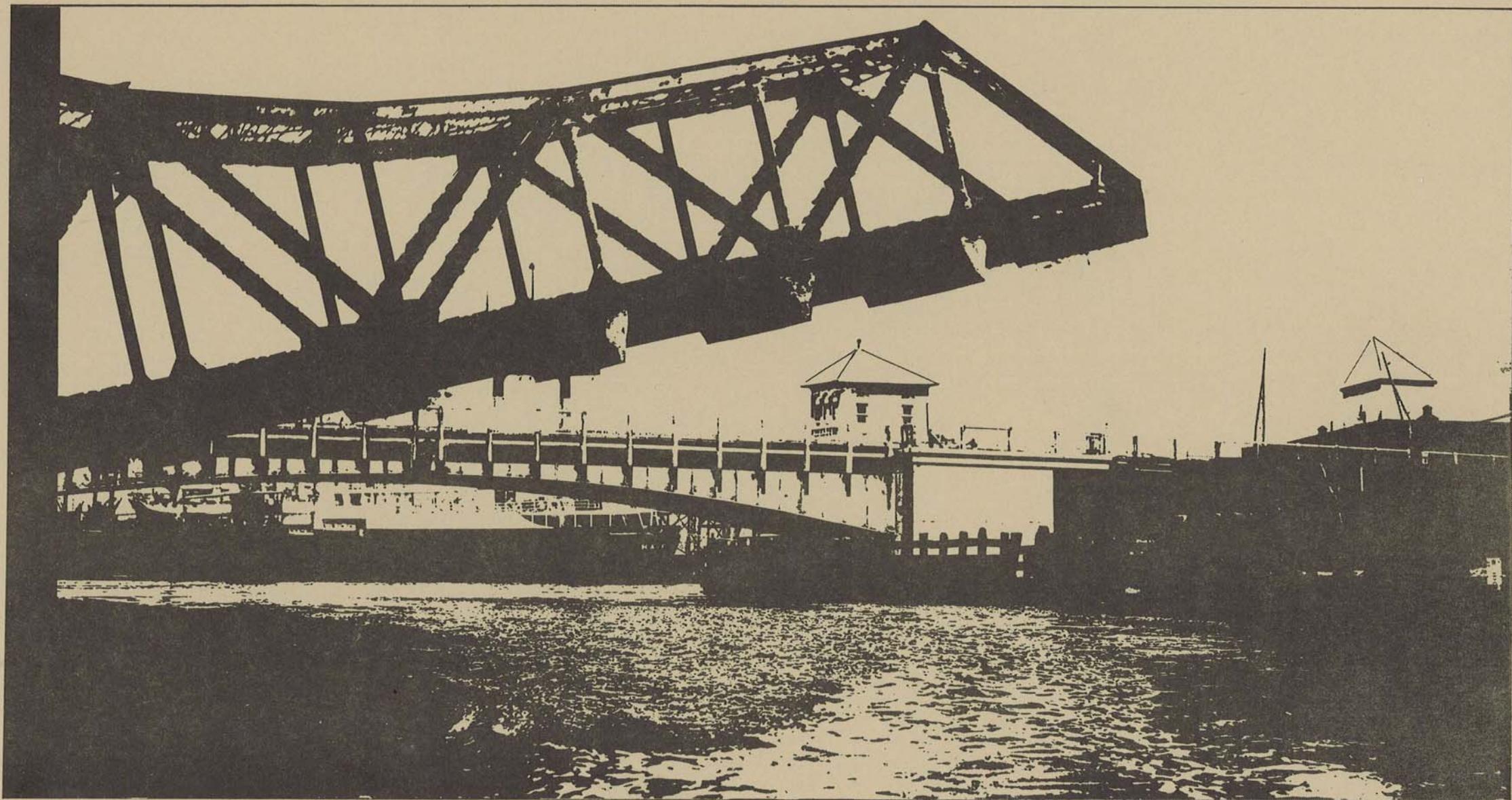


Shoreline Situation Report
CITIES OF CHESAPEAKE, NORFOLK, AND PORTSMOUTH



Supported by the National Science Foundation, Research Applied to National Needs Program
NSF Grant Nos. GI 34869 and GI 38973 to the Wetlands/Edges Program, Chesapeake Research Consortium, Inc.

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Special Report In Applied Marine Science and Oceanic Engineering Number 136 of the

VIRGINIA INSTITUTE OF MARINE SCIENCE

William J. Hargis Jr., Director
Gloucester Point, Virginia 23062

1976

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CHAPTER 1

Introduction

CHAPTER 1

INTRODUCTION

1.1 PURPOSES AND GOALS

It is the objective of this report to supply an assessment, and at least a partial integration, of those important shoreland parameters and characteristics which will aid the planners and the managers of the shorelands in making the best decisions for the utilization of this limited and very valuable resource. The report gives particular attention to the problem of shore erosion and to recommendations concerning the alleviation of the impact of this problem. In addition, we have tried to include in our assessment a discussion of those factors which might significantly limit development of the shoreline and, in some instances, a discussion of some of the potential or alternate uses of the shoreline, particularly with respect to recreational use, since such information could aid potential users in the perception of a segment of the shoreline.

The basic advocacy of the authors in the preparation of the report is that the use of shorelands should be planned rather than haphazardly developed in response to the short term pressures and interests. Careful planning could reduce the conflicts which may be expected to arise between competing interests. Shoreland utilization in many areas of the country, and indeed in some places in Virginia, has proceeded in a manner such that the very elements which attracted people to the shore have been destroyed by the lack of planning and forethought.

The major man-induced uses of the shorelands are:

- Residential, commercial, or industrial development
- Recreation
- Transportation
- Waste disposal
- Extraction of living and non-living resources

Aside from the above uses, the shorelands serve various ecological functions.

The role of planners and managers is to optimize the utilization of the shorelands and to minimize the conflicts arising from competing demands. Furthermore, once a particular use has been decided upon for a given segment of shoreland, both the planners and the users want that selected use to operate in the most effective manner. A park planner, for example, wants the allotted space to fulfill the design most efficiently. We hope that the results of our work are useful to the planner in designing the beach by pointing out the technical feasibility of altering or enhancing the present configuration of the shore zone. Alternately, if the use were a residential development, we would hope our work would be useful in specifying the shore erosion problem and by indicating defenses likely to succeed in containing the erosion. In summary our objective is to provide a useful tool for enlightened utilization of a limited resource, the shorelands of the Commonwealth.

Shorelands planning occurs, either formally or informally, at all levels from the private owner of shoreland property to county governments, to planning districts and to the state and federal agency level. We feel our results will be useful at all these levels. Since the most basic level of comprehensive planning and zoning is at the county or city level, we have executed our report on that level although we realize some of the information may be most useful at a higher governmental level. The Commonwealth of Virginia has traditionally chosen to place as much as possible, the regulatory decision processes at the county level. The Virginia Wetlands Act of 1972 (Chapter 2.1, Title 62.1, Code of Virginia), for example provides for the establishment of County Boards to act on applications for alterations of wetlands. Thus, our focus at the county level is intended to interface with and to support the existing or pending county regulatory mechanisms concerning activities in the shorelands zone.

1.2 ACKNOWLEDGEMENTS

This report has been prepared and published with funds provided to the Commonwealth by the Office of Coastal Zone Management, National Oceanic and Atmospheric Administration, grant number 04-5-158-50001. The Shoreline Situation Report series was originally developed in the Wetlands/Edges Program of the Chesapeake Research Consortium, Inc., as supported by the Research Applied to National Needs (RANN) program of the National Science Foundation. The completion of this report would have been impossible without the expert services of Beth Marshall, who typed several drafts of the manuscript, Bill Jenkins and Ken Thornberry, who prepared the photographs, and Sam White, who piloted the aircraft on the many photo acquisition and reconnaissance flights. We especially thank the Southeastern Virginia Planning District Commission for its assistance in the assimilation of information. Also we thank the numerous other persons who, through their direct aid, criticisms, and suggestions, have assisted our work.

CHAPTER 2

Approach Used and Elements Considered

CHAPTER 2

APPROACH USED AND ELEMENTS CONSIDERED

2.1 APPROACH TO THE PROBLEM

In the preparation of this report the authors utilized existing information wherever possible. For example, for such elements as water quality characteristics, zoning regulations, or flood hazard, we reviewed relevant reports by local, state, or federal agencies. Much of the desired information, particularly with respect to erosional characteristics, shoreland types, and use was not available, so we performed the field work and developed classification schemes. In order to analyze successfully the shoreline behavior we placed heavy reliance on low altitude, oblique, color, 35 mm photography. We photographed the entire shoreline of each county and cataloged the slides for easy access at VIMS, where they remain available for use. We then analyzed these photographic materials, along with existing conventional aerial photography and topographic and hydrographic maps, for the desired elements. We conducted field inspection over much of the shoreline, particularly at those locations where office analysis left questions unanswered. In some cases we took additional photographs along with the field visits to document the effectiveness of shoreline defenses.

The basic shoreline unit considered is called a subsegment, which may range from a few hundred feet to several thousand feet in length. The end points of the subsegments were generally chosen on physiographic consideration such as changes in the character of erosion or deposition. In those cases where a radical change in land use occurred, the point of change was taken as a boundary point of the subsegment. Segments are groups of sub-segments. The boundaries for segments also were selected on physiographic units such as necks or peninsulas between major tidal creeks. Finally, the county itself is considered as a sum of shoreline segments.

The format of presentation in the report follows a sequence from general summary statements for the county (Chapter 3) to tabular segment summaries and finally detailed descriptions and maps for each subsegment (Chapter 4). The purpose in choosing this format was to allow selective use

of the report since some users' needs will adequately be met with the summary overview of the county while others will require the detailed discussion of particular subsegments.

2.2 CHARACTERISTICS OF THE SHORELANDS INCLUDED IN THE STUDY

The characteristics which are included in this report are listed below followed by a discussion of our treatment of each.

- a) Shorelands physiographic classification
- b) Shorelands use classification
- c) Shorelands ownership classification
- d) Zoning
- e) Water quality
- f) Shore erosion and shoreline defenses
- g) Limitations to shore use and potential or alternate shore uses
- h) Distribution of marshes
- i) Flood hazard levels
- j) Shellfish leases and public shellfish grounds
- k) Beach quality

a) Shorelands Physiographic Classification

The shorelands of the Chesapeake Bay System may be considered as being composed of three interacting physiographic elements: the fastlands, the shore and the nearshore. A graphic classification based on these three elements has been devised so that the types for each of the three elements portrayed side by side on a map may provide the opportunity to examine joint relationships among the elements. As an example, the application of the system permits the user to determine miles of high bluff shoreland interfacing with marsh in the shore zone.

For each subsegment there are two length measurements, the shore-nearshore interface or shoreline, and the fastland-shore interface. The two interface lengths differ most when the shore zone is embayed or extensive marsh. On the subsegment maps, a dotted line represents the fastland-shore interface when it differs from the shoreline. The fastland-shore interface length is the base for the fastland statistics.

Definitions:

Shore Zone

This is the zone of beaches and marshes. It is a buffer zone between the water body and the fastland. The seaward limit of the shore zone is the break in slope between the relatively steeper shoreface and the less steep nearshore zone. The approximate landward limit is a contour line representing one and a half times the mean tide range above mean low water (refer to Figure 1). In operation with topographic maps the inner fringe of the marsh symbols is taken as the landward limit.

The physiographic character of the marshes has also been separated into three types (see Figure 2). Fringe marsh is that which is less than 400 feet in width and which runs in a band parallel to the shore. Extensive marsh is that which has extensive acreage projecting into an estuary or river. An embayed marsh is a marsh which occupies a reentrant or drowned creek valley. The purpose in delineating these marsh types is that the effectiveness of the various functions of the marsh will, in part, be determined by type of exposure to the estuarine system. A fringe marsh may, for example, have maximum value as a buffer to wave erosion of the fastland. An extensive marsh, on the other hand, is likely a more efficient transporter of detritus and other food chain materials due to its greater drainage density than an embayed marsh. The central point is that planners, in the light of ongoing and future research, will desire to weight various functions of marshes and the physiographic delineation aids their decision making by denoting where the various types exist. The classification used is:

Beach

Marsh

Fringe marsh, < 400 ft. (122 m) in width
along shores

Extensive marsh

Embayed marsh, occupying a drowned valley
or reentrant

Artificially stabilized

Fastland Zone

The zone extending from the landward limit of the shore zone is termed the fastland. The fastland is relatively stable and is the site of most material development or construction. The

physiographic classification of the fastland is based upon the average slope of the land within 400 feet (122 m) of the fastland - shore boundary. The general classification is:

- Low shore, 20 ft. (6 m) or less of relief; with or without cliff
- Moderately low shore, 20-40 ft. (6-12 m) of relief; with or without cliff
- Moderately high shore, 40-60 ft. (12-18 m) of relief; with or without cliff
- High shore, 60 ft. (18 m) or more of relief; with or without cliff.

Two specially classified exceptions are sand dunes and areas of artificial fill.

Nearshore Zone

The nearshore zone extends from the shore zone to the 12-foot (MLW datum) contour. In the smaller tidal rivers the 6-foot depth is taken as the reference depth. The 12-foot depth is probably the maximum depth of significant sand transport by waves in the Chesapeake Bay area. Also, the distinct drop-off into the river channels begins roughly at the 12-foot depth. The nearshore zone includes any tidal flats.

The class limits for the nearshore zone classifications were chosen following a simple statistical study. The distance to the 12-foot underwater contour (isobath) was measured on the appropriate charts at one-mile intervals along the shorelines of Chesapeake Bay and the James, York, Rappahannock, and Potomac Rivers. Means and standard deviations for each of the separate regions and for the entire combined system were calculated and compared. Although the distributions were non-normal, they were generally comparable, allowing the data for the entire combined system to determine the class limits.

The calculated mean was 919 yards with a standard deviation of 1,003 yards. As our aim was to determine general, serviceable class limits, these calculated numbers were rounded to 900 and 1,000 yards respectively. The class limits were set at half the standard deviation (500 yards) each side of the mean. Using this procedure a narrow nearshore zone is one 0-400 yards in width, intermediate 400-1,400, and wide greater than 1,400.

The following definitions have no legal significance and were constructed for our classification

purposes:

- Narrow, 12-ft. (3.7 m) isobath located \leq 400 yards from shore
- Intermediate, 12-ft. (3.7 m) isobath 400-1,400 yards from shore
- Wide, 12-ft. (3.7 m) isobath $>$ 1,400 yards from shore

- Subclasses: with or without bars
- with or without tidal flats
- with or without submerged vegetation

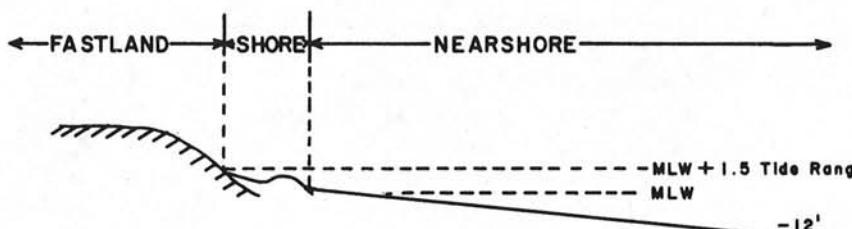


Figure 1

A profile of the three shorelands types.

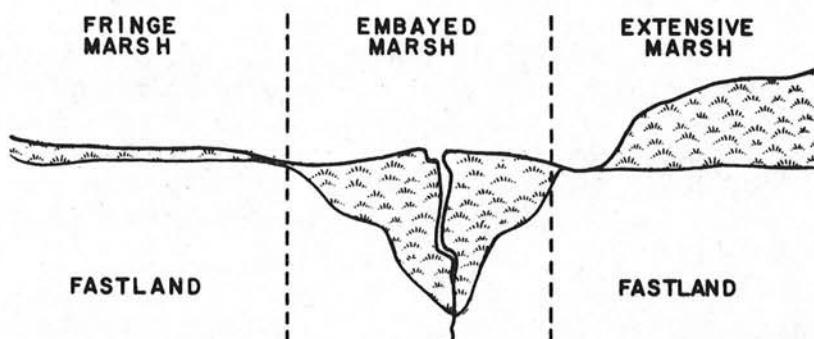


Figure 2

A plan view of the three marsh types.

b) Shorelands Use Classification

Fastland Zone

Residential

Includes all forms of residential use with the exception of farms and other isolated dwellings. In general, a residential area consists of four or more residential buildings adjacent to one another. Schools, churches, and isolated businesses may be included in a residential area.

Commercial

Includes buildings, parking areas, and other land directly related to retail and wholesale trade and business. This category includes small industry and other anomalous areas within the general commercial context. Marinas are considered commercial shore use.

Industrial

Includes all industrial and associated areas. Examples: warehouses, refineries, shipyards, power plants, railyards.

Governmental

Includes lands whose usage is specifically controlled, restricted, or regulated by governmental organizations: e.g., Camp Peary, Fort Story. Where applicable, the Governmental use category is modified to indicate the specific character of the use, e.g., residential, direct military, and so forth.

Recreational and Other Public Open Spaces

Includes designated outdoor recreation lands and miscellaneous open spaces. Examples: golf courses, tennis clubs, amusement parks, public beaches, race tracks, cemeteries, parks.

Preserved

Includes lands preserved or regulated for

environmental reasons, such as wildlife or wild-fowl sanctuaries, fish and shellfish conservation grounds, or other uses that would preclude development.

Agricultural

Includes fields, pastures, croplands, and other agricultural areas.

Unmanaged

Includes all open or wooded lands not included in other classifications:

- a) Open: brush land, dune areas, wastelands; less than 40% tree cover.
- b) Wooded: more than 40% tree cover.

The shoreland use classification applies to the general usage of the fastland area to an arbitrary distance of half mile from the shore or beach zone or to some less distant, logical barrier. In multi-use areas one must make a subjective selection as to the primary or controlling type of usage. For simplicity and convenience, managed woodlands are classified as "unmanaged, wooded" areas.

Shore Zone

Bathing
Boat launching
Bird watching
Waterfowl hunting

Nearshore Zone

Pound net fishing
Shellfishing
Sport fishing
Extraction of non-living resources
Boating
Water sports

c) Shorelands Ownership Classification

The shorelands ownership classification used has two main subdivisions, private and governmental, with the governmental further divided into

federal, state, county, and town or city. Application of the classification is restricted to fastlands alone since the Virginia fastlands ownership extends to mean low water. All bottoms below mean low water are in State ownership.

d) Water Quality

The water quality sections of this report are based upon data abstracted from Virginia State Water Control Board's publication Water Quality Standards (November, 1974) and Water Quality Inventory (305 (b) Report) (April, 1976).

Additionally, where applicable, Virginia Bureau of Shellfish Sanitation data is used to assign ratings of satisfactory, intermediate, or unsatisfactory. These ratings are defined primarily in regard to number of coliform bacteria. For a rating of satisfactory the maximum limit is an MPN (Most Probable Number) of 70 per 100 ml. The upper limit for fecal coliforms is an MPN of 23. Usually any count above these limits results in an unsatisfactory rating, and, from the Bureau's standpoint, results in restricting the waters from the taking of shellfish for direct sale to the consumer.

There are instances however, when the total coliform MPN may exceed 70, although the fecal MPN does not exceed 23, and other conditions are acceptable. In these cases an intermediate rating may be assigned temporarily, and the area will be permitted to remain open pending an improvement in conditions.

Although the shellfish standards are somewhat more stringent than most of the other water quality standards, they are included because of the economic and ecological impacts of shellfish ground closures. Special care should be taken not to endanger the water quality in existing "satisfactory" areas.

e) Zoning

In cases where zoning regulations have been established the existing information pertaining to the shorelands has been included in the report.

f) Shore Erosion and Shoreline Defenses

The following ratings are used for shore erosion:

- slight or none - less than 1 foot per year
- moderate - - - 1 to 3 feet per year
- severe - - - greater than 3 feet per year

The locations with moderate and severe ratings are further specified as being critical or non-critical. The erosion is considered critical if buildings, roads, or other such structures are endangered.

The degree of erosion was determined by several means. In most locations the long term trend was determined using map comparisons of shoreline positions between the 1850's and the 1940's. In addition, aerial photographs of the late 1930's and recent years were utilized for an assessment of more recent conditions. Finally, in those areas experiencing severe erosion field inspections and interviews were held with local inhabitants.

The existing shoreline defenses were evaluated as to their effectiveness. In some cases repetitive visits were made to monitor the effectiveness of recent installations. In instances where existing structures are inadequate, we have given recommendations for alternate approaches. Furthermore, recommendations are given for defenses in those areas where none currently exist. The primary emphasis is placed on expected effectiveness with secondary consideration to cost.

g) Limitations to Shore Use and Potential or Alternate Shore Uses

In this section we point out specific factors which may impose significant limits on the type or extent of shoreline development. This may result in a restatement of other factors from elsewhere in the report, e.g., flood hazard or erosion, or this may be a discussion of some other factor pertaining to the particular area.

Also we have placed particular attention on the recreational potential of the shore zone. The possible development of artificial beach, erosion protection, etc., influence the evaluation of an area's potential. Similarly, potential alternate shore uses are occasionally noted.

h) Distribution of Marshes

The acreage and physiographic type of the marshes in each subsegment is listed. These estimates of acreages were obtained from topographic maps and should be considered only as approximations. Detailed county inventories of the wetlands are being conducted by the Virginia Institute of Marine Science under the authorization of the Virginia Wetlands Act of 1972 (Code of Virginia 62.1-13.4). These surveys include detailed acreages of the grass species composition within individual marsh systems. In Shoreline Situation Reports of counties that have had marsh inventories, the marsh number is indicated, thus allowing the user of the Shoreline Situation Report to key back to the formal marsh inventory for additional data. The independent material in this report is provided to indicate the physiographic type of marsh land and to serve as a rough guide to marsh distribution, pending a formal inventory. Additional information on wetlands characteristics may be found in Coastal Wetlands of Virginia: Interim Report No. 3, by G.M. Silberhorn, G.M. Dawes, and T.A. Barnard, Jr., SRAMSOE No. 46, 1974, and in other VIMS publications.

i) Flood Hazard Levels

The assessment of tidal flooding hazard for the whole of the Virginia tidal shoreland is still incomplete. However, the United States Army Corps of Engineers has prepared reports for a number of localities which were used in this report. Two tidal flood levels are customarily used to portray the hazard. The Intermediate Regional Flood is that flood with an average recurrence time of about 100 years. An analysis of past tidal floods indicates it to have an elevation of approximately 8 feet above mean water level in the Chesapeake Bay area. The Standard Project Flood level is established for land planning purposes which is placed at the highest probable flood level.

j) Shellfish Leases and Public Grounds

The data in this report show the leased and public shellfish grounds as portrayed in the Virginia State Water Control Board publication "Shellfish growing areas in the Commonwealth of Virginia: Public, leased and condemned,"

November, 1971, and as periodically updated in other similar reports. Since the condemnation areas change with time they are not to be taken as definitive. However, some insight to the conditions at the date of the report are available by a comparison between the shellfish grounds maps and the water quality maps for which water quality standards for shellfish were used.

k) Beach Quality

Beach quality is a subjective judgment based upon considerations such as the nature of the beach material, the length and width of the beach area, and the general aesthetic appeal of the beach setting.

CHAPTER 3
Present Shorelands Situation

CHAPTER 3

PRESENT SHORELANDS SITUATION

3.1 THE SHORELANDS OF CHESAPEAKE, NORFOLK, AND PORTSMOUTH

This study is concerned with the cities which are located along the Elizabeth River system and the south side of Hampton Roads. The three cities, Chesapeake, Norfolk, and Portsmouth, plus part of Virginia Beach, form practically a single community, united by the same commercial interests and served by the same ship channels. Development along the shorelands has progressed with little regard to political boundaries.

The study area has 353.8 miles of measured shoreline and 382.0 miles of measured fastland, which are divided amongst the political entities as follows:

	<u>Shoreline</u>	<u>Fastland</u>
Portsmouth	78.5 mi.	83.1 mi.
Chesapeake	110.2 mi.	125.2 mi.
Norfolk	150.1 mi.	155.7 mi.
Virginia Beach	15.1 mi.	17.9 mi.
Total	353.9 mi.	381.9 mi.*

* Differences in mileage figures due to rounding.

All shorelands have elevations of less than 20 feet, seventy-five percent being classified as low shore and twenty-five percent being artificial fill. The artificial fill is found mainly at the large docks, where the shoreline has been filled and stabilized to allow easy access to the docking facilities. The largest fill site is the Craney Island Disposal Area at the mouth of the Elizabeth River. A large peninsula is being formed by the Corps of Engineers from maintenance dredge spoil from the nearby channels.

Although only thirty-eight percent of the shoreline is artificially stabilized, almost the entire channel-fronting shoreline is stabilized, especially in the highly industrialized areas.

(Only twenty-four percent of the shoreline borders on channels deep enough for ocean-going vessels.) Marshes, especially fringe marshes, comprise sixty percent of the shoreline. The remaining shoreline is beach, mainly along the Ocean View section.

The use of the shorelands is directly dependent upon the proximity of nearshore channels. The various channels along the Elizabeth River and its branches give excellent access to the deepwater docking facilities. Briefly, the existing channels are located along the Elizabeth River system as follows:

- a) Along the main channel of the Elizabeth River, from the entrance to its juncture with the Eastern and Southern Branches (40-45-foot depths for 10.2 nm);
- b) along the Western Branch to the Churchland Bridge (14-foot depths for 2.5 nm), then to Drum Point (7-foot depths for 1.9 nm);
- c) along the Eastern Branch to the turning basin near the mouth of the Indian River (22-25-foot depths for 2.5 nm); and
- d) along the Southern Branch to the turning basin south of Newton Creek (35-40-foot depths for 5.4 nm).

Most docking facilities are concentrated along the Norfolk side of the main channel of the Elizabeth River, along both banks of the Eastern Branch upstream to the Campostella Bridge, and along both banks of the Southern Branch to the Gilmerton Bridge. The deepwater terminals handle a varied cargo ranging from petroleum products and coal to fertilizer and chemicals to fruit and grains. The docking facilities are generally comprised of loading and unloading equipment, various storage buildings, and maintenance facilities. Railroad lines provide ready access for inland transport.

There are numerous federal lands that are used for a variety of purposes along the Elizabeth River system. Some of the facilities are:

- 1) U.S. Naval Reservation at Sewells Point, City of Norfolk, Segments 9 and 10. The Naval Reservation includes almost three

quarters of the Willoughby Bay shorelands and also the area around Sewells Point. Among the facilities in the complex are the Naval Air Station, various living quarters, a golf course and heliport along Willoughby Bay. Sewells Point is used for docks and associated industrial facilities. The military lands extend south to within a mile of the Lafayette River. The Armed Forces Staff College is located in the interior part of the base. Another part of the reservation is located approximately halfway between Sewells Point and Tanner Point. This site also is used for industrial purposes, having several docks;

- 2) U.S. Naval Hospital at Hospital Point, City of Portsmouth, Segment 4. The facilities here are mainly the hospital buildings plus an athletic field;
- 3) Norfolk Naval Shipyard, City of Portsmouth, Subsegment 5A. The shorelands are entirely used for industrial purposes, having many docks and drydocks. The shipyard has many associated storage and repair buildings, and living quarters; there is a golf course inland. North of the Naval Shipyard is a Coast Guard Base also used for industrial type purposes;
- 4) U.S. Navy Ammunition Depot, City of Chesapeake, Subsegment 5B. The entire facility, located at the mouth of St. Julian Creek, is used for industrial purposes;
- 5) U.S. Coast Guard Station, Craney Island Creek, City of Portsmouth, Subsegment 2A. Some buildings are located at the mouth of the creek, but much of the land is unused;
- 6) U.S. Naval Supply Center, Craney Island, City of Portsmouth, Subsegments 1B and 2A. The section bordering the Elizabeth River has some docks and many storage facilities. Much of the land bordering the creek is unused;
- 7) Craney Island Disposal Area, City of Portsmouth, Subsegment 1B. This area is a dredged spoil disposal site used by the U.S. Army Corps of Engineers.

There are also several federal holdings near the locks on Deep Creek and at Great Bridge. These lands are for open-space recreational parks.

Although the Elizabeth River is noted for its deepwater docking facilities and many military bases, over fifty percent of the shorelands are used for residential purposes. Primary residential centers are located along the Lafayette River, along much of the Western Branch and the head of the Eastern Branch, and along Ocean View and Little Creek. Basically, wherever industry has failed to locate, residences have been built. Normally, there is a buffer zone of either unused or commercial lands between major military or industrial holdings and residential developments. However, in Chesapeake, Norfolk and Portsmouth, this does not seem to be the case. There are many sections where industry and residences are side by side. This is probably due both to the redevelopment of old residential areas for industrial purposes and to the lack of undeveloped lands in the three cities. The shorelands of the Elizabeth River and its tributaries contain only 22.1 miles of unmanaged, wooded and unwooded land, most of which is located along Deep Creek and at the head of the Southern Branch.

Approximately five percent of the shorelands (19.2 miles) are used for recreation. In a large metropolitan area, recreation is synonymous with open space. However, development threatens to obliterate space relationships through general sprawl. Along the shoreline, most areas with beaches are vied for by a variety of residential, commercial, and industrial developers. Such development threatens to consume the little available shoreline remaining.

The shorelands of Chesapeake, Norfolk, and Portsmouth are generally very vulnerable to flooding due to hurricanes and northeasters. The main hurricane season is from May to November, with most hurricanes occurring from August to October. Northeast storms occur frequently in winter and spring, the most severe often being in March and April. Usually, hurricanes tend to be brief (only one tidal cycle) while northeasters may remain over an area for several tidal cycles (The northeast storm of March, 1962 caused flooding for five successive high astronomical tides.). The rate of rise of a particular storm-induced flood is dependent upon the size, intensity, direction, and speed

of the storm. According to the Norfolk District of the U.S. Army Corps of Engineers, the Standard Project Flood, which is the maximum flood for the area, would occur during a hurricane approaching from an east southeast direction at a speed of about 52 miles per hour, on a path which would bring the storm center about 35 nautical miles south of Norfolk Harbor. This would place the area in the path of the maximum onshore winds and cause water levels to reach 13 feet above MSL along the Elizabeth River. The Intermediate Regional Tidal Flood (the 100 year flood) would reach 8.5 to 9.0 feet above MSL. Generally, the heavily developed areas along the Elizabeth River have average elevations of 10 feet or less. Most large industrial areas are directly bordering the shoreline and have elevations below 10 feet. The 100 year storm would cause severe flooding along most of the shoreline. The Standard Project Flood would inundate most of the area and extend inland for several miles in many sections.

According to the Virginia State Water Control Board's "Water Quality Inventory" (305(b)Report), (April, 1976), Virginia's "navigable water shall be of the quality to provide for the protection and propagation of a balanced population of shellfish, fish, and wildlife, and allow recreational activities in and on the water." The Elizabeth River system does not meet these criteria for water quality. The low water quality is due to several major causes, all stemming, either directly or indirectly, from the intensive industrial and residential use of the area and its shorelands:

- 1) There are numerous waste discharges into the river. Various chemicals and domestic wastes are discharged directly into the system;
- 2) oil spills, due to the intense usage of the river by deepwater craft, are frequent occurrences in the area;
- 3) due to the large amount of bulkhead, leaching of the creosote from the structural members is a continuing problem.

According to the 305(b)Report, it is questionable whether the river can be restored to acceptable levels in the foreseeable future.

The Lafayette River also does not meet the 305(b)Report standards. The river suffers from high fecal coliform levels due to the small freshwater inflow, numerous domestic waste discharges, and the boating and marina activities along the river. Little Creek has no major discharges, but fails to meet water quality standards due to the numerous marine activities which are centered on the creek.

The only area which probably meets the State water quality standards extends from Little Creek to Willoughby Spit. This area fronts the Chesapeake Bay and is very near the Bay mouth. Thus, any pollutants are quickly flushed into the Bay and ocean systems. The good water quality of the section has allowed the Ocean View shoreline to become the recreational center of the area.

3.2 SHORE USE LIMITATIONS

There are many factors which limit the development potential of a particular area. In a highly used area such as Chesapeake, Norfolk, and Portsmouth, where various industrial and commercial interests vie for any unused land, a main limiting factor is the existing land use. Many areas along the shorelands in the tri-city area are already completely used, leaving no room for development. Furthermore, the existing land use for one area should limit the potential land use for surrounding areas (For example, a housing development should not be planned for location adjacent to a factory which gives off fumes and smoke having a high sulfur content.). Though several developments have located in close proximity to heavy industrial areas, this is the exception rather than the rule.

The heavy industrial and commercial use in the tri-city area is mainly associated with the deepwater docking facilities which, by necessity, have to be located along the deepwater channels. As previously stated, these channels extend along parts of all three branches of the Elizabeth River. Elsewhere, some industrial and commercial use is present, but the shorelands are largely consumed by residential developments.

The shorelands along the Elizabeth River have a very limited water-related recreational potential.

Besides the little land available, the poor water quality does not allow the use of the river except for boating activities. Thus, any recreational park along the shorelands must center its facilities toward the use of the land rather than toward the use of the water. Since any shoreland in this area is usually valued at a much higher rate than a comparable site further inland, it is expected that recreational facilities will locate on inland areas.

Another factor which limits the use of any of the shorelands of Chesapeake, Norfolk, and Portsmouth is the high flood hazard. The shorelands usually have elevations of 5 to 10 feet. Since the 100 year storm would flood areas up to 8.5 to 9.0 feet, most structures along the shoreline would be damaged. Any construction in this area, therefore, must deal with this potential threat.

3.3 ALTERNATE SHORE USE

There are few alternatives, if any, to the existing use of the shorelands of Chesapeake, Norfolk, and Portsmouth. The extensive industrial, military, commercial, and residential uses completely consume large amounts of the shorelands. The unsatisfactory water quality and high flood hazard of the area severely limits further development.

One of the main uses of the remaining unused shorelands should be a comprehensive effort to save areas with marshes or other peculiar natural resources. This could be accomplished by creating a series of open-space parks along the shoreline. In a metropolitan area such as the tri-cities, a major effort should be given to the creation and maintenance of open space. These areas not only conserve the quality of the shorelands but also improve the quality of life for the residents.

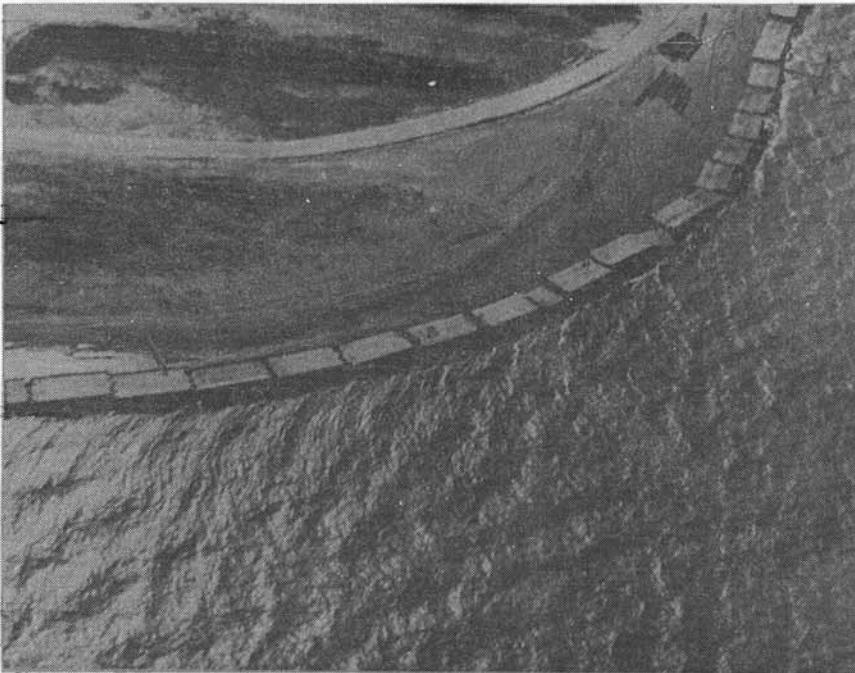


FIGURE 3

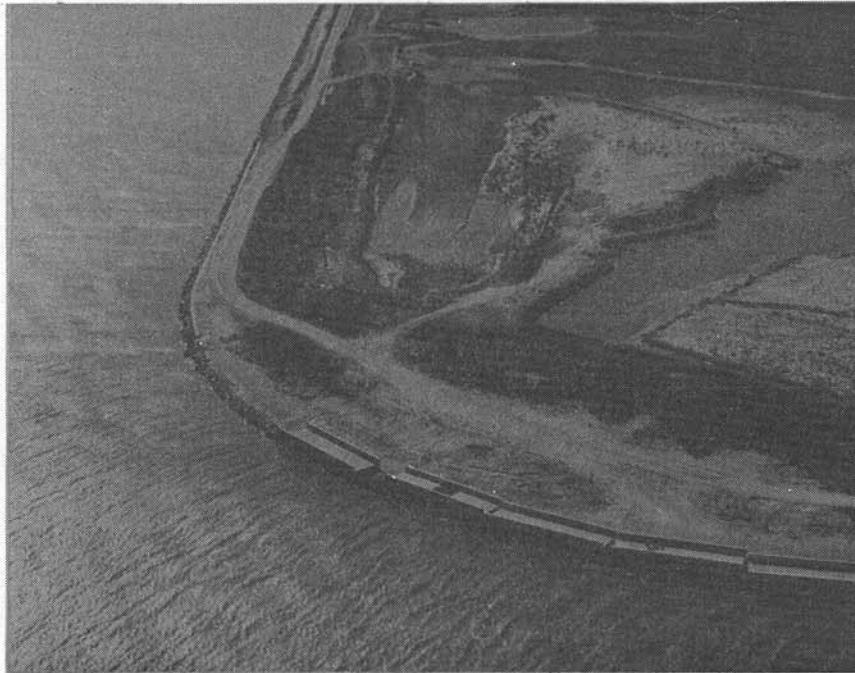


FIGURE 4



FIGURE 5

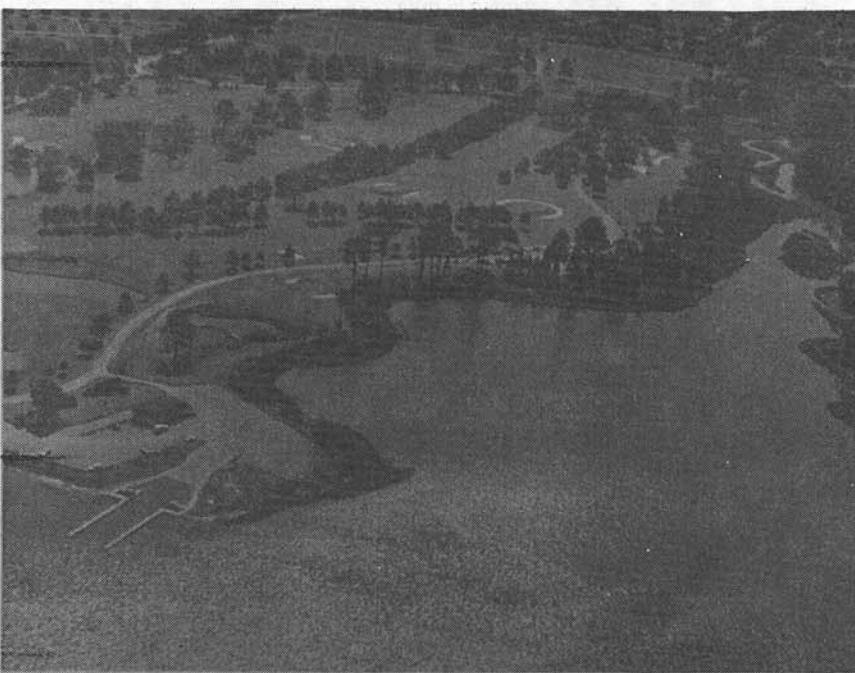


FIGURE 6

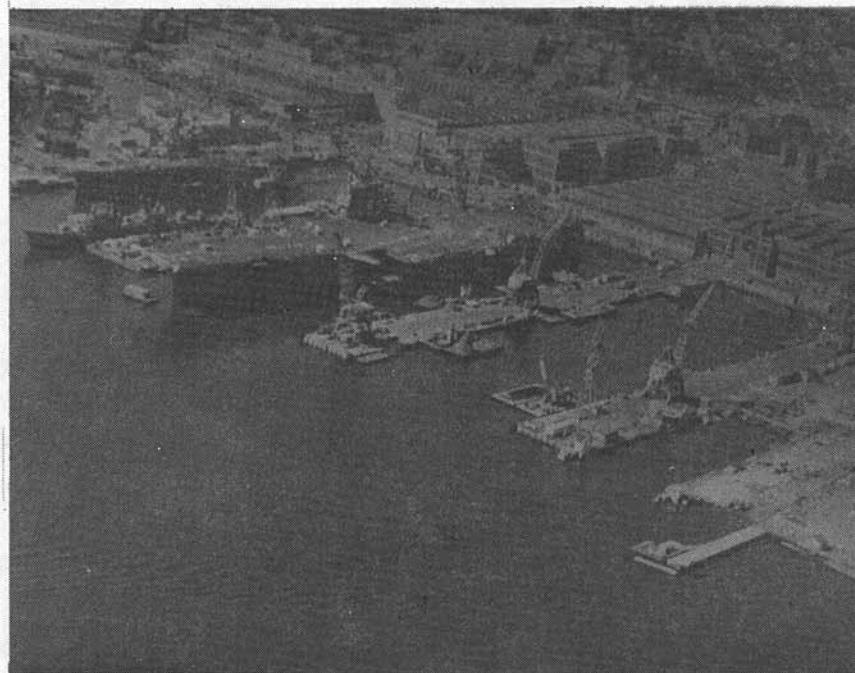


FIGURE 7

FIGURE 3: Craney Island Disposal Site, Subsegment 1B, Portsmouth. The slabs along the shoreline are from the old James River Bridge. This site is used by the U.S. Army Corps of Engineers as a dredge disposal site for the Hampton Roads area.

FIGURE 4: Craney Island Disposal Site, Subsegment 1B, Portsmouth. Most of the area is stabilized with rubble riprap. The Disposal Site will be filled in the near future.

FIGURE 5: Filled marsh area along Western Branch, Subsegment 3B, Chesapeake. Marshes have vital ecological functions and serve as buffers against erosion and flooding. Since 1972, such areas are protected by the Virginia Wetlands Act.

FIGURE 6: City-owned park, Western Branch, Subsegment 3C, Portsmouth. There are few public open space parks in the study area. Open space is a critical concern in metropolitan areas, as it provides much needed recreational opportunities for the surrounding population.

FIGURE 7: Norfolk Naval Shipyard, Southern Branch, Subsegment 5A, Portsmouth. There are numerous such military areas along the Elizabeth River and its branches.

FIGURE 8: Housing development along Deep Creek, Sub-segment 5D, Chesapeake. This area is one of the few sections left which is largely undeveloped. The houses and the surrounding agricultural and wooded areas are very susceptible to flooding.

FIGURE 9: Fringe industrial development, Southern Branch, Subsegment 5B, Chesapeake. Several areas which used to be marsh have been developed along the Southern Branch for industrial purposes. Note the agricultural lands behind.

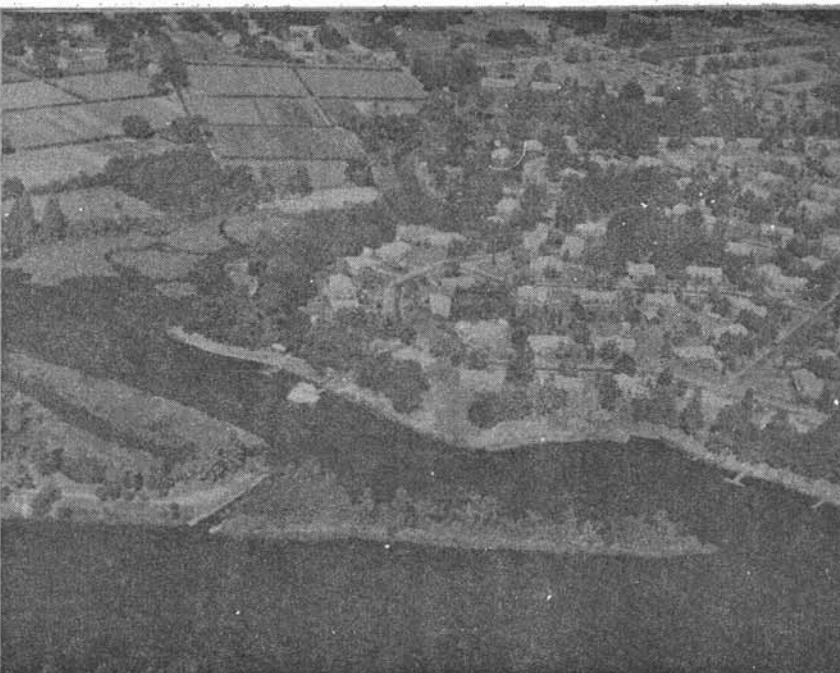


FIGURE 8

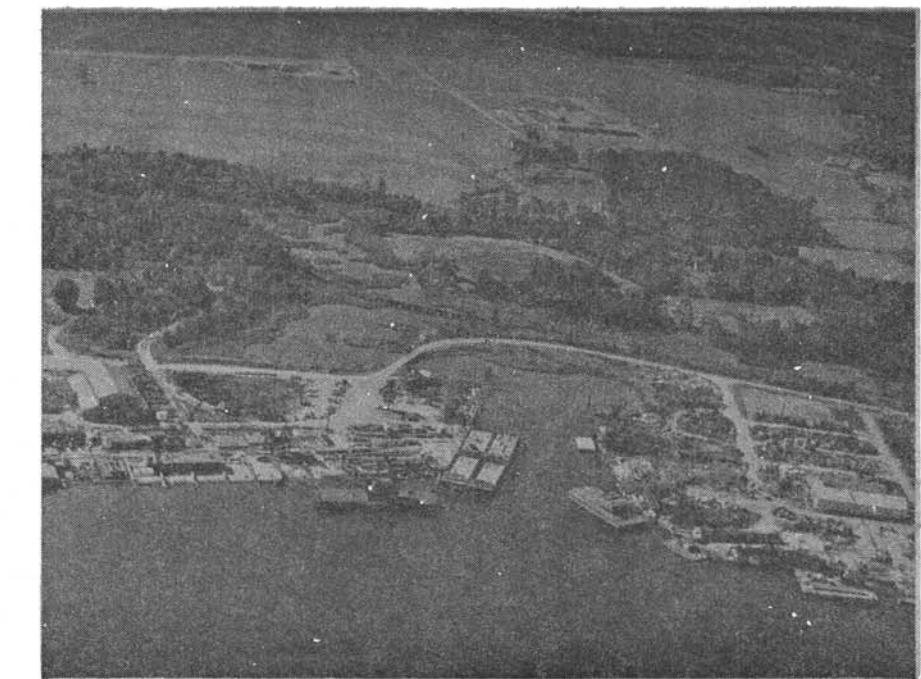


FIGURE 9

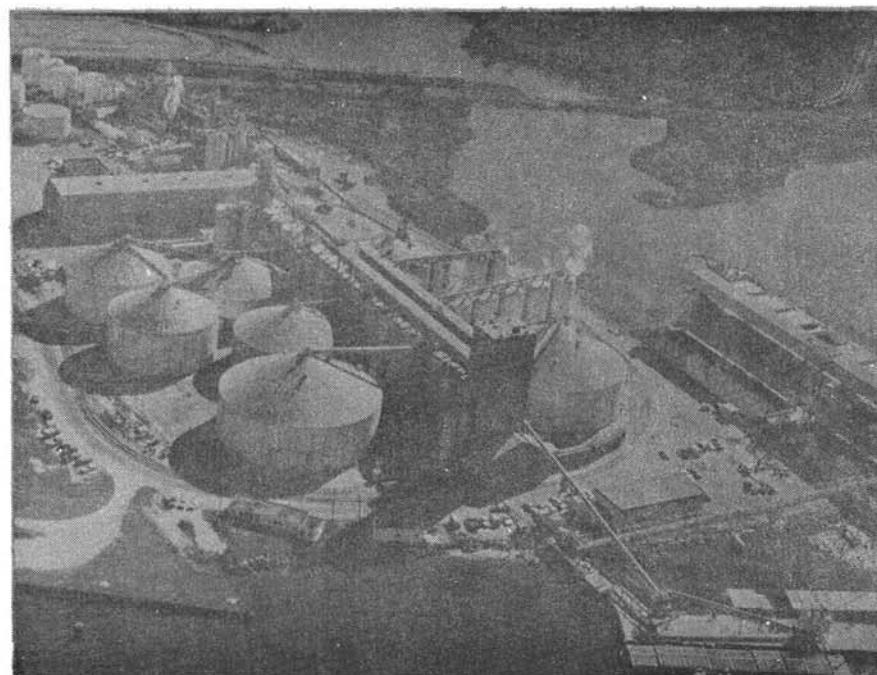


FIGURE 10

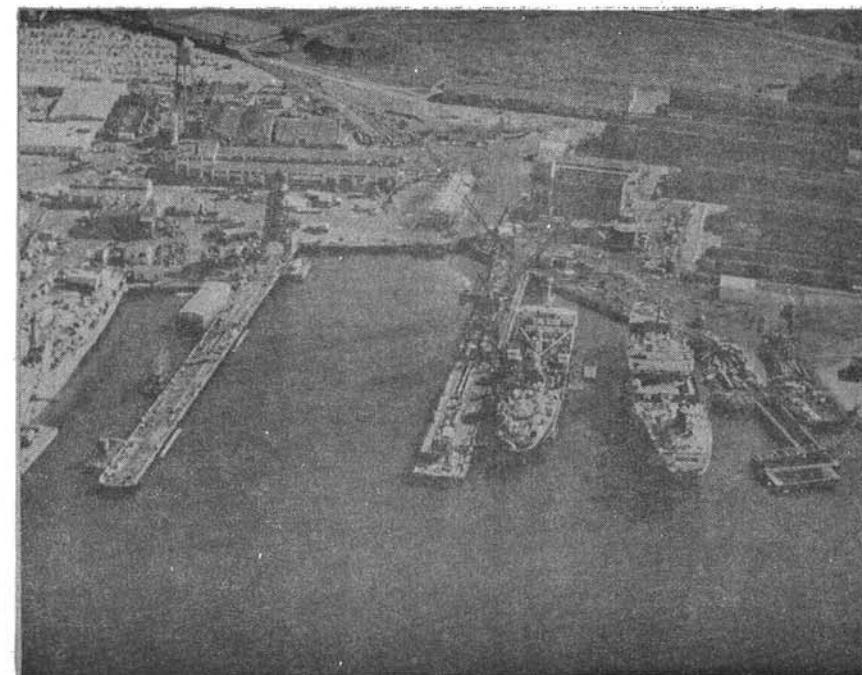


FIGURE 11

FIGURE 10: Mouth of Jones Creek, Southern Branch, Sub-segment 5C, Chesapeake. Development has occurred along most of the shoreline in this part of the Southern Branch, despite the high flood hazard. Industrial and domestic wastes have polluted the Elizabeth River and its tributaries.

FIGURE 11: Docking facilities, Southern Branch, Sub-segment 5C, Norfolk. The good channels allow a wide variety of vessels to dock along the Elizabeth River.

FIGURE 12: Near mouth of Southern Branch, Subsegment 5C, Norfolk. A representative picture of much of the Elizabeth River shoreline.

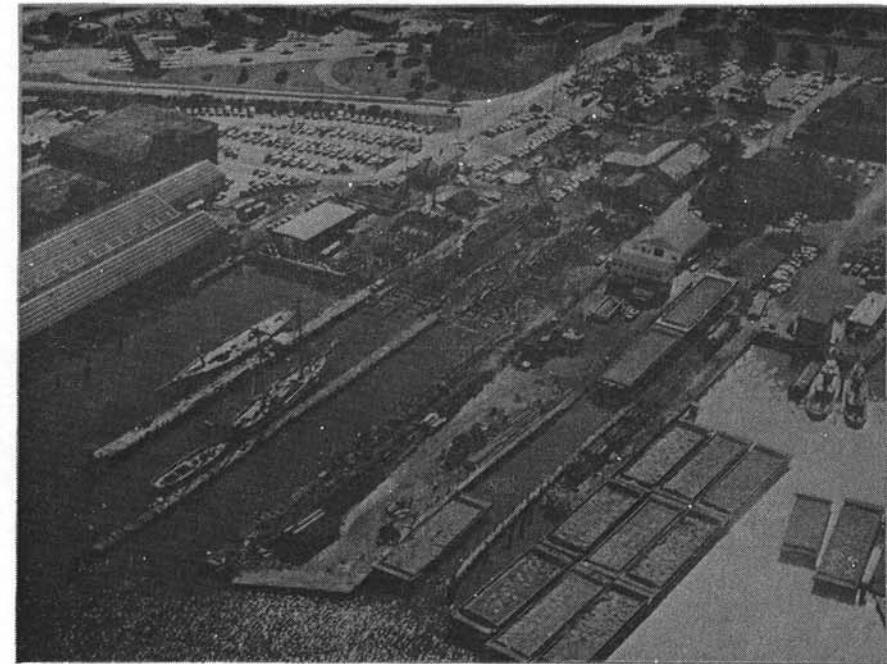


FIGURE 12

FIGURE 13: Cluttered shoreline, Eastern Branch, Subsegment 6A, Norfolk. Such areas are sources of debris in the Elizabeth River system. The area behind is Riverside Memorial Park.

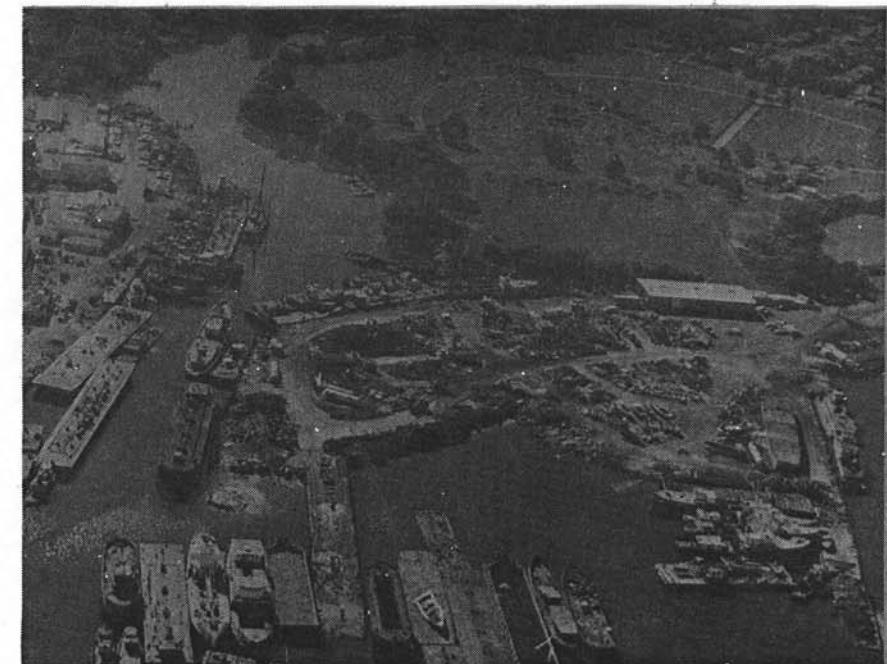


FIGURE 13

FIGURE 14: Head of Indian River, Subsegment 6B, Chesapeake. Residential development here precludes other alternate development. Note the alteration of the shore in the bottom-center of the photo.

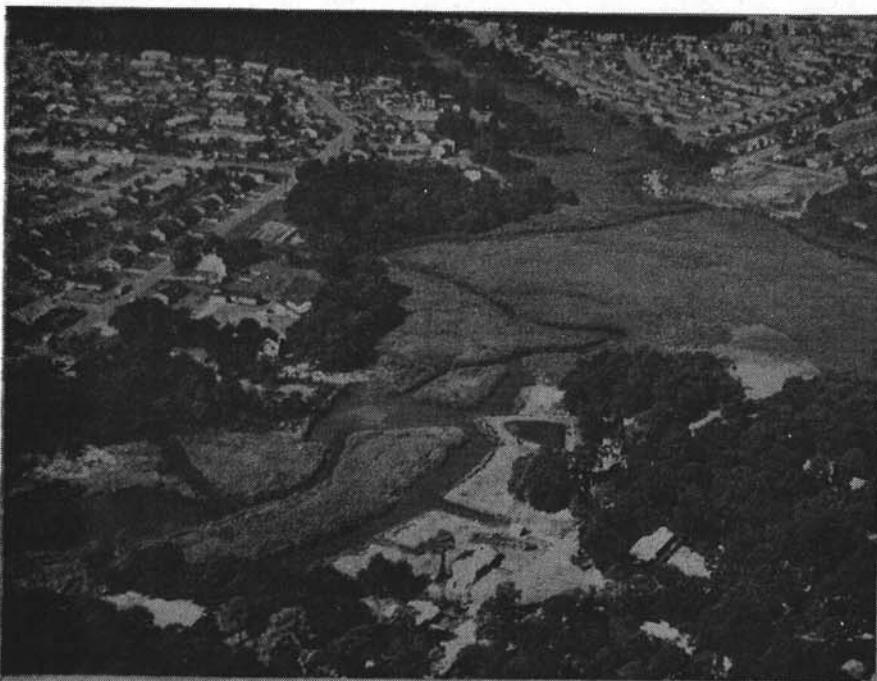


FIGURE 14

FIGURE 15: I-64 bridge, Eastern Branch, Subsegments 6C and 6D, Norfolk and Virginia Beach. This is one of the few agricultural areas along the Eastern Branch. The residential section is in Virginia Beach.



FIGURE 15

FIGURE 16: Residential development, Lafayette River, Segment 8, Norfolk. This area is typical of the intense residential use along most of the Lafayette River.



FIGURE 16

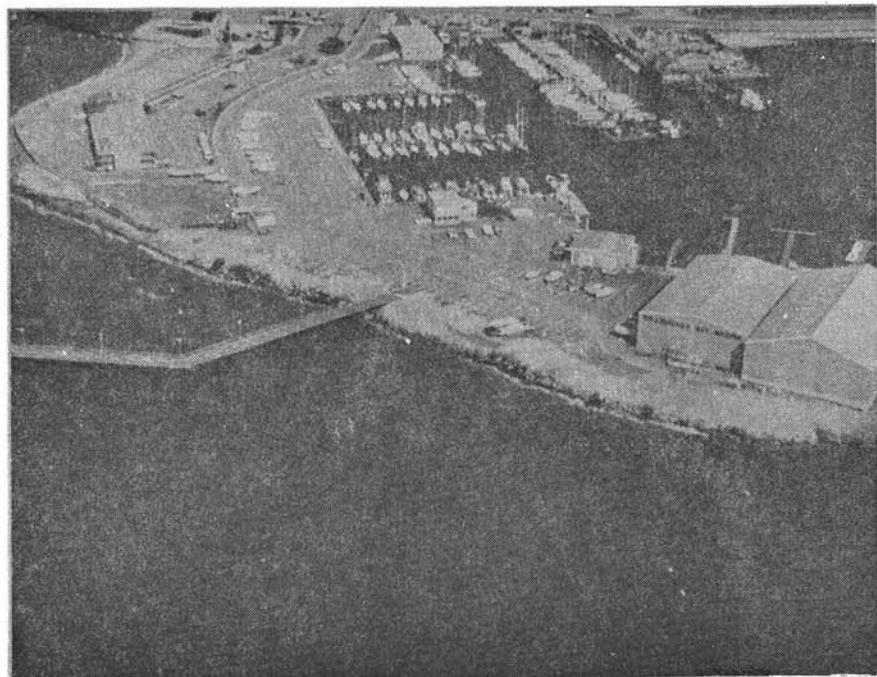


FIGURE 17

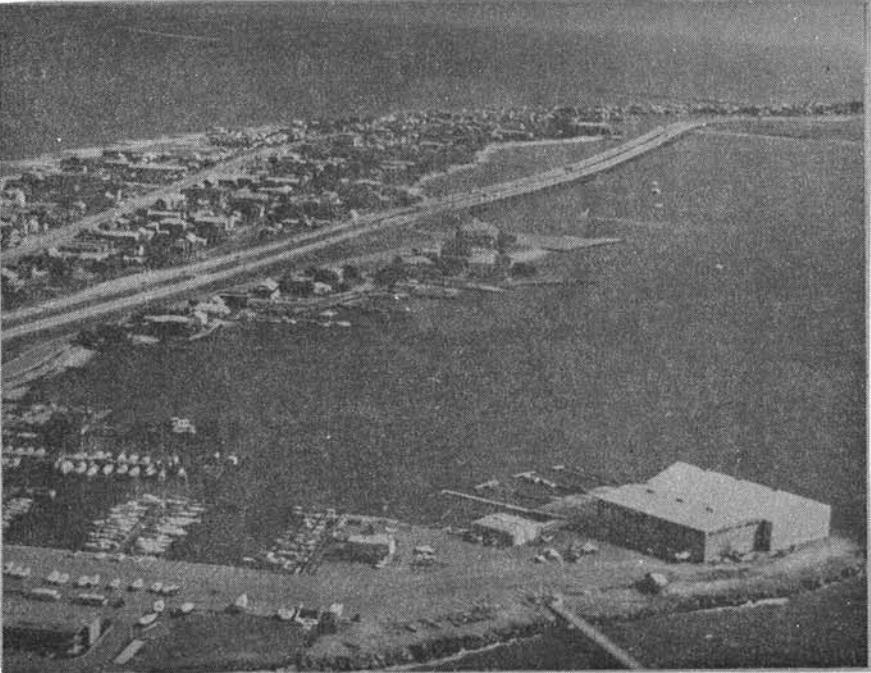


FIGURE 18

FIGURE 17: Willoughby Spit, Hampton Roads, Segment 10, Norfolk. The marina, located on the tip of the spit, is indicative of the great amount of private pleasure boating in the area.

FIGURE 18: Willoughby Spit overview, Hampton Roads, Segments 10 and 11, Norfolk. The spit, used for residential and commercial purposes, would be completely inundated during the 100-year storm.

FIGURE 19: Along Ocean View, Chesapeake Bay, Segment 11, Norfolk. The beach fronting the residential areas is owned by the City of Norfolk. The good water quality allows this section to be used for a variety of recreational purposes.

FIGURE 20: Little Creek, Segment 12, Norfolk. Though there are no major dischargers in the area, intense boating activities cause water quality problems. The shorelands are used for residential and commercial purposes.

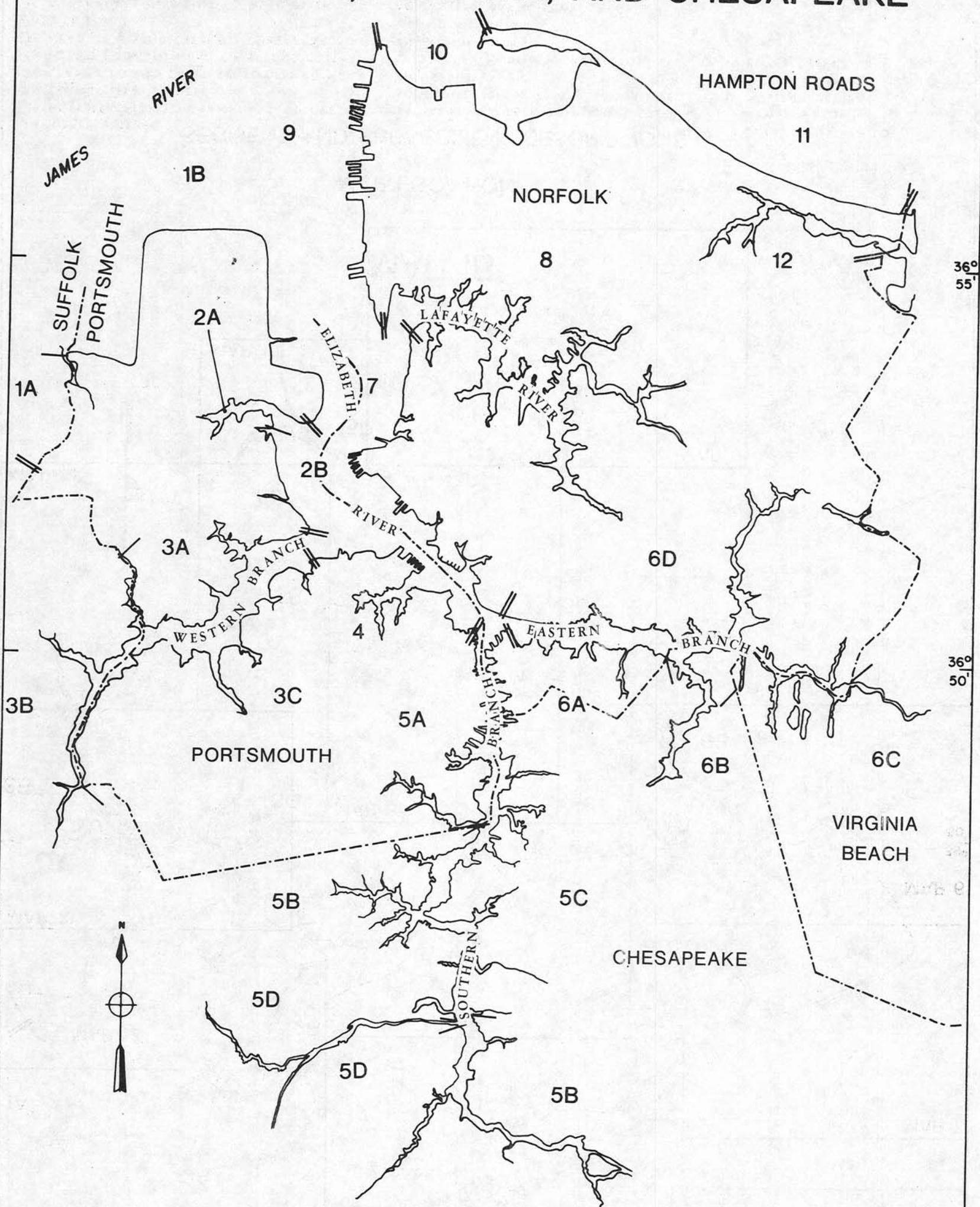


FIGURE 19



FIGURE 20

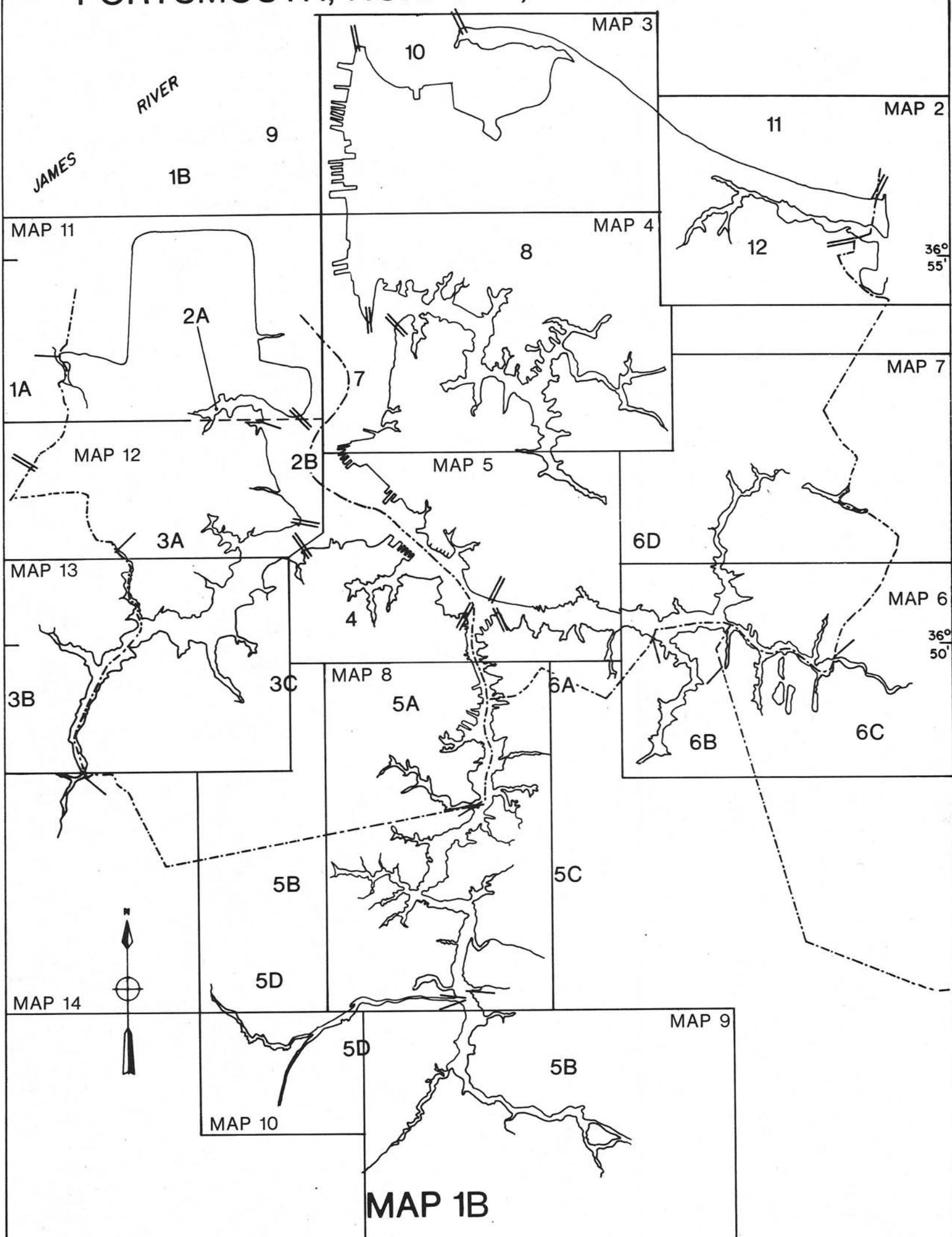
PORTSMOUTH, NORFOLK, AND CHESAPEAKE



MAP BASE COURTESY OF SOUTHEASTERN VIRGINIA PLANNING DISTRICT COMMISSION

1 0 1 2

PORPSMOUTH, NORFOLK, AND CHESAPEAKE



MAP LOCATIONS

SEGMENT AND SUBSEGMENT DESCRIPTIONS

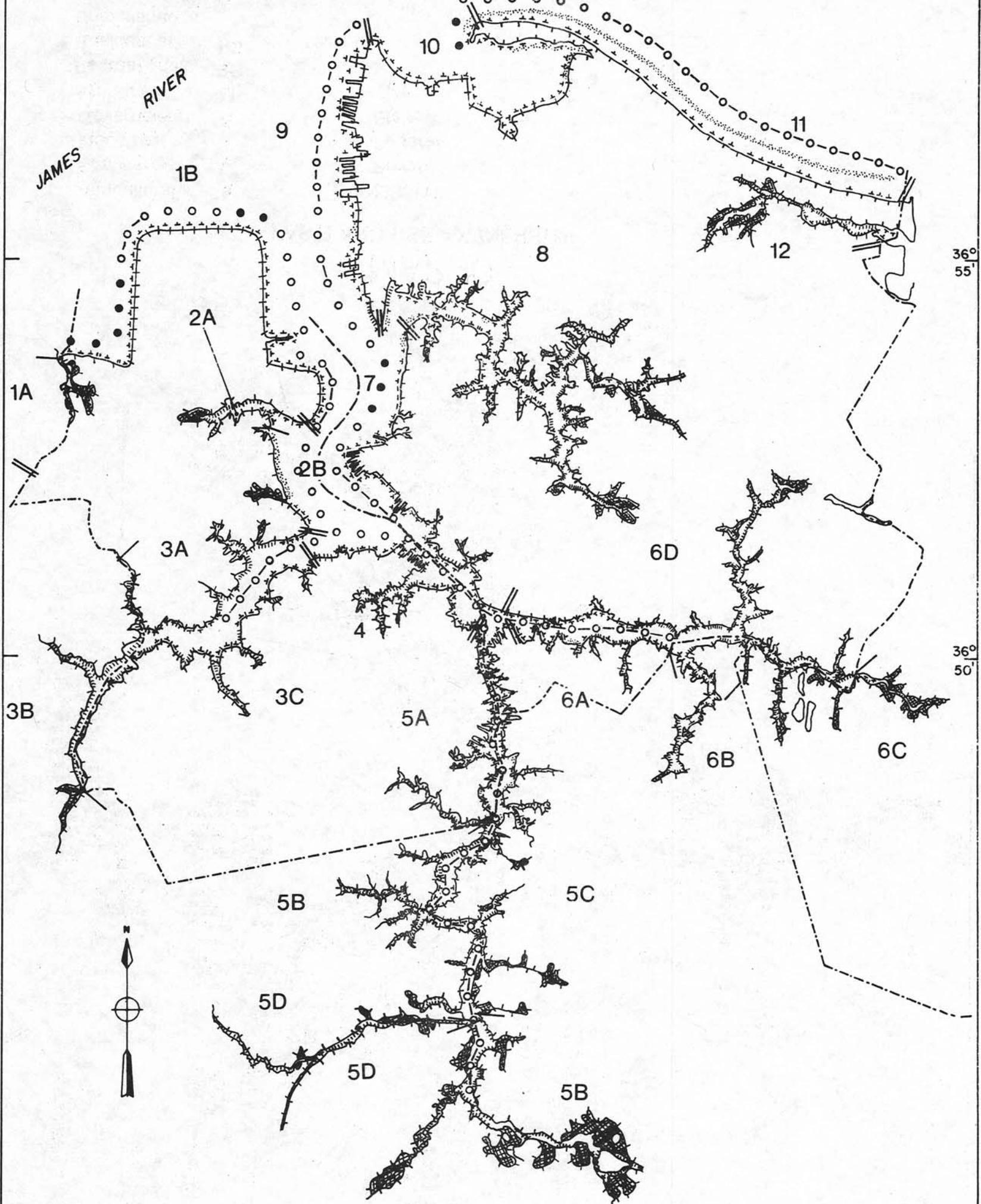
- 1A HOFFLER CREEK
- 1B HOFFLER CREEK TO CRANEY ISLAND CREEK
- 2A CRANEY ISLAND CREEK
- 2B CRANEY ISLAND CREEK TO LOVETT POINT
- 3A LOVETT POINT TO HEAD OF STERNS CREEK
- 3B HEAD OF STERNS CREEK TO CHESAPEAKE CITY LINE
- 3C CHESAPEAKE CITY LINE TO HULL CREEK
- 4 PINNER POINT AREA
- 5A MOUTH OF SOUTHERN BRANCH TO PARADISE CREEK
- 5B PARADISE CREEK TO HODGES CREEK
- 5C HODGES CREEK TO BERKLEY BRIDGE
- 5D DEEP CREEK
- 6A BERKLEY BRIDGE TO MOUTH OF INDIAN RIVER
- 6B INDIAN RIVER
- 6C EASTERN BRANCH (VA. BEACH)
- 6D EASTERN BRANCH (NORFOLK)
- 7 TOWN POINT TO LAFAYETTE RIVER
- 8 LAFAYETTE RIVER
- 9 LAFAYETTE RIVER TO SEWELLS POINT
- 10 WILLOUGHBY BAY
- 11 OCEAN VIEW
- 12 LITTLE CREEK

76°12' 76°15'

SCALE OF MILES



PORPSMOUTH, NORFOLK, AND CHESAPEAKE

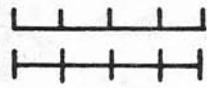


MAP 1C

SHORELANDS TYPES

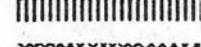
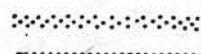
FASTLAND

- Low Shore
- Artificial Fill



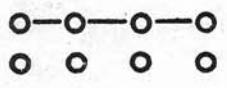
SHORE

- Beach
- Fringe Marsh
- Embayed Marsh
- Artificially Stabilized



NEARSHORE

- Narrow
- Intermediate
- Wide



76° 20'

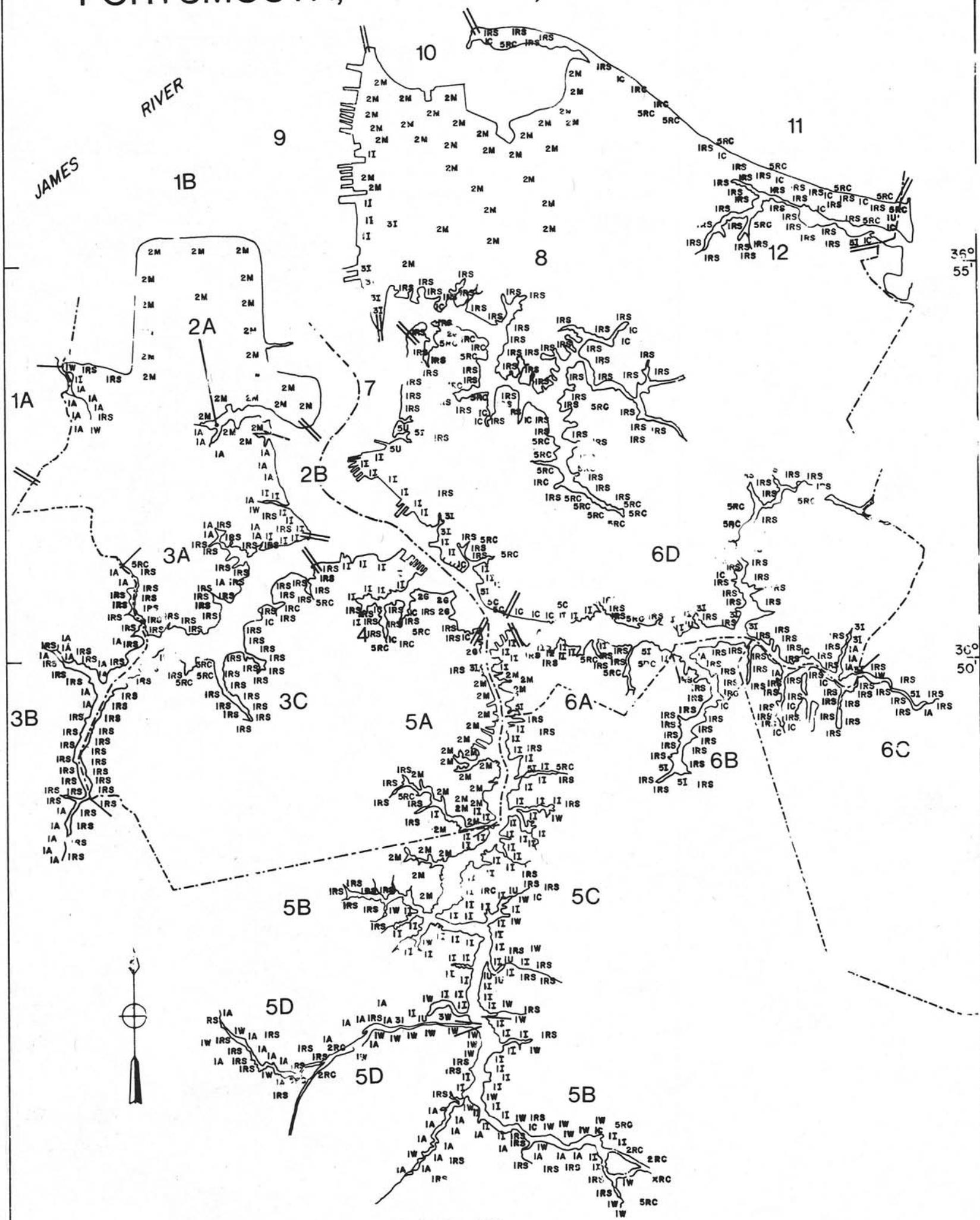
76° 15'

SCALE OF MILES



2

PORPSMOUTH, NORFOLK, AND CHESAPEAKE



MAP 1D

FASTLAND USE, OWNERSHIP

USE

Agricultural	A
Commercial	C
Industrial	I
Government	G
Military	M
Recreational	RC
Residential	RS
Unmanaged	
Unwooded	U
Wooded	W

OWNERSHIP	
Private	1
Federal	2
State	3
City	5

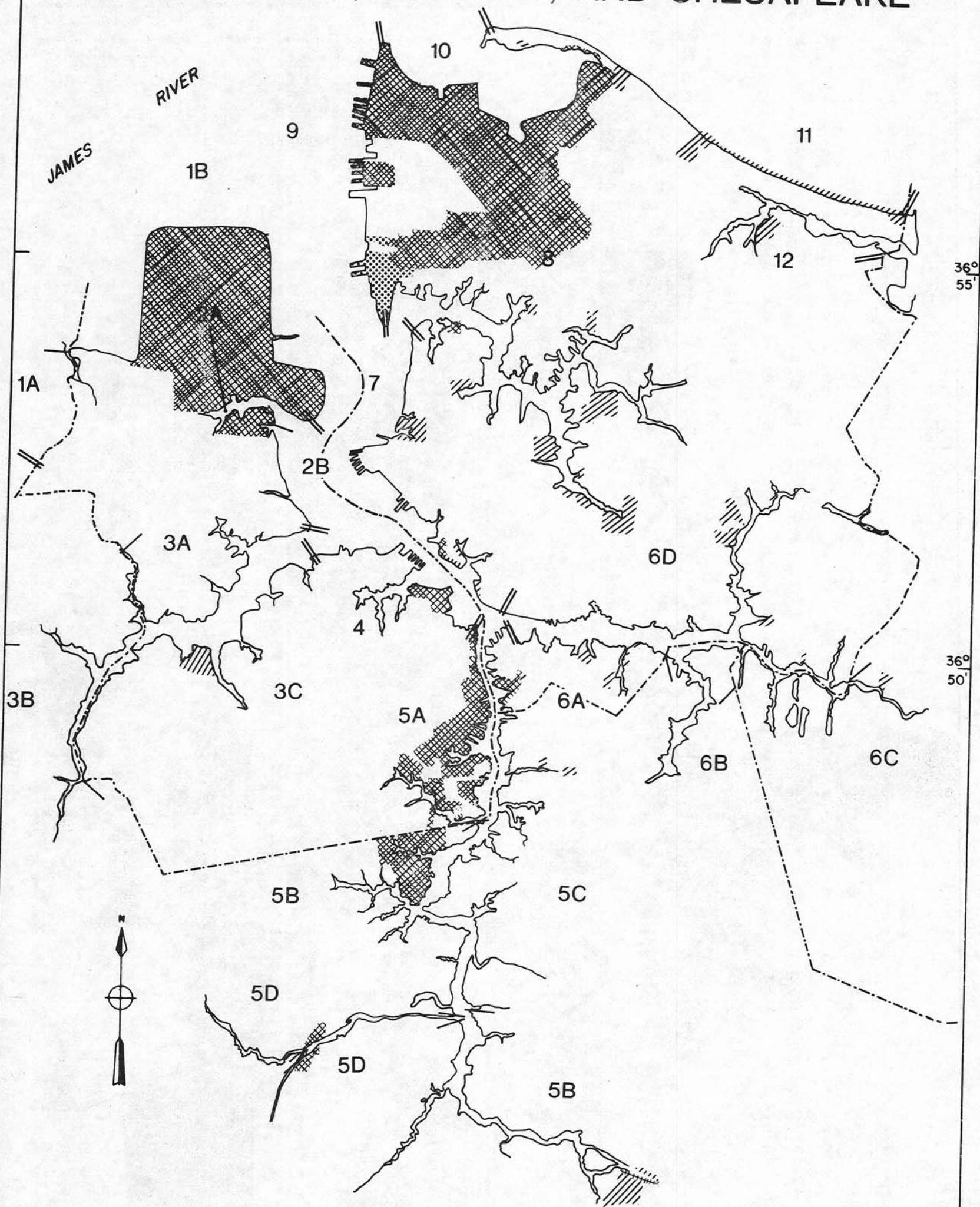
76° 20'

76° 15'

SCALE OF MILES



PORPSMOUTH, NORFOLK, AND CHESAPEAKE



MAP 1E

FASTLAND OWNERSHIP

- [Hatched square] City
- [Cross-hatched square] Federal
- [Solid dark square] State
- No Symbol Private

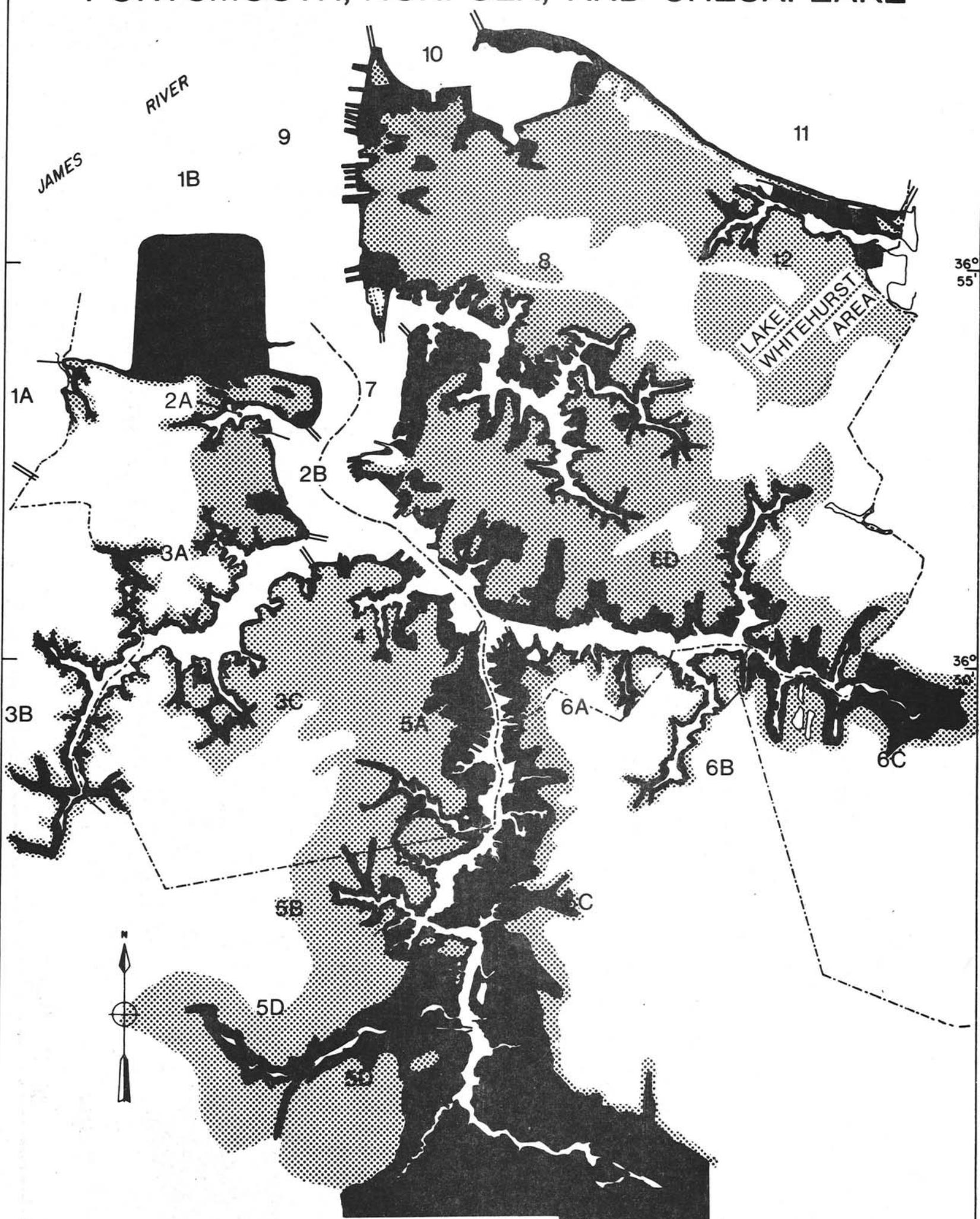
76° 20'

76° 15'

SCALE OF MILES



PORTSMOUTH, NORFOLK, AND CHESAPEAKE



MAP 1F

FLOOD PLAINS

Intermediate Regional Tidal Flood

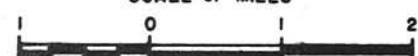
Standard Project Tidal Flood

- ¹ Data Extracted From:
"Flood Plain Information, Coastal Flooding, Portsmouth, Virginia", U. S. Army Corps Of Engineers, Norfolk District, February, 1973.
"Flood Plain Information, Coastal Flooding, City Of Chesapeake, Virginia", U. S. Army Corps Of Engineers, Norfolk District, December, 1972.
² "Flood Plain Information, Coastal Flooding, Norfolk, Virginia," U. S. Army Corps Of Engineers, Norfolk District, March, 1970.
All Flood Data For Military Bases Extrapolated From USGS, 7.5 MIN, Ser. Topographs.

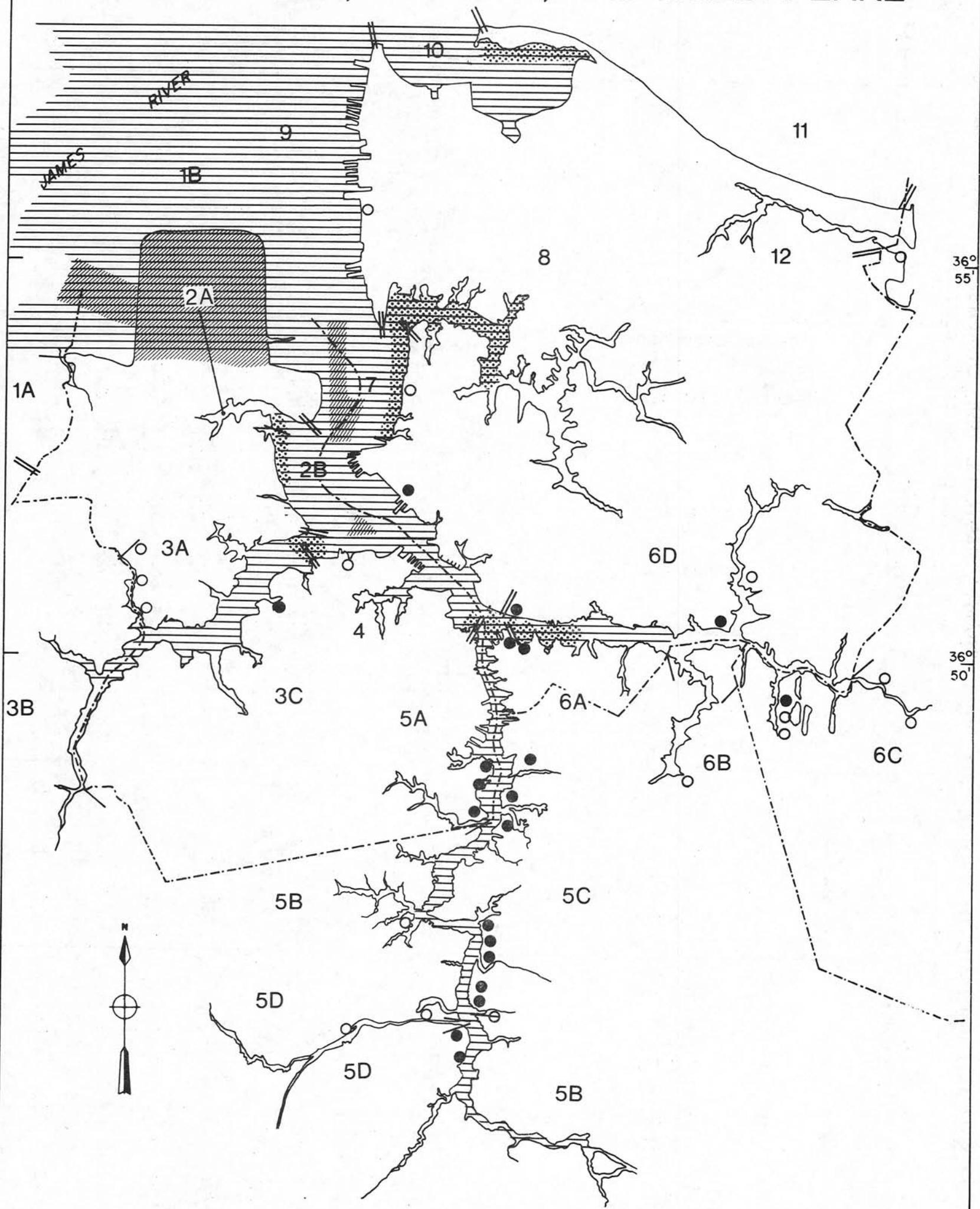
SCALE OF MILES

$76^{\circ} 20'$

$76^{\circ} 15'$



PORPSMOUTH, NORFOLK, AND CHESAPEAKE



MAP 1G

SHELLFISH AREAS

Public Grounds	
Leased Areas	
Condemned Areas	

WASTE DISCHARGES

Industrial	
Domestic	

[Data From: "Public, Leased And Condemned Shellfish Growing Areas In The Commonwealth Of Virginia", Virginia State Water Control Board, May, 1971.]

SCALE OF MILES

76°120'

76°15'

0 1 2

TABLE 1. CHESAPEAKE, NORFOLK, AND PORTSMOUTH SHORELANDS PHYSIOGRAPHY, FASTLAND USE, OWNERSHIP (STATUTE MILES)

Physiographic, use and ownership classification	SHORELANDS PHYSIOGRAPHY										FASTLANDS USE						OWNERSHIP			TOTAL MILES				
	FASTLAND		SHORE					NEARSHORE																
	ARTIFICIAL FILL	LOW SHORE	ARTIFICIALLY STABILIZED	BEACH	FRINGE MARSH	EMBAYED MARSH	EXTENSIVE MARSH	NARROW	INTERMEDIATE	WIDE	AGRICULTURAL	COMMERCIAL	GOVERNMENTAL	INDUSTRIAL	RECREATIONAL	RESIDENTIAL	UNMANAGED, UNWOODED	UNMANAGED, WOODED	PRIVATE	CITY	FEDERAL	STATE	SHORE	FASTLAND
Subsegment																								
1A		4.7		0.2	1.8			C R E E K		4.6		0.1							4.7				2.0	4.7
1B	7.2	1.2	7.6	0.1	0.7	2.6		C R E E K	1.4 3.9	7.3		0.9						1.1	7.3			8.4	8.4	
2A	2.0	3.3	1.0	1.1	0.5	0.8			2.0	1.2	4.1							1.2	4.1			5.1	5.3	
2B	1.1	2.8	1.1	1.1	0.5	0.8			2.5	0.8	0.9	1.6						3.0	0.9			3.6	3.9	
3A	4.0	13.8	5.6	0.2	10.0	0.7		R I V E R		15.3								17.8				16.6	17.8	
3B	2.3	32.5	2.0		19.5	10.6			0.2 2.6	0.5								34.7	0.1			32.1	34.8	
3C	3.6	14.8	5.0	0.1	10.8	2.8			0.6 3.6	1.1	1.5	5.2						16.7	1.7			18.6	18.4	
4	5.7	5.7	6.3	0.5	4.5				8.4	0.1	8.2	2.4	0.1	2.5				9.8	1.6			11.4	11.4	
5A	8.9	4.4	8.6	0.4	1.8	2.0			10.6	4.5	0.7	1.9	7.7	2.4	9.8	12.9	35.3	2.0	2.2	0.4		32.5	39.9	
5B	5.8	34.1	5.5	0.4	16.3	10.3			9.2	0.6	1.2	10.3	0.3	13.7	0.7	1.2	26.0	0.7	1.2	0.1		24.8	28.0	
5C	9.5	18.5	10.2	0.6	10.1	3.9		C R E E K		1.8								6.4	1.6	1.1	0.8	8.4	9.9	
5D		9.9	0.6	1.5	3.6	2.8			3.6	0.1		4.5	0.9	1.4				5.9	1.1			7.0	7.0	
6A	3.6	3.4	3.9	0.2	2.8					0.7	0.4		1.2		14.2			15.6	0.9			16.2	16.5	
6B	0.8	15.7	4.4		11.1	0.7		R I V E R	1.6	0.8	0.4		0.2	0.6	15.4		0.5	17.1	0.8			15.1	17.9	
6C	1.1	16.8	3.5		7.7	3.9				0.9	1.0	0.2	5.3	1.0	23.2	0.6		29.4	1.3		1.5	30.5	32.2	
6D	5.7	26.5	10.1	0.1	18.7	1.6			4.7	0.2	0.2	10.1	0.4	2.7	0.9		11.9	2.4	0.2		14.5	14.5		
7	12.7	1.8	14.0		0.5			R I V E R	10.7 0.8	1.6	2.0	0.4	0.9	5.4	50.4			52.6	5.2	0.4	0.9	56.6	59.1	
8	4.2	54.9	22.0	0.6	28.0	5.6	0.5		6.4 1.4		3.5	4.3						1.9	3.5	2.4		7.8	7.8	
9	7.8		7.0	0.4	0.4				0.3	1.2	7.4		0.3	1.3				2.5	0.3	7.4		10.2	10.2	
10	7.6	2.6	8.7	1.3	0.2					5.4	1.7	1.0	5.0					6.0	1.1			7.1	7.1	
11		7.1	4.2	2.9						2.7		0.1	0.7	10.4				13.1	0.8			12.5	13.9	
12	1.1	12.8	3.3	0.7	6.4	2.2		C R E E K																
TOTAL	94.7	287.3	134.6	11.1	155.2	52.3	0.5		61.7 19.6	5.0	33.3	12.0	36.8	54.6	19.2	203.9	2.9	19.2	321.9	20.3	33.7	6.1	353.8	382.0
% of FASTLAND	25%	75%									9%	3%	10%	14%	5%	53%	1%	5%	84%	5%	9%	2%		100%
% of SHORELINE				38%	3%	44%	15%	1%	17% 6%	1%													100%	

CHAPTER 4

- 4.1 Table of Subsegment Summaries
- 4.2 Segment and Subsegment Descriptions
- 4.3 Segment and Subsegment Maps

TABLE 2. SUBSEGMENT SUMMARIES, CITIES OF CHESAPEAKE, NORFOLK, AND PORTSMOUTH, VIRGINIA

SUBSEGMENT	SHORELANDS TYPE	SHORELANDS USE	OWNERSHIP	FLOOD HAZARD	WATER QUALITY	BEACH QUALITY	SHORE EROSION SITUATION	ALTERNATE SHORE USE
1A PORTSMOUTH HOFFLER CREEK, EAST BANK 2.0 miles (4.7 miles of fastland)	FASTLAND: Entirely low shore. SHORE: Fringe marsh 13% and embayed marsh 87%. CREEK: Narrow and shallow.	FASTLAND: Agricultural 98% and industrial 2%. SHORE: Some waterfowl hunting in the marshes, but mostly unused. CREEK: Some sport fishing but mostly unused.	Private.	Low, noncritical.	No data for Hoffler Creek. The lower James River suffers from water quality problems due to industrial and residential buildup.	No beaches.	No data. The area appears to be stable. There are no endangered or shore protective structures.	Low. The lack of access to the shore reduces development potential. A low intensity recreational park is feasible near the head of the creek.
1B PORTSMOUTH HOFFLER CREEK TO CRANEY ISLAND CREEK 8.4 miles (8.4 miles of fastland)	FASTLAND: Artificial fill 85% and low shore 15%. SHORE: Artificially stabilized 91%, beach 1%, and fringe marsh 8%. NEARSHORE: Narrow 17%, intermediate 46%, and wide 36%.	FASTLAND: Governmental 86%, residential 11%, and unmanaged, wooded 3%. SHORE: The narrow shore zone affords little use of the area. NEARSHORE: Commercial and military shipping to the numerous docks along the Elizabeth River and Hampton Roads.	Federal 86% and private 14%.	Severe, critical.	Unsatisfactory.	Poor to fair. The subsegment has beaches of moderate width in some areas, though they are often vegetated.	No data. Most areas have been artificially stabilized, thus eliminating any erosion problems.	Low. All the shorelands in this subsegment are effectively used by either federal or private concerns.
2A PORTSMOUTH CRANEY ISLAND CREEK 5.1 miles (5.3 miles of fastland)	FASTLAND: Artificial fill 37% and low shore 63%. SHORE: Artificially stabilized 20%, fringe marsh 28%, and embayed marsh 52%. CREEK: Too narrow and shallow for classification.	FASTLAND: Agricultural 23% and governmental 77%. SHORE: Most of the shore zone is owned and used by the government. CREEK: Craney Island Creek is little used.	Federal 77% and private 23%.	Severe, critical.	Unsatisfactory.	No beaches.	No data. The area appears to be stable. The mouth of Craney Island Creek has riprap on the northern bank and bulkhead on the southern bank. These structures appear to be effective.	Low. The only alternate use of the shorelands would be along the creek head, where a low intensity public park could be established.
2B PORTSMOUTH CRANEY ISLAND CREEK TO LOVETT POINT 3.6 miles (3.9 miles of fastland)	FASTLAND: Artificial fill 29% and low shore 71%. SHORE: Artificially stabilized 30%, beach 32%, fringe marsh 15%, and embayed marsh 23%. RIVER: Intermediate.	FASTLAND: Agricultural 19%, governmental 23%, industrial 42%, residential 9%, and unmanaged, wooded 7%. SHORE: Commercial access to the river, especially at Lovett Point. RIVER: Commercial and military shipping to the docks on the Elizabeth River.	Federal 23% and private 77%.	Moderate, noncritical.	Unsatisfactory.	Poor to fair. Most areas have thin, strip beaches. The area north of the mouth of Lake Kingman has a nice wide beach.	No data. The area appears to be stable. The bulkhead at the Coast Guard Station is mainly for retaining fill. The Lovett Point area has some effective rubble riprap.	Low. This area lacks any lands suitable for development as a public recreational park.
3A PORTSMOUTH LOVETT POINT TO STERNS CREEK 16.6 miles (17.8 miles of fastland)	FASTLAND: Artificial fill 23% and low shore 77%. SHORE: Artificially stabilized 34%, beach 1%, fringe marsh 61%, and embayed marsh 4%. RIVER: Narrow 15%. The remainder of the shoreline is located along Lilly and Sterns Creeks.	FASTLAND: Agricultural 15%, industrial 4%, and residential 81%. SHORE: The shore zone is used for industrial purposes near Lovett Point. The remainder is privately used. RIVER: Some commercial shipping and pleasure boating.	Private.	Moderate, critical.	Unsatisfactory.	Poor. There is one section of narrow, strip beach in this subsegment.	No data. The area appears to be stable. There is approximately 5.6 miles of effective artificially stabilized shoreline in this subsegment. The majority is cosmetic bulkhead used for retaining fill.	Low. The eastern bank of Lilly Creek is the only area which could have any moderate scale development, though this would be at the sacrifice of the agriculture.
3B CHESAPEAKE STERNS CREEK TO THE CHESAPEAKE - PORTSMOUTH CITY LINE 32.1 miles (34.8 miles of fastland)	FASTLAND: Artificial fill 7% and low shore 93%. SHORE: Artificially stabilized 6%, fringe marsh 61%, and embayed marsh 33%. RIVER: Too narrow and shallow for classification.	FASTLAND: Agricultural 44%, recreational 3%, and residential 53%. SHORE: Privately used in the residential sections. RIVER: Little commercial use. The Western Branch is mainly used for pleasure boating.	Private 99% and city <1%.	Moderate, critical.	Unsatisfactory.	No beaches.	No data. The area appears to be stable. Approximately 10,400 feet of the shoreline has been artificially stabilized. The majority of this is cosmetic bulkheading.	Low. There are some areas along Goose Creek which could be developed as recreational parks. However, the area loses much of its water-related value due to the poor water quality and the shallowness of the creek.
3C PORTSMOUTH CITY LINE TO THE MOUTH OF HULL CREEK 18.6 miles (18.4 miles of fastland)	FASTLAND: Artificial fill 19% and low shore 81%. SHORE: Artificially stabilized 27%, beach <1%, fringe marsh 58%, and embayed marsh 15%. RIVER: Narrow 1% and intermediate 14%. The remainder of Western Branch is too narrow and shallow for classification.	FASTLAND: Commercial 3%, recreational 12%, and residential 85%. SHORE: Little used except at the City Park along the west bank of Baines Creek. RIVER: Some commercial traffic but mostly pleasure boating.	Private 91% and city 9%.	Moderate, critical.	Unsatisfactory.	Poor. There are several areas of thin, strip beaches in the subsegment.	No data. The area appears to be stable. There are approximately 26,200 feet of artificially stabilized shoreline in this subsegment, the majority being effective cosmetic bulkheading.	Low. There is little shoreland available for development in this subsegment.
4 PORTSMOUTH PINNER POINT AREA 11.4 miles (11.4 miles of fastland)	FASTLAND: Artificial fill 50% and low shore 50%. SHORE: Artificially stabilized 55%, beach 5%, and fringe marsh 40%. NEARSHORE: Narrow 5% and intermediate 32%. The remaining shoreline is located along Scott Creek which is too shallow and narrow for classification.	FASTLAND: Commercial 9%, governmental 14%, industrial 46%, and residential 31%. SHORE: Approximately half the shoreline is used for commercial and industrial purposes. The remainder is used for private recreation. NEARSHORE: Commercial shipping and some pleasure boating.	Private 86% and federal 14%.	Severe, critical.	Unsatisfactory.	Poor. The area fronting Bay View Blvd. has a thin, strip beach interspersed with fringe marsh.	No data. The area appears to be stable. Approximately 33,400 feet of the shoreline is artificially stabilized, two-thirds being bulkhead and the rest riprap. These structures are for cosmetic purposes and appear to be effective.	None. The entire subsegment is actively used and no lands are available for alternate development.

TABLE 2 (Cont'd)

SUBSEGMENT	SHORELANDS TYPE	SHORELANDS USE	OWNERSHIP	FLOOD HAZARD	WATER QUALITY	BEACH QUALITY	SHORE EROSION SITUATION	ALTERNATE SHORE USE
5A PORTSMOUTH MOUTH OF SOUTHERN BRANCH TO PARADISE CREEK 12.8 miles (13.3 miles of fastland)	FASTLAND: Artificial fill 67% and low shore 33%. SHORE: Artificially stabilized 67%, beach 4%, fringe marsh 14%, and embayed marsh 15%. NEARSHORE: Narrow 66%. Paradise Creek is too narrow and shallow for classification.	FASTLAND: Commercial 1%, governmental 62%, industrial 18%, recreational 1%, and residential 18%. SHORE: Military - industrial usage along much of the shoreline (Naval Shipyards). NEARSHORE: Commercial, industrial, and military traffic to the docks along the Southern Branch.	Private 36%, federal 62%, and city 2%.	Severe, critical.	Unsatisfactory.	Poor. There are two areas with thin, strip beaches.	No data. The area appears to be stable. Sixty-seven percent of the shoreline is artificially stabilized, most of which is bulkhead. This bulkhead is mainly for cosmetic purposes rather than for erosion protection.	Low. No new or alternate development seems possible for the subsegment.
5B CHESAPEAKE PARADISE CREEK TO HODGES CREEK 32.5 miles (39.9 miles of fastland)	FASTLAND: Artificial fill 14% and low shore 86%. SHORE: Artificially stabilized 17%, beach 1%, fringe marsh 50%, and embayed marsh 32%. NEARSHORE: Narrow 33%. The remainder of the subsegment is located along several creeks, which are too narrow and shallow for classification.	FASTLAND: Agricultural 11%, commercial 2%, governmental 5%, industrial 19%, recreational 6%, residential 25%, and unmanaged, wooded 32%. SHORE: Some industrial, commercial, and military usage. NEARSHORE: Commercial and industrial use in the upper portion, and pleasure boating in the lower portion.	Private 88%, federal 6%, city 5%, and state 1%.	Severe, critical.	Unsatisfactory.	Poor. There is one stretch of thin, strip beach near the mouth of St. Julian Creek.	No data. The area appears stable. There is approximately 29,000 feet of artificially stabilized shoreline, most of which is bulkhead. These structures are mainly for cosmetic purposes rather than for erosion protection.	Low. Embayed marshes and low elevations limit development along the unused portions of the shoreline.
5C CHESAPEAKE AND NORFOLK HODGES CREEK TO BERKLEY BRIDGE 24.8 miles (28.0 miles of fastland)	FASTLAND: Artificial fill 34% and low shore 66%. SHORE: Artificially stabilized 41%, beach 3%, fringe marsh 41%, and embayed marsh 15%. NEARSHORE: Narrow 33%. The remainder of the subsegment is located along several creeks, which are too narrow and shallow for classification.	FASTLAND: Commercial 2%, governmental 4%, industrial 37%, recreational 1%, residential 49%, unmanaged, unwooded 3%, and unmanaged, wooded 4%. SHORE: Mostly commercial and industrial use. NEARSHORE: Commercial and industrial traffic to the docks along the Elizabeth River. Pleasure boating to the Intracoastal Waterway.	Private 93%, federal 4%, city 3%, and state <1%.	Severe, critical.	Unsatisfactory.	Poor to fair. Several areas have nice sand beaches, though they are fairly thin and sometimes vegetated.	No data. The area appears stable. There is approximately 53,800 feet of artificially stabilized shoreline, the majority of which is bulkhead. Most of this bulkhead is for industrial purposes rather than for erosion control.	Low. A recreational park could be located along Milldam or Jones Creeks. Apart from these areas, there is little land available for development.
5D CHESAPEAKE DEEP CREEK 8.4 miles (9.9 miles of fastland)	FASTLAND: Entirely low shore. SHORE: Artificially stabilized 7%, beach 17%, fringe marsh 42%, and embayed marsh 34%. CREEK: The dredged channel in Deep Creek had controlling depths of 9 feet in 1973.	FASTLAND: Agricultural 18%, recreational 27%, residential 6%, unmanaged, unwooded 7%, and unmanaged, wooded 42%. SHORE: Some waterfowl hunting in the marshes, but mostly unused. CREEK: Sport boating.	Private 65%, federal 11%, state 8%, and city 16%.	Severe, critical.	Unsatisfactory.	Fair to good. The beaches along Deep Creek are fairly wide, although there is little access to there.	No data. Field investigations show that erosion of the marshes and exposed fastland is occurring along most of the subsegment. This is mainly due to boat wakes.	Low. This area has a severe flood hazard, thus limiting further development.
6A NORFOLK BERKLEY BRIDGE TO THE MOUTH OF INDIAN RIVER 7.0 miles (7.0 miles of fastland)	FASTLAND: Artificial fill 52% and low shore 48%. SHORE: Artificially stabilized 57%, beach 3%, and fringe marsh 40%. NEARSHORE: Intermediate 51%. The remainder of the subsegment is located along the creeks, which are too narrow and shallow for classification.	FASTLAND: Commercial 1%, industrial 65%, recreational 13%, and residential 21%. SHORE: Mostly commercial and industrial use. NEARSHORE: Commercial and pleasure boating.	Private 84% and city 16%.	Severe, critical.	Unsatisfactory.	Poor. There is a thin, strip beach west of Riverside Memorial Park.	No data. The area appears stable. There is approximately 20,800 feet of artificially stabilized shoreline, two-thirds of which is bulkhead. These structures are mainly for cosmetic purposes rather than for erosion control.	Low. This subsegment has no available shorelands for alternate development.
6B CHESAPEAKE INDIAN RIVER TO VIRGINIA BEACH CITY LINE 16.2 miles (16.5 miles of fastland)	FASTLAND: Artificial fill 5% and low shore 95%. SHORE: Artificially stabilized 27%, fringe marsh 69%, and embayed marsh 4%. RIVER: Narrow 10%. The remainder of the subsegment is located along Indian River, which is too narrow and shallow for classification.	FASTLAND: Agricultural 4%, commercial 3%, industrial 7%, and residential 86%. SHORE: Mostly used for private access to the water. RIVER: Mostly sport boating.	Private 94% and city 6%.	Moderate, critical.	Unsatisfactory.	No beaches.	No data. The area appears stable. Approximately 23,000 feet of shoreline is artificially stabilized, most of which is bulkhead. These structures are mainly for cosmetic purposes rather than for erosion control.	Low. The shorelands are already extensively used.
6C VIRGINIA BEACH EASTERN BRANCH ELIZABETH RIVER 15.1 miles (17.9 miles of fastland)	FASTLAND: Artificial fill 6% and low shore 94%. SHORE: Artificially stabilized 23%, fringe marsh 51%, and embayed marsh 26%. RIVER: This portion of the Elizabeth River is too narrow and shallow for classification.	FASTLAND: Agricultural 5%, commercial 2%, industrial 1%, recreational 3%, residential 86%, and unmanaged, wooded 3%. SHORE: Private access to the river. RIVER: Mostly pleasure boating.	Private 96% and city 4%.	Severe, critical.	Unsatisfactory.	No beaches.	No data. The area appears stable. There is approximately 18,400 feet of bulkhead in the subsegment. These structures are for cosmetic purposes rather than for erosion control.	Moderate. The wooded and agricultural lands at the head of the Eastern Branch could be developed as a low intensity recreational park.

TABLE 2 (Cont'd)

SUBSEGMENT	SHORELANDS TYPE	SHORELANDS USE	OWNERSHIP	FLOOD HAZARD	WATER QUALITY	BEACH QUALITY	SHORE EROSION SITUATION	ALTERNATE SHORE USE
6D NORFOLK I-64 BRIDGE TO TOWN POINT 30.5 miles (32.2 miles of fastland)	FASTLAND: Artificial fill 18% and low shore 82%. SHORE: Artificially stabilized 33%, beach 1%, fringe marsh 61%, and embayed marsh 5%. NEARSHORE: Narrow 16%. The remainder of the subsegment is located along Broad Creek and the head of Eastern Branch, which are too narrow and shallow for classification.	FASTLAND: Agricultural 3%, commercial 3%, governmental 1%, industrial 16%, recreational 3%, residential 72%, and unmanaged, unwooded 2%. SHORE: Mostly industrial and commercial use. NEARSHORE: Commercial traffic to the turning basin, some pleasure boating.	Private 91%, city 4%, and state 5%.	Severe, critical.	Unsatisfactory.	Poor. There is one section of thin, strip beach in this subsegment.	No data. The area appears stable. There is approximately 53,400 feet of artificially stabilized shoreline, most of which is bulkhead. These structures are mainly for cosmetic purposes rather than for erosion control.	Low. The city owned areas could be developed as public parks, but little other alternate use seems possible for this area.
7 NORFOLK TOWN POINT TO MOUTH OF LAFAYETTE RIVER 14.5 miles (14.5 miles of fastland)	FASTLAND: Artificial fill 87% and low shore 13%. SHORE: Artificially stabilized 96% and fringe marsh 4%. NEARSHORE: Narrow 74%, intermediate 5%, and wide 10%. The remainder of the subsegment is located along Smith Creek, which is too narrow and shallow for classification.	FASTLAND: Commercial 1%, governmental 1%, industrial 70%, recreational 3%, residential 19%, and unmanaged, unwooded 6%. SHORE: Commercial and industrial use; some private use along Smith Creek. NEARSHORE: Commercial and industrial traffic. Some sport boating from Smith Creek.	Private 82%, city 16%, and federal 2%.	Severe, critical.	Unsatisfactory.	Poor. There are several patches of beach fronting the bulkhead.	No data. The area is stable. Basically the entire segment is artificially stabilized, the majority being bulkhead. These structures are mainly for cosmetic purposes rather than for erosion control.	Low. No lands are available for new development. Redevelopment is possible, though this would probably be for commercial or industrial purposes rather than for recreational facilities.
8 NORFOLK LAFAYETTE RIVER 56.6 miles (59.1 miles of fastland)	FASTLAND: Artificial fill 7% and low shore 93%. SHORE: Artificially stabilized 39%, beach 1%, fringe marsh 49%, embayed marsh 10%, and extensive marsh 1%. RIVER: The Lafayette River has controlling depths of 6 feet to the Route 460 bridge.	FASTLAND: Commercial 3%, governmental 1%, industrial 2%, recreational 9%, and residential 85%. SHORE: Some recreational use. RIVER: Pleasure boating.	Private 89%, city 9%, federal 1%, and state >1%.	Severe, critical.	Unsatisfactory.	Poor. There are only thin, strip beaches in this subsegment.	No data. The area appears stable. There is approximately 73,800 feet of artificially stabilized shoreline, most of which is bulkhead. Rubble riprap is located at the mouth of the river. These structures are mainly for cosmetic purposes rather than for erosion control.	Low. The present use of the shoreline precludes other alternate use.
9 NORFOLK TANNER POINT TO SEWELLS POINT 7.8 miles (7.8 miles of fastland)	FASTLAND: Entirely artificial fill. SHORE: Artificially stabilized 89%, beach 6%, and fringe marsh 5%. NEARSHORE: Narrow 82% and intermediate 18%.	FASTLAND: Governmental 45% and industrial 55%. SHORE: Industrial and commercial use. NEARSHORE: Commercial and military traffic to the docks.	Private 24%, federal 45%, and state 31%.	Severe, critical.	Unsatisfactory.	Poor. There is one small section of nice beach. However, the industrial use severely limits access and use of this area.	No data. Most of the shoreline is artificially stabilized, thus eliminating any erosion problems.	Low. The present shore use prohibits alternate development.
10 NORFOLK WILLOUGHBY BAY 10.2 miles (10.2 miles of fastland)	FASTLAND: Artificial fill 75% and low shore 25%. SHORE: Artificially stabilized 86%, beach 12%, and fringe marsh 2%. NEARSHORE: Wide 3%. Willoughby Bay has general depths of 7 to 12 feet.	FASTLAND: Commercial 12%, governmental 73%, recreational 3%, and residential 12%. SHORE: Mostly military use, some private use. NEARSHORE: Pleasure boating.	Private 24%, city 3%, and federal 73%.	Severe, critical.	Unsatisfactory.	Fair to good. The beaches along the spit are usually fairly wide and clean.	No data. The area appears stable. There is approximately 45,800 feet of artificially stabilized shoreline, 12,600 feet of which is riprap. All structures appear to be effective.	Low. No lands are available for alternate use. Some facilities for picnicking could be established at the city owned land along Willoughby Spit.
11 NORFOLK OCEAN VIEW 7.1 miles (7.1 miles of fastland)	FASTLAND: Entirely low shore. SHORE: Artificially stabilized 59% and beach 41%. NEARSHORE: Narrow 76% and intermediate 24%.	FASTLAND: Commercial 14%, recreational 16%, and residential 70%. SHORE: Mostly recreational. NEARSHORE: Commercial and sport fishing. Commercial and military traffic in Thimble Shoal Channel.	Private 84% and city 16%.	Severe, critical.	Satisfactory.	Good. The segment generally has nice, clean beaches.	Historical erosion rates for this area range from 1.6 to 2.5 feet per year. Field investigations show slight or no current erosion due to the expansive groin system along the shoreline. Apart from the groins, there is approximately 22,000 feet of bulkhead in the segment which appears to be effective.	Low. This segment is entirely used and little alternate use seems probable or necessary.
12 NORFOLK LITTLE CREEK 12.5 miles (13.9 miles of fastland)	FASTLAND: Artificial fill 8% and low shore 92%. SHORE: Artificially stabilized 26%, beach 5%, fringe marsh 51%, and embayed marsh 18%. CREEK: Little Creek is too narrow and shallow for classification.	FASTLAND: Commercial 20%, industrial 1%, recreational 5%, and residential 74%. SHORE: Commercial use. NEARSHORE: Sport boating and commercial traffic.	Private 94% and city 6%.	Severe, critical.	Unsatisfactory.	Poor. There are several areas of thin, strip beach.	No data. The area appears stable. There is approximately 17,200 feet of artificially stabilized shoreline, most of which is bulkhead. These structures are mostly for cosmetic purposes rather than for erosion control.	Low. The city owned lands near the creek head could be used as a public park. No other alternate development seems possible for the area.

SUBSEGMENT 1A

PORPSMOUTH CITY

HOFFLER CREEK - EAST BANK

Map 11

EXTENT: 10,800 feet (2.0 mi.) of shoreline along the eastern bank of Hoffler Creek. The subsegment includes 24,800 feet (4.7 mi.) of fastland.

SHORELANDS TYPE

FASTLAND: Entirely low shore.

SHORE: Fringe marsh 13% (0.2 mi.) and embayed marsh 87% (1.8 mi.).

CREEK: Hoffler Creek is too narrow and shallow for classification.

SHORELANDS USE

FASTLAND: Agricultural 98% (4.6 mi.) and industrial 2% (0.1 mi.).

SHORE: Some waterfowl hunting in the marshes, but mostly unused.

CREEK: Some sport fishing, but mostly unused.

WIND AND SEA EXPOSURE: Hoffler Creek trends basically S - N. The creek is sheltered from direct wind and wave exposure.

OWNERSHIP: Private.

FLOOD HAZARD: Low, noncritical. The Intermediate Regional Tidal Flood (100 year flood) level for the Hampton Roads area is 8.5 feet above mean sea level (MSL). The fastland along Hoffler Creek has elevations of 10 to 15 feet within 500 feet of shore and is thus not very susceptible to flooding. No structures are endangered.

WATER QUALITY: No data for Hoffler Creek. According to the "Water Quality Inventory" (305(b) Report), (Virginia State Water Control Board, April, 1976), the lower James River suffers from a variety of water quality problems due to industrial and residential buildup.

BEACH QUALITY: There are no beaches in the subsegment.

PRESENT SHORE EROSION SITUATION

EROSION RATE: No data. The subsegment appears stable.

ENDANGERED STRUCTURES: None.

SHORE PROTECTIVE STRUCTURES: None.

OTHER SHORE STRUCTURES: None.

SHORE USE LIMITATIONS:

There are several factors which would limit development along Hoffler Creek. Eighty-seven percent of the shoreline is embayed marsh, which is protected by the Virginia Wetlands Act of 1972. Also, the creek is too narrow and shallow for most boat access toward the creek head. Without water access to the river, the area loses much of its water-related residential value.

ALTERNATE SHORE USE:

Low. Though the subsegment is mostly undeveloped, there appears to be little alternate use potential. There is little shore access, which would limit the feasibility of building a public recreational facility along the shore. However, a low intensity recreational park for nature walks or picnicking is possible for an area near the creek head.

MAPS: USGS, 7.5 Min.Ser. (Topo.), NEWPORT NEWS SOUTH Quadr., 1964, pr. 1968.
C&GS, #12222 (562), 1:40,000 scale,
CHESAPEAKE BAY, Cape Charles to Norfolk
Harbor, 16th ed., 1976.

PHOTOS: Aerial-VIMS 22Oct76 PM-1A/1456-1463.

SUBSEGMENT 1B

PORPSMOUTH CITY

HOFFLER CREEK TO CRANEY ISLAND CREEK

Maps 11 and 12

EXTENT: 44,400 feet (8.4 mi.) of shoreline along the James River, from the mouth of Hoffler Creek to the mouth of Craney Island Creek, including Craney Island Disposal area. The subsegment also has 44,400 feet (8.4 mi.) of fastland.

SHORELANDS TYPE

FASTLAND: Artificial fill 85% (7.2 mi.) and low shore 15% (1.2 mi.).

SHORE: Artificially stabilized 91% (7.6 mi.), beach 1% (0.1 mi.), and fringe marsh 8% (0.7 mi.).

NEARSHORE: Narrow 17%, intermediate 46%, and wide 36%.

SHORELANDS USE

FASTLAND: Governmental 86% (7.3 mi.), residential 11% (0.9 mi.), and unmanaged, wooded 3% (0.2 mi.).

SHORE: The narrow shore zone affords little use of the area.

NEARSHORE: Commercial and military shipping to and from the numerous industrial and military docks along the Elizabeth River and other sections of Hampton Roads.

WIND AND SEA EXPOSURE: The shoreline trends basically W - E in the subsegment. Fetches at the western tip of the Craney Island Disposal Area are NE - unlimited across the Chesapeake Bay, and NW - 18 nm. The fetch at the tip of Craney Island is N - 6.9 nm.

NOTE: The unlimited fetch to the NE from Craney Island Disposal Area is somewhat lessened in significance due to the Hampton Roads Tunnel.

OWNERSHIP: Federal 86% and private 14%. (NOTE: Craney Island is used by the U.S. Navy while Craney Island Disposal Area is controlled by the Corps of Engineers.)

FLOOD HAZARD: Severe, critical. The 100 year

flood would inundate all of the Disposal Area and much of Craney Island. Structures would be endangered on Craney Island by such a flood. The residential area west of the disposal site would not be susceptible to flooding.

WATER QUALITY: Unsatisfactory. The Elizabeth River area suffers from pollution due to numerous industrial and domestic waste discharges.

BEACH QUALITY: Poor to fair. The subsegment has beaches of moderate width in several areas, though they are often vegetated.

PRESENT SHORE EROSION SITUATION

EROSION RATE: No data. Most areas which historically could have had an erosion problem have been artificially stabilized. No area seems to be suffering from erosion at the present time.

ENDANGERED STRUCTURES: None.

SHORE PROTECTIVE STRUCTURES: Ninety-one percent of the shoreline is artificially stabilized. The Craney Island Disposal Area is riprapped, with additional protection recently provided by laying concrete slabs (from the old James River Bridge) along the shore in some places. Several areas of the shoreline have been stabilized by bulkhead. All artificial stabilization seems effective.

OTHER SHORE STRUCTURES: There are several piers along the shore.

SHORE USE LIMITATIONS:

Craney Island Disposal Area is in the process of being filled with dredge spoil which prohibits any development in the area. Craney Island is a U.S. Naval Supply Depot and thus is not available for development. The small area of privately-owned land from Hoffler Creek to the disposal site has already been developed for residential purposes.

ALTERNATE SHORE USE:

Low. No shorelands in the subsegment are available for any development, since they are effectively consumed by either private or federal concerns.

MAPS: USGS, 7.5 Min.Ser. (Topo.), NEWPORT NEWS SOUTH Quadr., 1964, pr. 1968;
USGS, 7.5 Min.Ser. (Topo.), NORFOLK NORTH Quadr., 1965, pr. 1970.
C&GS, #12222 (562), 1:40,000 scale,

CHESAPEAKE BAY, Cape Charles to Norfolk Harbor, 16th ed., 1976.

PHOTOS: Aerial-VIMS 22Oct76 PM-1B/1374-1455.

SUBSEGMENT 2A

PORPSMOUTH CITY

CRANEY ISLAND CREEK

Maps 11 and 12

EXTENT: 26,800 feet (5.1 mi.) of shoreline along Craney Island Creek. The subsegment also includes 27,800 feet (5.3 mi.) of fastland.

SHORELANDS TYPE

FASTLAND: Artificial fill 37% (2.0 mi.) and low shore 63% (3.3 mi.).

SHORE: Artificially stabilized 20% (1.0 mi.), fringe marsh 28% (1.4 mi.), and embayed marsh 52% (2.6 mi.).

CREEK: Craney Island Creek is too shallow for classification.

SHORELANDS USE

FASTLAND: Agricultural 23% (1.2 mi.) and governmental 77% (4.1 mi.).

SHORE: Most of the shore zone is owned and used by the government.

CREEK: Craney Island Creek is little used.

WIND AND SEA EXPOSURE: Craney Island Creek trends basically E - W. No significant fetches affect the subsegment.

OWNERSHIP: Federal 77% and private 23%. The government-owned lands are comprised of the U.S. Naval Supply Center and the U.S. Coast Guard Station.

FLOOD HAZARD: Severe, critical. The shorelands have average elevations of less than 10 feet. The 100 year flood would inundate the fastland up to 8.5 feet above MSL, thus affecting some structures. The Standard Project Tidal Flood would cover most of the subsegment.

WATER QUALITY: Unsatisfactory. The Elizabeth River area suffers from pollution due to numerous industrial and domestic waste discharges.

BEACH QUALITY: There are no beaches in the subsegment.

PRESENT SHORE EROSION SITUATION

EROSION RATE: No data. The area appears to be stable.

ENDANGERED STRUCTURES: None.

SHORE PROTECTIVE STRUCTURES: The mouth of Craney Island Creek has riprap on the northern bank and bulkhead on the southern bank. All structures appear to be effective.

OTHER SHORE STRUCTURES: Several piers.

SHORE USE LIMITATIONS:

Seventy-seven percent of the shorelands are owned by the federal government and are not available for other development. The agricultural lands along the creek head are susceptible to flooding. Development along the shore is not advisable for flood-prone areas.

ALTERNATE SHORE USE:

Low. The only alternate use of the shorelands would be along the creek head, where a low intensity public park could be established. Any development should have proper facilities to ensure against any additional pollutants entering into the Elizabeth River system.

MAPS: USGS, 7.5 Min.Ser. (Topo.), NORFOLK NORTH Quadr., 1965, pr. 1970; USGS, 7.5 Min.Ser. (Topo.), NEWPORT NEWS South Quadr., 1964, pr. 1968. C&GS, #12222 (562), 1:40,000 scale, CHESAPEAKE BAY, Cape Charles to Norfolk Harbor, 16th ed., 1976.

PHOTOS: Aerial-VIMS 22Oct76 PM-2A/1345-1373.

SUBSEGMENT 2B

PORPSMOUTH CITY

CRANEY ISLAND CREEK TO LOVETT POINT

Map 12

EXTENT: 18,800 feet (3.6 mi.) of shoreline along the Elizabeth River from the mouth of Craney Island Creek to Lovett Point. The subsegment also includes 20,600 feet (3.9 mi.) of fastland.

SHORELANDS TYPE

FASTLAND: Artificial fill 29% (1.1 mi.) and low shore 71% (2.8 mi.).

SHORE: Artificially stabilized 30% (1.1 mi.), beach 32% (1.1 mi.), fringe marsh 15% (0.5 mi.), and embayed marsh 23% (0.8 mi.).

RIVER: Intermediate 55%. Craney Island Reach, part of the Elizabeth River channels, lies approximately 4,600 feet off from the shore in this subsegment. The remainder of the shoreline is found in Lake Kingman, which is too shallow for classification.

SHORELANDS USE

FASTLAND: Agricultural 19% (0.8 mi.), governmental 23% (0.9 mi.), industrial 42% (1.6 mi.), residential 9% (0.3 mi.), and unmanaged, wooded 7% (0.3 mi.).

SHORE: Some access to the river, especially at Lovett Point.

RIVER: Military and commercial traffic to and from the numerous docks along the Elizabeth River.

WIND AND SEA EXPOSURE: The shoreline trends basically NNW - SSE in the subsegment. Craney Island protects this area from any significant fetches.

OWNERSHIP: Federal 23% and private 77%.

FLOOD HAZARD: Moderate, noncritical. Except for the Lake Kingman area, only moderate flooding of the fastland would occur during the 100 year flood. The entire area would be inundated during the Standard Project Tidal Flood.

WATER QUALITY: Unsatisfactory. The Elizabeth

River suffers from pollution due to numerous industrial and domestic discharges.

BEACH QUALITY: Poor to fair. Though most areas have thin, strip beaches, there is a nice beach north of the mouth of Lake Kingman.

PRESENT SHORE EROSION SITUATION

EROSION RATE: No data. The area appears stable.

ENDANGERED STRUCTURES: None.

SHORE PROTECTIVE STRUCTURES: The bulkhead at the Coast Guard Station is mainly for holding fill. The Lovett Point area has rubble riprap. All structures appear to be effective.

OTHER SHORE STRUCTURES: There are several piers at the Coast Guard Station and at Lovett Point.

SHORE USE LIMITATIONS:

The Coast Guard Station is unavailable for development since it is government-owned. Lovett Point is already developed for both residential and industrial use. Only the lands between Lake Kingman and the Coast Guard Station have a development potential. The proposed Portsmouth Oil Refinery is planned for this area. However, the present agricultural use of these lands would have to be sacrificed for any development.

ALTERNATE SHORE USE:

Low. The area lacks any lands suitable for development as public recreational facilities.

MAPS: USGS, 7.5 Min.Ser. (Topo.), NORFOLK NORTH Quadr., 1965, pr. 1970;
USGS, 7.5 Min.Ser. (Topo.), NORFOLK SOUTH Quadr., 1965, pr. 1970.
C&GS, #12043 (452), 1:20,000 scale, NORFOLK HARBOR AND ELIZABETH RIVER, 23rd ed., 1973.

PHOTOS: Aerial-VIMS 220ct76 PM-2B/1318-1344.

SUBSEGMENT 3A

PORPSMOUTH CITY

LOVETT POINT TO STERNS CREEK

Maps 12 and 13

EXTENT: 87,400 feet (16.6 mi.) of shoreline along the Western Branch of the Elizabeth River from Lovett Point to the head of Sterns Creek, including Lilly Creek. The subsegment also includes 94,000 feet (17.8 mi.) of fastland.

SHORELANDS TYPE

FASTLAND: Artificial fill 23% (4.0 mi.) and low shore 77% (13.8 mi.).

SHORE: Artificially stabilized 34% (5.6 mi.), beach 1% (0.2 mi.), fringe marsh 61% (10.0 mi.), and embayed marsh 4% (0.7 mi.).

RIVER: Narrow 15%. The remainder of the shorelands are located along Lilly and Sterns Creeks, which are too shallow for classification.

SHORELANDS USE

FASTLAND: Agricultural 15% (2.7 mi.), industrial 4% (0.7 mi.), and residential 81% (14.4 mi.).

SHORE: The shore zone is used for some industrial purposes near Lovett Point and for some private recreation in front of residences.

Otherwise, the shore is unused.

RIVER: Some commercial shipping at the mouth and pleasure boating.

WIND AND SEA EXPOSURE: The shoreline trends basically NE - SW from Lovett Point to the mouth of Sterns Creek. Sterns Creek trends SSE - NNW. No significant fetches affect the shoreline.

OWNERSHIP: Private.

FLOOD HAZARD: Moderate, critical. Though flooding is not as great a hazard along the protected shoreline of this subsegment, several structures would be endangered during the 100 year flood.

WATER QUALITY: Unsatisfactory. The Elizabeth River and its tributaries suffer from numerous industrial and domestic waste discharges.

BEACH QUALITY: Poor. There is one section of

thin, strip beach in the subsegment.

PRESENT SHORE EROSION SITUATION

EROSION RATE: No data. The area appears to be stable.

ENDANGERED STRUCTURES: None.

SHORE PROTECTIVE STRUCTURES: There is approximately 5.6 miles of artificially stabilized shoreline in the subsegment, most of which is bulkhead. These structures are mainly for cosmetic purposes and many front artificially filled areas. All structures appear to be effective.

OTHER SHORE STRUCTURES: There are numerous piers along the shoreline of the subsegment.

SHORE USE LIMITATIONS:

The main limitation to development in this subsegment is the great amount of development already located along the shoreline. Approximately eighty-five percent of the shorelands are already consumed. The only areas not extensively used are located along Lilly Creek, mainly along its eastern bank.

ALTERNATE SHORE USE:

Low. The eastern bank of Lilly Creek, which is currently used for agriculture, is the only area which could have any moderate scale development. However, this would be at the sacrifice of the agriculture. The area has a possible use as a recreational park for the surrounding residential communities. However, any shoreline development should ensure against additional pollutants entering the already endangered Elizabeth River water system.

MAPS: USGS, 7.5 Min.Ser. (Topo.), NORFOLK SOUTH Quadr., 1965, pr. 1970; USGS, 7.5 Min.Ser. (Topo.), BOWERS HILL Quadr., 1965, pr. 1970. C&GS, #12043 (452), 1:20,000 scale, NORFOLK HARBOR AND ELIZABETH RIVER, 23rd ed., 1973.

PHOTOS: Aerial-VIMS 22Oct76 PM-3A/1228-1317.

SUBSEGMENT 3B

CHESAPEAKE CITY

STERNS CREEK

TO THE CHESAPEAKE - PORTSMOUTH CITY LINE

Maps 13 and 14

EXTENT: 169,600 feet (32.1 mi.) of shoreline along the Western Branch of the Elizabeth River from the head of Sterns Creek to the Chesapeake - Portsmouth City Line. The subsegment includes 183,800 feet (34.8 mi.) of fastland.

SHORELANDS TYPE

FASTLAND: Artificial fill 7% (2.3 mi.) and low shore 93% (32.5 mi.).

SHORE: Artificially stabilized 6% (2.0 mi.), fringe marsh 61% (19.5 mi.), and embayed marsh 33% (10.6 mi.).

RIVER: The Western Branch is too shallow for classification in this subsegment. The river has depths of six feet to Drum Point.

SHORELANDS USE

FASTLAND: Agricultural 44% (15.3 mi.), recreational 3% (1.1 mi.), and residential 53% (18.4 mi.).

SHORE: Much of the shore zone is little used except for private use in front of residential areas.

RIVER: Little commercial use. The Western Branch is mainly used for pleasure boating.

WIND AND SEA EXPOSURE: The shoreline trends basically NNE - SSW in the subsegment. No significant fetches affect the shorelands.

OWNERSHIP: Private 99% and city < 1%.

FLOOD HAZARD: Moderate, critical. Though the subsegment is not exposed to direct wind and wave attacks, the shorelands adjacent to the river would be inundated during the 100 year flood. Several structures along the shore would be endangered by such a flood.

WATER QUALITY: Unsatisfactory. The Elizabeth River suffers from numerous industrial and domestic waste discharges.

BEACH QUALITY: There are no beaches in the subsegment.

PRESENT SHORE EROSION SITUATION

EROSION RATE: No data. The area appears to be stable.

ENDANGERED STRUCTURES: None.

SHORE PROTECTIVE STRUCTURES: Approximately 10,400 feet of shoreline has been artificially stabilized with bulkhead. However, these structures are mainly for cosmetic rather than for protective purposes. All structures appear to be effective.

OTHER SHORE STRUCTURES: Numerous piers throughout the subsegment.

SHORE USE LIMITATIONS:

Forty-four percent of the shorelands are used for agriculture and therefore could be available for development if the need arose. However, much of this land is fronted by embayed marshes which should be preserved. The marshes restrict access to the river and thus lessen the relative residential value of the fastland. Also, the Elizabeth River has very low water quality, which severely restricts both the recreational use of the waters and the additional residential/industrial use of the fastland.

ALTERNATE SHORE USE:

Low. Continued development along the shoreline of the Elizabeth River would probably worsen the already degraded water quality of the river. Therefore, any new housing should ensure against adding pollutants to the river environment. There are several areas along Goose Creek which could be developed as recreational parks. However, the area loses much of its water-related recreational value due to the shallowness of the creek and the poor water quality.

MAPS: USGS, 7.5 Min.Ser. (Topo.), BOWERS HILL Quadr., 1965, pr. 1970.
C&GS, #12043 (452), 1:20,000 scale, NORFOLK HARBOR AND ELIZABETH RIVER, 23rd ed., 1973.

PHOTOS: Aerial-VIMS 120ct76 CH-3B/1126-1203;
220ct76 CH-3B/1204-1227.

SUBSEGMENT 3C

PORTSMOUTH CITY

**CHESAPEAKE - PORTSMOUTH CITY LINE
TO THE MOUTH OF HULL CREEK**

Maps 5, 13, 14

EXTENT: 98,400 feet (18.6 mi.) of shoreline along the Western Branch of the Elizabeth River from the Chesapeake - Portsmouth City Line to the mouth of Hull Creek, including Hull and Baines Creeks. The subsegment has 97,000 feet (18.4 mi.) of fastland.

SHORELANDS TYPE

FASTLAND: Artificial fill 19% (3.6 mi.) and low shore 81% (14.8 mi.).
SHORE: Artificially stabilized 27% (5.0 mi.), beach <1% (0.1 mi.), fringe marsh 58% (10.8 mi.), and embayed marsh 15% (2.8 mi.).
RIVER: Narrow 1% and intermediate 14%. The remainder of Western Branch is too narrow and shallow for classification.

SHORELANDS USE

FASTLAND: Commercial 3% (0.5 mi.), recreational 12% (2.2 mi.), and residential 85% (15.7 mi.).
SHORE: Little used except at the City Park along the west bank of Baines Creek.
NEARSHORE: Some commercial traffic, but mainly pleasure boating.

WIND AND SEA EXPOSURE: The shoreline trends basically SW - NE in the subsegment. No significant fetches affect the shoreline.

OWNERSHIP: Private 91% and city 9%.

FLOOD HAZARD: Moderate, critical. The 100 year storm would flood areas with elevations up to 8.5 feet. Many structures along the shorelands would be endangered by such a flood.

WATER QUALITY: Unsatisfactory. The Elizabeth River suffers from numerous industrial and domestic waste discharges.

BEACH QUALITY: Poor. There are several areas of thin, strip beaches in the subsegment.

PRESENT SHORE EROSION SITUATION

EROSION RATE: No data. The area appears stable.

ENDANGERED STRUCTURES: None.

SHORE PROTECTIVE STRUCTURES: There is approximately 26,200 feet of artificially stabilized shorelands in the subsegment, most of which is bulkhead. These structures are mainly for cosmetic purposes rather than for erosion protection. Most structures appear to be effective.

OTHER SHORE STRUCTURES: There are numerous piers and several boat ramps in the subsegment.

SHORE USE LIMITATIONS:

The entire subsegment can be classified as urban, with intensive residential and commercial development along the entire shoreline. The only major area of non-intensive use is the city-owned park west of Baines Creek. There are very limited amounts of shoreland in the subsegment which could be developed. Also, the severe water quality problems along the Elizabeth River lessens the water-related value of the shorelands.

ALTERNATE SHORE USE:

Low. There is little shoreland available for any type of development. Though some isolated development or redevelopment is possible in the subsegment, no significant change in the land use statistics is probable.

MAPS: USGS, 7.5 Min.Ser. (Topo.), BOWERS HILL Quadr., 1965, pr. 1970;
USGS, 7.5 Min.Ser. (Topo.), NORFOLK SOUTH Quadr., 1965, pr. 1970.
C&GS, #12043 (452), 1:20,000 scale, NORFOLK HARBOR AND ELIZABETH RIVER, 23rd ed., 1973.

PHOTOS: Aerial-VIMS 120ct76 PM-3C/1036-1125.

SEGMENT 4

PORPSMOUTH CITY

PINNER POINT AREA

Map 5

EXTENT: 60,200 feet (11.4 mi.) of shoreline along the Elizabeth River, from Hull Creek to the mouth of the Southern Branch, including Scott Creek. The segment also contains 60,200 feet (11.4 mi.) of fastland.

SHORELANDS TYPE

FASTLAND: Artificial fill 50% (5.7 mi.) and low shore 50% (5.7 mi.).

SHORE: Artificially stabilized 55% (6.3 mi.), beach 5% (0.5 mi.), and fringe marsh 40% (4.5 mi.).

NEARSHORE: Narrow 5% and intermediate 32%. The remaining shoreline is located on Scott Creek, which is too narrow and shallow for classification.

SHORELANDS USE

FASTLAND: Commercial 9% (1.1 mi.), governmental 14% (1.5 mi.), industrial 46% (5.2 mi.), and residential 31% (3.6 mi.).

SHORE: Approximately fifty percent of the shore is used for commercial and industrial purposes. Much of the remaining shoreline is used for private recreation.

NEARSHORE: Mostly commercial and industrial shipping to and from the numerous docks along the Elizabeth River. The river is also used for pleasure boating.

WIND AND SEA EXPOSURE: The shoreline trends basically W - E, then NW - SE. The fetch at the middle of Pinner Point is N by 3/4 W - 9.1 nm.

OWNERSHIP: Private 86% and federal 14%.

FLOOD HAZARD: Severe, critical. Many developed areas of the shoreline would be inundated during the 100 year storm, especially the docks along Pinner Point and the Hospital Point area. The entire segment would be flooded during the Standard Project Tidal Flood.

WATER QUALITY: Unsatisfactory. The Elizabeth

River suffers from numerous industrial and domestic waste discharges.

BEACH QUALITY: Poor. The area fronting Bay View Boulevard has thin, strip beach interspersed with fringing marsh.

PRESENT SHORE EROSION SITUATION

EROSION RATE: No data. The area appears to be stable.

ENDANGERED STRUCTURES: None.

SHORE PROTECTIVE STRUCTURES: Approximately 33,400 feet of the shoreline (55%) is artificially stabilized, two-thirds of which is bulkhead and the rest riprap. These structures are more for cosmetic purposes (holding fill) rather than for erosion protection.

OTHER SHORE STRUCTURES: Numerous piers and several boat ramps.

SHORE USE LIMITATIONS:

The shorelands are already intensely used throughout the segment. No lands are available for development.

ALTERNATE SHORE USE:

None. The entire segment is actively used. No lands are available for any alternate use.

MAPS: USGS, 7.5 Min.Ser. (Topo.), NORFOLK SOUTH Quadr., 1965, pr. 1970.
C&GS, #12043 (452), 1:20,000 scale, NORFOLK HARBOR AND ELIZABETH RIVER, 23rd ed., 1973.

PHOTOS: Aerial-VIMS 12Oct76 PM-4/987-1035.

SUBSEGMENT 5A

PORPSMOUTH CITY

MOUTH OF SOUTHERN BRANCH TO PARADISE CREEK

Maps 5 and 8

EXTENT: 67,800 feet (12.8 mi.) of shoreline along the Southern Branch of the Elizabeth River, from the river mouth to Paradise Creek, including Paradise Creek. The subsegment also contains 70,200 feet (13.3 mi.) of fastland.

SHORELANDS TYPE

FASTLAND: Artificial fill 67% (8.9 mi.) and low shore 33% (4.4 mi.).

SHORE: Artificially stabilized 67% (8.6 mi.), beach 4% (0.4 mi.), fringe marsh 14% (1.8 mi.), and embayed marsh 15% (2.0 mi.).

NEARSHORE: Narrow 66%. Paradise Creek is too narrow and shallow for classification.

SHORELANDS USE

FASTLAND: Commercial 1% (0.1 mi.), governmental 62% (8.2 mi.), industrial 18% (2.4 mi.), recreational 1% (0.1 mi.), and residential 18% (2.5 mi.).

SHORE: Military-industrial (Naval Shipyards) usage along much of the shoreline.

NEARSHORE: Commercial, industrial, and military traffic to and from numerous docks along the Southern Branch.

WIND AND SEA EXPOSURE: The shoreline trends basically N - S in the subsegment. No significant fetches affect the subsegment.

OWNERSHIP: Private 36%, federal 62%, and city 2%.

FLOOD HAZARD: Severe, critical. The 100 year storm would cause flooding along the entire shoreline, covering areas as far as 4,000 feet inland. Many structures are endangered by such flooding.

WATER QUALITY: Unsatisfactory. The Southern Branch is the most industrialized section of the Elizabeth River. Numerous industrial and domestic wastes are discharged into the river system, causing severe water quality problems.

BEACH QUALITY: Poor. There are two areas with thin, strip beaches.

PRESENT SHORE EROSION SITUATION

EROSION RATE: No data. The area appears to be stable.

ENDANGERED STRUCTURES: None.

SHORE PROTECTIVE STRUCTURES: Sixty-seven percent of the shoreline is artificially stabilized, most of which is bulkhead. There are only isolated sections of riprap. The bulkhead is mainly for cosmetic and industrial purposes rather than for erosion protection. (The only probable erosive force along this section of the river is boat wakes.) All structures appear to be effective.

OTHER SHORE STRUCTURES: Numerous boat docks along the entire length of the river-fronting shoreline.

SHORE USE LIMITATIONS:

The entire subsegment is actively and intensely used for a variety of commercial, industrial, residential, and governmental purposes.

ALTERNATE SHORE USE:

Low. No new or alternate development seems possible for the subsegment.

MAPS: USGS, 7.5 Min.Ser. (Topo.), NORFOLK SOUTH Quad., 1965, pr. 1970.
C&GS, #12043 (452), 1:20,000 scale, NORFOLK HARBOR AND ELIZABETH RIVER, 23rd ed., 1973.

PHOTOS: Aerial-VIMS 120ct76 PM-5A/942-986.

Ground-VIMS 22Sep76 PM-5A/1-10.

SUBSEGMENT 5B

CHESAPEAKE CITY

PARADISE CREEK TO HODGES CREEK

Maps 8 and 9

EXTENT: 171,800 feet (32.5 mi.) of shoreline along the Southern Branch of the Elizabeth River, from Paradise Creek to Great Bridge, then back to Hodges Creek, including St. Julian and New Mill Creeks. The subsegment also contains 210,600 feet (39.9 mi.) of fastland.

SHORELANDS TYPE

FASTLAND: Artificial fill 14% (5.8 mi.) and low shore 86% (34.1 mi.).

SHORE: Artificially stabilized 17% (5.5 mi.), beach 1% (0.4 mi.), fringe marsh 50% (16.3 mi.), and embayed marsh 32% (10.3 mi.).

NEARSHORE: Narrow 33%. The remainder of the nearshore zone is located along the several creeks in this subsegment.

SHORELANDS USE

FASTLAND: Agricultural 11% (4.5 mi.), commercial 2% (0.7 mi.), governmental 5% (1.9 mi.), industrial 19% (7.7 mi.), recreational 6% (2.4 mi.), residential 25% (9.8 mi.), and unmanaged, wooded 32% (12.9 mi.).

SHORE: Some industrial, commercial, and military usage, but mostly unused.

NEARSHORE: Commercial and industrial traffic along the upper portion of the subsegment and pleasure boating along the lower portion. The Southern Branch ends at the Great Bridge Locks and is part of the Intracoastal Waterway.

WIND AND SEA EXPOSURE: The shoreline trends basically N - S, then WNW - ESE in the subsegment. No significant fetches affect the subsegment.

OWNERSHIP: Private 88%, federal 6%, city 5%, and state 1%.

FLOOD HAZARD: Severe, critical. The 100 year storm would cause moderate flooding from Paradise Creek to St. Julian Creek, and severe flooding elsewhere in the subsegment. Many structures both along the shoreline and further inland would be endangered by the flood

waters.

WATER QUALITY: Unsatisfactory. The Elizabeth River has poor water quality due to numerous industrial and domestic waste discharges.

BEACH QUALITY: Poor. There is one stretch of thin, strip beach near the mouth of St. Julian Creek.

PRESENT SHORE EROSION SITUATION

EROSION RATE: No data. The area appears stable. Slight erosion may occur in some areas due to boat wakes and some downhill rain runoff.

ENDANGERED STRUCTURES: None.

SHORE PROTECTIVE STRUCTURES: There is approximately 29,000 feet of bulkhead and riprap in the subsegment, the majority of which is bulkhead. These structures are mainly for cosmetic or industrial purposes rather than for erosion protection.

OTHER SHORE STRUCTURES: There are numerous piers and several boat ramps along the shoreline.

SHORE USE LIMITATIONS:

Present development is concentrated from Paradise Creek to Deep Creek, with pocket developments located throughout the subsegment. These pocket developments are interspersed along the shoreline with embayed marshes and are backed by agricultural or wooded lands. (There are wooded areas along the shoreline for thirty-two percent of the subsegment.) However, the undeveloped portions of the subsegment are characterized by extremely low elevations, usually averaging 5 feet. The entire shoreline and large portions of the inland areas are subject to severe flooding during the 100 year storm. Any structures located in these areas would be endangered by such a flood.

ALTERNATE SHORE USE:

Low. Though thirty-two percent of the shorelands are wooded, the extreme low elevation of the land would limit development. Also, much of the shoreline fronting the wooded section is embayed marsh. These marshes, protected by the Virginia Wetlands Act of 1972, should not be destroyed. Therefore, though development is probable for inland areas, little buildup seems likely for the shorelands.

MAPS: USGS, 7.5 Min.Ser. (Topo.), NORFOLK SOUTH Quadr., 1965, pr. 1970;
USGS, 7.5 Min.Ser. (Topo.), DEEP CREEK Quadr., 1954, pr. 1971;
USGS, 7.5 Min.Ser. (Topo.), FENTRESS Quadr., 1954, pr. 1971.
C&GS, #12043 (452), 1:20,000 scale, NORFOLK HARBOR AND ELIZABETH RIVER, 23rd ed., 1973.

PHOTOS: Aerial-VIMS 12Oct76 CH-5B/751-829;
878-941.

SUBSEGMENT 5C

CHESAPEAKE AND NORFOLK CITIES
HODGES CREEK TO BERKLEY BRIDGE

Maps 5 and 8

EXTENT: 131,000 feet (24.8 mi.) of shoreline along the Southern Branch of the Elizabeth River, from Hodges Creek to Berkley Bridge, including Hodges, Newton, Milldam, Gilligan, Jones, and Scuffeltown Creeks. The subsegment also includes 147,600 feet (28.0 mi.) of fastland.

NOTE: The Norfolk portion of the subsegment includes 20,400 feet (3.9 mi.) of both shoreline and fastland.

SHORELANDS TYPE

FASTLAND: Artificial fill 34% (9.5 mi.) and low shore 66% (18.5 mi.).

SHORE: Artificially stabilized 41% (10.2 mi.), beach 3% (0.6 mi.), fringe marsh 41% (10.1 mi.), and embayed marsh 15% (3.9 mi.).

NEARSHORE: Narrow 33%. The remainder of the nearshore zone is located along the several creeks in the subsegment, which are too narrow and shallow for classification.

SHORELANDS USE

FASTLAND: Commercial 2% (0.6 mi.), governmental 4% (1.2 mi.), industrial 37% (10.3 mi.), recreational 1% (0.3 mi.), residential 49% (13.7 mi.), unmanaged, unwooded 3% (0.7 mi.), and unmanaged, wooded 4% (1.2 mi.).

SHORE: Mostly commercial and industrial use.

NEARSHORE: Commercial and industrial traffic to and from the numerous docks on the Elizabeth River, and pleasure boating, especially to the Intracoastal Waterway.

WIND AND SEA EXPOSURE: The shoreline trends basically S - N in the subsegment. No significant fetches affect the shorelands.

OWNERSHIP: Private 93%, federal 4%, city 3%, and state < 1%.

FLOOD HAZARD: Severe, critical. The 100 year storm would damage many structures along the shoreline.

WATER QUALITY: Unsatisfactory. The Elizabeth River suffers from numerous industrial and domestic waste discharges.

BEACH QUALITY: Poor to fair. Several areas have nice sand beach, though they are fairly thin and sometimes vegetated.

PRESENT SHORE EROSION SITUATION

EROSION RATE: No data. The area appears to be stable.

ENDANGERED STRUCTURES: None.

SHORE PROTECTIVE STRUCTURES: There is approximately 53,800 feet of artificial stabilization in the subsegment, the majority being bulkhead. Most of the bulkhead is located at the numerous industrial plants and docks located throughout the subsegment. These structures are for industrial purposes rather than for erosion control. All appear to be effective.

OTHER SHORE STRUCTURES: There are numerous piers and docks throughout the subsegment.

SHORE USE LIMITATIONS:

Ninety-three percent of the shorelands are already actively used for a variety of commercial, industrial, residential, and military purposes. The entire river-fronting shoreline is so consumed. Only along the several creeks are there any unused shorelands. However, the very narrow and shallow creeks are mostly unnavigable. Without access to the river, lands along the creeks loose much development potential for either industrial or residential use.

Another factor which would limit development along the creeks is the presence of embayed marshes in the creek interior. Such marshes are protected by the Virginia Wetlands Act of 1972 and should be preserved. Embayed marshes serve to further limit access to the shoreline.

ALTERNATE SHORE USE:

Low. There is little land available for any development along the shoreline. A recreational park could be located along Milldam or Jones Creek. In an intensely developed area such as Norfolk, a prime recreational need is open space, an area for picnicking, walking, and other such low intensity activities. Other than the two creek areas, little development seems possible for the subsegment.

MAPS: USGS, 7.5 Min.Ser. (Topo.), NORFOLK SOUTH Quadr., 1965, pr. 1970.
C&GS, #12043 (452), 1:20,000 scale, NORFOLK HARBOR AND ELIZABETH RIVER, 23rd ed., 1973.

PHOTOS: Aerial-VIMS 12Oct76 NF-5C/662-673;
12Oct76 CH-5C/674-750.

Ground-VIMS 22Sep76 CH-5C/11-69.

SUBSEGMENT 5D

CHESAPEAKE CITY

DEEP CREEK

Maps 8 and 10

EXTENT: 44,600 feet (8.4 mi.) of shoreline along Deep Creek to the Route 17 bridge, including part of the Gilmerton Deep Creek Canal. The subsegment also includes 52,200 feet (9.9 mi.) of fastland.

SHORELANDS TYPE

FASTLAND: Entirely low shore.

SHORE: Artificially stabilized 7% (0.6 mi.), beach 17% (1.5 mi.), fringe marsh 42% (3.6 mi.), and embayed marsh 34% (2.8 mi.).

CREEK: The dredged channel in Deep Creek had controlling depths of 9 feet in 1973.

SHORELANDS USE

FASTLAND: Agricultural 18% (1.8 mi.), recreational 27% (2.7 mi.), residential 6% (0.6 mi.), unmanaged, unwooded 7% (0.7 mi.), and unmanaged, wooded 42% (4.1 mi.).

SHORE: Some waterfowl hunting in the marshes, but mostly unused.

CREEK: Sport boating to the Southern Branch of the Elizabeth River and to the Dismal Swamp Canal.

WIND AND SEA EXPOSURE: Deep Creek trends basically ENE - SWS. No significant fetches affect the subsegment.

OWNERSHIP: Private 65%, federal 11%, state 8%, and city 16%.

FLOOD HAZARD: Severe, critical. The 100 year storm would cause extensive flooding along the shorelands of Deep Creek. Many structures in the developments near the Dismal Swamp Canal Locks would be endangered.

WATER QUALITY: Unsatisfactory. The entire Elizabeth River system suffers from pollution due to numerous industrial and domestic waste discharges.

BEACH QUALITY: Fair to good. The beaches along

Deep Creek are usually fairly wide, although there is little access.

PHOTOS: Aerial-VIMS 12Oct76 CH-5D/830-877.

Ground-VIMS 22Sep76 CH-5D/70-77.

PRESENT SHORE EROSION SITUATION

EROSION RATE: No data. Field investigations show that erosion of the marshes and the exposed fastland is occurring along most of the subsegment. Erosion along Deep Creek is mainly due to boat wakes hitting the shoreline. Boat speed limits should be strictly enforced in such areas to reduce the shoreline retreat.

ENDANGERED STRUCTURES: None.

SHORE PROTECTIVE STRUCTURES: Approximately 3,000 feet of the shoreline is artificially stabilized with bulkhead. These structures are located along the shoreline fronting the housing developments at the Gilmerton Canal and the head of Deep Creek. All structures appear to be effective.

OTHER SHORE STRUCTURES: There are numerous piers, most of which are located at the head of Deep Creek.

SHORE USE LIMITATIONS:

The Deep Creek area is very susceptible to flooding. Many sections have marshes both on the shoreline and pocket marshes inland. Low elevations limit the development potential of the shorelands. Several residential developments have already located near the head of Deep Creek and along the Gilmerton Deep Creek Canal. Care should be taken to ensure that pollutants are not added to the fragile creek environment.

ALTERNATE SHORE USE:

Low. The subsegment is largely unused except for the lands near the Dismal Swamp Canal Locks and some agricultural areas. However, several areas near the Locks are either city or federally owned and are used as public open space parks. Little other development is foreseen for this subsegment.

MAPS: USGS, 7.5 Min.Ser. (Topo.), NORFOLK SOUTH Quadr., 1965, pr. 1970;
USGS, 7.5 Min.Ser. (Topo.), DEEP CREEK Quadr., 1954, pr. 1971.
C&GS, #12043 (452), 1:20,000 scale, NORFOLK HARBOR AND ELIZABETH RIVER, 23rd ed., 1973.

SUBSEGMENT 6A

NORFOLK CITY

BERKLEY BRIDGE TO THE MOUTH OF INDIAN RIVER

Maps 5 and 6

EXTENT: 36,800 feet (7.0 mi.) of shoreline along the Eastern Branch of the Elizabeth River, from Berkley Bridge to the mouth of the Indian River, including Steamboat Creek. The subsegment also contains 36,800 feet (7.0 mi.) of fastland.

SHORELANDS TYPE

FASTLAND: Artificial fill 52% (3.6 mi.) and low shore 48% (3.4 mi.).

SHORE: Artificially stabilized 57% (3.9 mi.), beach 3% (0.2 mi.), and fringe marsh 40% (2.8 mi.).

NEARSHORE: Intermediate 51%. The remainder of the nearshore zone is located along the creeks in this subsegment.

SHORELANDS USE

FASTLAND: Commercial 1% (0.1 mi.), industrial 65% (4.5 mi.), recreational 13% (0.9 mi.), and residential 21% (1.4 mi.).

SHORE: Mostly commercial and industrial use.

NEARSHORE: Commercial traffic to and from the numerous docks in the subsegment, and some sport boating traffic. The turning basin for commercial traffic is located at the end of the subsegment.

WIND AND SEA EXPOSURE: The shoreline trends basically W - E in the subsegment. No significant fetches affect the shoreline.

OWNERSHIP: Private 84% and city 16%.

FLOOD HAZARD: Severe, critical. Though a large inland area is not susceptible to damage during the 100 year flood, any flooding along such a developed shoreline is severe and endangers structures.

WATER QUALITY: Unsatisfactory. The Elizabeth River suffers from pollution due to numerous industrial and domestic waste discharges.

BEACH QUALITY: Poor. There is approximately

1,200 feet of thin strip beach west of Riverside Memorial Park.

PRESENT SHORE EROSION SITUATION

EROSION RATE: No data. The area appears stable.

ENDANGERED STRUCTURES: None.

SHORE PROTECTIVE STRUCTURES: There is approximately 20,800 feet of artificial stabilization in the subsegment, two-thirds of which is bulkhead and one-third is riprap. These structures are mainly for cosmetic and industrial purposes rather than for erosion protection. All seem to be effective.

OTHER SHORE STRUCTURES: Numerous docks and piers, some boat ramps, and several highway and railroad crossings.

SHORE USE LIMITATIONS:

This section of the Eastern Branch of the Elizabeth River is heavily used for a variety of commercial, industrial, and residential purposes. The high intensity usage and the extremely poor water quality of the river severely limits other shore use.

ALTERNATE SHORE USE:

Low. This subsegment does not have available shorelands for any development. No alternate shore use seems possible for the area.

MAPS: USGS, 7.5 Min.Ser. (Topo.), NORFOLK SOUTH Quadr., 1965, pr. 1970; USGS, 7.5 Min.Ser. (Topo.), KEMPSVILLE Quadr., 1965, pr. 1970. C&GS, #12043 (452), 1:20,000 scale, NORFOLK HARBOR AND ELIZABETH RIVER, 23rd ed., 1973.

PHOTOS: Aerial-VIMS 1Sep76 NF-6A/633-636; 12Oct76 NF-6A/637-661.

SUBSEGMENT 6B

CHESAPEAKE CITY

INDIAN RIVER TO VIRGINIA BEACH CITY LINE

Map 6

EXTENT: 85,400 feet (16.2 mi.) of shoreline including Indian River and a portion of the Eastern Branch of the Elizabeth River to the Virginia Beach City Line. This subsegment also includes 87,200 feet (16.5 mi.) of fastland.

SHORELANDS TYPE

FASTLAND: Artificial fill 5% (0.8 mi.) and low shore 95% (15.7 mi.).

SHORE: Artificially stabilized 27% (4.4 mi.), fringe marsh 69% (11.1 mi.), and embayed marsh 4% (0.7 mi.).

RIVER: Narrow 10%. The remainder of the nearshore zone is located along the Indian River, which is too shallow and narrow for classification.

SHORELANDS USE

FASTLAND: Agricultural 4% (0.7 mi.), commercial 3% (0.4 mi.), industrial 7% (1.2 mi.), and residential 86% (14.2 mi.).

SHORE: Mostly used for private access to the river.

RIVER: Mostly sport boating.

WIND AND SEA EXPOSURE: The shoreline trends basically W - E; Indian River trends N - S from the mouth to the head of the river. No significant fetches affect the shoreline.

OWNERSHIP: Private 94% and city 6%.

FLOOD HAZARD: Moderate, critical. The Indian River section of the subsegment is not very susceptible to flooding. However, the Tanglewood area shoreline would receive damage to structures during the 100 year storm.

WATER QUALITY: Unsatisfactory. The Elizabeth River suffers from pollution due to numerous industrial and domestic waste discharges.

BEACH QUALITY: There are no beaches in the

subsegment.

PRESENT SHORE EROSION SITUATION

EROSION RATE: No data. The area appears to be stable.

ENDANGERED STRUCTURES: None.

SHORE PROTECTIVE STRUCTURES: The subsegment has approximately 23,000 feet of artificially stabilized shoreline, several hundred feet of which is riprap and the rest is bulkhead. The structures are for cosmetic purposes rather than for erosion protection and all appear to be effective.

OTHER SHORE STRUCTURES: There are numerous piers and several private boat ramps in the subsegment.

SHORE USE LIMITATIONS:

Most shorelands (86%) in the subsegment are already used for residential purposes. Ten percent of the shorelands are used for commercial and industrial purposes. The remaining four percent is used for agriculture. The intensive use of the shorelands limits other development in the subsegment.

ALTERNATE SHORE USE:

Low. Though the area needs facilities for public recreation, the shorelands are already extensively used. There is no room for other development in the subsegment.

MAPS: USGS, 7.5 Min.Ser. (Topo.), KEMPSVILLE Quadr., 1965, pr. 1970.
C&GS, #12043 (452), 1:20,000 scale, NORFOLK HARBOR AND ELIZABETH RIVER, 23rd ed., 1973.

PHOTOS: Aerial-VIMS 1Sep76 CH-6B/596-632.

SUBSEGMENT 6C

VIRGINIA BEACH CITY

EASTERN BRANCH - ELIZABETH RIVER

Map 6

EXTENT: 79,600 feet (15.1 mi.) of shoreline along the Eastern Branch of the Elizabeth River, from the Virginia Beach City Line to just east of the I-64 bridge. The subsegment also includes 94,600 feet (17.9 mi.) of fastland.

SHORELANDS TYPE

FASTLAND: Artificial fill 6% (1.1 mi.) and low shore 94% (16.8 mi.).

SHORE: Artificially stabilized 23% (3.5 mi.), fringe marsh 51% (7.7 mi.), and embayed marsh 26% (3.9 mi.).

RIVER: This portion of the Elizabeth River is too narrow and shallow for classification.

SHORELANDS USE

FASTLAND: Agricultural 5% (0.8 mi.), commercial 2% (0.4 mi.), industrial 1% (0.2 mi.), recreational 3% (0.6 mi.), residential 86% (15.4 mi.), and unmanaged, wooded 3% (0.5 mi.).

SHORE: Mostly used for private access to the river.

RIVER: Mostly for pleasure and sport boating.

WIND AND SEA EXPOSURE: The shoreline trends basically WNW - ESE. No significant fetches affect the shoreline.

OWNERSHIP: Private 96% and city 4%.

FLOOD HAZARD: Severe, critical. The 100 year storm would flood large areas of the shorelands and endanger many structures.

WATER QUALITY: Unsatisfactory. The Elizabeth River suffers from pollution due to numerous industrial and domestic waste discharges.

BEACH QUALITY: There are no beaches in the subsegment.

PRESENT SHORE EROSION SITUATION

EROSION RATE: No data. The area appears to be stable.

ENDANGERED STRUCTURES: None.

SHORE PROTECTIVE STRUCTURES: There is approximately 18,400 feet of bulkhead in the subsegment. These structures are for cosmetic purposes rather than for erosion control. Most appear to be effective.

OTHER SHORE STRUCTURES: There are numerous piers and several private boat ramps in the subsegment.

SHORE USE LIMITATIONS:

The majority of the shorelands is already used for residential, commercial, and industrial purposes. Eight percent of the subsegment's shoreline are used for agriculture or are unused, wooded. These areas are fronted by embayed marshes and are located along the very narrow and shallow river head. This area affords little access to the shore and little water access to the river.

ALTERNATE SHORE USE:

Moderate. The wooded and agricultural lands at the head of the Eastern Branch could be developed as a public recreational park. The site could have nature walks along the marshes, picnic areas, and other low intensity recreational facilities. Little development elsewhere in the subsegment seems probable.

MAPS: USGS, 7.5 Min.Ser. (Topo.), KEMPSVILLE Quadr., 1965, pr. 1970.

C&GS, #12043 (452), 1:20,000 scale, NORFOLK HARBOR AND ELIZABETH RIVER, 23rd ed., 1973.

PHOTOS: Aerial-VIMS 1Sep76 VB-6C/580-595.

SUBSEGMENT 6D

NORFOLK CITY

I-64 BRIDGE TO TOWN POINT

Maps 5, 6, 7

EXTENT: 161,000 feet (30.5 mi.) of shoreline along the Eastern Branch of the Elizabeth River, from the I-64 bridge to Town Point, including Broad Creek. The subsegment also includes 170,200 feet (32.2 mi.) of fastland.

SHORELANDS TYPE

FASTLAND: Artificial fill 18% (5.7 mi.) and low shore 82% (26.5 mi.).

SHORE: Artificially stabilized 33% (10.1 mi.), beach 1% (0.1 mi.), fringe marsh 61% (18.7 mi.), and embayed marsh 5% (1.6 mi.).

NEARSHORE: Narrow 16%. The remainder of the nearshore zone is located along Broad Creek and the head of the Eastern Branch, which are too shallow and narrow for classification.

SHORELANDS USE

FASTLAND: Agricultural 3% (0.9 mi.), commercial 3% (1.0 mi.), governmental 1% (0.2 mi.), industrial 16% (5.3 mi.), recreational 3% (1.0 mi.), residential 72% (23.2 mi.), and unmanaged, unwooded 2% (0.6 mi.).

SHORE: Mostly industrial and commercial use from Town Point to Broad Creek; private access along Broad Creek and near the I-64 bridge.

NEARSHORE: Commercial traffic along the Eastern Branch to the turning basin, then pleasure boating along Broad Creek and the river head.

WIND AND SEA EXPOSURE: The Eastern Branch trends basically W - E. Broad Creek trends S - N from the mouth to head. No significant fetches affect the shoreline.

OWNERSHIP: Private 91%, city 4%, and state 5%.

FLOOD HAZARD: Severe, critical. Large areas of the shorelands would be flooded during the 100 year storm, causing damage to numerous structures.

WATER QUALITY: Unsatisfactory. The Elizabeth River is polluted due to numerous industrial

and domestic waste discharges.

BEACH QUALITY: Poor. There is one section of thin strip beach in the subsegment.

PRESENT SHORE EROSION SITUATION

EROSION RATE: No data. The area appears to be stable.

ENDANGERED STRUCTURES: None.

SHORE PROTECTIVE STRUCTURES: There is approximately 53,400 feet of artificially stabilized shoreline in the subsegment, most of which is bulkhead. These structures are mainly for commercial/industrial and cosmetic purposes rather than for erosion protection. Most appear to be effective.

OTHER SHORE STRUCTURES: Numerous piers and docks, some boat ramps, and several highway and railroad bridges.

SHORE USE LIMITATIONS:

The shorelands of the subsegment are already extensively used for a variety of commercial, industrial, residential, and governmental purposes. All river-fronting shorelands are consumed. The only area which has some unused shoreline is along the upper section of Broad Creek. However, the shallowness of the creek near its head would prohibit development for commercial water-related purposes.

ALTERNATE SHORE USE:

Low. The only lands in the subsegment which are not already extensively used are along the head of Broad Creek. This area is residential in nature and will continue to be used for such purposes. Several areas along the shore are owned by the city and could be developed as public parks and playgrounds serving the surrounding residential sections. Little other alternate shore use seems likely for this subsegment.

MAPS: USGS, 7.5 Min.Ser. (Topo.), NORFOLK SOUTH Quadr., 1965, pr. 1970;
USGS, 7.5 Min.Ser. (Topo.), KEMPSVILLE Quadr., 1965, pr. 1970.
C&GS, #12043 (452), 1:20,000 scale, NORFOLK HARBOR AND ELIZABETH RIVER, 23rd ed., 1973.

PHOTOS: Aerial-VIMS 1Sep76 NF-6D/531-579.

SEGMENT 7

NORFOLK CITY

TOWN POINT TO THE MOUTH OF LAFAYETTE RIVER

Maps 4 and 5

EXTENT: 76,600 feet (14.5 mi.) of shoreline along the Elizabeth River, from Town Point to the mouth of the Lafayette River, including Smith Creek. The segment also contains 76,600 feet (14.5 mi.) of fastland.

SHORELANDS TYPE

FASTLAND: Artificial fill 87% (12.7 mi.) and low shore 13% (1.8 mi.).

SHORE: Artificially stabilized 96% (14.0 mi.) and fringe marsh 4% (0.5 mi.).

NEARSHORE: Narrow 74%, intermediate 5%, and wide 10%. The remainder of the nearshore zone is located along Smith Creek, which is too narrow and shallow for classification.

SHORELANDS USE

FASTLAND: Commercial 1% (0.2 mi.), governmental 1% (0.2 mi.), industrial 70% (10.1 mi.), recreational 3% (0.4 mi.), residential 19% (2.7 mi.), and unmanaged, unwooded 6% (0.9 mi.).

SHORE: Commercial and industrial use along most of the shore, some private recreational use along Smith Creek.

NEARSHORE: Commercial and industrial traffic to and from numerous docks along the shoreline. Some sport boating from Smith Creek.

WIND AND SEA EXPOSURE: The shoreline trends basically SE - NW from Town Point to Lamberts Point, then SSW - NNE from Lamberts Point to the mouth of the Lafayette River. The fetch at Lamberts Point is NNW - 7.5 nm.

OWNERSHIP: Private 82%, city 16%, and federal 2%.

FLOOD HAZARD: Severe, critical. Much of the shoreland would be flooded during the 100 year storm, endangering many structures.

WATER QUALITY: Unsatisfactory. The many domestic and industrial discharges into the Elizabeth River as well as the great amount of traffic along the river have polluted the system.

BEACH QUALITY: Poor. There are several patches of beach fronting the bulkhead in the segment.

PRESENT SHORE EROSION SITUATION

EROSION RATE: No data. The area is stable.

ENDANGERED STRUCTURES: None.

SHORE PROTECTIVE STRUCTURES: Basically the entire segment is artificially stabilized, most areas being bulkhead. These structures are mainly for industrial and cosmetic purposes, though in some areas, erosion could be a problem without the shore protection. All structures appear to be effective.

OTHER SHORE STRUCTURES: There are numerous piers and docks throughout the segment.

SHORE USE LIMITATIONS:

The entire segment is already intensely used for a variety of purposes.

ALTERNATE SHORE USE:

Low. There is no available land in the segment which could be developed. Redevelopment of several areas is possible, though this would probably be for commercial or industrial purposes rather than for recreational facilities.

MAPS: USGS, 7.5 Min.Ser. (Topo.), NORFOLK NORTH Quadr., 1965, pr. 1970;
USGS, 7.5 Min.Ser. (Topo.), NORFOLK SOUTH Quadr., 1965, pr. 1970.
C&GS, #12222 (562), 1:40,000 scale,
CHESAPEAKE BAY, Cape Charles to Norfolk
Harbor, 16th ed., 1976.

PHOTOS: Aerial-VIMS 120ct76 NF-7/493-497;
1Sep76 NF-7/498-530.

SEGMENT 8

NORFOLK CITY

LAFAYETTE RIVER

Maps 4 and 5

EXTENT: 299,000 feet (56.6 mi.) of shoreline along the Lafayette River. The segment also includes 312,000 feet (59.1 mi.) of fastland.

SHORELANDS TYPE

FASTLAND: Artificial fill 7% (4.2 mi.) and low shore 93% (54.9 mi.).

SHORE: Artificially stabilized 39% (22.0 mi.), beach 1% (0.6 mi.), fringe marsh 49% (28.0 mi.), embayed marsh 10% (5.6 mi.), and extensive marsh 1% (0.5 mi.).

RIVER: The Lafayette River has controlling depths of 6 feet to the Route 460 bridge.

SHORELANDS USE

FASTLAND: Commercial 3% (2.0 mi.), governmental 1% (0.4 mi.), industrial 2% (0.9 mi.), recreational 9% (5.4 mi.), and residential 85% (50.4 mi.).

SHORE: Some recreational use.

RIVER: The Lafayette River is used by pleasure boats heading to the Elizabeth River and thence to the Chesapeake Bay.

WIND AND SEA EXPOSURE: The Lafayette River trends basically NW - SE from the mouth to the Route 460 bridge through a meander, where it forks to the NE and the SE. No significant fetches affect the segment.

OWNERSHIP: Private 89%, city 9%, federal 1%, and state > 1%.

FLOOD HAZARD: Severe, critical. The 100 year storm would flood the entire shoreline, covering large portions of several sections near the river mouth. Many structures would be endangered by such a flood.

WATER QUALITY: Unsatisfactory. The Lafayette River system suffers from domestic and industrial waste discharges as well as boating and marina activities. The river has a small freshwater inflow and tidal flushing is relatively poor.

BEACH QUALITY: Poor. The several stretches of beach along the Lafayette River are usually very thin.

PRESENT SHORE EROSION SITUATION

EROSION RATE: No data. The area appears stable.

ENDANGERED STRUCTURES: None.

SHORE PROTECTIVE STRUCTURES: There is approximately 73,800 feet of artificially stabilized shoreline in the segment, most of which is bulkhead. There is several thousand feet of riprap along the Lafayette River, mainly near the river mouth. These structures are mainly for cosmetic purposes rather than for erosion control and appear to be effective.

OTHER SHORE STRUCTURES: There are numerous piers and some boat ramps in the segment.

SHORE USE LIMITATIONS:

The Lafayette River is an intensely used area, most sections being for residential use. The shorelands also contain three marinas, several boat ramps, a government-owned hospital, and numerous city-owned areas (including Lafayette Park with the Norfolk Zoo, Barraud Park, and numerous schools). There are no areas of unused shorelands along the river.

ALTERNATE SHORE USE:

Low. The present intense use of the shorelands along the Lafayette River precludes other alternate shore use.

MAPS: USGS, 7.5 Min.Ser. (Topo.), NORFOLK NORTH Quadr., 1965, pr. 1970;
USGS, 7.5 Min.Ser. (Topo.), NORFOLK SOUTH Quadr., 1965, pr. 1970.
C&GS, #12222 (562), 1:40,000 scale,
CHESAPEAKE BAY, Cape Charles to Norfolk
Harbor, 16th ed., 1976.

PHOTOS: Aerial-VIMS 1Sep76 NF-8/256-258;
12Oct76 NF-8/259-492.

SEGMENT 9

NORFOLK CITY

TANNER POINT TO SEWELLS POINT

Maps 3 and 4

EXTENT: 41,400 feet (7.8 mi.) of shoreline from Tanner Point at the mouth of the Lafayette River to Sewells Point. The segment also includes 41,400 feet (7.8 mi.) of fastland.

SHORELANDS TYPE

FASTLAND: Entirely artificial fill.

SHORE: Artificially stabilized 89% (7.0 mi.), beach 6% (0.4 mi.), and fringe marsh 5% (0.4 mi.).

NEARSHORE: Narrow 82% and intermediate 18%.

SHORELANDS USE

FASTLAND: Governmental 45% (3.5 mi.) and industrial 55% (4.3 mi.).

SHORE: Industrial and commercial use.

NEARSHORE: Industrial, commercial, and military traffic to and from the numerous docks in the segment.

WIND AND SEA EXPOSURE: The shoreline trends basically S - N in the segment. Fetches at Sewells Point are NNW - 3 nm and W - 5.5 nm.

OWNERSHIP: Private 24%, federal 45%, and state 31%.

FLOOD HAZARD: Severe, critical. The 100 year storm would cause extensive flooding in the segment, endangering many structures.

WATER QUALITY: Unsatisfactory. The Elizabeth River system is polluted from a variety of industrial and domestic waste discharges. The industrial and commercial traffic along the river adds to the pollution of the river.

BEACH QUALITY: Poor. There is a small section of relatively nice beach in the segment. However, the surrounding industrial use would severely limit the access and use of the beach.

PRESENT SHORE EROSION SITUATION

EROSION RATE: No data. Though erosion probably was a problem for this area, the shoreline is

artificially stabilized.

ENDANGERED STRUCTURES: None.

SHORE PROTECTIVE STRUCTURES: There is approximately 36,800 feet of artificially stabilized shoreline in the segment, of which 5,000 feet is riprap and the rest is bulkhead. Like most stabilized areas in Norfolk, the structures are for industrial purposes rather than for erosion control. Most structures appear to be effective.

OTHER SHORE STRUCTURES: There are numerous docks along the shoreline.

SHORE USE LIMITATIONS:

The shorelands are intensely used for military and industrial/commercial purposes, which would severely limit other shore use.

ALTERNATE SHORE USE:

Low. The present shore use effectively prohibits other alternate use.

MAPS: USGS, 7.5 Min.Ser. (Topo.), NORFOLK NORTH Quadr., 1965, pr. 1970.
C&GS, #12222 (562), 1:40,000 scale,
CHESAPEAKE BAY, Cape Charles to Norfolk
Harbor, 16th ed., 1976.

PHOTOS: Aerial-VIMS 1Sep76 NF-9/220-256.

SEGMENT 10

NORFOLK CITY
WILLOUGHBY BAY

Map 3

EXTENT: 53,600 feet (10.2 mi.) of shoreline from Sewells Point to the tip of Willoughby Spit. The segment includes 53,600 feet (10.2 mi.) of fastland.

SHORELANDS TYPE

FASTLAND: Artificial fill 75% (7.6 mi.) and low shore 25% (2.6 mi.).

SHORE: Artificially stabilized 86% (8.7 mi.), beach 12% (1.3 mi.), and fringe marsh 2% (0.2 mi.).

NEARSHORE: Wide 3%. Willoughby Bay has general depths of 7 to 12 feet.

SHORELANDS USE

FASTLAND: Commercial 12% (1.2 mi.), governmental 73% (7.4 mi.), recreational 3% (0.3 mi.), and residential 12% (1.3 mi.).

SHORE: Mostly military use, some private access to boats.

NEARSHORE: Willoughby Bay is generally too shallow for most ships. The bay is mostly used by pleasure craft from the Willoughby Spit area.

WIND AND SEA EXPOSURE: Willoughby Bay is an E - W bay approximately 2.7 miles long, formed between the mainland and Willoughby Spit at the mouth of the Elizabeth River. The only significant fetch at the mouth of the bay is NW - 4.2 nm.

OWNERSHIP: Private 24%, city 3%, and federal 73%.

FLOOD HAZARD: Severe, critical. The shorelands along Willoughby Bay, especially Willoughby Spit, would be flooded during the 100 year storm. All structures along Willoughby Spit and many structures along the rest of the shoreline would be endangered by the flood.

WATER QUALITY: Unsatisfactory. The bay suffers from pollution due to numerous industrial and domestic waste discharges upstream and from

boating activities.

BEACH QUALITY: Fair to good. The beaches along Willoughby Spit are usually fairly wide and clean. However, they front private residences and have little public recreation potential.

PRESENT SHORE EROSION SITUATION

EROSION RATE: No data. The area appears stable.

ENDANGERED STRUCTURES: None.

SHORE PROTECTIVE STRUCTURES: There is approximately 45,800 feet of artificially stabilized shoreline in the segment, of which there is approximately 12,600 feet of riprap, and the rest is bulkhead. Riprap protects the toe of several areas of bulkhead. Though most stabilized areas in the bay are for cosmetic purposes, the bulkhead at the tip of Willoughby Spit is for erosion protection. All structures appear to be effective.

OTHER SHORE STRUCTURES: There are numerous piers and docks in the segment, as well as several boat ramps. Willoughby Bay Marina, at the tip of the spit, has a boat ramp and some boat docks.

SHORE USE LIMITATIONS:

Seventy-three percent of the shorelands are part of the U.S. Naval Reservation and are unavailable for other use. The other shorelands are already intensely used for residential, commercial, and some recreational purposes.

ALTERNATE SHORE USE:

Low. No areas are available for alternate use. The city-owned land along Willoughby Spit has a boat ramp. Some other facilities for picnicking could be established here.

MAPS: USGS, 7.5 Min.Ser. (Topo.), NORFOLK NORTH Quadr., 1965, pr. 1970.
C&GS, #12222 (562), 1:40,000 scale,
CHESAPEAKE BAY, Cape Charles to Norfolk
Harbor, 16th ed., 1976.

PHOTOS: Aerial-VIMS 120ct76 NF-10/158-219.

SEGMENT 11

NORFOLK CITY

OCEAN VIEW

Maps 2 and 3

EXTENT: 37,400 feet (7.1 mi.) of shoreline along the Chesapeake Bay shoreline, from the tip of Willoughby Spit to the Virginia Beach City Line near the mouth of Little Creek. The segment also includes 37,400 feet (7.1 mi.) of fastland.

SHORELANDS TYPE

FASTLAND: Entirely low shore.

SHORE: Artificially stabilized 59% (4.2 mi.) and beach 41% (2.9 mi.).

NEARSHORE: Narrow 76% and intermediate 24%.

SHORELANDS USE

FASTLAND: Commercial 14% (1.0 mi.), recreational 16% (1.1 mi.), and residential 70% (5.0 mi.).

SHORE: Mostly recreational. The City of Norfolk owns the beaches from near Little Creek to Ocean View Amusement Park.

NEARSHORE: The immediate nearshore is used for commercial fish trapping and sport fishing. Thimble Shoal Channel and the entrance channel to Norfolk Harbor lie approximately 1.7 to 3.3 nm offshore. Commercial and military traffic use these channels.

WIND AND SEA EXPOSURE: The shoreline trends basically WNW - ESE in the segment. Fetches from the N and NE are unlimited across the Chesapeake Bay.

OWNERSHIP: Private 84% and city 16%.

FLOOD HAZARD: Severe, critical. Though the 100 year storm would only cause limited flooding along much of the shoreline, the entire Willoughby Spit area would be inundated during the storm. All structures on the spit would be endangered.

WATER QUALITY: Satisfactory. Though the State Water Quality Inventory 305(b) Report does not comment specifically about this area, the segment's exposure to the Chesapeake Bay should

allow adequate flushing of the nearshore to keep the water quality satisfactory.

BEACH QUALITY: Good. The segment generally has very nice, clean beaches.

PRESENT SHORE EROSION SITUATION

EROSION RATE: Historical erosion rates for this area range from 1.6 to 2.5 feet per year. The direction of net longshore sand drift is to the west. The entrance to Little Creek Harbor at least partially interrupts the supply from the east. Although the existing extensive groin field is effective in trapping sand, some problems exist in holding sand, particularly in the area just west of the entrance to Little Creek. Except during severe storms, the existing shoreline structures protect the fastland from direct wave attack.

ENDANGERED STRUCTURES: None.

SHORE PROTECTIVE STRUCTURES: There is approximately 22,000 feet of bulkhead in the segment, most of which appears to be effective. The many groins in the segment are generally effective in trapping sand.

OTHER SHORE STRUCTURES: There are several piers in the segment.

SHORE USE LIMITATIONS:

The entire segment is intensely used for residential, recreational, and commercial purposes. The vulnerability of the segment to extensive damage from storm tides and storm erosion, combined with the present intensive shore use, would limit other development.

ALTERNATE SHORE USE:

Low. The segment is entirely used. This area has the only major public recreational facilities along Norfolk's shoreline. The city has several parks and owns much of the beach. Ocean View Amusement Park is also located along the shoreline in this segment. Little alternate use seems probable or necessary.

MAPS: USGS, 7.5 Min.Ser. (Topo.), NORFOLK NORTH Quadr., 1965, pr. 1970;
USGS, 7.5 Min.Ser. (Topo.), LITTLE CREEK Quadr., 1964, pr. 1970.
C&GS, #12222 (562), 1:40,000 scale,
CHESAPEAKE BAY, Cape Charles to Norfolk

Harbor, 16th ed., 1976.

PHOTOS: Aerial-VIMS 12Oct76 NF-11/87-157.

SEGMENT 12

NORFOLK CITY

LITTLE CREEK

Map 12

EXTENT: 66,200 feet (12.5 mi.) of shoreline along the Norfolk section of Little Creek. The segment includes 73,600 feet (13.9 mi.) of fast-land.

SHORELANDS TYPE

FASTLAND: Artificial fill 8% (1.1 mi.) and low shore 92% (12.8 mi.).

SHORE: Artificially stabilized 26% (3.3 mi.), beach 5% (0.7 mi.), fringe marsh 51% (6.4 mi.), and embayed marsh 18% (2.2 mi.).

CREEK: Little Creek is too narrow and shallow for classification.

SHORELANDS USE

FASTLAND: Commercial 20% (2.7 mi.), industrial 1% (0.1 mi.), recreational 5% (0.7 mi.), and residential 74% (10.4 mi.).

SHORE: Mostly used for commercial purposes.

CREEK: Sport boating and commercial traffic.

WIND AND SEA EXPOSURE: This section of Little Creek trends basically E - W from the mouth to the head. No significant fetches affect the shoreline.

OWNERSHIP: Private 94% and city 6%.

FLOOD HAZARD: Severe, critical. Large sections of the shorelands would be flooded during the 100 year storm, endangering many structures.

WATER QUALITY: Unsatisfactory. Though there are no major dischargers into Little Creek, the area suffers from pollution due to the heavy boat traffic, urban runoff, and faulty septic tanks of individual dwellings in the area.

BEACH QUALITY: Poor. The several small areas of beach are usually very thin.

PRESENT SHORE EROSION SITUATION

EROSION RATE: No data. The area appears stable.

ENDANGERED STRUCTURES: None.

SHORE PROTECTIVE STRUCTURES: There is approximately 17,200 feet of artificially stabilized shoreline in the segment, most of which is bulkhead. These structures are for cosmetic or commercial purposes rather than for erosion protection.

OTHER SHORE STRUCTURES: There are numerous piers and docks along Little Creek.

SHORE USE LIMITATIONS:

The shorelands are, for the most part, completely consumed by a variety of uses. The embayed marshes at the creek head are protected by the Virginia Wetlands Act of 1972.

ALTERNATE SHORE USE:

Low. No major new development seems possible for the Little Creek area. The city-owned lands near the creek head could be used as a public park, with nature walks and picnic facilities.

MAPS: USGS, 7.5 Min.Ser. (Topo.), LITTLE CREEK Quadr., 1964, pr. 1970.
C&GS, #12222 (562), 1:40,000 scale,
CHESAPEAKE BAY, Cape Charles to Norfolk
Harbor, 16th ed., 1976.

PHOTOS: Aerial-VIMS 12Oct76 NF-12/1-71.

76° 12' 30"

MAP 2A

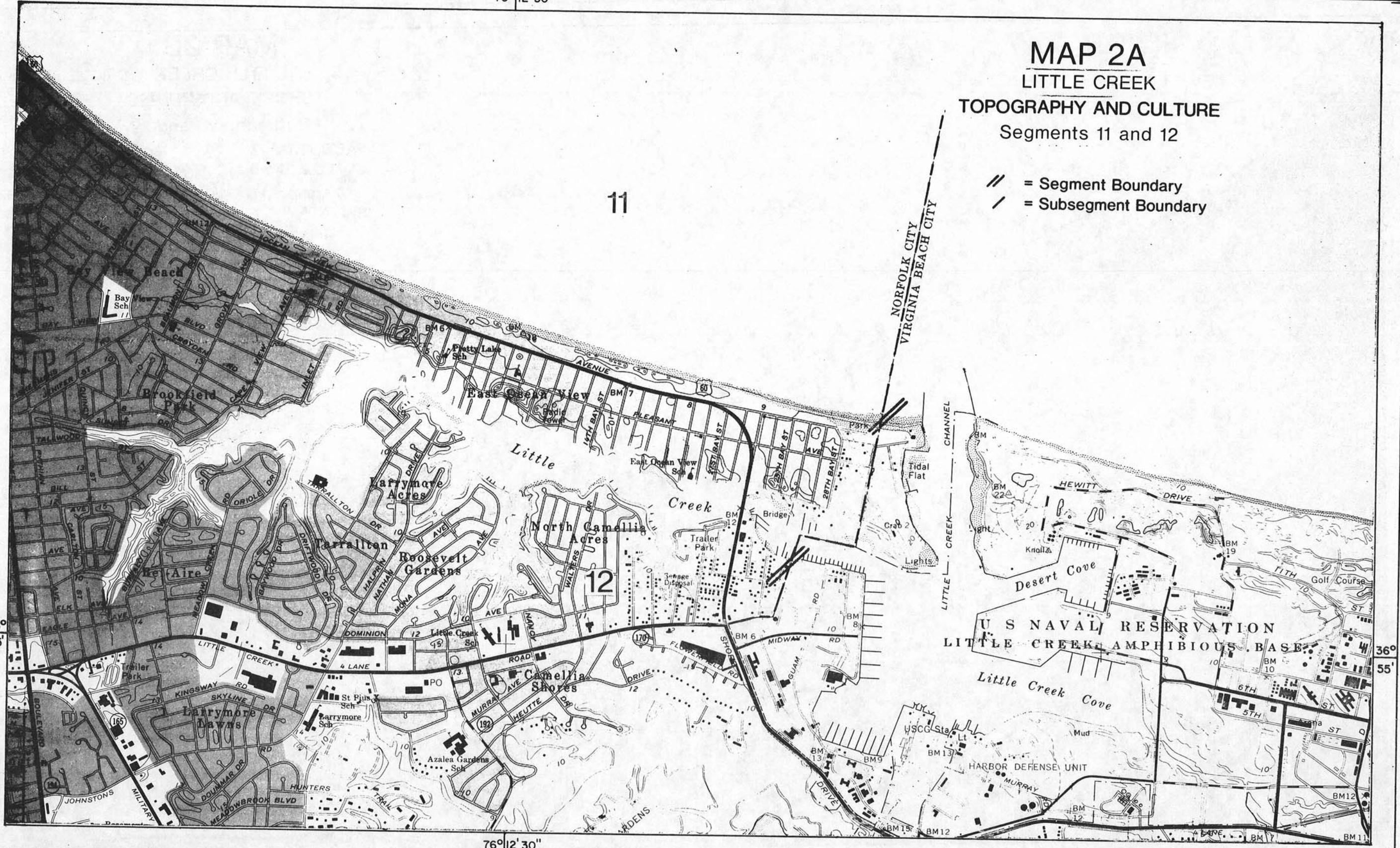
LITTLE CREEK

TOPOGRAPHY AND CULTURE

Segments 11 and 12

// = Segment Boundary
/ = Subsegment Boundary

11



76° 12' 30"

MAP 2B

LITTLE CREEK

SHORELANDS TYPES

Segments 11 and 12

FASTLAND

Low Shore

Artificial Fill

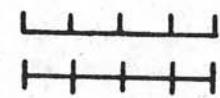
SHORE

Beach

Fringe Marsh

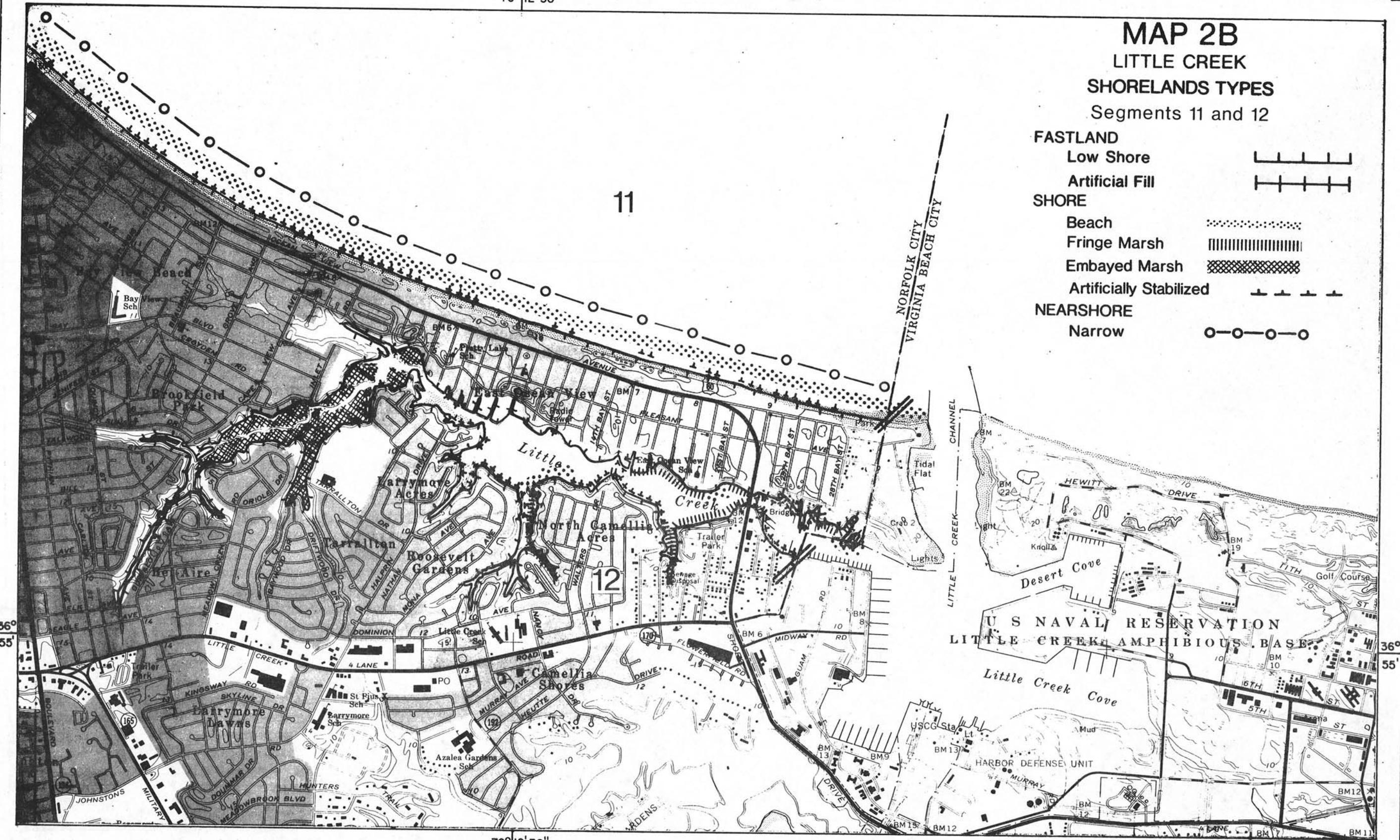
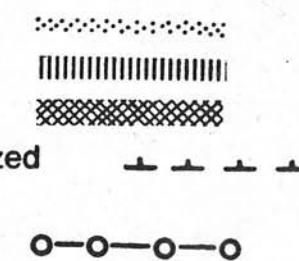
Embayed Marsh

Artificially Stabilized



NEARSHORE

Narrow



76° 12' 30"

76° 12' 30"

MAP 2C

LITTLE CREEK

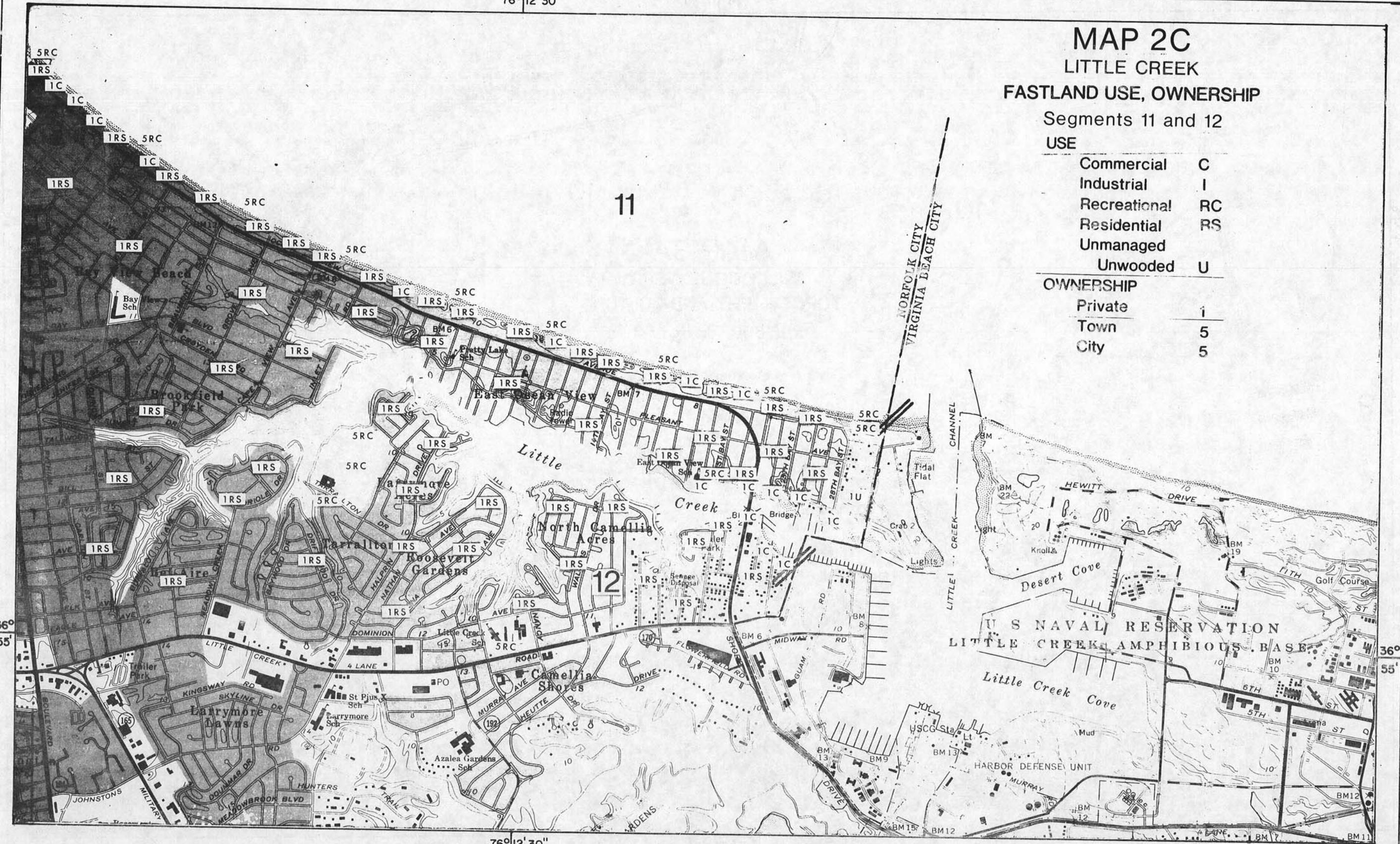
FASTLAND USE, OWNERSHIP

Seg
LSE

Commercial	C
Industrial	I
Recreational	RC
Residential	RS
Unmanaged	
Unwooded	U

OWNERSHIP

Private	1
Town	5
City	5



76° 17' 30"

36°
57'
30"

9

REACH

HARBOR

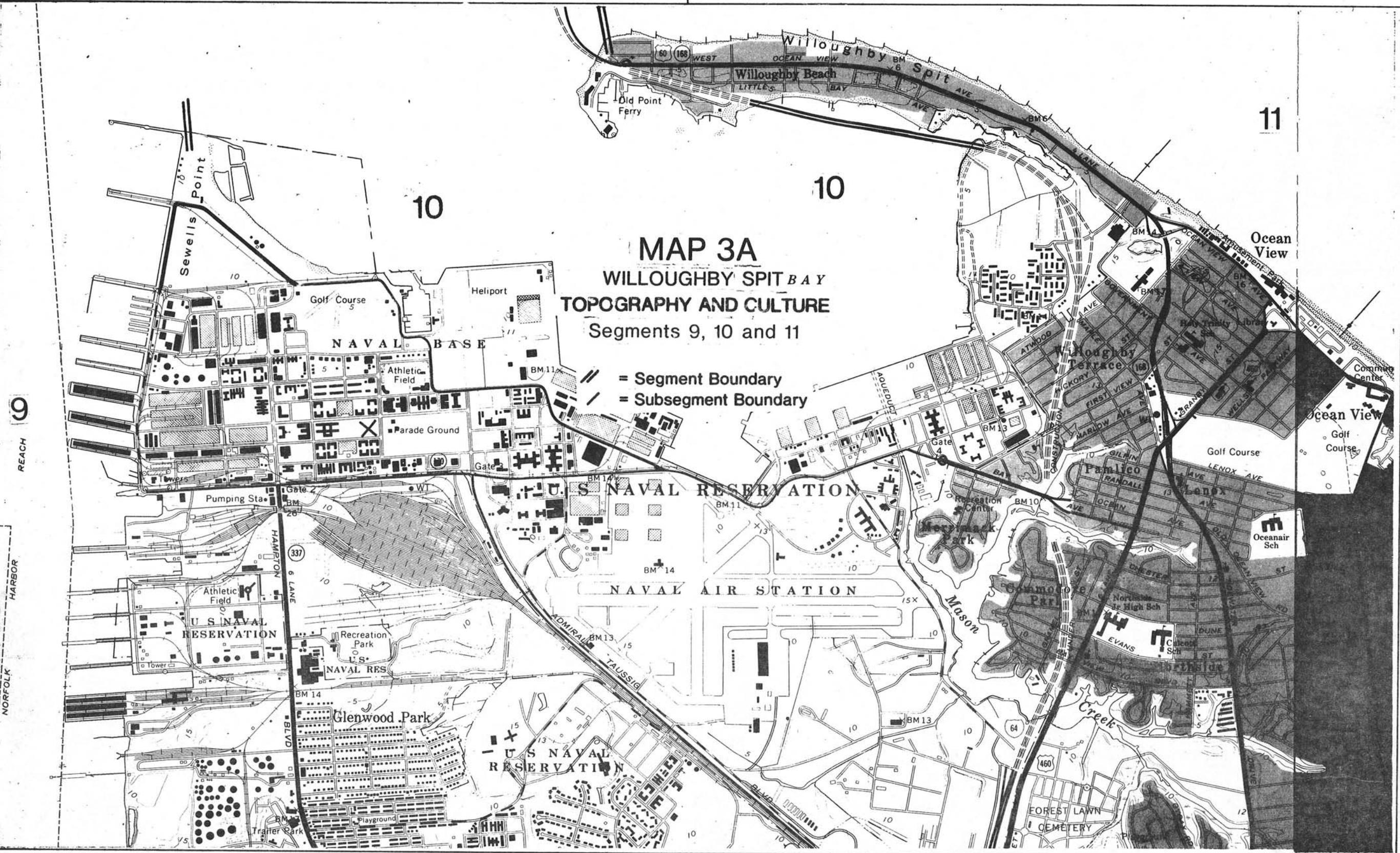
NORFOLK

10

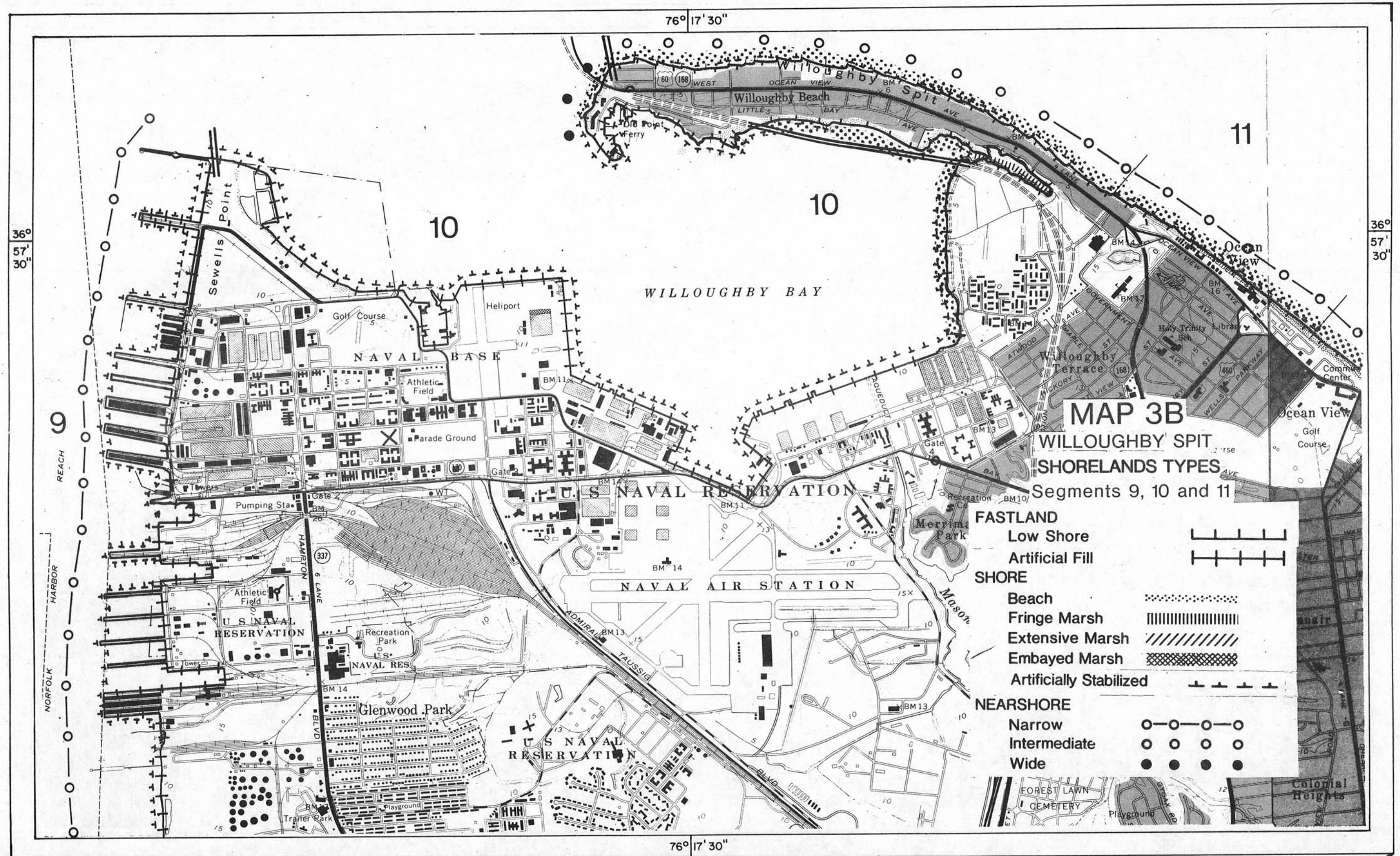
11

MAP 3A
WILLOUGHBY SPIT BAY
TOPOGRAPHY AND CULTURE
Segments 9, 10 and 11

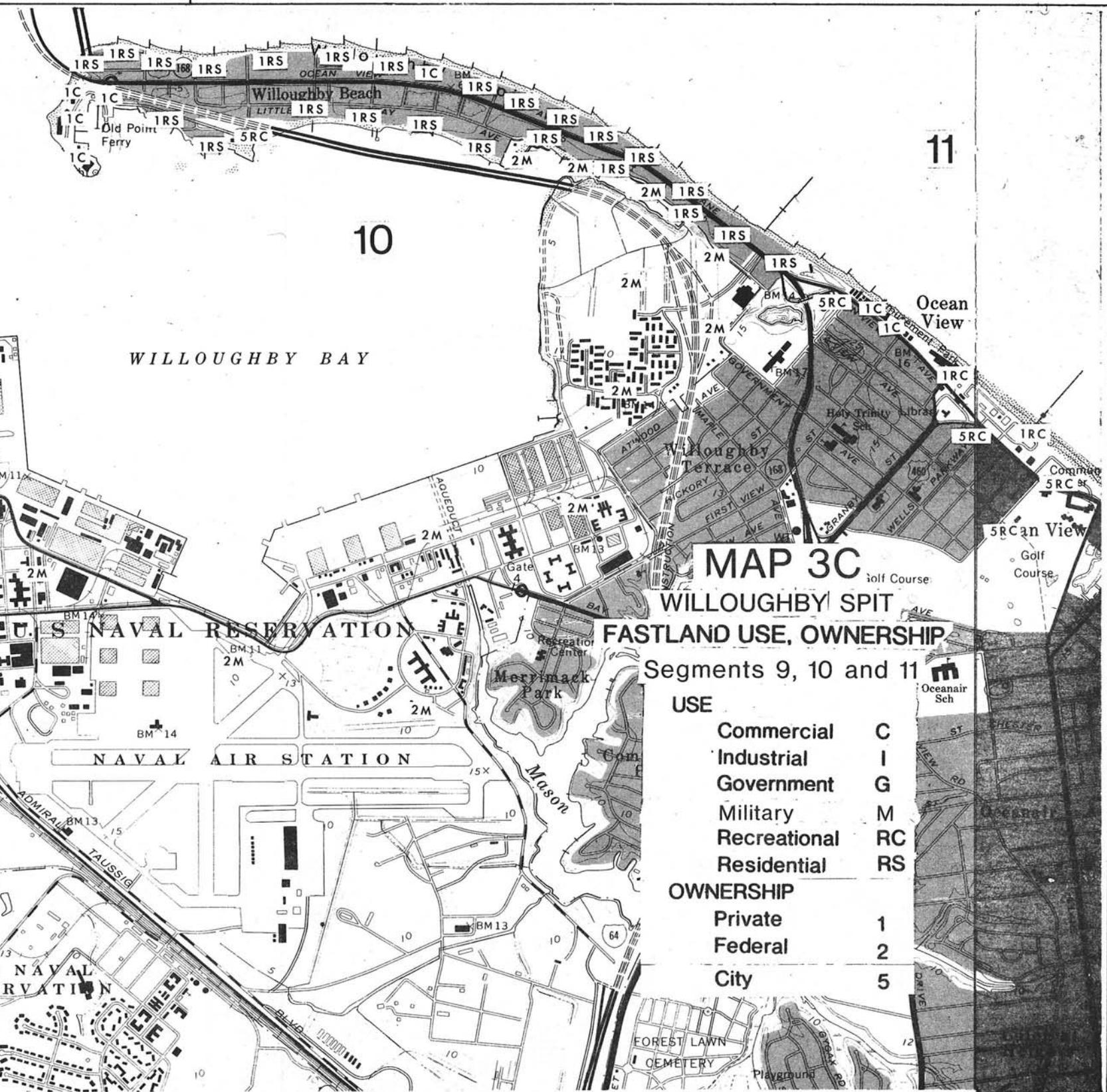
- // = Segment Boundary
/ = Subsegment Boundary



76° 17' 30"



76° 17' 30"



76° 20'

369

55'

36°

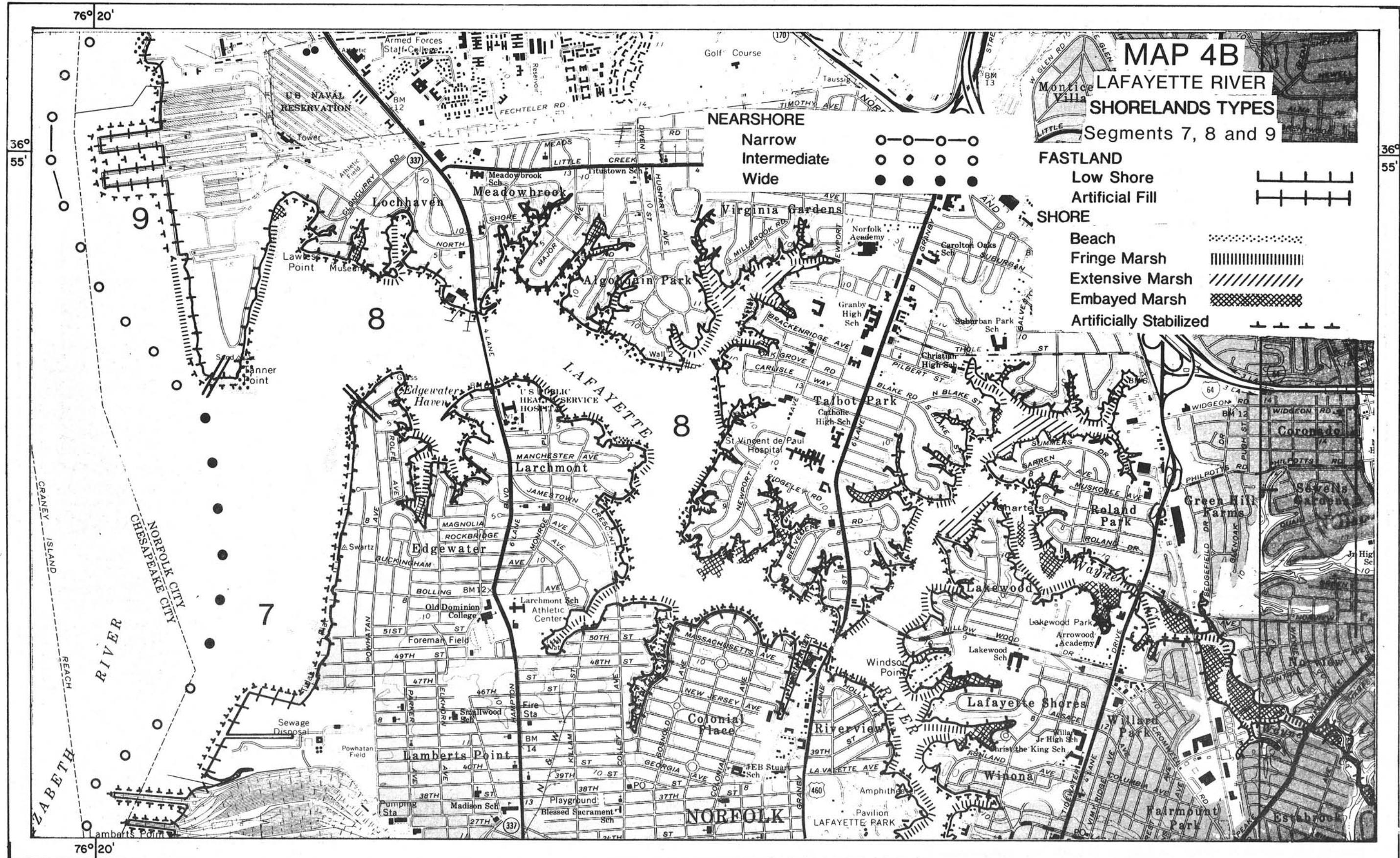
MAP 4A

LAFAYETTE RIVER TOPOGRAPHY AND CULTURE

Segments 7, 8 and 9

 = Segment Boundary
 = Subsegment Boundary

76° 20'



76° 20

5

364

卷之三

9

8

8

RIVIER

5

MAP 4C

AFAYETTE RIVER

Segments 7, 8 and 9

Commercial	C
Industrial	I
Government	G
Military	M
Recreational	RC
Residential	RS
Unmanaged	
Unwooded	U

OWNERSHIP

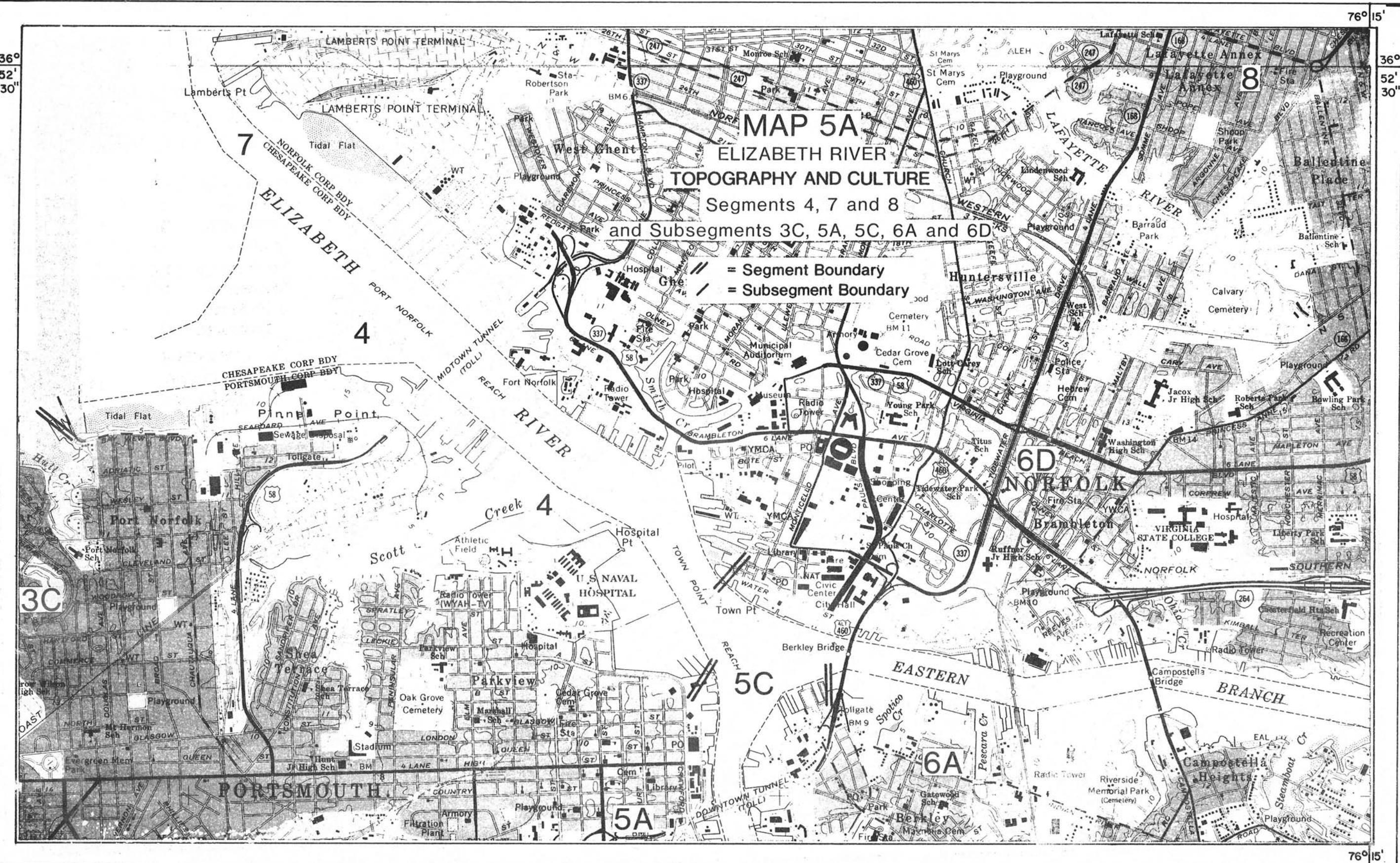
Private
Federal
State
City

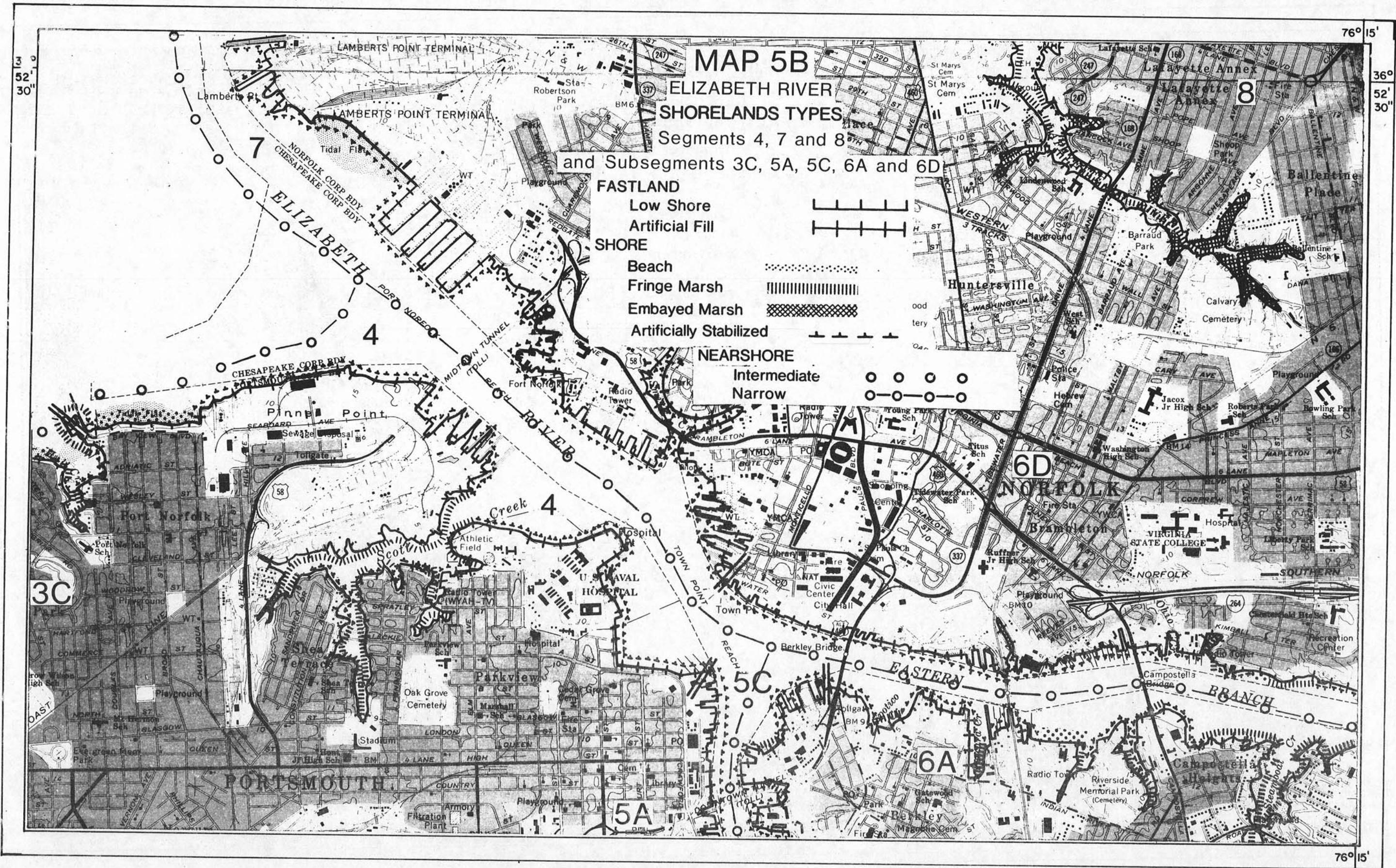
CHESA

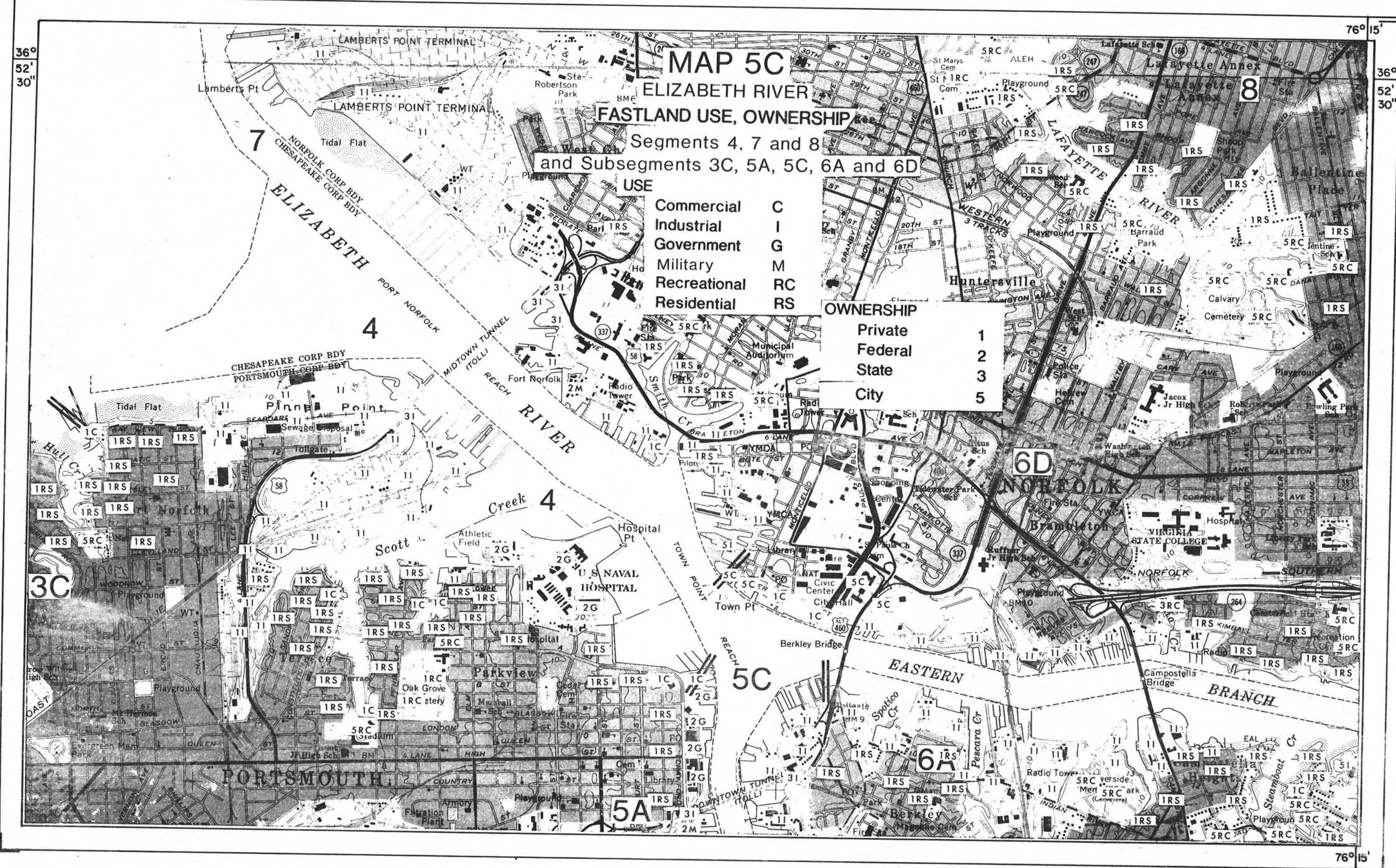
FOLK CITY

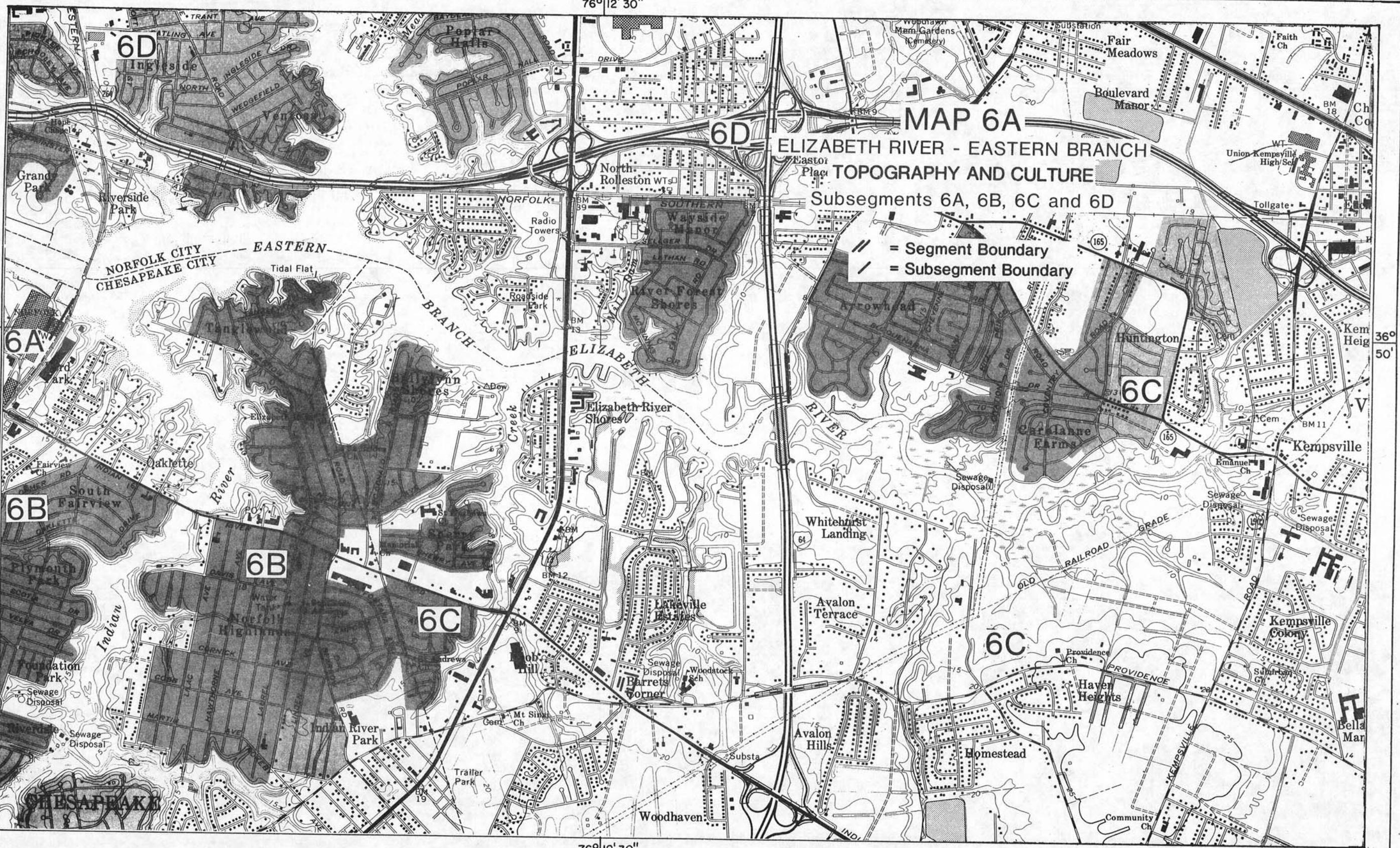
12

1



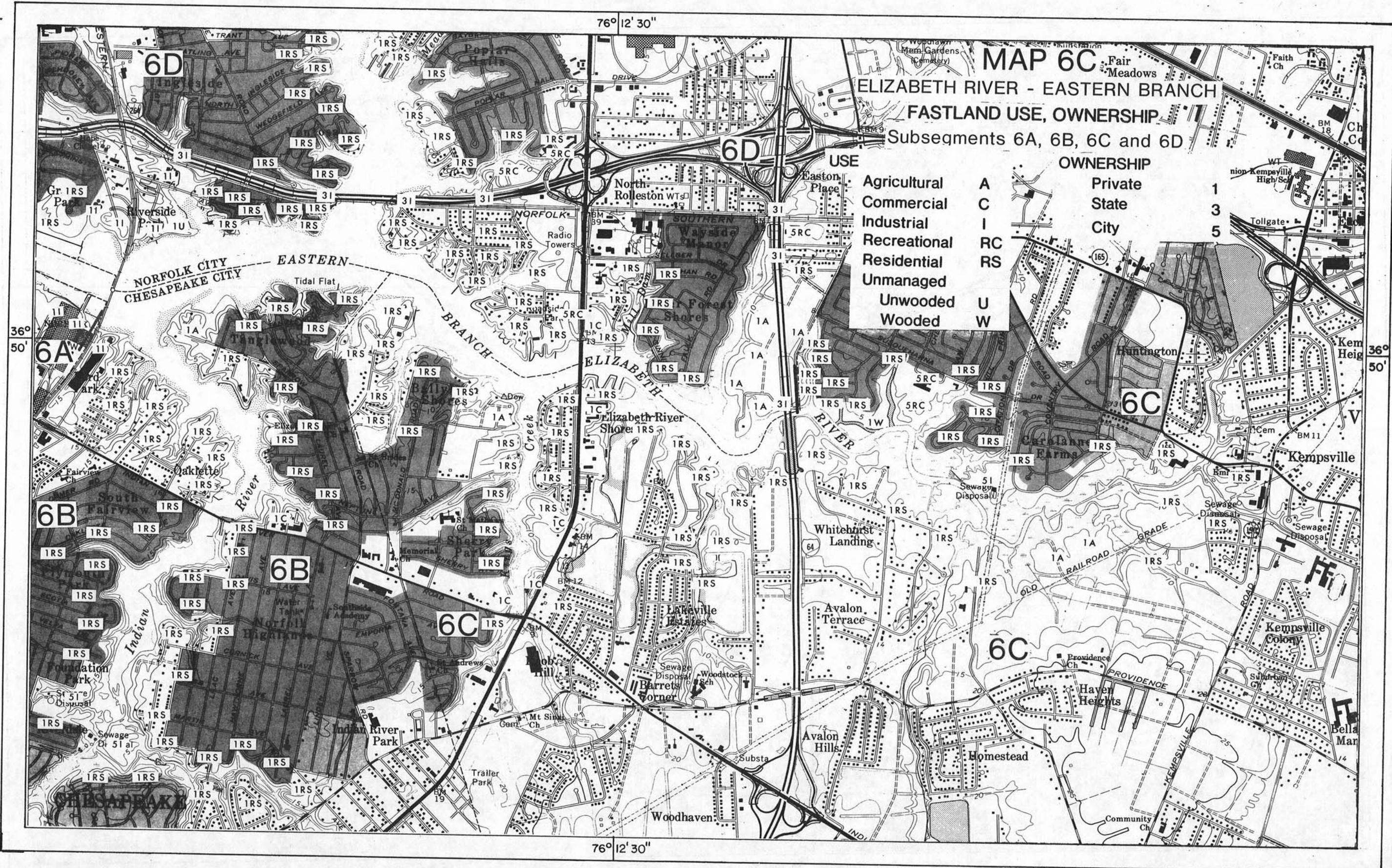






76° 12' 30"





36° 52' 30"

MAP 7A
HEAD OF BROAD CREEK
TOPOGRAPHY AND CULTURE

Subsegment 6D

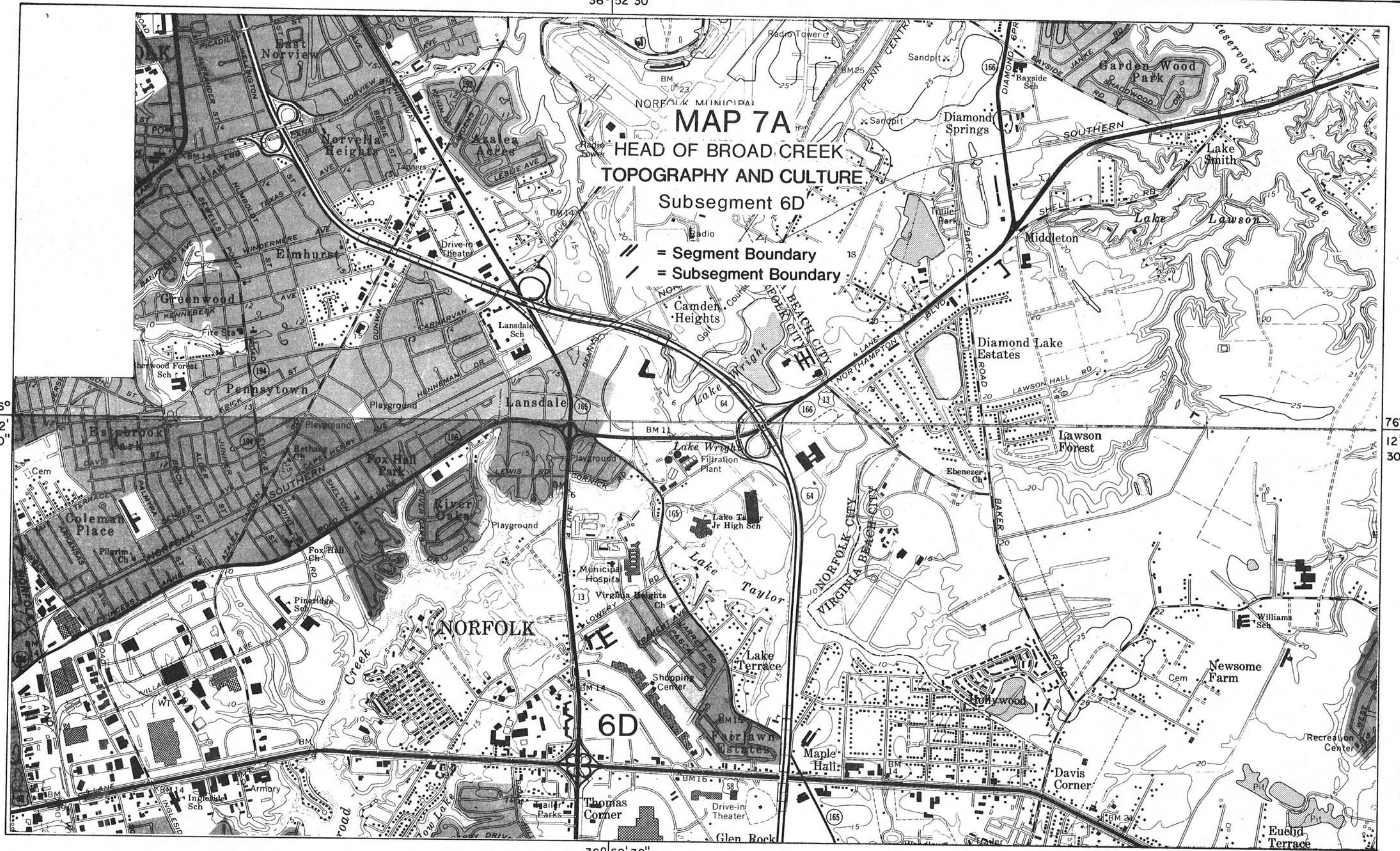
= Segment Boundary

- Subsegment Boundary

76°

12'
30"

12'
30"



36° 52' 30"

MAP 7B

HEAD OF BROAD CREEK

SHORELANDS TYPES

Subsegment 6D

FASTLAND

Low Shore

SHORE

Fringe Marsh

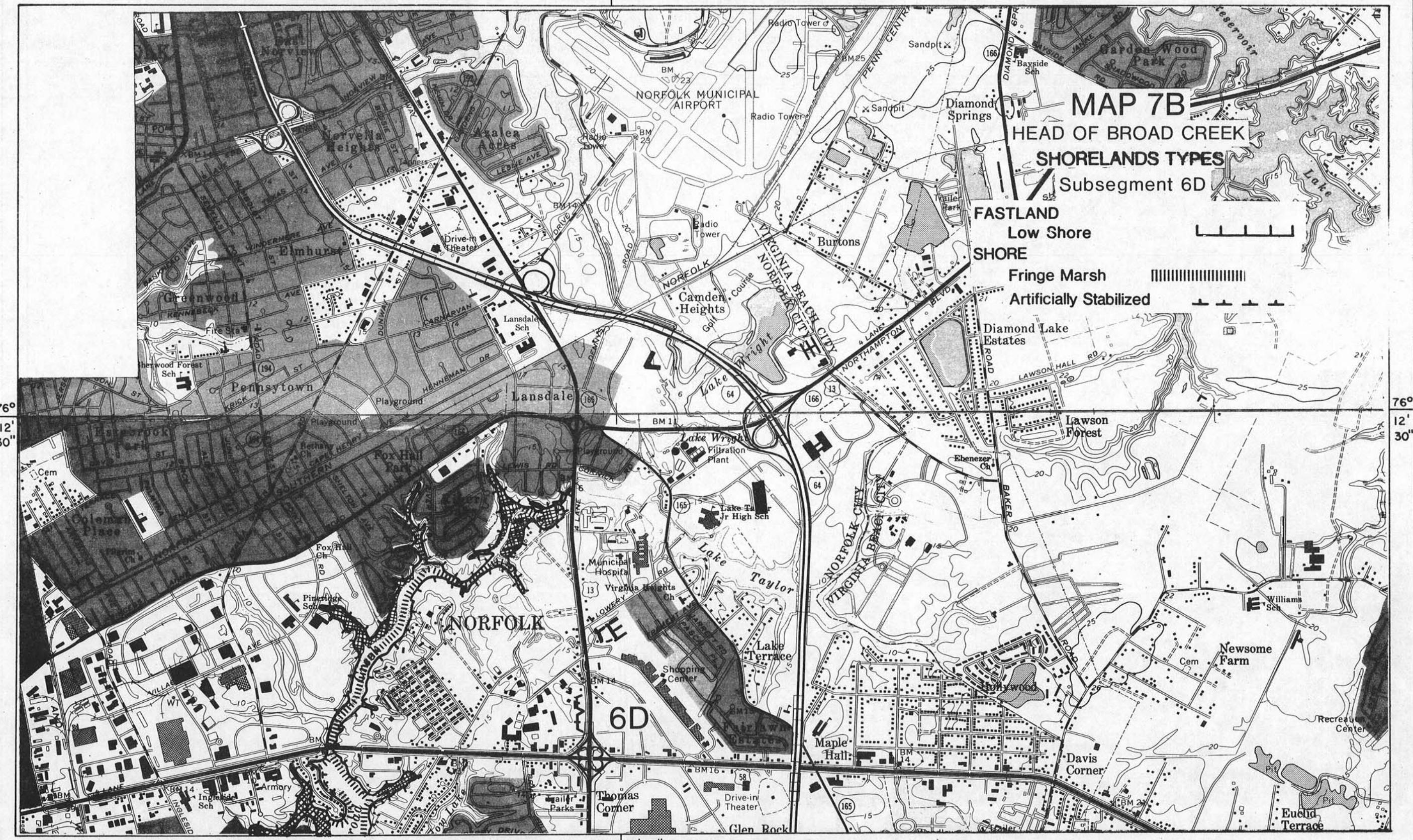
Artificially Stabilized

Diamond Lake Estates

Lawson Forest

Newsome Farm

Euclid Terrace



36° 52' 30"

MAP 7C
HEAD OF BROAD CREEK
FASTLAND USE, OWNERSHIP

Subsegment 6D

USE

Commercial
Military
Recreational
Residential
Unmanaged

Unwooded

OWNERSHIP

Private
State
Town
City

C

M

RC

RS

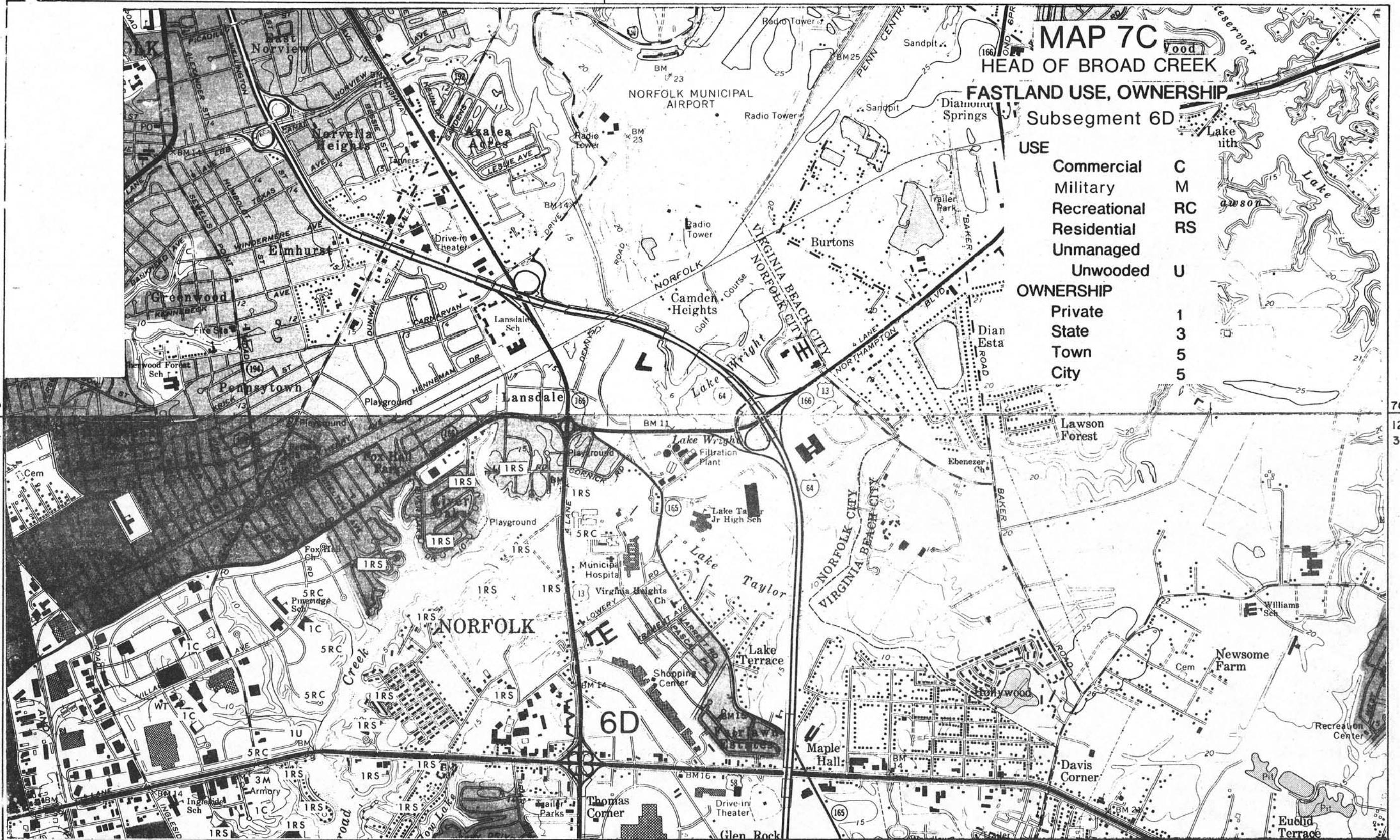
U

1

3

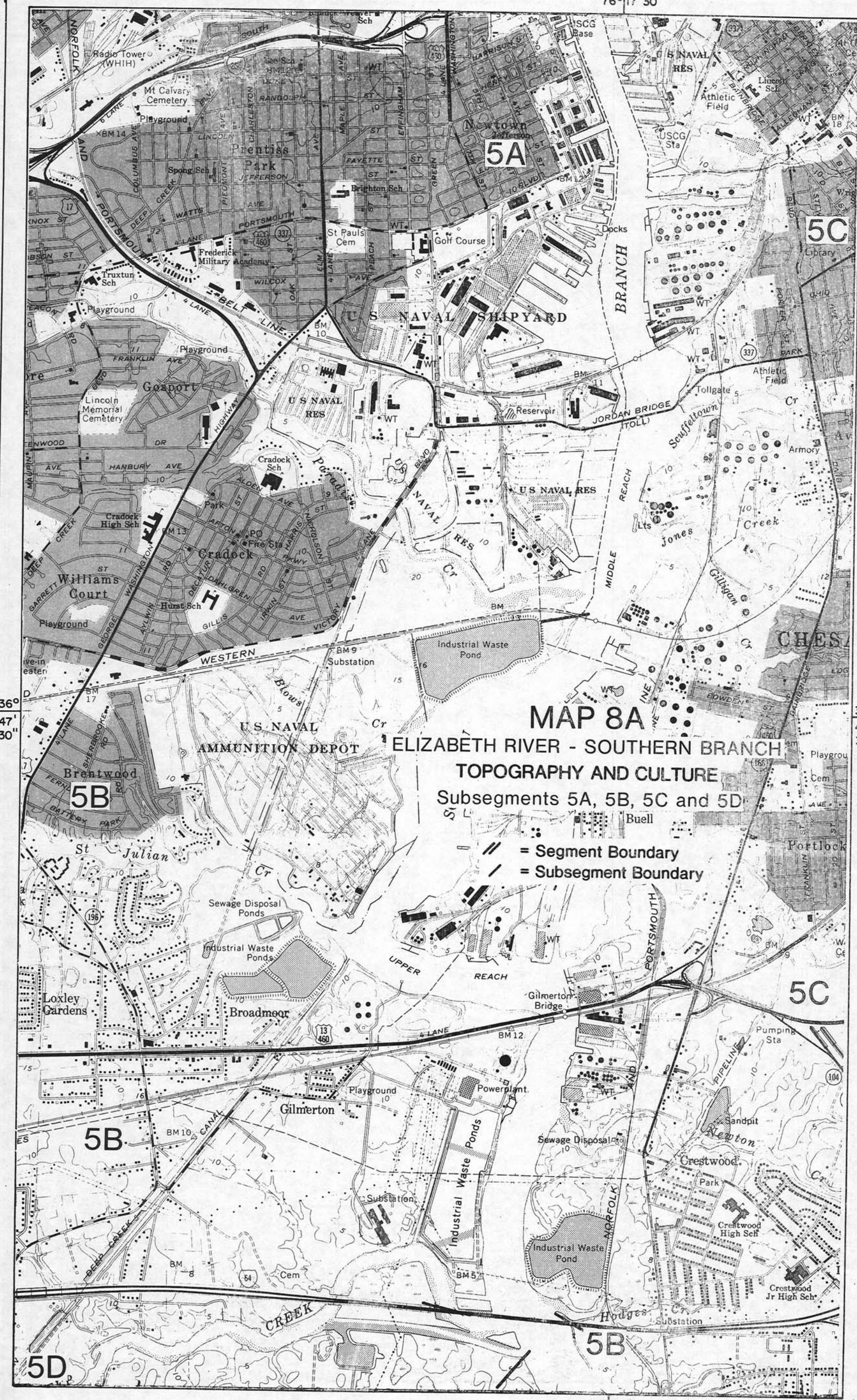
5

5



36° 52' 30"

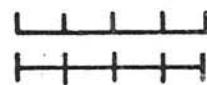
76° 17' 30"



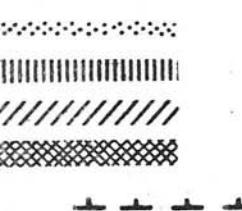
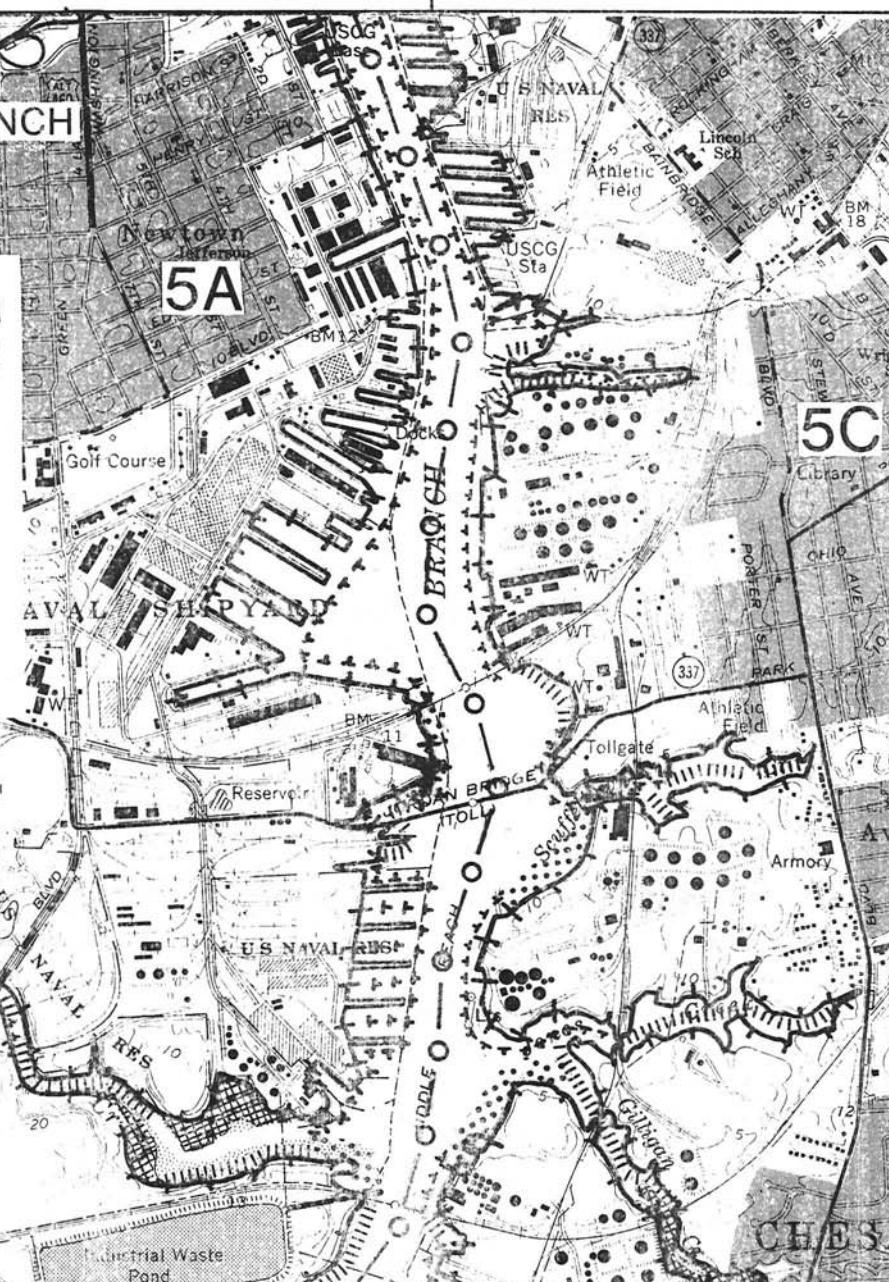
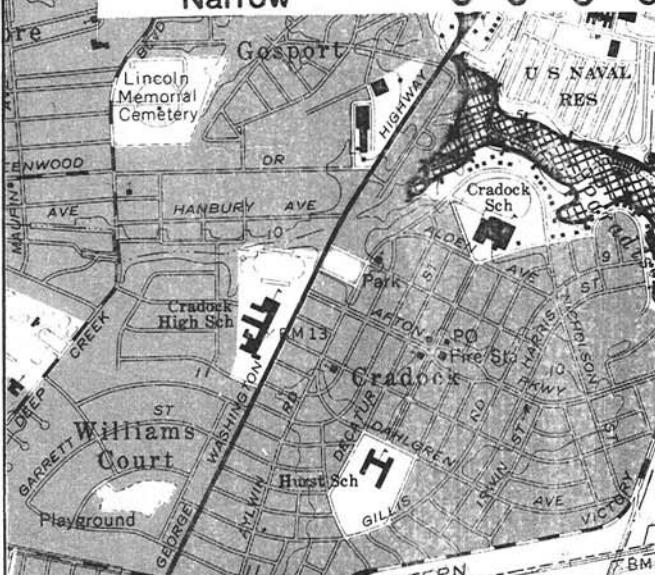
76° 17' 30"

MAP 8B
ELIZABETH RIVER - SOUTHERN BRANCH
SHORELANDS TYPES

Subsegments 5A, 5B, 5C and 5D

FASTLANDLow Shore
Artificial Fill**SHORE**

Beach
Fringe Marsh
Extensive Marsh
Embayed Marsh
Artificially Stabilized

**NEARSHORE****Narrow**

5C



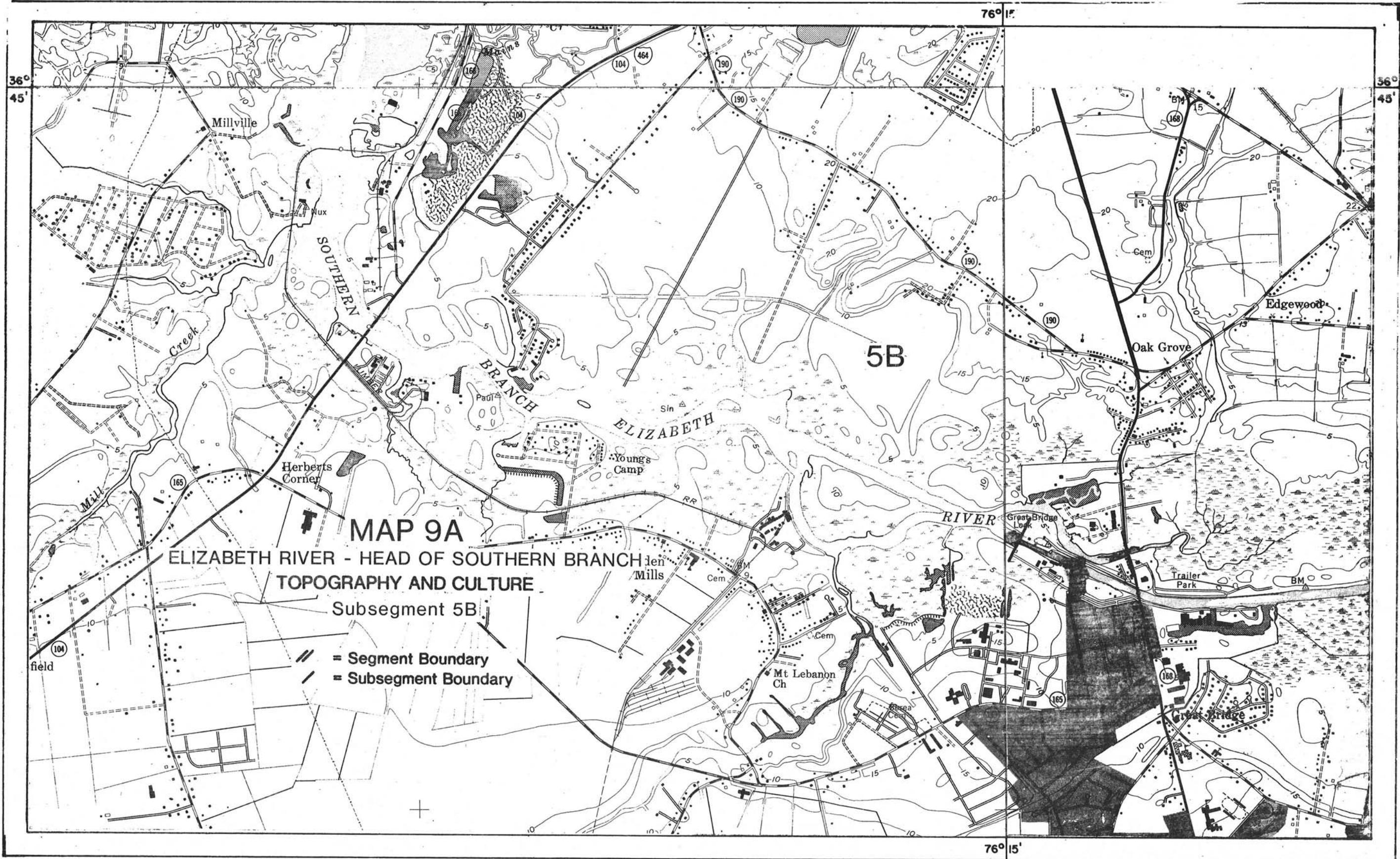
5C

5D

5B

76° 17' 30"





MAP 9B

ELIZABETH RIVER - HEAD OF SOUTHERN BRANCH

SHORELANDS TYPES.

Subsegment 5B

FASTLAND

Low Shore

Artificial Fill

SHORE

Fringe Marsh

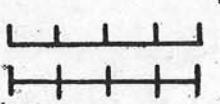
Embayed Marsh

Artificially Stabilized

NEARSHORE

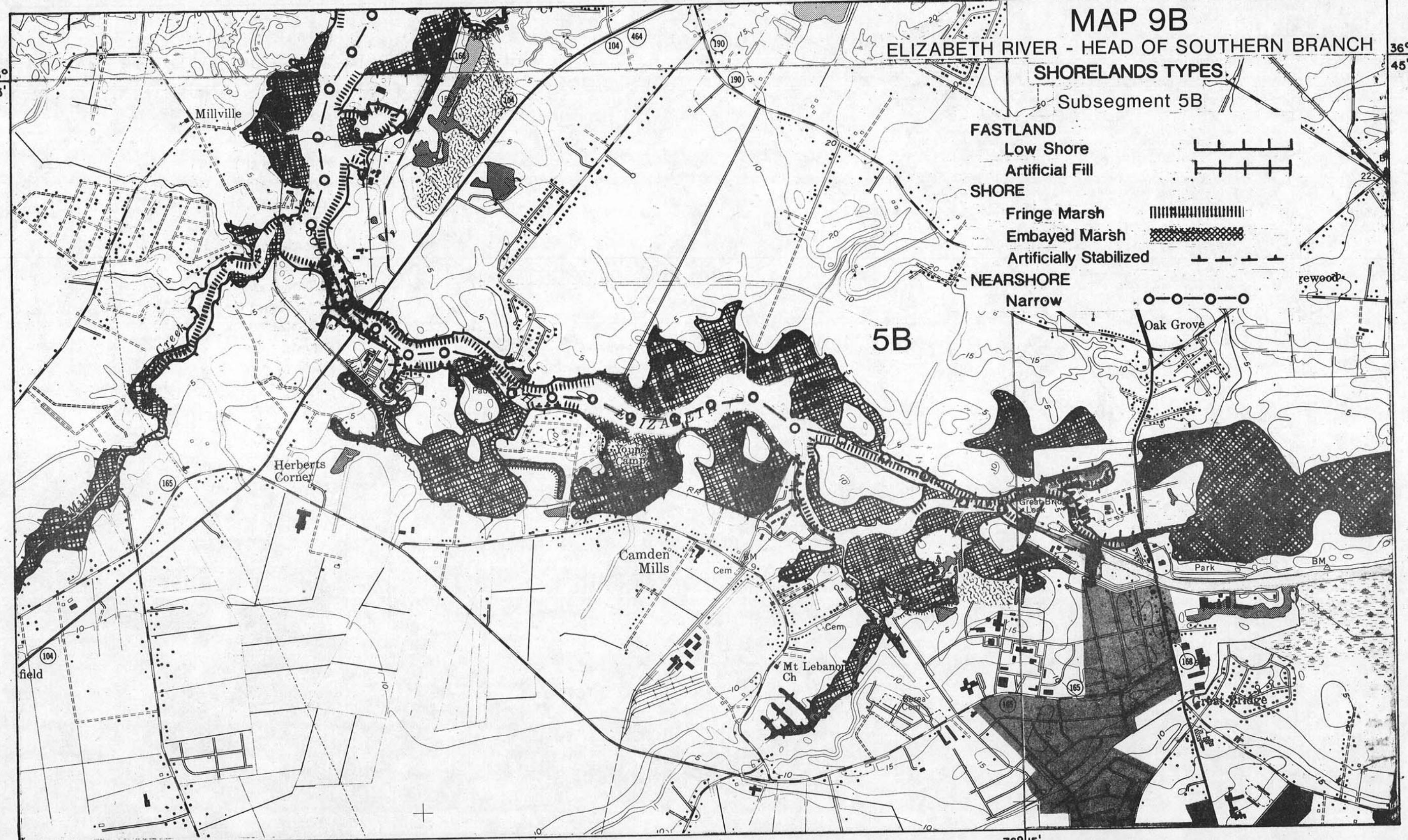
Narrow

5B



Oak Grove

ewood



76°15'

MAP 9C

ELIZABETH RIVER - HEAD OF SOUTHERN BRANCH

FASTLAND USE, OWNERSHIP

Subsegment 5B

USE

Agricultural
Commercial
Industrial
Recreational
Residential
Unmanaged
Unwooded
Wooded

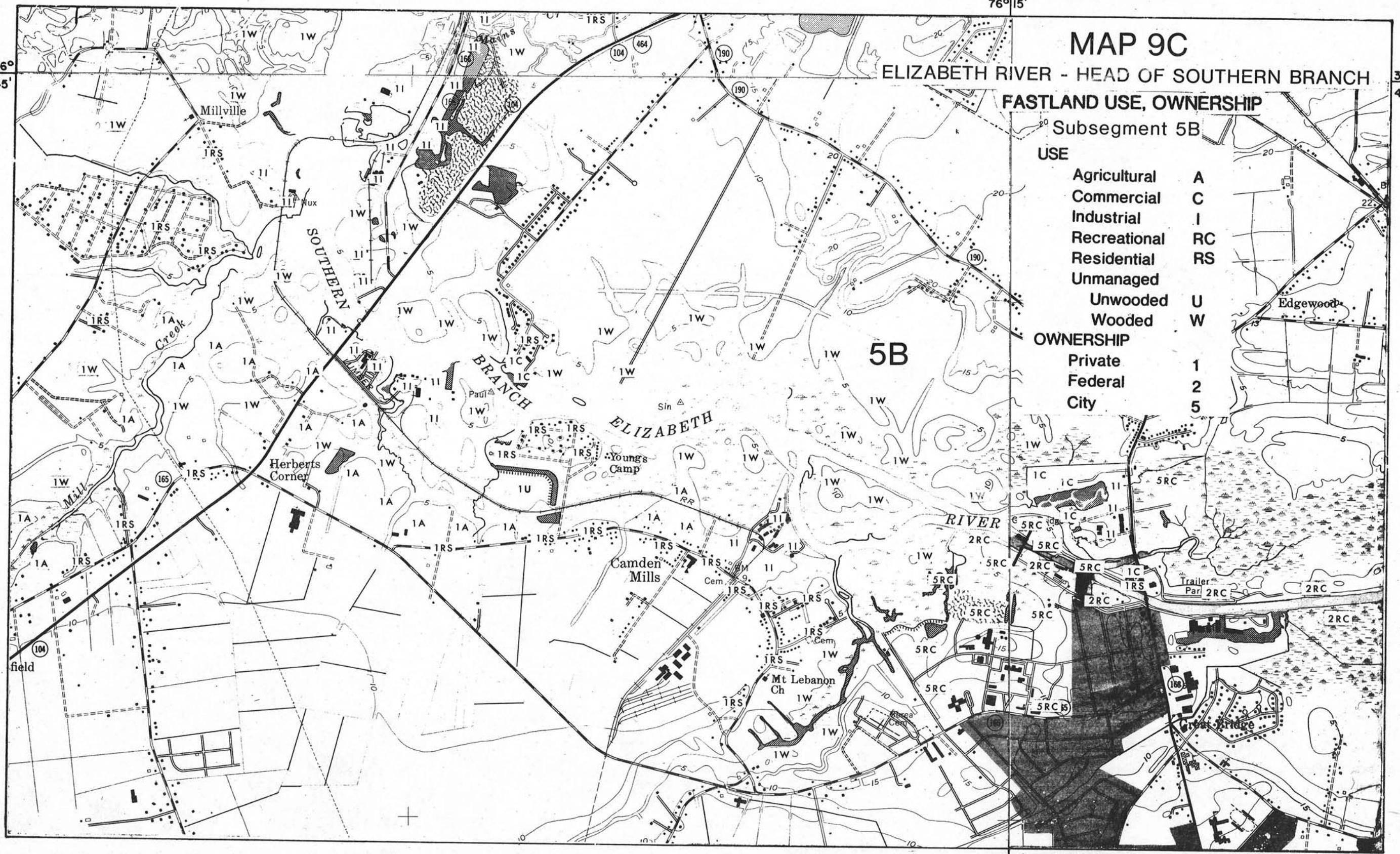
A
C
I
RC
RS
U
W

OWNERSHIP

Private
Federal
City

1
2
5

5B



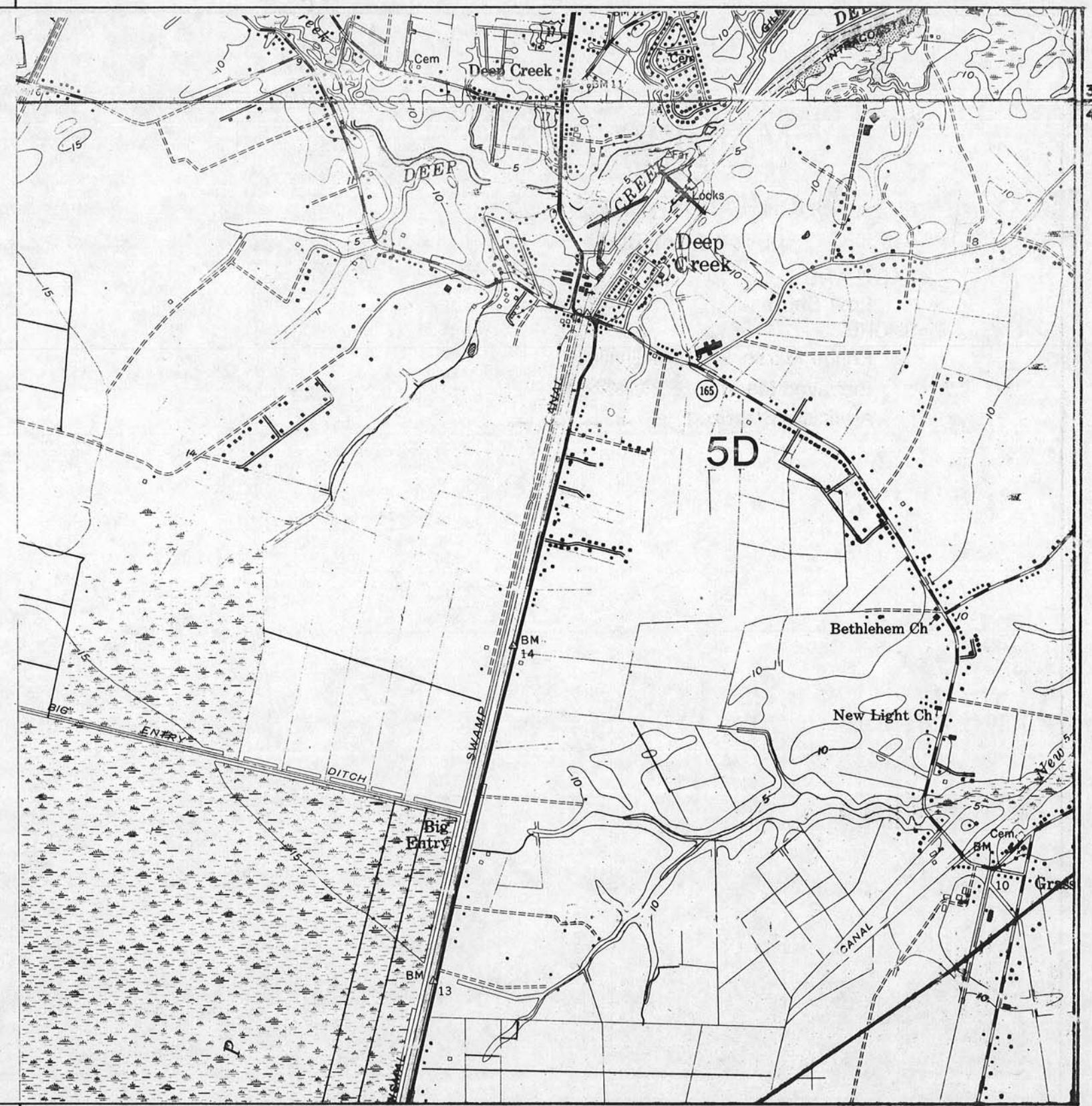
36°
45'

76° 22' 30"

36°
45'

MAP 10A
DEEP CREEK
TOPOGRAPHY AND CULTURE
Subsegment 5D

// = Segment Boundary
/ = Subsegment Boundary



76° 22' 30"

76° 22' 30"

36°
45'

MAP 10B
DEEP CREEK
SHORELANDS TYPES

Subsegment 5D

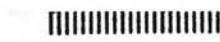
FASTLAND

Low Shore



SHORE

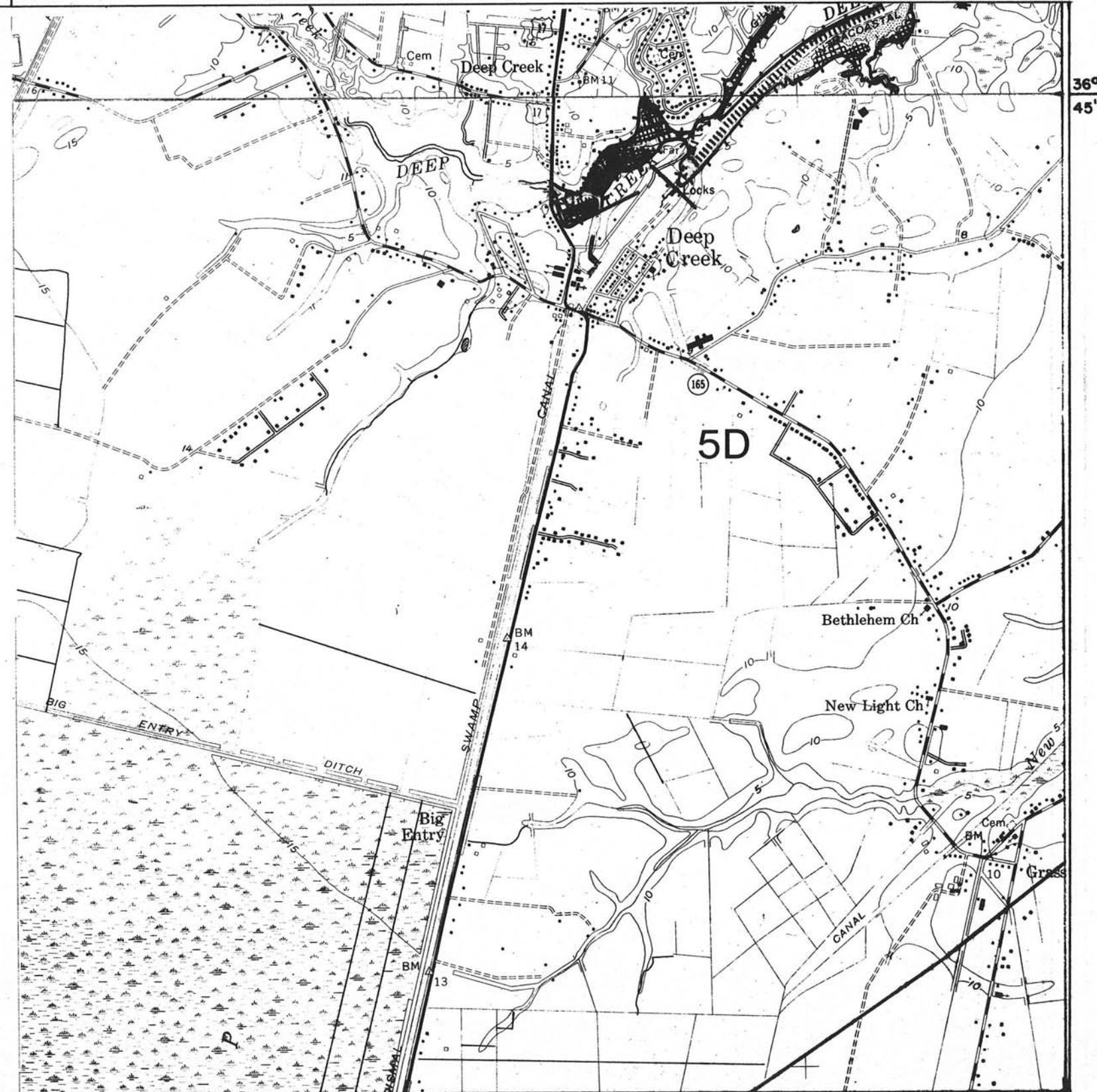
Fringe Marsh



Embayed Marsh



Artificially Stabilized



76° 22' 30"

76° 22' 30"

MAP 10C
DEEP CREEK
FASTLAND USE, OWNERSHIP

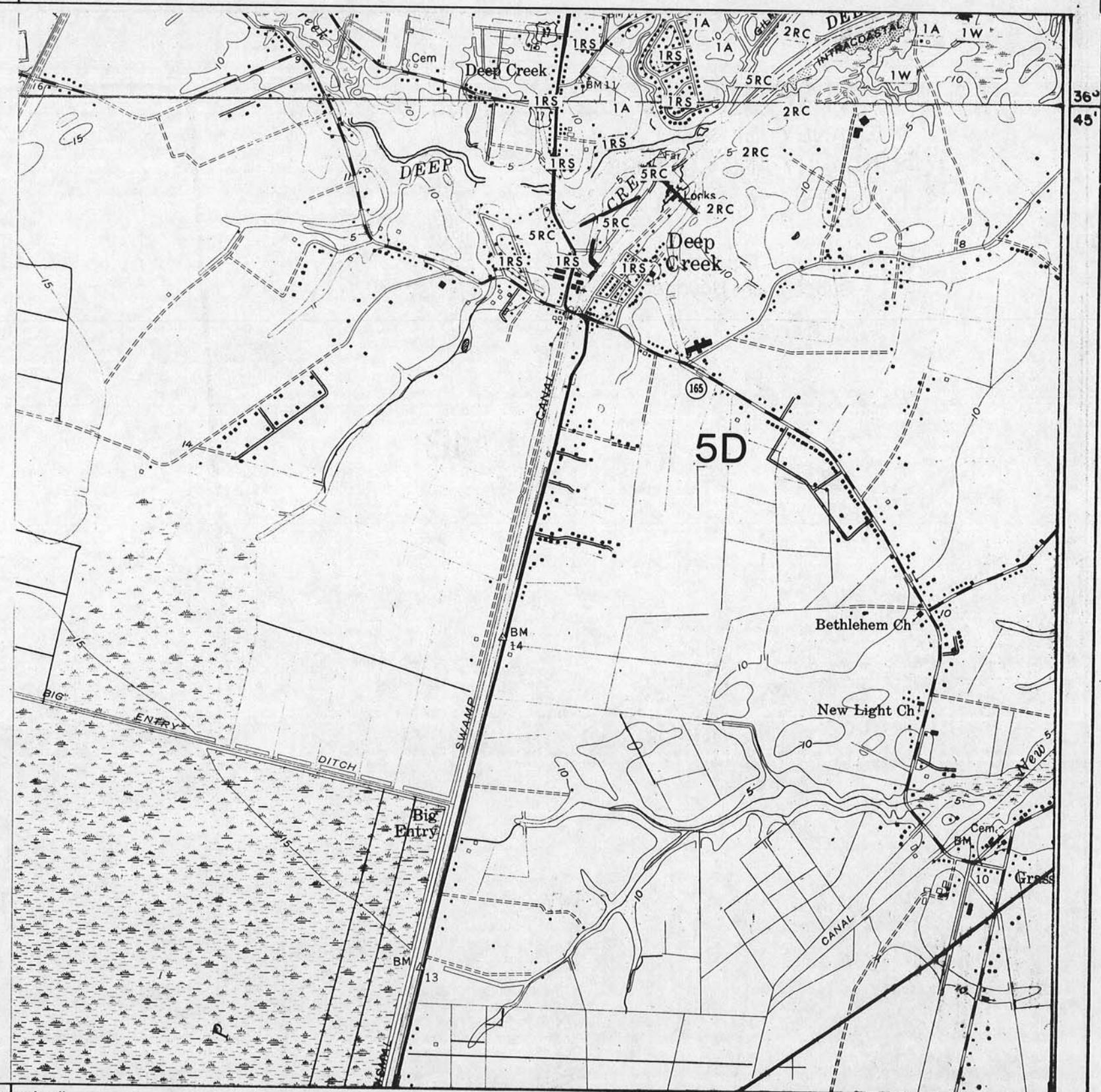
Subsegment 5D

USE

Agricultural	A
Recreational	RC
Residential	RS
Unmanaged	
Wooded	W

OWNERSHIP

Private	1
Federal	2
City	5



76° 22' 30"

76° 22' 30"

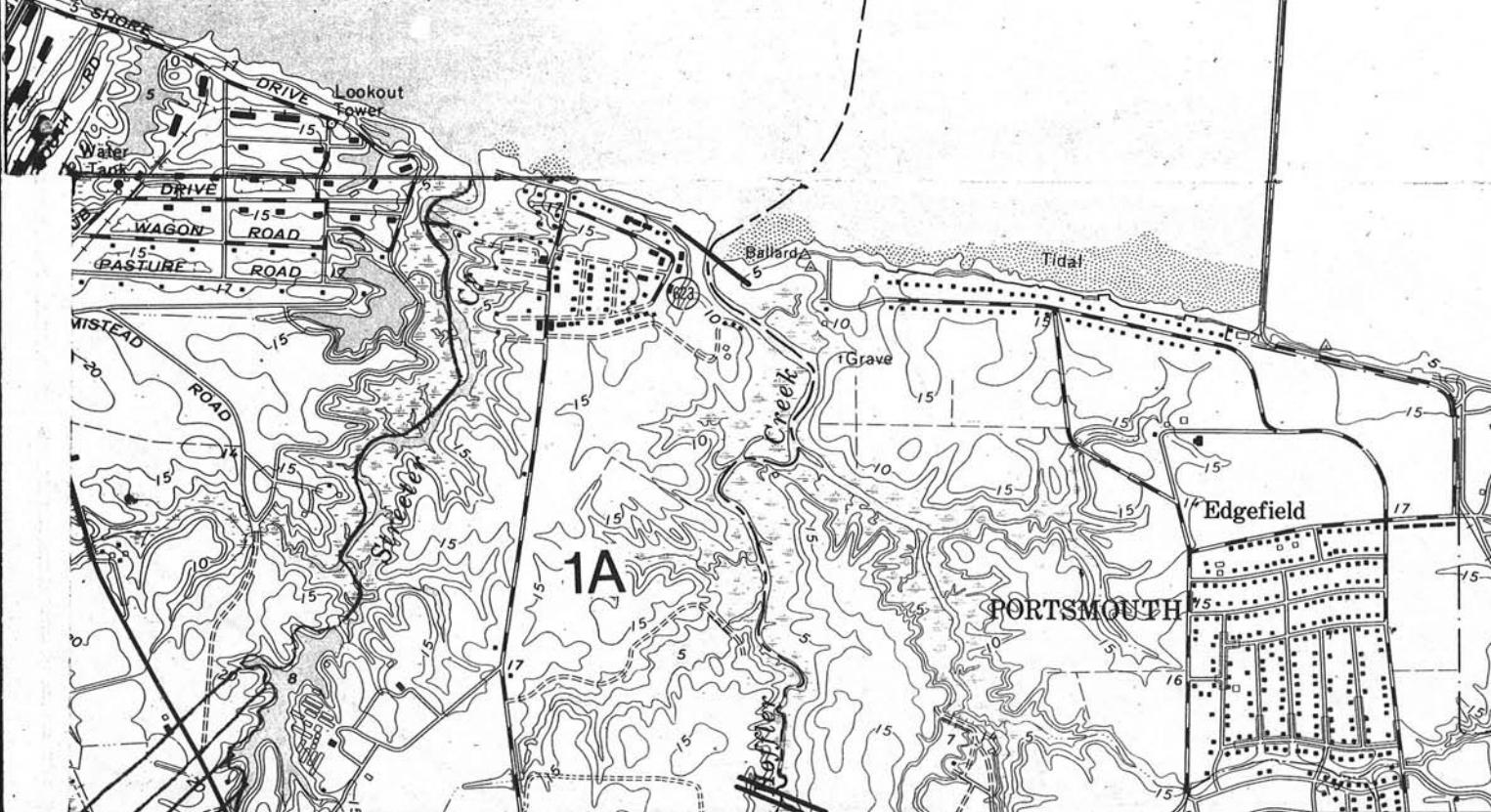
MAP 11A
CRANEY ISLAND
TOPOGRAPHY AND CULTURE
Subsegments 1A, 1B and 2A

- // = Segment Boundary
/ = Subsegment Boundary

36°
55'

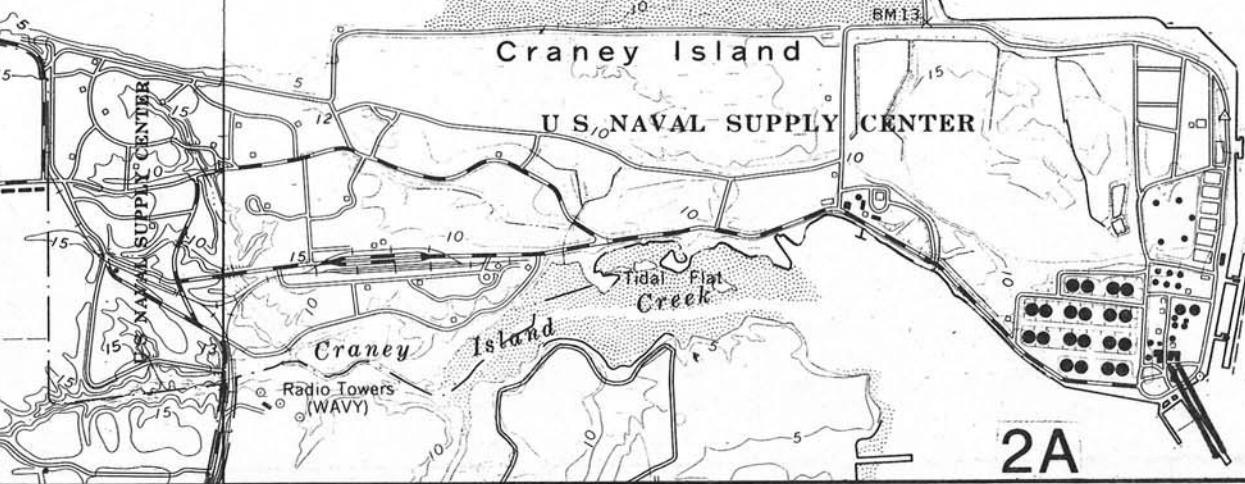
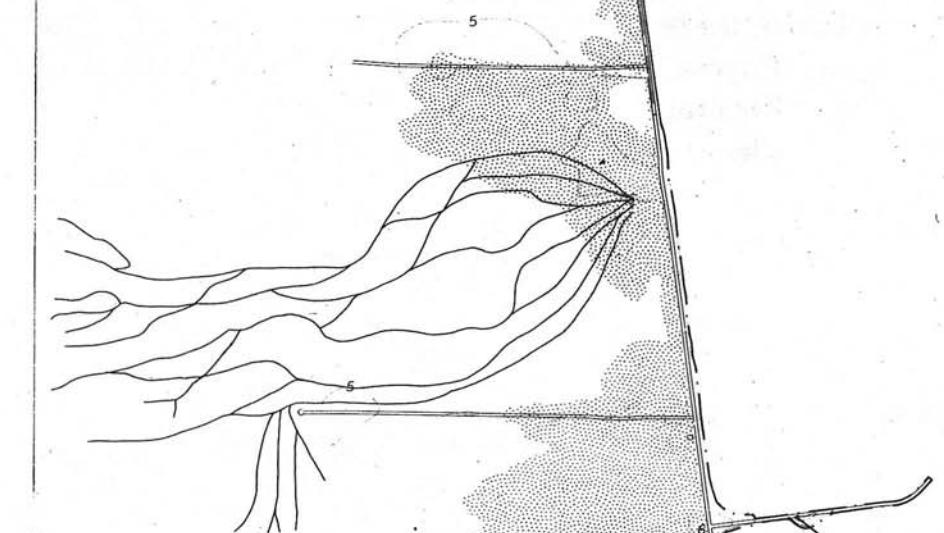
SUFFOLK CITY
PORTSMOUTH CITY

1B



U.S. NAVAL RESERVATION BOUNDARY

1B



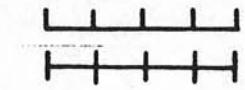
2A

MAP 11B
CRANEY ISLAND
SHORELANDS TYPES

Subsegments 1A, 1B and 2A

FASTLAND

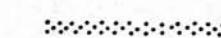
Low Shore



Artificial Fill

SHORE

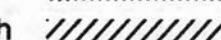
Beach



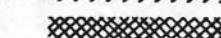
Fringe Marsh



Extensive Marsh



Embayed Marsh



Artificially Stabilized



NEARSHORE

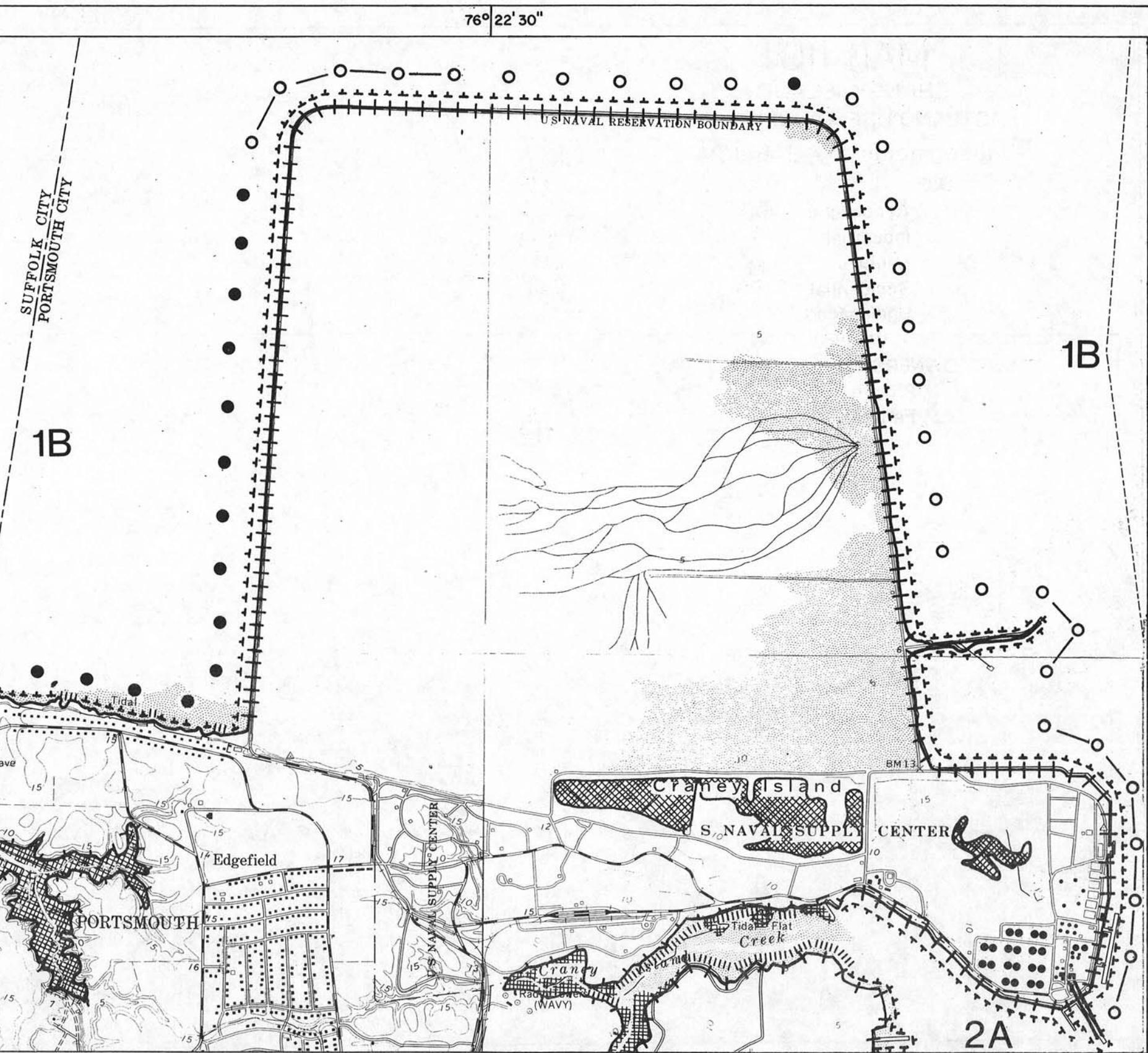
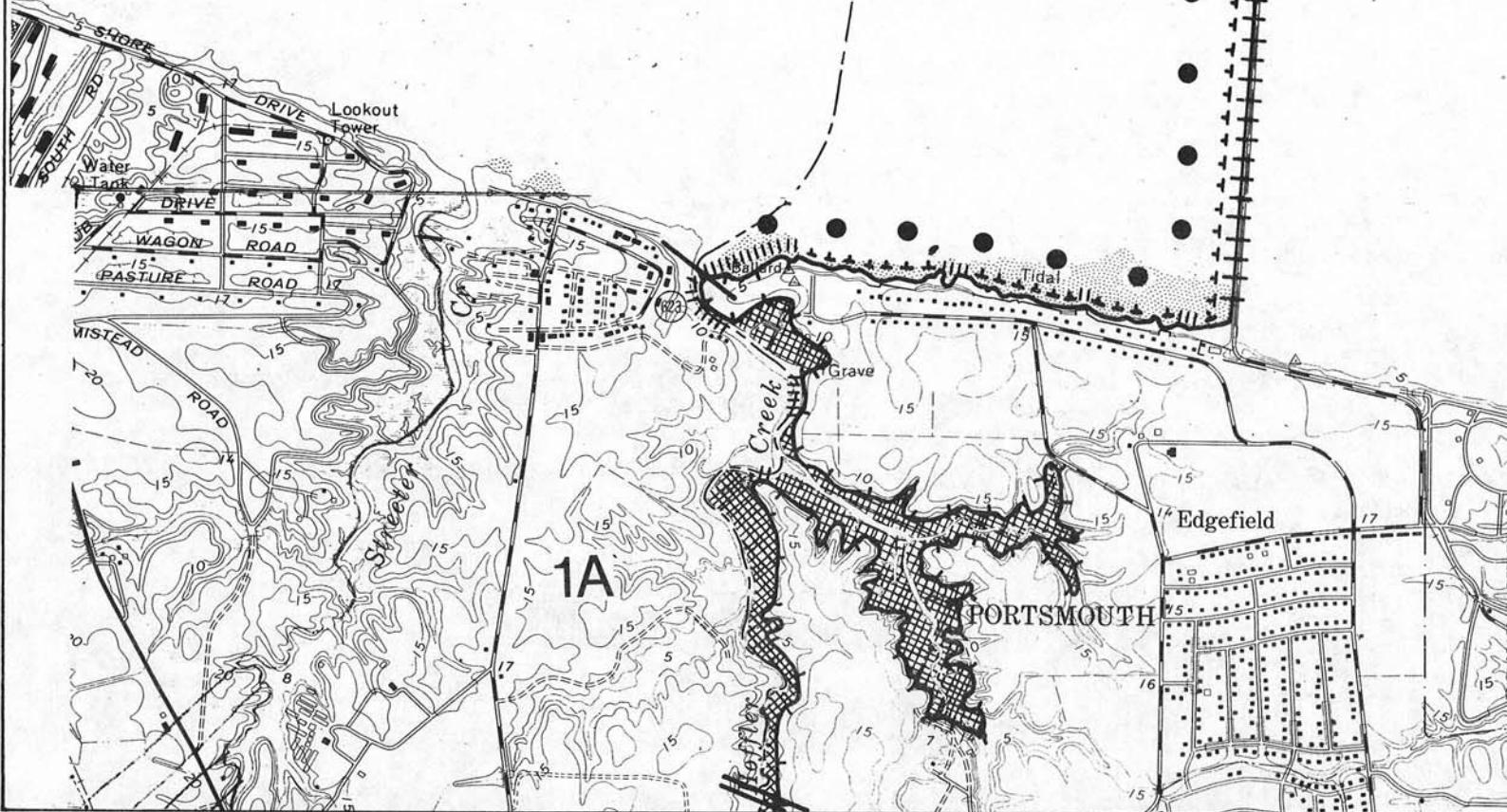
Narrow



Intermediate



Wide



76° 22' 30"

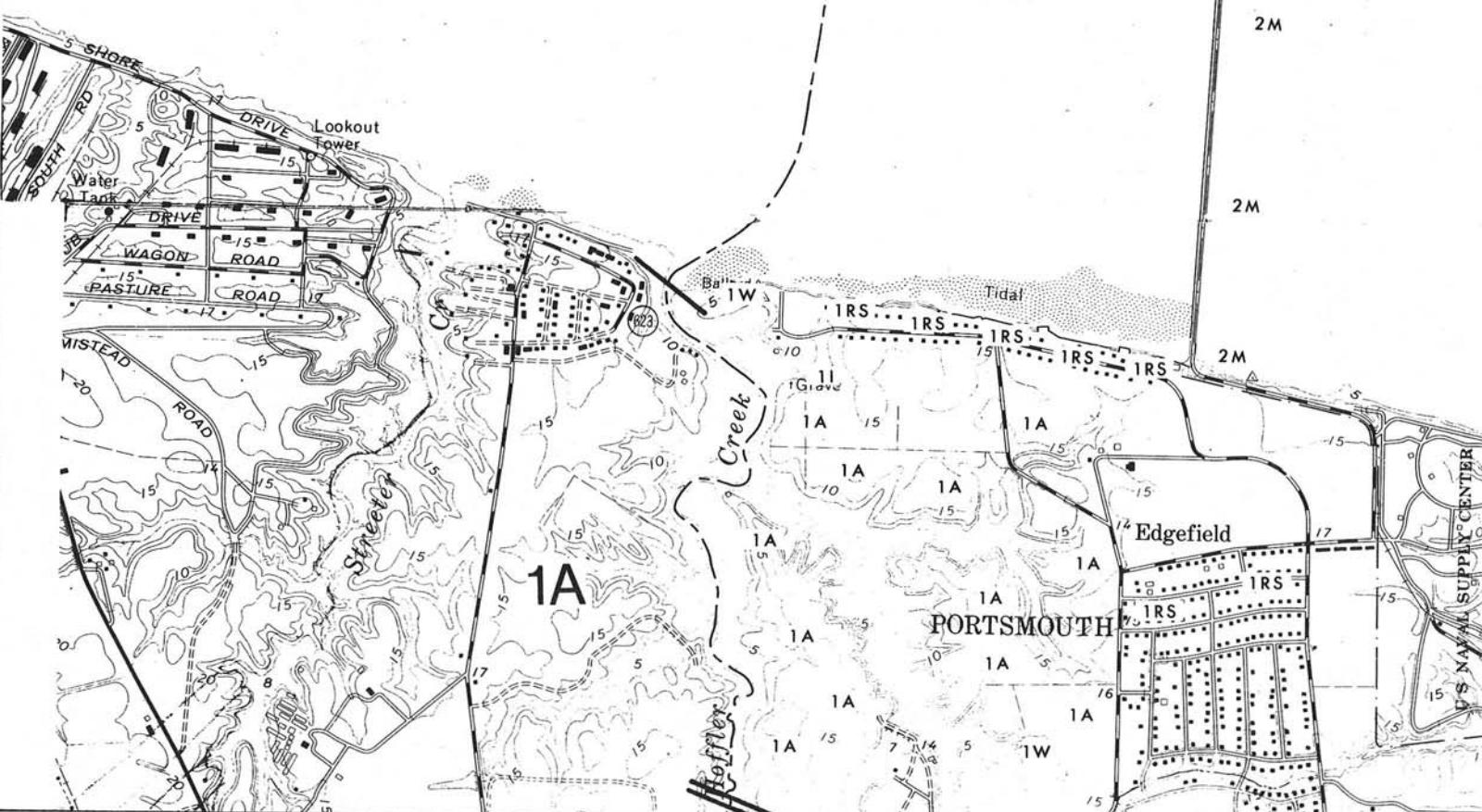
MAP 11C
CRANEY ISLAND
FASTLAND USE, OWNERSHIP
Subsegments 1A, 1B and 2A

USE

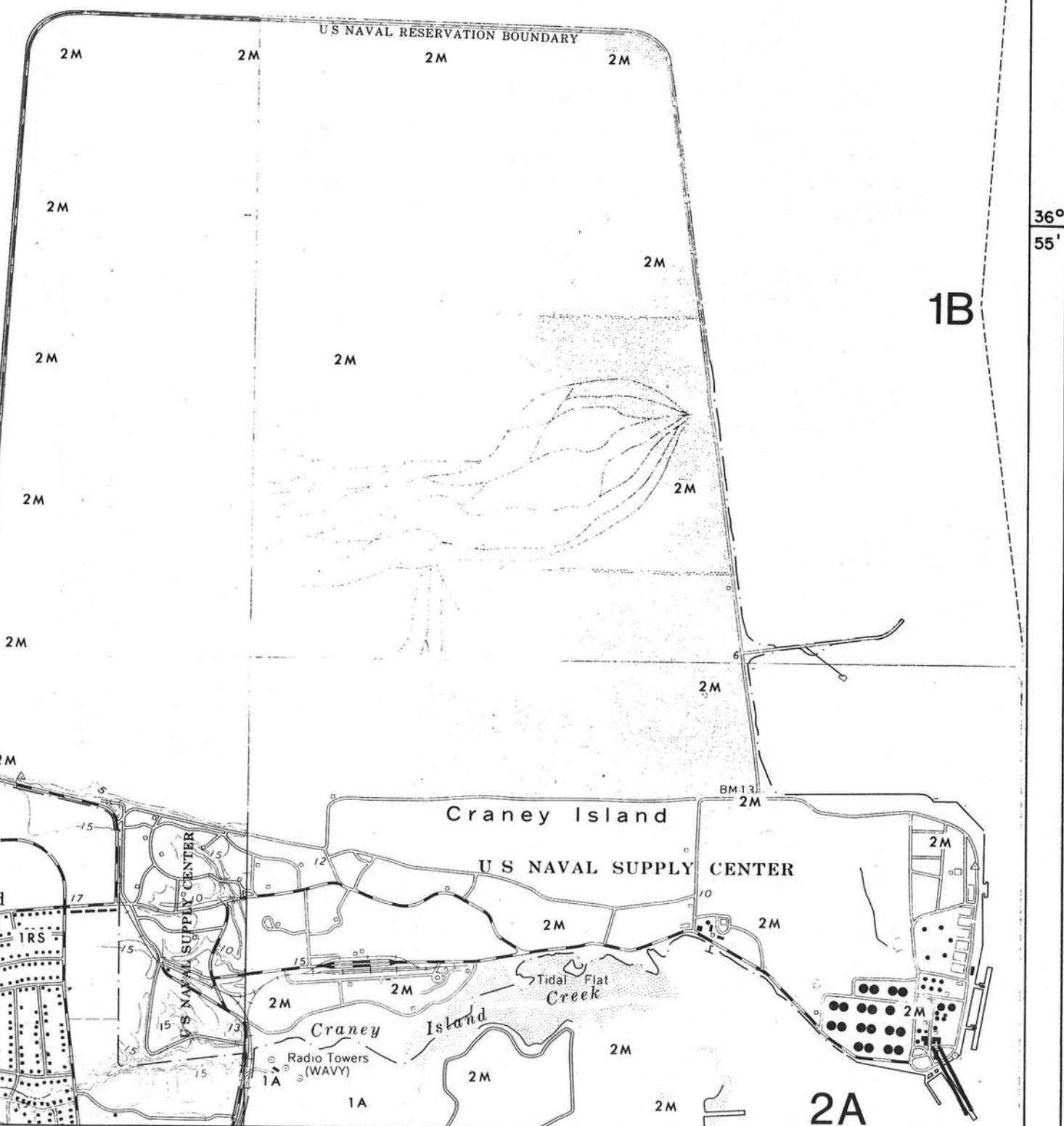
Agricultural	A
Industrial	I
Military	M
Residential	RS
Unmanaged	

WOODED

Private	1
Federal	2



US NAVAL RESERVATION BOUNDARY



76° 22' 30"

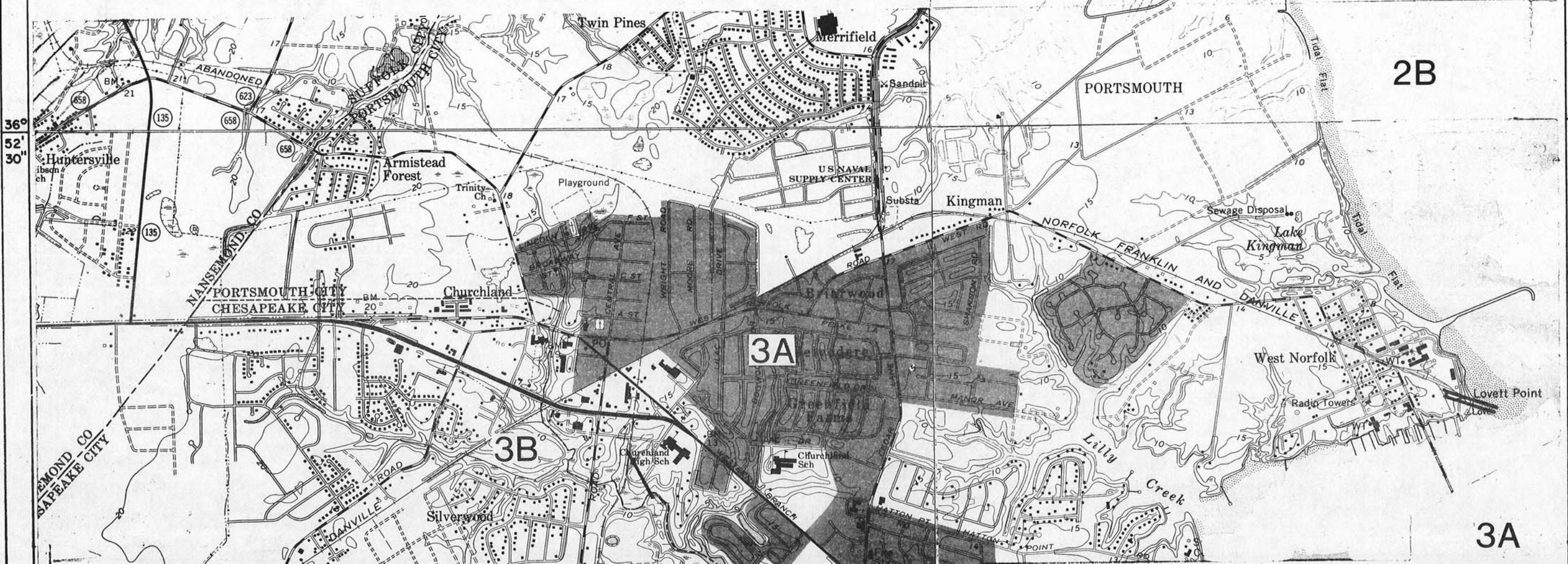
MAP 12A

CRANEY ISLAND CREEK

TOPOGRAPHY AND CULTURE

Subsegments 1B, 2A, 2B, 3A and 3B

- // = Segment Boundary
- / = Subsegment Boundary



76° 22' 30"

36°
52'
30"

36°
52'
30"

76° 22' 30"

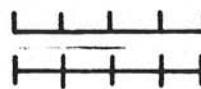
MAP 12B

CRANEY ISLAND CREEK SHORELANDS TYPES

Subsegments 1B, 2A, 2B, 3A and 3B

FASTLAND

Low Shore



Artificial Fill



SHORE

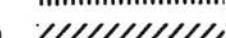
Beach



Fringe Marsh



Extensive Marsh



Embayed Marsh



Artificially Stabilized

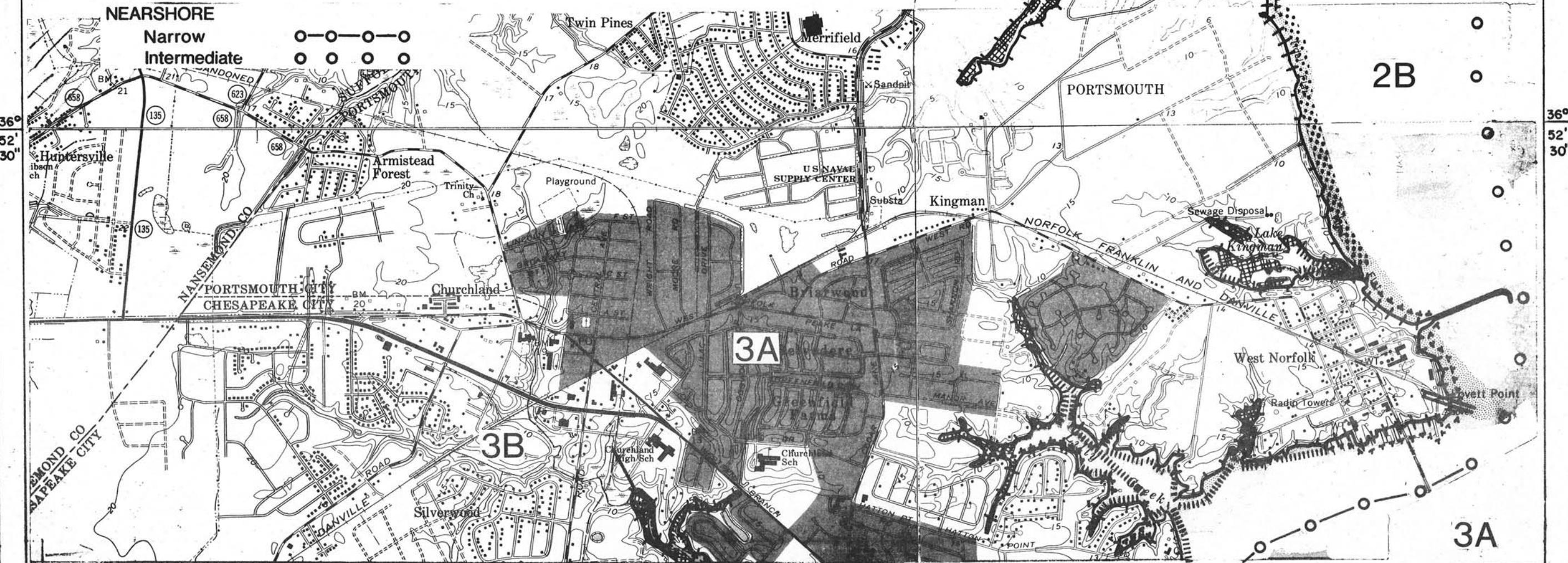


NEARSHORE

Narrow



Intermediate



76° 22' 30"

76° 22' 30"

MAP 12C**CRANEY ISLAND CREEK
FASTLAND USE, OWNERSHIP**

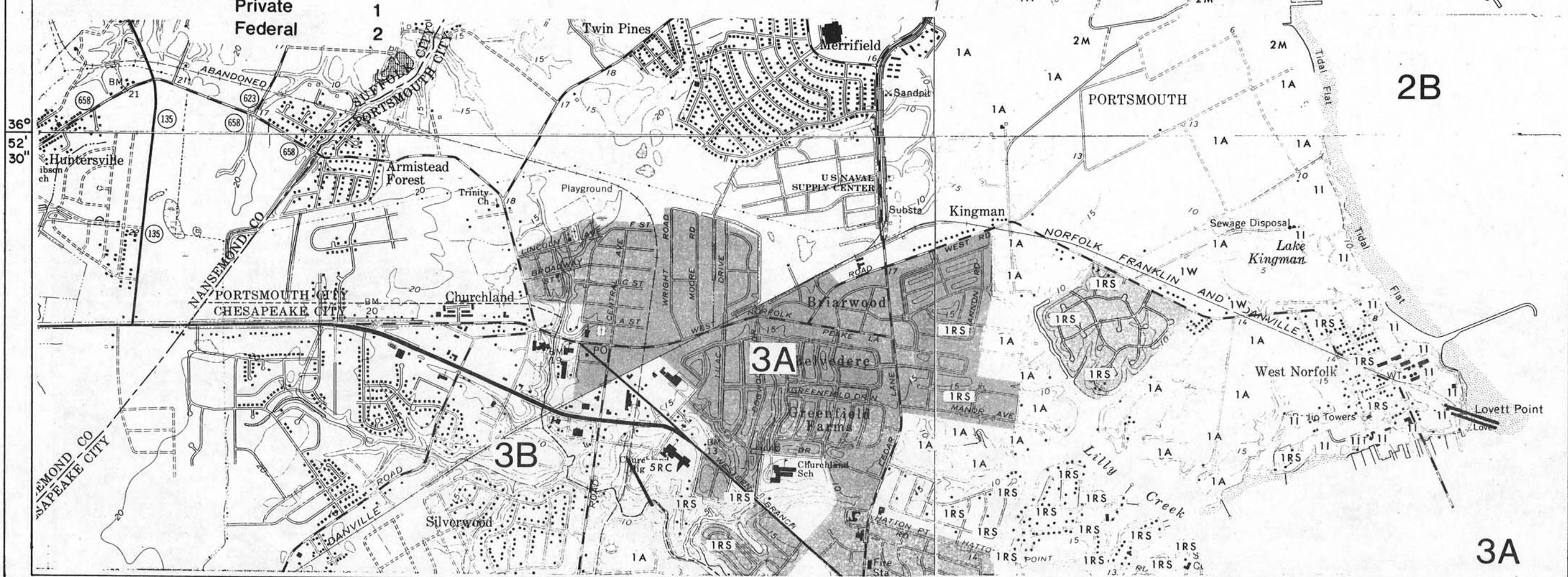
Subsegments 1B, 2A, 2B, 3A and 3B

USE

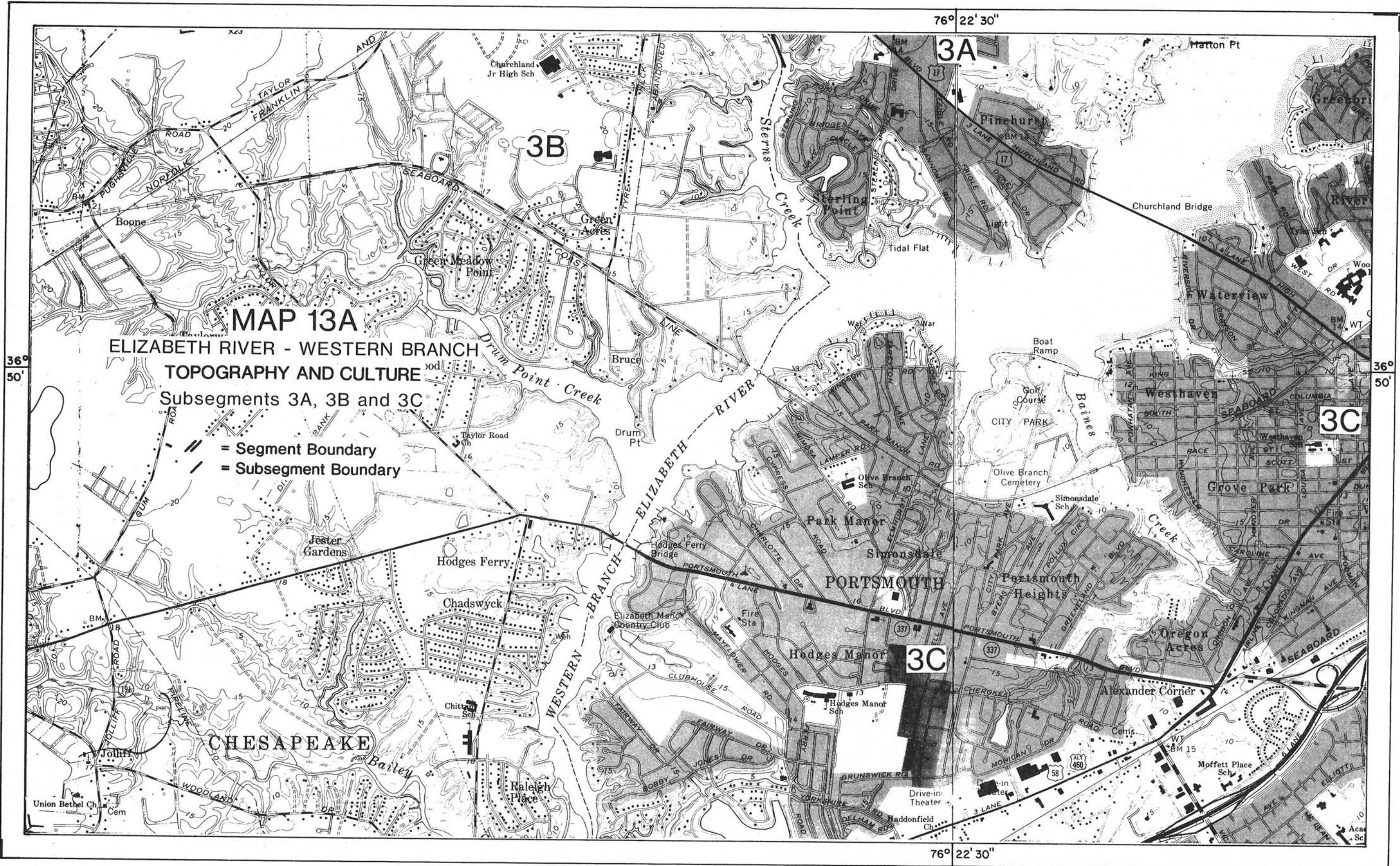
Agricultural	A
Industrial	I
Military	M
Recreational	RC
Residential	RS
Unmanaged	
Wooded	W

OWNERSHIP

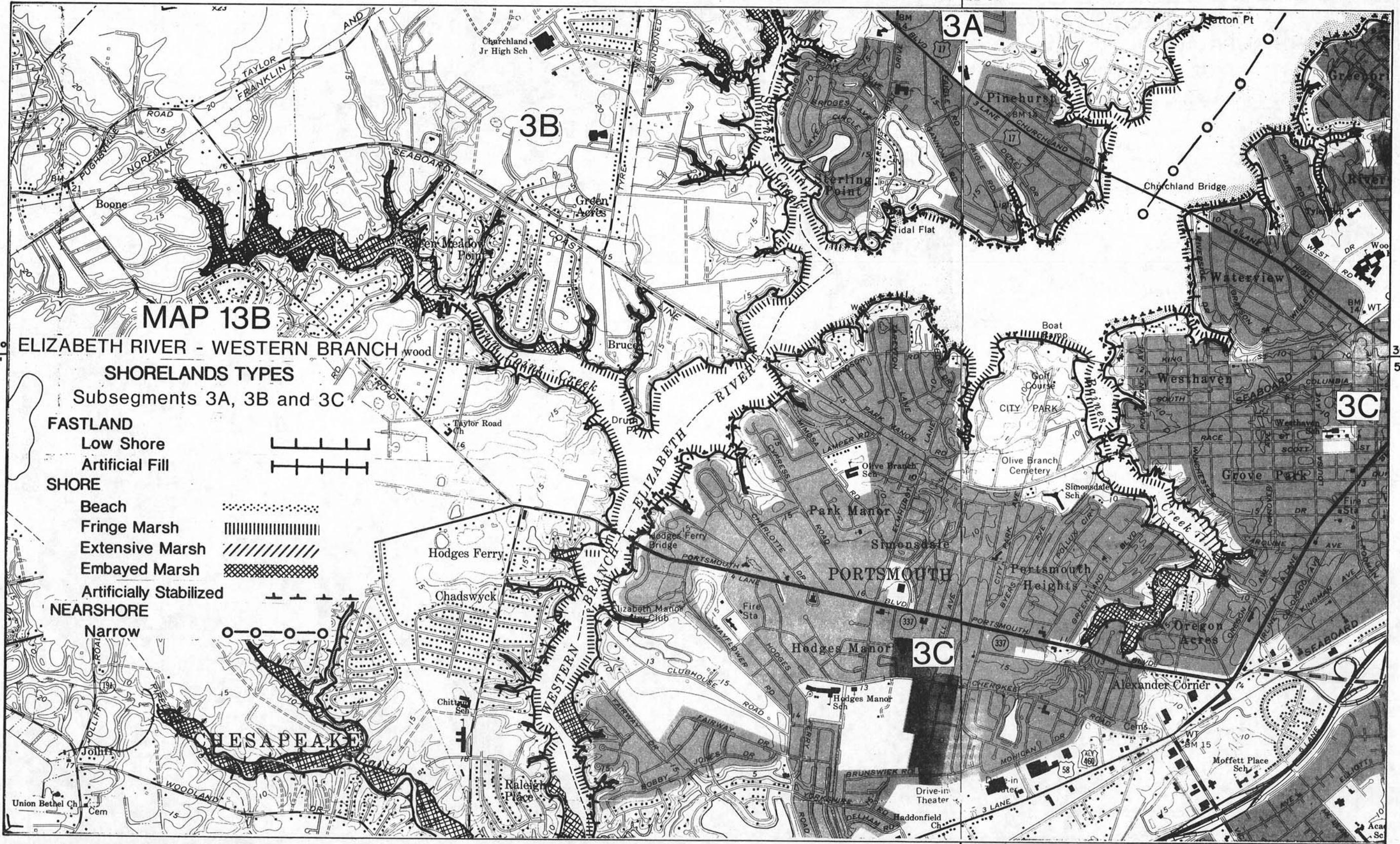
Private
Federal

**1B**CRANEY
ISLAND**2A****2B****3A**

76° 22' 30"



76° 22' 30"



76° 22' 30"

MAP 13C

ELIZABETH RIVER - WESTERN BRANCH

FASTLAND USE, OWNERSHIP

Subsegments 3A, 3B and 3C

76° 22' 30"

USE

- A Agricultural
- C Commercial
- RC Recreational
- RS Residential
- U Unmanaged
- W Wooded

OWNERSHIP

- P Private
- C City

36°

50'

36°

50'

36°

50'

36°

50'

36°

50'

36°

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36°

50'

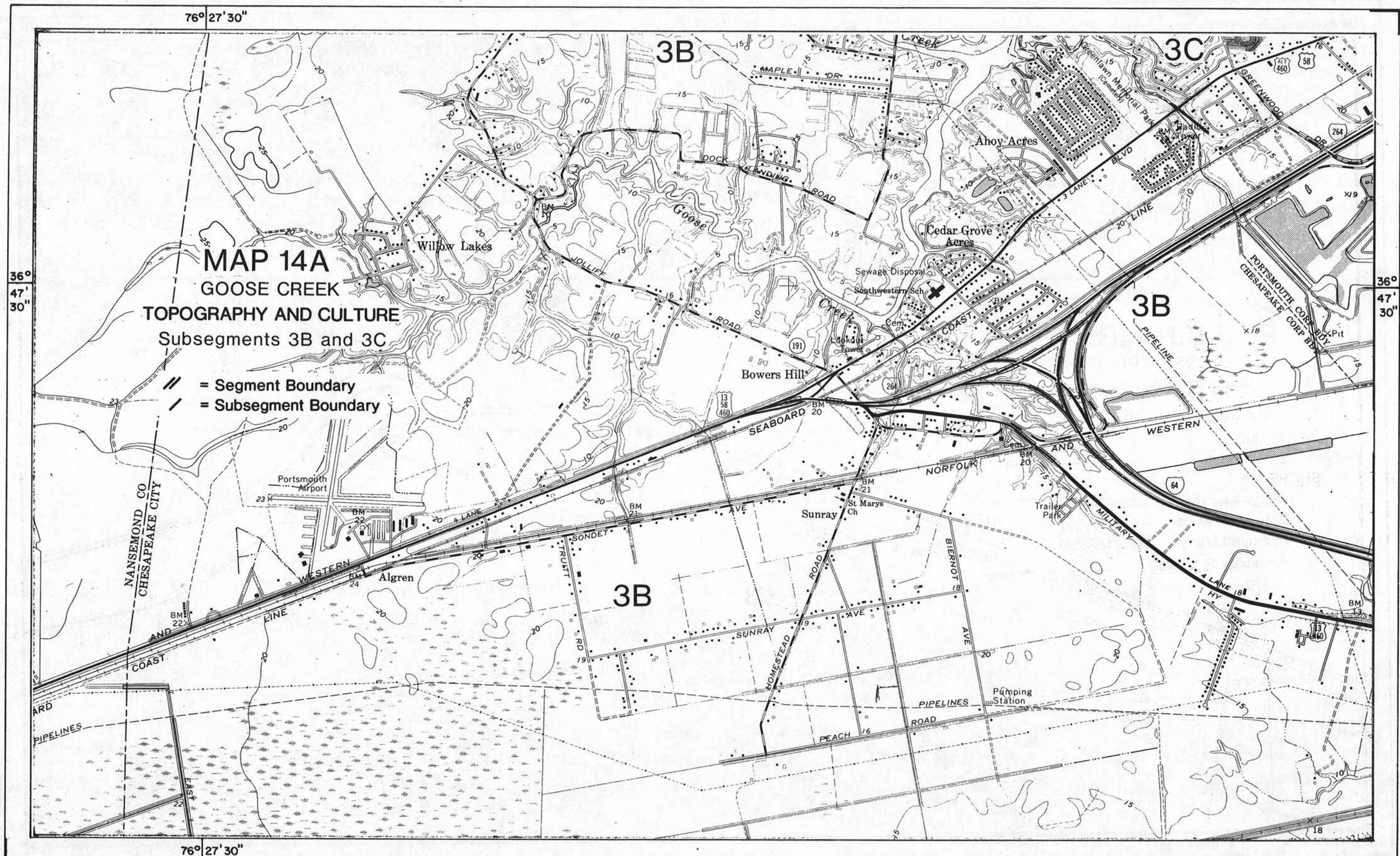
36°

50'

36°

50'

36°



76° 27' 30"

MAP 14C
GOOSE CREEK
FASTLAND USE, OWNERSHIP

Subsegments 3B and 3C

USE

Agricultural
Recreational
Residential
Unmanaged
Wooded

OWNERSHIP
Private
City

A

RC

RS

W

1

5

3B

3C

