ENVIRONMENTAL PROBLEMS IN THE COASTAL AND WETLANDS ECOSYSTEMS OF VIRGINIA BEACH, VIRGINIA

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U.S. Geological Survey

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16. Abstract

Many of the city of Virginia Beach's beach stabilization and sewage disposal problems are the result of an inadequate understanding of physical and biological systems. Influenced by population and economic pressures, natural systems were artificially stabilized by engineering projects which had to be constantly maintained. These same pressures continue to prevail today in spite of a new environmental awareness; changes are occurring very slowly.

Furthermore, the lack of adequate sewage disposal facilities and the continued urbanization of inappropriate areas are threatening Virginia Beach's attractiveness as a resort area.

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U.S. Geological Survey
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Foreword

The work reported herein is an offshoot of a larger effort investigating the potential of remote sensing as a source of land use and related environmental information in the USGS/NASA Central Atlantic Regional Ecological Test Site (CARETS). One aspect of the CARETS research and demonstration effort is the identification of environmental impacts of land use practices and changes, as observable with the aid of the remote sensor systems. Conducting field work in Virginia Beach, the authors were impressed with several examples of impacts of man's modifications of the natural environmental systems, the results of which eventually proved detrimental to the local users of the land and water resources. Identification and analysis of such environmental problems are essential if data collection and mapping programs are to contribute to solutions.

The authors prepared this report to summarize their observations for presentation at the annual meeting of the Association of American Geographers in Milwaukee, April 1975. It is presented here as a component of the final report of the CARETS project. Further details on the study area, including measurements of land use and land use change in Virginia Beach and the surrounding area as obtained from both LANDSAT and high-altitude aerial photography, can be found in Volume 2 of the CARETS project final report entitled "Norfolk and Environs: A Land Use Perspective,"

Robert H. Alexander
Principal Investigator, CARETS project

LIST OF FINAL REPORT VOLUMES

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By Peter J. Buzzanell and Herbert K. McGinty III

Abstract

Many of the city of Virginia Beach's beach stabilization and sewage disposal problems are the result of an inadequate understanding of the physical and biological systems. Influenced by population and economic pressures, natural systems were artificially stabilized by engineering projects that had to be constantly maintained. These same pressures continue to prevail today in spite of a new environmental awareness; changes are occurring very slowly.

Furthermore, the lack of adequate sewage disposal facilities and the continued urbanization of inappropriate areas are threatening Virginia Beach's attractiveness as a resort area.

INTRODUCTION

Population growth and its associated land-use change have placed great stress on the beaches, dunes, and wetlands of Virginia Beach, Virginia. Some policies and decisions, encouraged by economic interests and made without any thought for potential environmental consequences, have resulted in serious problems that, in turn, have required further environmental and economic measures. Policies of beach stabilization and replenishment and the problems associated with sewage disposal illustrate these problems.

As part of the Norfolk-Portsmouth SMSA, Virginia Beach has shared the rapid growth of an area heavily influenced by the nation's greatest concentration of naval facilities. Between 1960 and 1970 the city's population more than doubled from 85,000 to 170,000 and planners predict the population will reach 294,000 by 1980 (South Virginia Planning District Commission, 1970, p.2). Most of the population is concentrated in the northern half of the city adjacent to Norfolk; Virginia Beach's rural south, comprising 45 percent of the city's area, accounts for only 2 percent of its population.

Closely resembling a county, Virginia Beach includes large areas of open land. According to research conducted by the U.S. Geological Survey, Geography Program, agricultural land in Virginia Beach comprises 30 percent of the area, forest 27 percent, beaches and wetlands 10 percent, water bodies 17 percent, and urban and built-up land 16 percent.

BEACH STABILIZATION AND ITS EFFECT ON BACK BAY

Back Bay, in southeastern Virginia Beach, is the northernmost of a series of interconnected inland waters that include Currituck, Albemarle, and Pamlico Sounds. Back Bay has 10,935 ha of water and marsh (figure 1), averages 1 m in depth, and is separated from the ocean by a barrier beach 1.6-2.0 km wide. Before the barrier beach was stabilized, periodic seawater intrusions maintained the bay's salinity at an average of 3,200 ppm. The bay's flora and fauna were well adapted to these conditions (U.S. Bureau of Sport Fisheries and Wildlife and others, 1965, p. 19). Back Bay's ecology has been adversely affected by the decreased salinity and increased turbidity created by beach stabilization.

The unaltered barrier beach system adjusts to periodic storms because most initial storm stress is sustained by broad beaches and the lack of impenetrable landforms. In the natural system, seawater flows across the beaches and between the dunes, dissipating storm energy. Periodically, the combination of extremely high tides and large waves erodes the low-lying foredunes and carries sediment and great volumes of seawater across the beach into the marshes. This oceanic overwash replenishes sediments, creates new land, and maintains the brackishness of marsh and bay waters. The stabilized beach system creates an unbalanced condition by preventing overwash. Artificial barrier dunes have often caused a steady narrowing of the beach and a dramatic alteration of marsh and bay ecology (Dolan, 1973, p. 161).

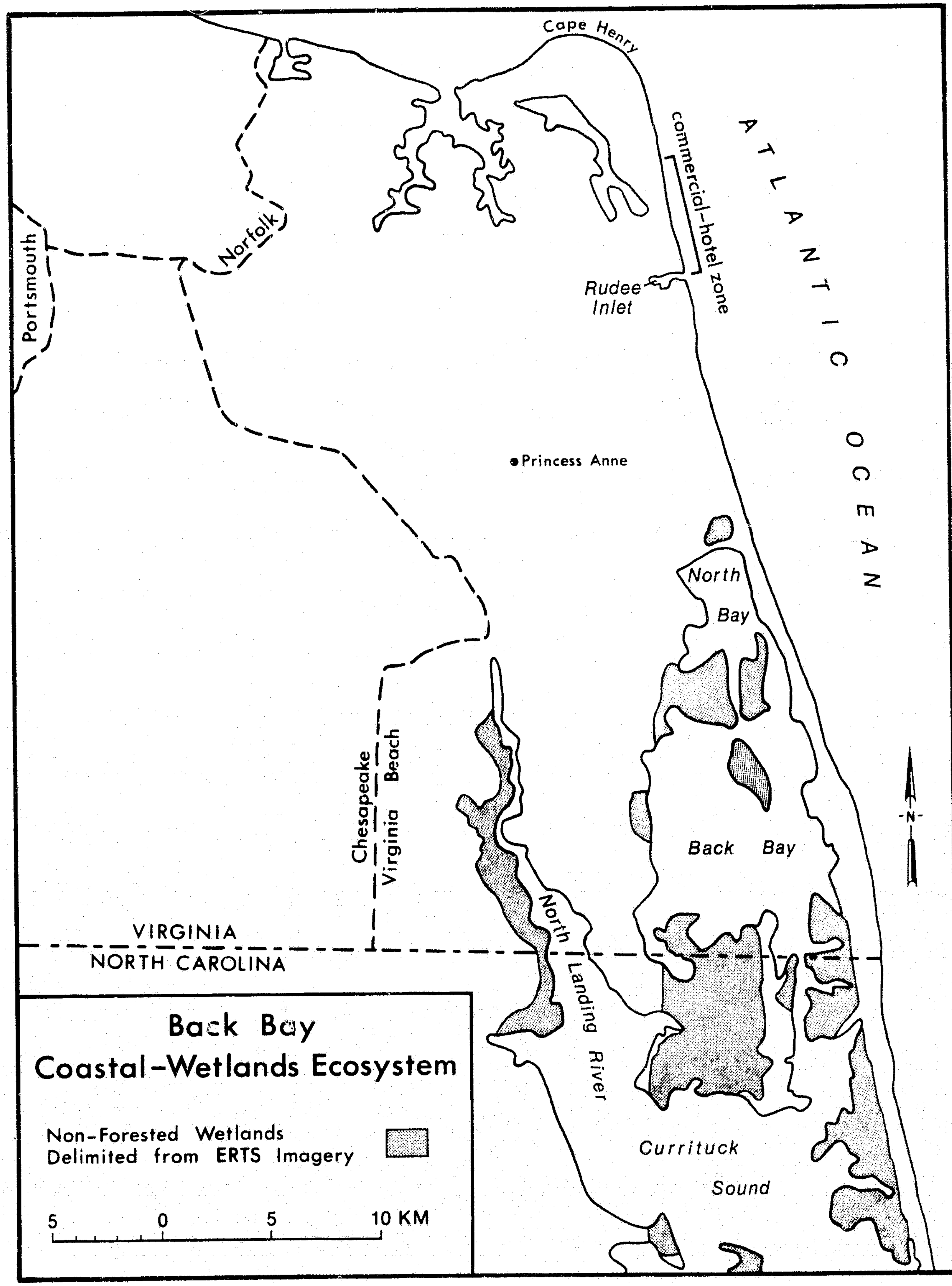
Cape Henry
ATLANTIC OCEAN
commercial-hotel zone
Rudee Inlet
Norfolk
Portsmouth
Princess Anne
North Bay
Back Bay
Chesapeake
Virginia Beach
North Landing River
VIRGINIA
NORTH CAROLINA
Currituck Sound
N
Back Bay
Coastal-Wetlands Ecosystem
Non-Forested Wetlands
Delimited from ERTS Imagery
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Figure 1

Because of the 1900 storm when seawater breached the Back Bay barrier beach and destroyed wildfowl habitats and fisheries in the bay, privately funded sand fences were constructed. After a 1933 hurricane destroyed the dune line, the Civilian Conservation Corps constructed sand fences. These fences and the sand dunes have been maintained by the U.S. Army Corps of Engineers and the National Park Service. Over the years the dunes thus created almost completely excluded seawater from Back Bay (U.S. Bureau of Sport Fisheries and Wildlife and others, 1965, p. 4).

With no seawater penetrating the dune line, and Oregon Inlet 96 km to the south, the bay's salinity declined from 8-10 percent seawater to 1.5-2.0 percent. This has resulted in a decline in fish species, and such saline marsh plants as sago pondweed and widgeon grass. This reduced production of marsh vegetation has decreased the bay's capacity to feed its waterfowl population (U.S. Bureau of Sport Fisheries and Wildlife and others, 1966, p. 29).

Decreases in aquatic vegetation resulted in increased turbidity as wind action stirred the bay's shallow bottom. Increased turbidity damaged the aquatic ecosystem by reducing light penetration, oxygen supply, survival of eggs and alevins, number and kind of bottom organisms, and ability of fish to find food. The combination of adverse effects created stress that changed population numbers and dominant species, thus altering original ecosystems (Ritchie, 1972, p. 125).

Within Back Bay, increased wave action along the shores and decreased aquatic vegetation have resulted in a reported erosion loss of 731 ha since the late 1930's (Virginia Dare Soil and Water Conservation District [VDSWCD], 1974, p. 5).

In response to such problems, the Bureau of Sport Fisheries and Wildlife (U.S. Bureau of Sport Fisheries and Wildlife and others, 1966, p. 64-65) recommended the introduction of limited amounts of seawater into the bay to deflocculate suspended silts and to reduce turbidity. In 1965 the Virginia Beach City Council appropriated funds for seawater diversion. Discharge has ranged from 3,381 to 4,227 kl per hour with pumping going on 320 hours per month. The bay's salinity has increased to 10 percent of seawater strength. Aquatic plants are recovering, increasing the supply of wildlife food. Birds have been able to feed throughout the year and therefore remain in the area rather than migrating south in early winter. More wildfowl were reported in Back Bay in 1970 than in any year in the previous decade. Fishing has improved, and the return of saltwater has brought large numbers of crabs into the bay, allowing commercial crabbing for the first time in many years. Finally, the bay's turbidity has been reduced, sunlight is penetrating to deeper depths, wave action is lessening and bank erosion is decreasing (VDSWCD, 1974, p. 6).

BEACH REPLENISHMENT IN THE COMMERCIAL HOTEL ZONE

Concern over the oceanfront commercial hotel strip, running from Rudee Inlet to 49th Street, has led Virginia Beach into a long-term struggle against beach erosion. A stable beach is not a permanent one, but rather one on which periods of erosion and of deposition are balanced. In Virginia Beach along the shore, sediment transport results in the net loss of approximately 45,000 m^3 of beach material annually. A concrete boardwalk and seawall was built along the commercial hotel strip in 1938 as a recreation facility and as protection against storm damage. This structure, however, has accelerated beach erosion by restricting the natural replenishment of sand.

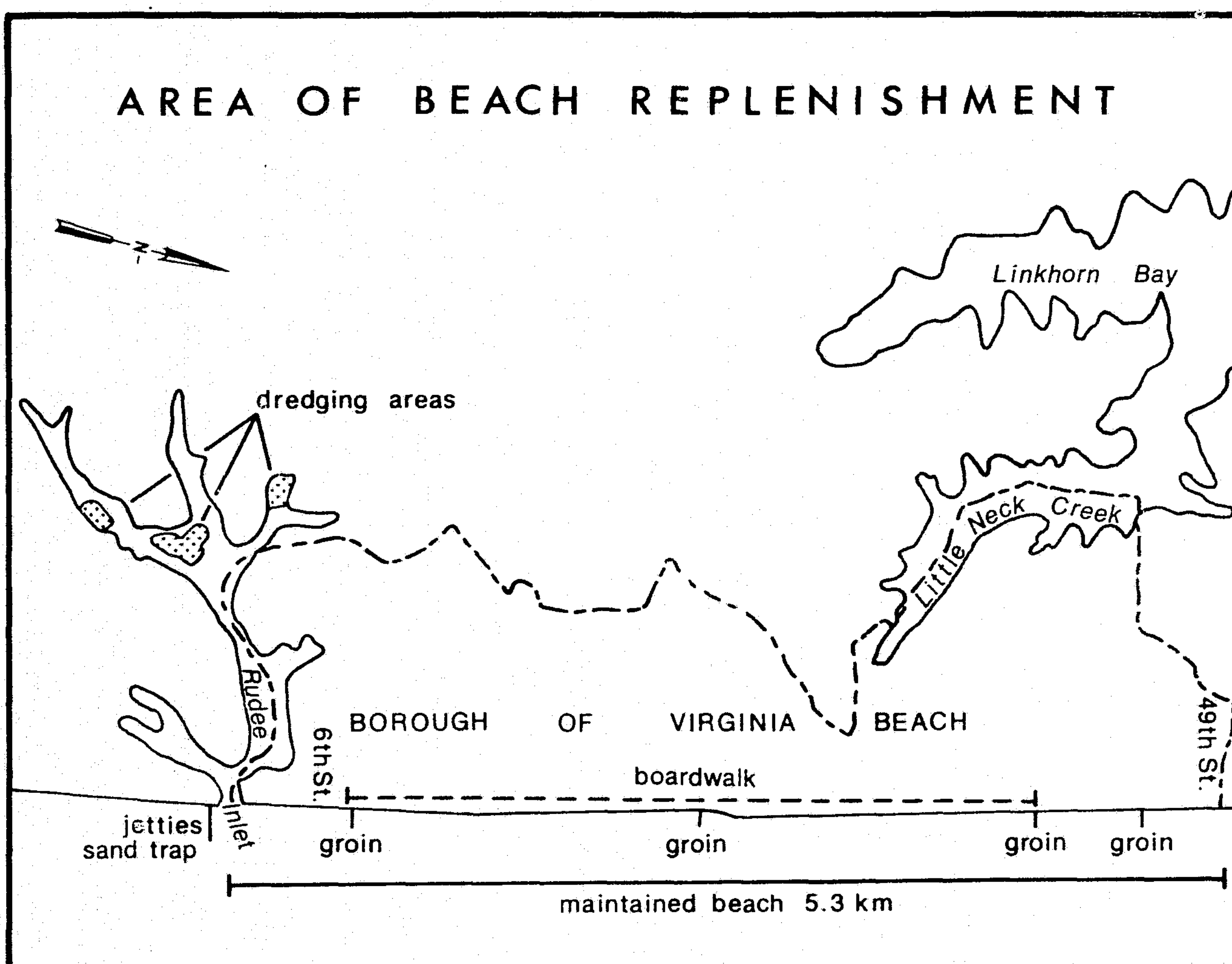

Figure 2--After Army Corps of Engineers, 1970.

A 1956 U.S. Army Corps of Engineers study documented damage to the seawall, the near obliteration of 1,829 m of beach, the reduction of the remaining beach, and the ocean's threat to private and public improvements landward of the seawall. The Corps' recommendation for beach restoration included a continuous nourishment program and the construction of groins (Langley and MacDonald, 1970).

The Virginia Beach Erosion Commission recommended sand replenishment by hydraulic dredging as the most economical solution. Since the early 1950's sand has been pumped onto the beach south of the commercialized zone and redistributed by waves and the northward flowing littoral drift (figure 2).

Beach replenishment, however, is becoming less tenable because of the ever-increasing difficulty of finding inexpensive sand of suitable size. Since the size of sand on a beach is related to wave energy, any sand added to the system that is smaller than the native sands will be winnowed out by wave action and transported offshore or alongshore. Material that is too large cannot be used because it will not disperse from the point where it is added; however, this is rarely a problem.

Sand for replenishment of Virginia Beach has come from a stationary dredging operation in Rudee Inlet. More recently, the U.S. Army Corps of Engineers has begun transporting Norfolk harbor dredge spoils by truck from Cape Henry to various dispersing areas. Future demand for sand can be most easily met from inshore deposits; but as land sources diminish, the value of sand deposits and the economic pressure for land-use change in areas overlying the deposits will increase.

Although beach replenishment is still considered necessary and viable in Virginia Beach, some planners and resource managers elsewhere are realizing that natural change is often essential to the maintenance of ecosystem structures and functions. The National Park Service, encouraged by Dolan's studies over the past several years, has abandoned its policy of fighting the sea on North Carolina's Outer Banks, concluding that natural forces should be allowed to shape coastal landscapes. Dolan has emphasized that the islands are not being washed away but are retreating by processes fundamental to their origin (Dolan, 1973, p. 161).

SEWAGE DISPOSAL PROBLEMS AND THEIR EFFECT ON VIRGINIA BEACH'S POORLY DRAINED AREAS

Urban growth in Virginia Beach has created problems of providing adequate sewage disposal. Because a compehensive sewage planning program was slow to develop, inadequate systems have proliferated. The problem has been compounded by extensive poorly drained areas that impose land-use suitability constraints on urbanization and the extension of sewage facilities. South of Princess Anne, the municipal seat, the highly rural population is served solely by septic tanks. Although septic tanks are suitable for areas of low population, the extensive wetlands to the south are not very suitable for their use. The North Landing River and Back Bay are bordered by wet soils or marshes unsuited for the installation of septic tanks or sewage lines. On the flat, poorly drained soils of the south-central agricultural area, the problem would be equally serious is present septic tank usage were significantly increased. Moreover, conditions are exacerbated by subsoils of stiff plastic clays, resulting in high water tables and frequent malfunctioning of septic tanks. Low usage makes the problem minimal, but conditions could worsen if pressure continues for the conversion of farmland to residential developments.

The sewage problem in the urbanized northern portion of the city is much more serious. The public sewage treatment agency for Virginia Beach (Hampton Roads Sanitation District Commission [HRSDC]) treats only part of the city's sewage. The remaining sewage is handled by private utilities and septic tanks (Wiley and Wilson, 1974, p. 83). The performance of private utilities has been poor, characterized by the dumping of inadequately treated sewage into public waters. The city has prohibited the establishment of new private utilities, but such firms still operate.

Hundreds of septic tanks are being used side-by-side in some residential developments (figure 3). Septic tanks were designed for sparing use in a rural environment; even under the best of natural conditions, the soil cannot absorb large volumes of sewage without adverse environmental effects. Wet and poorly drained land is going into residential development, and many residents are incurring the expense of removing raw sewage that has seeped into their own and adjacent lawns and gardens. Pollution of ground water and water bodies is significant and presents a potentially serious public health problem. In addition, the city lacks an ordinance requiring property owners to hook up to sewage lines once they are installed (Old Dominion University, 1974, p. 21). The city's planning department has recommended that HRSDC plants be enlarged to treat all the city's sewage in the northern urbanized area and that septic tanks be limited to the rural south.

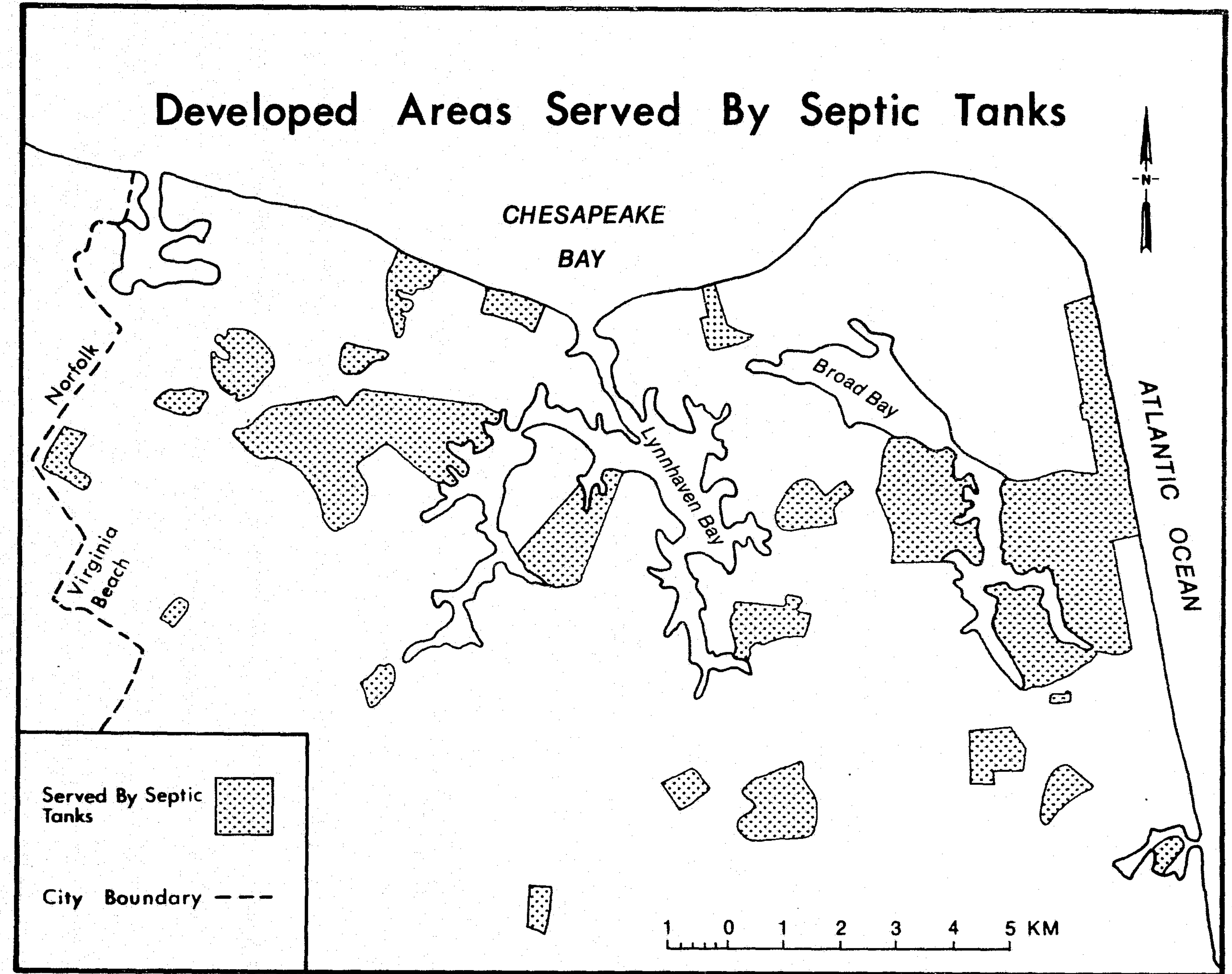

Figure 3--Adapted from Wiley and Wilson, 1974.

CONCLUSION

This brief review reflects the problems associated with a fast-growing area. The total picture, beyond the scope of this paper, should emphasize the multiple political and economic pressures that lead to environmental policy as well as the perception of the consequences of such policies. The pumping of seawater into Back Bay is likely to continue because it has been successful and inexpensive. Beach replenishment, though expensive, is also likely to continue because alternatives are not economically viable. The sewage disposal problem will probably change because its solution is vital to the city's public health and the maintenance of amenities that have economic significance.

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