

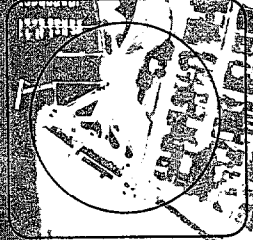
Coastal Zone  
Information  
Center

# COASTAL ZONE MANAGEMENT SERVICES

EARTH SATELLITE CORPORATION.

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1974

EARTHSAT  
1747 PENNSYLVANIA AVE. N.W.  
WASHINGTON, D.C.  
(202) 223-8100



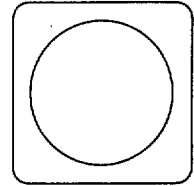
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EARTH SATELLITE CORPORATION

(EarthSat)



**COASTAL ZONE  
INFORMATION CENTER**

PENNSYLVANIA AVENUE, N.W., WASHINGTON, D. C. 20006  
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TELEX: EARTHSAT64449

The attached brochure briefly summarizes and highlights some of our capabilities as related to the protection and intelligent use of coastal resources. It is purposely brief in the hope that it will be read and passed on to your interested associates.

A partial list of clients and projects is included since this probably best indicates the range of our experiences and involvement in coastal zone management programs. In addition to our extensive experience in the utilization of remote sensing techniques, EarthSat personnel are well versed in ground survey techniques and data handling methodology. Our coastal investigations have involved a wide variety of legislative, legal and scientific issues. All of our work has proved to be cost effective for our clients and we enjoy a good reputation for performing to high quality standards and completing work on time.

If your office is contemplating coastal zone activities in response to the Coastal Zone Management Act of 1972, we would appreciate being considered as technical contractors. We are willing to discuss any potential projects and/or our capabilities at your convenience. Please call me or our coordinator for Coastal Zone programs, Mr. Robert Mairs, if we can be of assistance.

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David Thibault  
Director  
Geosciences and Environmental  
Applications Division

U.S. DEPARTMENT OF COMMERCE NOAA  
COASTAL SERVICES CENTER  
2234 SOUTH HOBSON AVENUE  
CHARLESTON, SC 29405-2413

Robert L. Mairs  
Acting Director  
Marine Resources and  
Fisheries Division

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## **EARTH SATELLITE CORPORATION (EARTHSAT)**

Earth Satellite Corporation (EarthSat) develops and applies remote sensing and data processing technologies to natural resource and environmental problems. Its focus is towards economic improvement and efficient resource usage by government and private organization decision makers.

EarthSat's principal asset is experienced scientists. Its full-time staff of over 120 professionals has over 2,000 man years of combined experience in the fields of oceanography, water resources, engineering, urban and regional planning, botany, biology, geology, land use and physical geography, wildlife management, meteorology, forestry, remote sensing, and data extraction and management.

This is the largest organization of scientific talent dedicated to the application of remote sensing techniques for solving the world's economic and resource management problems. Many of these scientists are internationally recognized authorities in a variety of scientific and professional disciplines. In addition, their associations with numerous universities and government agencies permit access to a vast pool of expertise and to existing satellite-acquired data.

EarthSat's projects include work undertaken with approximately 15 different federal agencies and departments, 20 private organizations, 15 state governments and 20 foreign governments. A list of selected clients with whom we are currently undertaking or have recently completed coastal zone programs follows. We would welcome inquiries concerning our services and capabilities, and would be most happy to provide representative samples of any phase of our activities in which you have a special interest.

**TABLE 1**

<b>Client</b>	<b>Project</b>
State of New Jersey	- Wetlands Inventory
NOAA	- Coastal Pollution and Estuarine Dynamics
State of Maryland	- Land Use
State of New Jersey	- Coastal Engineering
President's Council on Environmental Quality	- Land Use Indicators of Environmental Quality
Tennessee Valley Authority	- Water Control Planning
Environmental Protection Agency	- Water Quality Control & Pollution Hazards
Environmental Protection Agency	- Aerial Surveillance Oil Spill Prevention System
Environmental Protection Agency	- Institutional Arrangements for Water Quality Mgmt. Planning
Environmental Protection Agency	- River Basin Planning
National Center for Resource Recovery	- Solid Waste Recycling Study

## COASTAL ZONE MANAGEMENT

EarthSat offers general coastal zone environmental consulting services in four areas:

- Coastal Zone Inventory Program
- Environmental Impact Programs
- Wetlands Preservation Programs
- Coastal Zone Applied Research

The principal thrust of our state level programs has been to provide state and county officials with information to assist in management decisions and allocation of funds.

The *National Estuary Study*, to which EarthSat's staff and associates made major contributions, cited the need for an integrated approach to managing the nation's coastal resources. The study concluded that the coastal zone must provide for a wide variety of uses. At the same time, it recognized that pollution and unchecked development were fast destroying the ecological and recreational value of estuaries. EarthSat's staff has assisted in the preparation of state and federal laws affecting the coastal zone and has extensive experience in preparing and implementing plans for the management of coastal resources.



## COASTAL ZONE INVENTORY PROGRAMS

The Nation's Coastal Zone, as recognized in the Coastal Zone Management Act of 1972, is an area "rich in a variety of natural, commercial, recreational, industrial, and aesthetic resources of immediate and potential value to the present and future well-being of the Nation." As an area of immediate concern, an inventory of these resources is a first step in any coastal zone management program.

EarthSat offers the following coastal zone inventory services:

- Coastal zone definition and delineation based upon each state's diverse natural, institutional, and legal characteristics.
- Preparation of Coastal Land Resource Maps delineating areas of homogenous interrelationships of soils, landforms, vegetation, geology, and land use.
- Coastal zone land use inventories, and the preparation of land use maps.
- Inventory and evaluation of specific geographical areas for possible water fowl wildlife sanctuaries, parks and recreation areas.
- Mapping of wetlands boundaries and major wetlands plants species associations.
- Establishment of criteria for designating areas of particular concern, e.g., unique natural areas, critical environmental areas.

The examples on the following pages illustrate the format that several products of coastal zone analysis have taken in *one state* in which we have worked.

# REGIONAL ECOLOGICAL MAP NEW JERSEY

Let's protect our earth



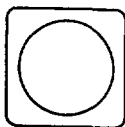
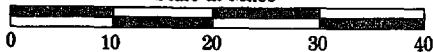
## NEW JERSEY DEPARTMENT OF ENVIRONMENTAL PROTECTION

Ecozones are defined as regional areas characterized by homogenous interrelationships of soils, landforms, vegetation, geology, drainage, and land use. Because of their regional areal size (at least 200 square miles) and uniform characteristics, ecozones should logically be recognized as integral regional planning units. Within New Jersey, certain ecozones contain critical environmental resources worthy of special protection and regulation: Coastal Zone (coastal bays and wetlands); Pine Barrens (unique forest associations and extensive aquifer zone); Agricultural Belt (prime agricultural land); Highlands and Kittatinny Mountain (relatively undisturbed forest areas). A small scale, synoptic view is required for the recognition and delineation of regionally similar land areas. Earth Resources Technology Satellite (ERTS) imagery is ideally suited for this purpose because each image covers approximately 10,000 square miles. Portions of only three ERTS-1 images were required to prepare this mosaic base on which the ecozones of New Jersey have been mapped.

### LEGEND

- A COASTAL ZONE:** coastal lands, wetlands and water directly affected by coastal processes
- B PINE BARRENS:** contiguous forest cover with low intensity land use
- C LAKEWOOD:** forested area with mixed residential and commercial land use
- D VINELAND:** mixed agriculture and forest
- E AGRICULTURAL BELT:** extensive farmland with small woodlots and some urban development
- F URBAN AND INDUSTRIAL ZONE:** areas of intensive land use
- G PIEDMONT PLAIN:** mixed cropland and urban land with scattered forested traprock ridges
- H HUNTERDON PLATEAU:** curvilinear forested ridges and cleared valleys
- I UPPER DELAWARE RIDGE AND TERRACE:** rolling terrain with forest and agricultural use
- J KITTATINNY MOUNTAIN:** steep series of forested ridges with low intensity land use
- K KITTATINNY VALLEY:** rolling topography with forested ridges, cleared valleys (agricultural use), and numerous small lakes
- L HIGHLANDS:** rugged, partially forested area with numerous lakes
- M WASHINGTON:** level valley (rural land use) enclosed by Highlands Ecozone
- N PASSAIC BASIN/WACHUNG MOUNTAINS:** forest cover and urban land use in a level river basin ringed by forested, traprock ridges
- O RIDGEWOOD:** urban land use and forest cover

Scale in Miles



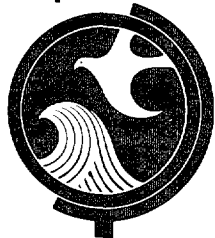
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Washington, D.C. 20006



This photomap produced from a NASA ERTS-1 mosaic of MSS band 5 taken on October 10, 1972

# NEW JERSEY COASTAL AREA

Let's protect our earth



## NEW JERSEY DEPARTMENT OF ENVIRONMENTAL PROTECTION

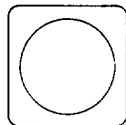
*The Legislature finds and declares that New Jersey's bays, harbors, sounds, wetlands, inlets, the tidal portions of fresh, saline, or partially saline streams and tributaries and their adjoining upland fastland drainage area nets, channels, estuaries, barrier beaches, near shore waters, and intertidal areas together constitute an exceptional, unique, irreplaceable, and delicately balanced physical, chemical, and biologically acting and interacting natural environmental resource called the coastal area, that certain portions of the coastal area are now suffering serious adverse environmental effects resulting from existing facility activity impacts that would preclude or tend to preclude those multiple uses which support diversity and are in the best long-term social, economic, aesthetic, and recreational interests of all people of the State; and that, therefore, it is in the interest of the people of the State that all of the coastal area should be dedicated to those kinds of land mix uses which promote the public health, safety, and welfare, protect public and private property, and are reasonably consistent and compatible with the natural laws governing the physical, chemical, and biological environment of the coastal area.*



SCALE IN MILES



EARTH SATELLITE CORPORATION



GEOSCIENCES AND  
ENVIRONMENTAL  
APPLICATIONS DIV.  
WASHINGTON, D.C.



## **Satellite Data Applied to Coastal Zone Management**

Earth Satellite Corporation has prepared the first composite image of a state's coastal zone utilizing satellite photography taken by NASA's Earth Resources Technology Satellite (ERTS-1). This photo map of New Jersey was presented to the State legislature during deliberations on the State's "Major Coastal Area Facilities Review Act," and was instrumental in its final passage into law.

The photo map was prepared by combining two multispectral scanner (MSS) bands from the ERTS-1 satellite. Infrared imagery (MSS Band 7) was used for the outlined coastal area (as defined by the New Jersey Coastal Area Facilities Review Act). This band accentuates the rivers, estuaries and wetlands as dark tones, while upland vegetation is lighter in color.

The remaining inland areas of the State are shown imaged by the red reflected energy (MSS Band 5) on the ERTS-1 photo. In these areas, cities such as Trenton and Newark image as a uniform light gray, while forest areas are darker, and farmland is seen in a characteristic checkerboard pattern.

This method of delineating and illustrating coastal areas can be used by other coastal states for environmental purposes and for complying with guidelines as set forth by the Federal Coastal Zone Management Act of 1972.

## **ENVIRONMENTAL IMPACT PROGRAMS**

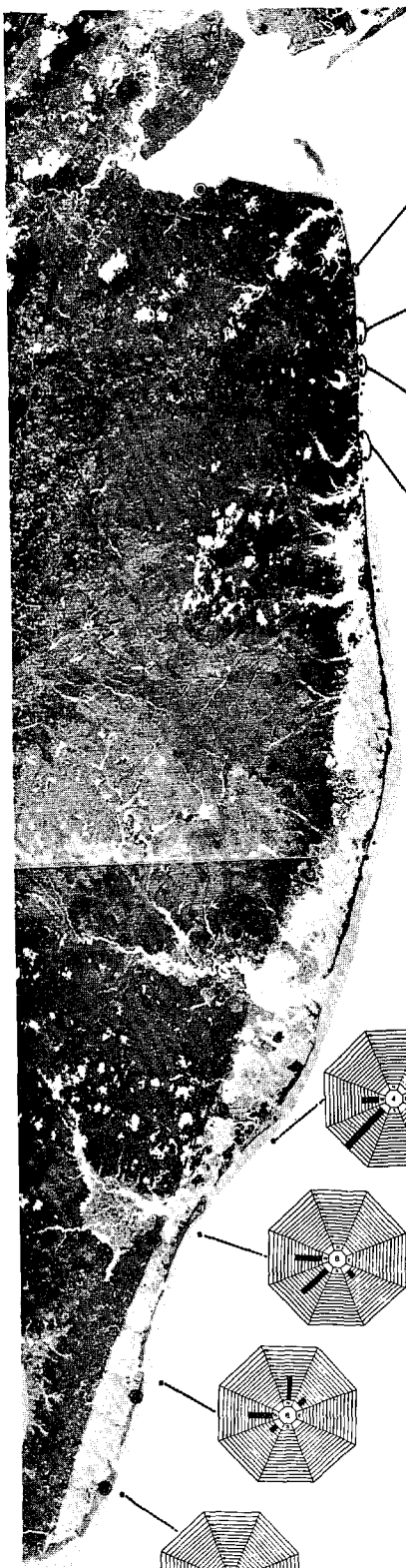
The coastal zone constitutes a unique and irreplaceable natural resource which can be seriously damaged by the careless siting of major facilities. There exists a need for balanced growth within the coastal zone which provides adequate environmental safeguards for the construction of new major facilities.

EarthSat has been involved in the siting and the environmental impact assessment of such major facilities as ocean outfalls, power plants, shore protection structures, housing developments, regional sewage treatment facilities, jetports, highways, canals, and solid and liquid waste disposal sites.

EarthSat offers the following environmental services in relation to siting of major facilities:

- **Site Selection**
- **Complete Environmental Impact Studies**
- **Nearshore Circulation Surveys**
- **Coastal Erosion Rate Analysis**
- **Estuarine Flushing and Assimilative Capacity Analysis**
- **Remote Sensing Environmental Monitoring Programs**
- **ADP Coastal Zone Surveillance Programs (Change Detection)**

The next few pages show examples of major facility environmental studies.



# OUTFALL PLANNING MAP

## NEARSHORE CURRENTS

### NEW JERSEY COASTAL AREA

Let's protect our earth



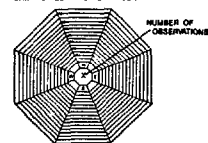
### NEW JERSEY DEPARTMENT OF ENVIRONMENTAL PROTECTION

THESE DATA SHOW THE PERCENT OF TIME SURFACE CURRENTS HAVE BEEN OBSERVED TO FLOW IN THE DIRECTIONS INDICATED WITHIN AN AREA JUST OUTSIDE THE LITTORAL ZONE EXTENDING TO ONE (1) MILE OFFSHORE. THESE DATA SETS WERE COMPILED FROM A COMBINATION OF INPUTS FROM SEVENTEEN (17) ORBITS OF THE EARTH RESOURCES TECHNOLOGY SATELLITE (ERTS-1), NINETEEN (19) YEARS OF SUPPLEMENTARY AIRCRAFT PHOTOGRAPHY INCLUDING NASA SUPPORT MISSIONS, AND FROM INDEPENDENT STUDIES. THE AREAS CHOSEN FOR ANALYSIS ARE BASED ON THE PROPOSED LOCATIONS FOR NEW JERSEY'S REGIONALIZED OCEAN OUTFALLS AND THE AVAILABILITY OF RESEA DATA. INFORMATION CONTAINED HEREIN INDICATES A PREDOMINANT NORTH-SOUTH FLOW ALONG THE NEW JERSEY COAST EXCEPT AT POINTS NEAR TIDAL INLETS WHERE A ROTARY FLOW CAN BE EXPECTED. THE PHOTOGRAPH ON WHICH THIS INFORMATION IS PLOTTED WAS PREPARED FROM BULK PROCESSED MULTISPECTRAL SCANNER (PSS) IMAGERY ACQUIRED BY THE NASA EARTH RESOURCES TECHNOLOGY SATELLITE (ERTS-1). THE IMAGE, A NEGATIVE OF BAND 7, WAS ACQUIRED IN THE NEAR INFRARED PORTION (800 - 1100 NANOMETERS) OF THE SPECTRUM.

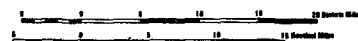
### LEGEND

- PROPOSED REGIONAL TREATMENT FACILITY
- SEWAGE PLANTS PRESENTLY DISCHARGING INTO ATLANTIC OCEAN
- OBSERVED OUTFALL LOCATIONS
- RYE SOURCE LOCATIONS

DRIFT DIRECTIONS AS PERCENTAGES



### SCALE



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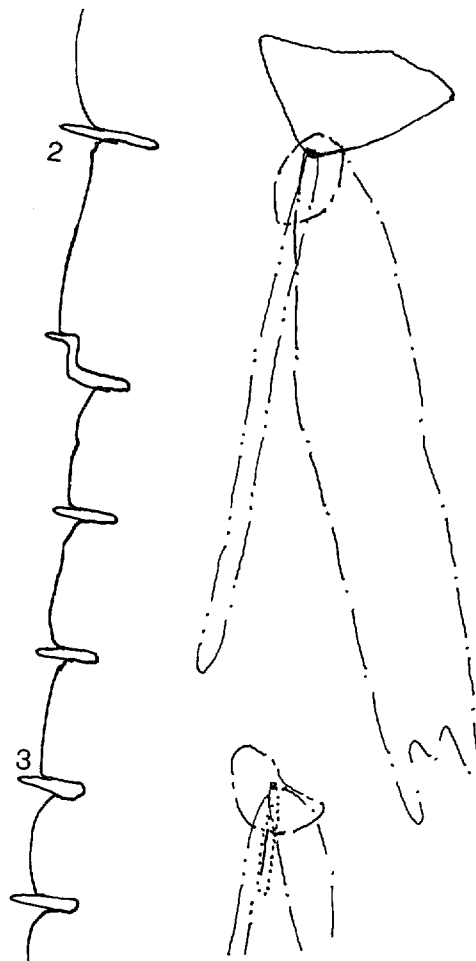


## WETLANDS PRESERVATION PROGRAMS

After nearly one hundred years of development pressure, a realization of the need for wetlands preservation is now broadly accepted among the coastal states. Wetlands laws have been enacted by many states and are facilitating wetland preservation.

Following legislative enactment, most state laws require a wetlands mapping program to establish which lands are subject to the law. State mapping programs vary widely in accuracy and complexity. Two boundaries commonly delineated, the upper wetland boundary (UWB) and the mean high water (MHW), are of particular concern since they differentiate between areas of state control and state ownership. Individual species and species association delineation *is the most complex type of wetlands mapping accomplished to date* and can provide a state with valuable data for assessing the value of various wetlands. While this type of mapping is expensive, it allows relevant land value classification, relative productivity estimation, and ecological viability determination within the wetlands. Such factors must be weighed against the economic justification of alternative land uses if wetlands are to survive the increasing coastal zone development pressures.

EarthSat mapped New Jersey's coastal wetlands for the State Department of Environmental Protection. In connection with its wetlands work, EarthSat developed a biological technique of delineating the MHW in New Jersey and has produced over nine hundred maps to National Mapping Accuracy Standards. These maps include an upper wetland boundary, the biological mean high water line, and species association delineations. A property ownership overlay for each map was also produced to create a legally acceptable, total information package to be used in regulation and management of wetlands.



Repetitive aerial coverage of ocean outfalls, such as the one above, yields information on surface flow of the waste field under differing environmental conditions. These analyses have contributed to the more environmentally sound placement of ocean outfall locations.

## WETLANDS PRESERVATION PROGRAMS

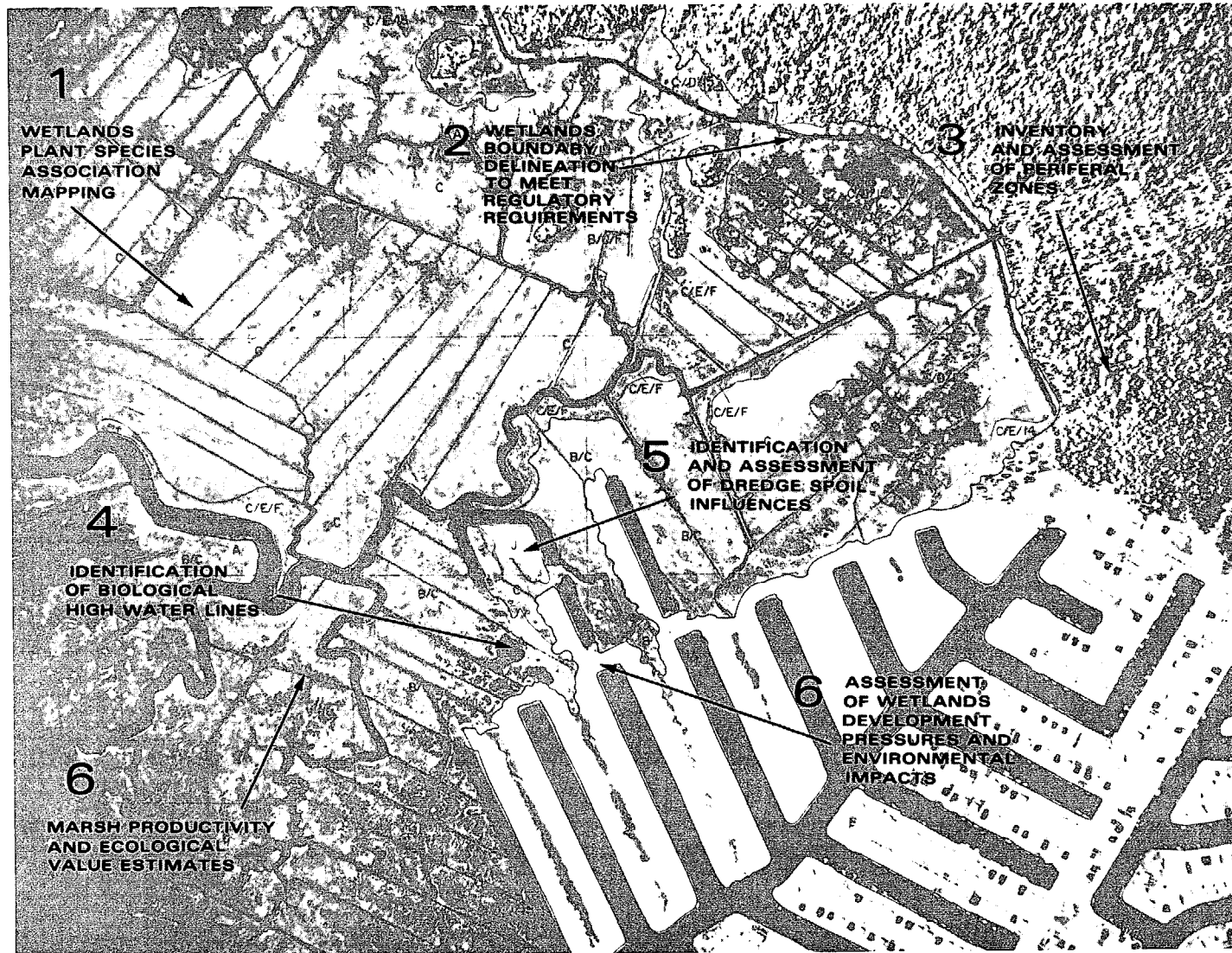
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A portion of a wetlands map produced by EarthSat for the State of New Jersey is included as an example of the products which have been developed to meet specific client needs. These maps meet the statutory requirements of the New Jersey Wetlands Act of 1970. The significant features are "the upper wetland boundary", the heavy line which can be seen between wetland and upland and between cleared land and wetland, and the inventory of plant species. The State's *Wetlands Order* applies to land seaward of the upper wetland boundary. Circumscribed areas within the wetlands which contain alpha-numeric designators are wetlands plant species groupings. This inventory of plant species will enable gross estimates of the productivity of the wetland to be made, and will aid state officials in evaluating the ecological significance of proposed activities affecting the wetlands. Such an activity is evident in the upper right hand corner of the map. This type of vacation community development is increasingly common in coastal areas. The low cost vacation housing is constructed on man-made land areas. Low lying areas are dredged to create canals and land; home owners are thus provided with access to nearby waterways for boats. As can be seen from the map, this development is destroying a viable wetland. This is the type of activity which states are to regulate under the Coastal Zone Management Act.

# EARTHSAT WETLANDS INVENTORY FEATURES



DIVERSIFIED EXPERIENCE AND CAPABILITIES  
IN  
SALINE—BRACKISH—FRESHWATER—TIDAL—NON-TIDAL—COASTAL—INTERIOR  
WETLANDS

## COASTAL ZONE APPLIED RESEARCH

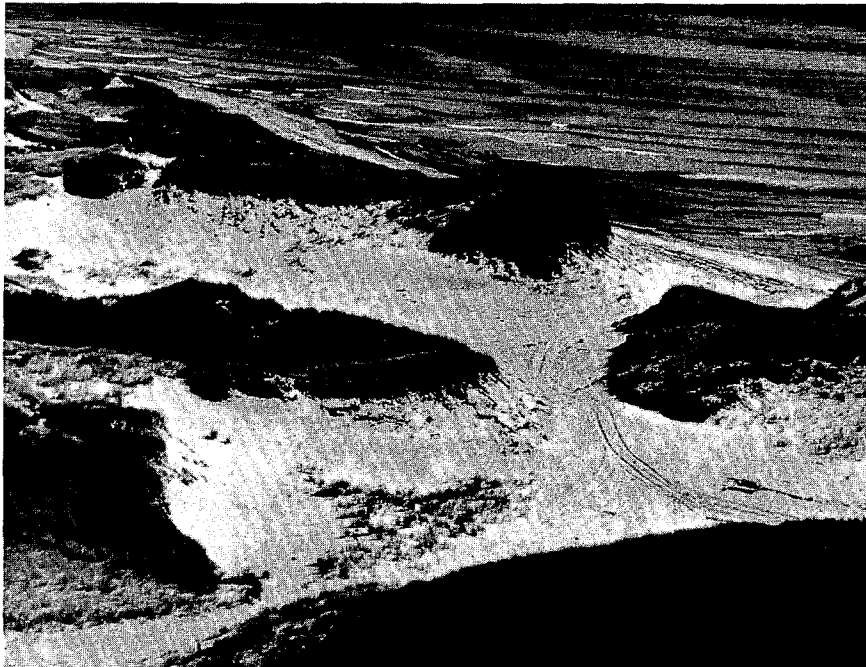
The coastal zone is an area of enormous variability and contains the most dynamic environmental characteristics found on earth. Because of these dynamic factors, it is particularly amenable to study via remote sensing technology. Coastal zone research combines the interrelated disciplines of physical oceanography, hydrology, hydraulics, geology, geography, meteorology, biology and engineering as they apply to the coastal area.

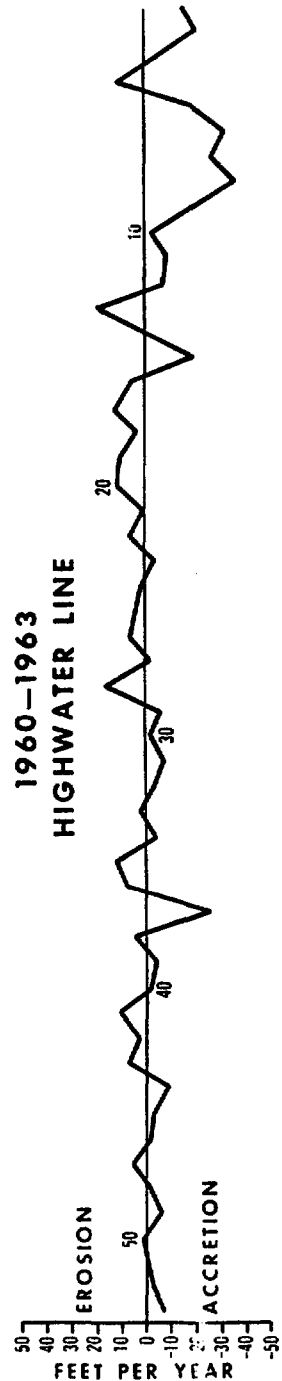
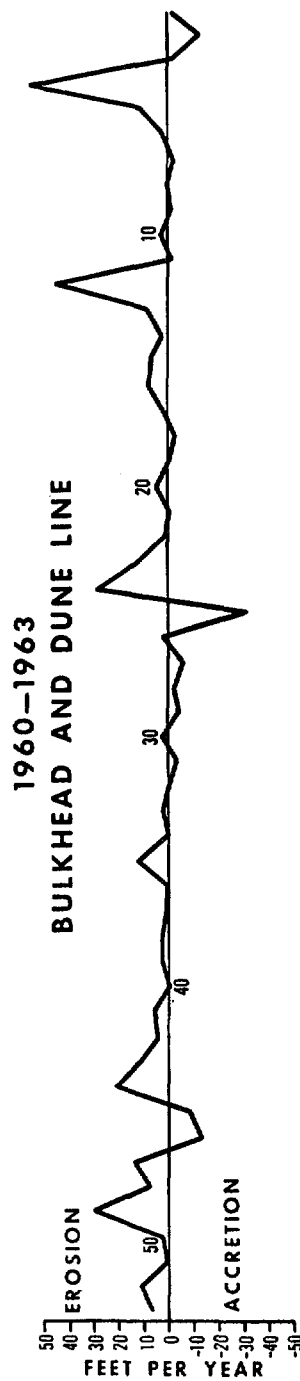
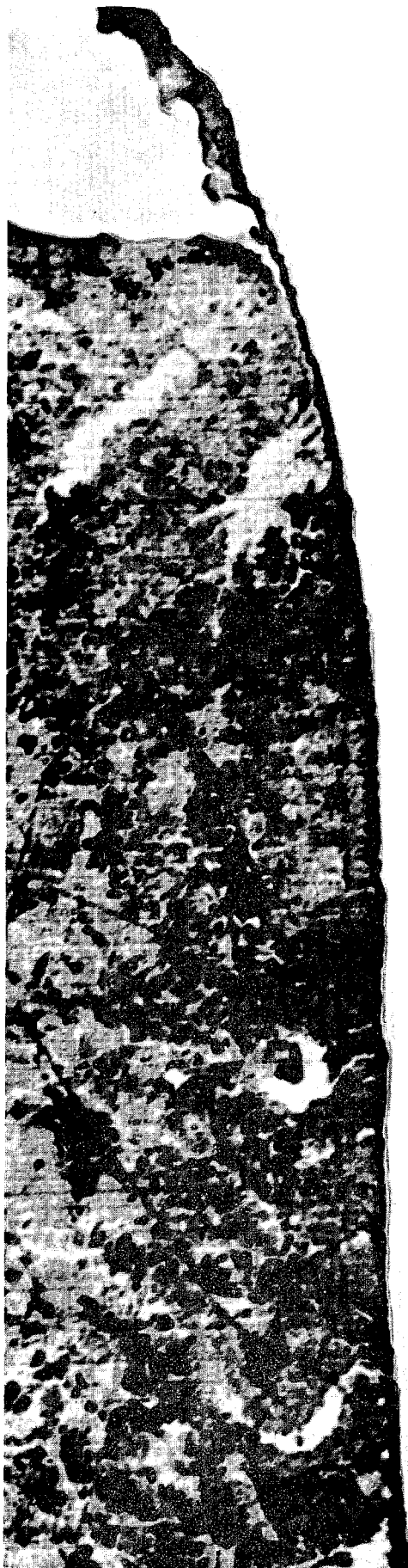
Earth Satellite Corporation has performed research to describe, understand, and monitor the physical, chemical and biological processes of marine environments and has provided practical information for the effective management of marine areas and for the rational use of their associated resources. It has developed practical coastal management tools in response to state and federal legislation.

This research is performed by the selective use of remote sensing devices in combination with appropriate surface and subsurface data to determine the impact of natural phenomena or man-made alterations.

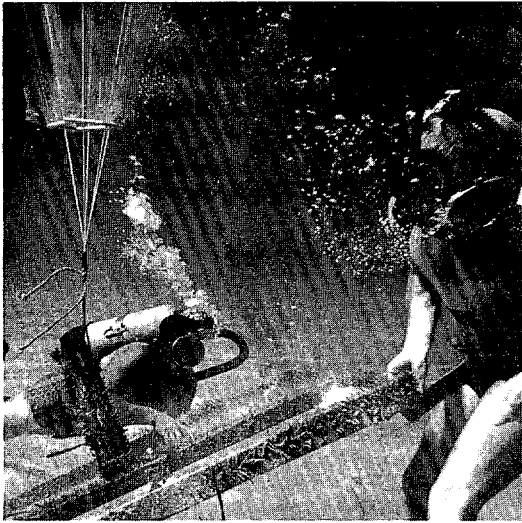
EarthSat personnel have received national acclaim for their work on estuarine circulation as it relates to water quality. EarthSat has a long list of accomplishments involving estuarine studies, including: circulation studies utilizing dye tracers and current meters, estuarine discharge volume estimates, water quality analyses, determination of wildlife forage crop for game management, numerous conventional oceanographic baseline data studies, interaction studies of tidal inundation with wetland biological activity, and shoreline erosional characteristic surveys. EarthSat personnel have conducted studies of estuarine quality for the following federal agencies: Navy, NASA and NOAA, and for these states: New Jersey, Maryland, North Carolina, South Carolina and Georgia. EarthSat personnel have been and/or are principal investigators for the NASA ERTS-1 spacecraft program and for the NASA JSC Earth Resources Aircraft Program in the field of estuarine quality.

Analytical products such as this one are being used by state personnel in making funding allocations for shore protection structure based upon EarthSat's remote sensing analytical procedures. Rates of erosion and accretion are computed along the coastline over a period of years and based upon this information, computer decision models have been developed to classify areas of the coast based upon erosional rates, property value, maintenance costs and construction costs.





All of EarthSat's work is done with the specific problem addressed in the forefront of the planned methodology. Whether the problem is best attacked from below the surface of the water or from satellite altitudes, EarthSat personnel have the background and experience to conduct proper analysis and make sound recommendation toward its solution.



Divers with underwater current meter array

Many of our nearshore and estuarine projects require the use of conventional marine sampling systems such as this underwater current meter array....

...and the use of experienced field personnel to conduct surface measurements....

1:20,000 scale aerial photo of dye implants for current analysis



Measurement of Biophysical Plant Response to Tidal Inundation in Stand of *Phragmites communis*

...our ground truth efforts are supplemented with the use of low to mid-level aerial photography....

...or for many applications higher level, small scale photography fulfills the problem need....



1:250,000 Scale U-2 Photo from 65,000' Altitude



1:1,000,000 Scale ERTS Enlargement from 680 Miles Altitude

...or even smaller scales covering larger ground areas



1:3,300,000 Scale ERTS Frame

Whatever the specific problem, EarthSat has the background and experience to provide valuable input to the management process.

## TECHNICAL PAPERS

Earth Satellite professionals have published numerous papers on various facets of the coastal zone. A partial list of these papers is given on the following pages; reprints of papers of interest are mailed on request, depending upon reprint supply available.

*Mairs, R. L. and Clark, D. K., "Remote Sensing of Estuarine Circulation Dynamics," Photogrammetric Engineering, Vol. 39, No. 9, September 1973.*

*Mairs, R. L., "Application of ERTS-1 Data to the Protection and Management of New Jersey's Coastal Environment," Symposium on Significant Results Obtained from ERTS-1, NASA GSFC, Volume 1, March 1973.*

*Garofalo, D. and Wobber, F. J., "Remote Sensing for Environmental Studies in Mined Areas: A Study of Clay Mining in New Jersey"; Photographic Applications in Science, Technology and Medicine, September 1973, 16 pp.*

*Macomber, R. T. and Mairs, R. L., "The Effects of Ocean Disposal of Barge-Delivered Wastes on the Nearshore Marine Environment," ASP - Remote Sensing on Oceanography, Orlando, Florida, October 1973.*

*Macomber, R. T. and Pettinger, L. R., "Development of a Quasi-Operational Change Detection System for New Jersey Coastal Zone Management," publication to be delivered at the Ninth International Symposium on Remote Sensing of Environment, University of Michigan, Ann Arbor, Michigan, April 15, 1974.*

*Wobber, F. J. and Anderson, R. R., "Coastal Marine Studies Using Small Scale Photography," XIX Rassegna Internazionale Elettronica Nucleare ed Aerospaziale, 1972. pp. 193-207.*

*Wobber, F. J., "Operational Wetlands Mapping Using Multiband Aerial Photography," Invited paper for the Coastal Mapping Symposium, sponsored by the American Society of Photogrammetry and ASCM, Washington, D.C., June 5-8, 1972. 25 pp. (publication expected)*

*Wobber, F. J. and Anderson, R. R., et al., "New Jersey Wetlands Mapping Pilot Project,"* prepared for the State of New Jersey, Department of Environmental Protection, Office of the Commissioner, Division of Marine Services, 1971, 45 pp.

*Marmelstein, Allan D., "Aerial Remote Sensing in Marine Archaeology,"* a paper presented before the Society of American Archaeology, Florida, May 4, 1972. (to be published with papers and proceedings from a remote sensing symposium held at this meeting)

*Marmelstein, Allan D. and Maughan, P. M. and Welch, R. I., "A Feasibility Demonstration of an Aerial Surveillance Spill Prevention System,"* Final Report to the Office of Research and Monitoring, Environmental Protection Agency, January 1972.

*Marmelstein, Allan D. and Maughan, P. M., "Operational Use of Remote Sensors in Commercial Fishing,"* Proceedings of the Symposium on Remote Sensing in Marine Biology and Fishery Resources, College Station, Texas, January 25-26, 1971. pp. 8-24.

*Stanczuk, Dennis T., "The Effects of Development on Barrier Island Evolution, Bogue Bank, North Carolina"* (publication expected 1974)

*Stanczuk, Dennis T., "Beach Profiles: A Measurement and Analysis Technique"* (publication expected 1974)

*Simonett, David S. and Thibault, D., "Land Use Indicators of Environmental Quality,"* Prepared for the Council on Environmental Quality, 1972.

*Simonett, David S., "The Utility of Photography and Other Remote Sensor Imagery in Thematic Land Use Mapping"* from Spacecraft and Aircraft Technical Report 169-1, Final Report USGS Contract 14-08-0001-12077, August 1970.

*Maughan, Paul M., "Remote Sensor Application in Fishery Research,"* *Marine Technology Society Journal*, Vol. 3, Number 2, May 1968.