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COASTAL ZONE
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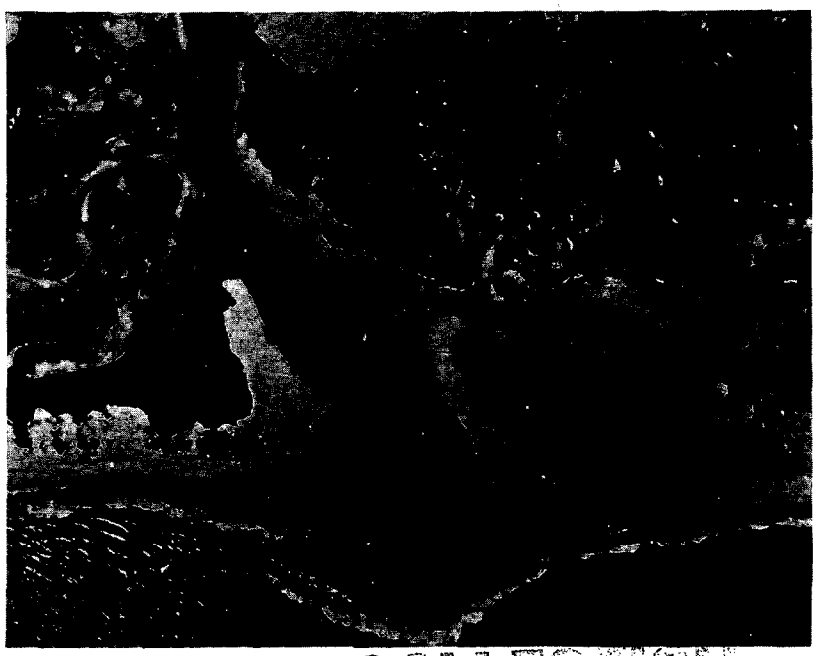
INLET HAZARD AREAS



CZIC COLLECTION

THE FINAL REPORT AND RECOMMENDATIONS

TO

THE COASTAL RESOURCES COMMISSION

BY

Loie J. Priddy and Rick Carraway

Technical Services Section

Division of Marine Fisheries

North Carolina Department of Natural Resources and Community Development

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BY
THE NORTH CAROLINA DIVISION OF MARINE FISHERIES
TECHNICAL SERVICES SECTION

TO

THE COASTAL RESOURCES COMMISSION
OF THE
THE NORTH CAROLINA DEPARTMENT OF NATURAL RESOURCES
AND
COMMUNITY DEVELOPMENT

North Carolina Department of Natural Resources & Community Development
James B. Hunt, Jr., Governor — Howard N. Lee, Secretary

Loie J. Priddy
Rick Carraway

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September 1978

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OBJECTIVES

The prime objective of the agreement between the Division of Marine Fisheries and the Coastal Resources Commission was as follows:

"The Division will develop and apply a Commission approved method for the identification and delineation of hazard areas adjacent to existing inlets for use by the Commission in designating Inlet Lands AEC's in the vicinity of inlets."

This prime objective was broken down in the agreement into two requirements:

A "one hundred percent of the inlets will be completed during the current contract period."

COMMENTS ..... North Carolina's twenty-three classic inlets may be categorized as exempt and non-exempt. Exempt inlets include those inlets bounded by federal lands. (See North Carolina Coastal Plan, Appendix "E"). These inlets include Oregon, Hatteras, Ocracoke, New Drum, the west side of Bear, Browns, and the east side of New River. Beaufort, Masonboro, and the north side of Oregon are specifically exempted as "stabilized" inlets in State Guidelines for Areas of Environmental Concern, Technical Appendix 3, Section .0900, Paragraph .0901.

The eastern shoreline of Little River Inlet, although classed as a non-exempt inlet, has migrated over one-thousand feet into South Carolina in recent years and should not be presently considered as a North Carolina inlet. Details of its territory and trends are included, however, since it may still be an influence.

Although the lands around Bardens Inlet are presently under condemnation for inclusion in the Cape Lookout National Seashore, they are still not technically federal lands, so it is considered non-exempt for this report.

All twenty-three of North Carolina's inlets, including so-called "exempt" and "stabilized" inlets, have been completed at this time.

B "The Division shall draft on photo-base mylars supplied by the OCM a line representing the extent of AEC boundaries on all inlets, using the approved procedure."

COMMENTS..... The extent of the recommended inlet hazard area boundary has been drafted for all inlets on the photo-base blueprints (not mylars) supplied for that purpose. It is recommended that plotting on the expensive photo-base mylars be done after the hazard area recommendations are accepted by the Commission.

USEFUL DEFINITIONS

LINEAR REGRESSION The mathematical technique of determining the most likely relationship between an independent and a dependent variable, assuming the variables to be related as first-degree polynomials of the form:

$$Y = nX + C$$

QUADRATIC REGRESSION The mathematical technique of determining the most likely relationship between an independent and a dependent variable, assuming the variables to be related as second-degree polynomials of the form:

$$Y = mX^2 + nX + C$$

It is important to remember that, regardless of true data tendencies, a linear regression will always yield a straight line relationship between variables, and a quadratic regression will always yield a parabolic relationship between variables. For example, if a stone is thrown into the air, physical laws cause its path to form a parabola. If measurements were made of the path of the stone, and this data was regressed linearly, a true but inaccurate linear regression would be the result. The type of regression selected is of ultimate importance to the accuracy of the results.

CUBIC, QUARTIC, ETC. Third and fourth degree polynomials of the forms:

$$Y = kX^3 + mX^2 + nX + C$$

$$Y = jX^4 + kX^3 + mX^2 + nX + C \ldots \ldots \text{etc.}$$

TRANSCENDENTAL, CYCLIC Equations containing an infinite number of algebraic operations ($Y = \log X$, $Y = e^x$, etc.) . Some transcendentals may repeat over and over and are thus cyclic ($Y = \sin X$, $Y = \cos X$, etc.).

CONFIDENCE INTERVAL The limits of a dependent variable between which a given percentage of values will probably occur for a given independent variable. In this report, a 99% probability within a 10 year projection is used. In other words, there should be only 1 chance out of 100 that any one segment of shoreline will exceed the designated hazard area at any time within the next 10 years.

X FIELD The range of values of X (independent variable) used in a regression.

PROCEDURES

Photography sources

All commercially available photography which met scale and coverage requirements and was readily obtainable was identified and catalogued by DMF , then purchased by CRC. In addition to this photography purchased by CRC, various non-commercial photographs taken or held by DMF, as well as some photographs held by private individuals, were used to generate a stronger data base. Sources included the National Ocean Survey, the U. S. Dept. of Agriculture, the U. S. Geological Survey, the National Archives, the N. C. Department of Transportation, the N. C. Division of Marine Fisheries, and others.

Scaling

A geographically stationary control system was established for each inlet or inlet complex so that an accurate scale for each photograph of the inlet could be established. Control systems for four inlets were carefully established using published photo-identifiable geodetic control stations. The absolute scales thus obtained were independently compared to the 1977 DOT photo-base blueprints. The results were so consistently accurate on these four inlets that the 1977 DOT scaled (1"= 400') photography has been accepted as the base control, and other photo-series are being scaled from it with only random checking. Frequently photographs from the ASCS approached the accuracy of the DOT photography.

Gridding

Using the previously determined scale in conjuction with identifiable photo-points, a geographically stationary grid system in the vicinity of each inlet or inlet complex was established. This grid system was oriented parallel to the predominant ocean shoreline to facilitate the detection of any lateral movement of the inlet's shoreline. A grid spacing of 300 feet was selected as providing adequate resolution of an inlet's gyrations.

Measurements

To prevent confusion, inlet shorelines were referred to as "left" and "right", as seen when facing the inlet from the ocean, rather than as "north shoreline", "southwest shoreline", etc. Measurements were made to the hundredth of an inch from a stationary zero point on the grid system to the estimated high water mark. Then, using the previously calculated scales, the measurements were converted to feet and tabulated for each grid on the photograph. Station 000 (zero) of the grid system is always on the right side of the inlet and measurements increase to the left. This technique simplifies the time series graphing of both sides of the inlet simultaneously.

Statistics

The left and right sides of each inlet were treated separately and individual inlet grids were regressed both linearly and quadratically to determine the best fit trends of the inlet. On accepted curve fits, the landwardmost 99% confidence interval projected to occur between 1978 and 1988 on a given grid was made to represent the limit of the inlet hazard area on that grid. A few inlets displayed apparent higher degree or complex transcendental movement, so some fits were rejected on these inlets for other methods. Due to the narrow forty year X-field of the data, some quadratic fits on shorelines showing wide short-term excursions had to be rejected as meaningless. Multiple throats, channel stabilization projects, and shoreline stabilization projects frequently interfere with the regression process, and some fits were rejected because of the existence of one or more of these.

Other methods

When inlets or grids did not conform to attempted regression methods, strong emphasis was placed on previous inlet territory, as determined by relict inlet ridge locations. The methods used are described by John J. Fisher in his two papers, Geomorphic Expression of Former Inlets Along the Outer Banks of North Carolina, 1962, and Development Patterns of Relict Beach Ridges, Outer Banks Barrier Chain, North Carolina, 1967. Documented historic locations, and structurally weak areas near the inlet were also considered in determination of the limits of the hazard areas.

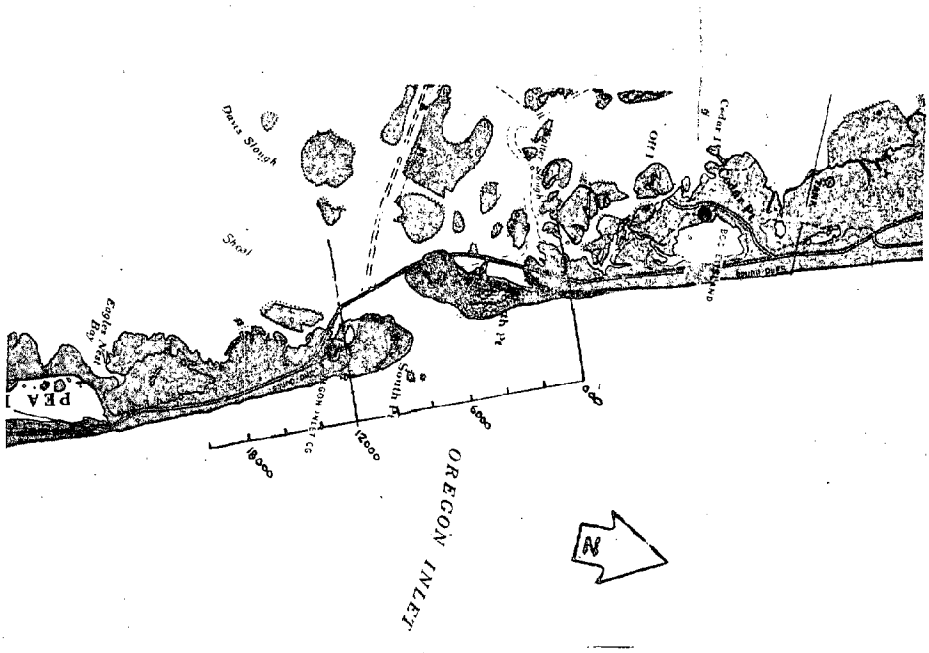
Final plotting

Points established according to the methods described above were then connected from grid to grid on the photo-base blueprints, thus generating the final Inlet Hazard Zone. It is recommended that in no instance should the final Inlet Hazard Area be less than an extension of the adjacent Ocean Hazard Area. Since the Ocean Hazard Area was not delineated on the photo-base blueprints supplied, DMF did not determine instances where this situation actually occurs; however, the Inlet Hazard Zones shown on the blueprints should be reviewed and modified, if necessary, to indicate the approved Inlet Hazard Area.

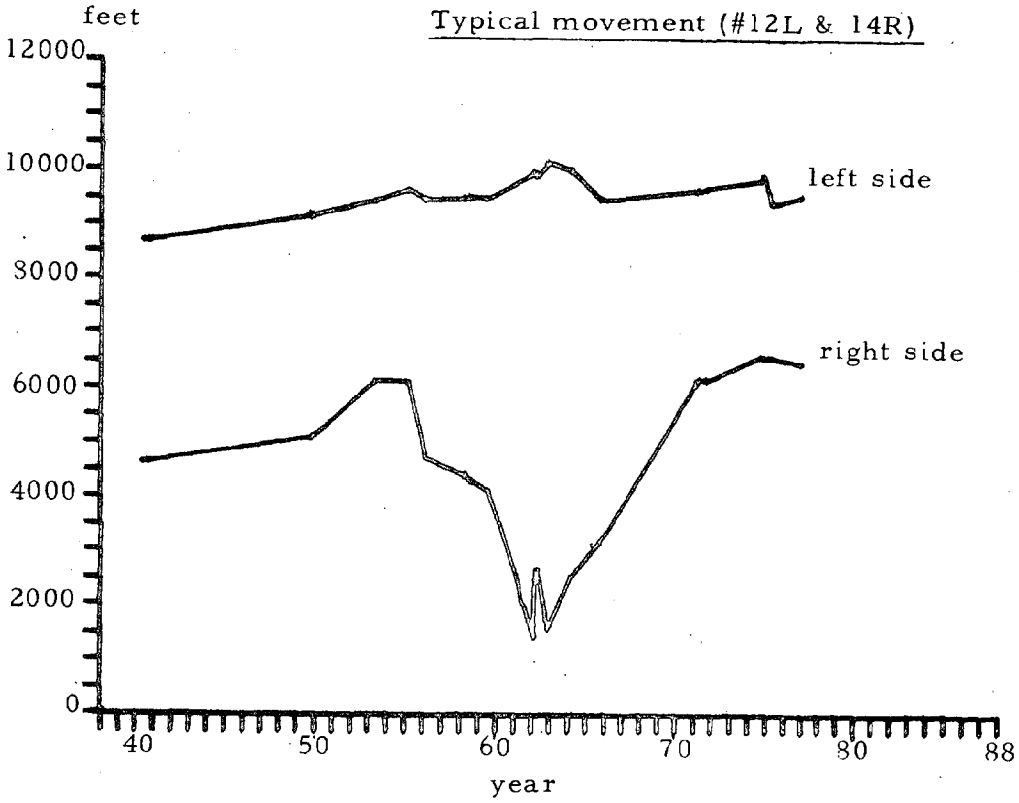
Final Comments Concerning the Statistical Analysis of Inlet Movement

Time and lack of a sophisticated computer limited the complexity of calculations so, for this report, only basic linear and quadratic regressions were examined. But, this severely limits a total regression analysis because any inlet is the product of many complex factors and is not necessarily polynomial in form. If the statistical process is to be fully utilized in the future, inlet movement should also be examined for higher order polynomials, cyclic or trancendental patterns, and methods of time-series forecasting applied. Even so, common sense and good judgement remain as important tools in establishing Inlet Hazard Areas.

RESULTS AND RECOMMENDATIONS



OREGON INLET



INLET HAZARD AREA RECOMMENDATIONS

OREGON INLET

Photographs used; 20 Typical grid is # 12, 13, 14

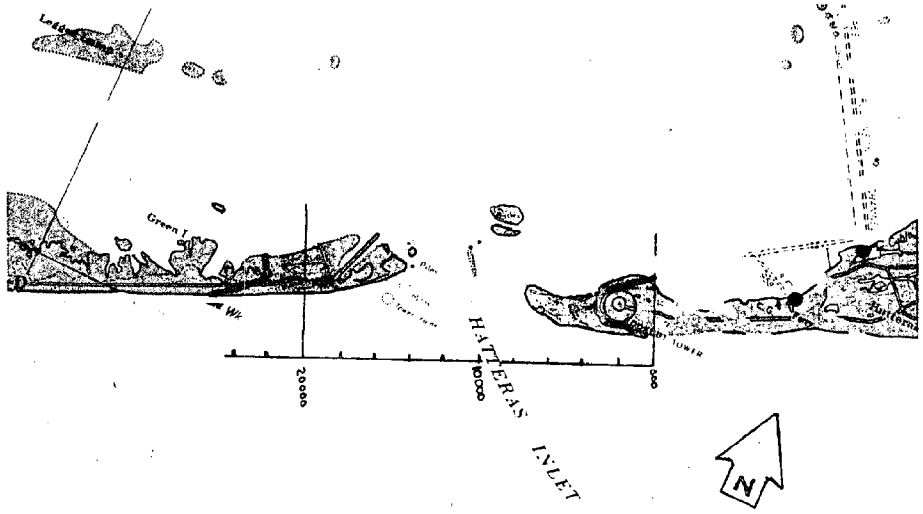
NOTES:

Channel maintained regularly. This has a stabilizing effect on both shorelines though neither shoreline has major groin or jetty stabilization. Maintenance must be continued to protect Oregon Inlet Bridge. Inlet opened during storm in 1846 and has a history of continuous southward migration since then. Photo data suggests that, except for a wide excursion of the right shoreline between 1955 and 1971, the inlet as a whole has been quadratic in nature since 1940 (6500/1940;7700/1960;8000/1977). The relatively slow southward drift since 1960 probably reflects the increased channel stabilization following the construction of the bridge in 1962.

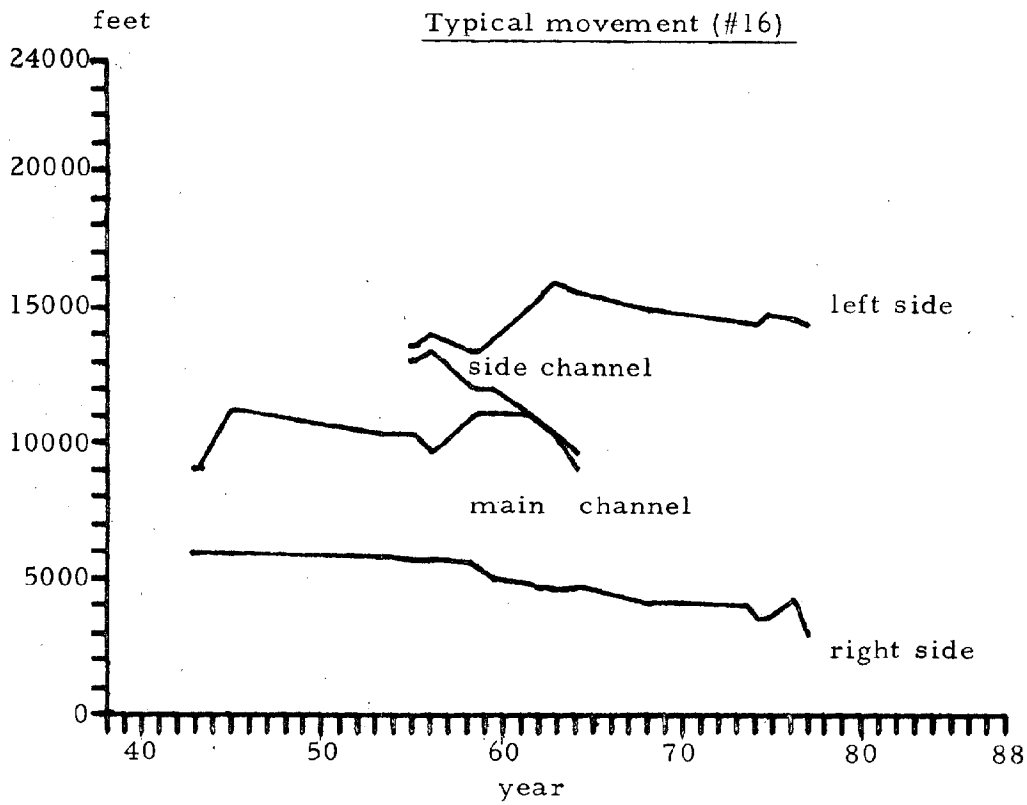
LEFT SIDE	RIGHT SIDE
Undeveloped, low development potential.	Undeveloped, low development potential.
Federal land, Cape Hatteras National Seashore.	Federal land, Cape Hatteras National Seashore.
Regresses quadratically, little movement since 1962.	Wide excursion (6000-1000-6000) between 1955 and 1971 negates normally used regression methods.
Channel stabilization interference.	Channel stabilization interference.
Recommend extension of ocean hazard line.	Recommend extension of ocean hazard line.

NOTE: NORTH SIDE OF INLET CONSIDERED STABILIZED. EXCLUDED FROM REQUIREMENTS. (N. C. COASTAL PLAN; Nov., 1977).

NOTE: ENTIRE INLET FEDERAL LANDS. SPECIFICALLY EXCLUDED FROM REQUIREMENTS. (N. C. COASTAL PLAN; APPENDIX E; Nov., 1977).



HATTERAS INLET



INLET HAZARD AREA RECOMMENDATIONS

HATTERAS INLET

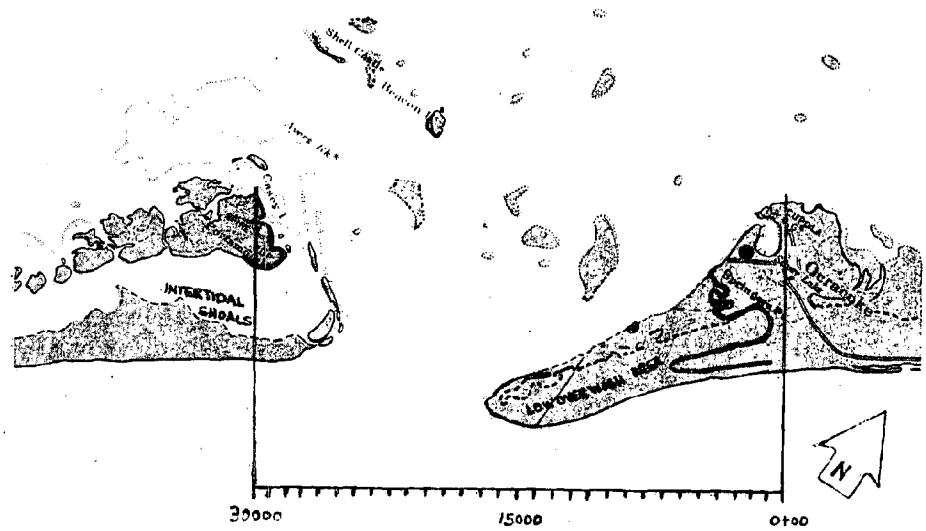
Photographs used: 23 Typical grid is #16(L);13(R)

NOTES:

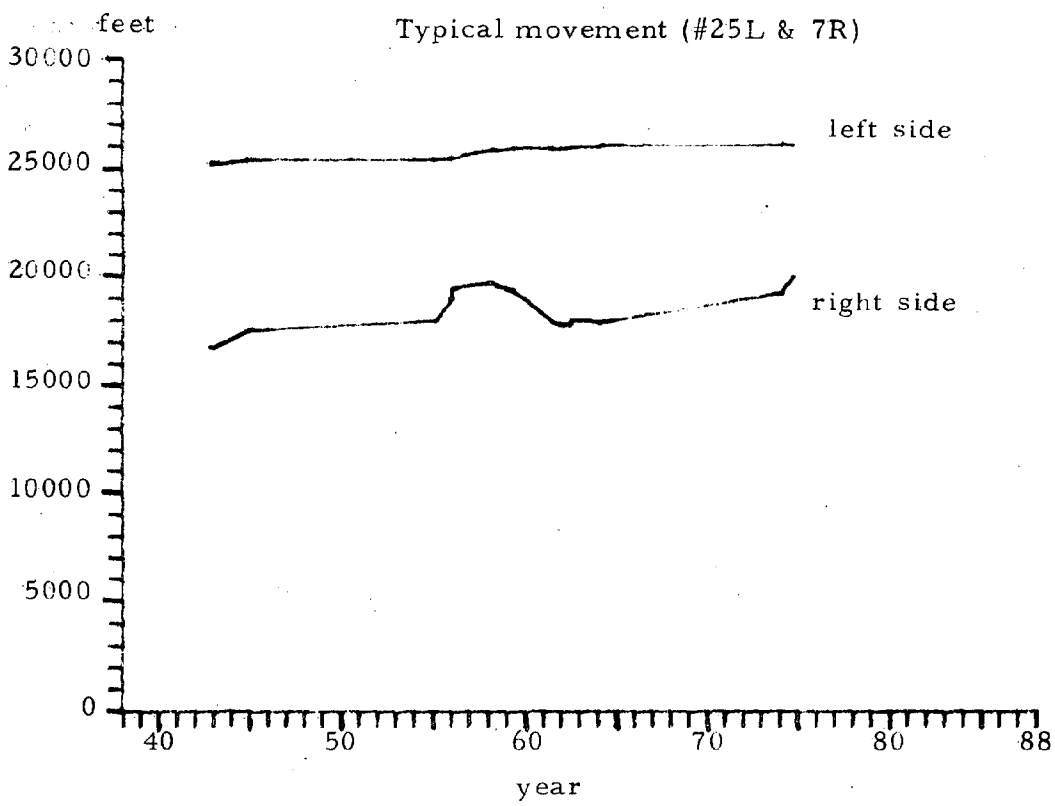
Naturally navigable; inside channels dredged. No shoreline stabilization. Inlet opened by a storm in 1846. Ridge data indicates a wide territory (3000 - 21500). Photographic data since 1943 reveals a westward drift of about 3700 feet. Secondary channel broke through **left** of main channel around 1955, twin channels existed until around 1962 when the two channels merged. In addition, several less significant channels have existed at various times since 1943.

LEFT SIDE	RIGHT SIDE
Undeveloped, low development potential.	Undeveloped, low development potential.
Federal lands, Cape Hatteras National Seashore.	Federal lands, Cape Hatteras National Seashore.
Multiple channels make regression questionable.	Regression data does not provide adequate protection considering overwash action in the area.
Regression data does not provide adequate protection considering overwash action in the area.	Recommended line as shown on map.
Recommended line as shown on map.	

NOTE: ENTIRE INLET FEDERAL LANDS. SPECIFICALLY EXCLUDED FROM REQUIREMENTS. (N. C. COASTAL PLAN ; APPENDIX E ; Nov., 1977).



OCRACOKE INLET



INLET HAZARD AREA RECOMMENDATIONS

OCRACOKE INLET

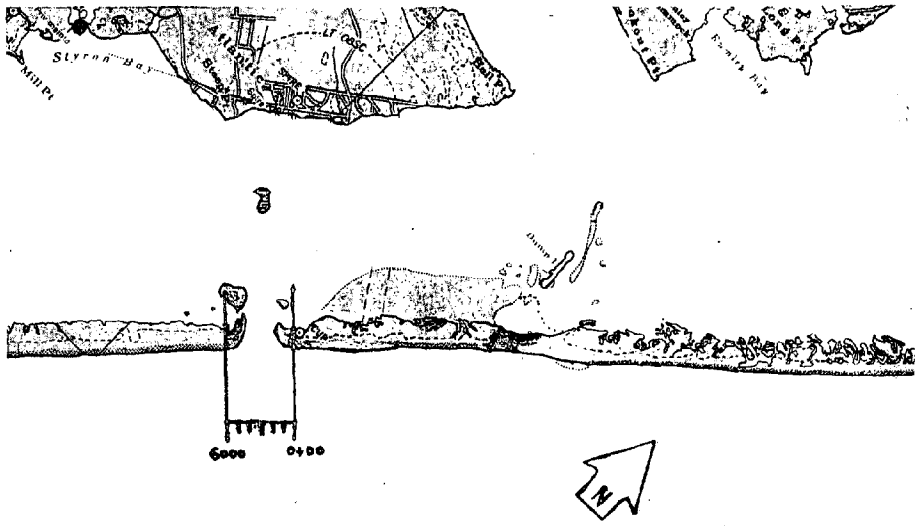
Photographs used: 17 Typical grid is #25(L);7(R)

NOTES:

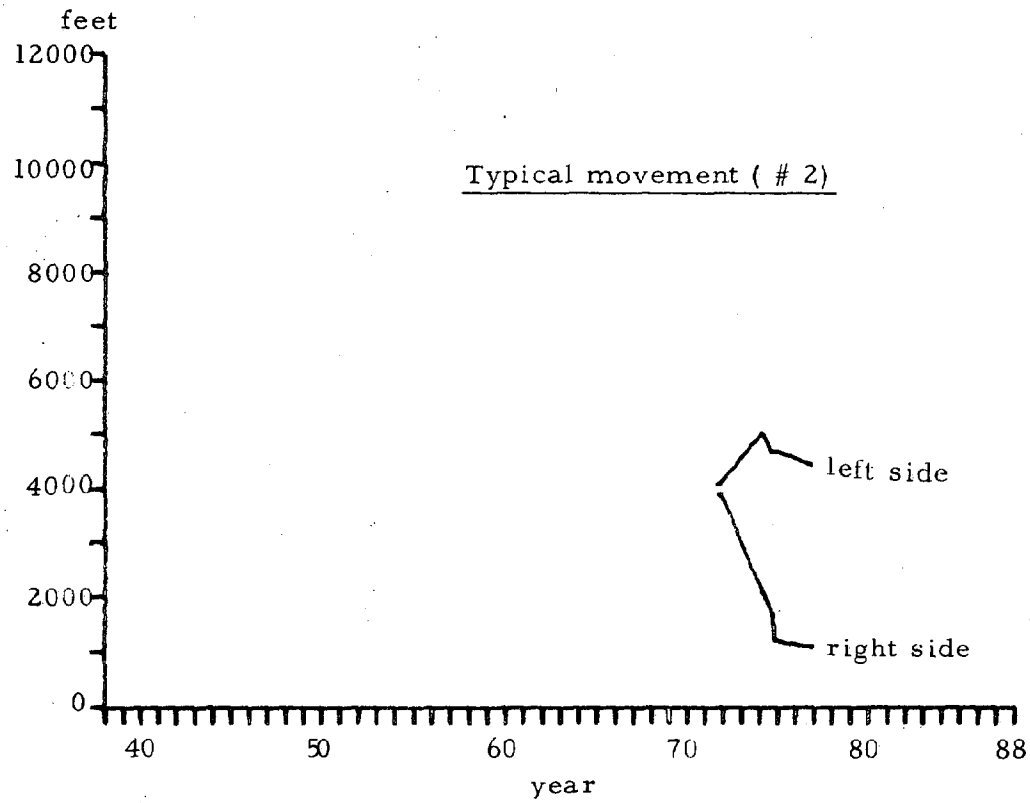
Naturally navigable prehistoric inlet. No shoreline stabilization but very stable with little tendency to migrate. Ridge data indicates a slow movement to the southwest. Photographic data since 1943 reveals that the right side has drifted southwest about 3000 feet. The left side has moved 1000 feet or less and the intertidal shoal on the left side seems to absorb most of this activity so that the shoreline further inside near Portsmouth village is almost stationary.

LEFT SIDE	RIGHT SIDE
Undeveloped, low development potential	Undeveloped, low development potential.
Federal lands, Cape Lookout National Seashore	Federal lands, Cape Hatteras National Seashore.
Fits linear regression extremely well	Good linear fit.
Recommend extension of Ocean Hazard Area.	Low overwash area to about 8000.
	Recommend extension of Ocean Hazard Area.

NOTE: ENTIRE INLET FEDERAL LANDS. SPECIFICALLY EXCLUDED FROM REQUIREMENTS. (N. C. COASTAL PLAN; APPENDIX E; Nov., 1977).



DRUM INLET


feet
12000
10000
8000
6000
4000
2000
0
Typical movement (# 2)
left side
right side
40
50
60
70
80
88
year

INLET HAZARD AREA RECOMMENDATIONS

DRUM INLET

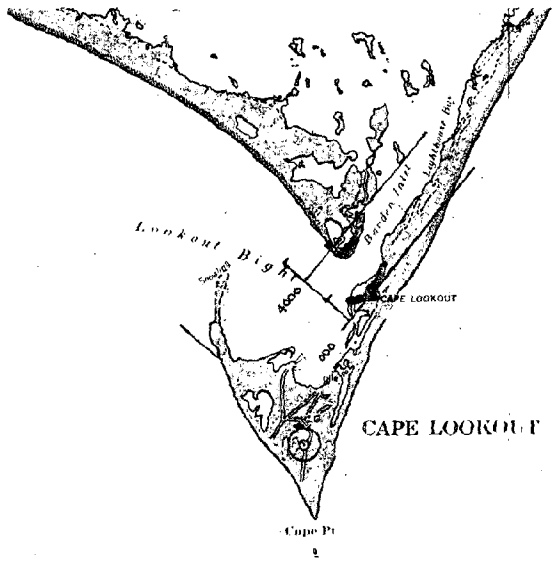
Photographs used; 6 + opening date Typical grid is # 2

NOTES:

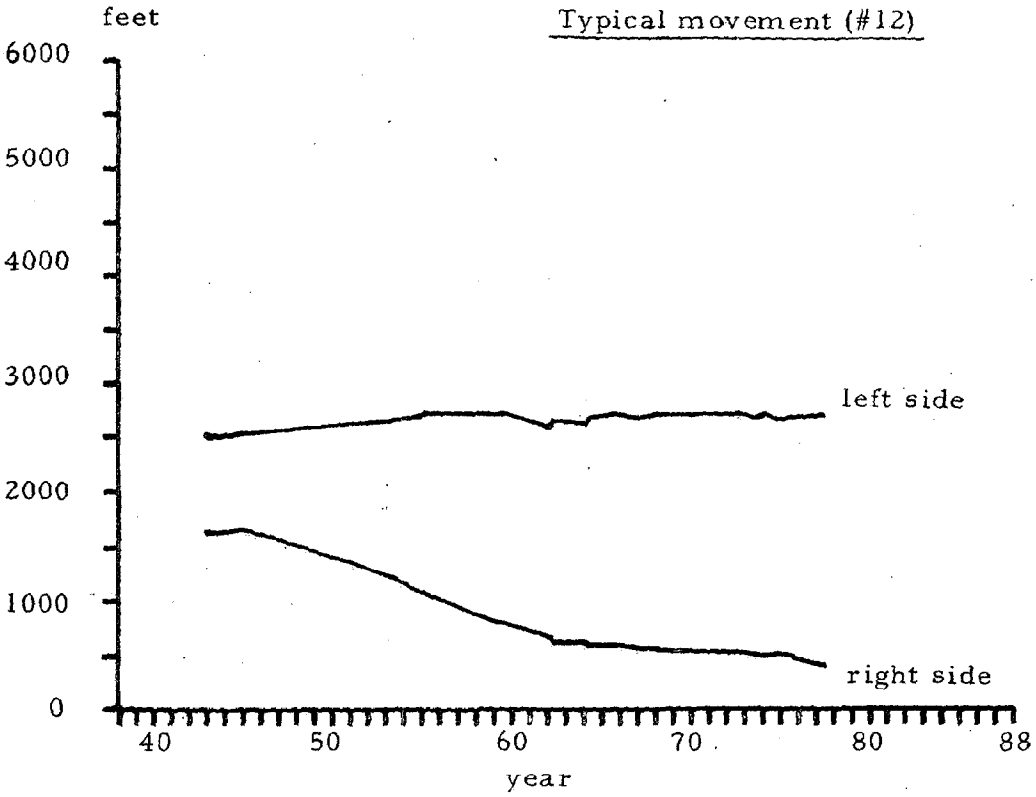
Artificially opened December 23, 1971 just south of natural location of former Drum Inlet. Original cut was 200' wide; inlet widened rapidly to over 3000'. Channel and sound inside of inlet are shoaling extensively. This inlet has not existed long enough to establish a true statistical fit. Drum Inlet will probably continue to widen and shoal even more, though its rate of widening has slowed since the rapid rate shown in its first few years of existence. It is possible that, without extensive dredging, the throat of the inlet may become so shallow that the inlet will close or become a wide "swash" like other former inlet sites in the vicinity.

LEFT SIDE	RIGHT SIDE
Undeveloped; low development potential.	Minor past development, low future development potential.
Federal land; Cape Lookout National Seashore	Federal land; Cape Lookout National Seashore.
No valid statistics due to short time of existence.	No valid statistics due to short time of existence
Recommend extension of Ocean Hazard Area.	Low overwash areas and very narrow barrier island extending northward past the old location of Drum Inlet.
	Recommend extension of Ocean Hazard Area

NOTE: ENTIRE INLET FEDERAL LANDS. SPECIFICALLY EXCLUDED FROM REQUIREMENTS. (N. C. COASTAL PLAN; APPEDIX E; Nov., 1977)



BARDENS INLET



INLET HAZARD AREA RECOMMENDATIONS

BARDENS INLET

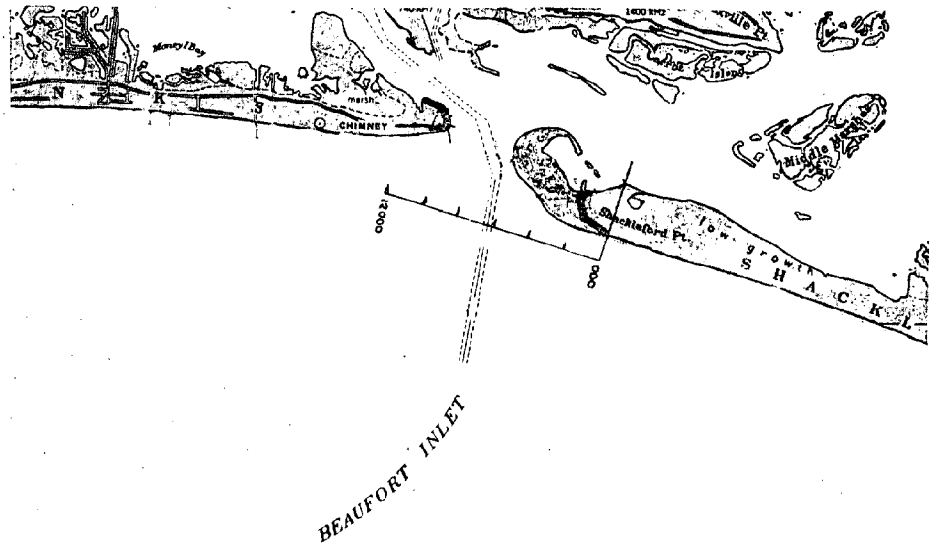
Photographs used: 28 Typical grid is # 12

NOTES:

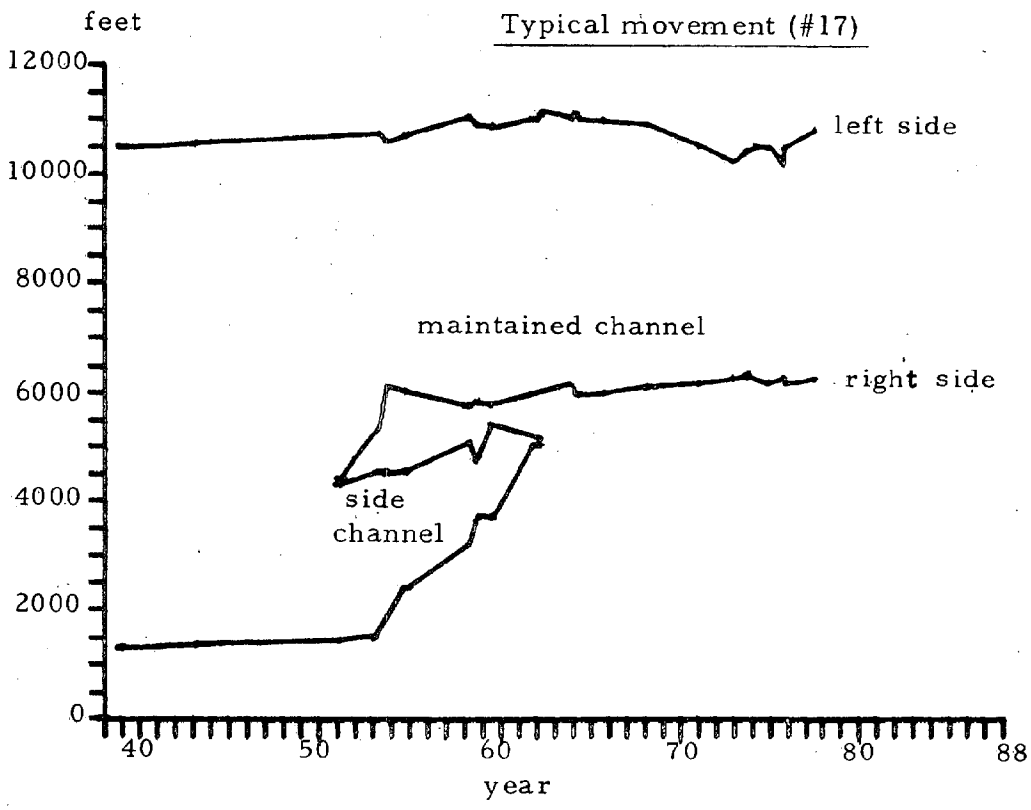
Navigable channel maintained by dredging, no shoreline stabilization. Present inlet opened around 1933 to a depth of 5 feet and a width of 50 feet. Mainly overwash area prior to that time. At first glance, the inlet appears to have migrated east about 700 feet since its opening; but closer examination reveals that the left shoreline has remained within a few hundred feet of its original location while the right shoreline has migrated eastward in excess of 1500 feet. This movement regresses quadratically with a rapid rate from 1943-1964 and a much slower rate from 1964-1976, see (*) below.

LEFT SIDE	RIGHT SIDE
Undeveloped, no land access, very low development potential.	Undeveloped, no land access, very low development potential.
Under condemnation by the National Park Service to become federal lands.	Parts under condemnation by the National Park Service to become federal lands.
Recommended line as shown on map.	(*) Movement rate has increased since 1976 and, if it continues, may require re-evaluation of data.
	Recommended line as shown on map.

NOTE: PORTIONS OF THIS INLET ARE NOW AND MOST SOON WILL BE EXCLUDED FROM REQUIREMENTS. (N. C. COASTAL PLAN; APPENDIX E ; Nov., 1977).



BEAUFORT INLET



INLET HAZARD AREA RECOMMENDATIONS

BEAUFORT INLET

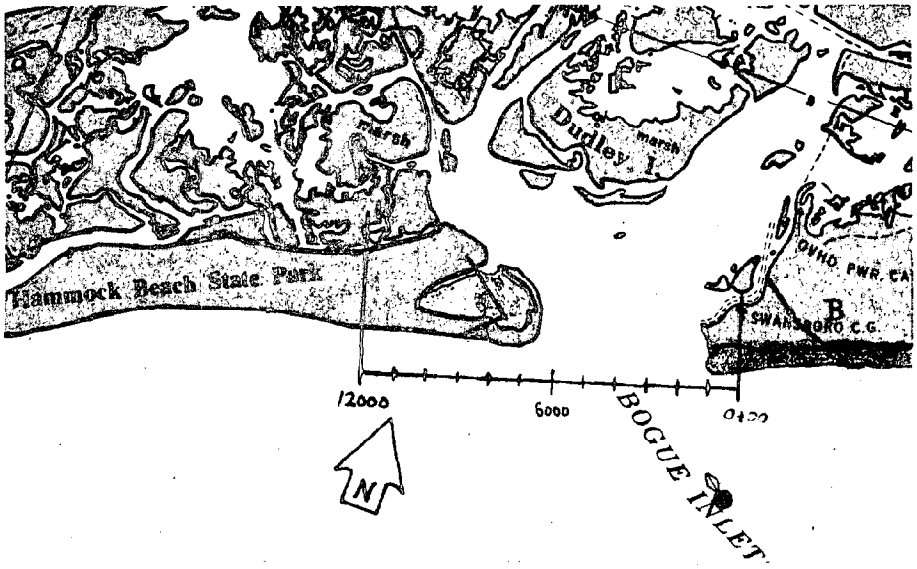
Photographs used: 32 Typical grid is # 17 -18

NOTES:

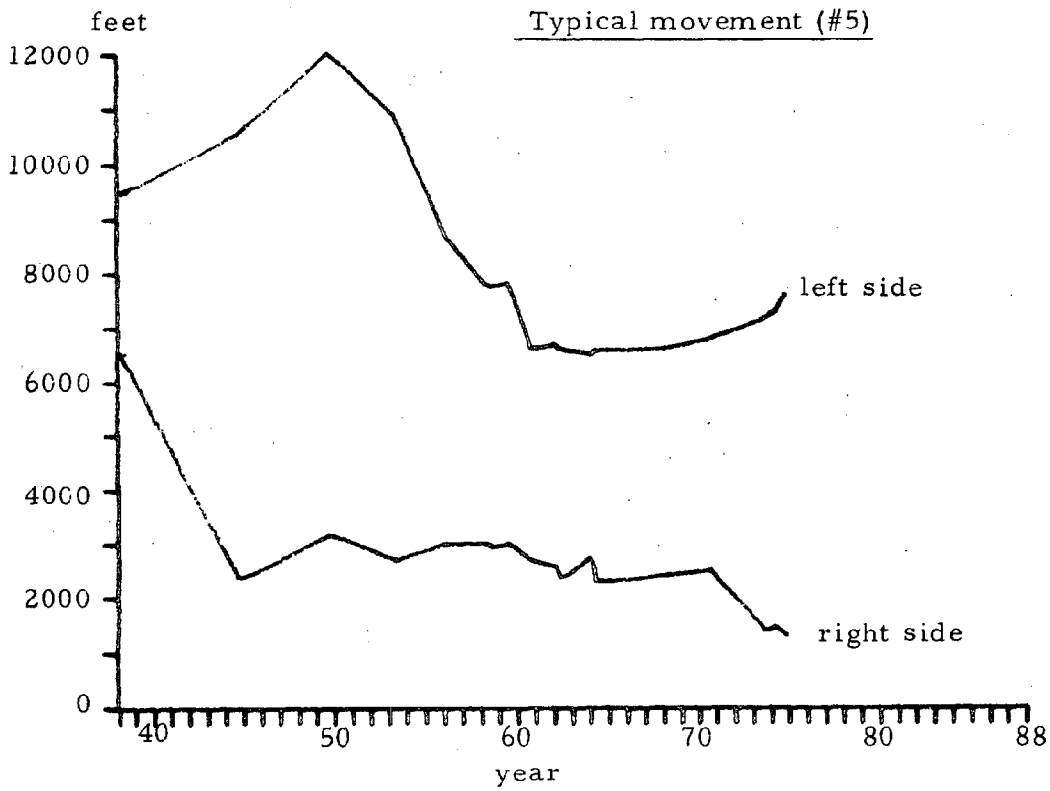
Seaport channel regularly maintained in same location since before 1952. Serves as outlet for Newport and North Rivers. It is thought that a former location may have been further east near the western end of Harkers Island, but it has maintained a relatively narrow territory for the past 156 years. Post-1938 photo data suggests a westward migration tendency that has been almost totally interrupted by extensive jettying on the right shoreline and extensive channelization. This interruption negates regression of either side.

LEFT SIDE	RIGHT SIDE
Undeveloped, state owned, Fort Macon State Park. Low development potential.	Undeveloped, under condemnation to be federal lands by National Park Service.
Stabilized by extensive jettys and groins.	Some groins from 000 to 2500.
Stabilization interference, not regressed.	4000'+ westward migration since 1938.
No hazard line established.	Migration arrested by maintained channel.
Recommend extension of ocean hazard line.	Channel interference, not regressed.
	Recommended line as shown on map.

NOTE: ENTIRE INLET SPECIFICALLY EXCLUDED FROM REQUIREMENTS. (N. C. COASTAL PLAN ; Nov. 1977).


Hammock Beach State Park
marsh
Dudley I.
marsh
OVHD PWR. CA
B
SWANSBORO C.G.
12000
6000
N
BOGUE INLET

BOGUE INLET


Typical movement (#5)
feet
12000
10000
8000
6000
4000
2000
0
left side
right side
40
50
60
70
80
88
year

INLET HAZARD AREA RECOMMENDATIONS

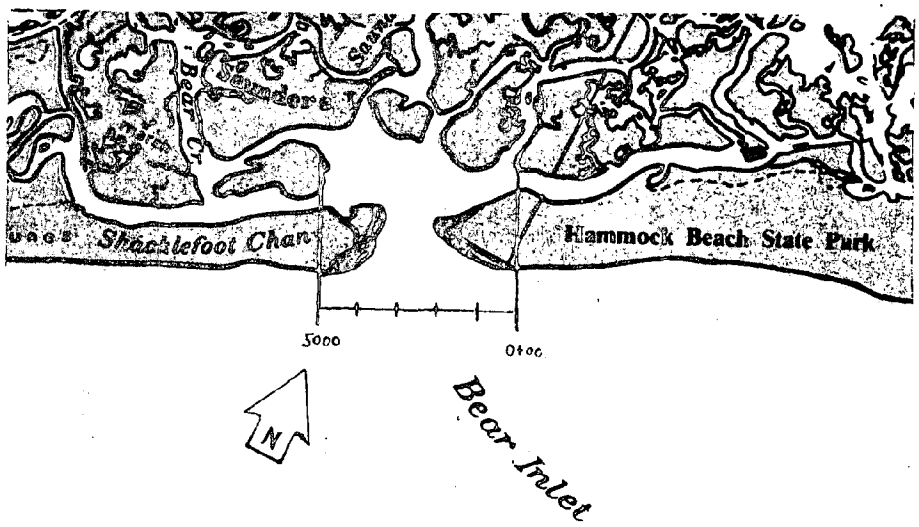
BOGUE INLET

Photographs used: 21 Typical grid is # 5

NOTES:

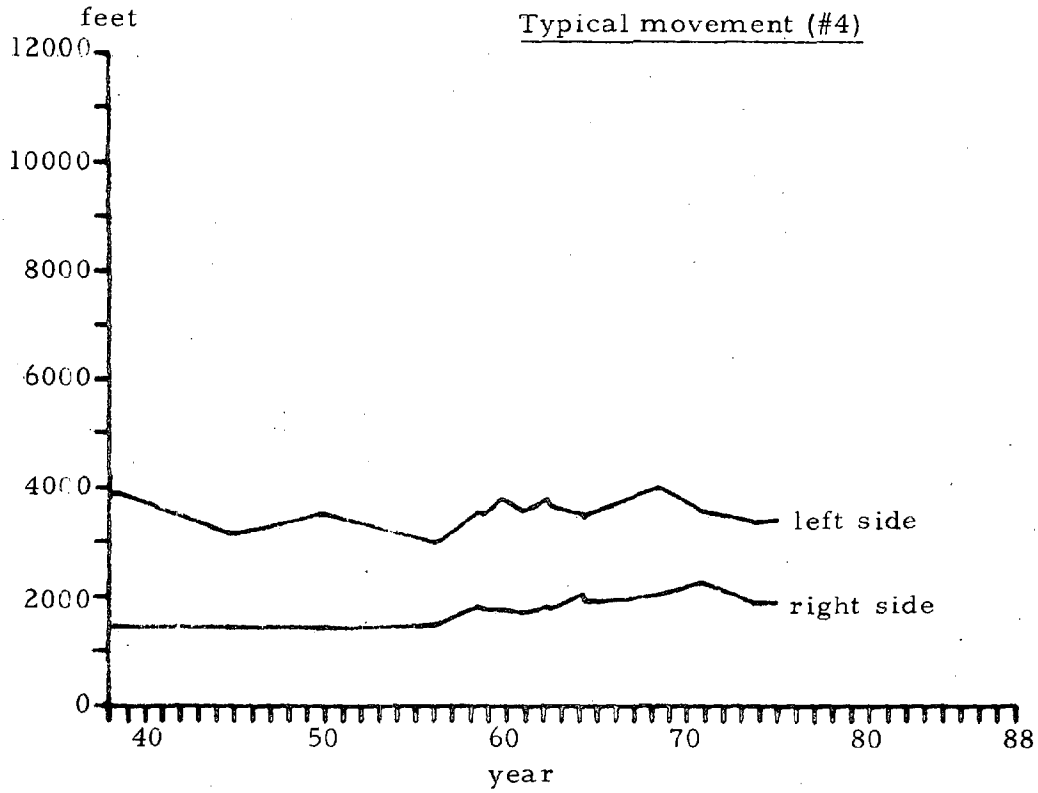
Pre-historic inlet occasionally maintained by dredging. Data since 1871 reveals the inlet to be subject to frequent, possibly cyclic, large scale excursions within its historic territory. It forms the mouth of the White Oak River and no significant migration is to be expected. Data since 1938 shows an unusual eastward movement of more than 3000 feet; possibly indicating the downward swing of the cyclic pattern mentioned above.

LEFT SIDE	RIGHT SIDE
No development, low development potential.	Moderate development, high development potential.
State lands, Hammocks Beach State Park	Moderate problems associated with erosion, development events since 1971.
Excursions to 12000 since 1938	Minor stabilization attempts since 1973.
Configuration makes regression validity doubtful.	Shoreline is presently farther east than at any time in recent history.
Recommended line as shown on map.	Configuration makes regression validity doubtful.
	Recommended line as shown on map



BEAR INLET

Typical movement (#4)



INLET HAZARD AREA RECOMMENDATIONS

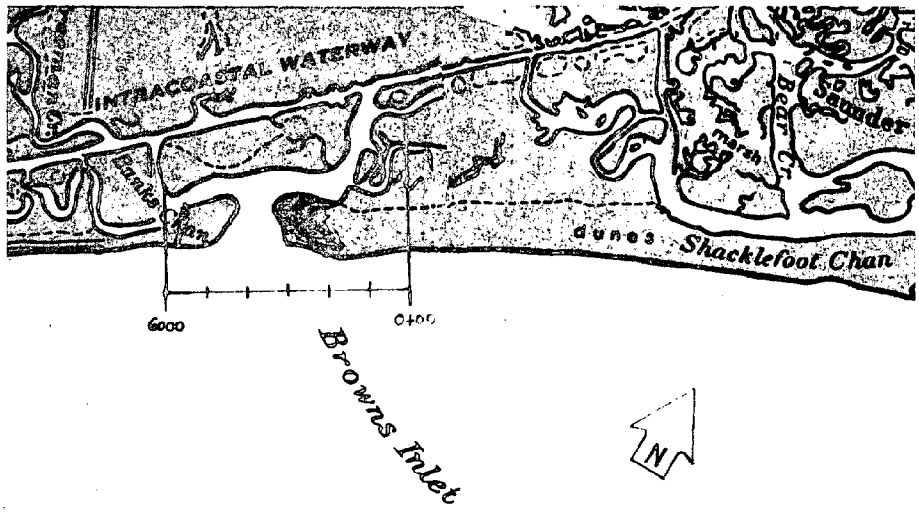
BEAR INLET

Photographs used: 15 Typical grid is # 4

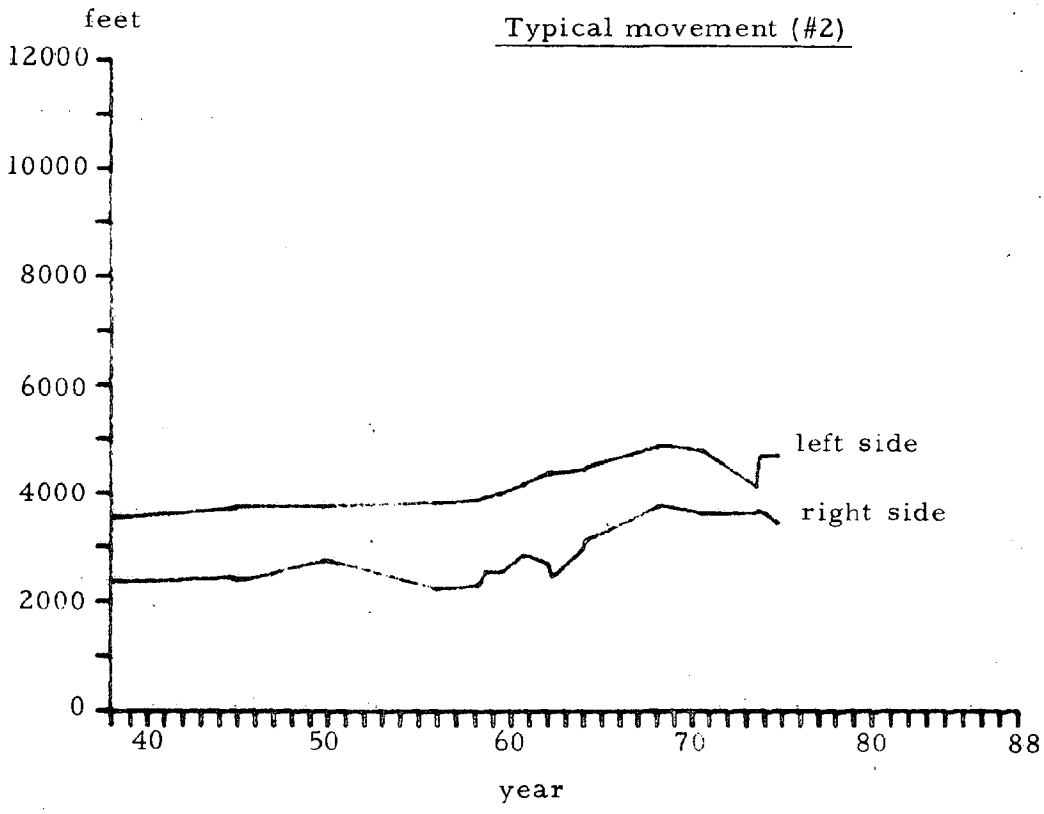
NOTES:

Minor inlet but very stable with strong regression data. The only instability of note in the area was the historical existence of nearby Sandy Inlet at about 11,000.

LEFT SIDE	RIGHT SIDE
No development, federal lands, very low development potential.	No development, low development potential.
Camp Lejeune Marine Base	Hammock Beach State Park
Recommended line as shown on map.	Recommended line as shown on map
NOTE: FEDERAL LANDS SPECIFICALLY EXCLUDED FROM REQUIREMENTS. (N. C. COASTAL PLAN; APPENDIX E; Nov. 1977).	



BROWNS INLET



INLET HAZARD AREA RECOMMENDATIONS

BROWNS INLET

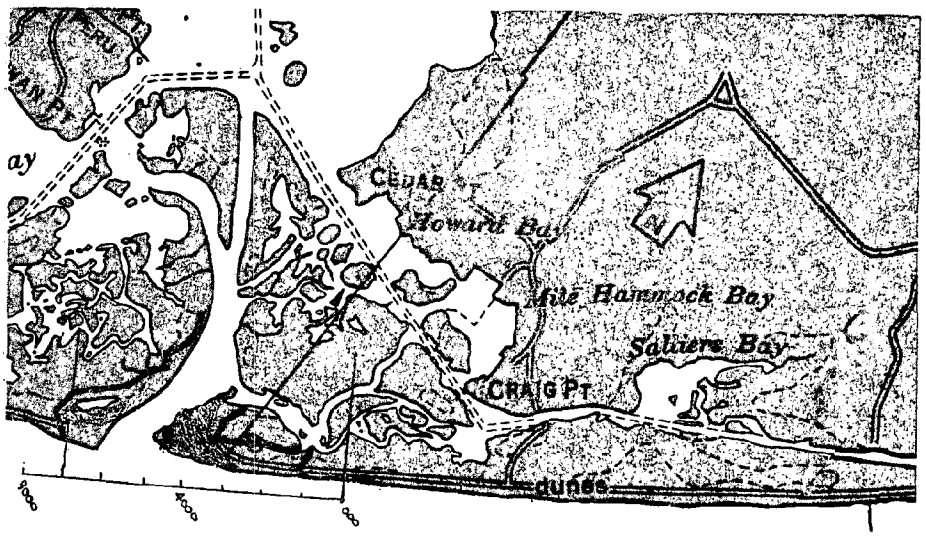
Photographs used: 19 Typical grid is # 2

NOTES:

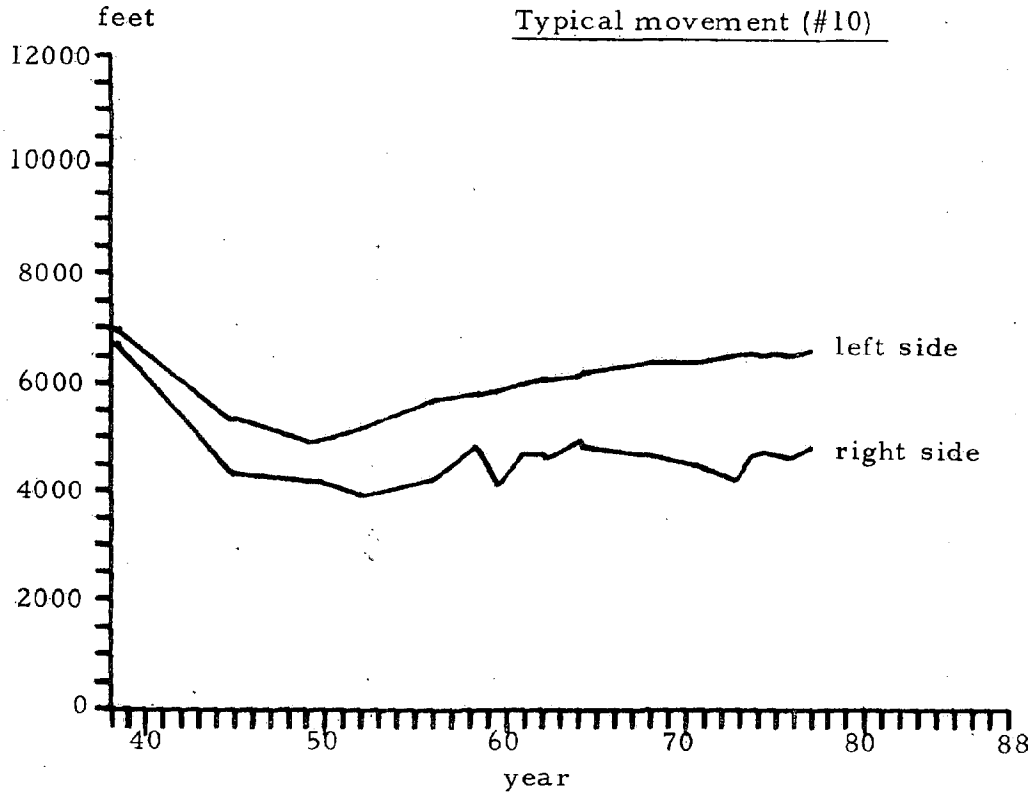
Minor, stable inlet providing good regression data. This inlet has moved very slowly westward since 1938, but it accelerated slightly between 1958 and 1972. Total movement since 1938 is about 1000 feet.

LEFT SIDE	RIGHT SIDE
No development, federal lands, very low development potential (both sides).	
Camp Lejeune Marine Base (both sides).	
Recommended lines as shown on map.	

NOTE: FEDERAL LANDS SPECIFICALLY EXCLUDED FROM REQUIREMENTS (N. C. COASTAL PLAN; APPENDIX E; Nov. 1977).



NEW RIVER INLET



INLET HAZARD AREA RECOMMENDATIONS

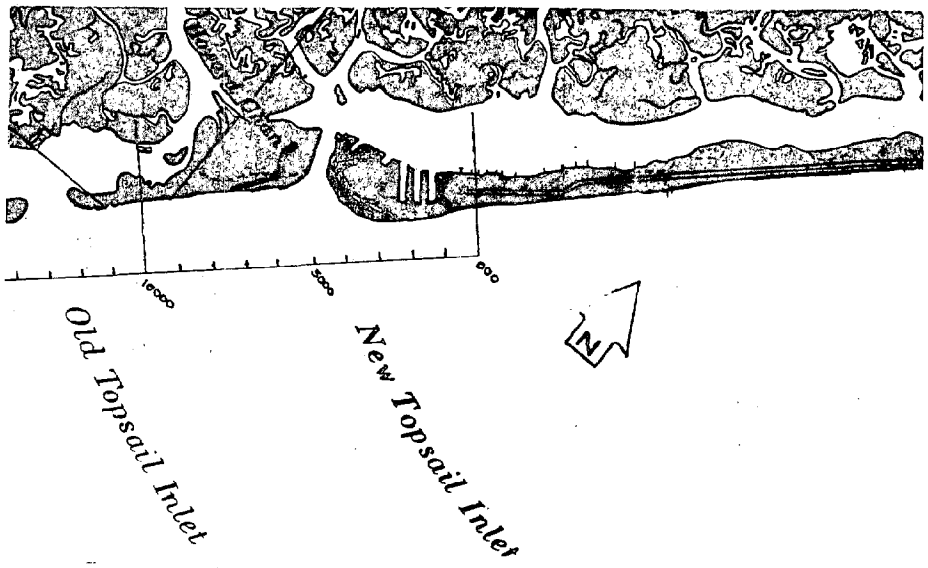
NEW RIVER INLET

Photographs used: 24 Typical grid is # 10 and 11

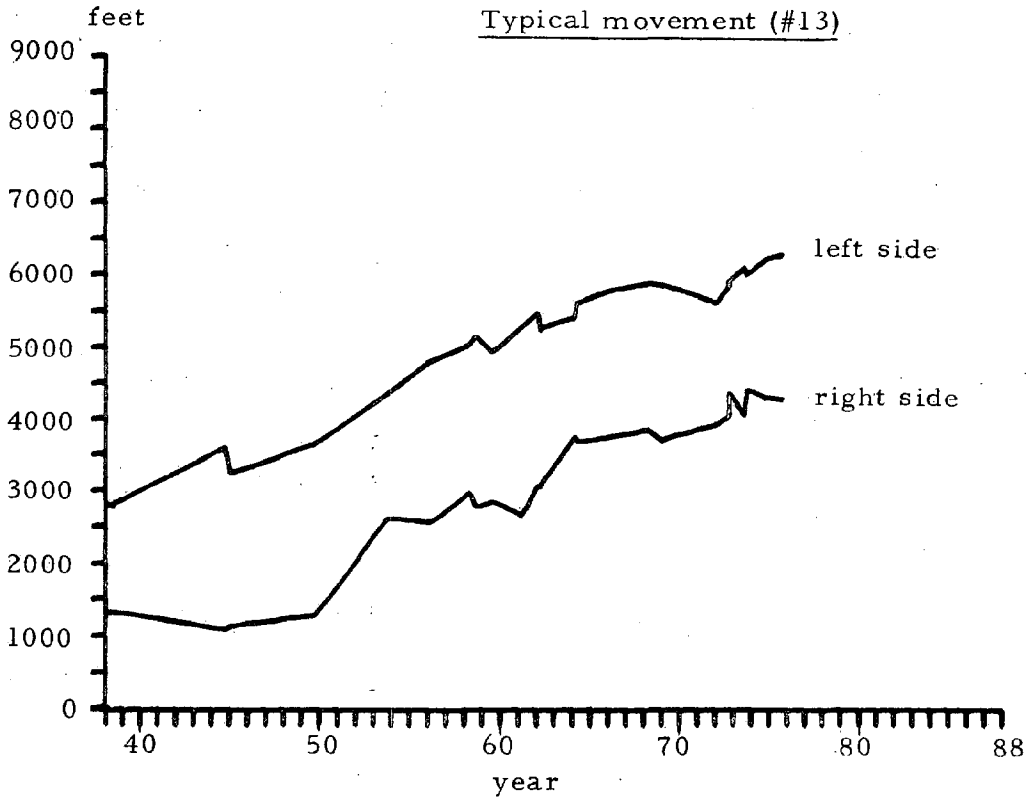
NOTES:

Navigable channel maintained by dredging but throat is subject to frequent, unpredictable, medium scale excursions within its historic territory. Evidence of some long-term cyclic trends is apparent. Since it serves as an outlet for New River, no great migration is to be expected away from the vicinity of the mouth of this river.

LEFT SIDE	RIGHT SIDE
Under development, moderate to high development potential.	Undeveloped, federal lands, very low development potential.
Ridge formations indicate activity to about 7600.	Camp Lejeune Marine Base.
Quadratic regression exaggerates prediction patterns because of cyclic trends.	Ridge formations indicate activity to about 1100.
Recommended line as shown on map.	Regressions distorted because of island (grids 11-12/1900-3800).
	Recommended line as shown on map.
	NOTE: FEDERAL LANDS SPECIFICALLY EXCLUDED FROM REQUIREMENTS. (N. C. COASTAL PLAN ; APPENDIX E; Nov. 1977).



NEW TOPSAIL INLET



INLET HAZARD AREA RECOMMENDATIONS

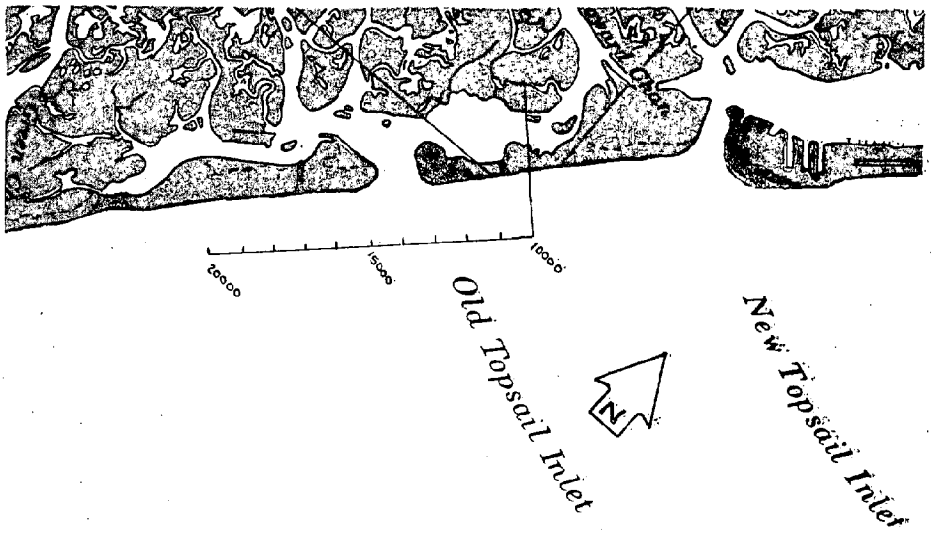
NEW TOPSAIL INLET

Photographs used: 27 Typical grid is # 13 and 14

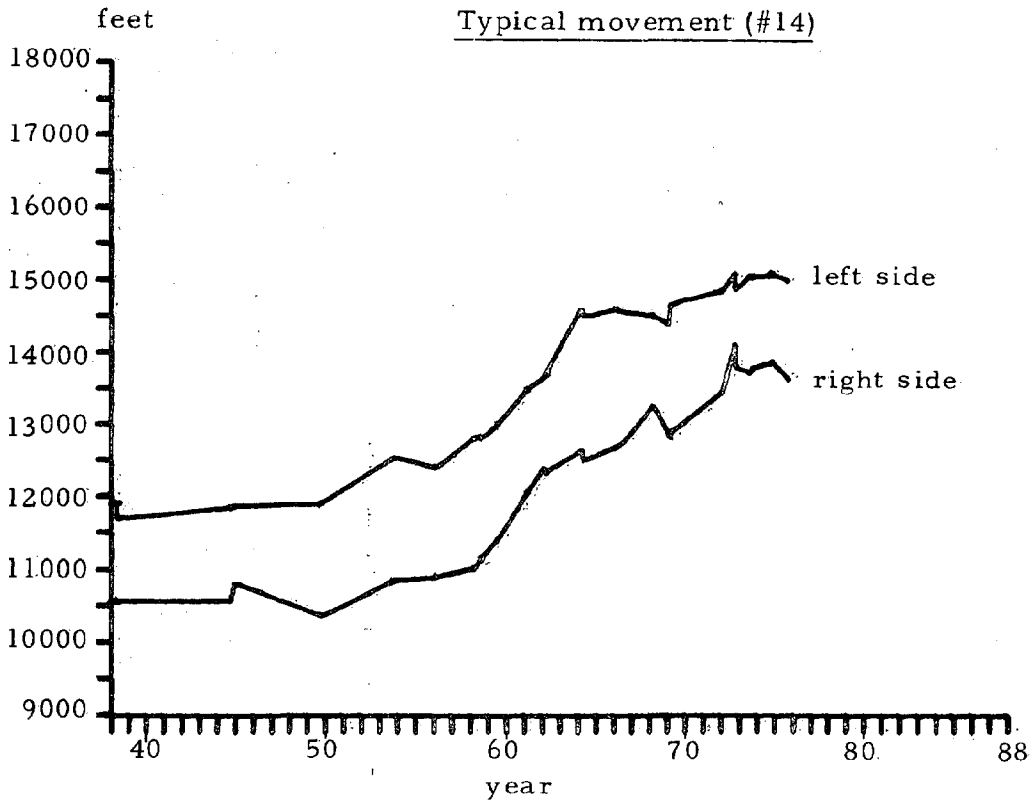
NOTES:

Navigable channel maintained by dredging, no major stabilization. Data since 1938 suggests a cubic southward movement; however, closer examination by means of triangulation station descriptions since 1914 reveals this apparent cubic trend to be a part of either a quartic or higher order function or a complex function consisting of a cyclic trancendental superimposed on another function. In any case, the result is a series of periods of rapid movement followed by periods of little or no movement (-1000/1914; 1800/1933; 2300/1948; 3900/1958; 5200/1977). Total southward movement 1938-1977: 3200 feet.

LEFT SIDE	RIGHT SIDE
Undeveloped, no land access, moderate development potential.	Medium development, high development potential.
Complex movement makes normally used regression methods questionable.	Minor groin and dune stabilization on ocean shoreline near inlet.
Recommended line as shown on map.	Long feeder channel to the north would seem to make a breakthrough in that direction likely.
	Finger channels in banks at 2000 create a vulnerable area.
	Ridge data indicates northern territory to be -3400.
	Complex movement and above conditions make normally used regression methods questionable.
	Recommended line as shown on map.



OLD TOPSAIL INLET



INLET HAZARD AREA RECOMMENTIONS

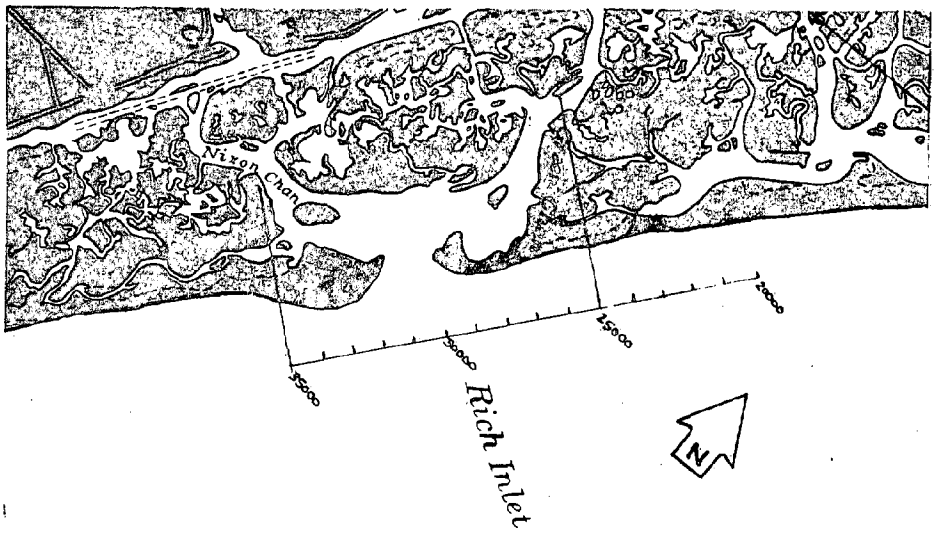
OLD TOPSAIL INLET

Photographs used: 28 Typical grid is # 14

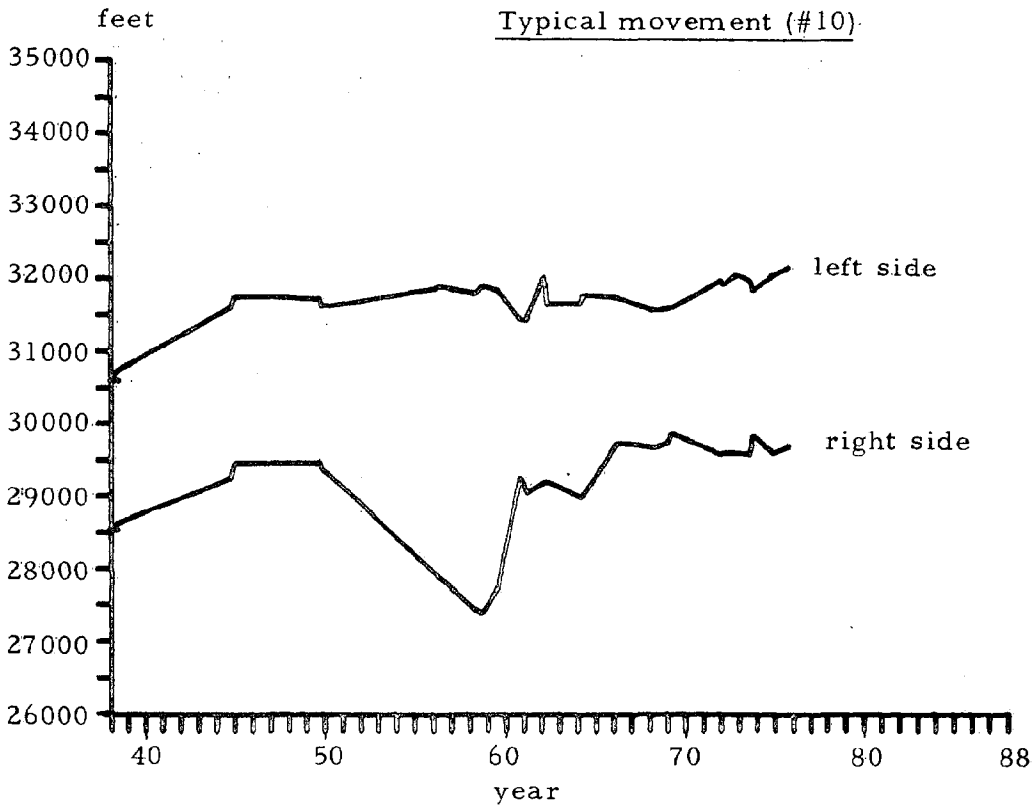
NOTES:

No maintained channel, no stabilization. Statistics suggest southward migration following a roughly cubic equation since 1938 (remained steady at 11200 from 1938-1950; increased rapidly from 11200-13500 between 1950-1966; slowed considerably between 1966-1977 from 13500-14300). Total movement southward was 3100 feet, 1938-1977. Ridge data indicates present position to be slightly further south than at any time in recent history. Inlet position may alternate between major channels at 9000 and 17000.

LEFT SIDE	RIGHT SIDE
Undeveloped, no land access, moderate development potential.	Undeveloped, no land access, moderate development potential.
Cubic southward drift negates normally used regression methods.	Cubic southward drift negates normally used regression methods.
Recommended line as shown on map.	Recommended line as shown on map.


Nixon Chan
Rich Inlet
N

RICH INLET


Typical movement (#10)
feet
35000
34000
33000
32000
31000
30000
29000
28000
27000
26000
left side
right side
40
50
60
70
80
88
year

INLET HAZARD AREA RECOMMENDATIONS

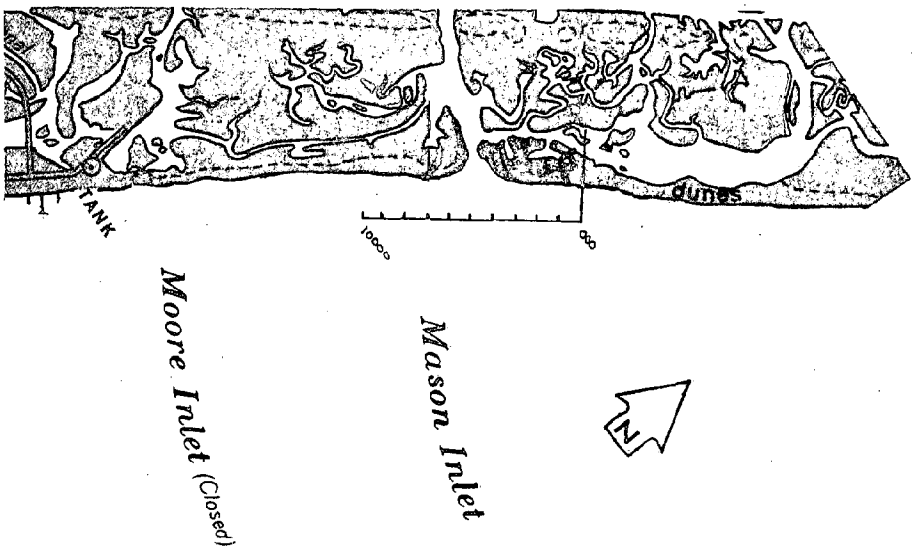
RICH INLET

Photographs used: 32 Typical grid is # 10 and 11

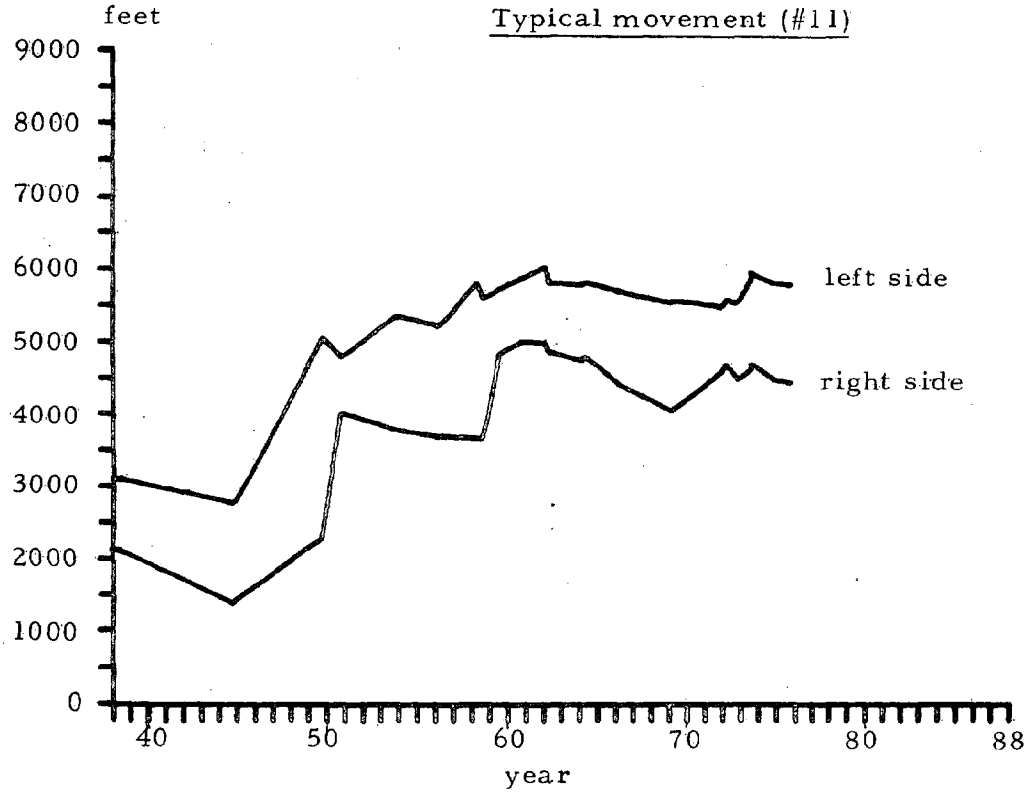
NOTES:

No maintained channel, no stabilization. Migrated 1200 feet southward since 1938. Ridge formations suggest that the inlet is presently at its southern limit of travel in recent history, that its territory is somewhat restricted possibly due to the intermittent historical existence of nearby Sidburry Inlet (Little Topsail) at 23000, and that the ocean shoreline on the left side of the inlet has accreted nearly 1000 feet.

LEFT SIDE	RIGHT SIDE
Little development, high development potential.	Undeveloped, no land access, moderate development potential.
Steady southward drift since 1938.	Predominant drift is southward; movement is erratic.
Recommended line as shown on map.	Recommended line as shown on map.


TANK
dunes
Moore Inlet (Closed)
Mason Inlet
N

MASON INLET


feet
Typical movement (#11)
9000
8000
7000
6000
5000
4000
3000
2000
1000
0
left side
right side
40
50
60
70
80
88
year

INLET HAZARD AREA RECOMMENDATIONS

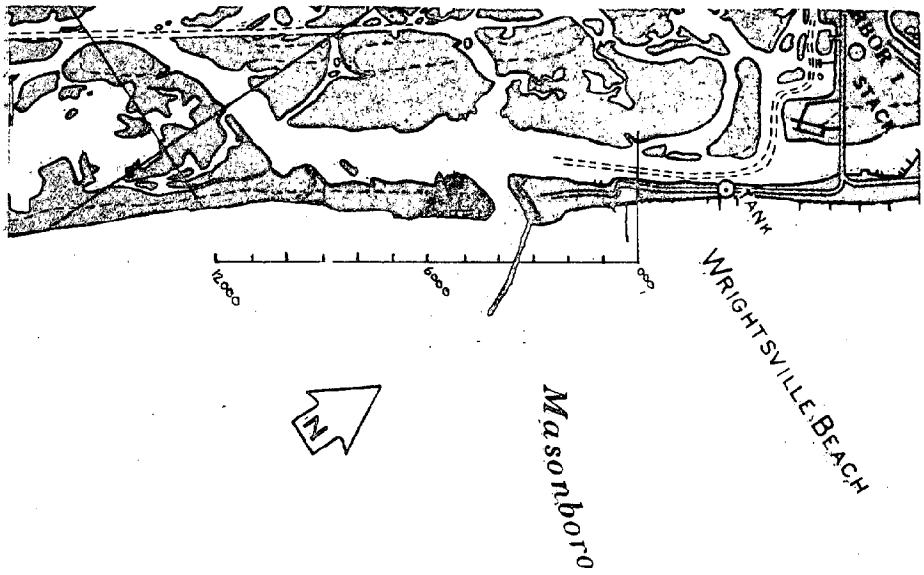
MASON INLET

Photographs used: 28 Typical grid is # 10 and 11

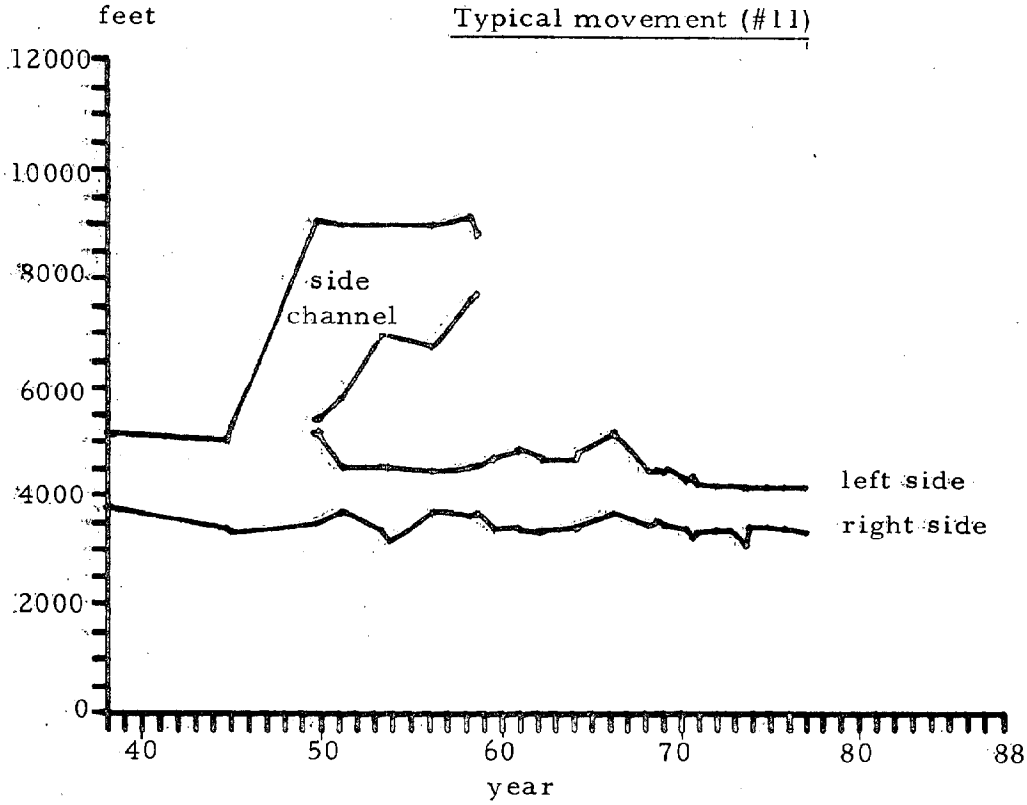
NOTES:

No maintained channel, no stabilization. Migrated 3000 feet southward between 1945 and 1963 but has drifted slowly northward since (2100/1945;5400/1963; 5100/1977), creating a quadratic **or** higher order statistical condition. Dune ridge territory is not definable.

LEFT SIDE	RIGHT SIDE
Undeveloped, high development potential.	Moderate development, high development potential.
Some overwashing past 9000.	If quadratic statistical trend is valid, substantial property loss may occur.
Recommended line as shown on map.	Finger channels in banks at 1300 and 3400 create a vulnerable area.
	Recommended line as shown on map.



MASONBORO INLET



INLET HAZARD AREA RECOMMENDATIONS

MASONBORO INLET

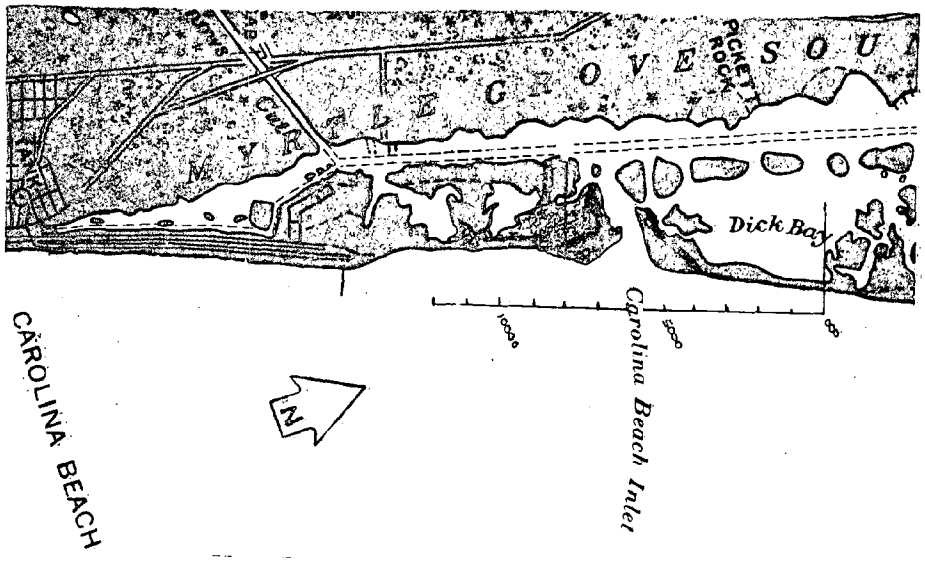
Photographs used: 32 Typical grid is # 11

NOTES:

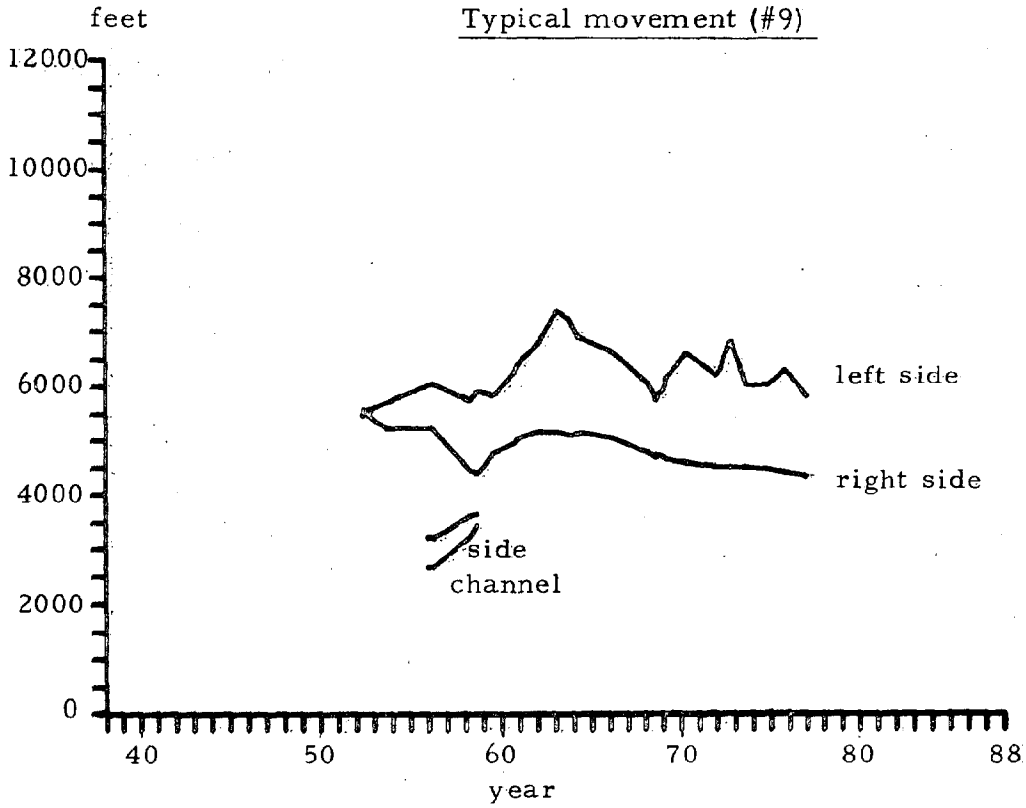
Channel maintained and considered stabilized. Insignificant movement since 1938 except for 4000 foot excursion on the left side between 1945 and 1959 (5300-9300-4600). This excursion created a double throat between 1951 and 1959, not an uncommon occurence according to historical notes.

LEFT SIDE	RIGHT SIDE
Extensive jetty planned for later in 1978.	Shoreline recently approached 3100.
	Stabilized by extensive jetty.
Past multiple channels negate accurate regression.	Not regressed, jetty interference.
Shoreline approached 9200 during the 1950s.	No hazard line established.
	Intense development to near capacity.
Ridge formations indicate activity to about 9400.	Recommend extension of ocean hazard line.
Presently undeveloped, proposed Masonboro Natural Area, low development potential.	
Recommended line as shown on map.	

NOTE: ENTIRE INLET SPECIFICALLY EXCLUDED FROM REQUIREMENTS. (N. C. COASTAL PLAN ; Nov. 1977).



CAROLINA BEACH INLET



INLET HAZARD AREA RECOMMENDATIONS

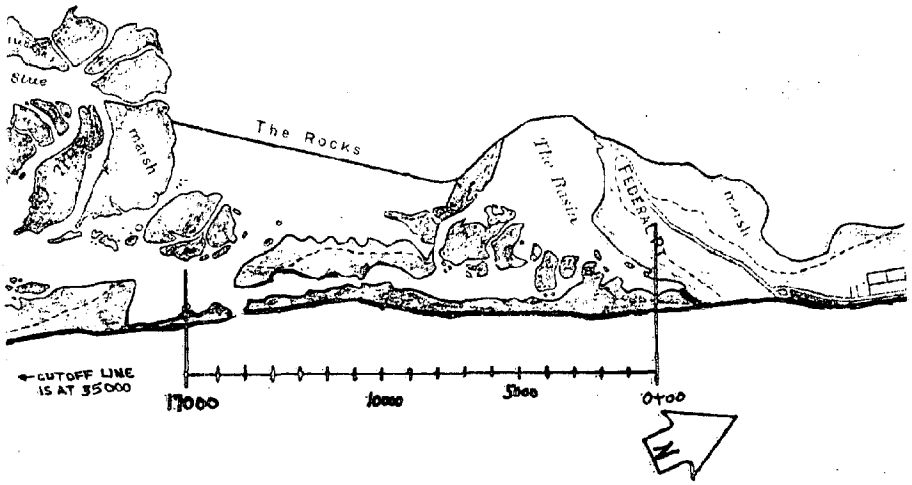
CAROLINA BEACH INLET

Photographs used: 25+opening date Typical grid is # 9

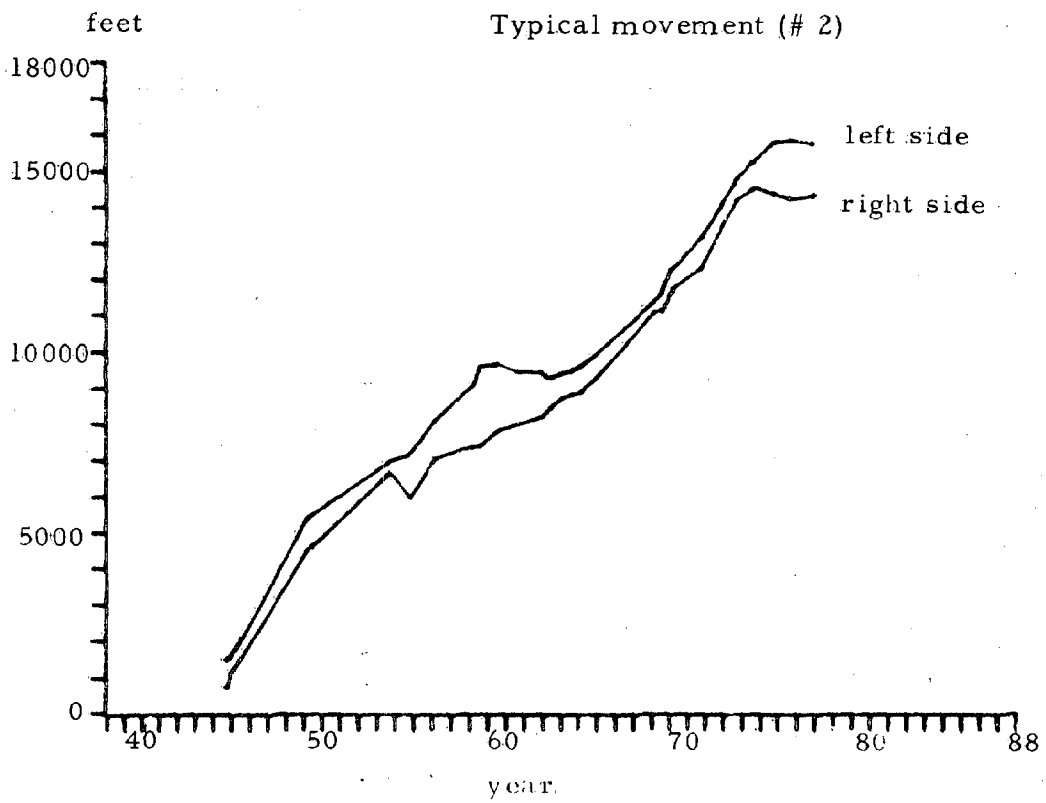
NOTES:

Opened by private interests on or about September 15, 1952. Double throat existed up to and including grid 10 during mid-fifties. Almost no migration tendencies. Navigable channel existing.

LEFT SIDE	RIGHT SIDE
Undeveloped, moderate to high development potential.	Undeveloped, proposed Masonboro Island Natural Area, low development potential.
Frequent overwashes to 13000.	Frequent overwashes to 000 and beyond.
Recommended line as shown on map.	Recommended line as shown on map.


The Rocks
marsh
marsh
CUTOFF LINE IS AT 35000
17000
10000
5000
0+00
N

NEW INLET


feet
Typical movement (# 2)
18000
15000
10000
5000
0
40
50
60
70
80
88
year
left side
right side

INLET HAZARD AREA RECOMMENDATIONS

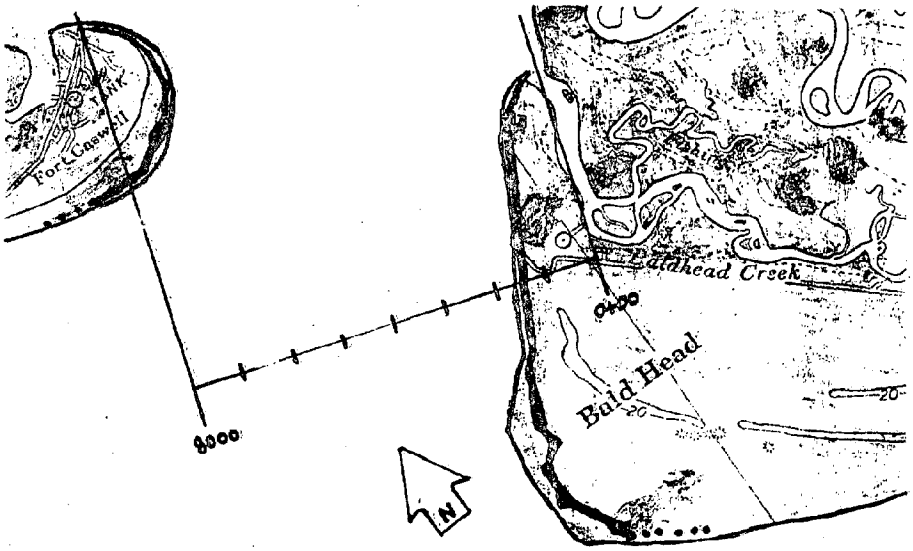
NEW INLET

Photographs used: 32 Typical grid is # 2

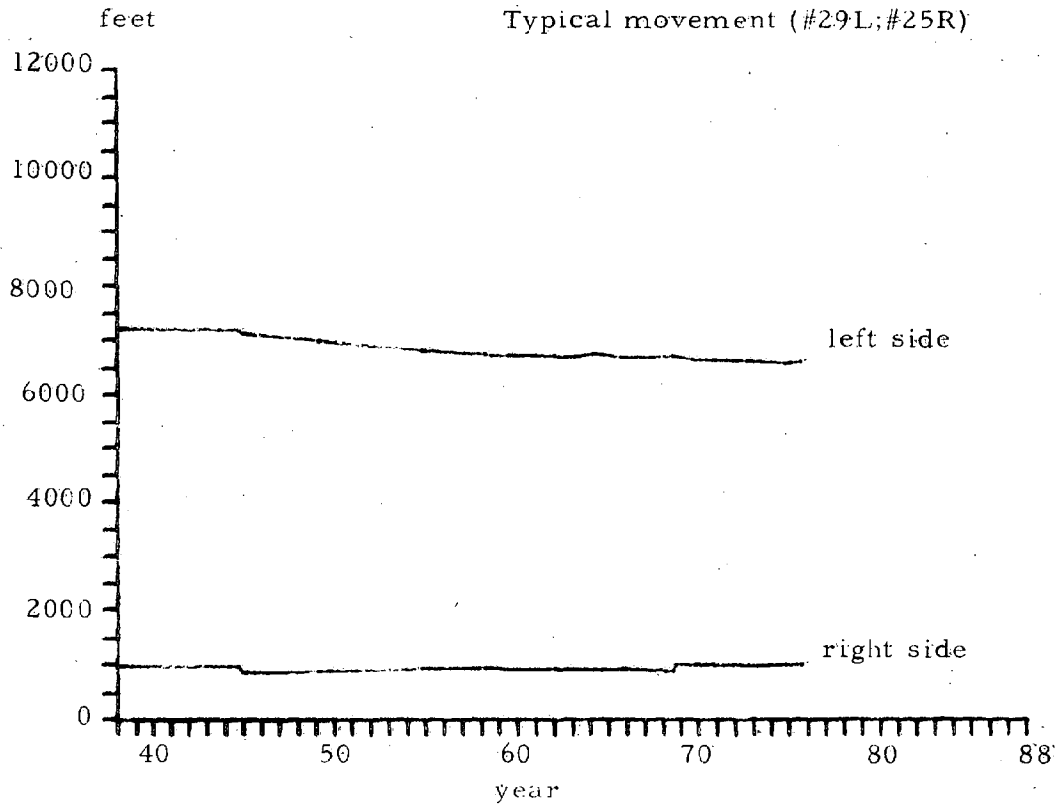
NOTES:

Minor unstable inlet having the highest migration rate of all North Carolina inlets (14,000 feet in 30 years). The present-day inlet is a part of a complex inlet/washover system extending from -2000 to 35,000. Since 1938, this system has included other inlets at 800, 5000, 8200, 18000, and 27000. According to triangulation station descriptions, the ocean shoreline in the vicinity has migrated westward as much as 2600 feet since 1853. Alone, New Inlet data yields a reasonably sound linear regression, but the entire system should be considered extremely volatile.

LEFT SIDE	RIGHT SIDE
Undeveloped, low development potential	Undeveloped, low development potential.
State lands (part of a recent agreement between the state and Carolina Cape Fear Corporation.)	May be state lands-boundary uncertain.
	Low, narrow overwash area to -2000
Low, narrow overwash area to 35,000	Recommended line as shown on map.
Recommended line as shown on map.	



CAPE FEAR INLET



INLET HAZARD AREA RECOMMENDATIONS

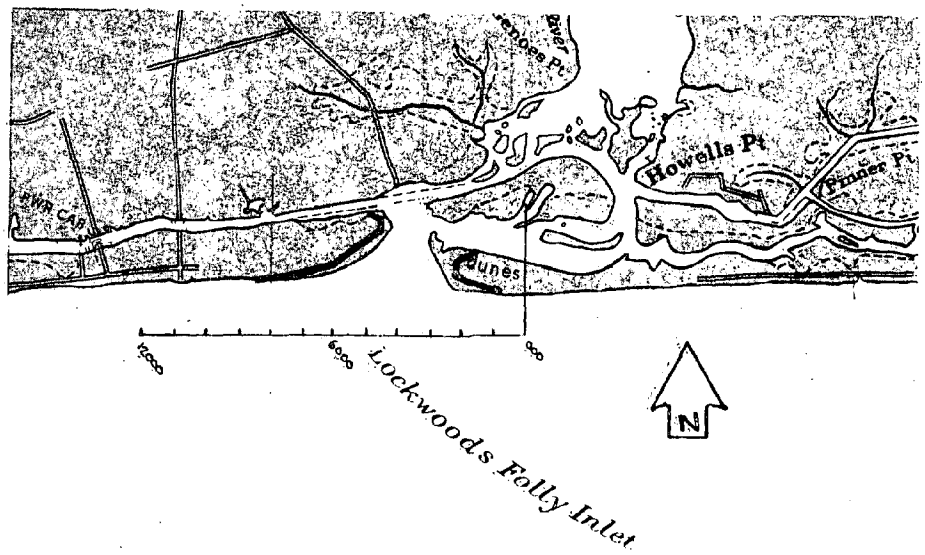
CAPE FEAR INLET

Photographs used: 23 Typical grid is #29L;25R

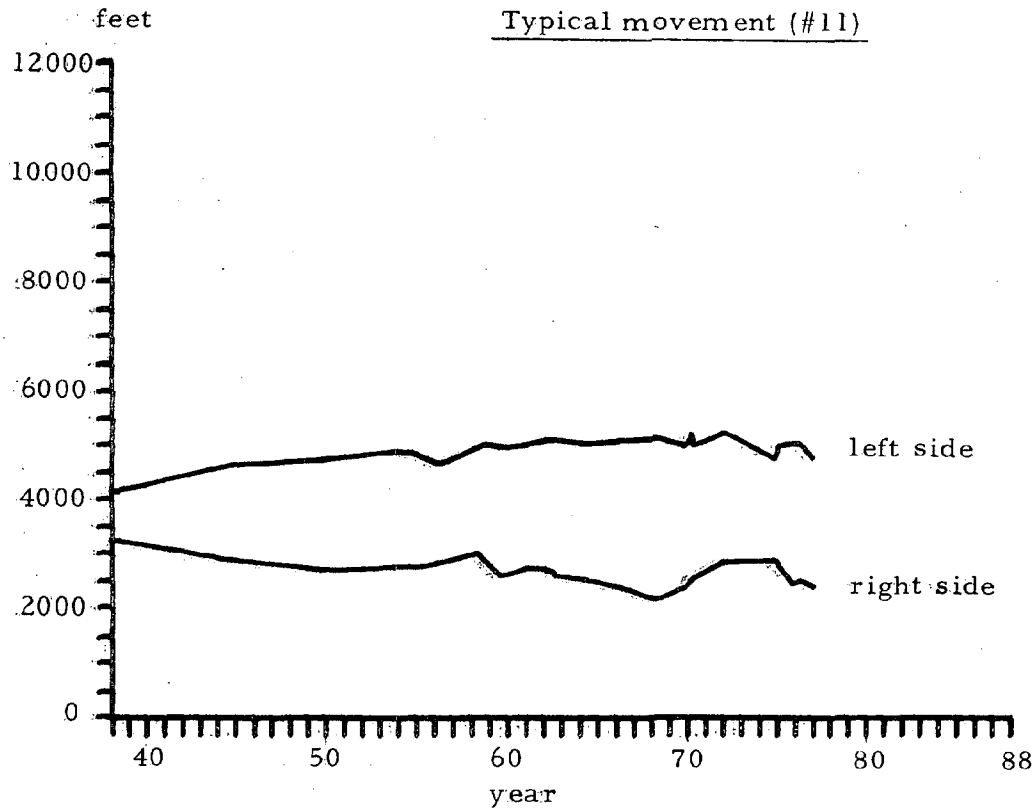
NOTES:

Prehistoric navigable inlet forming the mouth of the Cape Fear River. Very stable but navigation depths are maintained by dredging. Little movement since 1938. . little movement expected in future.

LEFT SIDE	RIGHT SIDE
Some development, moderate development potential.	Some development, high development potential.
Recommended line as shown on map	Recommended line as shown on map



LOCKWOOD FOLLY INLET



INLET HAZARD AREA RECOMMENDATIONS

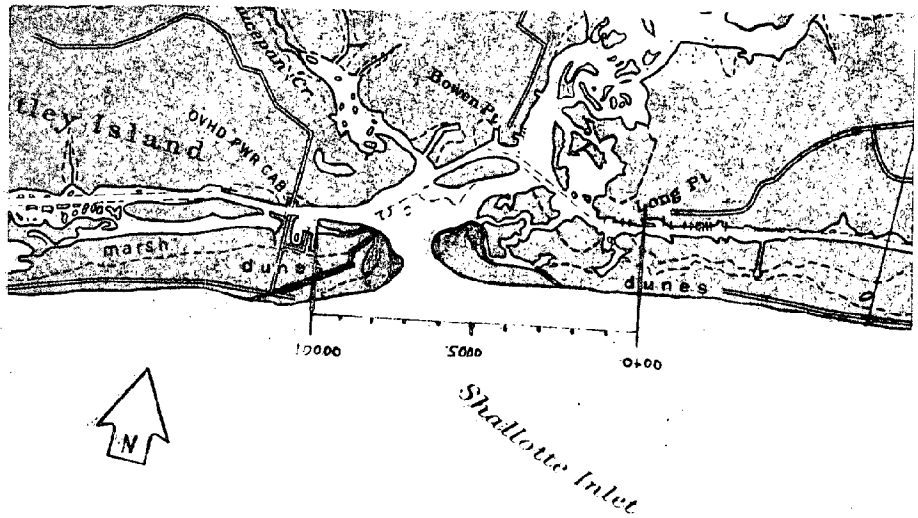
LOCKWOOD FOLLY INLET

Photographs used: 28 Typical grid is # 11 and 12

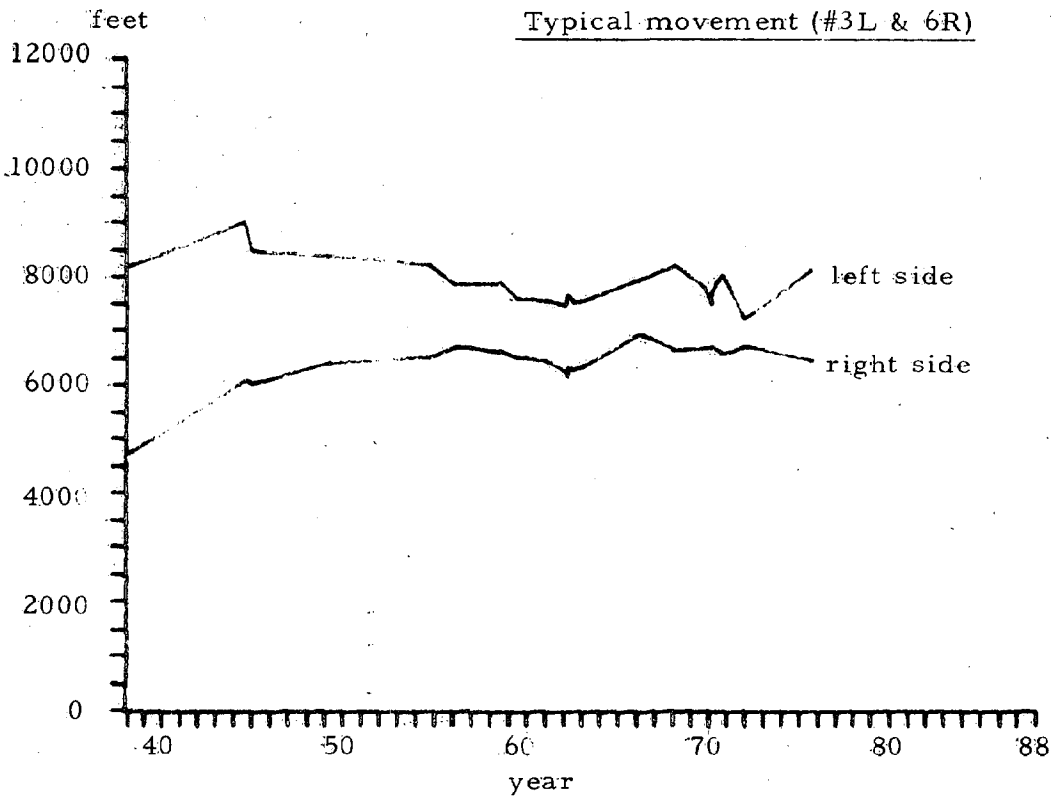
NOTES:

Navigable channel maintained by dredging. Inlet serves as outlet for Lockwood Folly River. Presently, a 5000 foot offset between the river and the inlet makes flanking via a new inlet breakthrough a definite possibility. This occurred in 1954 at the -4800 location but was quickly filled in artificially. In spite of its river outlet status, ridge data indicates a wide territory. Statistics indicate a slight eastward migration trend. Little movement since 1938.

LEFT SIDE	RIGHT SIDE
Moderately developed, moderate to high development potential.	Moderately developed, moderate to high development potential.
Ridge formations indicate historic activity to about 9000.	No ridge formations but known territory extends to -5000
Moderate losses due to ocean shoreline encroachment near inlet.	Small scale shoreline protection groin system built in early seventies.
Recommended line as shown on map.	Recommended line as shown on map.



SHALLOTTE INLET



INLET HAZARD AREA RECOMMENDATIONS

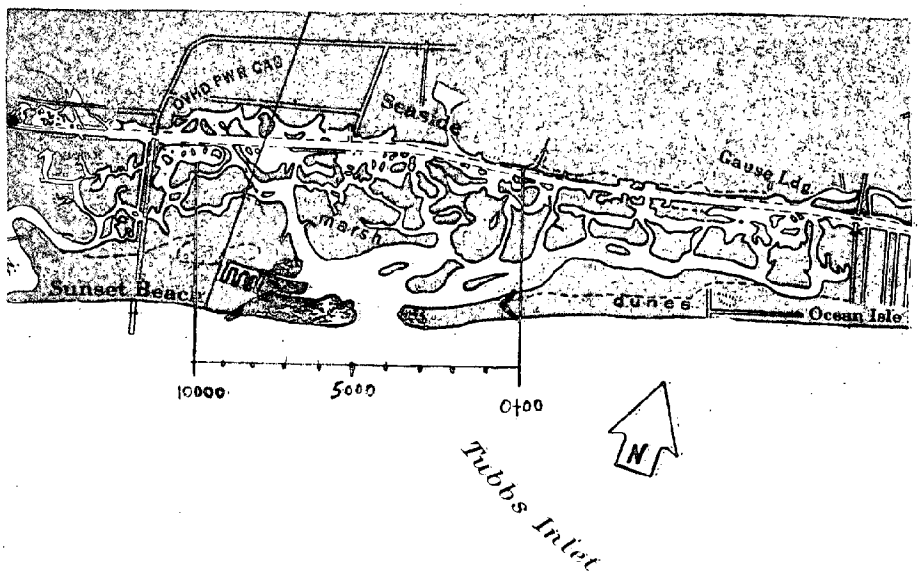
SHALLOTTE INLET

Photographs used: 24 Typical grid is #6

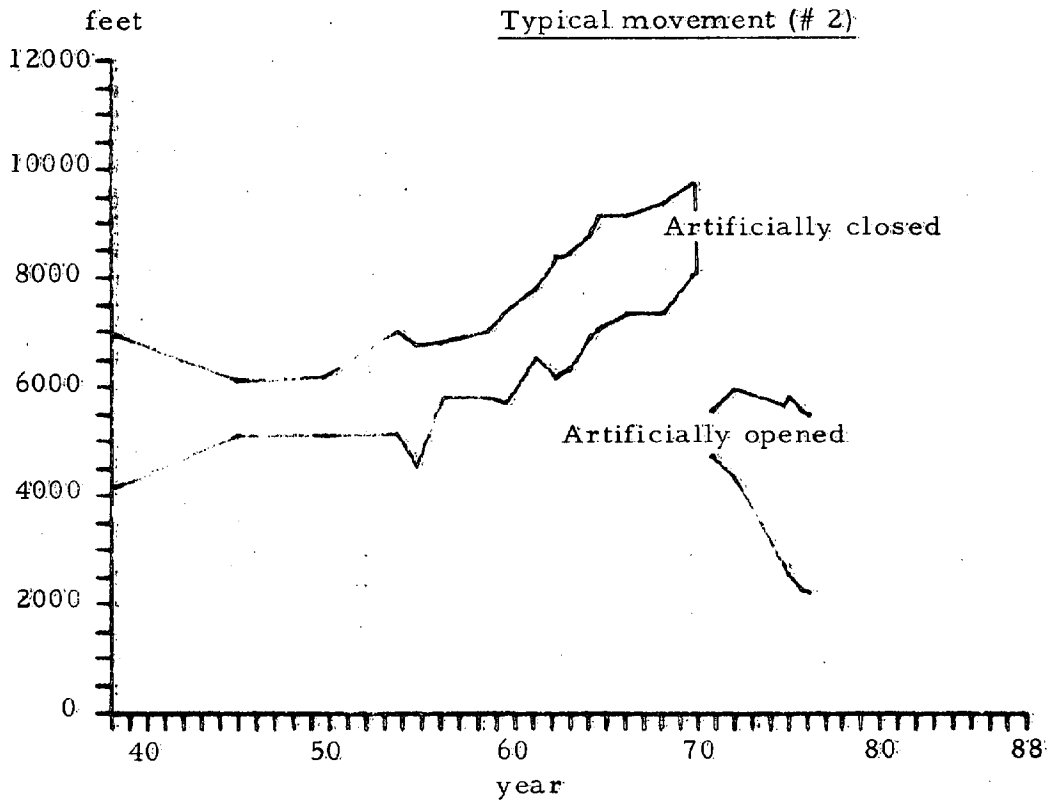
NOTES:

Prehistoric navigable inlet serves as outlet for Shallotte River. Some westward movement from 1938 to 1950, and a slower drift westward since then. The 4000 foot offset between the inlet and the river makes flanking via a new inlet a possibility. This occurred in 1954 at the 1500 location (probably the former site of Bacon Inlet).

LEFT SIDE	RIGHT SIDE
Moderately developed, Moderate to high development potential.	Light development; moderate to high development potential.
Ridge data indicates historic activity to about 9000.	Ridge data indicates historic activity to about 1000.
Moderate excursions with moderate erosion losses.	Moderate excursions.
Recommended line as shown on map.	Recommended line as shown on map.


Seaside
Causeway
marsh
Sunset Beach
dunes
Ocean Isle
10000
5000
0+00
N
Tubbs Inlet

TUBBS INLET


feet
Typical movement (# 2)
12000
10000
8000
6000
4000
2000
0
Artificially closed
Artificially opened
40
50
60
70
80
88
year

INLET HAZARD AREA RECOMMENDATIONS

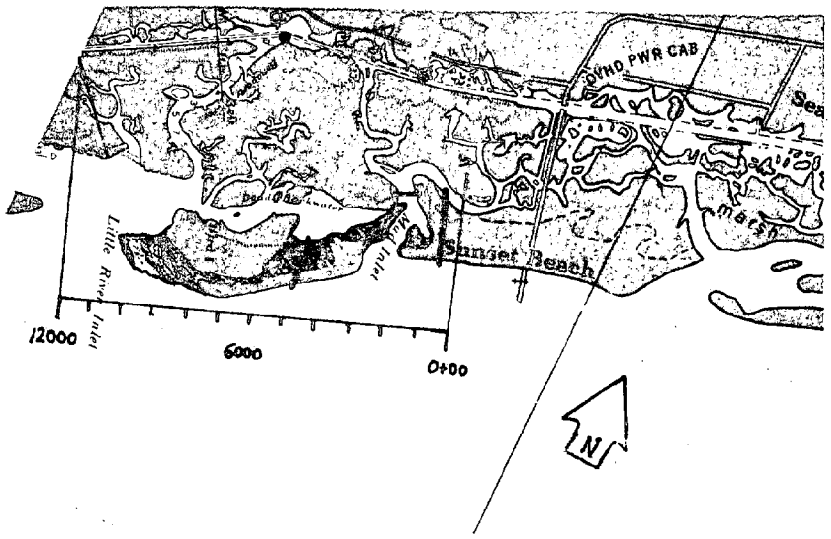
TUBBS INLET

Photographs used: 26 Typical grid is # 2

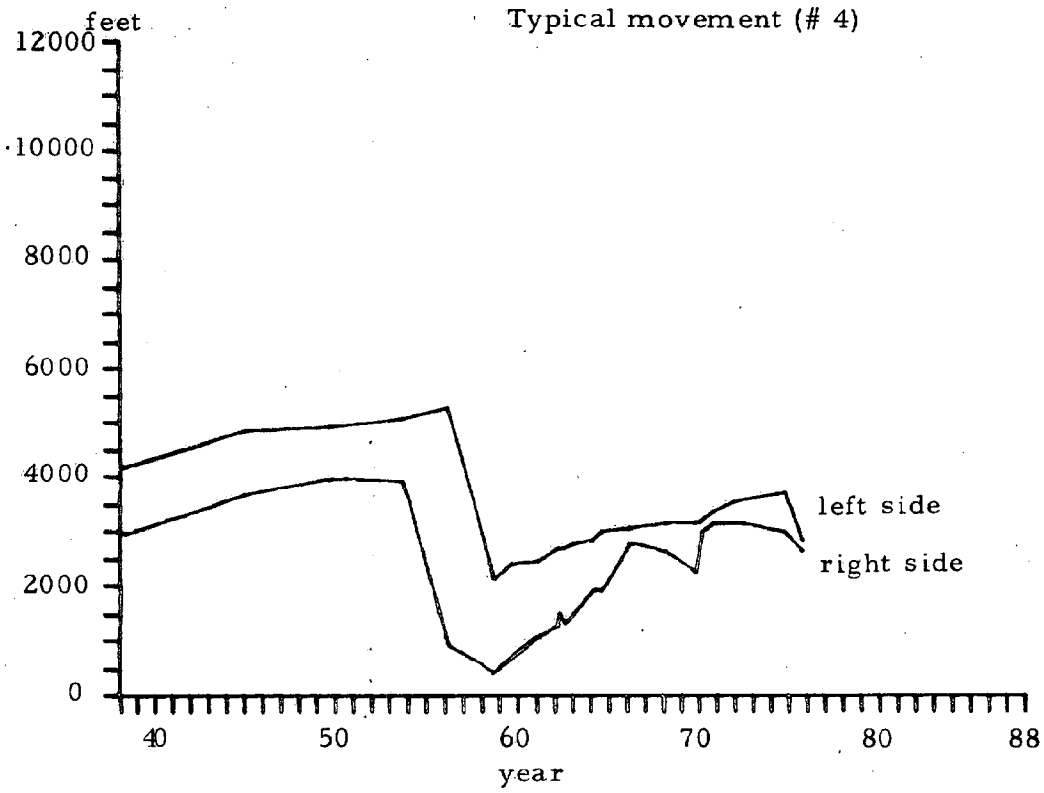
NOTES:

Insufficient data for statistical analysis. Old inlet location moved about 3000 feet (5500 to 8500) to the west from 1938 until it was closed artificially in 1970. It was artificially reopened in another location (5000) a few months later, and has widened with an apparent eastward drift since then.

LEFT SIDE	RIGHT SIDE
Moderately developed; high development potential.	Light development; high development potential.
Insufficient statistical data.	Insufficient statistical data.
Recommended line as shown on map.	Recommended line as shown on map.


Sunset Beach
Little River Inlet
12000
6000
0+00
N

MAD INLET


Typical movement (# 4)
feet
12000
10000
8000
6000
4000
2000
0
40
50
60
70
80
88
year
left side
right side

INLET HAZARD AREA RECOMMENDATIONS

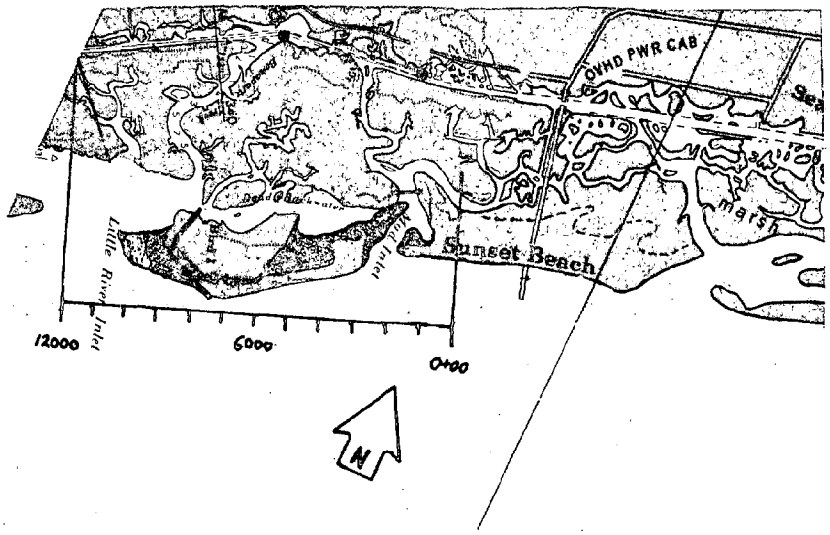
MAD INLET

Photos used: 23 Typical grid is #4

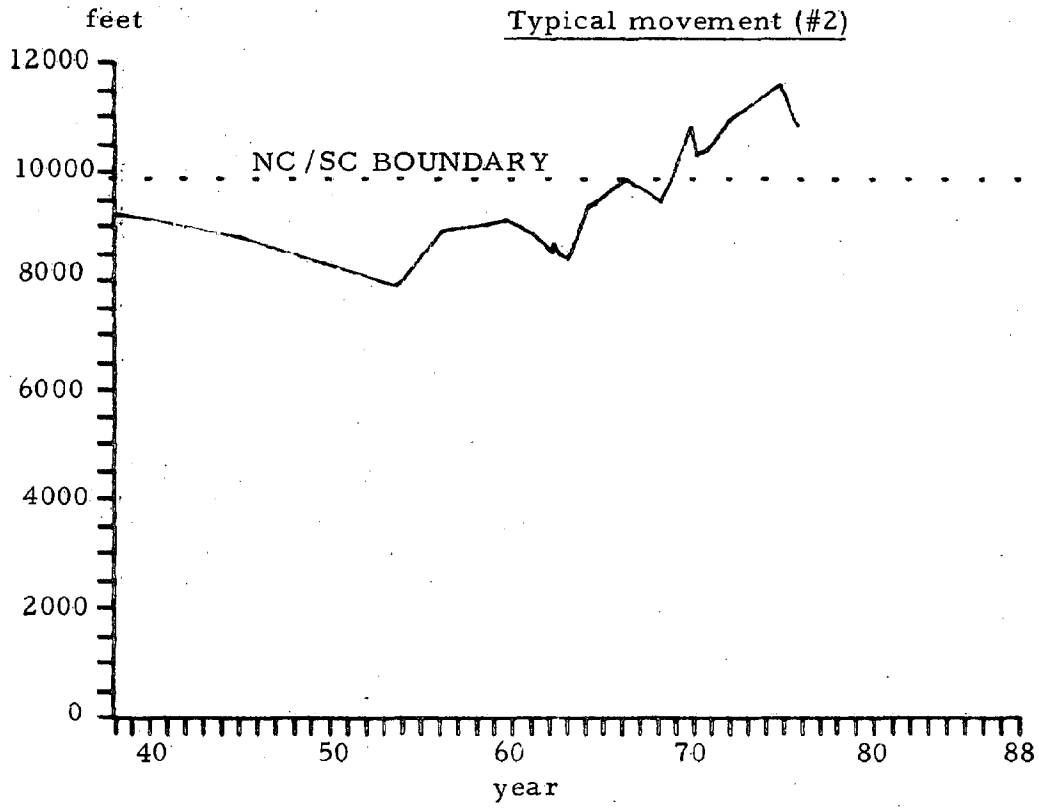
NOTES:

Minor, unstable inlet; wide excursion since 1938 (500 to 5000) makes statistical predictions weak. Inlet throat has narrowed from 1700 feet to 200 feet since 1960 and the inlet may be subject to closing completely.

LEFT SIDE	RIGHT SIDE
Undeveloped; moderate development potential.	Moderately developed; high development potential.
Weak statistical trends.	Weak statistical trends.
Recommended line as shown on map.	Recommended line as shown on map.



LITTLE RIVER INLET (Right side only)



INLET HAZARD AREA RECOMMENDATIONS

LITTLE RIVER INLET (Right side only)

Photos used: 23 Typical grid is #2

NOTES:

Prehistoric, navigable inlet forms mouth of Little River. Generally accepted as a rough border between North and South Carolina, however migration trends since 1955 have moved the entire inlet well into South Carolina.

LEFT SIDE	RIGHT SIDE
In South Carolina	Undeveloped; moderate development potential. Shoreline presently in S. C. Recommended line as shown on map.

APPENDIX

MEMORANDUM OF AGREEMENT

Involved Agencies: Office of Coastal Management
Division of Marine Fisheries
Coastal Resources Commission

Purpose

This is an agreement between the Office of Coastal Management (OCM) which provides primary staff support to the North Carolina Coastal Resources Commission (herein called the COMMISSION), and the N. C. Division of Marine Fisheries, Research and Management Section and Graphic Services Section (herein called the DIVISION), engaging the Division to perform certain duties as outlined herein relative to developing a methodology or methodologies for delineation of ocean hazard areas and applying this methodology to existing North Carolina inlets in order to establish the boundaries of areas of environmental concern.

Contract Period

This agreement shall cover the period from July 1, 1977 to February 28, 1978.

Authority

The North Carolina Coastal Area Management Act (hereinafter referred to as CAMA), was enacted in 1974 by the N. C. General Assembly to bring resource planning and management to the coastal area. A major portion of funding for implementation of CAMA was provided through the Federal Coastal Zone Management Act of 1972. The CAMA established a "Coastal Resources Commission" and delegated to the Commission the authority to establish certain "Areas of Environmental Concern" (herein referred to as AECs) as well as regulatory authority over these AECs once they are established. The AECs are intended to identify critical areas in the coastal area that, because of their nature, connote some special management technique of land use control within this area.

Problem

Due to the lack of detailed information about inlets with regard to their hazardous potential to adjacent development, the Commission finds it useful to obtain more information and develop specific techniques for identifying hazard areas adjacent to inlets.

Objective

The Division will develop and apply a Commission approved method for the identification and delineation of hazard areas adjacent to existing inlets for use by the Commission in Designating Inlet Lands AECs in the vicinity of inlets.

FY 1977-78

A. After the decision has been made by the Commission as to what method is most desirable, the Division would initiate application of the appropriate technique in establishing AEC boundaries on all inlets. Sixty percent of the inlets will be completed during the current contract period. It is expected that all the inlets will be completed by June 30, 1978.

B. The Division shall draft on photobase mylars supplied by the OCM a line representing the extent of AEC boundaries on all inlets using the approved procedure.

ESTIMATED BUDGET

		FY 1976-77
a.	Salaries and Fringe Benefits	$5,550
b.	Photographic, drafting, and graphic materials (for in-house darkroom)	900
c.	Aircraft time	300
d.	Travel	200
e.	Statistical Consultant @ $20/hr. (2 1/2 hrs.)	50
	Project Totals	$7,000

Conditions

The Division hereby agrees to abide by all provisions and conditions of NOAA Grant #04-6-158-44095, which is made a part hereof by reference and is attached.

Ownership of all equipment purchased pursuant to this agreement, including photography and map cabinets, will be retained by the OCM.

Quarterly performance reports will be submitted by the Division to the OCM for inclusion in the CZM program report to NOAA.

Continuation of this Agreement past February 28, 1978 is dependent upon the availability of adequate funds in the approved coastal zone management budget to support the described project.

MEMORANDUM OF AGREEMENT

Involved Agencies: Office of Coastal Management
Division of Marine Fisheries
Coastal Resources Commission

Purpose

This is an agreement between the Office of Coastal Management (OCM) which provides primary staff support to the North Carolina Coastal Resources Commission (herein called the COMMISSION), and the N. C. Division of Marine Fisheries, Research and Management Section and Graphic Services Section (herein called the DIVISION), engaging the Division to perform certain duties as outlined herein relative to developing a methodology or methodologies for delineation of ocean hazard areas and applying this methodology to existing North Carolina inlets in order to establish the boundaries of areas of enviornmental concern.

Contract Period

This agreement shall cover the period from March 1, 1978, to August 30, 1978.

Authority

The North Carolina Coastal Area Management Act (hereinafter referred to as CAMA), was enacted in 1974 by the N. C. General Assembly to bring resource planning and management to the coastal area. A major portion of funding for implementation of CAMA was provided through the Federal Coastal Zone Management Act of 1972. The CAMA established a "Coastal Resources Commission" and delegated to the Commission the authority to establish certain "Areas of Environmental Concern" (herein referred to as AECs) as well as regulatory authority over these AECs once they are established. The AECs are intended to identify critical areas in the coastal area that, because of their nature, connote some special management technique of land use control within this area.

Problem

Due to the lack of detailed information about inlets with regard to their hazardous potential to adjacent development, the Commission finds it useful to obtain more information and develop specific techniques for identifying hazard areas adjacent to inlets.

Objective

The Division will develop and apply a Commission approved method for the identification and delineation of hazard areas adjacent to existing inlets for use by the Commission in designating Inlet Lands AECs in the vicinity of inlets.

FY 1977-78

A. After the decision has been made by the Commission as to what method is most desirable, the Division would initiate application of the appropriate technique in establishing AEC boundaries on all inlets. One hundred percent of the inlets will be completed during the current contract period. It is expected that the inlets will be completed by August 30, 1978.

B. The Division shall draft on photobase mylars supplied by the OCM a line representing the extent of AEC boundaries on all inlets using the approved procedure.

ESTIMATED BUDGET

		FY 1977-78
a.	Salaries and Fringe Benefits	$ 3,600
b.	Photographic, drafting, and graphic materials (for in-house darkroom)	900
c.	Aircraft time	300
d.	Travel	200
	Project Totals	$ 5,000

Conditions

The Division hereby agrees to abide by all provisions and conditions of NOAA Grant #04-7-158-44094, which is made a part hereof by reference and is attached.

Ownership of all equipment purchased pursuant to this agreement, including photography and map cabinets, will be retained by the OCM.

Quarterly performance reports will be submitted by the Division to the OCM for inclusion in the CZM program report to NOAA.

An individual identifying program number shall be set up in the Departmental Accounting System to account for expenditures under this Memorandum of Agreement with appropriate backup receipts. Any portion of the project total unaccounted for on August 30, 1978 shall be forfeited by the Division of Marine Fisheries and no work may be funded after this date.

IN WITNESS WHEREOF, the parties hereto have executed this Agreement as of the 18th day of July, 1978.

THE DEPARTMENT OF NATURAL RESOURCES AND COMMUNITY DEVELOPMENT, FOR THE STATE OF NORTH CAROLINA

Contracting Officer
Deputy Director
Division of Marine Fisheries

Approved by
Department of Natural Resources and Community Development
Witness Connie Hood

OFFICE OF COASTAL MANAGEMENT

Contracting Officer
Executive Secretary
Coastal Resources Commission

Approved by
Department of Natural Resources and Community Development
Witness

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