E7.4-10.247
CR-136545
ESC No. 304

APPLICATION OF ERTS-1 DATA TO THE PROTECTION AND MANAGEMENT OF NEW JERSEY'S COASTAL ENVIRONMENT

ROBERT L. MAIRS
ROBERT T. MACOMBER
DENNIS STANCZUK
FRANK J. WOBBER
EARTH SATELLITE CORP.
1747 PENNSYLVANIA AVE., N.W.
WASHINGTON, D.C. 20006

ROLAND S. YUNGHANS
EDWARD B. FEINBERG
JO ANN STITT
NEW JERSEY DEPARTMENT
OF ENVIRONMENTAL PROTECTION
BOX 1390
TRENTON, NEW JERSEY 08625

JANUARY 1974
TYPE II PROGRESS REPORT FOR PERIOD: JULY 1, - DECEMBER 31, 1973
CONTRACT No. NAS5-21765

Prepared for:

ERTS PROGRAM OFFICE
NASA GODDARD SPACE FLIGHT CENTER
GREENBELT, MARYLAND 20771

TECHNICAL REPORT STANDARD TITLE PAGE

1. Report No.	2. Government Accession No.	3. Recipient's Catalog No.
ESC-304-6		

4. Title and Subtitle	5. Report Date
Application of ERTS-1 Data to the Protection & Management of New Jersey's Coastal Environment	January, 1974
	6. Performing Organization Code
7. Author(s) R. Mairs, R. Macomber, D. Stanczuk, E. Wobber, E. Feinberg, R. Yunghans, J. Stitt	8. Performing Organization Report No.
9. Performing Organization Name and Address New Jersey Department of Environmental Protection, Trenton, New Jersey 08625 Earth Satellite Corporation 1747 Pa. Ave., N.W., Wash., D.C. 20006	10. Work Unit No.
	11. Contract or Grant No. NAS-5-21765
	13. Type of Report and Period Covered Type II Report July - December 1973
12. Sponsoring Agency Name and Address ERTS Program Office Dr. E. F. Szajna, Technical Monitor	14. Sponsoring Agency Code

15. Supplementary Notes

16. Abstract

The principal thrust of this ERTS-1 experiment is to develop quasi-operational information products from analysis of ERTS-1 imagery and collateral aerial photography and to apply these products to the practical regulation, protection, and management of New Jersey's coastal environment. Incorporated into this goal is the development of procedures for the operational use of ERTS-1 data products within New Jersey's Department of Environmental Protection. Analysis and product preparation for operational needs has centered on four major coastal resource problem areas: detection of land-use changes in the coastal zone; siting of ocean outfalls; monitoring of offshore waste disposal; and calculation of recession rates along the Atlantic Shore. The relative utility and estimated monetary benefits derived from ERTS and aircraft imagery for each problem area have been determined. Of equal importance is the development of a capability within the State to use and understand remote sensor-derived information, and the application of this information to meet the requirements of current and anticipated coastal zone legislation.

17. Key Words (Selected by Author(s))	18. Distribution Statement
Offshore Waste Disposal, Ocean Outfalls, Shore Protection, Coastal Engineering, Land Use Change Detection, Nearshore Circulation, Environment	

19. Security Classif. (of this report)	20. Security Classif. (of this page)	21. No. of Pages	22. Price*
UNCLASSIFIED	UNCLASSIFIED		

*For sale by the Clearinghouse for Federal Scientific and Technical Information, Springfield, Virginia 22151.

PREFACE

The principal thrust of this ERTS-1 experiment is to develop quasi-operational information products from analysis of ERTS-1 imagery and collateral aerial photography and to apply these products to the practical regulation, protection and management of New Jersey's coastal environment. Incorporated into this goal is the development of procedures for the operational use of ERTS-1 data products within New Jersey's Department of Environmental Protection. Analysis and product preparation for operational needs has centered on four major coastal resource problem areas: detection of land-use changes in the coastal zone; siting of ocean outfalls; monitoring of offshore waste disposal; and calculation of recession rates along the Atlantic Shore. The relative utility and estimated monetary benefits derived from ERTS air aircraft imagery for each problem area has been determined. Of equal importance is the development of a capability within the State to use and understand remote sensor-derived information, and the application of this information to meet the requirements of current and anticipated coastal zone legislation.

In conclusion, ERTS data has increased efficiency within the State in several areas. Many ERTS-derived products have been evaluated and have been found to be either of yearly or one-time value, whereas other ERTS products have provided necessary repetitive

information needs. For operational needs, ERTS data, on its own, has proven to be of greatest value in (1) land use change detection, (2) waterfowl game management, (3) offshore waste disposal, (4) flood-plains mapping. Greatest overall benefit to the State has accrued from analysis of ERTS-1 data coupled with a well coordinated aircraft and ground data collection system. Problems of shore erosion and siting of ocean outfalls are best investigated through this approach.

For the resolution of specific coastal resource problems, our work indicates that ERTS overpasses coupled with repetitive aircraft coverage will be most productive and cost effective. The success of this ERTS investigation in addressing these coastal resource problems has convinced the State of New Jersey to include in its next budget fifty thousand dollars ($50,000) to participate in the kinds of activities addressed during this investigation.

TABLE OF CONTENTS

LIST OF ILLUSTRATIONS

LIST OF TABLES

TYPE II REPORT

APPLICATION OF ERTS-1 DATA TO THE PROTECTION AND MANAGEMENT OF NEW JERSEY'S COASTAL ENVIRONMENT

1.0 INTRODUCTION

1.1 General

This document is the third Type II Report submitted in association with NASA Contract Number NAS5-21765.

The primary objective of this experiment is to develop useful information products from analysis of imaged coastal land and marine resources and to apply these products to the regulation, protection, and management of New Jersey's coastal zone.

A secondary objective is to develop a capability within the New Jersey Department of Environmental Protection (NJDEP) to utilize remote sensor-derived data.

Analysis of ERTS-1 imagery and aircraft underflight data and the subsequent development of information products has shown that repetitive imaging of the coastal zone environment along the New Jersey shore can provide varying levels of useful information which is contributing and will continue to contribute to coastal management decision-making within NJDEP.

This Type II Progress Report describes the analysis of imagery to date and the development of remote sensor-derived information products and procedures that are being used and distributed within the State.

1.2 Summary of Accomplishments

The principal accomplishments and significant results during this reporting period are discussed below. Many of these accomplishments have been developed into user-oriented products (▬).

- Problem areas receiving analysis during this reporting period have been centered on ocean outfall placement, offshore waste disposal, coastal zone surveillance (developmental change detection), shore erosion/accretion case study, feasibility of automated data analysis for coastal zone surveillance, and waterfowl/forage crop prediction.

- A preliminary estimate of benefits to the State has been calculated for the four major problem areas: offshore waste disposal, coastal land resources, ocean outfalls, and shore protection.

- A working interface has been established between the State's local sewerage authorities, outfall designers and environmental consultants to facilitate the inclusion of ERTS-derived nearshore circulation information into future design of the State's ocean outfalls.

▬ • Computerized analysis techniques for monitoring offshore waste disposal dumping locations, drift vectors, and dispersion rates have been initiated and several shade prints of disposed wastes have been prepared. A well dispersed dredge spoil dump imaged on 9/22/73 was found

to include only four signal intensity levels (on MSS Band 5) between the background water and the most highly reflective area within the dump zone. However, fresh dumps as seen in other orbits are more readily discernible. An increase in the gain setting at the time of data collection would aid analysis of low contrast offshore scenes.

- Preliminary investigations have demonstrated the feasibility of a computerized change detection analysis of multi-date ERTS tapes to increase timeliness and accuracy over manual analysis and to utilize the maximum resolution capability of the ERTS system.

- Accurate discrimination of a well dispersed dump was facilitated on a color additive viewer and on color composite prints by increasing the gamma of ERTS 70mm negatives to a value of between 3 and 4.

- A paper entitled, "Remote Sensing of Marine Waste Disposal and Beach Erosion for Coastal Zone Monitoring and Protection" was presented at the Annual Fall Meeting of the American Society of Photogrammetry.

- Rates of erosion and accretion have been calculated from aircraft photography dating back to 1953 along two distinct types of New Jersey shoreline: a developed and a natural beach. These rates are presented in graphic form on an ERTS-1 base map at a scale of 1:250,000. These rates can be used to determine the effectiveness of various shore protection structures in preventing sand removal and encouraging sand accumulation. Information on maintenance and construction expenditures can also be used to obtain a cost effectiveness ratio for various shore protection devices. The relationship of erosion rates, property value, and project cost are all criteria for the selection of site type and the extent of a shore protection structure.

- A paper entitled, "Impact of ERTS-1 Images on Management of New Jersey's Coastal Zone" was presented at the Significant Results Symposium in December.

- A change detection analysis of two ERTS frames from two separate overpass dates has been completed, and a summary listing of the changes interpreted has been compiled. During the period between ERTS overpasses on October 10, 1972 and July 6, 1973, 276 alterations or changes of the scene were recorded on ERTS within the New Jersey coastal area. Aerial verification of change type has been accomplished.

- A Coastal Zone Surveillance Program has been developed in which systematic comparisons of early ERTS images and recently acquired images are regularly made to identify areas where changes (mainly due to development) have occurred. These changes are reported to NJDEP for field checking in compliance with "New Jersey's Wetlands Act" and their new "Coastal Area Facility Review Act" which call for the monitoring and protection of these areas.

- Preliminary conclusions drawn from the Shore Erosion case study indicate that in the northern Test Area (developed beach) erosion has occurred more often, is generally more severe, and the beach is slower to recover than in the southern Test Area (natural beach). From these data it appears that it may be possible to define areas most likely to experience further erosion. This is not, strictly speaking, a statistical prediction but rather an assumption that a recognized trend will continue. The assumption of continued erosion in areas that have at one time experienced severe erosion is supported by the simple fact that as a beach narrows, wave energy is concentrated on a narrower beach surface. The higher energy condition subsequently results in accelerated erosion. These analyses have direct operational value to NJDEP with respect to where the State allocates yearly funds for shore protection and may affect management decisions for future priorities as to the philosophy of shore protection.

- A continuing dialogue between EarthSat and NJDEP operational users is being maintained.

2.0 ANALYTICAL PROCEDURES AND TECHNIQUES

2.1 Initial Analysis

As of this reporting date, all imagery received has undergone initial analyses for information content. An initial evaluation of the imagery has been conducted as each ERTS-1 image set was received, with particular emphasis on the following characteristics, processes, and phenomena:

- cloud cover and haze level
- discolored (sediment-laden) current plumes
- changing morphology of sub-aerial and submergent coastal landforms
- nearshore waste disposal
- shoreline construction projects
- dredging and filling
- wetland delineations
- nearshore current indicators
- coastal development
- anomalous features

All recognized features impacting on the coastal environment have been annotated during this initial analysis indexing. This initial image annotation procedure provides a means of referencing, by environmental

phenomena, data that is useful for future analysis of successive image sets. These narrative analyses are recorded on an EarthSat form (New Jersey ERTS-1 Image Analysis Form).

2.2 Photo and Image Reproduction

EarthSat has expanded its photo laboratory processing facilities to accommodate both color and black-and-white processing capabilities. Routine enlargements and contact prints are made from the ERTS transparencies (as needed) as a regular part of the analysis cycle. Various phenomena can best be interpreted at different scales. Photographic enlargements of ERTS-1 images have been produced to allow ready transfer of observable coastal phenomena to existing nautical charts (with scales ranging from 1:40,000 to 1:1,000,000) and/or topographic maps (with scales ranging from 1:24,000 to 1:250,000). A color mosaic of the entire State has been prepared at a scale of 1:1,000,000.

2.3 Background Data

Existing collateral data, e.g. meterology, hydrography, coastal current records, coastal engineering reports, research papers, waste dumping schedules, outfall

design and capacities, etc. have been continually collected during Phases I, II and III to provide a substantial historical data base. A cross referenced bibliography has been prepared and is on file to assist in the further analysis of ERTS-1 imagery. NASA aerial remote sensing coverage of the test area, along with New Jersey Department of Environmental Protection routine coastal flight photography, has been used in the analysis of ERTS-1 imagery in order to obtain a more detailed assessment of local coastal conditions.

2.4 Ground Data Collection

The general approach to the selection of test sites has evolved so as to be more responsive to interdisciplinary needs within the NJDEP. Following interviews with a variety of NJDEP personnel and an assessment of the NJDEP data acquisition network, the concept of fixed test sites has been revised. Currently, the sites are chosen as the need arises to respond to the dynamic nature of the environmental and coastal management problems of NJDEP.

During this reporting period, field investigations have been carried out in the coastal waters around Wildwood, New Jersey to determine tidal current effects on estuarine discharges and possible pollutant dispersion. In addition,

low altitude aerial reconnaissance over the entire coastal area was conducted as verification for the Coastal Zone Surveillance Program.

3.0 RESULTS

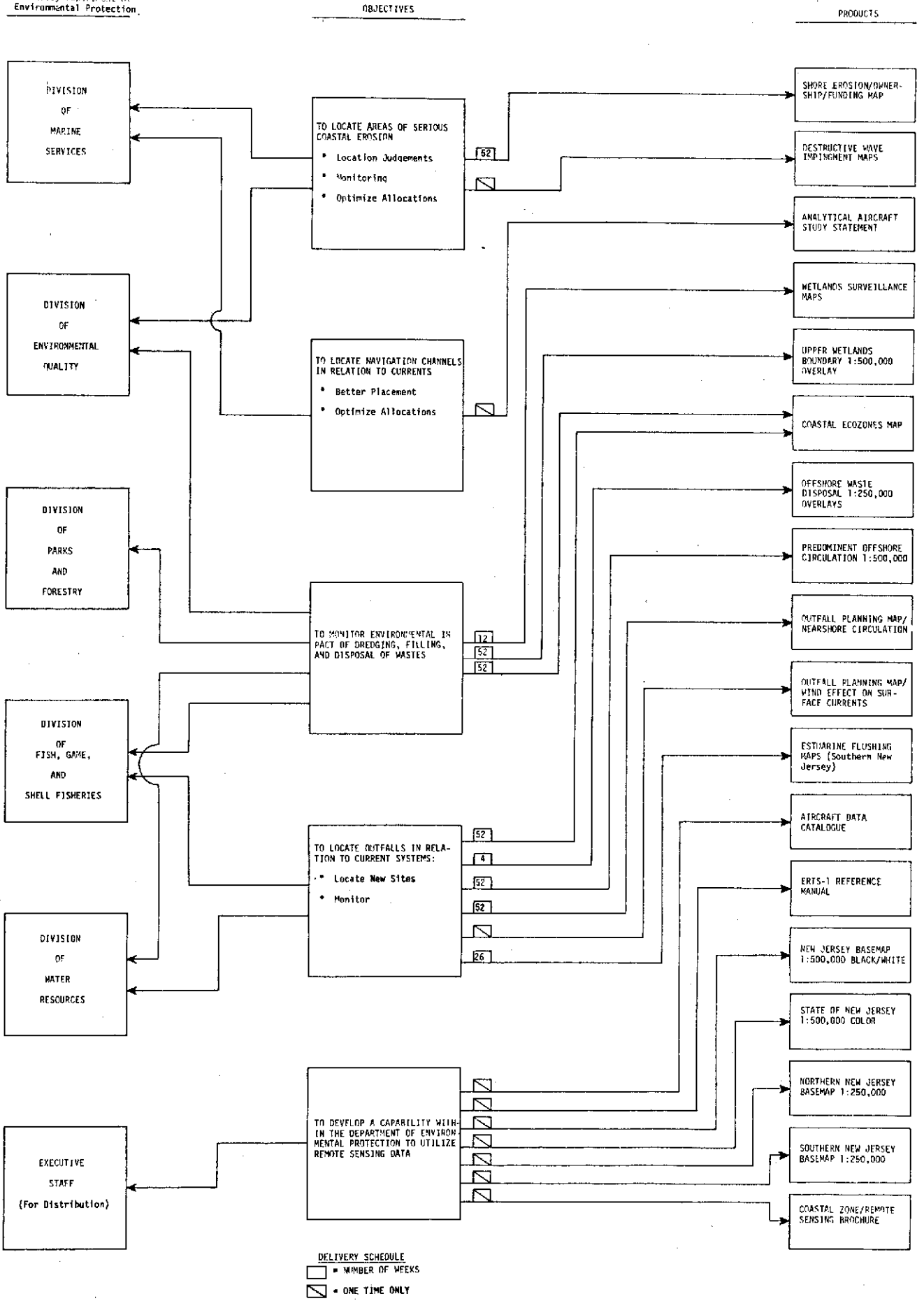
Contract objectives can be divided into two separate and distinct groups: (1) applications objectives which are directed to using ERTS imagery to solve practical coastal management problems and (2) objectives designed to develop a capability within NJDEP to use remote sensor-derived information. Based on this grouping of objectives, two categories of information products have emerged. Figure 1 lists some of the products developed during the experiment, their relationship to experimental objectives, and their distribution within the various operating Divisions of the NJDEP.

Analysis of ERTS-1 imagery during this reporting period has centered on these four major problem areas of importance to the State.

- Offshore Waste Disposal
- Ocean Outfall Placement
- Land Use Developmental Change Detection
- Shoreline Recession Rates

FIGURE 1

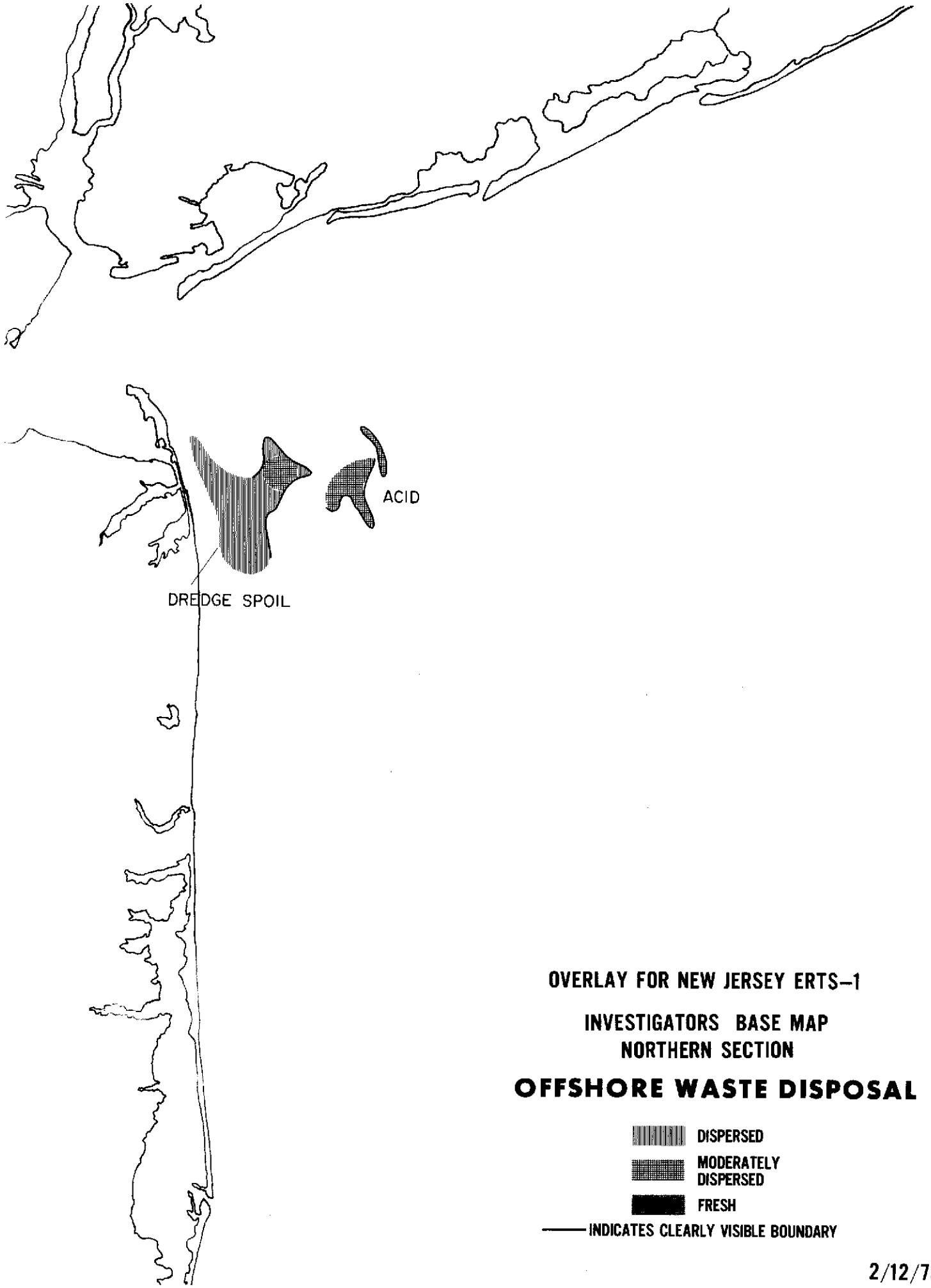
New Jersey Department of Environmental Protection



The development of a capability to operationally use remote sensor-derived information has been a principal task throughout the investigation. Interaction between EarthSat and NJDEP personnel has been an important aspect of the overall study. NJDEP personnel are now in the process of using ERTS-derived products in real operational programs. The demonstration efforts of Phases I and II have led to the identification of significant problem areas in which ERTS data is now providing and can continue to provide in the future, relevant real time answers.

3.1 Offshore Waste Disposal

Offshore waste disposal operations, as discussed in previous Progress Reports, continue to be of interest to NJDEP personnel. EarthSat routinely monitors the dumping sites with each orbit, delineating the apparent direction of drift and the dispersion characteristics. These data are providing NJDEP with the beginnings of an environmental monitoring program to document and assess both the short- and long-term environmental effects. These effects must be understood in relation to their impact on the future of New Jersey's beaches, marine life and public health. Dumps are classified as either fresh, moderately dispersed, or well dispersed.



OVERLAY FOR NEW JERSEY ERTS–1

INVESTIGATORS BASE MAP
NORTHERN SECTION

OFFSHORE WASTE DISPOSAL

DISPERSED

MODERATELY DISPERSED

FRESH

—— INDICATES CLEARLY VISIBLE BOUNDARY

2/12/73

Waste dump overlays (Figure 2) are prepared by using the Bauch and Lomb Zoom Transfer Scope (ZTS). The ZTS enables the operator to view two documents, such as a photo and a map in superposition. In this case, the image is a 70mm ERTS-1 transparency of the New York Bight Area, and the base map is a 1:250,000 ERTS-1 photomap of the same area produced from the January 25, 1973 ERTS-1 overpass.

ERTS-1 transparencies from each overpass are registered according to prominent landforms with the base maps by using the magnification and field rotation controls on the ZTS. After the image and map are registered, an overlay of tracing paper is placed on the base map, and registration marks are made on the overlay. By alternately increasing and decreasing the illumination of the photo and map, the outline of a waste dump is traced directly onto the overlay. Waste dumps have spectral signatures that differ from the surrounding waters depending upon the amount of dispersion that has occurred from the time of the overpass. Each is descriptively classified as either fresh, moderately dispersed, or dispersed, depending upon the average photographic density of the dump site. On several overpass dates multiple dumps in various stages of dispersion are apparent, and often several levels of dispersion within one dump are

visible in which case an attempt is made to identify each density or dispersion level using different map symbols. With multiple density levels or very faint but detectable waste dumps, it is often difficult for an interpreter to delineate the perimeter of the dump area on one 70mm frame of a single MSS band. Dump sites are most often located on positive MSS band 5 imagery, but for well dispersed dumps, positive MSS band 4 may be used. When analyzing multiple dumps ranging from fresh to dispersed, the negatives of MSS bands 4 and 5 are used.

From analysis to date, actual dumps do not always coincide with designated and approved dumping sites for different waste materials. Table 1 provides a listing of imaged dumps, disposed materials, locations, and total area covered by each dump. ERTS-1 has proven to be a valuable means of monitoring compliance with ocean waste disposal regulations.

The predominant dispersion and movement of relict (imaged) dumps is southwest towards the New Jersey Shoreline. The dump site overlay products are providing useful information for the establishment of water quality sampling criteria applicable to the disposal of waste materials and for identifying pollution problem areas that require investigation by NJDEP or EPA personnel.

TABLE 1

OFFSHORE WASTE DISPOSAL

ERTS MONITOR

Overpass Date	Waste Classification	Dispersion Extent	Aerial Extent (Sq. Mi.)*	Distance From Nearest Shore (Statute Mi.)
8/16/72	Acid	Fresh/Dispersed	6.9	10 NY/NJ
9/3/72	Acid/Dredge	Moderate/Dispersed	10.7	5 NJ
9/22/72	Acid/Dredge	Fresh/Moderate/ Dispersed	28.5	1 NJ
12/2/72	Acid	Fresh	10.2	14 NY
1/25/73	Acid	Moderate/Dispersed	20.2	16 NJ
2/12/73		Moderate/Dispersed	36.3	1 NJ
3/2/73	Acid	Fresh/Moderate	5.6	12 NJ
3/20/73	Acid	Fresh	3.0	14 NJ
4/7/73	Acid	Fresh/Moderate	16.5	12 NJ
5/13/73	Acid	Fresh/Moderate/ Dispersed	40.2	12 NJ
5/31/73	Acid	Dispersed	78.6	11 NJ
7/6/73	Acid	Fresh/Moderate	8.6	9 NJ
7/24/73	Acid	Moderate/Dispersed	37.8	8 NY
8/29/73	Acid	Dispersed	34.0	9 NJ

* Approved Interim Dumping Sites, as set forth by the Environmental Protection Agency, Federal Register, May 16, 1973. Approved dumping grounds cover an area of 2 square miles each for both dredge and waste acid disposal.

3.2 Ocean Outfall Placement

As reported in the last Type II Progress Report, the objective of this portion of the investigation is to develop nearshore circulation and dispersion information that could be integrated into NJDEP's plan for regionalized ocean outfalls. The marine environmental conditions extant at a proposed outfall site have previously had little to do with final design specifications of ocean outfalls. Analysis of remote sensor data has shown that the environment is extremely variable in the nearshore zone and that the circulation and dispersion conditions along any stretch of coastline must be evaluated before environmentally sound outfalls can be constructed.

Work during this reporting period has centered on the education and interaction between the remote sensor analyst, NJDEP personnel, the local sewerage authorities, and the design engineers. Several meetings have taken place between these entities and a working relationship has been established. The local sewerage authorities and the design engineers are now looking into the effects of circulation on waste water disposal and are eager to participate in further evaluations of their systems and in the analysis of the remote sensing data. Considerable progress has been

made during this six-month reporting period in relation to the problems at hand, supervisory help from the State, and involvement at the local level.

More work is needed in understanding the actual dilution and dispersion of ocean outfall effluents and NJDEP and EarthSat are proposing to continue the investigative efforts at a level that will provide information potentially useful to all states planning ocean outfall locations. The level of effort required for this additional task is not within the resources of the present contract.

3.3 Land Use Developmental Change Detection

In 1973, New Jersey passed its Coastal Area Facility Review Act which places some 1,750 square miles of coastal land under the jurisdiction of its Department of Envionmental Protection. The act requires prior approval from NJDEP for any modification of the landscape. An environmental impact statement describing in detail the proposed alteration and its possible effects on the environment must be filed with and approved by NJDEP before any dredging, filling, clearing, erecting of structures, or altering of any sort may begin.

The problem is now one of monitoring and enforcement. The Division of Marine Services is charged with the responsibility of inspecting all dredging and filling operations in the wetlands and all clearing and development activities in the adjacent upland. This has become a very difficult task. The Division employs numerous inspectors, the marine police, helicopters, and light aircraft and still has difficulty in monitoring the more remote regions of the Coastal Area.

Prior to the Coastal Area Facility Review Act, only the wetlands needed to be monitored. Now some, 1,750 square mile of upland and wetland must be monitored, which is a

Figure 3a: Photo Quad Sheet #29 - Marmora - Site #211 - Land cleared in wooded area in preparation for development lots. Circumscribed area is that seen in aerial oblique below. Dashed delineation (red) interpreted in the office from two ERTS images. Solid delineation (blue) derived from field observation and oblique view below

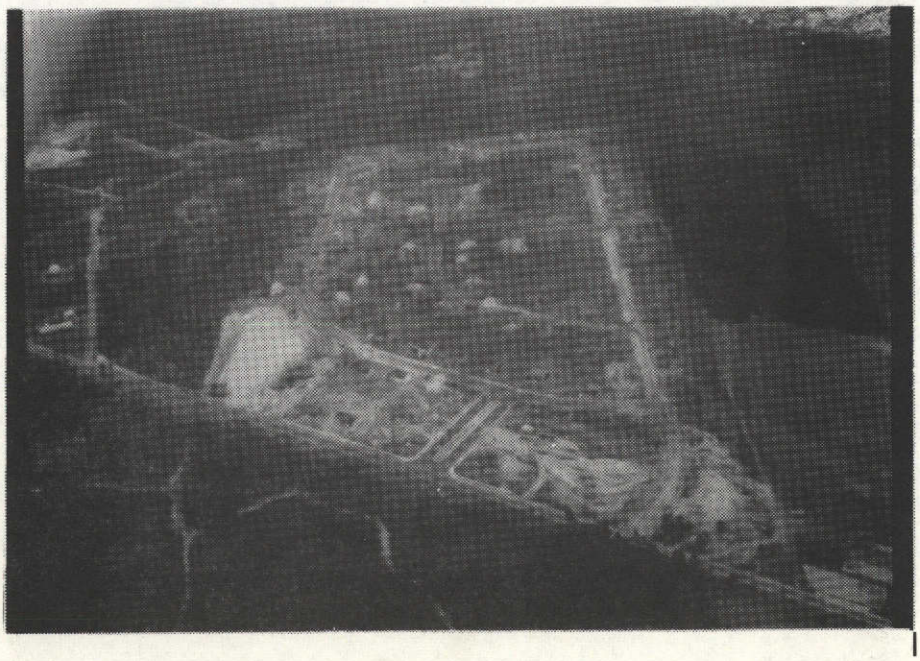


Figure 3b: Low altitude aerial oblique view of development site on December 13, 1973

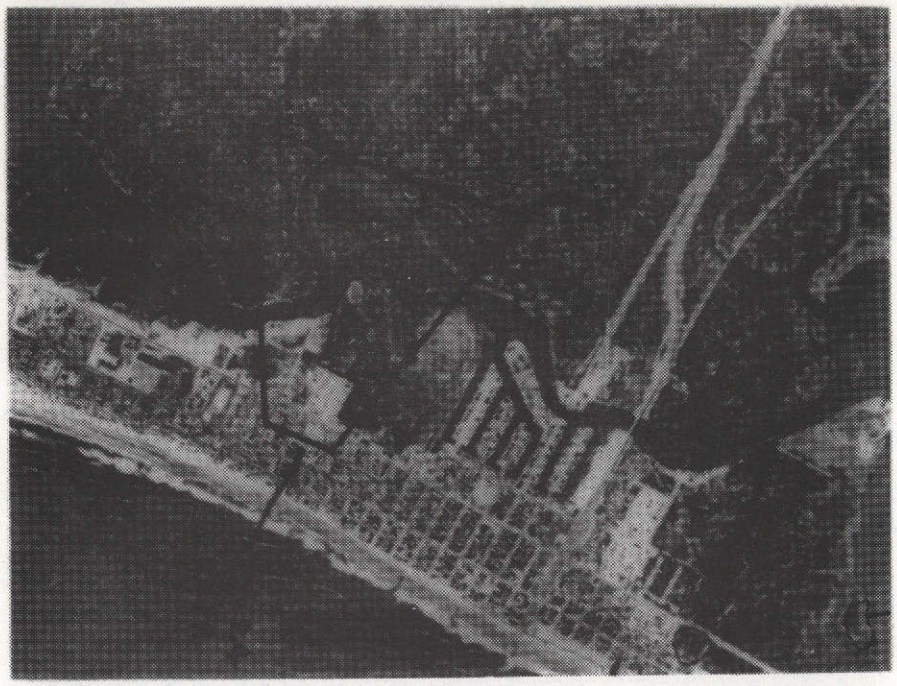


Figure 4a: Photo Quad Sheet #33 - Sea Isle City Site #227A - Land fill presently underway in viable productive wetland area below mean high water. Solid line as delineated from field truth within circumscribed area. Change not interpreted on ERTS but found to be in existence at time of field observation. Site 227 was interpreted to have changed on ERTS but no change was evident in the field.

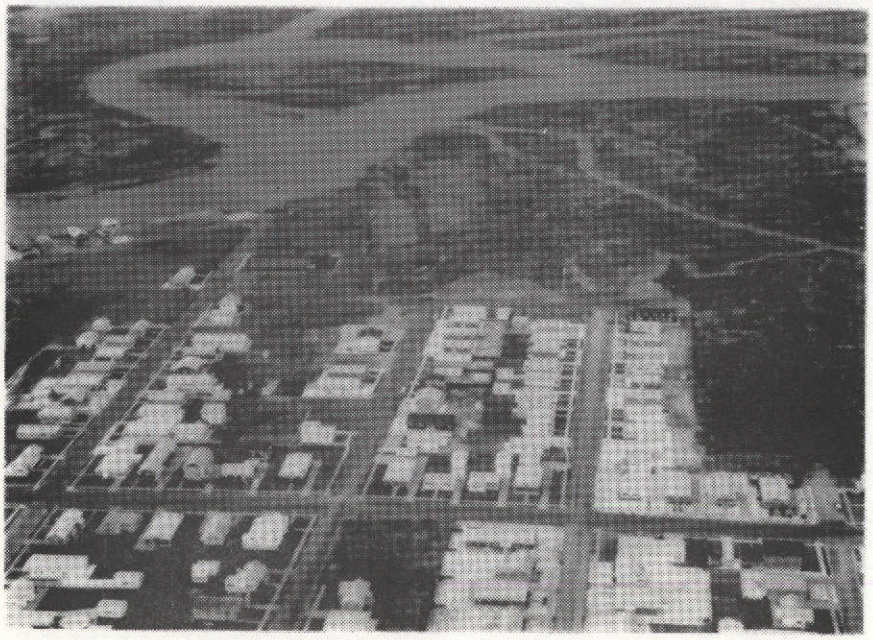


Figure 4b: Low altitude aerial oblique view of land fill underway. Two dump trucks and a bulldozer working on site at the time of the photo. NJDEP notified of these activities and a check is being made on status of permit application. If not permit has been granted, this activity constitutes a violation of the Coastal Area Law.

considerably more demanding task. The Division of Marine Services is relying heavily on reports from citizens on operations commencing in their area, and on the regional inspector's ability to keep abreast of all activities in his area. ERTS is now providing a repetitive, more reliable source of data in the form of a repetitive change detection system with high resolution and frequency to aid the field inspectors in their enforcement activities.

The development and refinement of an analysis technique for land use developmental change detection was completed during this past six month reporting period. The technique involves the comparative analysis of multi-date ERTS imagery. The accuracy of the technique has been verified by light aircraft observation field work (Figures 3 & 4) and is considered quasi-operational at this time. The NJDEP has been sufficiently satisfied with the developed system to directly implement these procedures into the operational monitoring program required under the Coastal Area Facility Review Act.

During this reporting period a thorough analysis of images from two ERTS overpass dates has been completed, and a summary of the changes interpreted has been compiled.

Between ERTS overpasses on October 10, 1972 and July 6, 1973, 276 alterations or changes of the scene recorded by ERTS occurred within the New Jersey coastal area. These changes were of seven basic types:

1) Land clearing for development
2) Temporal/seasonal vegetative
3) Agricultural
4) Shoreline erosion/accretion
5) Tidally induced
6) Meteorologically induced
7) Unexplainable

The analysis is proceeding according to the following series of tasks:

Degree of Completion	Task	Description
100%	1	Selection of ERTS imagery for the period.
100%	2	Construction of two black mask 70mm film chip holders.
100%	3	Initial comparison of the imagery of the two dates on a zoom stereo
100%	4	In-depth analysis of the imagery and production of a change location summary map 1:500,000 scale ERTS mosaic of the coastal area.
100%	5	Location and delineation of each of the 276 changes (listed on the summary map) on 38 1:24,000 photo quad sheets.
100%	6	Assignment of site numbers to each location.
100%	7	Aerial field observation planning.

Degree of Completion	Task	Description
90%	8	Light aircraft observation field check to provide verification of the nature and extent of each change delineated and the accuracy of location and delineation.
10%	9	Cross referencing of field information (photos, observation narrative) with site information on the photo quad sheets.
10%	10	Tabulation and analysis of findings.
5%	11	Final report and recommendations for this phase of the study.

Each change interpreted[1/] during the comparative analysis (Task 4) was subsequently located and delineated on 1:24,000 photo quad sheets. These sheets are used to provide a larger scale base which greatly facilitates the interpretability of ERTS. After initial orientation, each interpreter was able to accurately and consistently locate and delineate the ERTS interpreted changes on the photo quad sheets.

After completing delineation of the 276 changes (spanning the nine-month period) an aerial field effort was initiated to provide accuracy verification of the overall change detection program. The 28-photo quad sheets were plotted on the Washington and the New York Sectional Aeronautical Charts (1:500,000 scale) for navigational ease in making transition

1/ An example of such a change can be found on Figure 5, detailing the extent of one particularly large change.

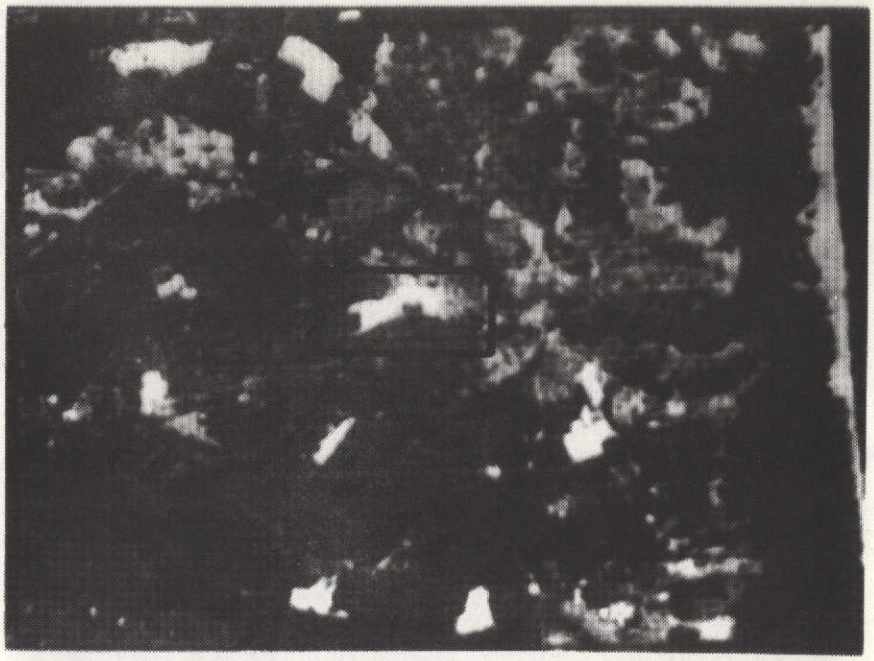


Figure 5a
ERTS Overpass
October 10, 1972

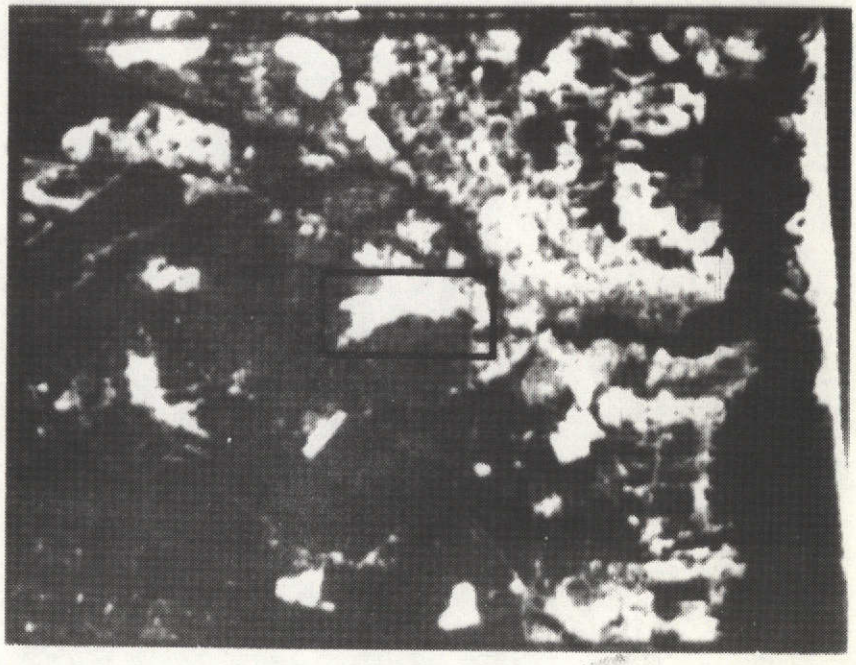


Figure 5b
ERTS Overpass
July 7, 1973

Figure 5a & 5b: Many times ERTS enlargements shown in the two photos above approximates what the interpreter sees through zoom stereoscope. "Flicker Technique" allows easy recognition of development areas as large as this one.

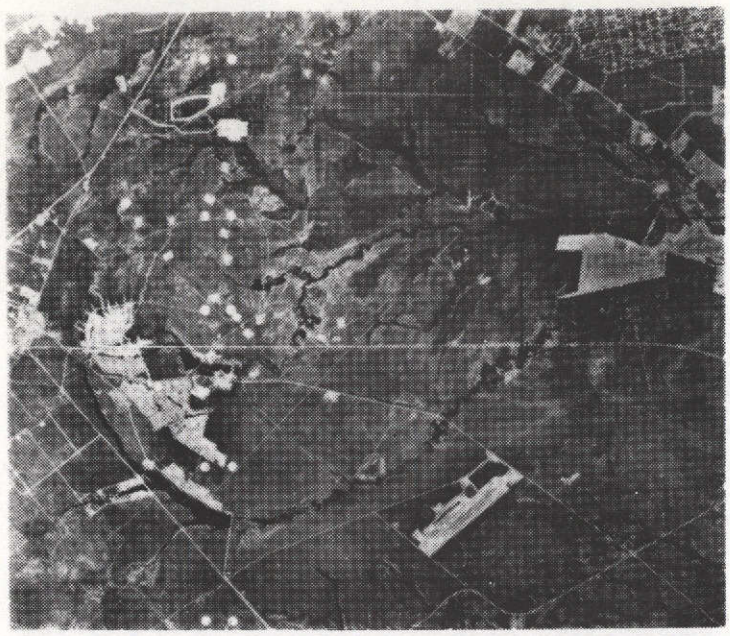


Figure 5c: Photo Quad Sheet #11 - Keswick Grove - Site #121
Dashed line indicates delineation of cleared area
from ERTS interpretation.

Figure 5d: Low altitude aerial oblique view verifies accurate
delineation of the recently cleared area.

from one site to the next and from one photo quad sheet to the next.

Flight planning consisted of plotting an efficient flight path to cover all the sites. Verification of each of the 276 changes along the coast of New Jersey was thus accomplished in 9.5 hours of flight time over a period of three days. At each site the observer narrated his observations as to the type of change found and the accuracy of delineation. An oblique photo was taken at most sites to document the extent of change at that point in time. A 35mm camera and a portable tape recorder increased the efficiency of the airborne field observations. Altitudes varying from 500 feet to 3,000 feet were found convenient depending upon the extent of the area being observed.

Work is presently underway to annotate and cross reference the field photos and observations with the sites delineated on the photo quad sheets. The result will be an organized, easy-to-use document detailing the extent of development existing at each site on the date visited.

A package of final products will include:

(1) ERTS images used in the analysis

(2) 1:500,000 scale change detection summary map

(3) 38 photo quad sheets containing 276 sites delineated as interpreted from ERTS in red ink, as noted in the field in blue ink.

(4) A tabular summary of the numbers of each type of change detected and a percent rating of accuracy of location.

This package will provide verification of the contribution ERTS is making to a Coastal Zone Change Detection Monitoring System.

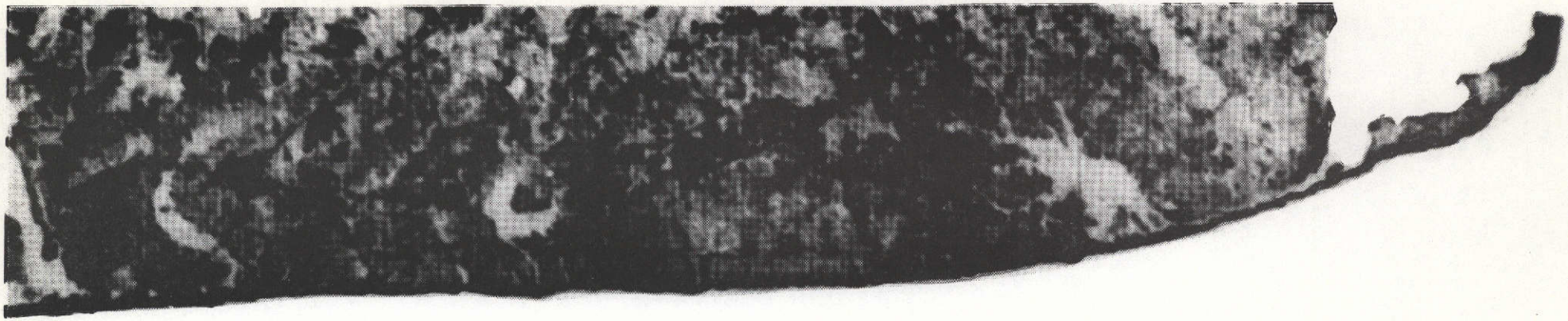
3.4 Shoreline Recession Rates

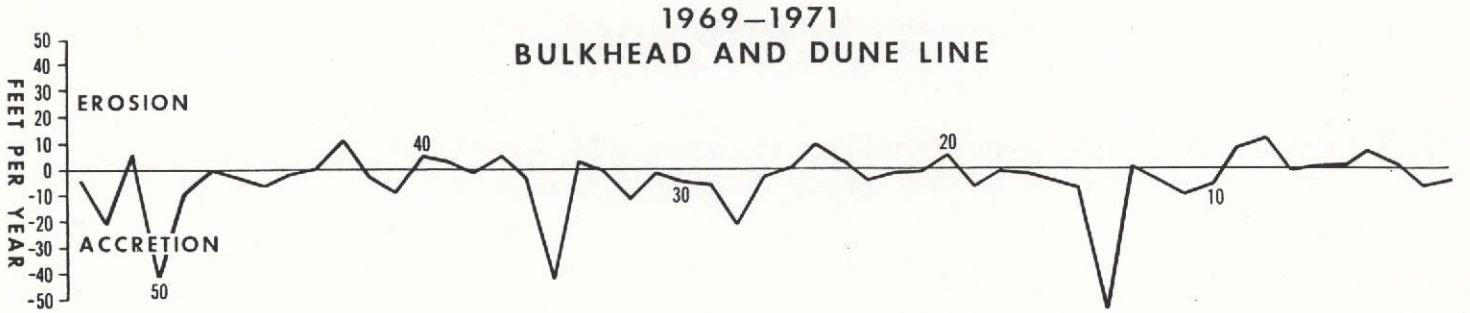
As previously reported, manual and optical analyses of ERTS imagery have not provided information needed by NJDEP in shore protection planning and allocation of funds. The temporal scale for monitoring the dynamic systems causing shoreline changes and the spatial resolutions required to accurately measure a majority of these changes are not generally met by ERTS-1. The ERTS satellite is capable of the repetitive coverage needed to monitor long-term shoreline changes, but better spatial resolution is required for acquiring shore protection data. However, computer enhancement techniques may serve to accentuate subtle littoral current patterns and/or shoreline positional changes. This was not budgeted, and add-on funding may be requested if further preliminary work substantiates the feasibility.

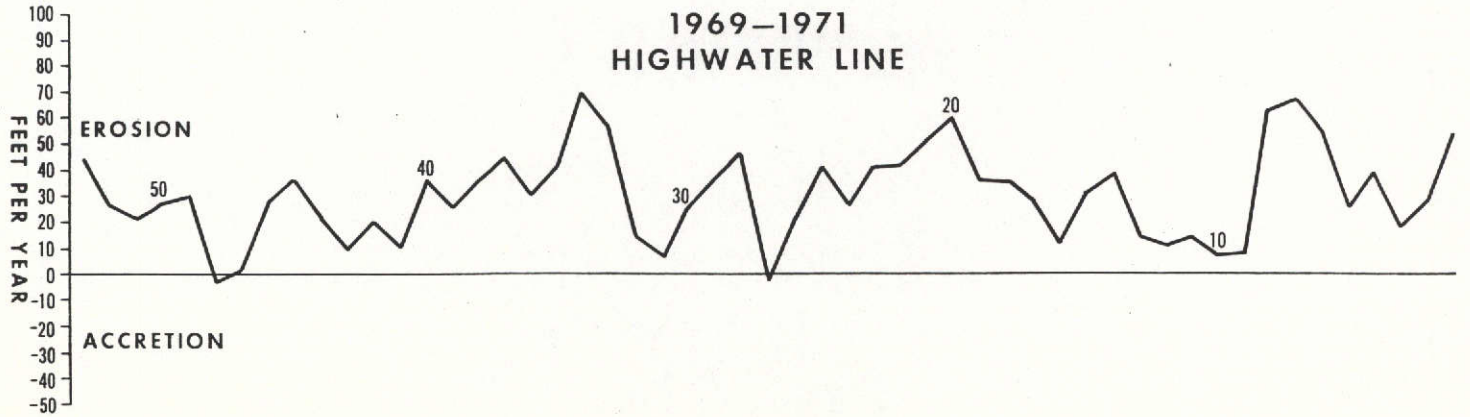
The case study using aerial photography is nearing completion. Rates of erosion and accretion have been calculated from aircraft photography (dating back to 1953) along two distinct types of New Jersey shoreline: a developed and a natural beach. These rates have been presented in graphic form on an ERTS-1 base map at a scale of 1:250,000. The graphs, as plotted on the ERTS-1 base map, provide for a qualitative synoptic evaluation of the

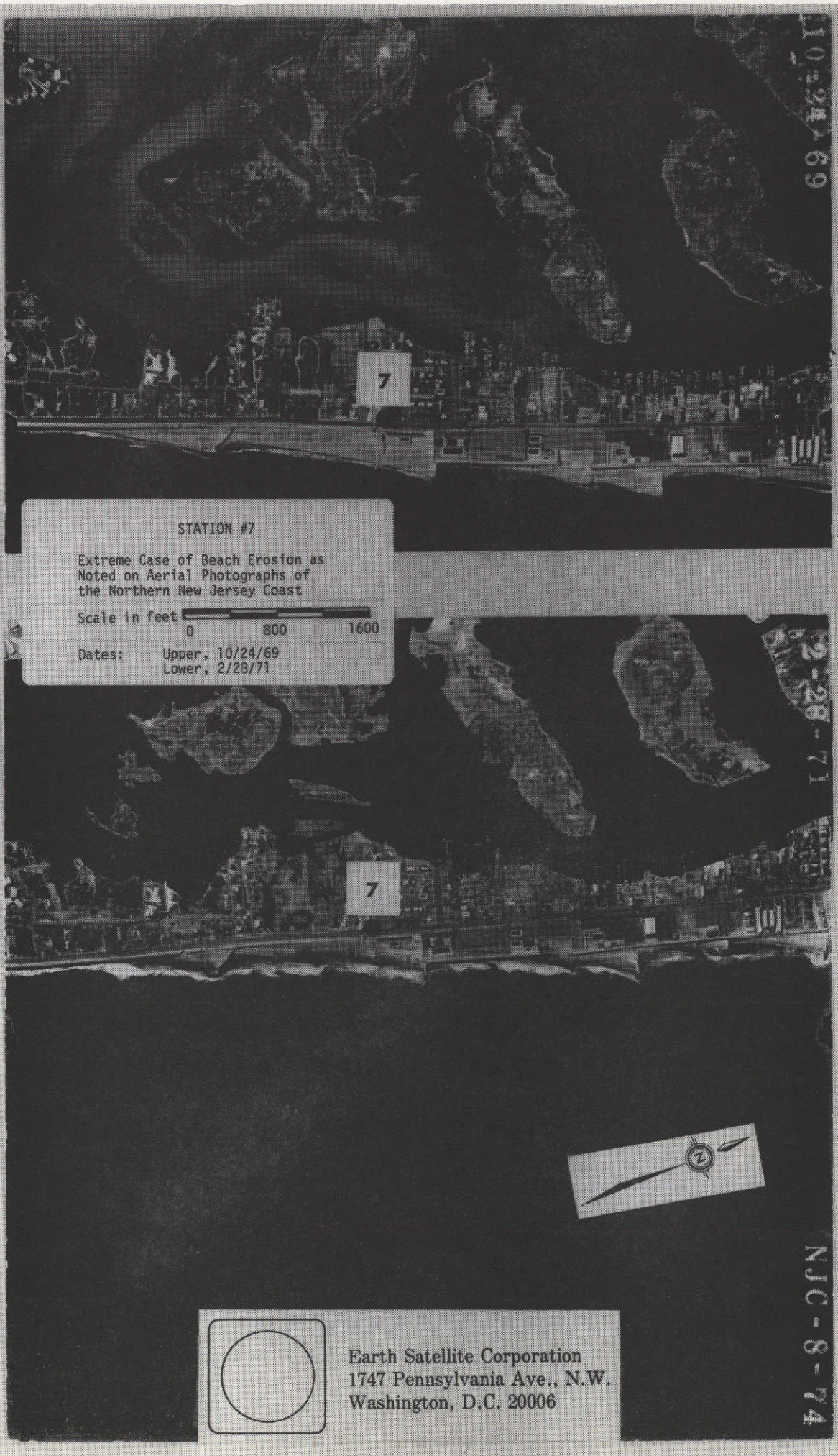
two areas. For quantitative analysis, tables containing the actual amount of beach change and the rates of change have been prepared. As an example: initial evaluation of beach changes at Station 7 from October 24, 1969 to February 28, 1971 are made by examining the graph in Figure 6. The actual positional change of the high water line (HWL) in feet and the rate of change appears in Table 2. The positional change of the HWL for Station 7 has been calculated to be 99.39 feet during the 1.5-year period. This appears to be an extremely large amount of erosion in a 1.5-year period. However, upon examining the aerial photographs (Figure 7) from which the measurements have been made, it is immediately evident that there was severe erosion at Station 7 between October 1969 and February 1971.

This example is an extreme case, but it is not uncommon to find such extremes within the test area. This is evident upon examining the graph in Figure 6. Conclusions drawn from this Shore Erosion case study indicate that in the northern test area (developed beach) erosion has occurred more often, is generally more severe, and the beach is slower to recover than in the southern test area (natural beach). From these data it appears that it may be possible to define areas most likely to




1969–1971
BULKHEAD AND DUNE LINE
FEET PER YEAR
50
40
30
20
10
0
-10
-20
-30
-40
-50
EROSION
ACCRETION
40
50
30
20
10


1969–1971
HIGHWATER LINE
FEET PER YEAR
100
90
80
70
60
50
40
30
20
10
0
-10
-20
-30
-40
-50
EROSION
ACCRETION
50
40
30
20
10



Earth Satellite Corporation
1747 Pennsylvania Ave., N.W.
Washington, D.C. 20006

RATES OF CHANGE IN FEET PER YEAR FOR
THE HIGHWATER LINE
FROM HIGHLANDS BEACH TO MANASQUAN INLET
1969 TO 1971
TIME INTERVAL: 1.50 YEARS
NEGATIVE VALUES INDICATE ACCRETION

Stations	Positional Change In Feet	Rate/Yr.	Stations	Positional Change In Feet	Rate/Yr.
1	80.36	53.57	28	70.08	46.72
2	43.00	28.67	29	53.74	35.82
3	28.00	18.67	30	37.06	24.71
4	57.72	38.48	31	9.48	6.32
5	37.59	25.06	32	21.35	14.23
6	81.94	54.63	33	86.50	57.67
7	99.39	66.26	34	103.82	69.21
8	92.68	61.78	35	61.28	40.85
9	12.79	8.52	36	45.53	30.35
10	11.22	7.48	37	66.95	44.63
11	21.19	14.13	38	52.52	35.02
12	17.54	11.69	39	38.37	25.58
13	21.05	14.03	40	17.84	11.90
14	62.41	41.61	41	14.98	9.98
15	45.11	30.08	42	29.56	19.70
16	16.84	11.23	43	13.59	9.06
17	42.36	28.24	44	31.68	21.12
18	52.79	35.19	45	54.82	36.55
19	53.59	35.72	46	40.48	26.99
20	89.09	59.39	47	0.65	0.44
21	77.04	51.36	48	-5.41	-3.61
22	63.10	42.07	49	45.20	30.13
23	60.83	40.56	50	40.92	27.28
24	38.79	25.86	51	31.12	20.75
25	61.49	41.00	52	39.77	26.51
26	31.14	20.76	53	66.46	44.30
27	-4.89	-3.26			

RATES OF CHANGE IN FEET PER YEAR FOR
THE BULKHEAD OR DUNE LINE
FROM HIGHLANDS BEACH TO MANASQUAN INLET
1969 TO 1971
TIME INTERVAL: 1.50 YEARS
NEGATIVE VALUES INDICATE ACCRETION

Stations	Positional Change In Feet	Rate/Yr.	Stations	Positional Change In Feet	Rate/Yr.
1	-6.54	-4.36	28	-31.94	-21.29
2	-8.91	-5.94	29	-9.46	-6.31
3	3.48	2.32	30	-4.58	-3.05
4	11.35	7.57	31	-3.98	-2.65
5	3.08	2.05	32	-16.00	-10.66
6	3.09	2.06	33	-2.78	-1.85
7	-0.08	-0.05	34	5.44	3.62
8	-13.65	-9.10	35	-63.71	-42.47
9	12.79	8.52	36	-5.75	-3.83
10	-9.14	-6.09	37	7.52	5.01
11	-14.65	-9.77	38	-2.76	-1.84
12	-6.50	-4.33	39	5.69	3.79
13	1.86	1.24	40	4.96	3.31
14	-53.53	-35.69	41	-14.58	-9.72
15	-11.04	-7.36	42	-4.78	-3.19
16	-6.71	-4.47	43	18.20	12.13
17	-3.17	-2.12	44	1.46	0.97
18	-2.39	-1.59	45	-3.05	-2.03
19	-10.26	-6.84	46	-10.11	-6.74
20	7.62	5.08	47	-5.88	-3.92
21	-1.89	-1.26	48	-1.13	-0.75
22	-2.24	-1.49	49	-12.44	-8.29
23	-6.43	-4.29	50	-61.93	-41.28
24	5.09	3.39	51	7.79	5.19
25	13.96	9.31	52	-32.42	-21.61
26	1.38	0.92	53	-6.59	-4.39
27	-4.89	-3.26			

experience further erosion. This is not, strictly speaking, a statistical prediction but rather an assumption that a recognized trend will continue. The assumption of continued erosion in areas that have at one time experienced severe erosion is supported by the relationships between beach width and energy dispersion. As a beach erodes, wave energy is concentrated on a narrower beach surface. The higher wave energy per unit area subsequently results in accelerated erosion. These analyses have direct operational value to NJDEP with respect to geographical allocations of yearly funds for shore protection and may impact management decisions for future priorities as to the philosophy of shore protection. The calculation of these rates is the first step in determining the effectiveness of various shore protection structures in preventing sand removal and encouraging sand accumulation.

Further work is needed in this problem area, and as part of a NASA ERTS add-on proposal NJDEP and EarthSat propose to continue these efforts through both State and Federal sponsorship. The significance of this additional effort goes beyond the New Jersey focus. All states experiencing erosion problems need definitive information for making management decisions involving millions of dollars each year.

The proposed work should yield a computer-generated decision model upon which future allocations of funds for maintenance and construction of shore protection structures can be made. This decision model will take into account the identification of past erosion trends, estimates of future erosional trends, and cost effectiveness of maintenance and construction of shore protection structures. The cost effectiveness evaluation will consider three basic variables and classify them as either high (H) or low (L):

(1) Value of property protected;

(2) Cost of construction or maintenance;

(3) Rate or severity of erosion in the area.

Table 3 illustrates the possible acceptable or unacceptable combination of three variables that would yield a decision.

TABLE 3

Combination of Variables	Unacceptable				Acceptable			
Shore Protection Expenditure	H	H	H	L	H	L	L	L
Recession Rate	H	L	L	H	H	L	L	H
Property Value	L	H	L	H	H	L	H	L

Consider: An unacceptable combination of a HIGH shore protection expenditure in an area with a LOW recession rate and LOW property value. In this case, money is being

wasted because the erosion rate is LOW, and this land is not valuable enough, economically, to justify a large expenditure for protection. Conversely, for an acceptable combination a HIGH but acceptable expenditure is being made in an area of HIGH property value and HIGH rates of erosion.

4.0 BENEFITS

Table 4 has been prepared illustrating the benefits derived by the State of New Jersey through the use of ERTS-1 data. The quantification of benefits to date has been directed toward four candidate areas: waste disposal, coastal land resources, ocean outfalls, and shore protection. A qualitative matrix of ERTS-1 data and its uses for various kinds of problems has been prepared in addition to the quantitative matrix of monetary benefits for each of the candidate problem areas.

Monetary benefits have been estimated for both one-time cost savings and for possible yearly savings. Data are based on cost of efforts, and funds allocated to problem areas by the State.

5.0 PROGRAM FOR NEXT REPORTING PERIOD

5.1 Task Summary

- Continue analysis of all incoming ERTS and aircraft imagery for NJDEP as received by EarthSat.
- Routinely monitor and prepare New York Bight off shore waste disposal overlays illustrating dispersion patterns and directions of movement.
- Continue the attempt to discriminate (by spectral comparisons) and categorize for NJDEP the different waste materials dumped offshore.

TABLE 4: ERTS-1 CAPABILITIES AND BENEFITS FOR NEW JERSEY

	New Information	Cheaper Information	Manpower Savings	Instrument Savings	Management Information	Time Savings	Analysis Savings	Environment Savings			One-Time Benefits	Yearly Benefits	
WASTE DISPOSAL													
(1) Monitoring	X	X	X		X	X	X					50K	
(2) Circulation Analysis	X		X	X	X						200K		Not previously done
(3) Site Recommendations								X				300K	1% recreation increase
COASTAL LAND RESOURCES													
(1) New Legislation		X			X	X	X	X			100K		Land worth $2.5 Billion/yr
(2) Ecozones	X	X	X		X	X	X	X				25K	
(3) Surveillance		X	X	X	X	X	X	X				170K	
OCEAN OUTFALLS													
(1) Placement	X	X	X	X	X	X	X	X			2,500K		
SHORE PROTECTION													
(1) Processes/Analyses		X			X			X				50K	
(2) Funds Allocation	X	X			X		X					25K	With aircraft $1.0 Million/yr

- Continue routine reporting to NJDEP, any changes in areas noted on successive ERTS overpasses within the legally described Coastal Area and more specifically in the wetlands, to further evaluate ERTS as a monitor for change detection and ultimately as an implement to enforcement of the Coastal Zone regulations.

- Establish letter contacts with other coastal states detailing NJDEP program objectives, principal products, and results to date.

- Prepare and finalize sections of the Type III final report.

- Calculate percent recognition rate of land development changes versus anomalous spectral changes to determine accuracy of Coastal Zone Surveillance Program in recording actual changes.

- Perform operational test of Coastal Zone Surveillance using CCT's provided by NASA within 5 days. EarthSat will generate a print for manual analysis and forward changes interpreted to NJDEP to direct field inspection.

- Finalize Shore Erosion case study and prepare recommendations.

6.0 CONCLUSIONS

A principal objective of the ERTS program - user involvement and solution to natural resources problems - is being met in New Jersey. Analysis of ERTS-1 imagery and support aircraft photography, and the development of information products derived from these data are providing coastal management information to the NJDEP for the regulation and protection of the State's coastal resources.

Remote sensing has played and will continue to play an important role in the New Jersey Department of Environmental Protection's programming for the environmentally sound use of the coastal zone. New Jersey's wetlands and coastal zone statutes could not have been implemented without remote sensing. The NJDEP and EarthSat have jointly developed ERTS-1 and aircraft products which have helped New Jersey solve practical problems and have demonstrated to NJDEP personnel potential uses of remote sensing.

ERTS data has proven of value to the State in several areas of immediate concern:

(1) Monitoring dispersion and extent of offshore waste disposal practices;

(2) Detecting changes (primarily development) in the coastal zone;

(3) Monitoring large scale circulation patterns in the nearshore zone; and

(4) In delineating coastal land resources and ecozones.

Experimental objectives as related to shoreline erosional/accretional trends and the monitoring of existing ocean outfalls have not been met through the use of ERTS data alone. However, with complementary aircraft analyses, these objectives have been met.

These combined products have led to increased operational efficiency within the State through their use within various divisions of the NJDEP. Many ERTS-derived products have been evaluated and have been found to provide both repetitive and one-time value. The NJDEP believes ERTS to be of greatest value to the State in the future in terms of: (1) Land Use Developmental Change Detection; (2) Waterfowl Game Management; (3) Offshore Waste Disposal; and (4) Floodplains Mapping.

The investigators note a need for shorter time intervals between repetitive ERTS coverage, at somewhat higher spatial resolutions and greater speed in delivery of ERTS imagery from NASA to make the system of delivery of ERTS analytical products operationally efficient within the NJDEP. The most important requirement to meet operational needs is to receive data within several days after the overpass. Secondly, greater resolution is desirable, and finally, shorter intervals between repetitive coverage; although the latter is not a limiting requirement. Many of the products developed would have a greater impact on management decisions if the ERTS system were improved in the above mentioned manner. Additional funding to accelerate computer-based change detection and data display will be requested and are summarized in the following section.

7.0 RECOMMENDATIONS

After 18 months of analysis of ERTS and complementary data, NJDEP and EarthSat have established a remote sensing system that is quasi-operational and is providing new and needed information for coastal zone management decision-making.

As a result of this coastal resource analysis program, additional requirements and resource problems have been identified that were not incorporated into the investigation as originally proposed and funded. New types of coastal resource information products (mainly computer generated), which will illustrate the value of ERTS data to other coastal states, could be prepared and promptly integrated into NJDEP's coastal management program. New Jersey (like other coastal states) has an operational need for information concerning the dynamics of cultural and natural changes in the usable format. It is, therefore, recommended that the investigation be expanded to incorporate further analyses in the following areas to generate products relating to the following problem areas. An ERTS-1 add-on proposal will detail each experimental objective:

(1) Coastal Zone Land-Use Change Detection (computer analysis)

(2) Ocean Outfall Dispersion (computer analysis)

(3) Shoreline Positional Changes (computer and manual analysis)

(4) Forage Crop Estimates for Waterfowl Game Management (computer and manual analysis)

(5) Floodplains Mapping

(6) Offshore Waste Disposal

(7) Discrimination of Red-Tide Blooms

(8) Continue Interaction Between State Users and EarthSat Remote Sensing/Natural Resource Analyst

APPENDIX A

TASK STATUS REPORT

Contract NAS5-21765

▨ = Completed Tasks

TASK	HEADING	STATUS	COMMENTS
		PHASE I	
3.1.1	Determine existence of Pre-ERTS imagery for analysis	Completed 10/1/72	Visits were made to NASA MSC (Earth Resources Aircraft Data Bank) at Houston, Texas. A catalog of aircraft imagery has been prepared and delivered to NJDEP for use by state offices.
3.1.2	Assemble ERTS Data Analysis Equipment at NJDEP	Completed 2/1/73	The NJDEP ERTS data analysis facility at the Trenton, New Jersey Headquarters is operational. Basic image analysis equipments are available for ERTS investigators.
3.1.3	Analyze Pre-ERTS imagery set as a demonstration of technique	Completed 10/1/72	ERTS-1, Apollo, and aircraft imagery and their analysis were used to brief NJDEP officials. A manual for reference by state representatives was prepared and distributed.
3.1.4	Organize and conduct preliminary briefing with NJDEP	Completed 10/5/72	Briefing was held at NJDEP to demonstrate remote sensing techniques and possible products to be developed from ERTS. A manual for reference by state representatives was prepared and distributed.
3.1.5	Select candidate test sites	Completed 11/5/72	The Northern New Jersey Shore will be the primary test site with secondary test sites to be studied as NJDEP interest, or environmental problems arise.
3.1.6	Collect and organize existing ground truth data	Completed 12/1/72	A bibliography has been prepared. Collection of pertinent ground truth will continue throughout experiment. These data will be delivered to NJDEP.

APPENDIX A

TASK STATUS REPORT

Contract NAS5-21765

▨ = Completed Tasks

TASK	HEADING	STATUS	COMMENTS
		PHASE I	
3.1.7	Perform reconnaissance of test area	Completed 2/15/73	EarthSat field-checked the northern New Jersey test site in February, 1973. In addition, a reconnaissance of the entire test area was made subsequent to studies conducted at the northern New Jersey test site. EarthSat suggests a modification to this task. In the future, a phone call will be made directly to the DEP advising them of EarthSat's intention to conduct field checking. This will be followed by a brief written communication to document the timing and content of the field exercise.
3.1.8	Develop final interview plan and conduct interviews	Completed 12/10/72	Interviews with key personnel in early December have led to initial plans for information products. Subsequent briefings after initial products are prepared will be needed. EarthSat will work closely with NJDEP in using the products.
3.1.9	Prepare ground truth collection plan	Completed 3/1/73	A multi-agency cooperative ground truth effort was planned for the period April 6-13, 1973.
3.1.10	Instrument test sites	Completed 4/7/73	Instrumentation (current meters, transmissometer, spectraradiometers, temperature recorders, PRT-5, tide gauge, etc.) was initiated in late March 1973 and was completed for the Northern Test area on April 7, 1973.
3.1.11	Prepare aerial survey plan	Completed 4/7/73	Five aircraft collected supplementary data over test site during ground survey effort on April 7, 1973; the NASA JSC C-130, NASA

APPENDIX A

TASK STATUS REPORT

Contract NAS5-21765

▨ = Completed Tasks

TASK	HEADING	STATUS	COMMENTS
		PHASE I	
▨			Wallops C-54, University of Michigan C-47, and two helicopters.
▨ 3.1.12	Collect ground truth data	Completed 4/7/73	Preliminary field sampling was accomplished during reconnaissance survey and extensive sampling was completed during the April 7, 1973 effort.
▨ 3.1.13	NJDEP shall assemble equipments specified in 3.1.9 at (Toms River Facility)	Completed 4/7/73	NJDEP personnel and equipments were made available and used during April 7, 1973 ground survey effort. Personnel and equipments were coordinated from Monmouth Beach Marine Police Station.
▨ 3.1.14	Prepare line base maps for test area using simulated ERTS imagery	Completed 5/1/73	The production of line maps as designated in contract are unnecessary because all of the specified information is available on the USGS 7-1/2 minute quadrangle sheets and NOS and Naval Oceanographic Office nautical charts.
▨ 3.1.15	Use simulated ERTS imagery for candidate base maps	Completed 6/30/73	A folio of candidate ERTS-1 products has been assembled. The folio includes analytical maps for shore protection planning, ocean outfal placement, and effects of barge-dumped waste disposal. NOTE: ERTS imagery was available and there was no need to simulate it.
▨ 3.1.16	Develop and conduct Preliminary Cost-Benefits Analysis	Completed 6/15/73	The method's package for assessing and documenting benefits has been established. Two alternative methods for quantifying benefits were discussed with NJDEP (histori-

APPENDIX A

TASK STATUS REPORT

Contract NAS5-21765

▨ = Completed Tasks

TASK	HEADING	STATUS	COMMENTS
PHASE I			
▨			cal and future savings) and a decision to proceed on projection of future savings has been accepted. The quantification of benefits will be directed to four candidate areas: shore protection, ocean outfalls, navigation channels, and waste disposal.
▨ 3.1.17	Brief NJDEP on use of candidate information products	Completed 7/13/73	Following the approval of the Principal Investigator, DEP personnel were briefed on the utilization of ERTS information products as well as methods for assessing benefits. This briefing took place during the week of July 9-13, 1973. It is anticipated that a close interaction between EarthSat and DEP personnel will occur throughout the remainder of the program so as to facilitate full product utilization to various Department offices.
3.1.18	Establish letter contacts with other States	Pending	A draft letter has been prepared detailing the benefits derived by the State from the use of ERTS-1 and complementary aircraft data for problems related to the management, protection, & regulation of the coastal zone. This letter will be finalized and sent to all coastal states during the next reporting period.
▨ 3.1.19	Prepare plan for analysis of ERTS imagery	Completed 12/1/72	Due to compression of Phase I, initial analysis plan for ERTS Imagery was established during initial briefings with NJDEP.

APPENDIX A

TASK STATUS REPORT

Contract NAS5-21765

▨ = Completed Tasks

TASK	HEADING	STATUS	COMMENTS
		PHASE II	
3.2.1	First-look analysis of first imagery	Completed 9/29/72	First-look analysis documented in first NASA progress report.
3.2.2	Analyze all ERTS imagery during Phase II	Completed 4/30/73	EarthSat has analyzed all ERTS-1 imagery as received and is in the process of developing information products. Tasks 3.1.15 and 3.2.2 are essentially the same because of the early receipt of ERTS-1 imagery. As a matter of routine, all scientific observations related to coastal processes made during ERTS-1 imagery analysis are documented on EarthSat forms which constitute permanent project records (Appendix A).
3.2.3	Analyze all ERTS imagery during Phase II by spectral band	Completed 4/30/73	All ERTS imagery is routinely analyzed by spectral band. These analyses have been referenced in previous progress reports and are part of a continuing program of image analysis. The usefulness of each spectral band (for seasons to date) has been determined and will be summarized in the First-Look Data Analysis Report. Judgements as to the usefulness of each spectral band were documented for NJDEP in October, 1972 at the initial briefing session.
3.2.4	Map coastal land-forms and outline the wetlands	Completed 3/1/73	Maps showing the outline of New Jersey wetlands as well as principal coastal ecozones (as judged from ERTS imagery) have been prepared and were delivered to NJDEP in July, 1973.

APPENDIX A

TASK STATUS REPORT

Contract NAS5-21765

▨ = Completed Tasks

TASK	HEADING	STATUS	COMMENTS
		PHASE II	
3.2.5	Use optical analysis equipment, and enhancement techniques in analysis of ERTS imagery	Completed 10/31/73	This is a continuing Task and will be underway throughout the experiment. Equipment includes, I^{2}S Digicol, I^{2}S Addcol, Bausch & Lomb ZTS, MacBeth Densitometer, etc.
3.2.6	Review and finalize information distribution with NJDEP	Completed 7/9/73	A flow diagram has been prepared and delivered to NJDEP as a convenient visual reference to describe the ERTS information products distribution system. The relationship of each product to study objectives and a schedule for distribution of information products within the Department is presented. It is anticipated that the distribution system will be continually updated as new Department needs and products evolve.
3.2.7	Distribution of information products within NJDEP according to approved schedule.	Completed 7/13/73	Information products shall be distributed through the Principal Investigator, who will ensure that the necessary responses from Department personnel are obtained. EarthSat shall keep the Department informed of any difficulties in acquiring supporting data and of the results of product evaluation by NJDEP personnel. As specified in Task 3.1.8, close interaction between Department and EarthSat personnel is anticipated as a continuing function for the duration of the experiment.
3.2.8	Prepare preliminary data analysis report at completion of Phase II	Completed 4/20/73	EarthSat has prepared a preliminary data analysis report which details analytical results through May 15, 1973 summarizes the utility of each ERTS band for coastal

APPENDIX A

TASK STATUS REPORT

Contract NAS5-21765

▨ = Completed Tasks

TASK	HEADING	STATUS	COMMENTS
		PHASE II	
▨			studies, and includes copies of specific experimental analyses which have been conducted. Some results have already been reported in a paper presented at the NASA Goddard Symposium on Significant ERTS-1 Results.
▨ 3.2.9	Prepare a revised data analysis plan for Phase III	Completed 5/1/73	The revised Data Analysis Plan has been submitted.
▨ 3.2.10	Preliminary data analysis report and revised data analysis plan sent to NASA	Completed 6/1/73	
▨ 3.2.11	Finalize format and content of information products package for Phase III	Completed 7/13/73	Most of ERTS information products developed as a result of Department needs, respond to a one-time-only need and/or an immediate response, e.g., oil spills or pollution of coastal waterways and beaches, etc. Routine (repetitive) deliverables will include dredge spoil disposal and coastal surveillance maps prepared for NJDEP field inspectors. It is unlikely that rapid changes will occur in all of the information products delivered to NJDEP as was originally anticipated. The scale, format, or content of repetitively utilized products is subject to change.

APPENDIX A

TASK STATUS REPORT

Contract NAS5-21765

 = Completed Tasks

TASK	HEADING	STATUS	COMMENTS
		PHASE III	
3.3.2	Modify data analysis procedures	Underway	This could be a continuing task throughout the experiment as new areas of analysis are uncovered and delivery schedules are modified.
3.3.3	Distribute final information products on a routine basis	Underway	All ERTS data, collateral aircraft data, and ground truth data received during the investigation will be analyzed to the extent necessary to prepare practical information products. Additional field observations will be required in the conduct of this task.
3.3.4	Work closely with NJDEP to best apply and distribute information products and document benefits derived thereof	Underway	The requirements of this task are basic to the investigation and are being met by EarthSat as the program proceeds. New activities and analyses (with unexpected benefits) are being addressed as funds permit.
4.3	Prepare final report	Underway	Sections of the final report are being written as the experiment progresses.
4.4	Prepare a program for continuing ERTS applications within New Jersey	Underway	Three new areas of interest have been identified for development into quasi-operational status; further outfall analysis, automated change detection, and waterfowl forage crop prediction. This brochure will accompany the
4.5	Prepare coastal states briefing package	Underway	A brochure for coastal states is presently being prepared detailing the work performed under this investigation. This brochure will accompany the letter prepared under Section 3.1.18.