrison et al., 1967
 Lyman et al., 1970
 Peart and Banno, 1972
 Anonymous, 1978





MAP 46 CHESAPEAKE BAY

Anchoa mitchilli - BAY ANCHOVY
Potential Habitat
DISTRIBUTION
FUTURE AVERAGE

LEGEND

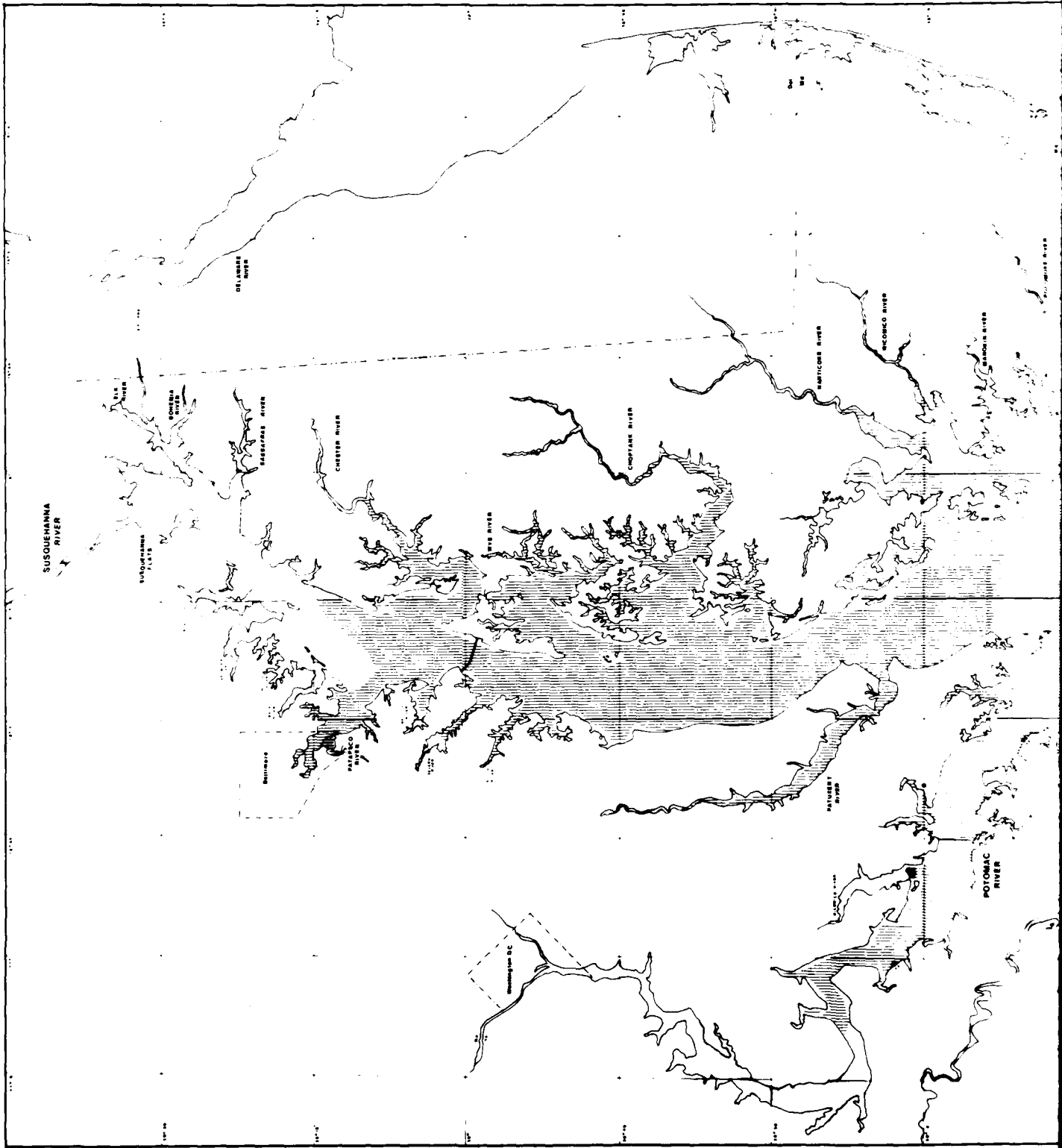
Eggs
 Larvae
 --- Adults - Head of Tide to Bay Mouth

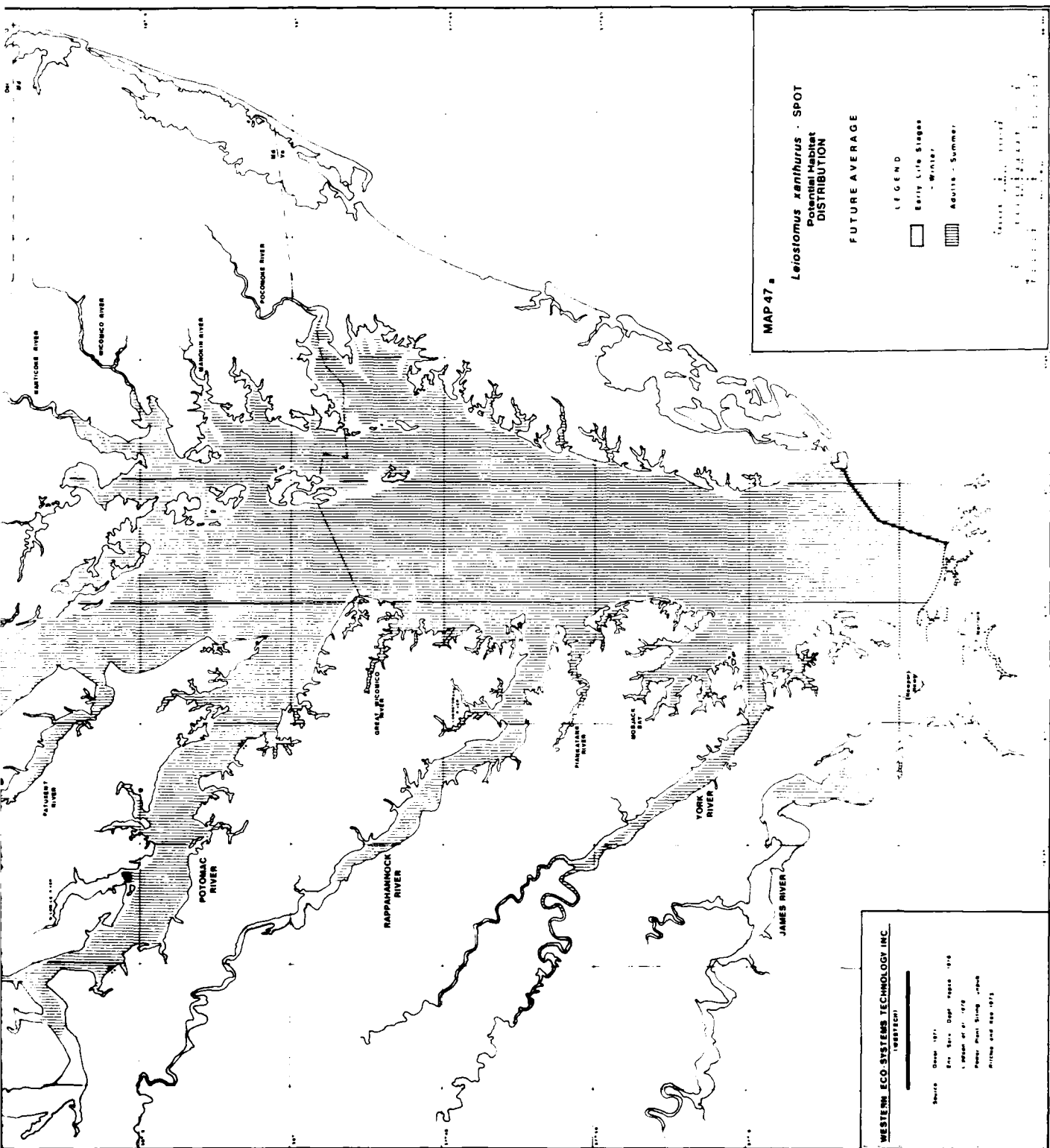
Scale: 1:50,000

North Arrow

WESTERN ECO SYSTEMS TECHNOLOGY INC.
PREFACE

Sources: *Anchoa mitchilli* - Chesapeake Bay
 Distribution in 1980
 Distribution in 1985
 Distribution in 1990
 Distribution in 1995
 Distribution in 2000





MAP 47

Leptostomus xanthurus - SPOT
Potential Habitat
DISTRIBUTION

FUTURE AVERAGE

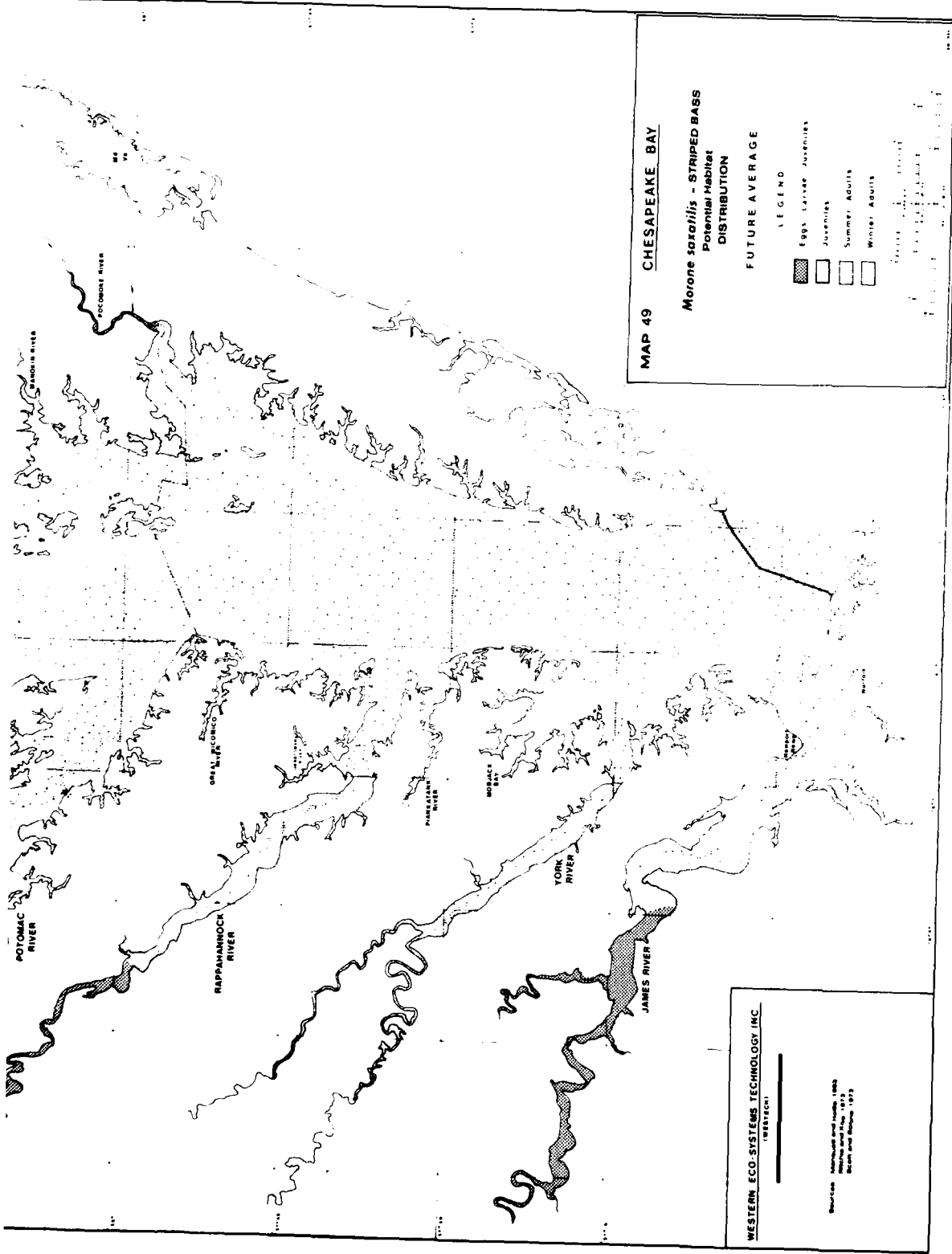
LEGEND

- Early Life Stages - Winter
- ▨ Adults - Summer
- ▩ Future Average

WESTERN ECO SYSTEMS TECHNOLOGY INC.
 (WESTECH)

Source: Quinn 1971
 Env. Serv. Dept. Report 814
 Lambert et al. 1976
 Federal Water Survey - Chesapeake Bay 1973





MAP 49 CHESAPEAKE BAY

Morone saxatilis - STRIPED BASS
 Potential Habitat
 DISTRIBUTION
 FUTURE AVERAGE

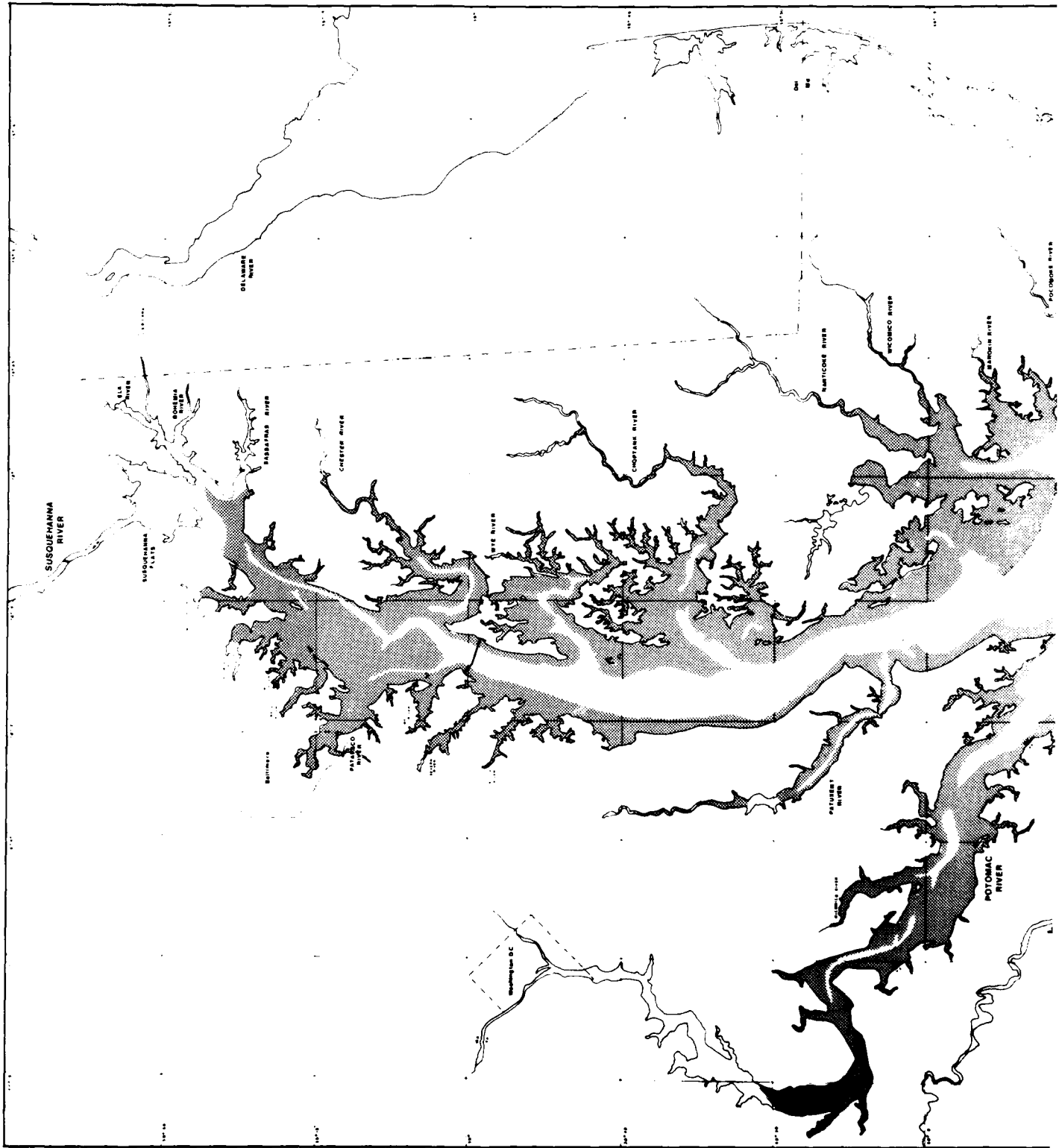
LEGEND

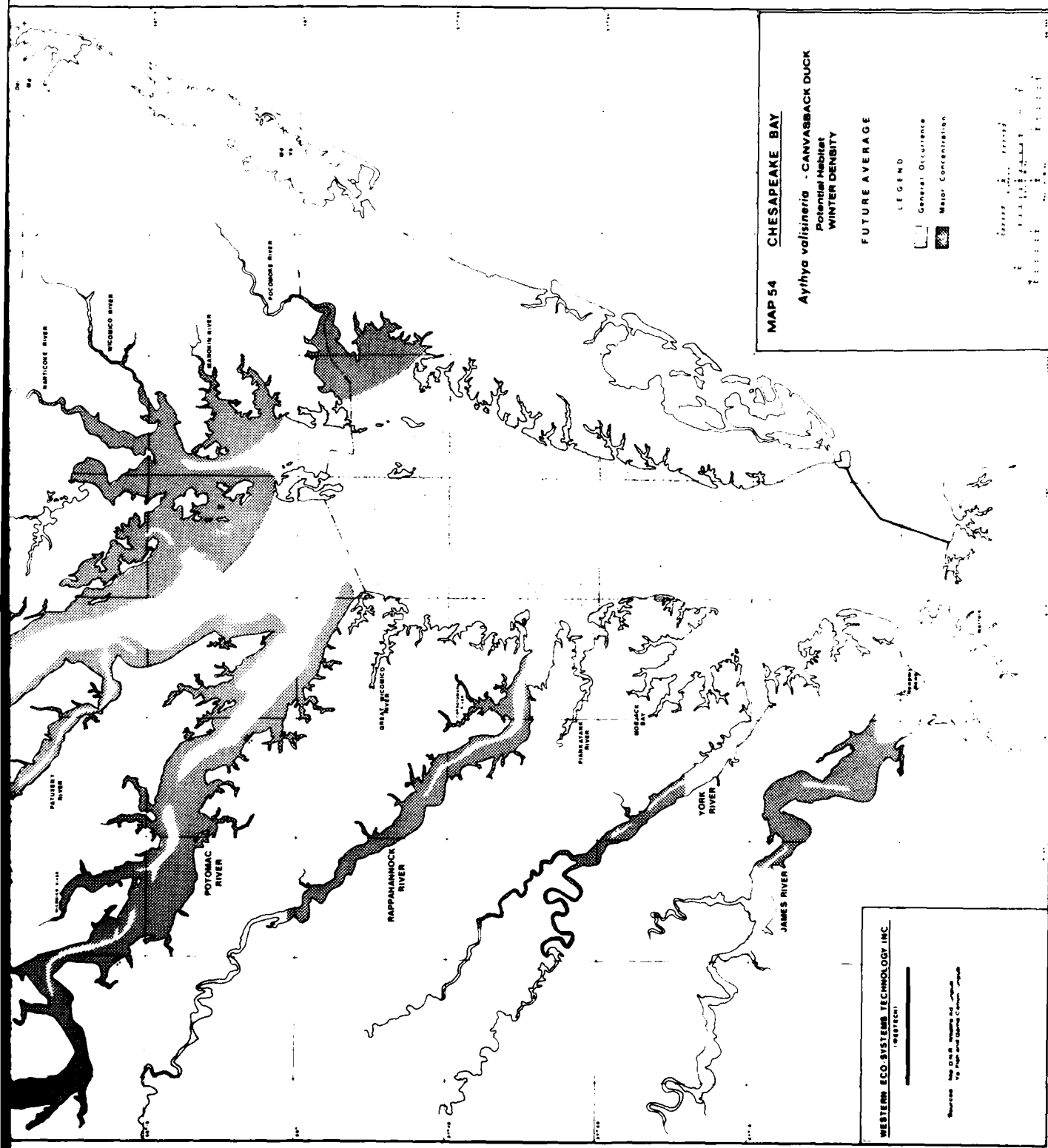
- Eggs/Larvae
- Juveniles
- Summer Adults
- Winter Adults

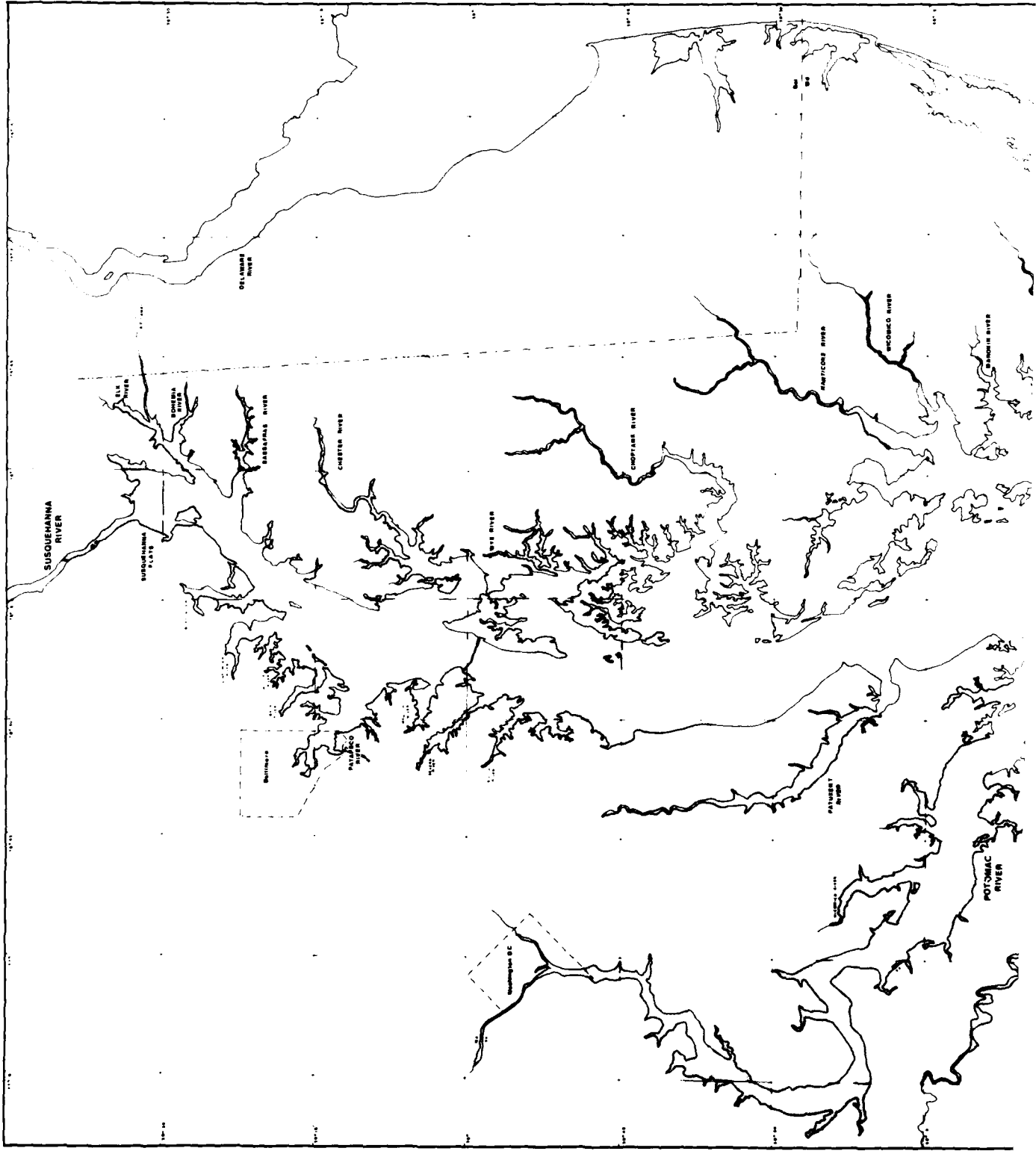
Scale: 1:50,000
 North Arrow

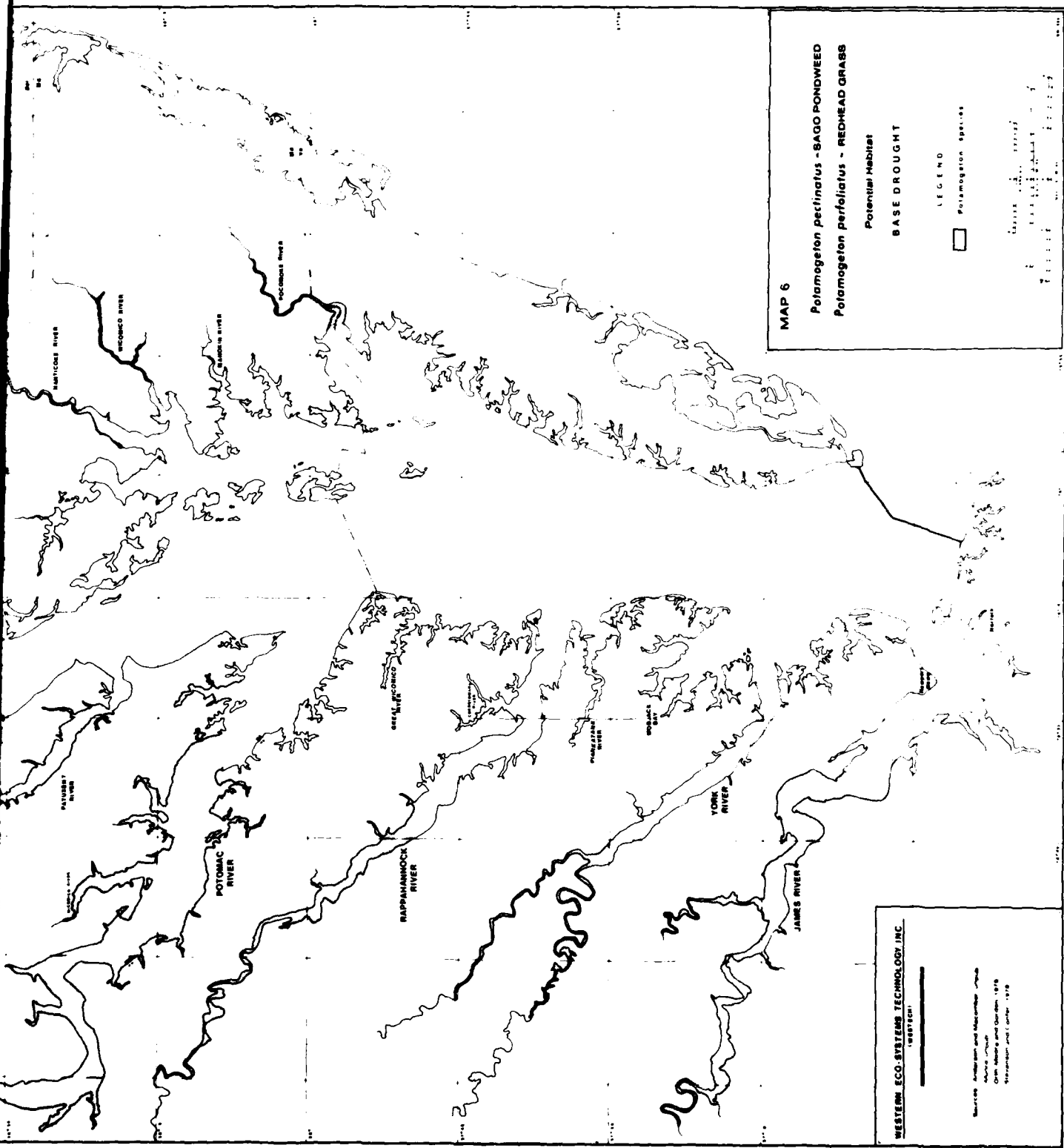
WESTERN ECO-SYSTEMS TECHNOLOGY INC.
 (WESTECH)

Source: Modified from Jones, 1988
 and other sources, 1988
 March and April, 1989









MAP 6

Potamogeton pectinatus - SAGO PONDWEED
Potamogeton perfoliatus - REDHEAD GRASS

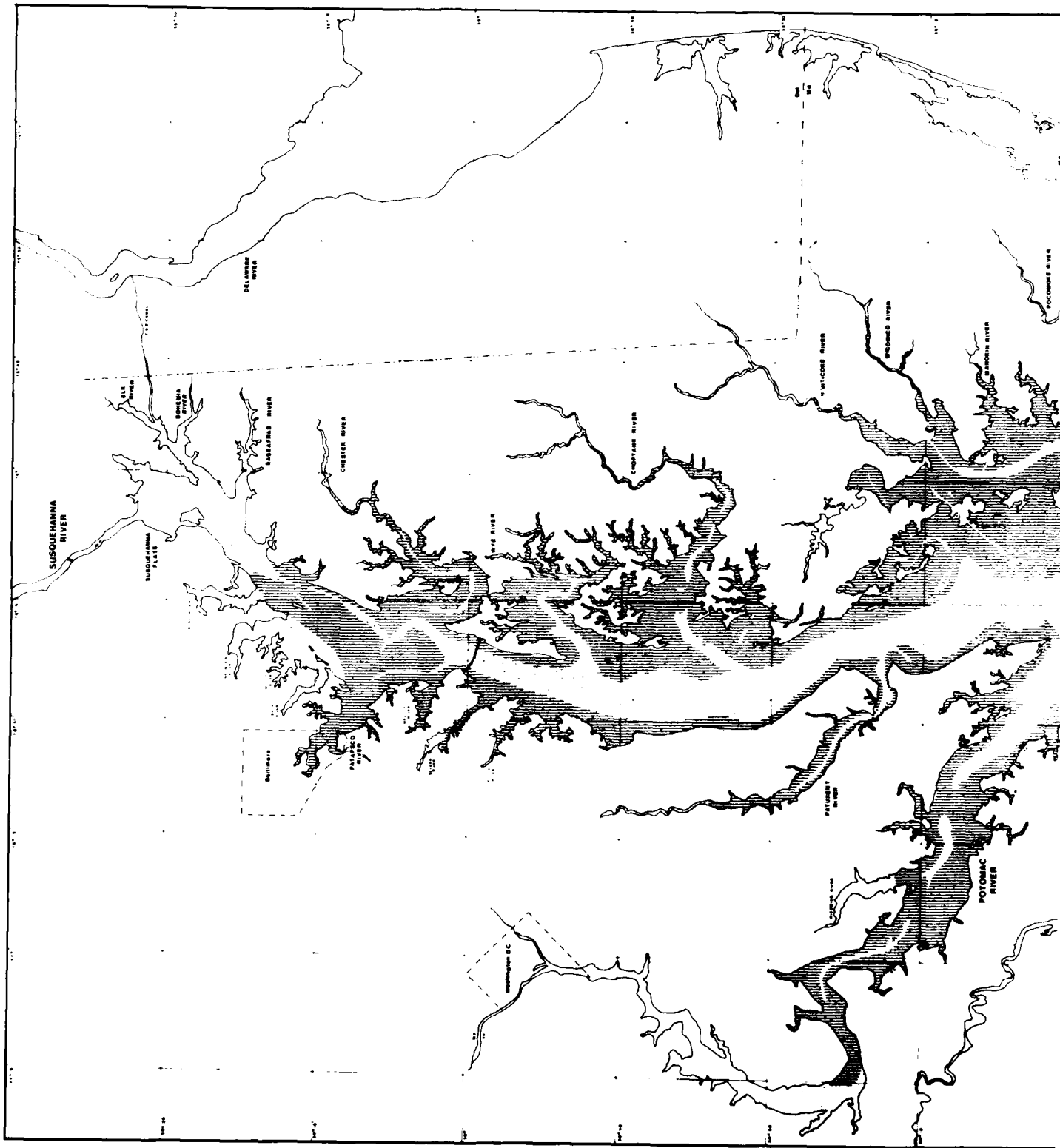
Potential Habitat
BASE DROUGHT

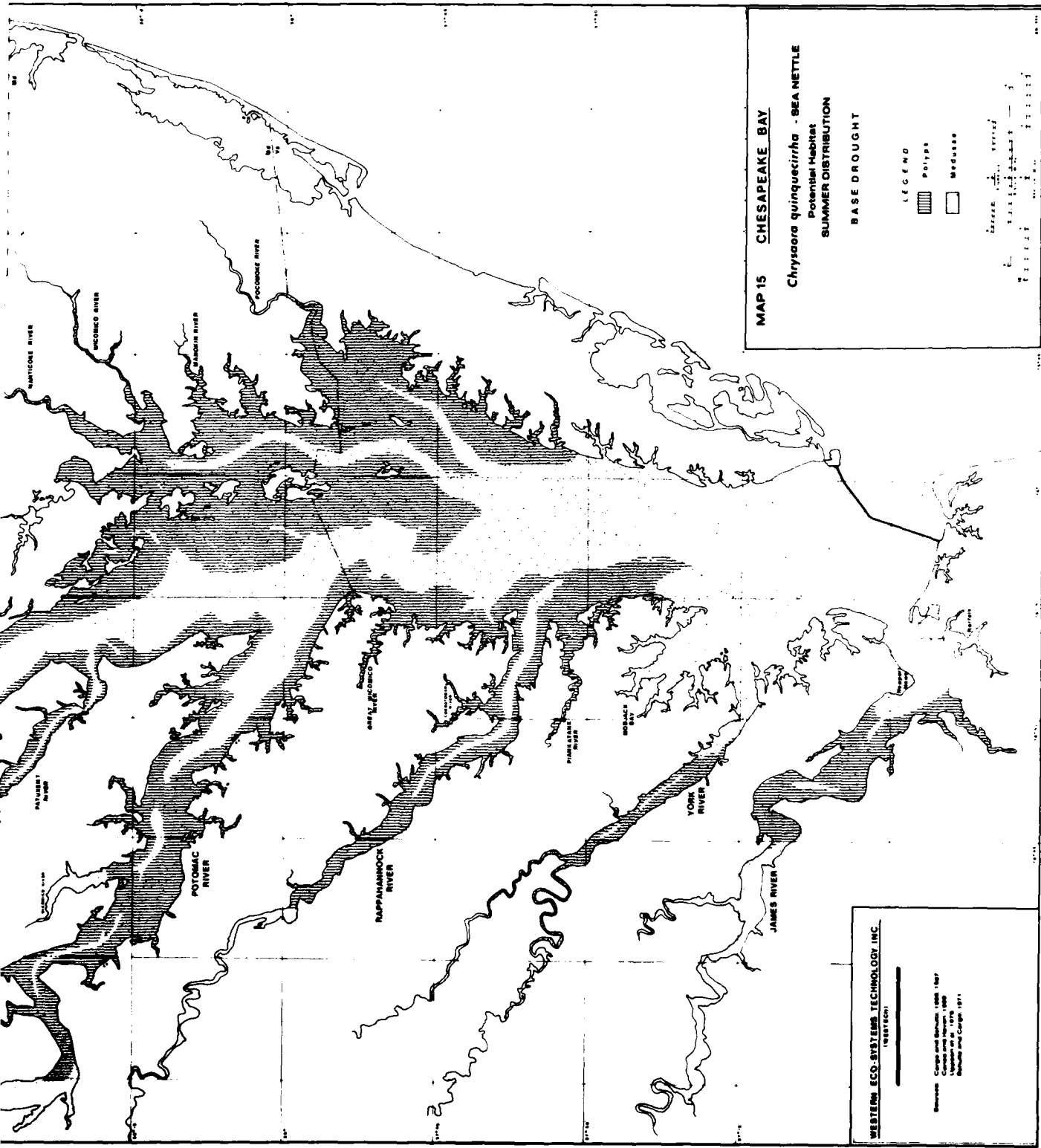
LEGEND
 □ Potamogeton species

Scale: 1:50,000
 0 1 2 3 4 5 Miles
 0 1 2 3 4 5 Kilometers

WESTERN ECO-SYSTEMS TECHNOLOGY, INC.
 TREVISO, CALIF.

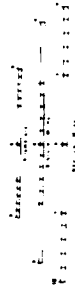
Source: Author and Mapmaker
 Author: [Name]
 Date: [Date]
 Revision: [Date]





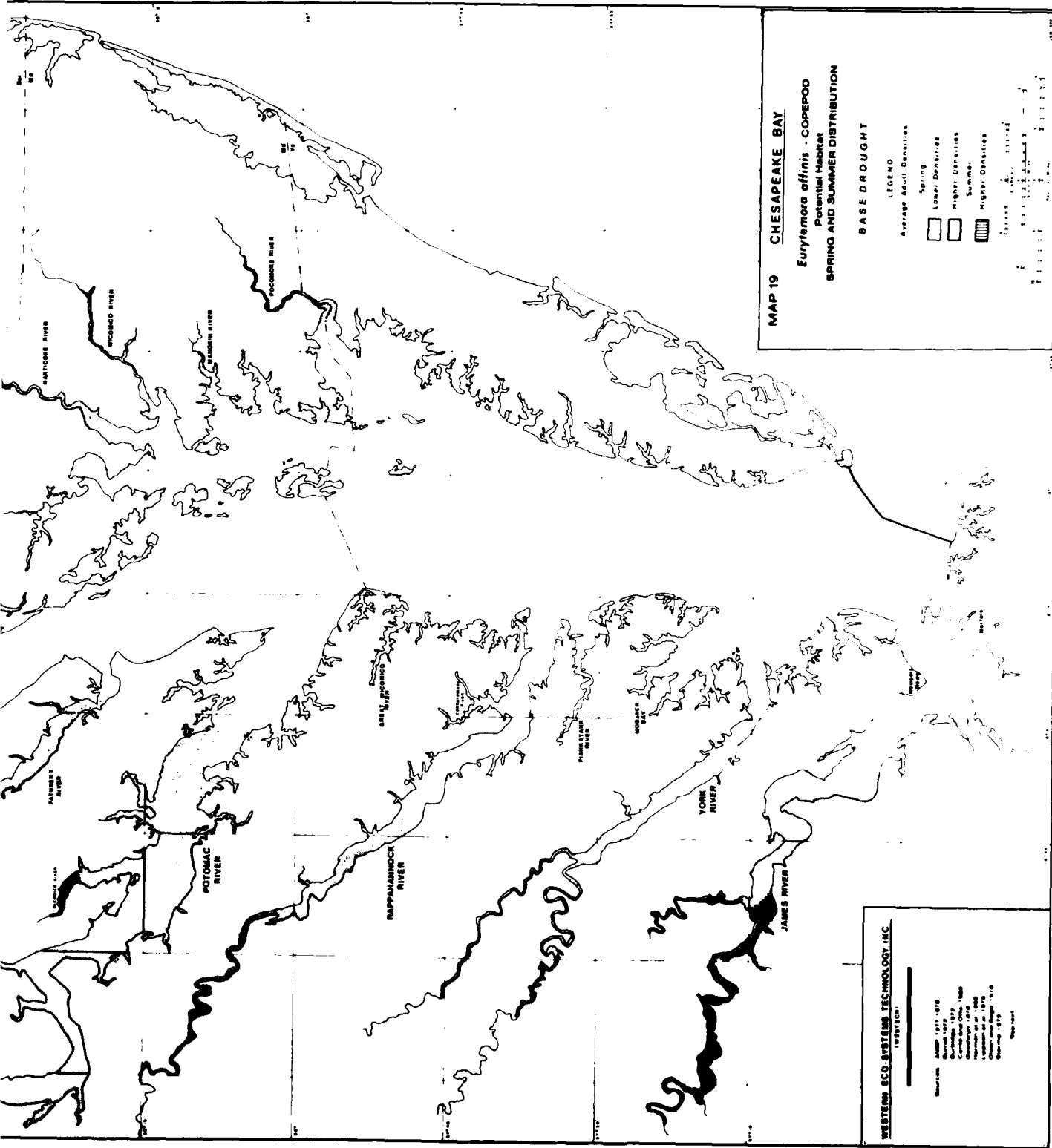
MAP 15 CHESAPEAKE BAY
Chrysaora quinquecirrha - SEA NETTLE
 Potential Habitat
 SUMMER DISTRIBUTION
 BASE DROUGHT

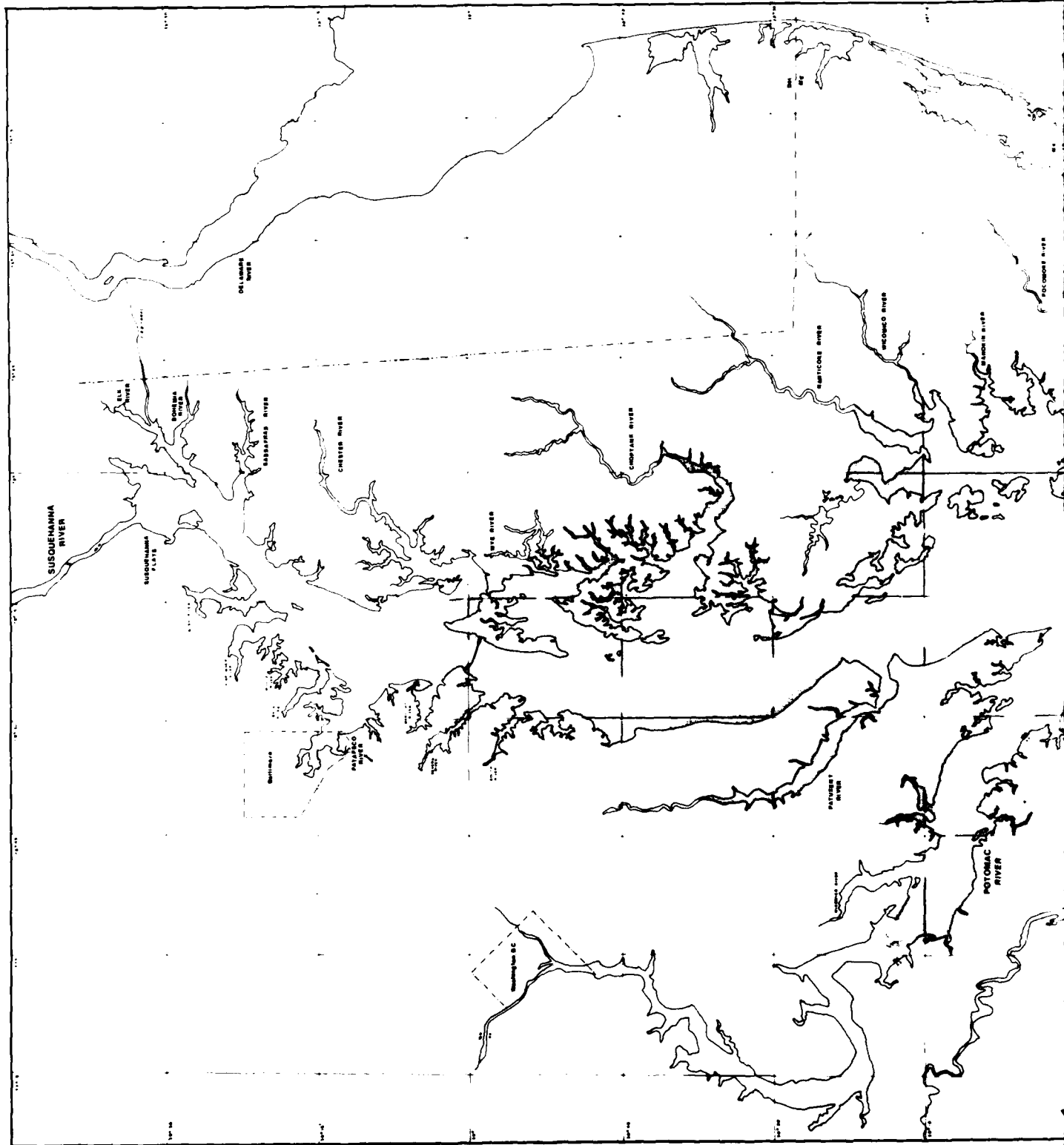
LEGEND
 [Hatched Box] Potential Habitat
 [Dotted Box] Points
 [White Box] Mediums

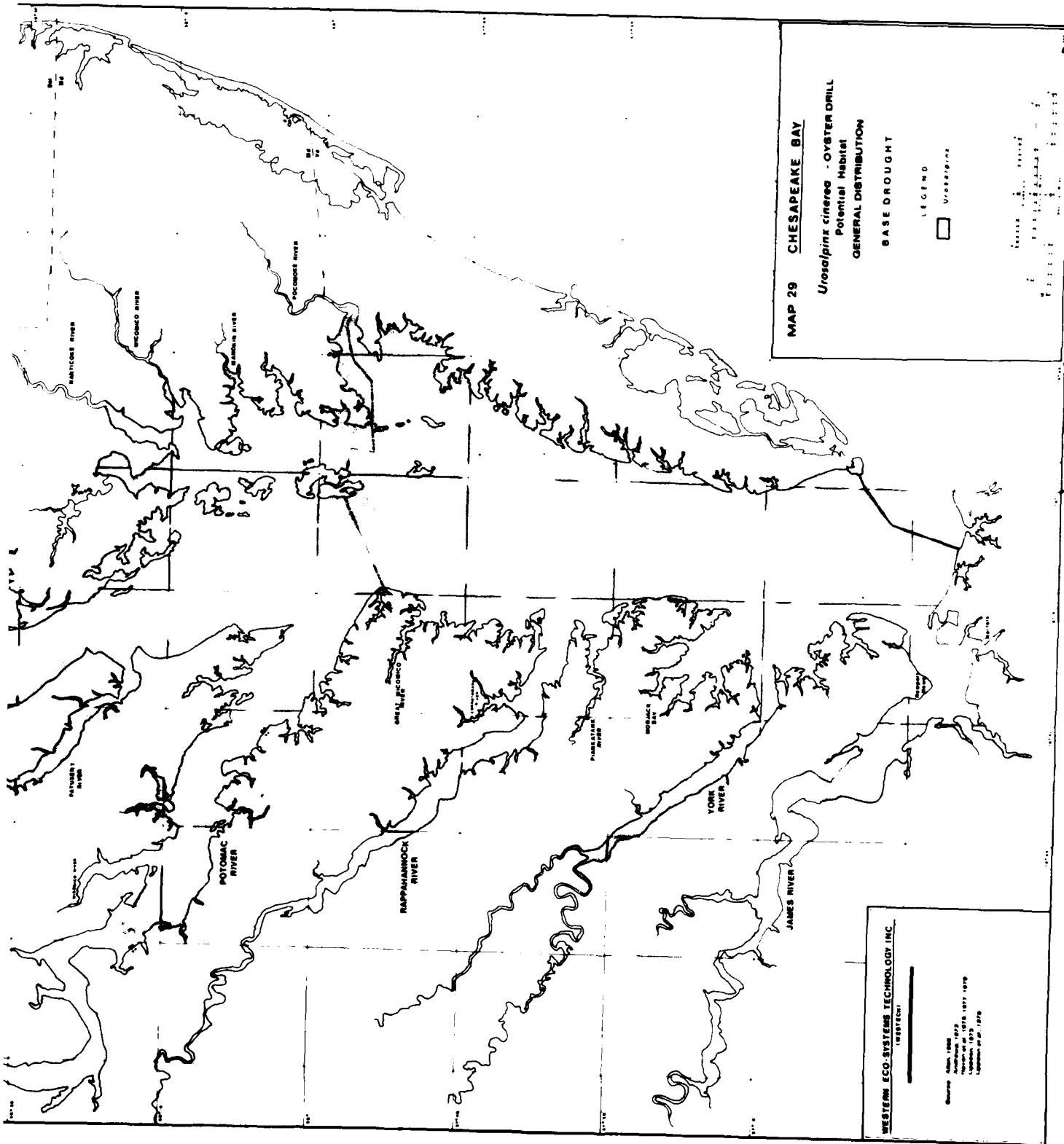


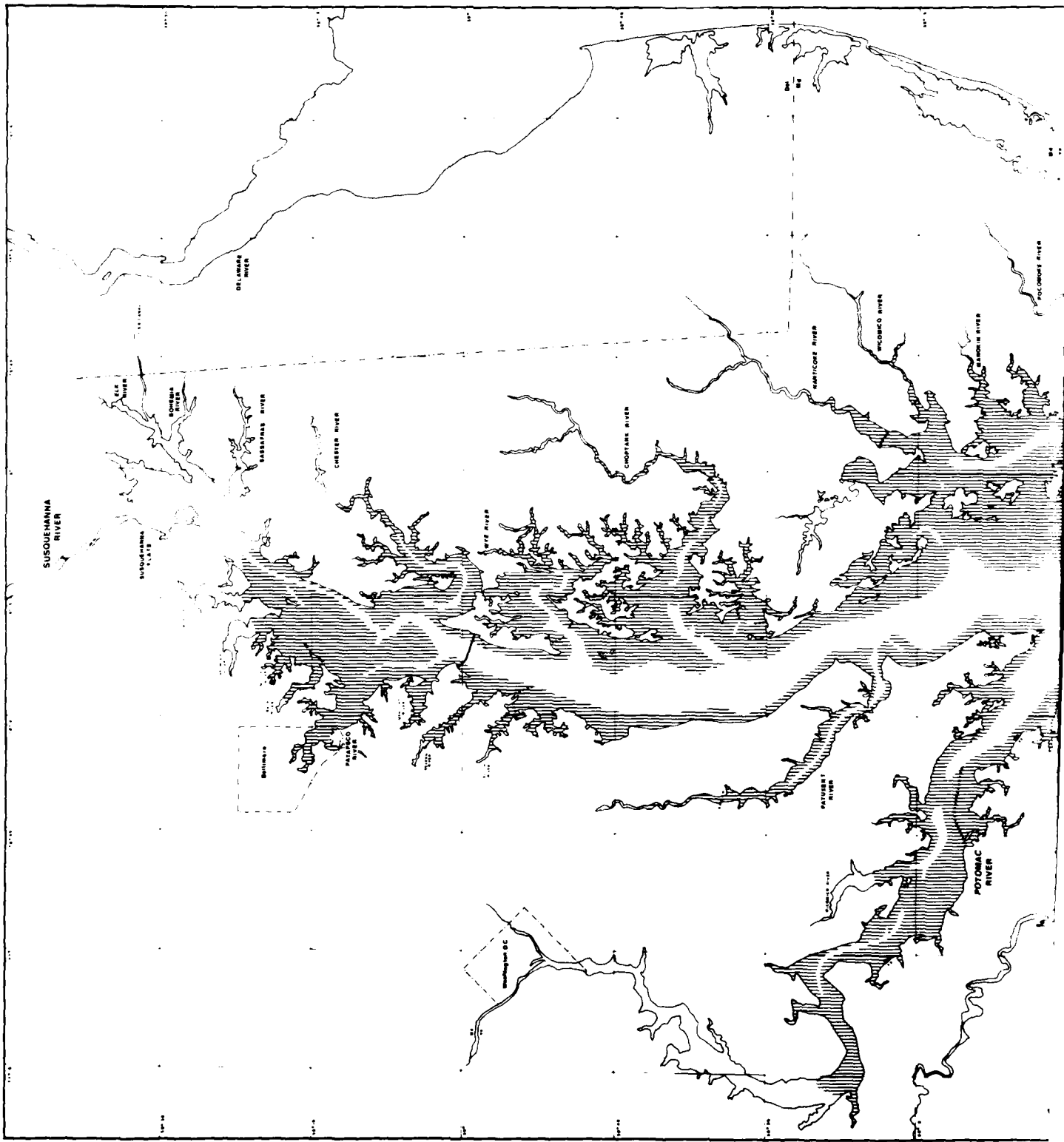
WESTERN ECO-SYSTEMS TECHNOLOGY, INC.
 WESTTECH

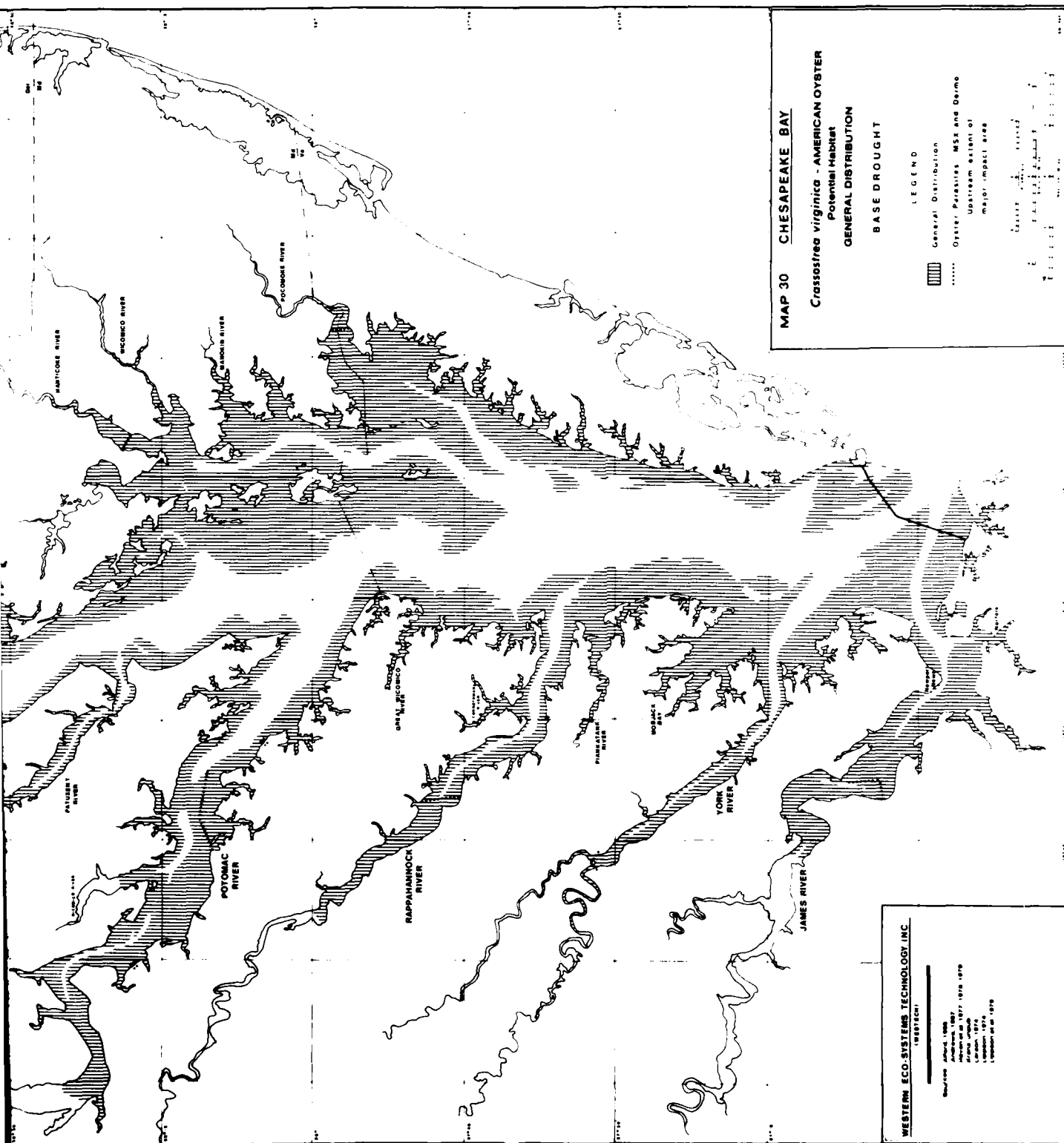
Source: Cragg and Schultz 1988, 1987
 Cragg and Schultz 1988
 Modified by Cragg 1991











MAP 30 CHESAPEAKE BAY

Crossostrea virginica - AMERICAN OYSTER
Potential Habitat

GENERAL DISTRIBUTION

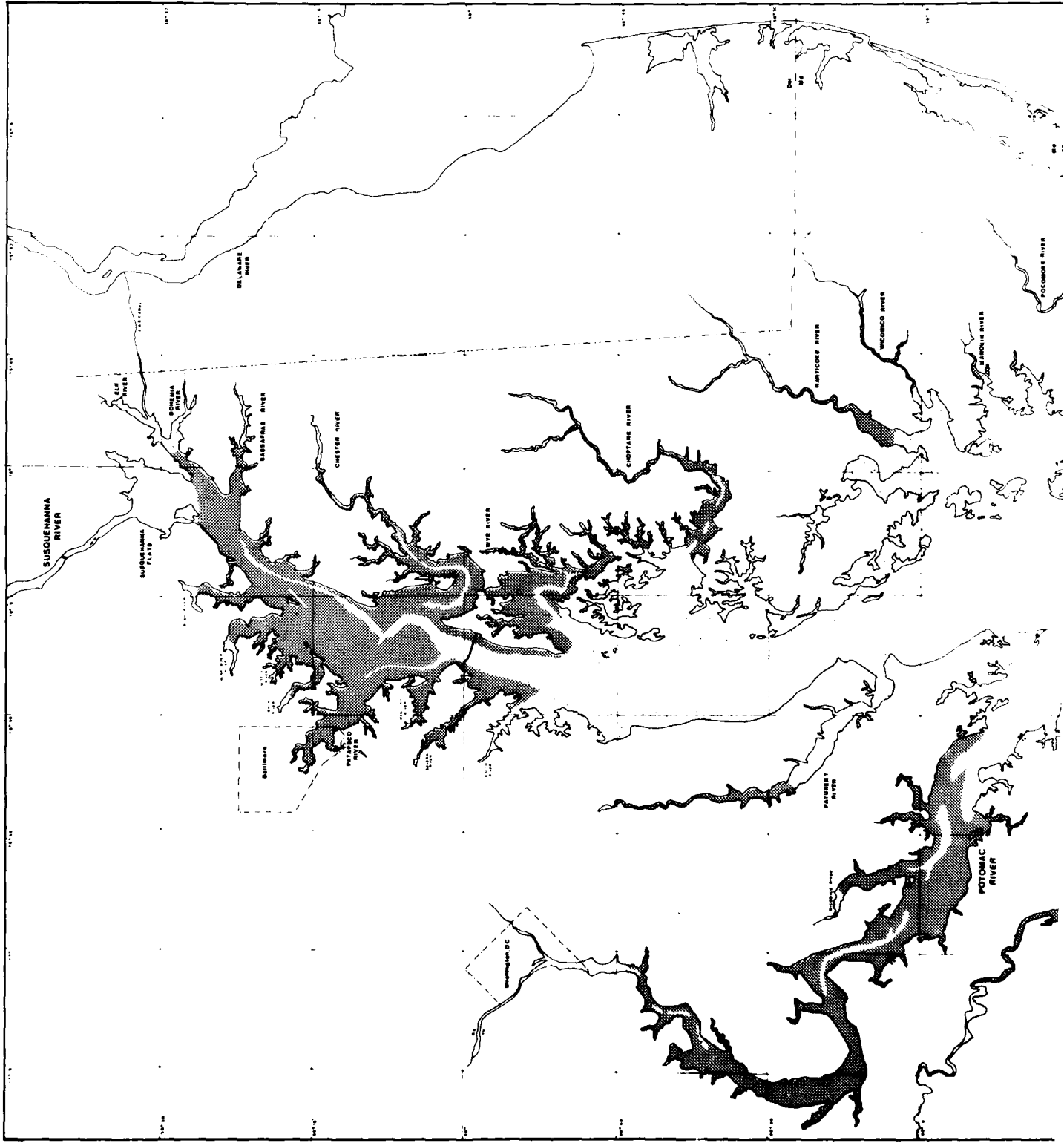
BASE DROUGHT

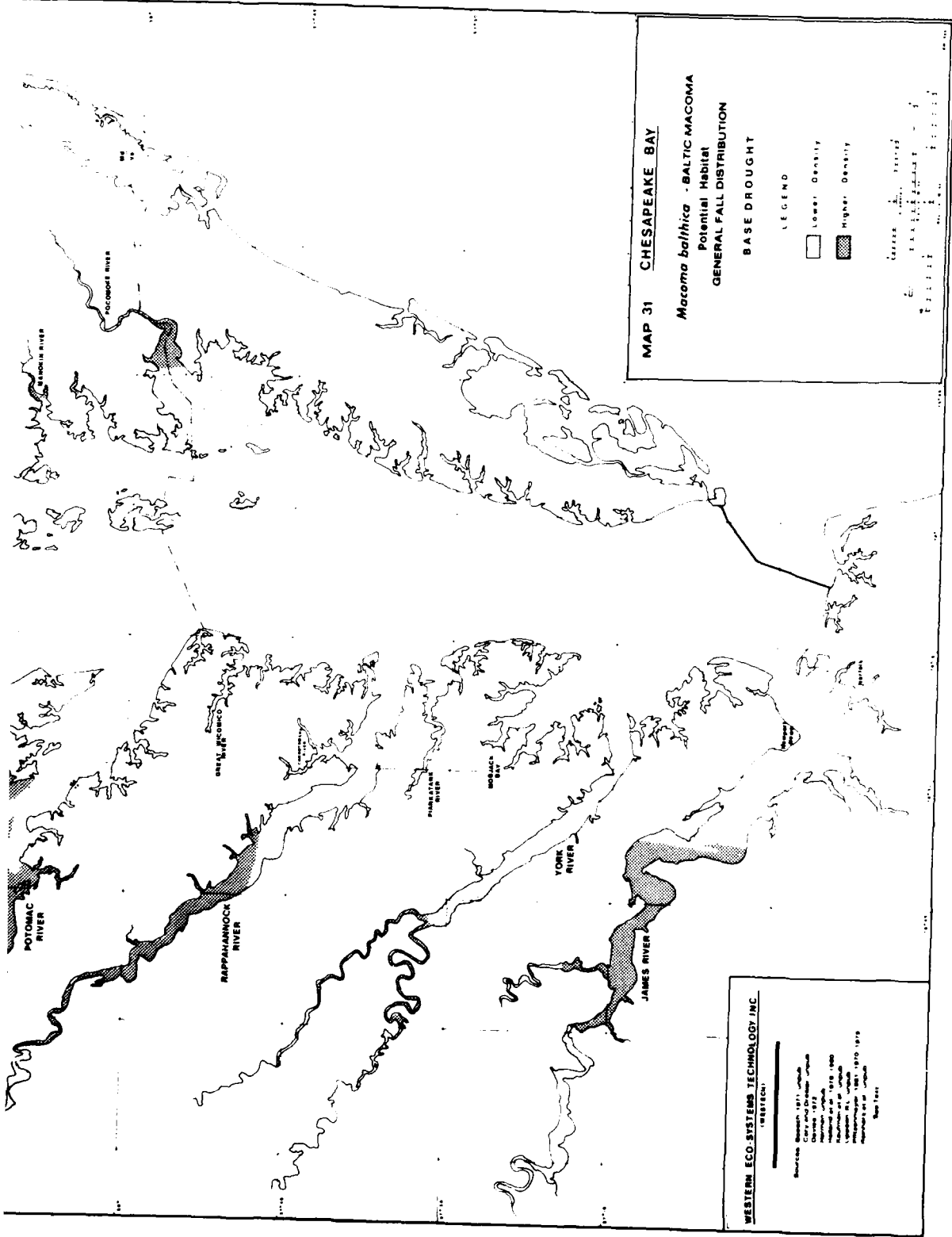
LEGEND

- ▨ General Distribution
- Oyster Parasites, MSX and Osimo
- Upstream extent of major impact area

WESTERN ECO-SYSTEMS TECHNOLOGY, INC.
(WESTECH)

Developed: April, 1986
 Approved: 1987
 Modified: 1987, 1988, 1979
 Revised: 1974
 Updated: 1974
 Updated: 1979





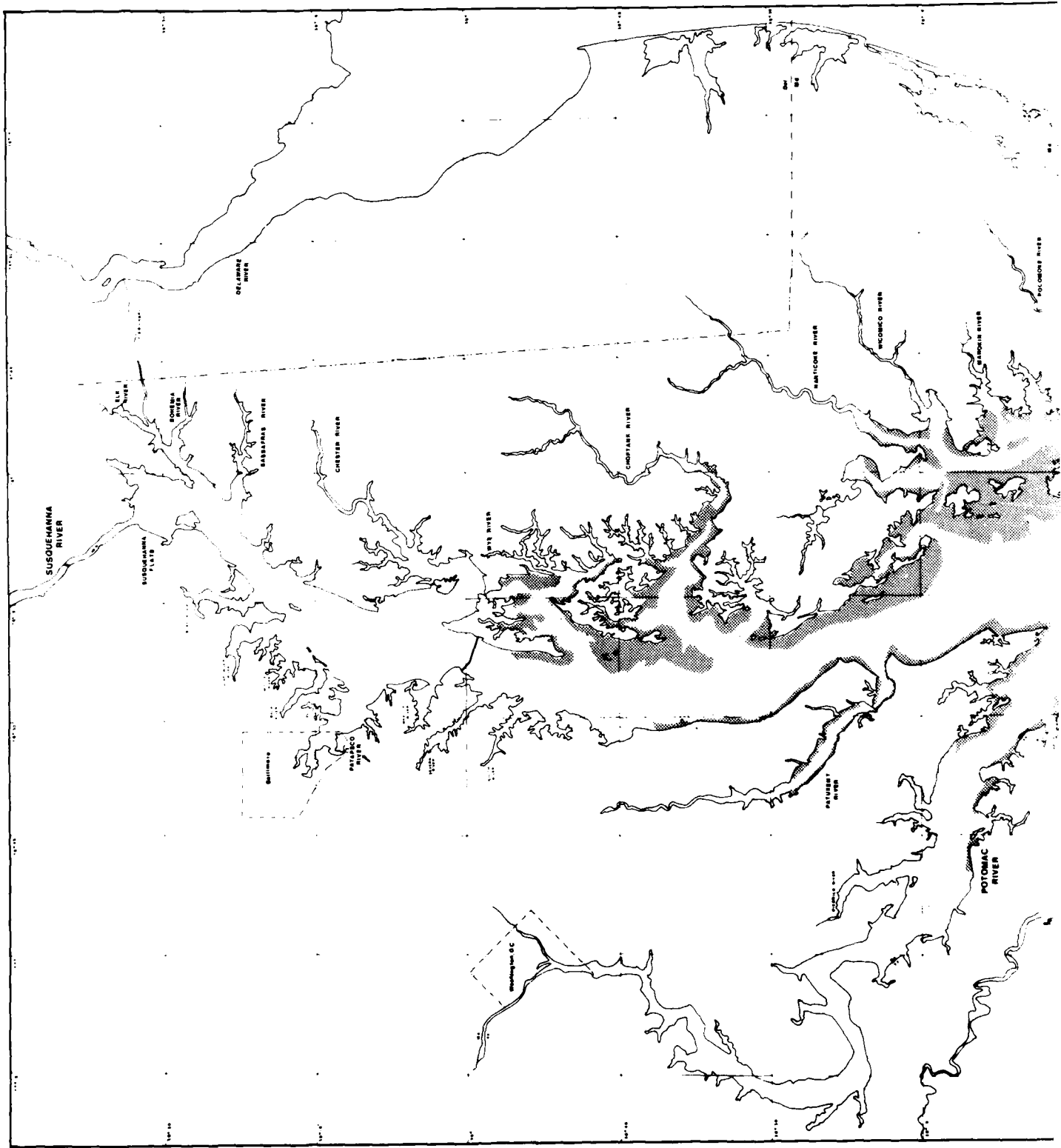
MAP 31 CHESAPEAKE BAY
Macoma balthica - BALTIC MACOMA
 Potential Habitat
 GENERAL FALL DISTRIBUTION
 BASE DROUGHT

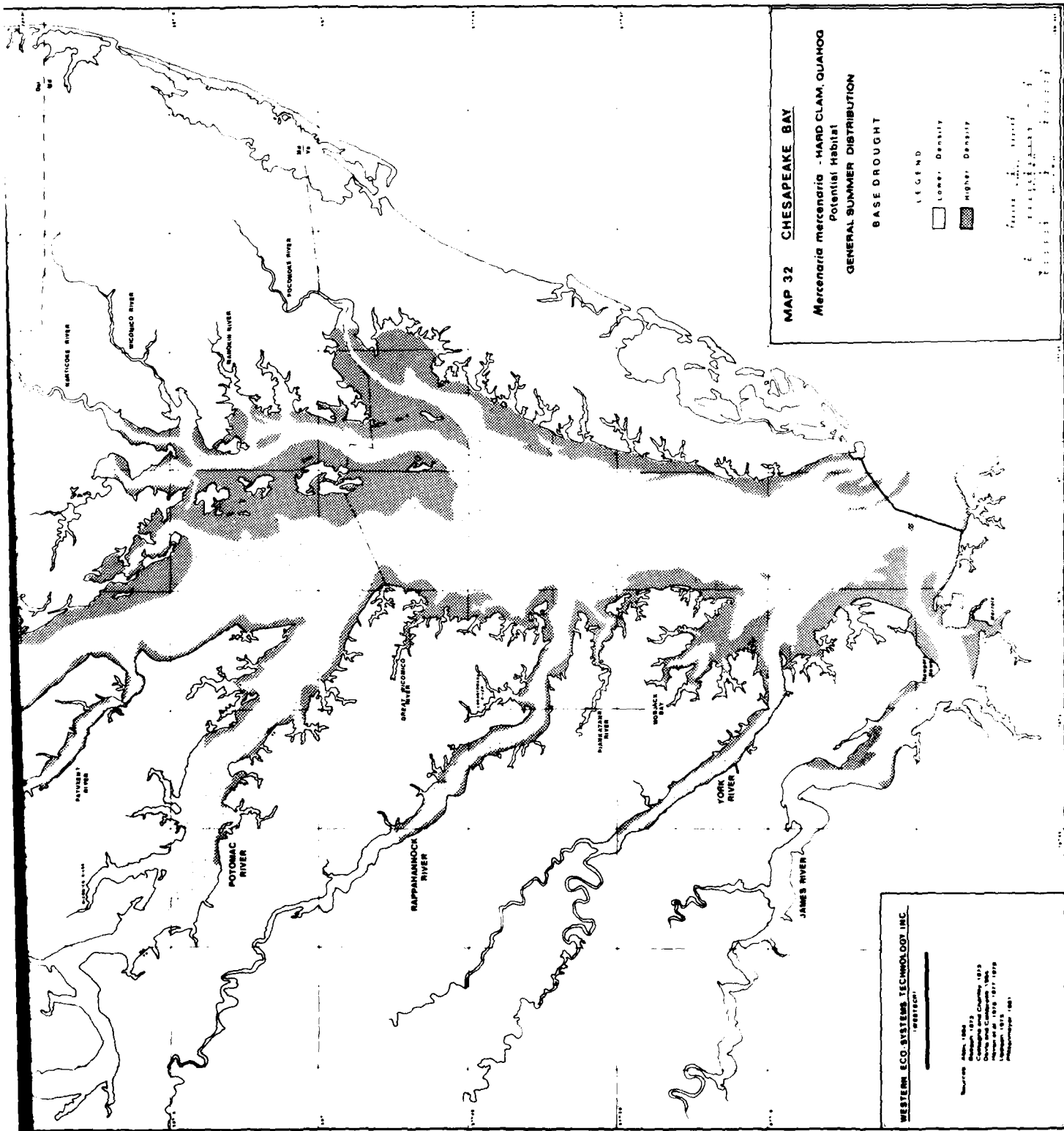
LEGEND
 Lower Density
 Higher Density

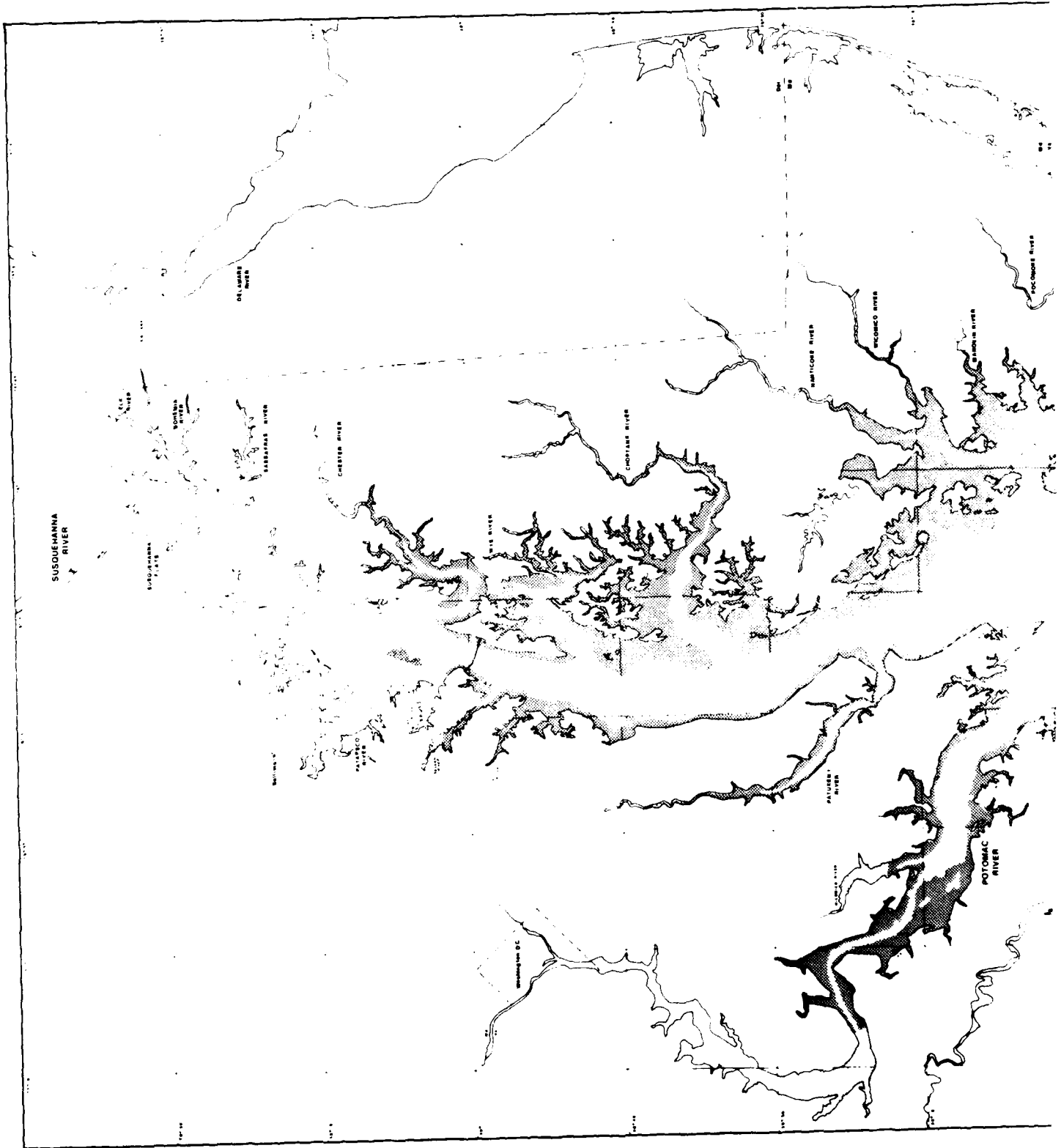
Scale: 0 100 Miles
 0 100 Kilometers

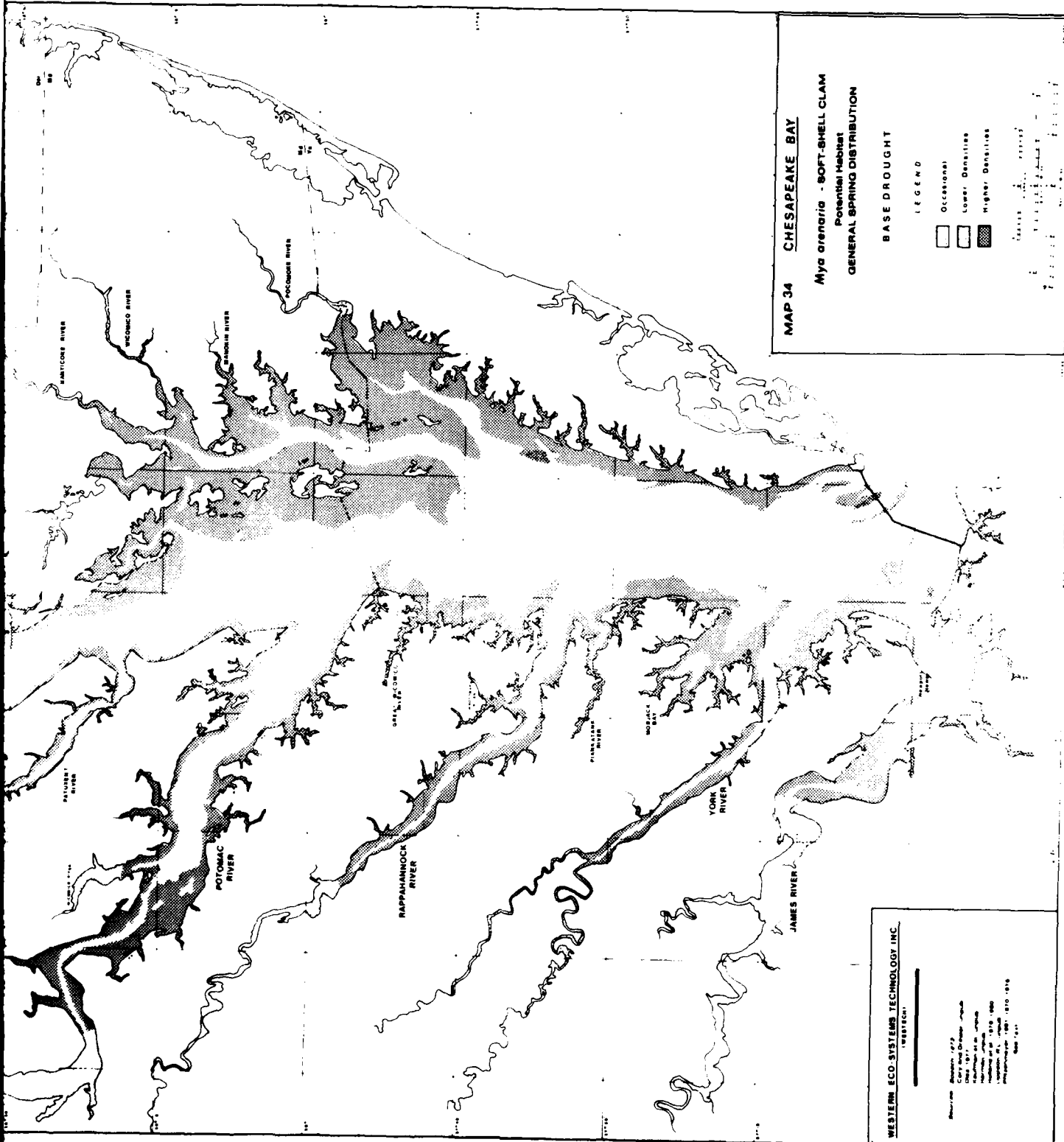
WESTERN ECO-SYSTEMS TECHNOLOGY INC.
 (WESTTECH)

San Francisco, California
 1000 California Street
 Suite 1000
 San Francisco, CA 94109
 Telephone: (415) 774-1000
 Telex: 251100
 Fax: (415) 774-1001









MAP 34 CHESAPEAKE BAY
Mya arenaria - SOFT-SHELL CLAM
 Potential Habitat
GENERAL SPRING DISTRIBUTION

BASE DROUGHT

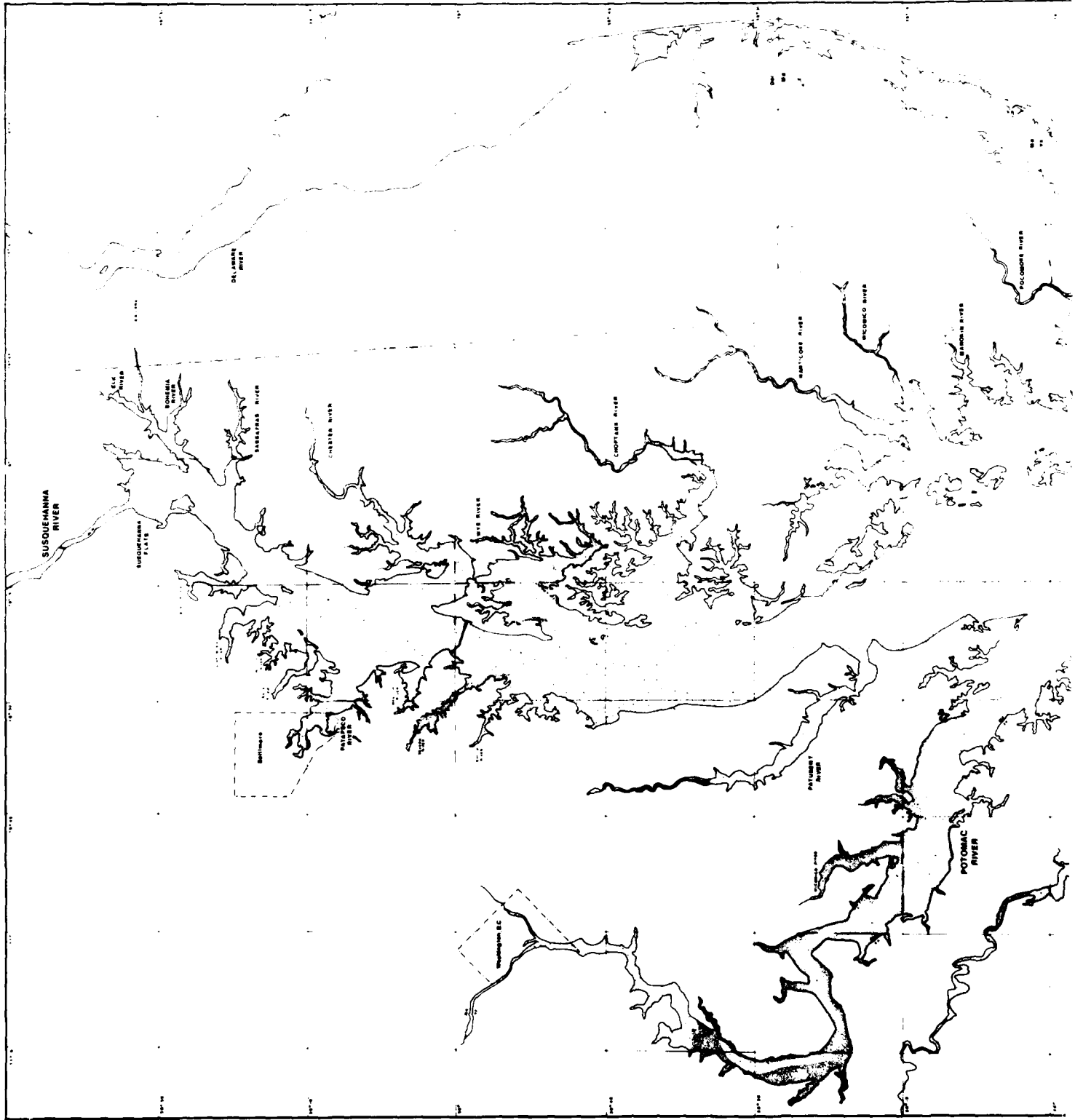
LEGEND

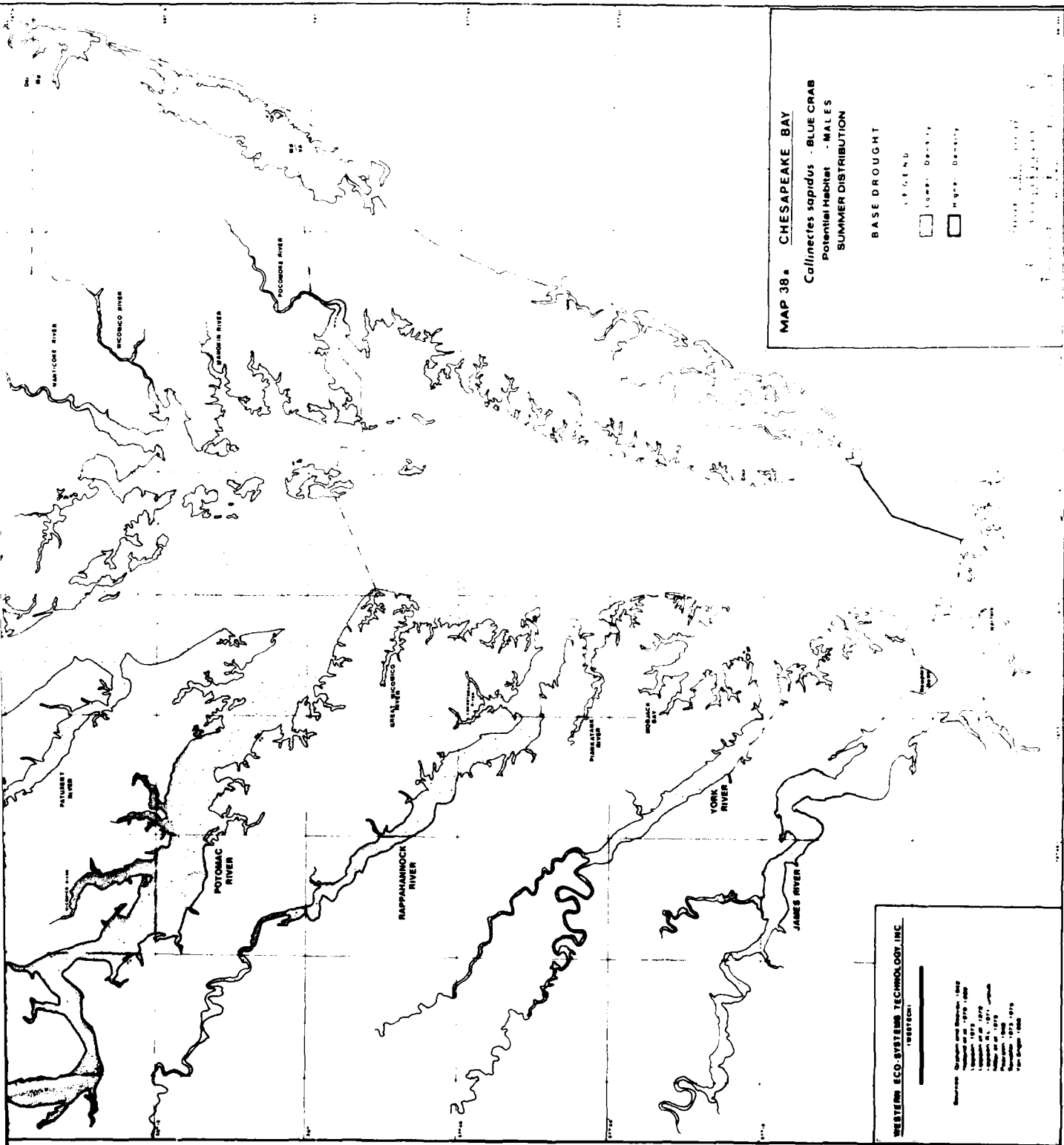
- Occasional
- ▨ Lower Densities
- ▩ Higher Densities

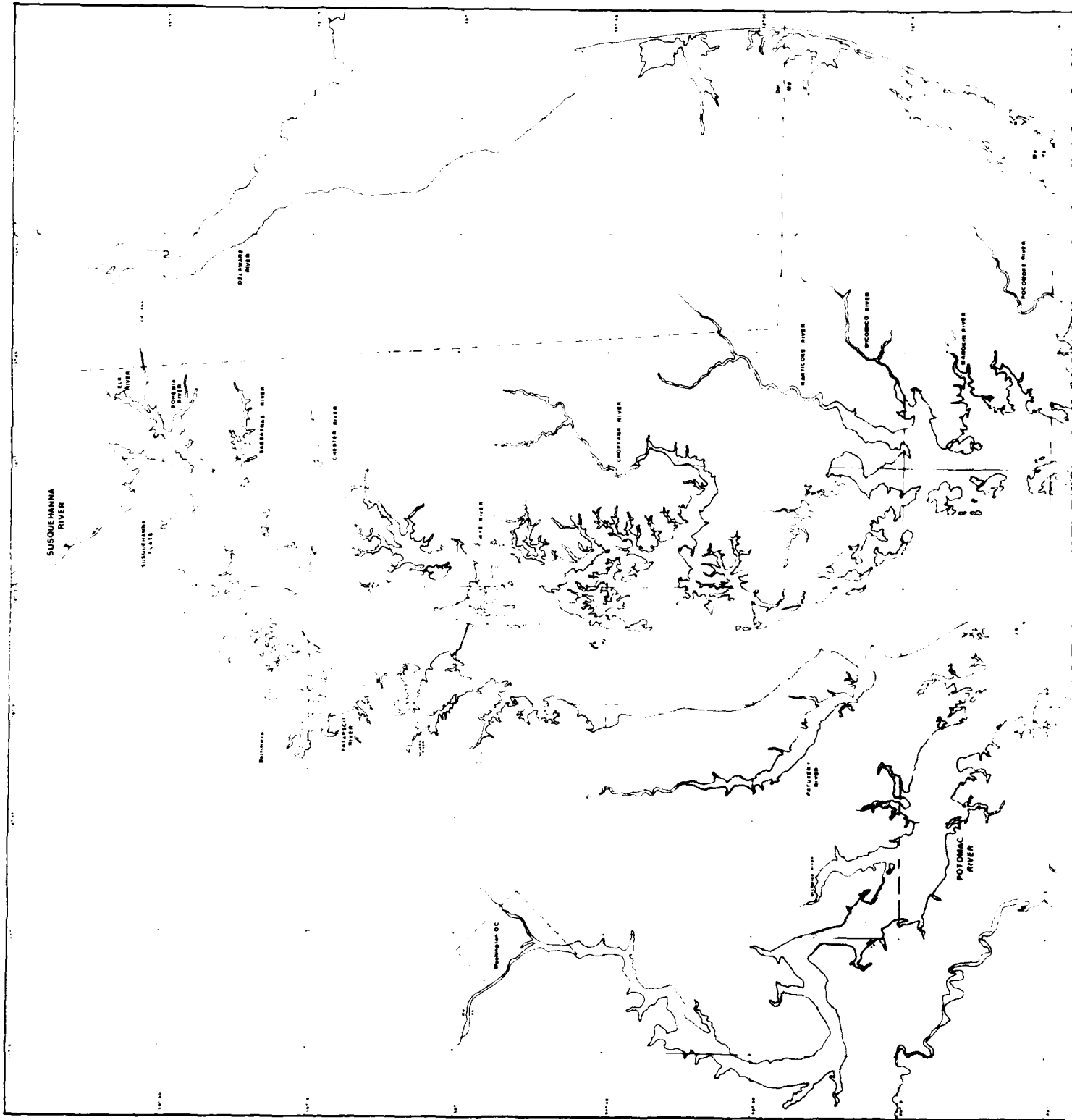
Scale: 1:50,000
 North Arrow

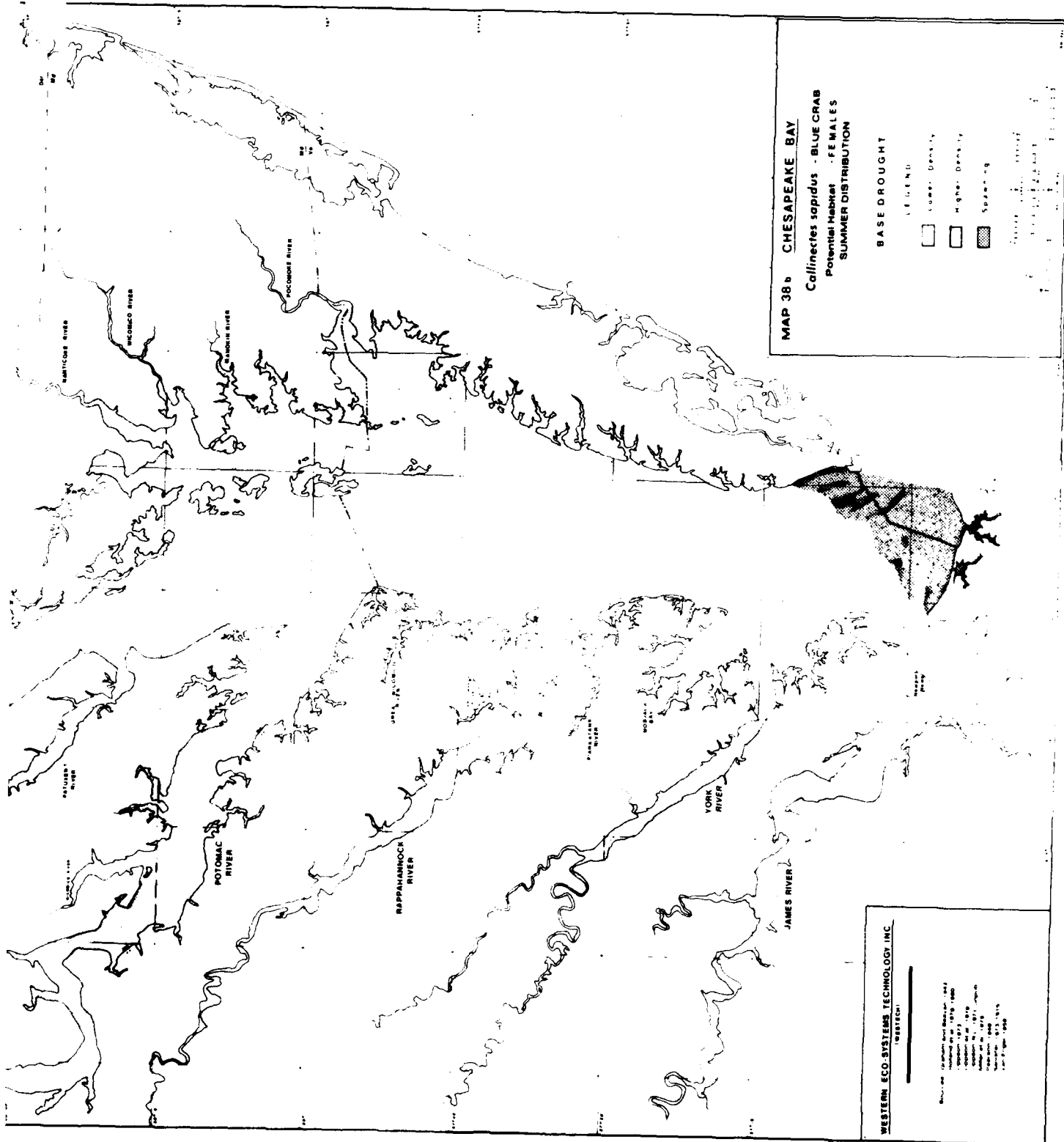
WESTERN ECO-SYSTEMS TECHNOLOGY, INC.
 MEMPHIS, TENN.

Prepared by: Robert L. Galt
 Date: 1977
 Project: Chesapeake Bay
 Contract: WET-77-010
 Date: 1977









MAP 38b CHESAPEAKE BAY
Callinectes sapidus - BLUE CRAB
 Potential Habitat - FE MALES
 SUMMER DISTRIBUTION

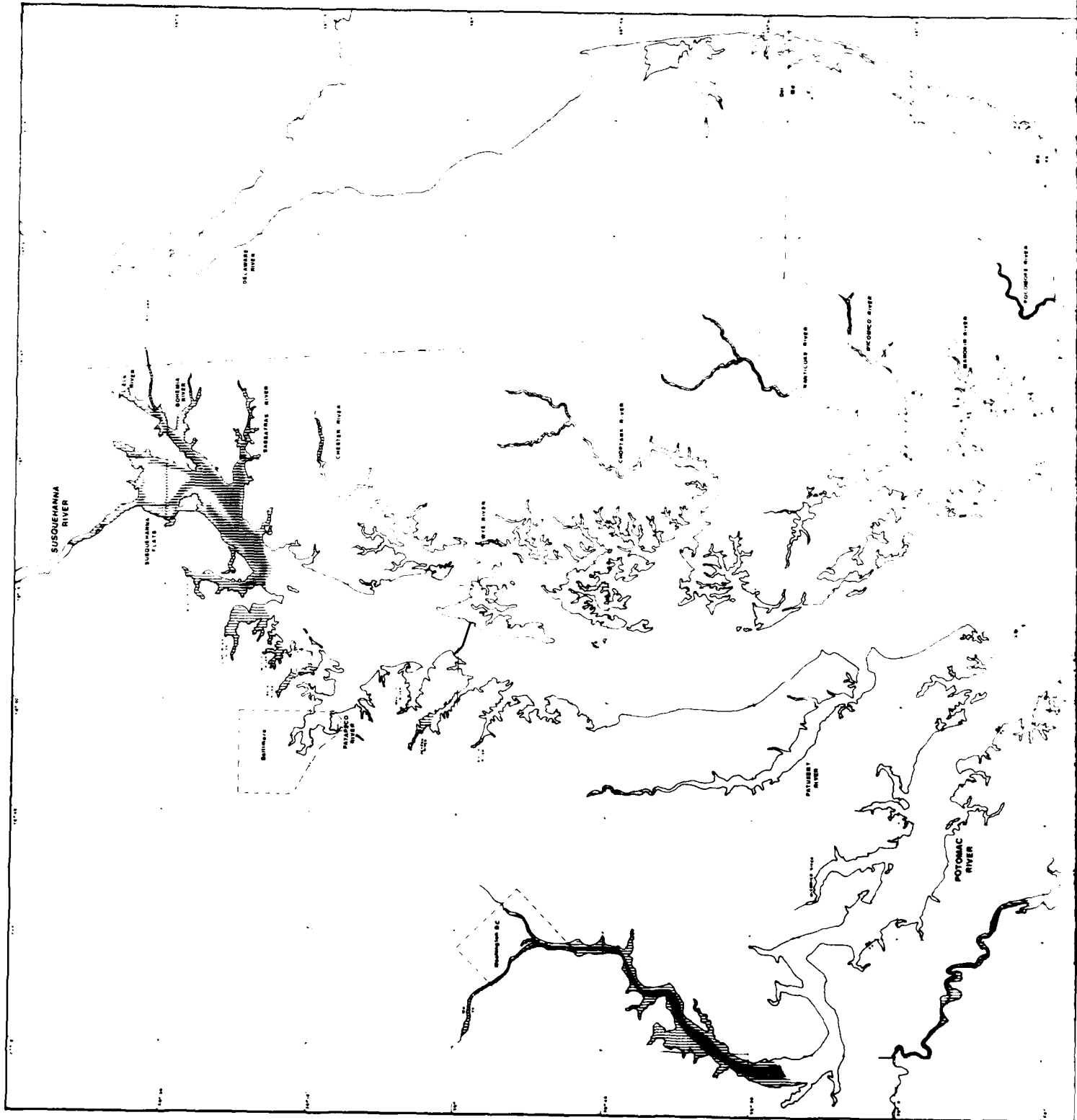
BASE DROUGHT

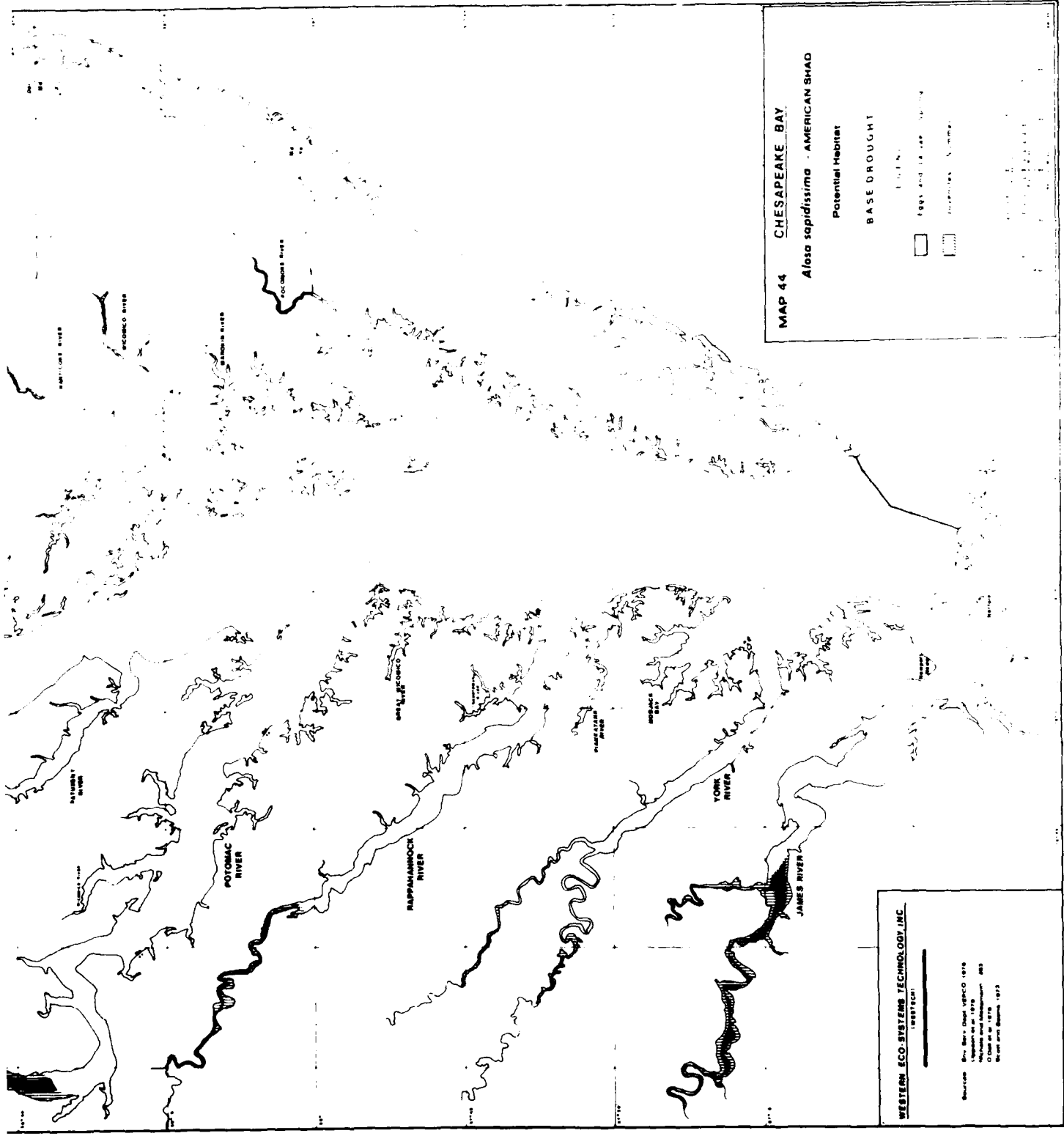
LEGEND

- None
- Lower Density
- Higher Density
- Spawning

WESTERN ECO-SYSTEMS TECHNOLOGY INC.
 (WESTECH)

10000 West 100th Street, Suite 100
 Overland Park, KS 66214
 Telephone: (913) 666-1000
 Telex: 157100
 Fax: (913) 666-1001
 Copyright © 1977, 1978, 1979
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MAP 44 CHESAPEAKE BAY
Alosa sapidissima - AMERICAN SHAD

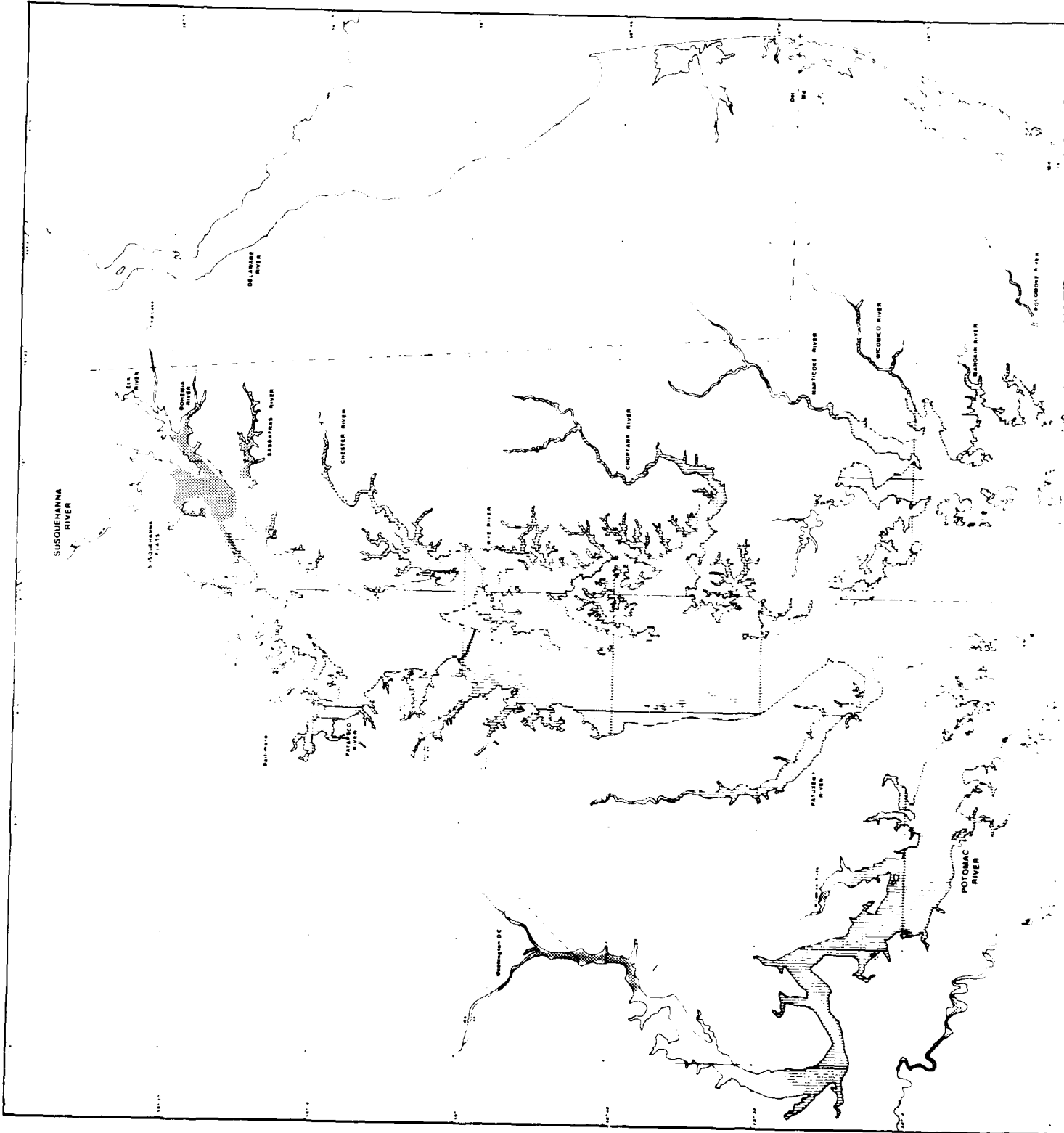
Potential Habitat
 BASE DROUGHT

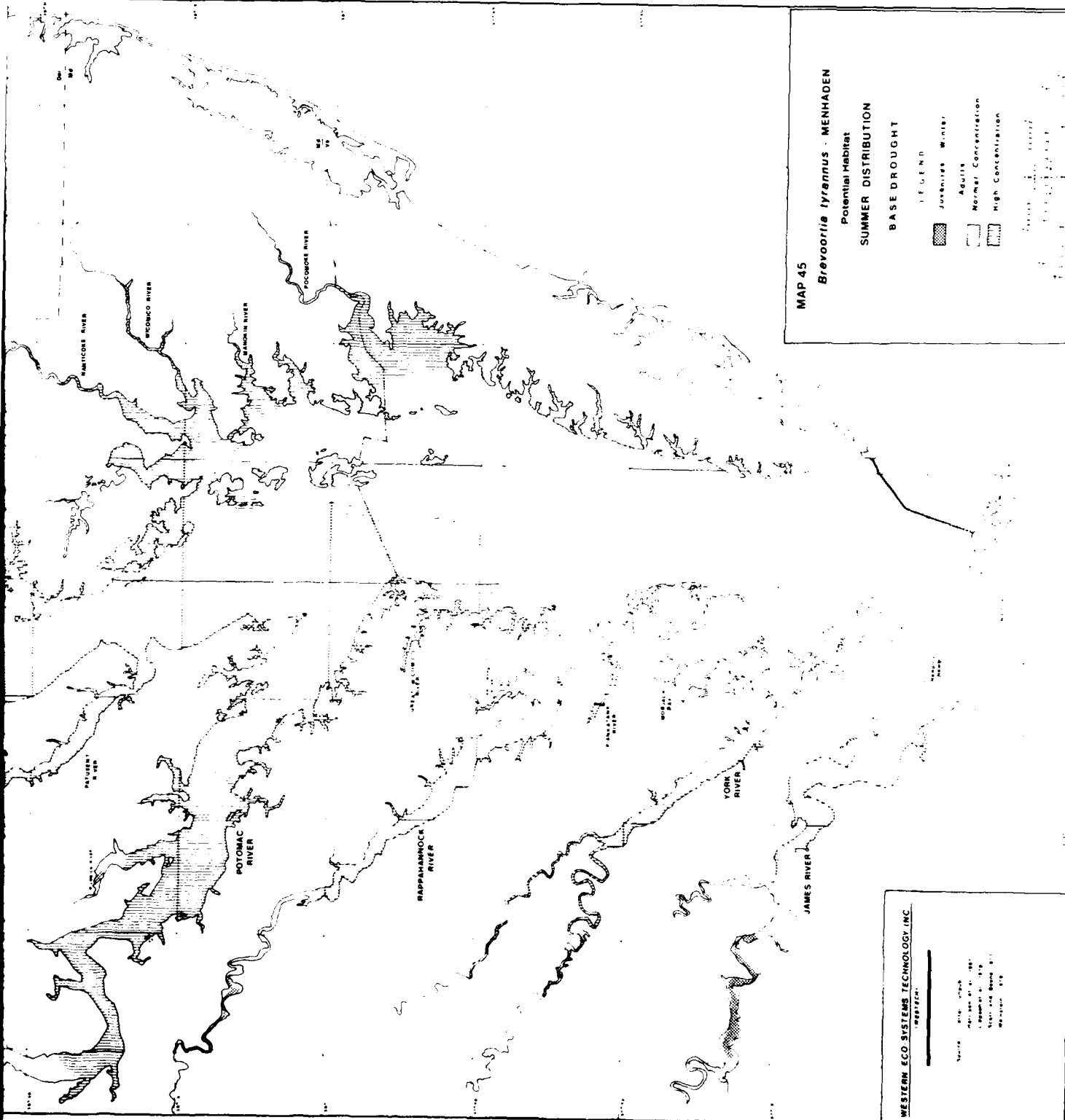
1:10,000
 1981 AND 1982 DATA

Legend:
 [Solid Line] Potential Habitat
 [Dashed Line] Base Drought

WESTERN ECO-SYSTEMS TECHNOLOGY, INC.
 WESTECH

Source: U.S. Fish and Wildlife Service
 1978
 1981
 1982
 1983
 1984





MAP 45
Brevoortia tyrannus - MENHADEN
 Potential Habitat
 SUMMER DISTRIBUTION

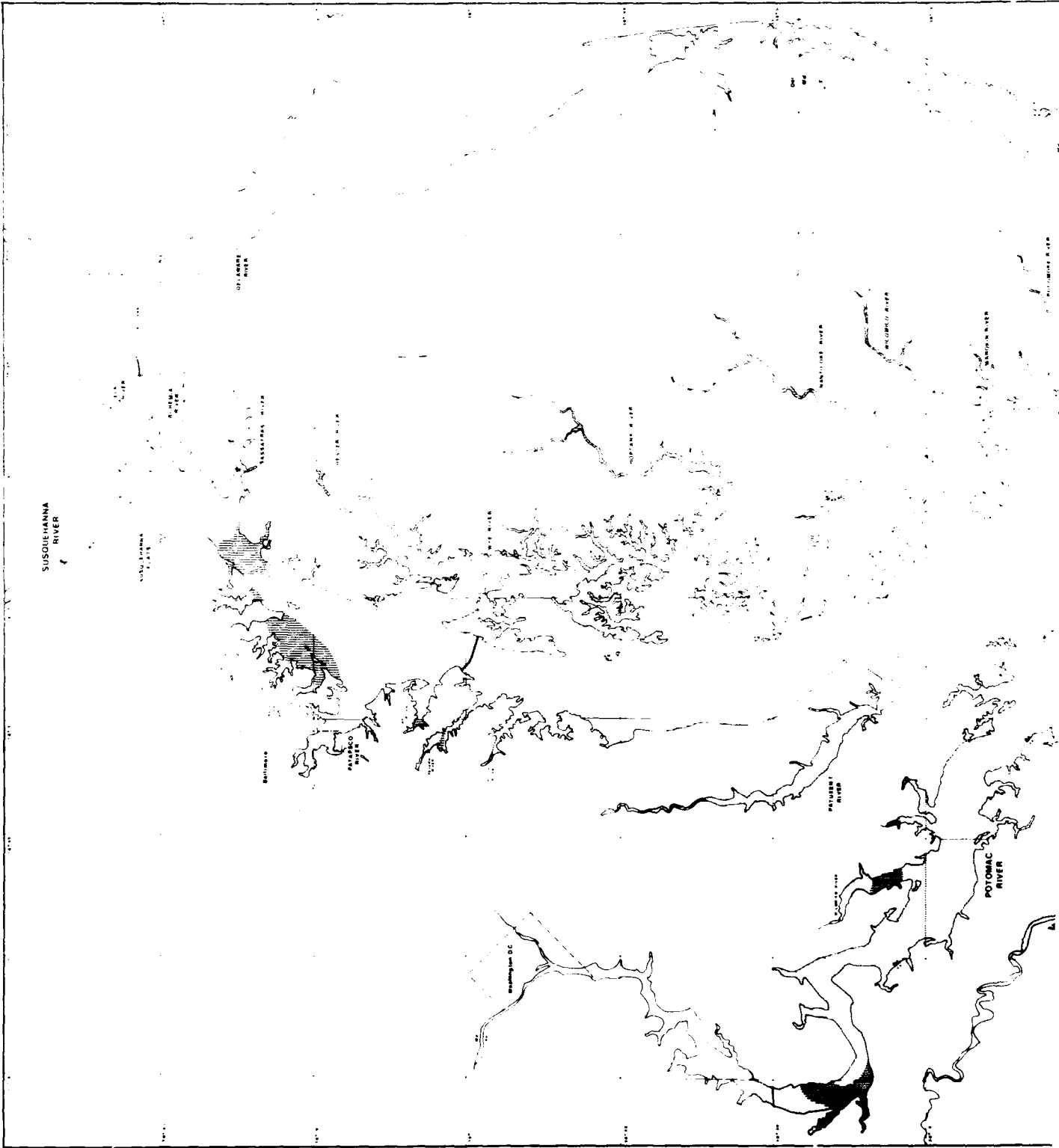
BASE DROUGHT

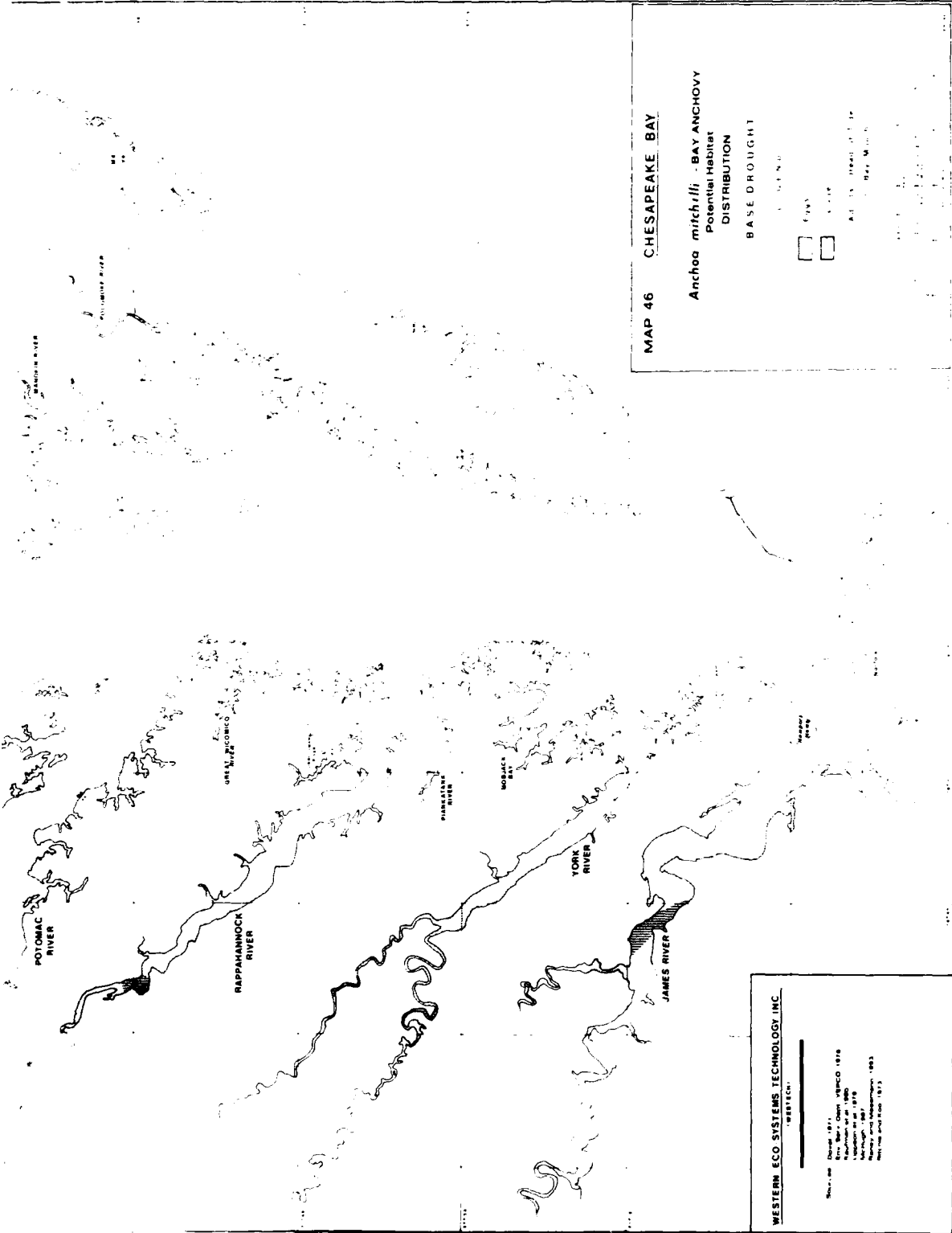
LEGEND

- Juveniles
- Adults
- Normal Concentration
- High Concentration

Scale: 1:50,000
 Date: 1978
 Author: [illegible]

WESTERN ECO SYSTEMS TECHNOLOGY INC.
 10000
 10000
 10000
 10000
 10000





MAP 46 CHESAPEAKE BAY

Anchoa mitchilli - BAY ANCHOVY
Potential Habitat
DISTRIBUTION
BASE DROUGHT

Legend

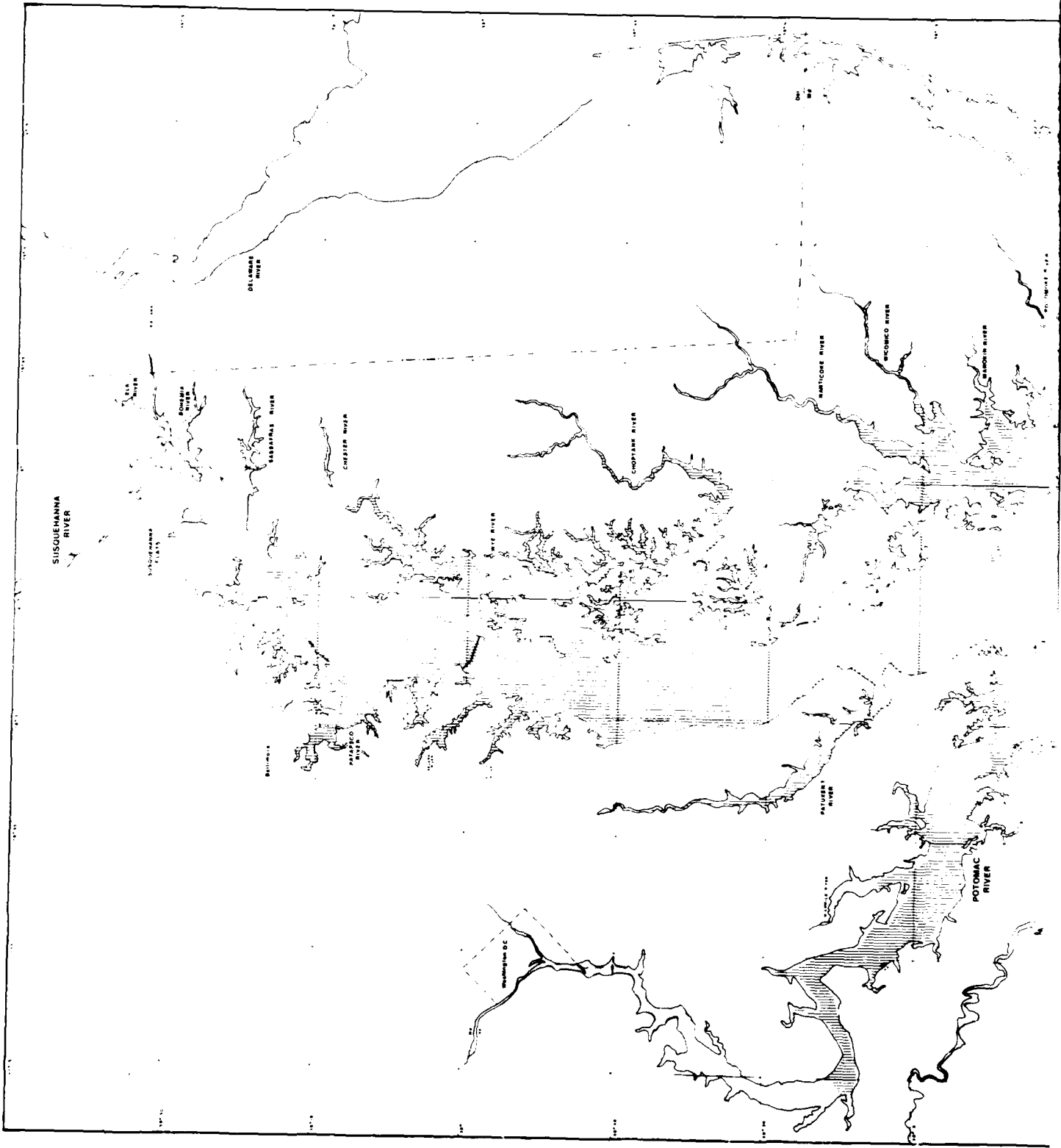
[Shaded Area] POTENTIAL HABITAT

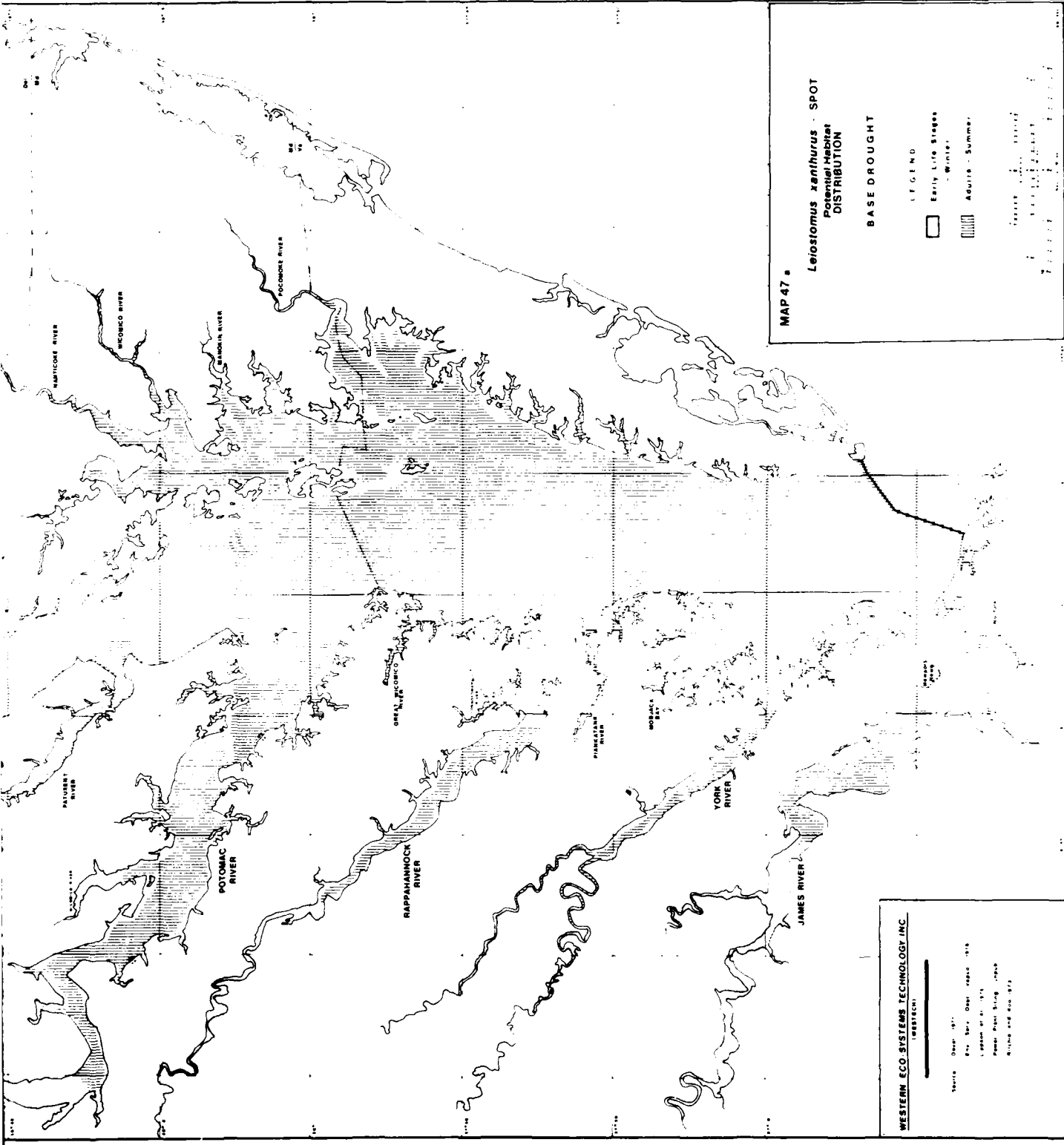
[Hatched Area] BASE DROUGHT

Scale: 1:50,000
North Arrow

WESTERN ECO SYSTEMS TECHNOLOGY INC.
"WESTECH"

Developed by
Dr. Robert C. Clarke
Dr. Robert C. Clarke
Landscape Architect
Washington, D.C. 20004





MAP 47

Leiostomus xanthurus - SPOT
Potential Habitat
DISTRIBUTION

BASE DROUGHT

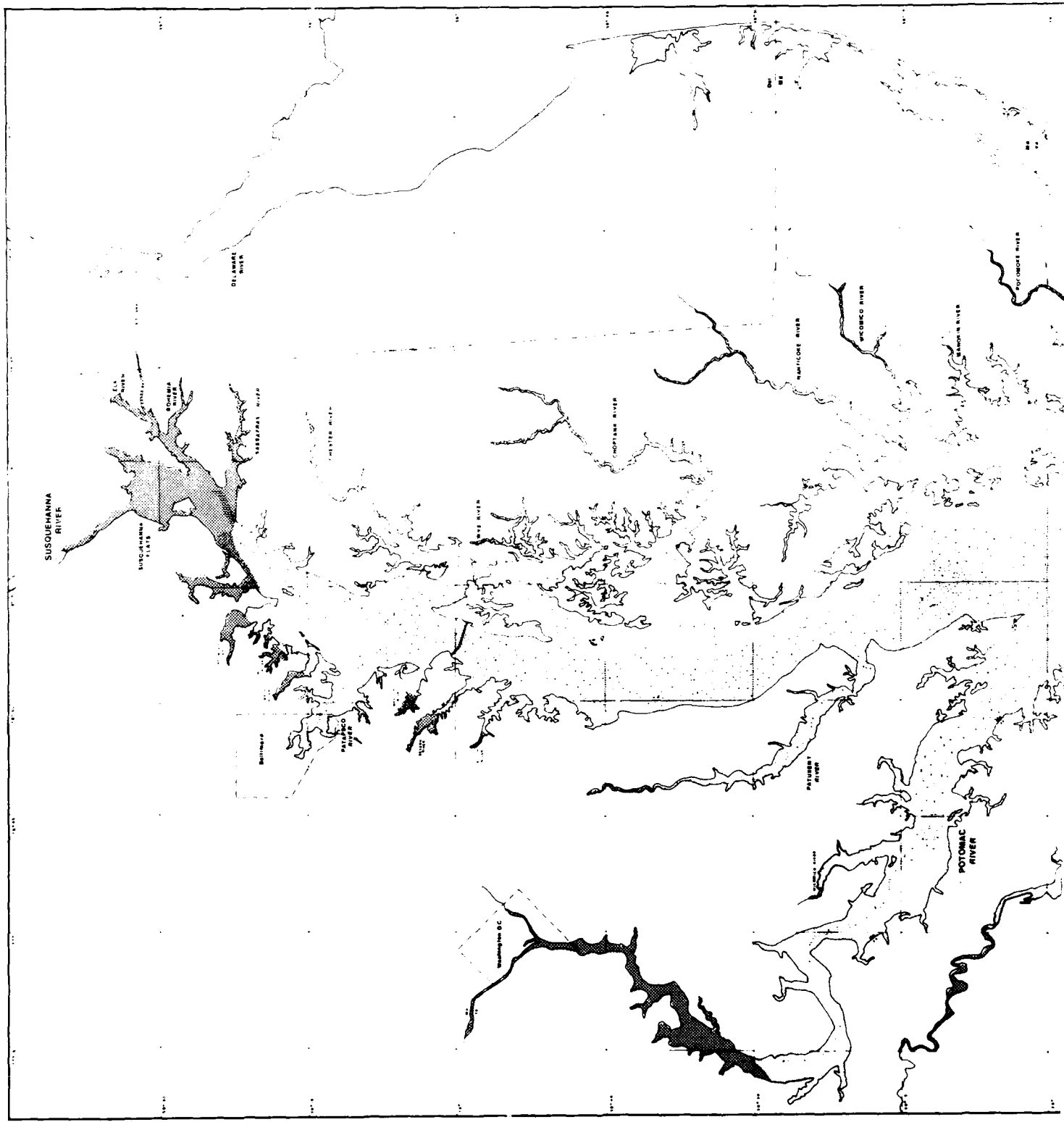
LEGEND

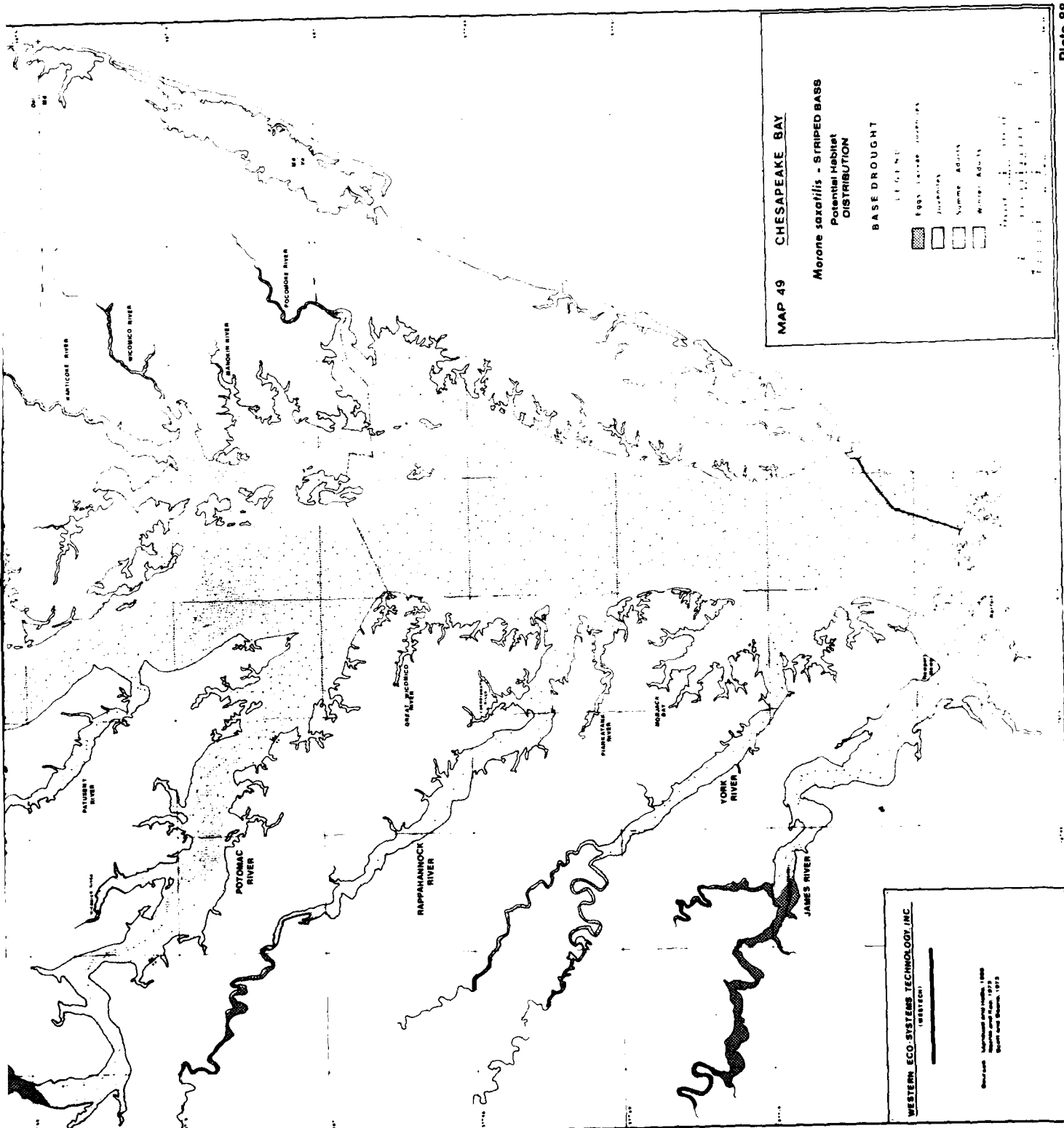
- Early Life Stages
- ▨ Winter
- ▩ Adults - Summer

Scale: 1:50,000
 0 1 2 3 4 5 Miles
 0 1 2 3 4 5 Kilometers

WESTERN ECO SYSTEMS TECHNOLOGY, INC.
 (ESESTECH)

Source: Olson, 1977
 Ely, 1971; Olson, 1968; 1978
 Lippman et al., 1971
 Penna, 1961; King, 1968
 Ritchie and Olson, 1973





MAP 49 CHESAPEAKE BAY

Morone saxatilis - STRIPED BASS
Potential Habitat
DISTRIBUTION

BASE DROUGHT

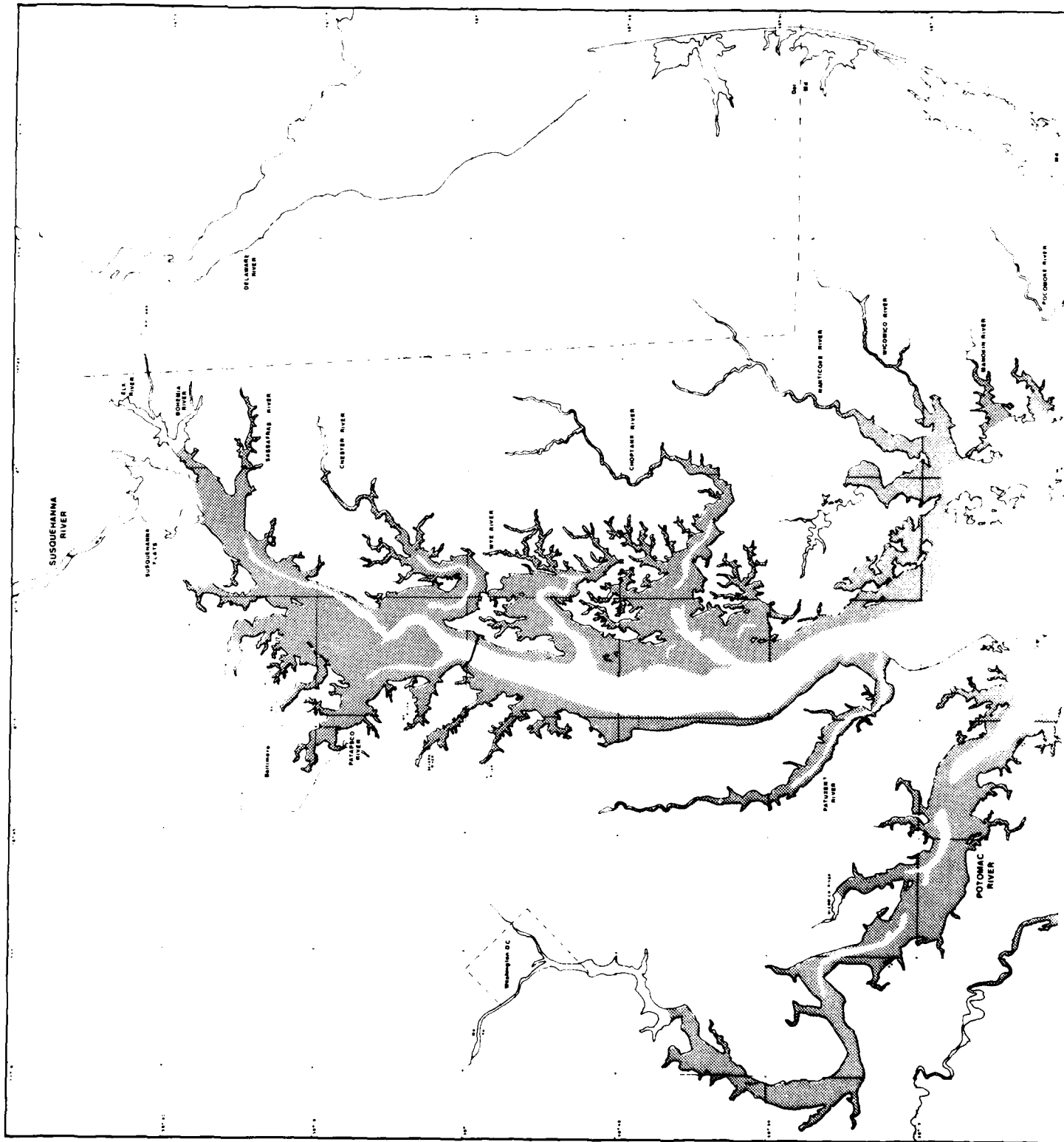
LEGEND

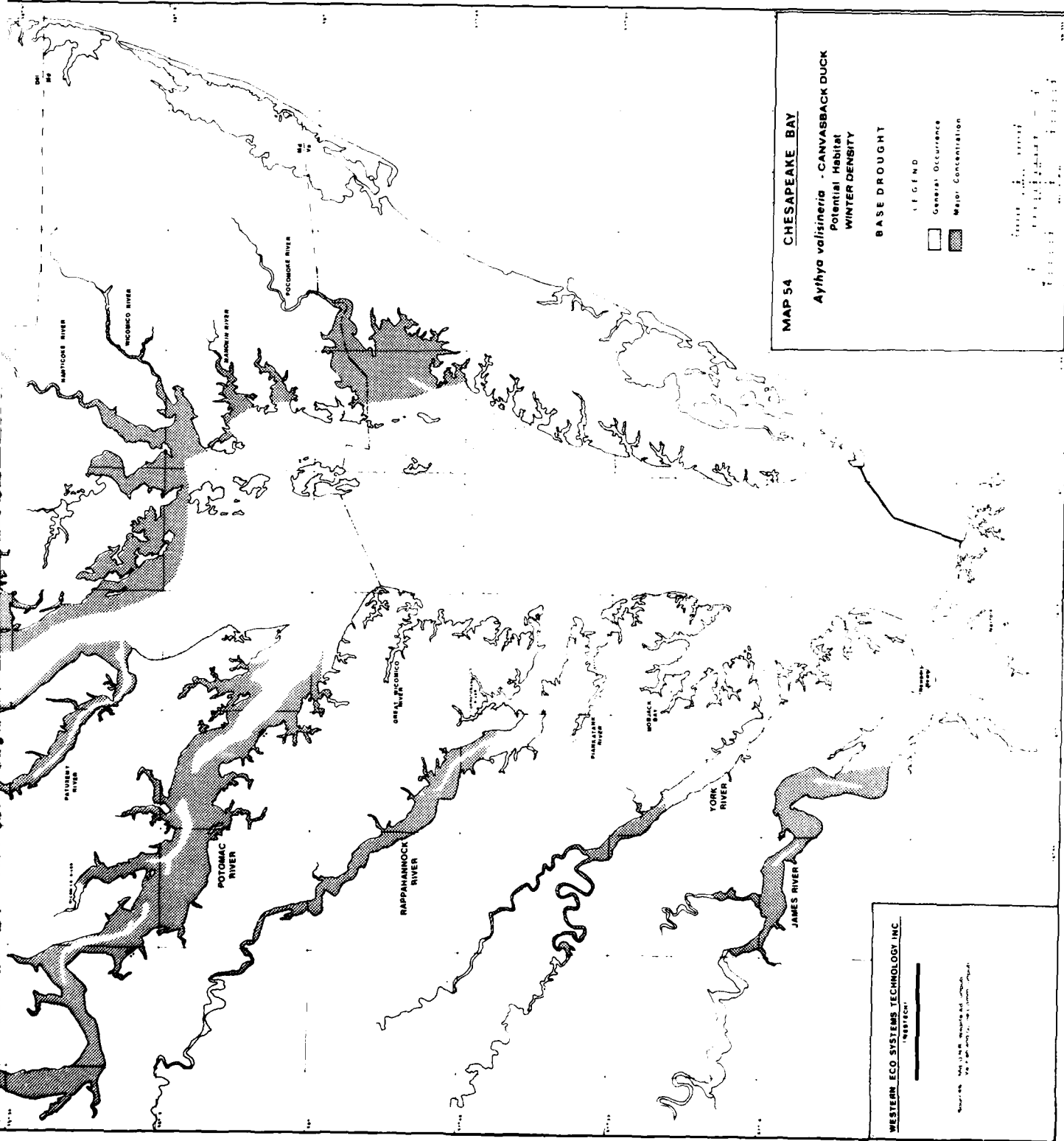
- Egg Larvae
- Juveniles
- ▨ Summer Adults
- ▩ Winter Adults

Scale: 1:50,000
NAD 83

WESTERN ECO-SYSTEMS TECHNOLOGY, INC.
(WESTECH)

Contract: Habitat and Distribution Study
for the Chesapeake Bay
October 1990 - February 1993



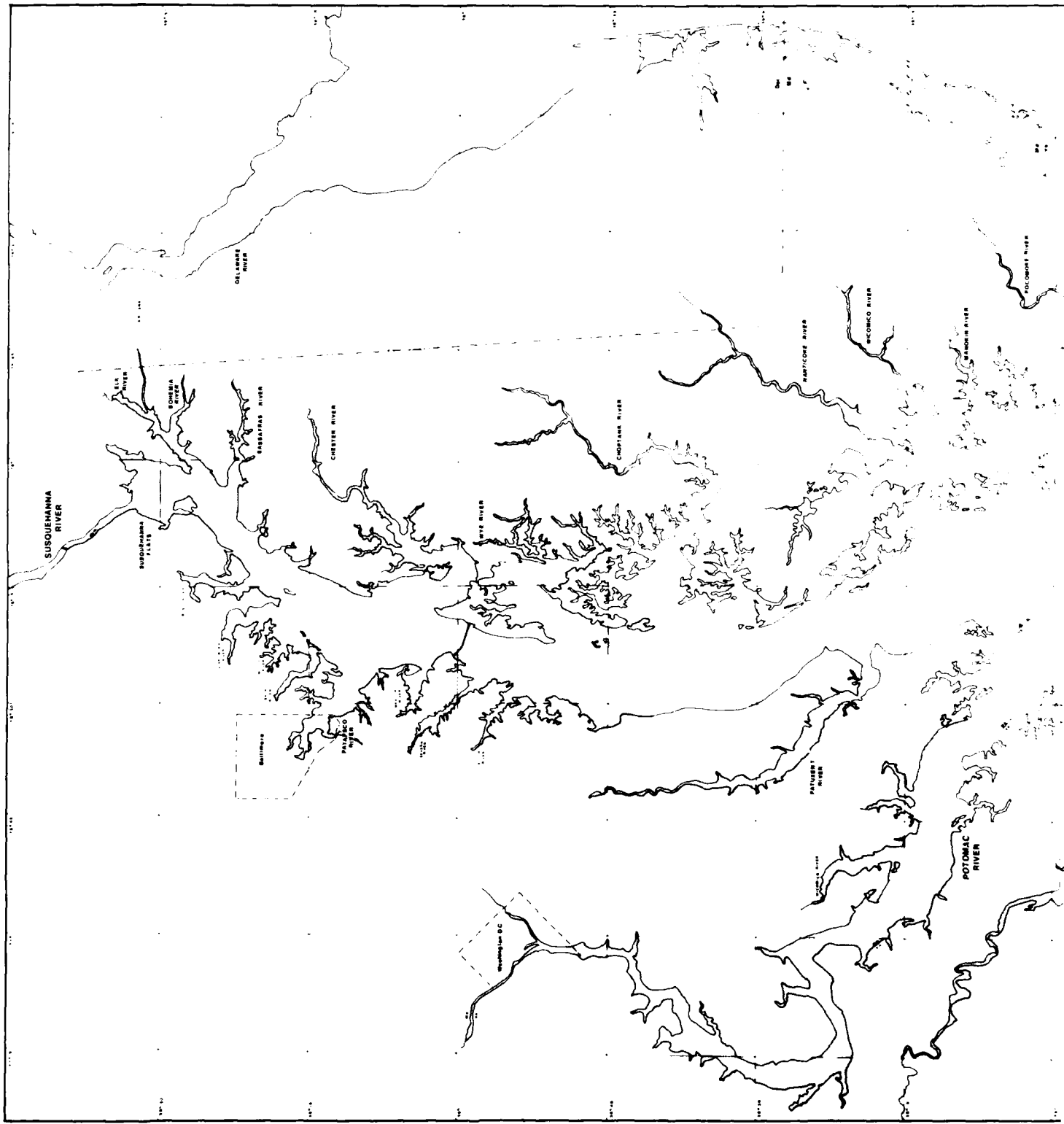


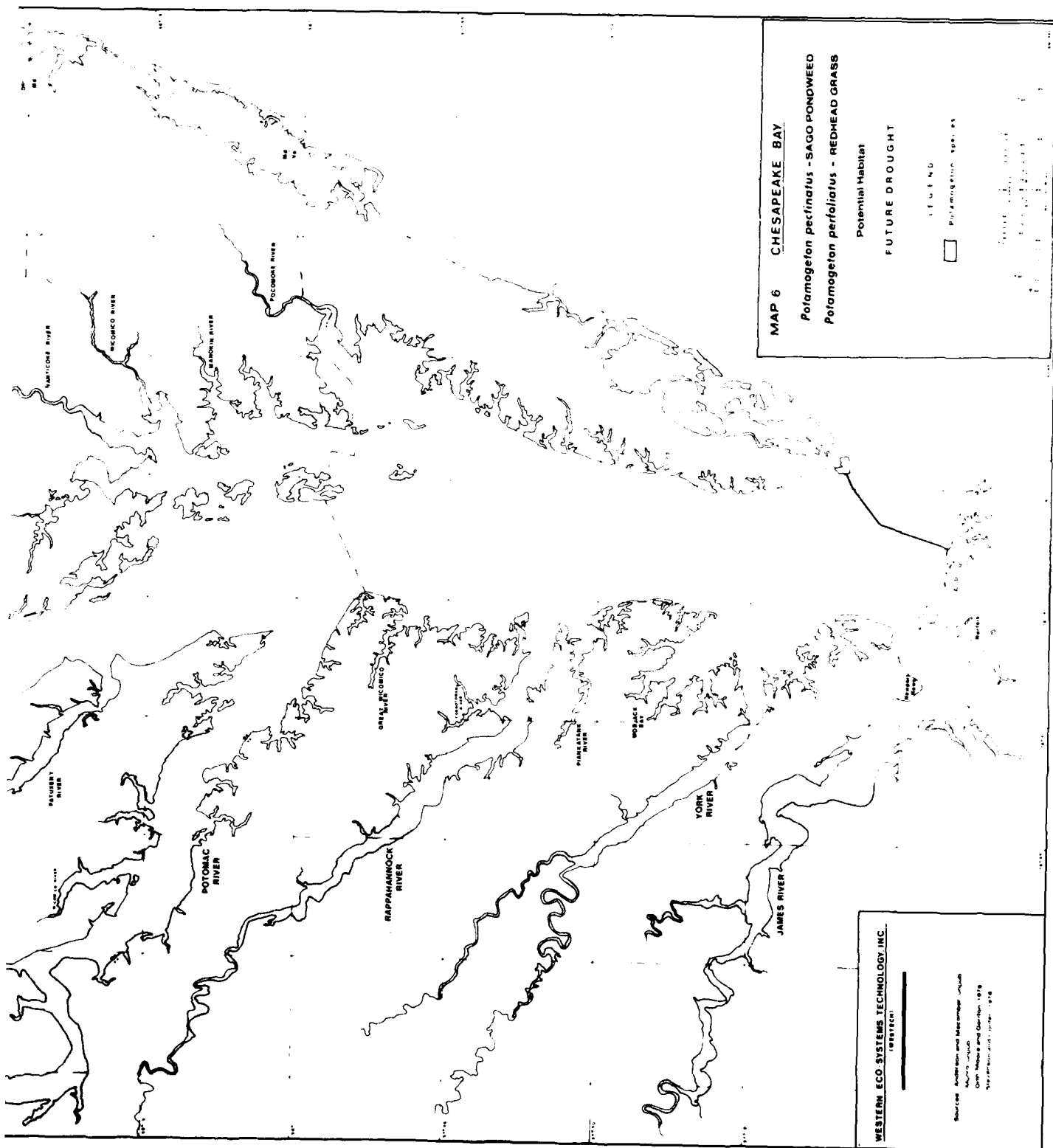
MAP 54 CHESAPEAKE BAY
Aythya valisineria - CANVASBACK DUCK
 Potential Habitat
 WINTER DENSITY
 BASE DROUGHT

LEGEND
 General Occurrence
 Major Concentration

Scale: 1:50,000
 0 1 2 3 4 5 Miles
 0 1 2 3 4 5 Kilometers

WESTERN ECO SYSTEMS TECHNOLOGY INC.
 14575 145th Ave.
 Redmond, WA 98073
 (509) 881-1111





MAP 6 CHESAPEAKE BAY

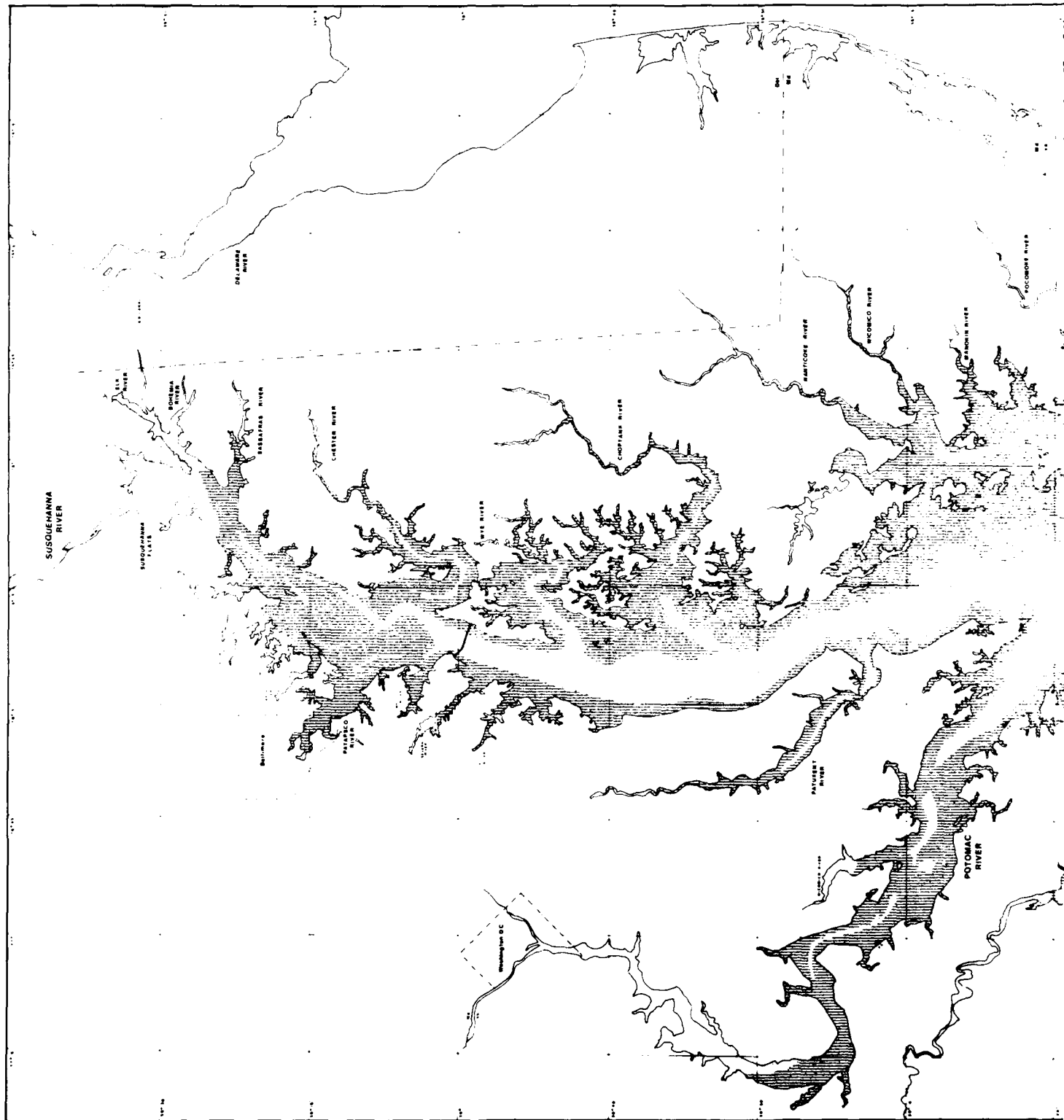
Potamogeton pectinatus - SAGO PONDWEED
Potamogeton perfoliatus - REDHEAD GRASS

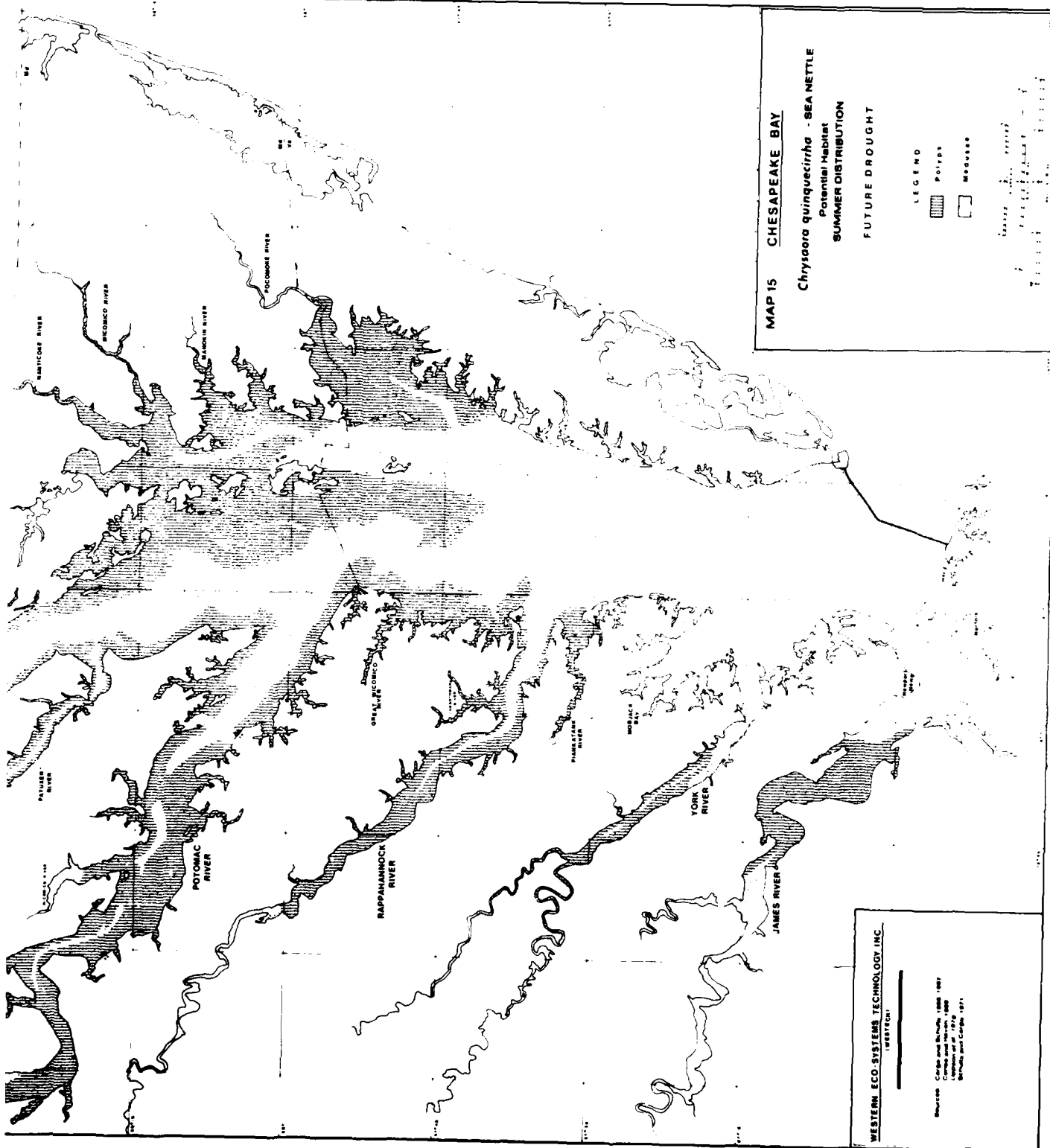
Potential Habitat
 FUTURE DROUGHT

LEGEND
 [Symbol] *Potamogeton* spp., etc.

WESTERN ECO SYSTEMS TECHNOLOGY, INC.
 (ESTETECH)

Source: Audubon and Migratory Birds
 Survey, 1974
 Data: Rogers and Gardner, 1979
 Distribution and Abundance, 1978





MAP 15 CHESAPEAKE BAY

***Chrysoora quinquecirrha* - SEA NETTLE**
 Potential Habitat
SUMMER DISTRIBUTION

FUTURE DROUGHT

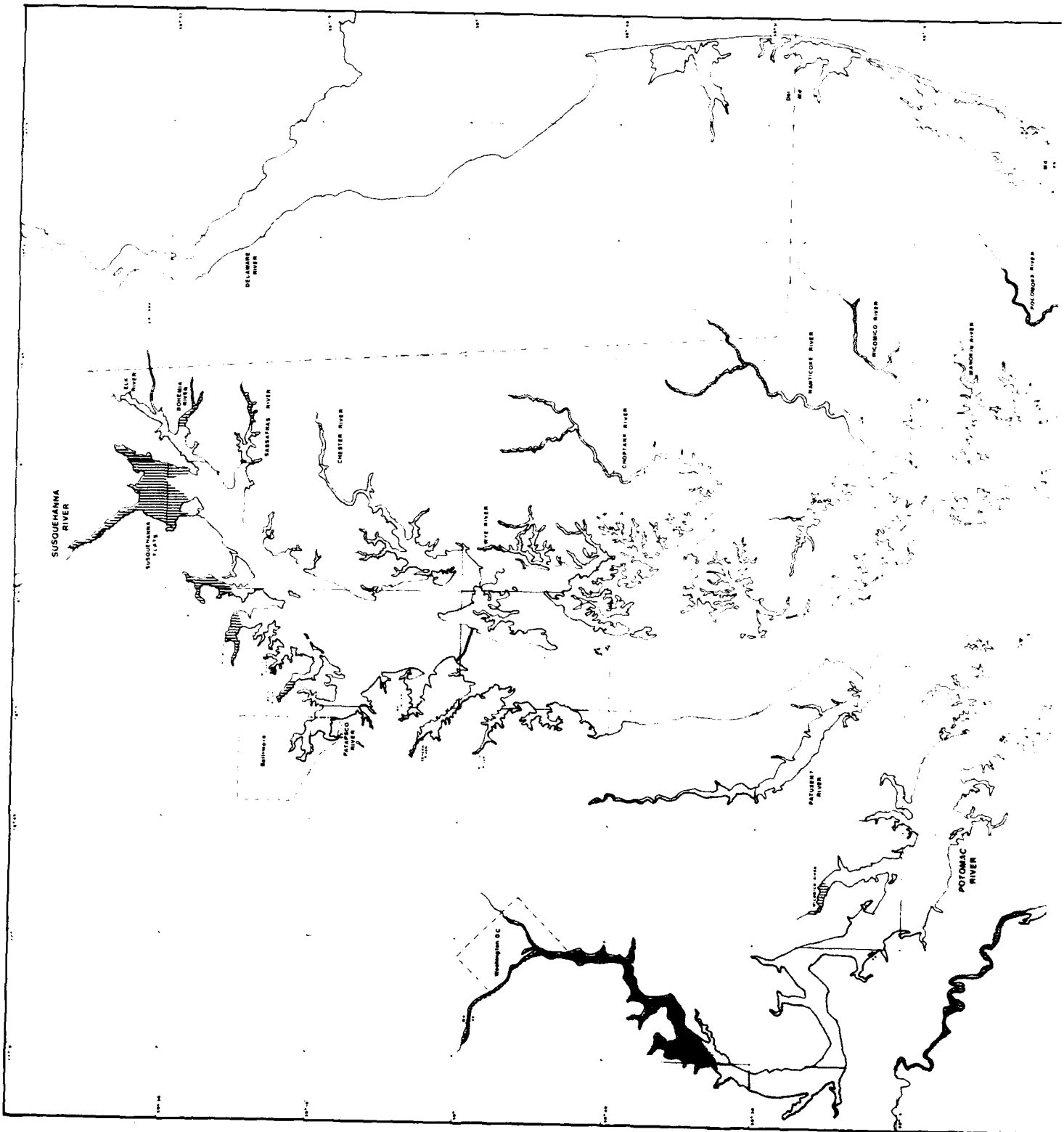
LEGEND

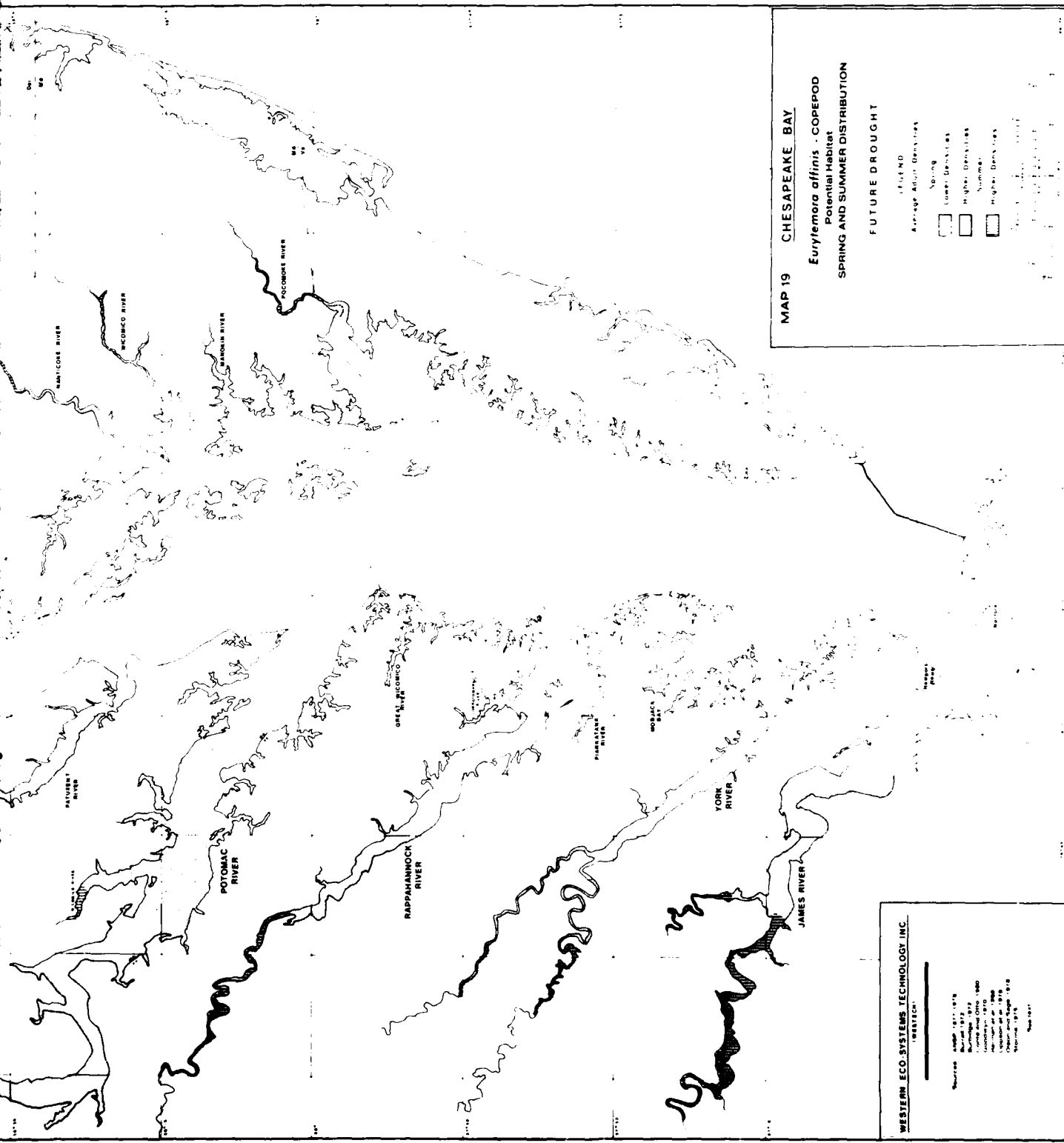
Potential Habitat
 Future Drought

Scale: 1:50,000
 Date: 1987
 Project: Chesapeake Bay
 Author: WETECH

WESTERN ECO SYSTEMS TECHNOLOGY INC.
 WETECH

Sources: Clarke and Blanton, 1988, 1987
 Clarke and Blanton, 1988
 Clarke et al., 1989
 Clarke and Blanton, 1991





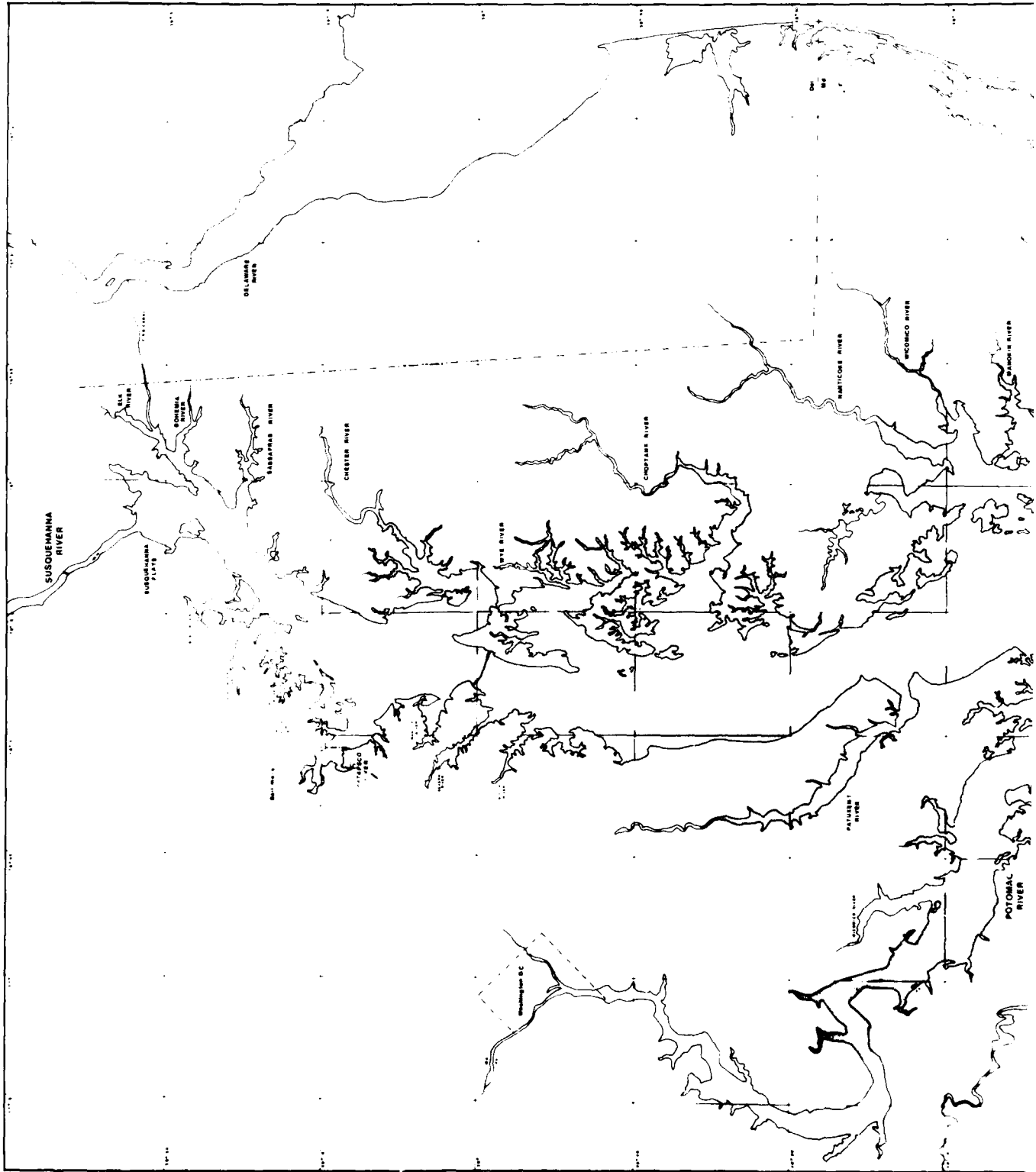
MAP 19 CHESAPEAKE BAY
Eurytemora affinis - COPEPOD
 Potential Habitat
 SPRING AND SUMMER DISTRIBUTION
 FUTURE DROUGHT

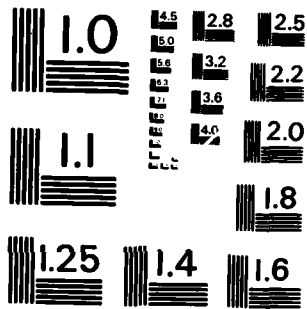
Legend:
 Average Adult Densities
 Spring
 Lower Densities
 Higher Densities
 Summer
 Higher Densities
 Future Drought

WESTERN ECO-SYSTEMS TECHNOLOGY INC.
 WESTECON

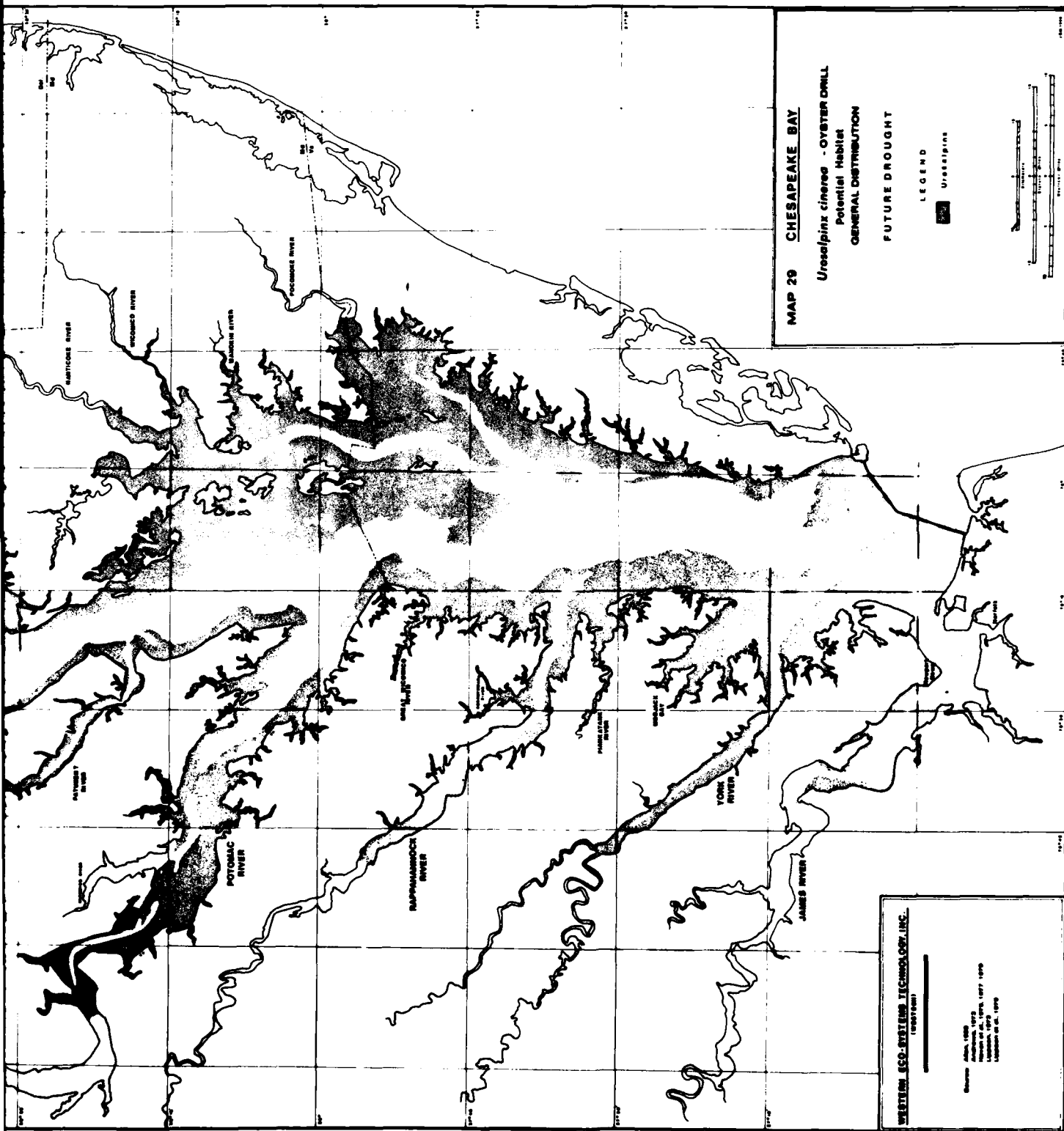
Source:
 Smith 1971, 1972
 Smith 1973
 Smith and Otto 1980
 Smith 1981
 Smith 1982
 Smith and Page 1978
 Smith 1979

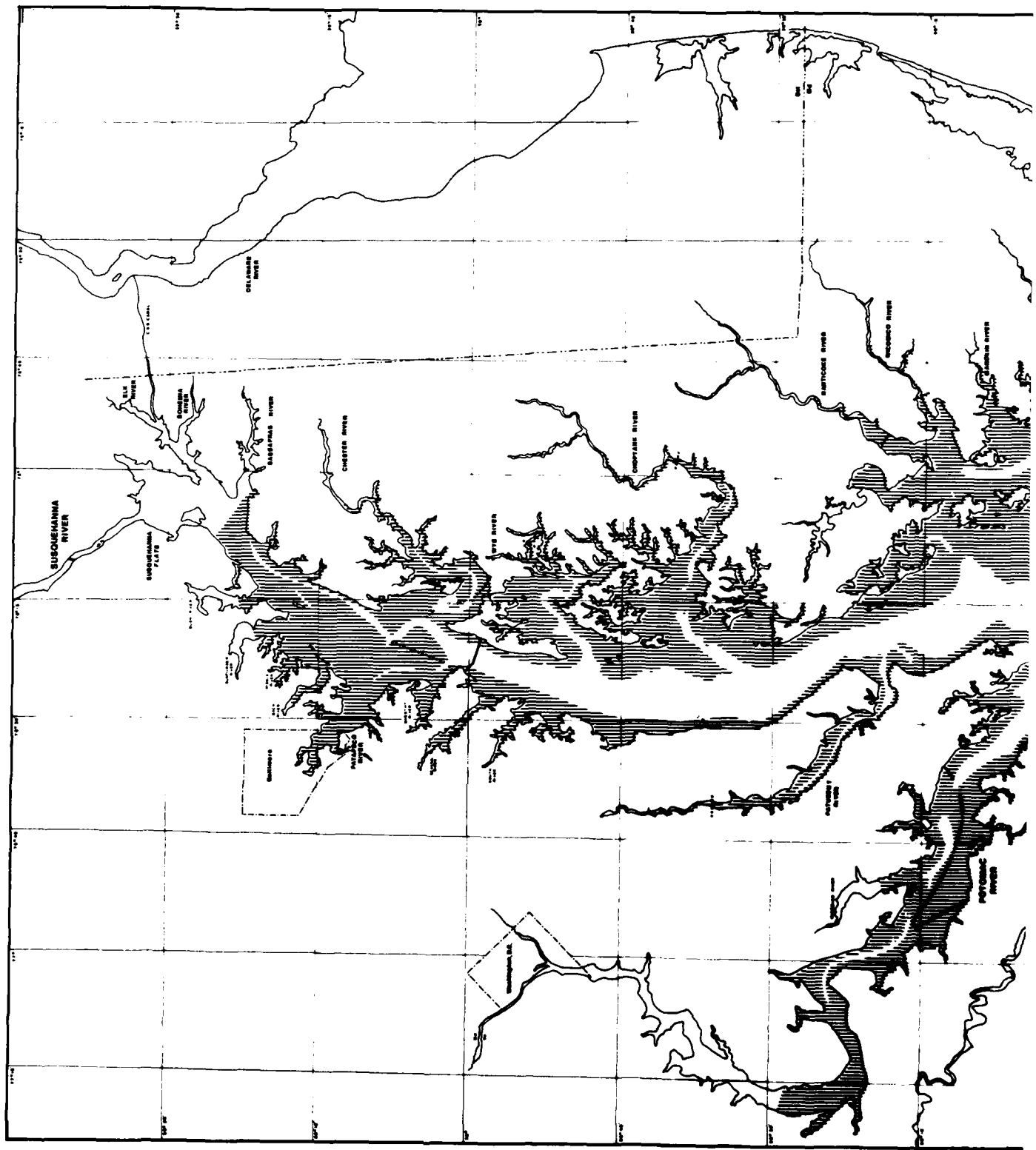
Map 19-11





MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS - 1963 - A





MAP 30 CHESAPEAKE BAY

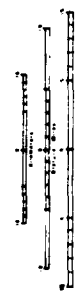
Crassostrea virginica - AMERICAN OYSTER
Potential Habitat

GENERAL DISTRIBUTION

FUTURE DROUGHT

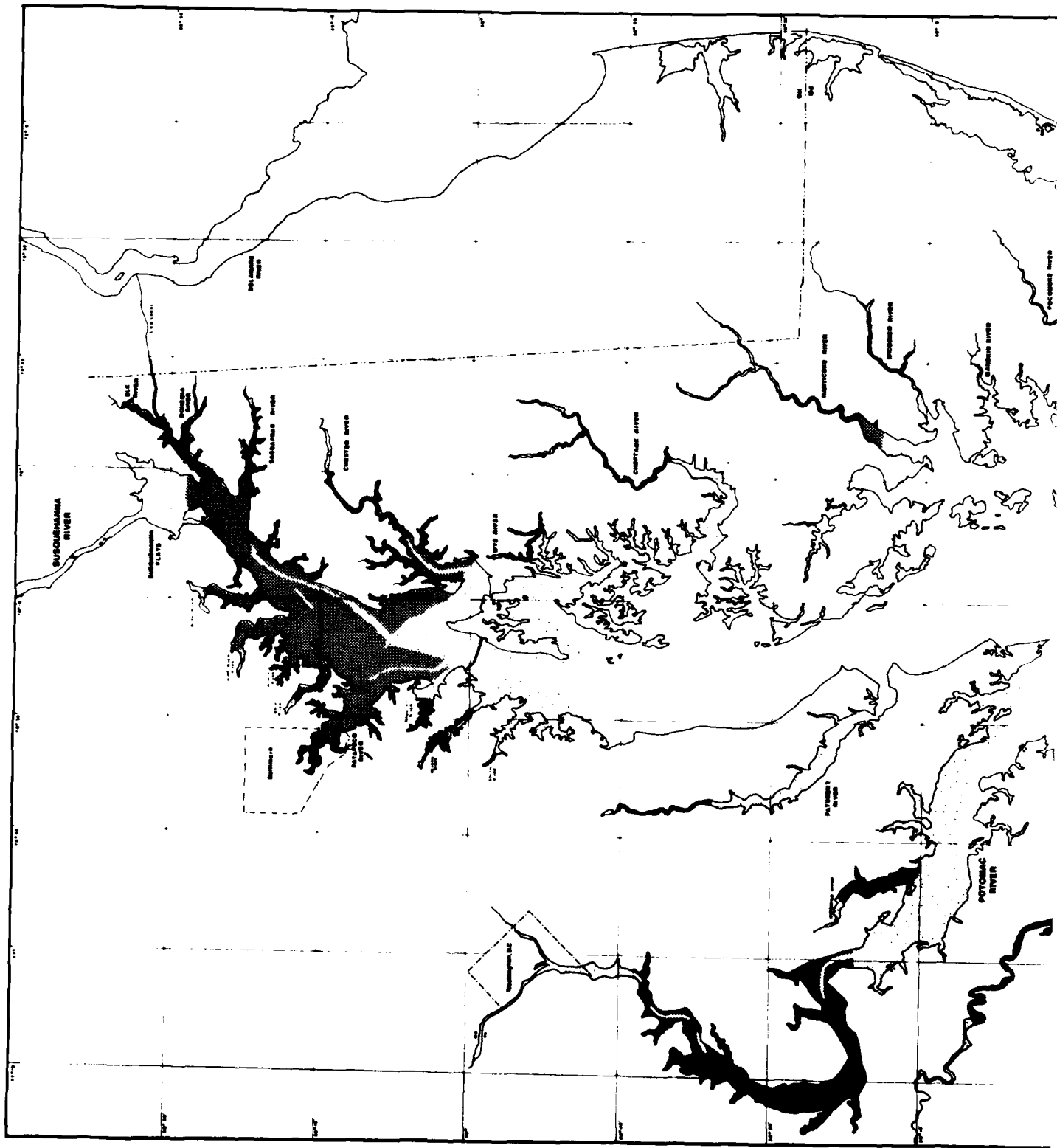
LEGEND

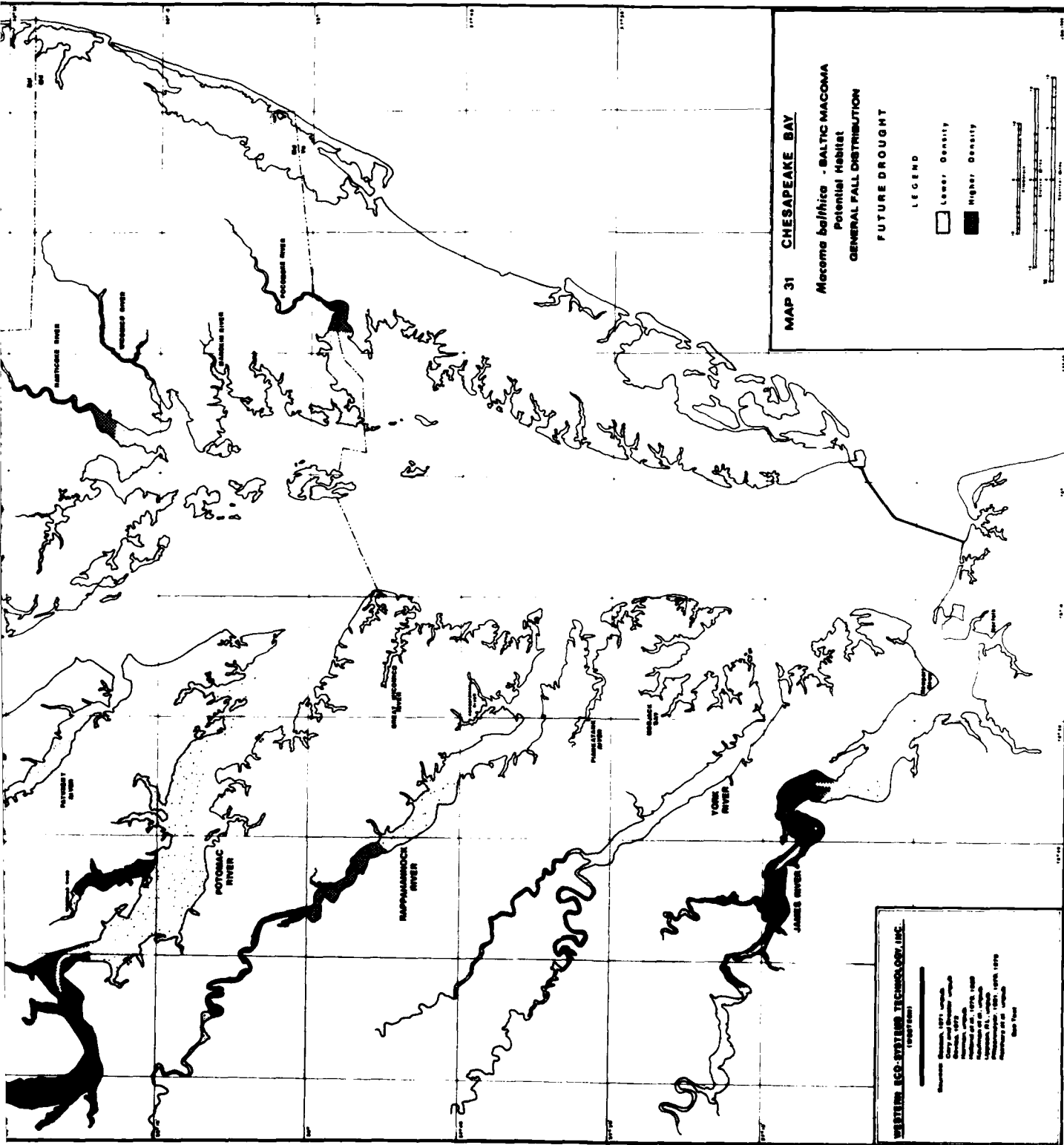
- ▨ General Distribution
- Oyster Parasites MEI and Dermo
- Upstream extent of major impact zone

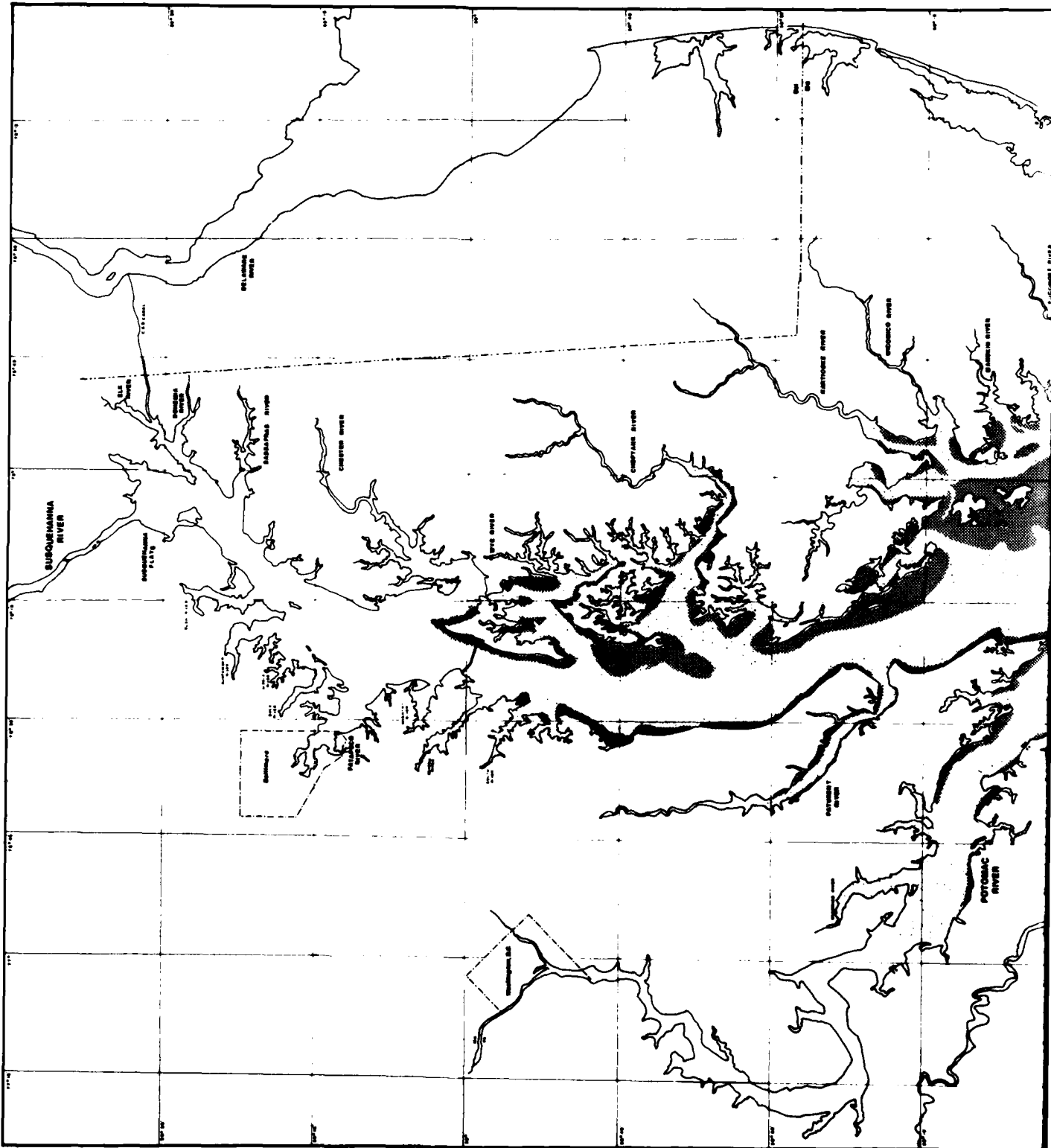


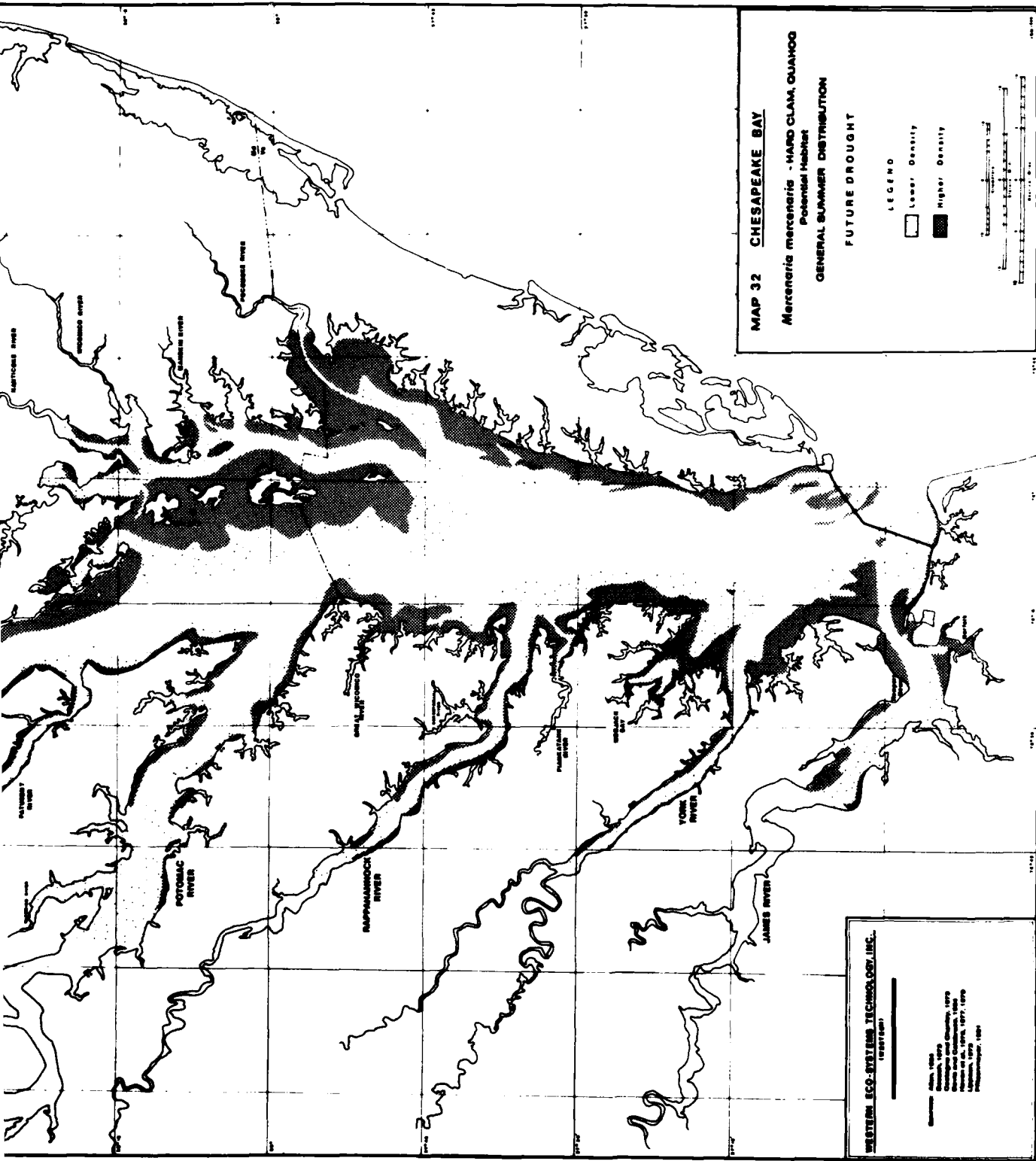
WESTERN ECO-SYSTEMS TECHNOLOGY, INC.

10001 E. 10th Avenue
 Denver, Colorado 80231
 Telephone: (303) 755-1000
 Telex: 251101
 Fax: (303) 755-1001









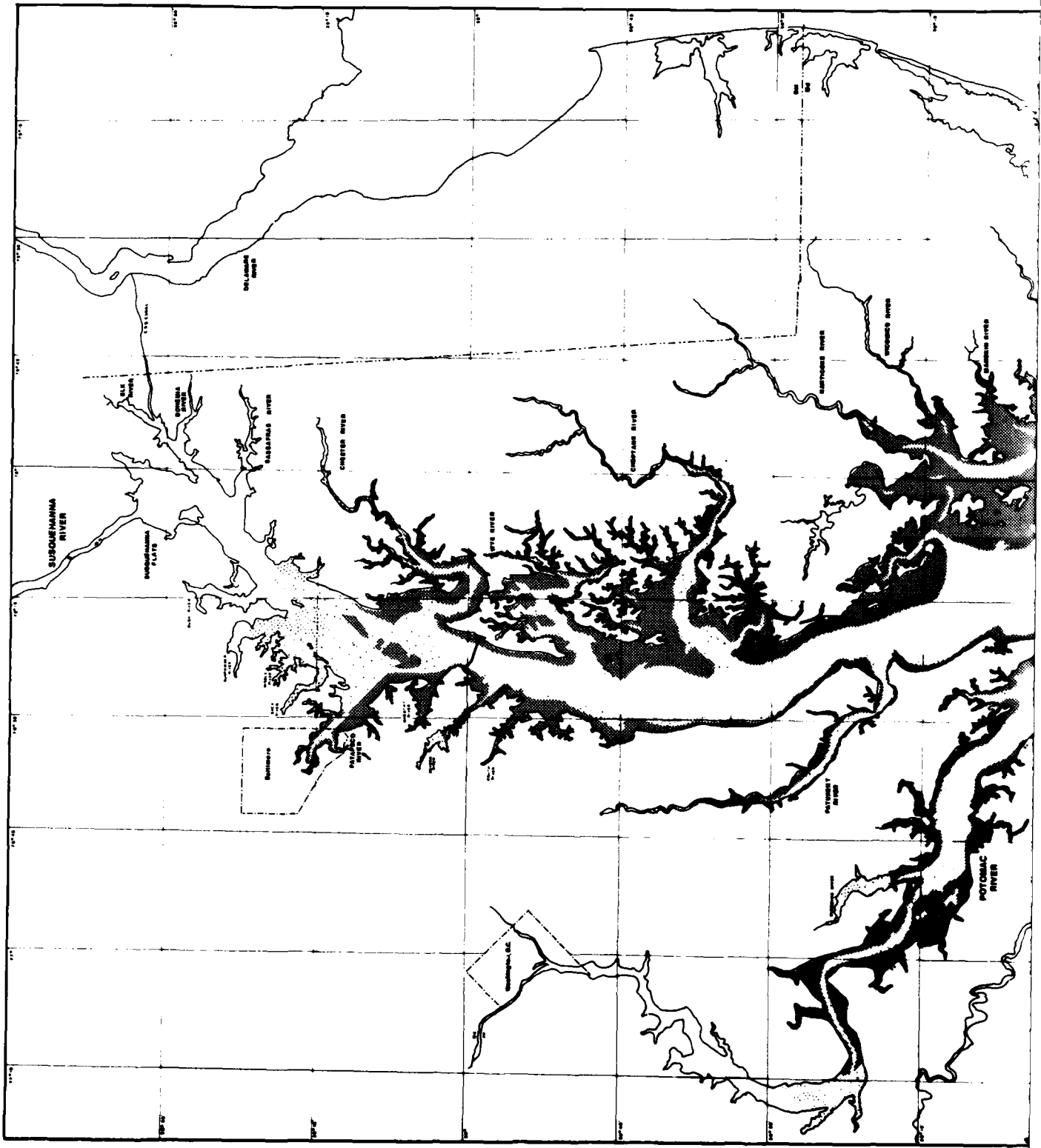
MAP 32 CHESAPEAKE BAY
Mercenaria mercenaria - HARD CLAM, OYSTER
 Potential Habitat
 GENERAL SUMMER DISTRIBUTION
 FUTURE DROUGHT

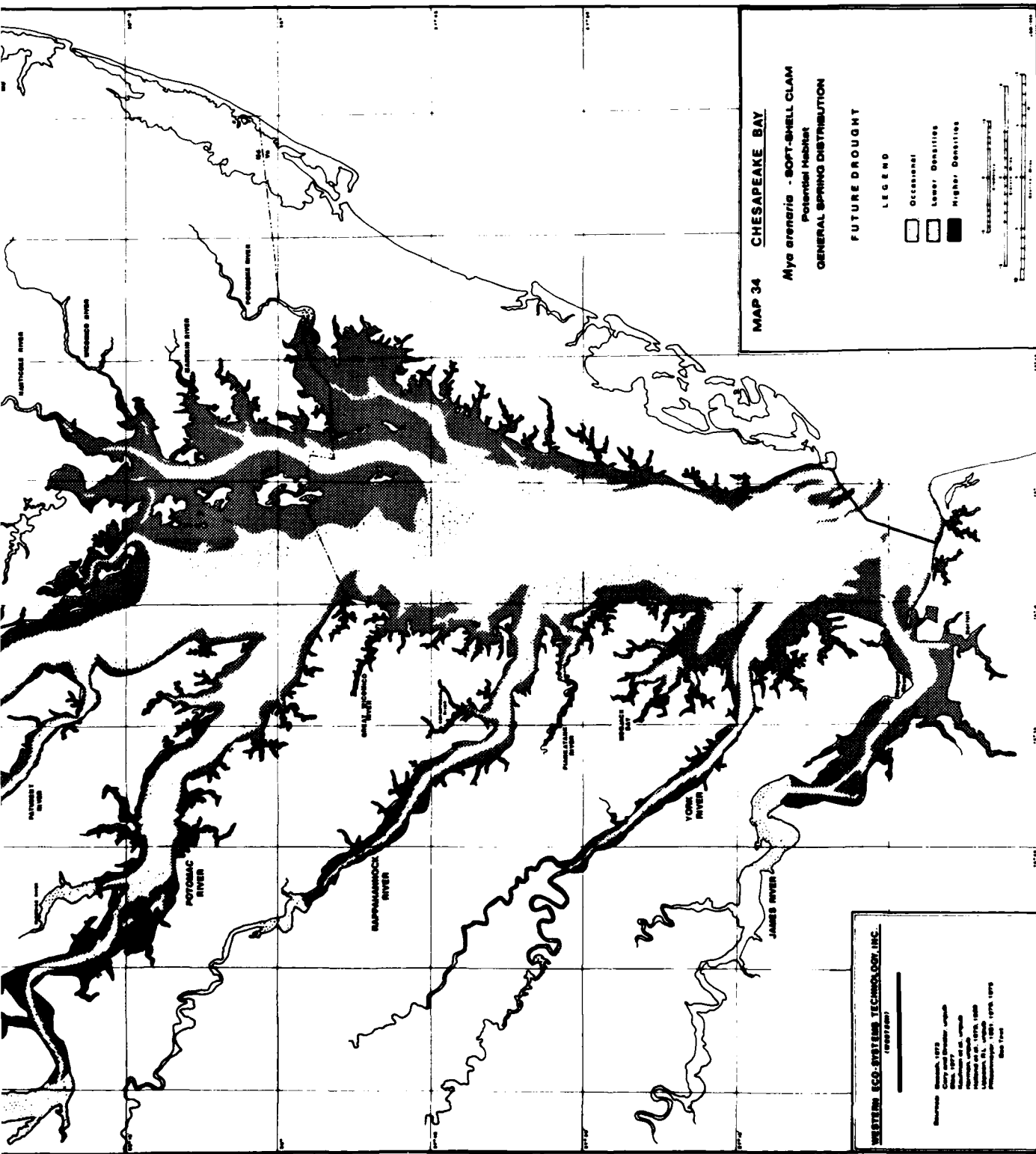
LEGEND
 Lower Density
 Higher Density

Scale: 0 10 20 30 40 50 Miles
 0 10 20 30 40 50 Kilometers

WESTERN ECO-SYSTEMS TECHNOLOGY, INC.
 (continued)

1985, 1986
 1987, 1988
 1989, 1990
 1991, 1992
 1993, 1994
 1995, 1996
 1997, 1998
 1999, 2000
 2001, 2002
 2003, 2004
 2005, 2006
 2007, 2008
 2009, 2010
 2011, 2012
 2013, 2014
 2015, 2016
 2017, 2018
 2019, 2020
 2021, 2022
 2023, 2024
 2025, 2026
 2027, 2028
 2029, 2030





MAP 34 CHESAPEAKE BAY
Mya arenaria - SOFT-SHELL CLAM
 Potential Habitat
GENERAL SPRING DISTRIBUTION
FUTURE DROUGHT

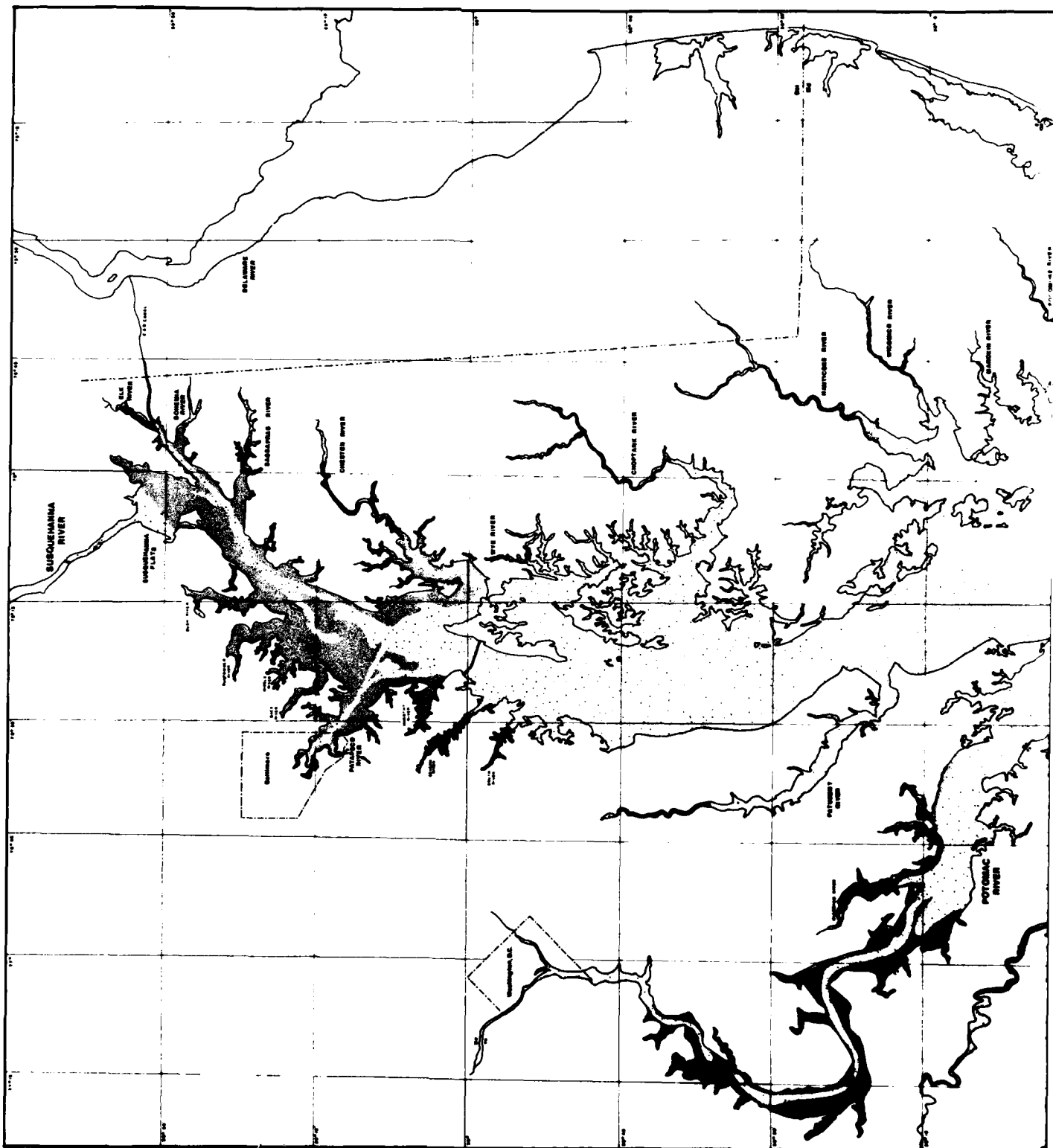
LEGEND

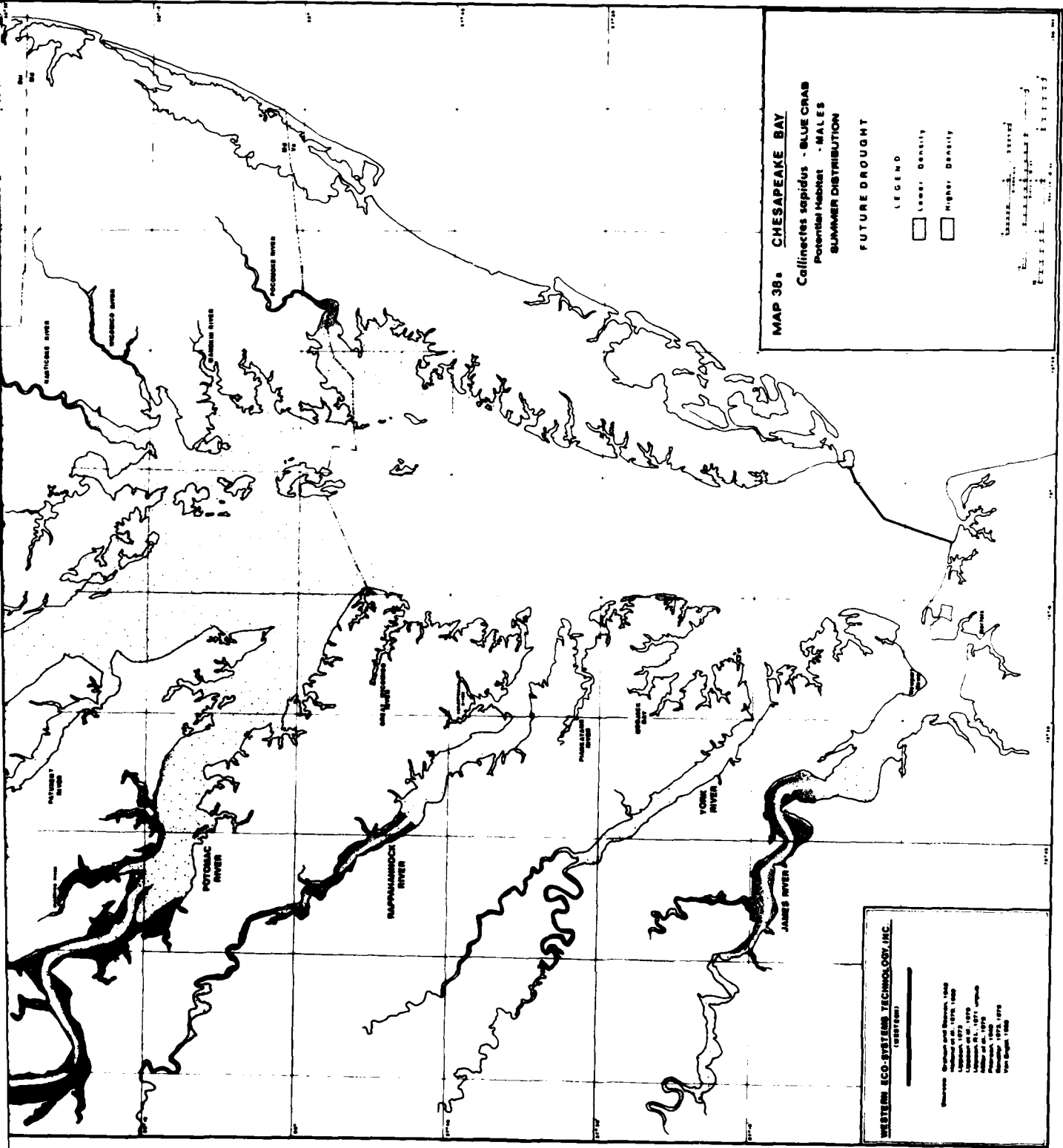
Occasional
 Lower Densities
 Higher Densities

0 10 20 30 40 50 60 70 80 90 100
 Miles
 0 10 20 30 40 50 60 70 80 90 100
 Kilometers

WESTERN EGO-SYSTEMS TECHNOLOGY, INC.
 (800) 777-2700

Project: Mya arenaria
 Date: 1997
 Prepared by: J. L. ...
 Approved by: J. L. ...
 Date: 1997





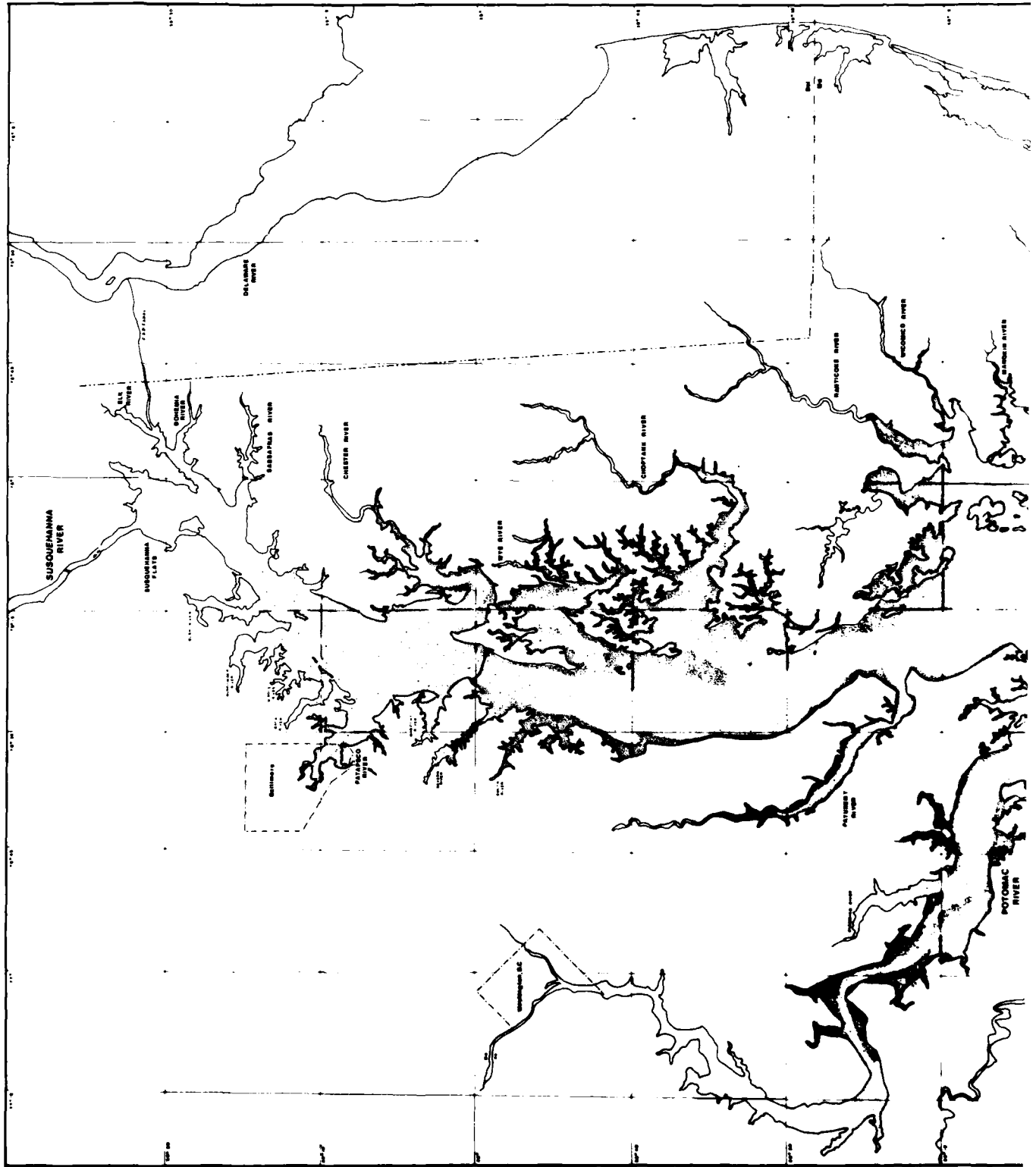
MAP 38. CHESAPEAKE BAY
Callinectes sapidus - BLUE CRAB
 Potential Habitat - MALES
 SUMMER DISTRIBUTION
 FUTURE DROUGHT

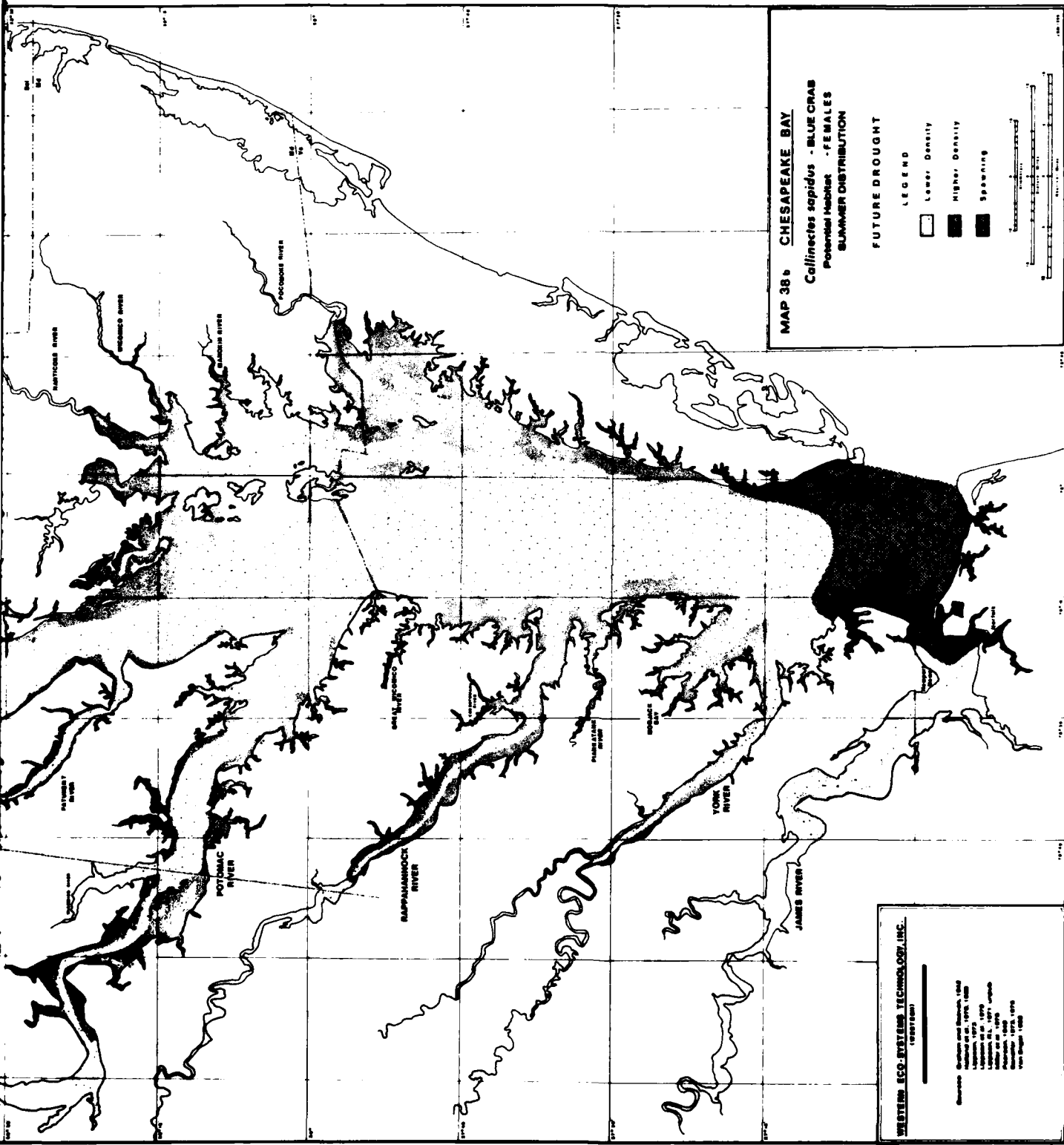
LEGEND
 [Light Shaded Box] Lower Density
 [Dark Shaded Box] Higher Density

Scale: 1:50,000
 North Arrow

WESTERN ECO-SYSTEMS TECHNOLOGY, INC.
 (800) 854-2222

Western Eco-Systems Technology, Inc.
 10000 West 10th Avenue
 Golden, CO 80401
 Telephone: (303) 440-1000
 Telex: 251100
 Fax: (303) 440-1001





MAP 38b CHESAPEAKE BAY

Callinectes sapidus - BLUE CRAB
 Potential Habitat - FEMALE MALES
 SUMMER DISTRIBUTION

FUTURE DROUGHT

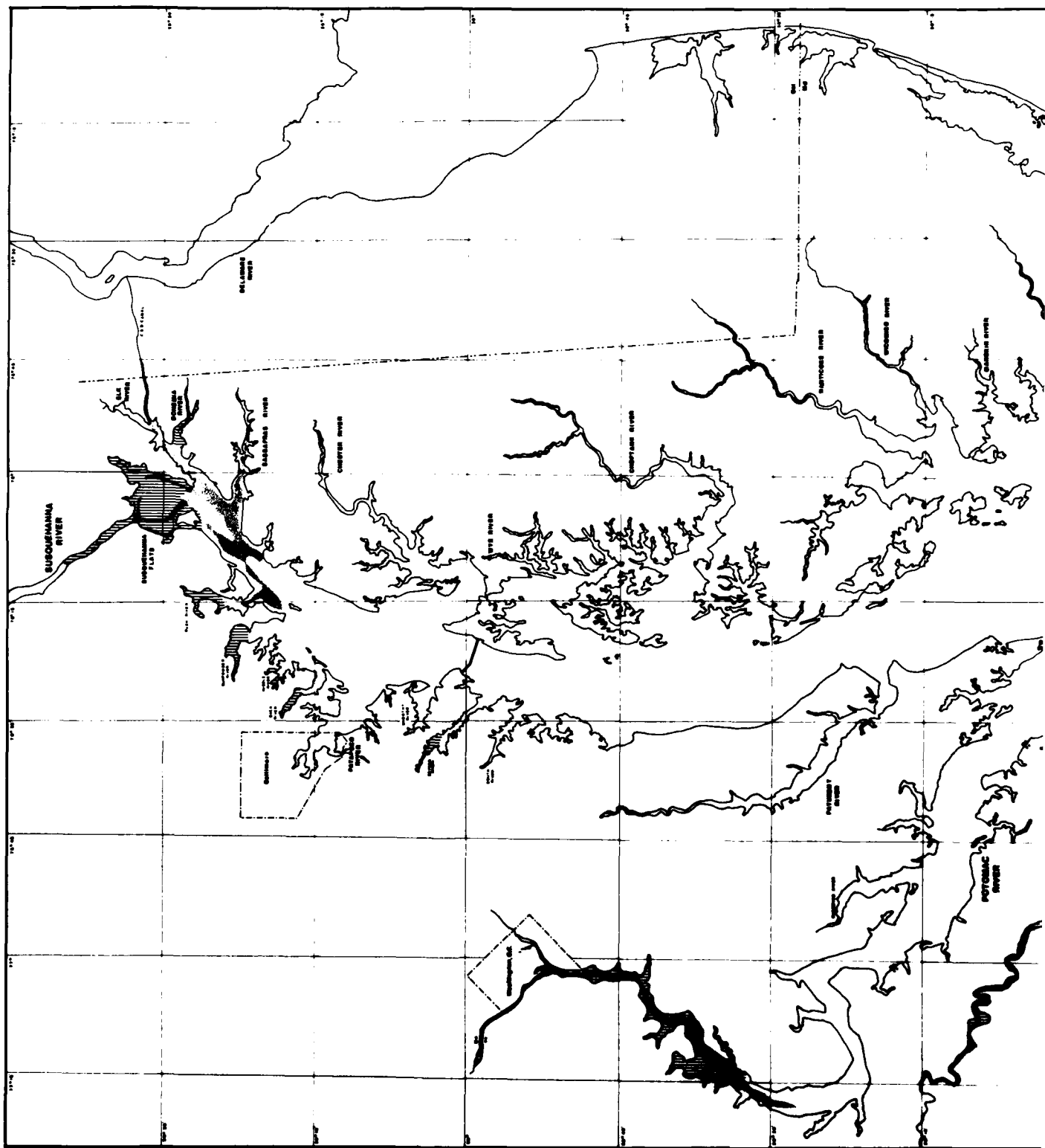
LEGEND

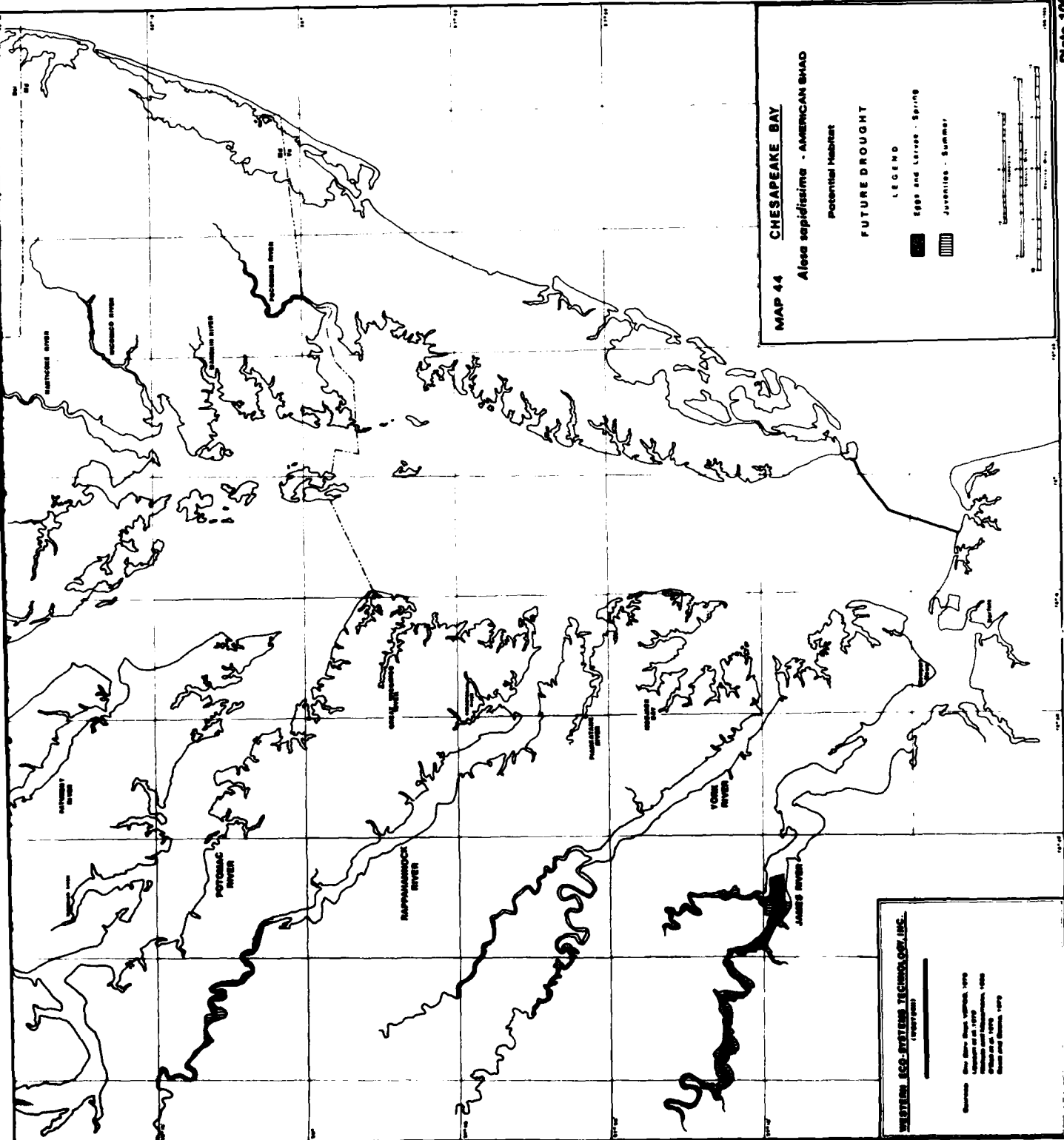
- Lower Density
- Higher Density
- Spawning

Scale: 0 10 20 30 40 50 Miles

WESTERN ESCO SYSTEMS TECHNOLOGY, INC.
 (continued)

Source: National and State, 1980
 Anderson et al., 1976, 1980
 Lyman, 1975
 Lyman et al., 1975
 Lyman et al., 1977, 1980
 Lyman et al., 1979
 Lyman et al., 1980
 Lyman et al., 1981

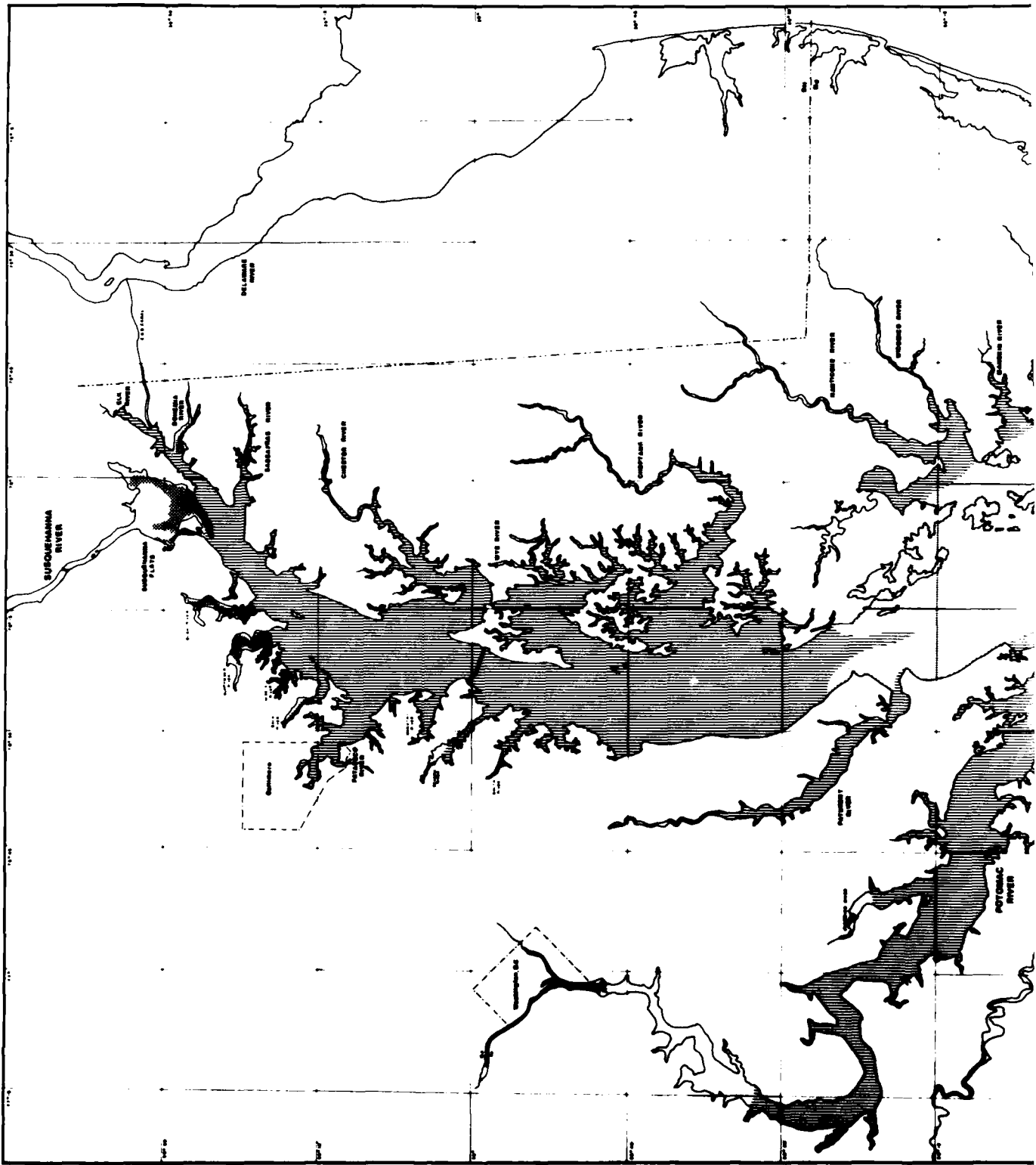


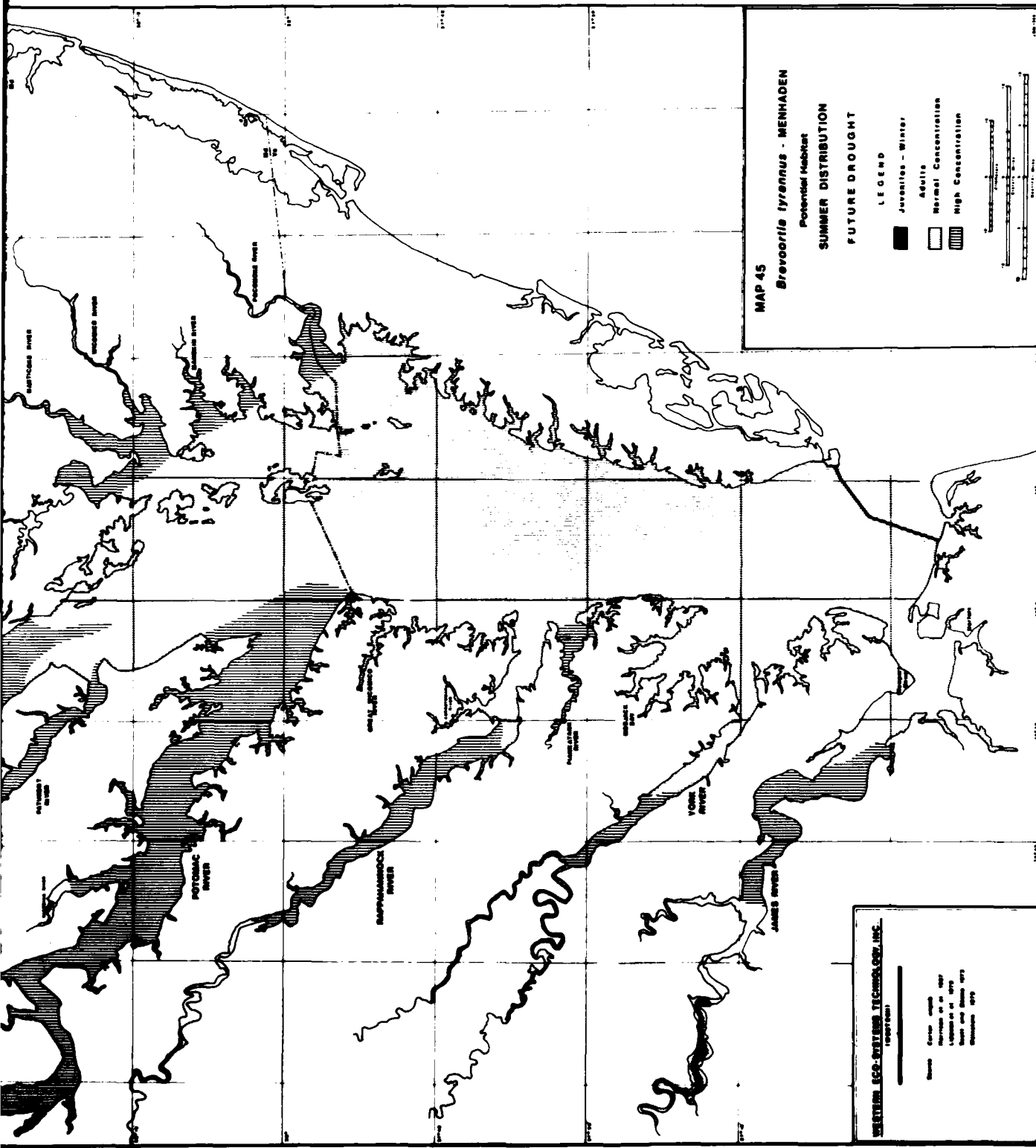


MAP 44
CHESAPEAKE BAY
 Aleo sapiidissima - AMERICAN SHAD

Potential Habitat
FUTURE DROUGHT
 LEGEND
 Eggs and Larvae - Spring
 Juveniles - Summer

WESTERN ECO-SYSTEMS TECHNOLOGY, INC.
 (1989) (1991)
 10000
 10000
 10000
 10000
 10000





MAP 45
Brevoortia tyrannus - MENHADEN
 Potential Habitat

SUMMER DISTRIBUTION

FUTURE DROUGHT

LEGEND

Juveniles - Winter

Adults

Normal Concentration

High Concentration

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 Report 101

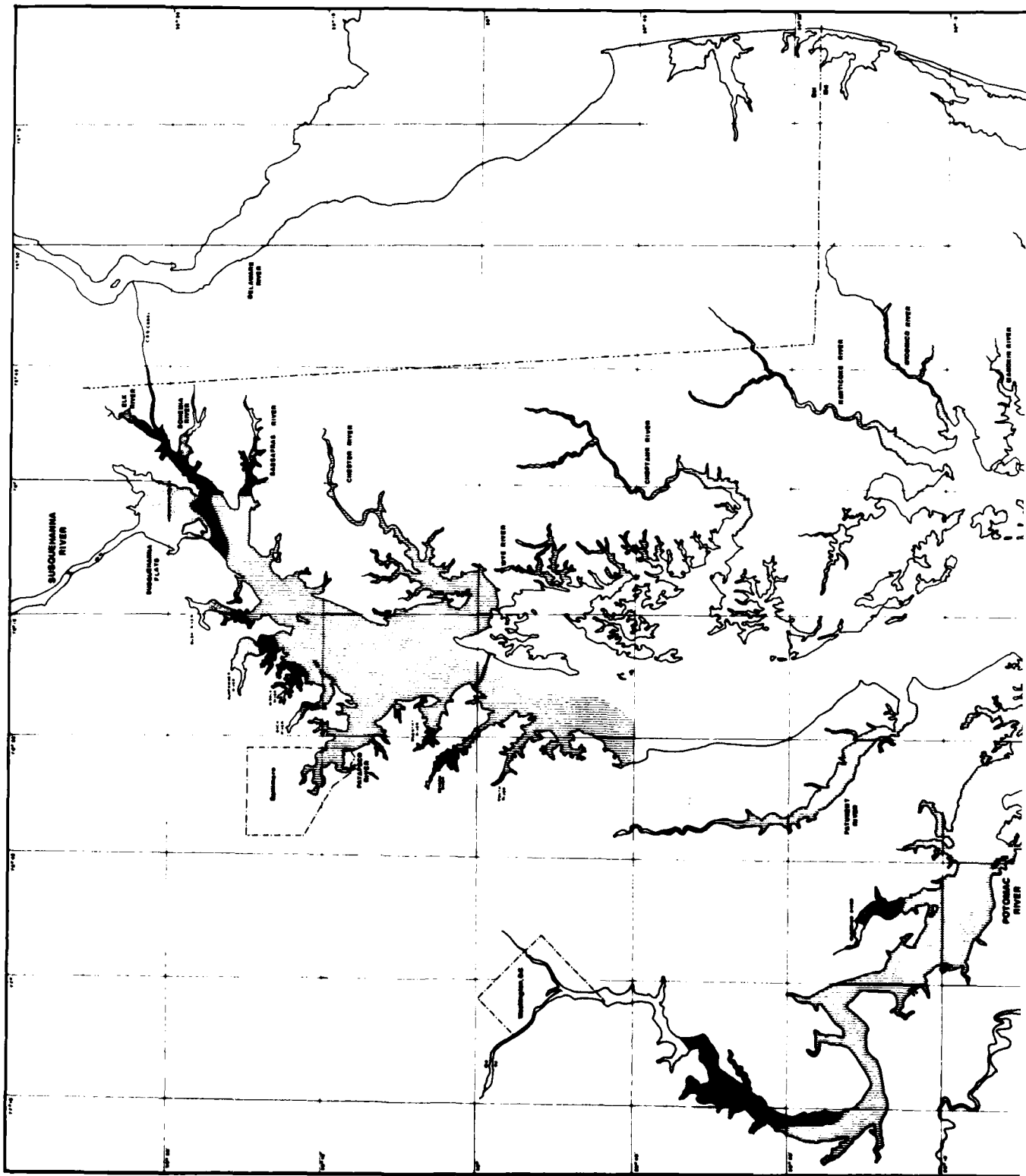
Scale: 1:50,000

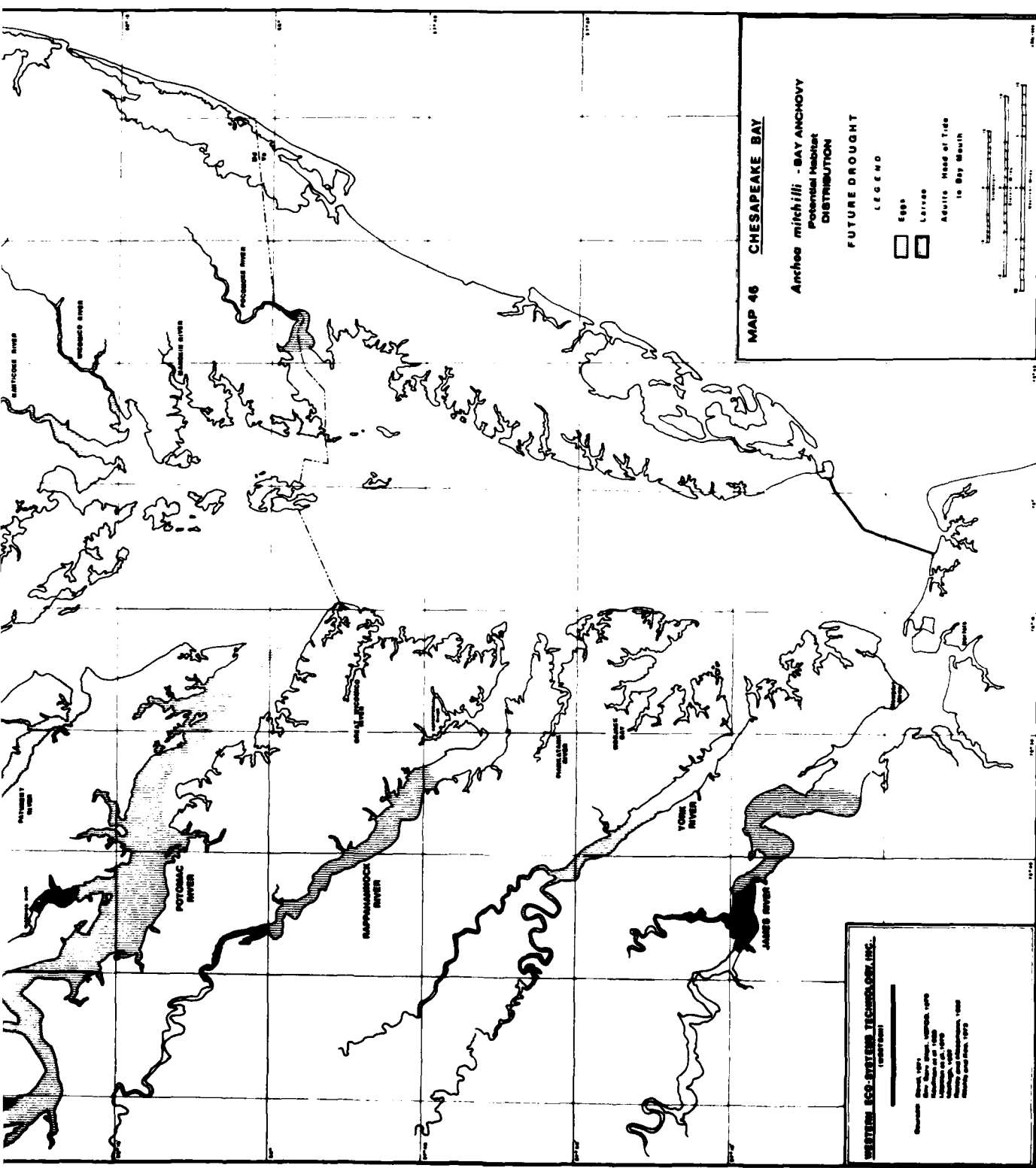
Prepared at: 1987

Revised at: 1987

Map and Data: 1987

Revised: 1987





MAP 46 CHESAPEAKE BAY

Anchoa mitchilli - BAY ANCHOVY
 Potential Habitat
 DISTRIBUTION
 FUTURE DROUGHT

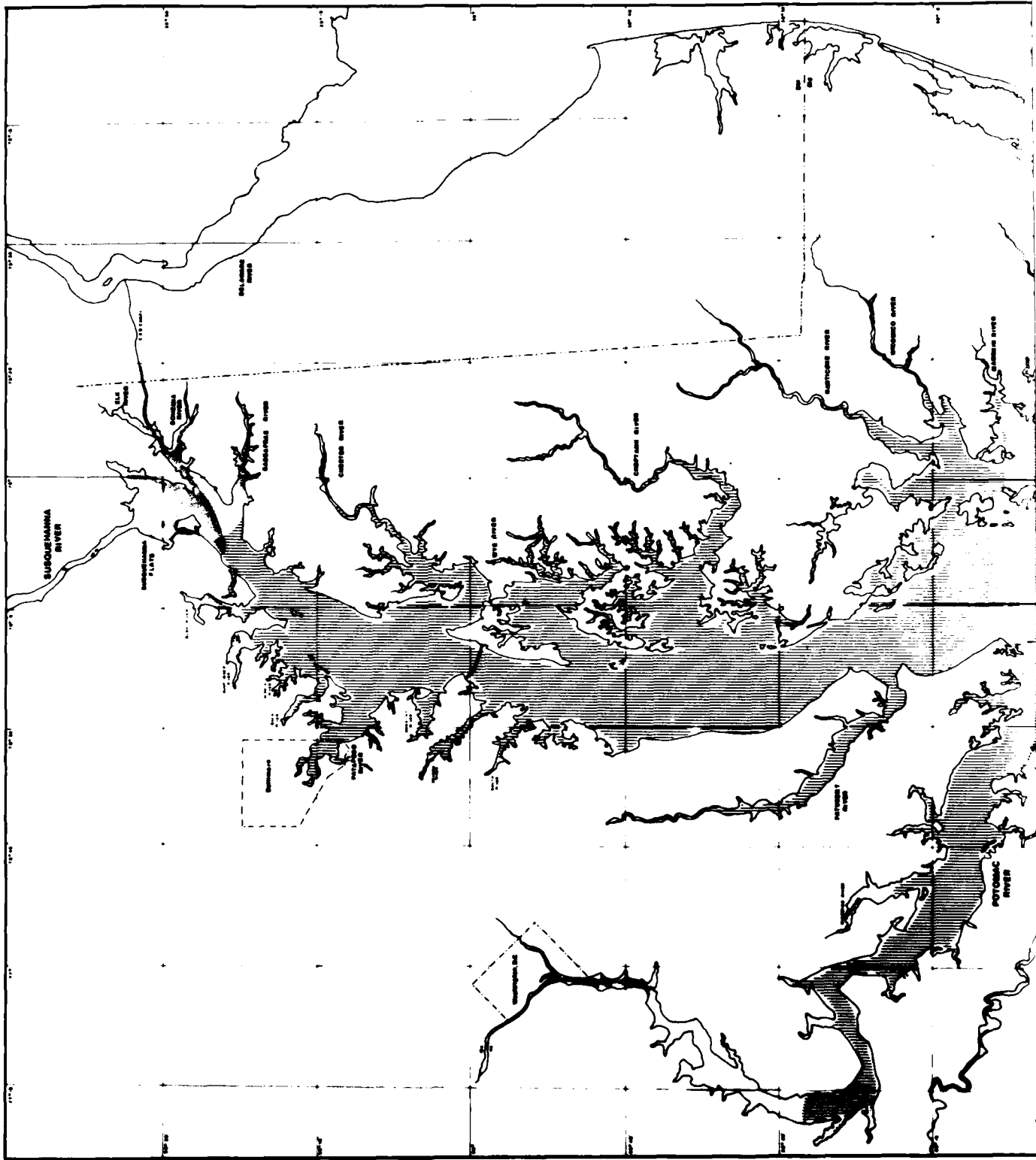
LEGEND

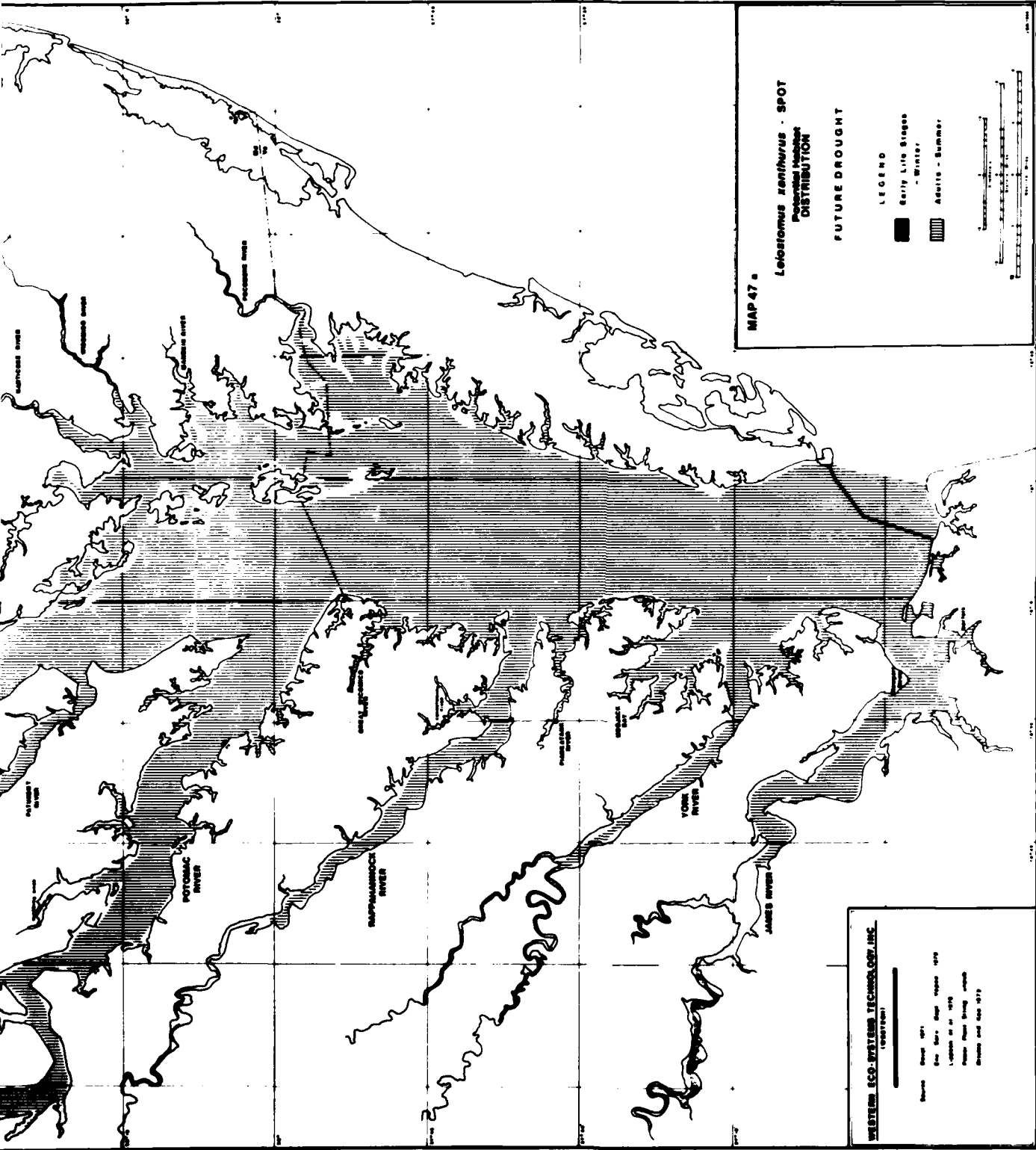
Eggs
 Larvae
 Adults Head of Tide to Bay Mouth

0 10 20 30 40 50 Miles
 0 10 20 30 40 50 Kilometers

WESTERN GEO-SYSTEMS TECHNOLOGY, INC.
 (continued)

Project: Chesapeake Bay, 1989
 Date: August 1989
 Author: J. R. ...
 Title: ...
 Scale: ...
 Date: ...





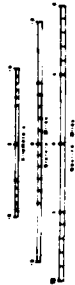
MAP 47

Leiostronotus xenithurus - SPOT
Potential Habitat
DISTRIBUTION

FUTURE DROUGHT

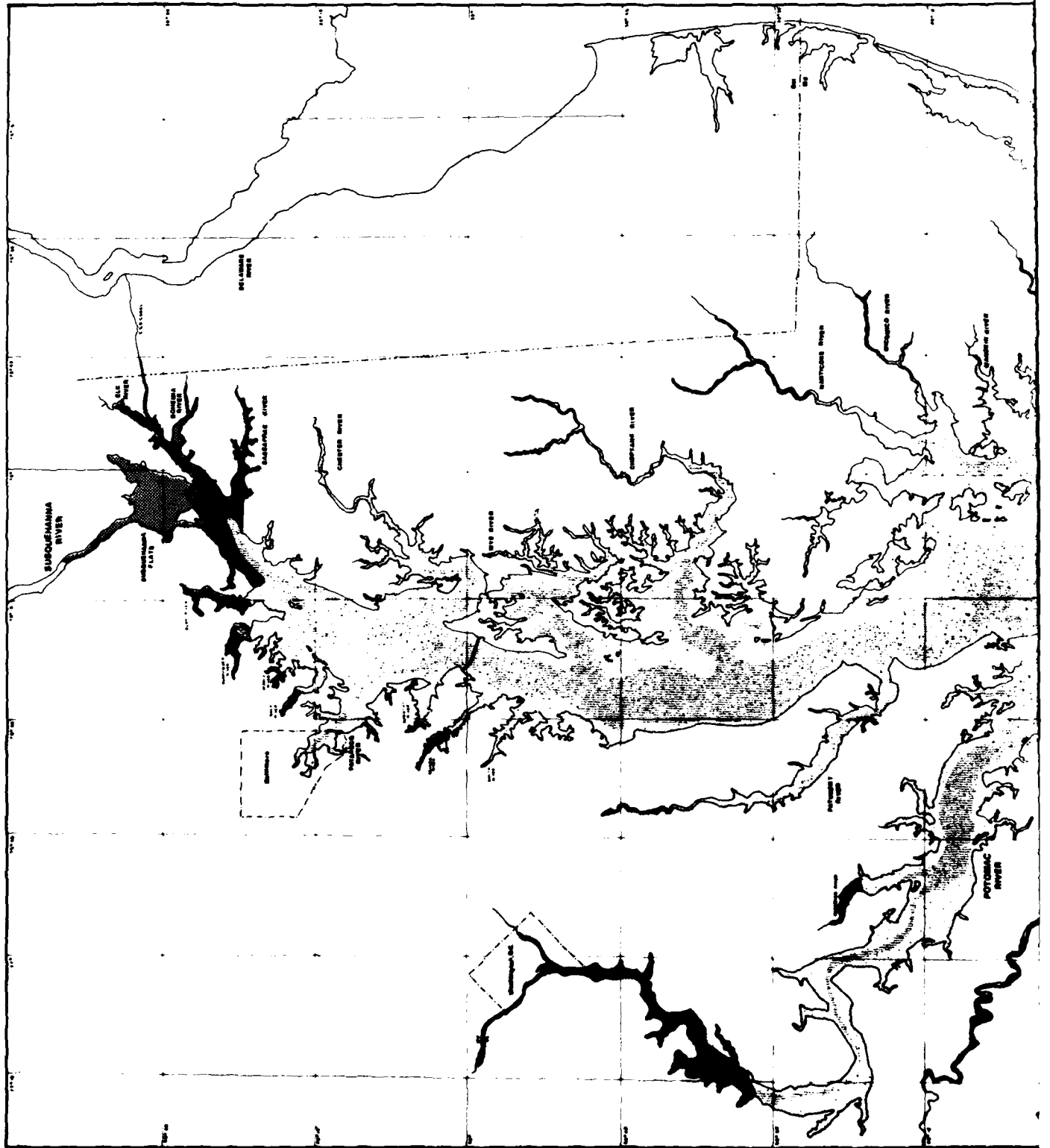
LEGEND

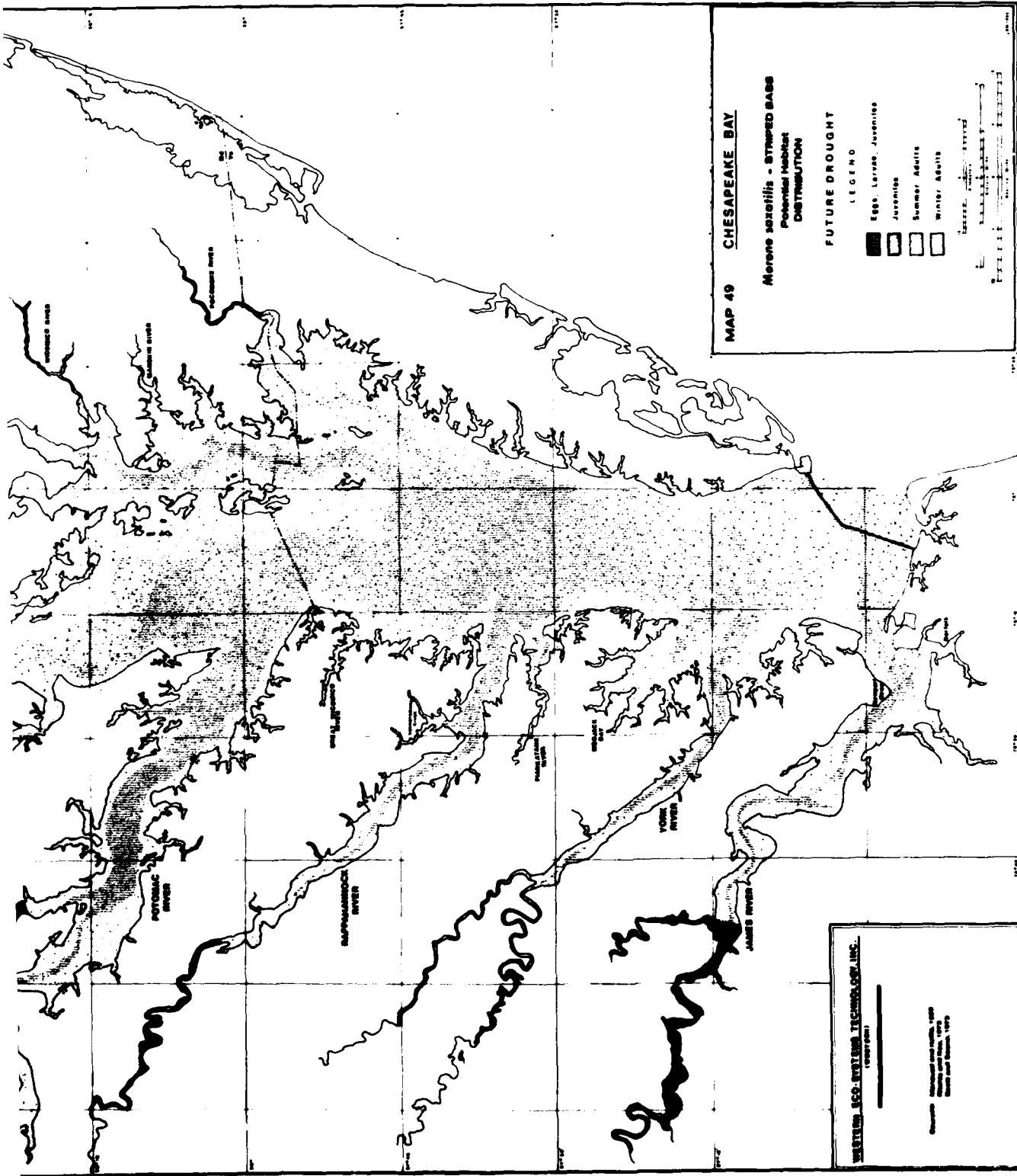
- Early Life Stages
- ▨ Winter
- ▤ Adults - Summer



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Copyright

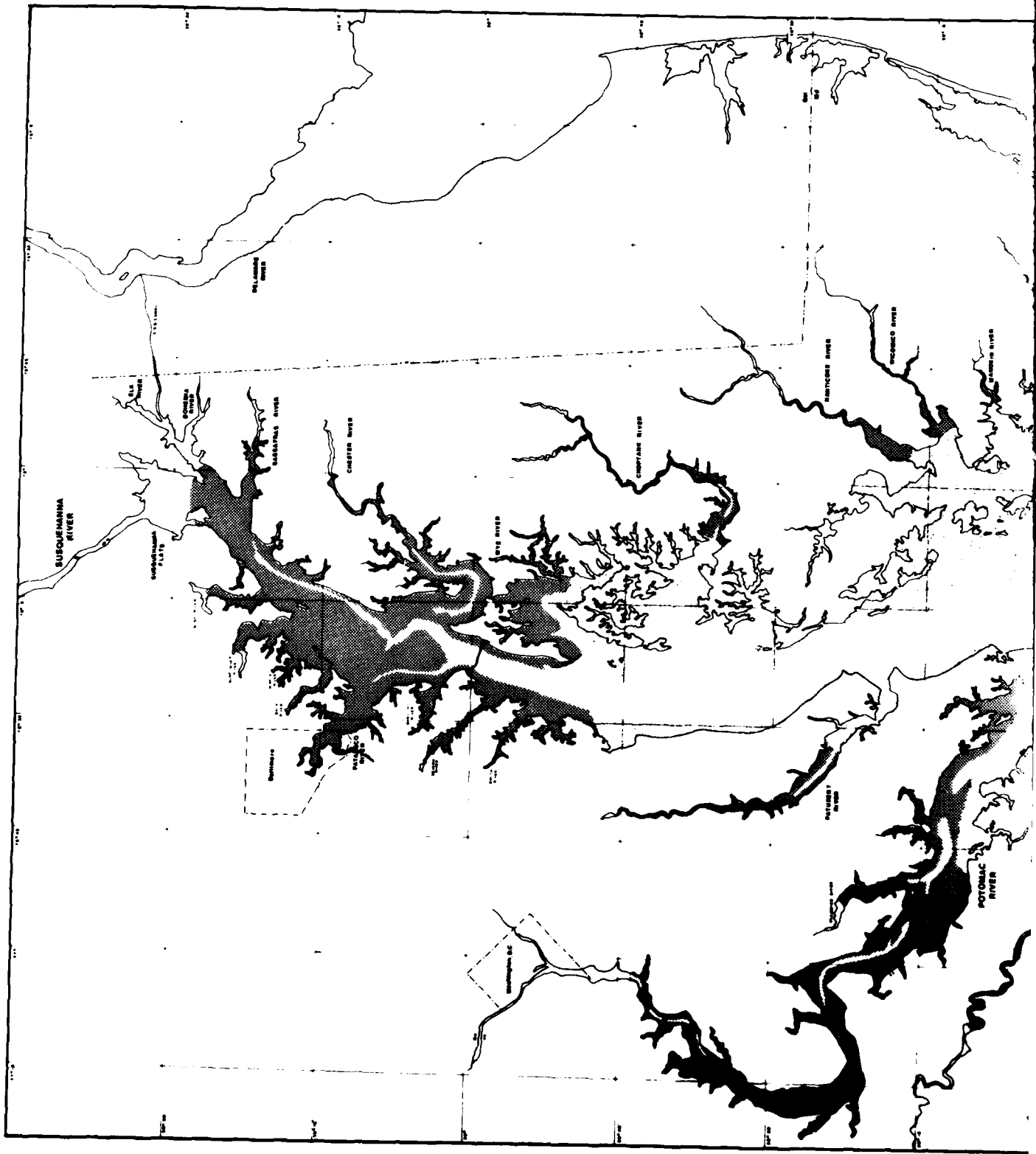
Date: 1971
 File No.: 8001
 Location: 10170
 Project: 8001
 Date: 10/17/71

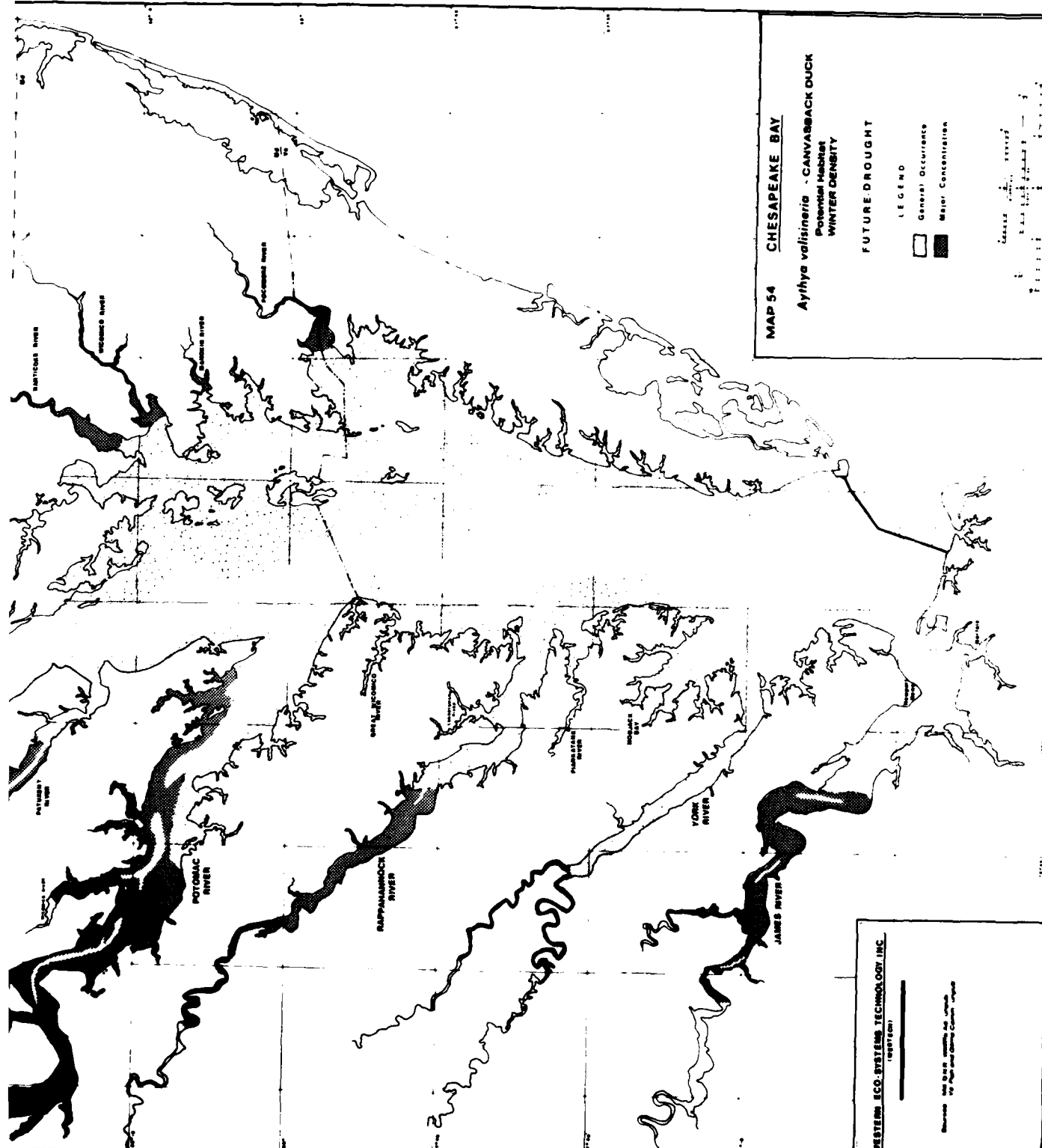




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1987-1991

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MAP 54 CHESAPEAKE BAY

Aythya valisineria - CANVASBACK DUCK
 Potential Habitat
 WINTER DENSITY

FUTURE DROUGHT

LEGEND

General Occurrence

Major Concentration

Scale: 1:50,000

DATE: 1982

WESTERN ECO-SYSTEMS TECHNOLOGY, INC.
 (EST. 1978)

1000 N. 17th Street, Suite 100
 Durham, NC 27705

END

DATE
FILMED

3-83

DTIC