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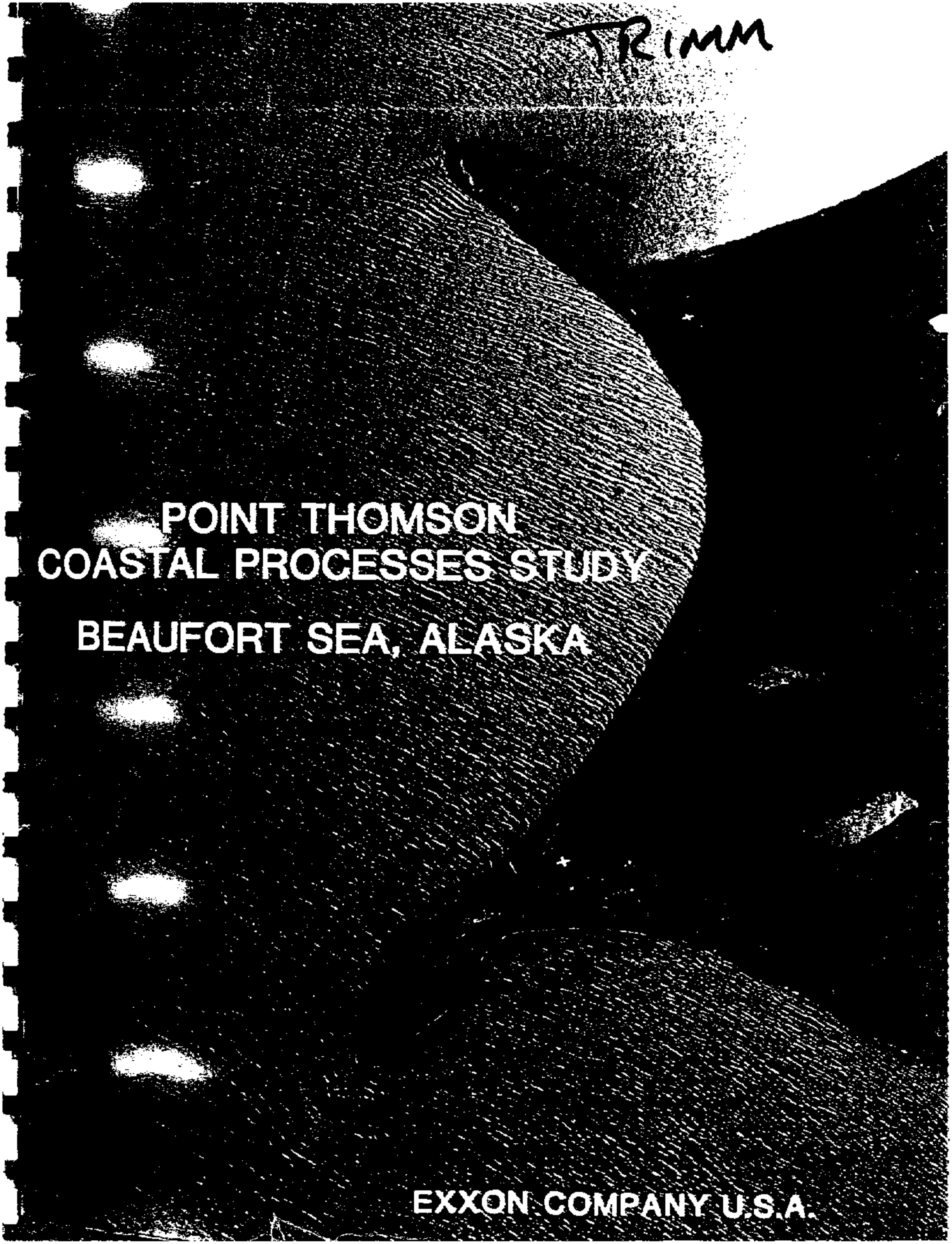

POINT THOMSON COASTAL PROCESSES STUDY

BEAUFORT SEA, ALASKA

EXXON COMPANY U.S.A.

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TEKMARINE PROJECT TCN-033

IRC-0439

PT. THOMSON COASTAL PROCESSES AND SEDIMENT DYNAMICS STUDY BEAUFORT SEA, ALASKA

PREPARED FOR:
EXXON COMPANY U.S.A.
CONTRACT NO. PTD-8206

TEKMARINE, INC.

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JANUARY 1983

EXECUTIVE SUMMARY

This study describes the coastal processes occurring in the Pt. Thomson region of Northern Alaska. The study area is located on the shores of the Beaufort Sea approximately 45 nautical miles east of Prudhoe Bay.

The objectives of the study program are as follows:

- o Establishment of a monumented coastal survey network to allow repetitive measurements of coastal change;
- o Characterization of the coastal processes on the basis of both quantitative measurements taken during the study and historical information found in the literature;
- o Assessment of the implications of the coastal processes as they related to the planning and design of coastal structures in the Pt. Thomson region.

This report describes the results of the study undertaken during the summer of 1982 in which all of the tasks listed above were accomplished.

Geographically, the study area is divided into two distinct parts. The coastal portion consists of a total of 14 nautical miles of continuous shoreline located on the mainland. A chain of barrier islands consisting of Flaxman, Mary Sachs, North Star, Duchess, and Alaska Islands, and an independent shoal located three nautical miles west of Challenge Island, comprise the offshore portion of the study region.

Two field trips were undertaken during the summer of 1982. During the first field trip, a total of 67 monumented coastal transects were established, and such tasks as detailed surveying of beach profiles, sediment sampling, morphological reconnaissance, and photographic documentation were performed. During the second field trip, each transect was recovered and re-profiled to quantify the changes associated with the intervening period between the surveys.

The survey results show that the shores of the mainland coast are the most stable within the study area. This is due, in part, to the sheltering effect of the offshore islands. In contrast, the offshore islands are quite dynamic. The high northern bluff of Flaxman Island is eroding continuously at a long-term rate of 12 feet/year, based on a survey comparison spanning the 1955-1982 period. This bluff erosion supplies a portion of the beach sediment that nourishes the barrier island complex located to the west.

The barrier islands are constantly undergoing changes in form and location. Typical changes that have been documented include island migration, inlet formation and filling, and fluctuations in shoreline position occasioned by brief, yet extreme, storm events. These islands actively respond to persistent easterly wind and waves resulting in a westward long-term migration that averaged 80 feet/year during the 1908-1982 period. The observed correlation of shoreline configuration with the submerged longshore bars suggests that the underwater topography in the nearshore zone may be just as dynamic.

To utilize the dynamic landforms within the study area as sites for oil development, it is recommended that coastal set-back distances be respected so as to separate the new facility from the active bluff or shore. This strategy of hazard avoidance is deemed to be less expensive than to attempt to control the erosion by artificial means.

The conceptual design of coastal drilling pads has been performed for four distinct zones within the study area. These zones include the high mainland shore, the low mainland shore, the Flaxman Island surface bordered by the eroding bluff, and the low-lying barrier island/lagoon environment.

A conceptual design has been performed for a gravel causeway to connect the mainland shore to Flaxman Island. The perceived environmental impacts associated with such a structure are the localized degradation of water quality within the lagoon and the impoundment of littoral sediments by the causeway structure. Possible mitigative actions include the construction of causeway breaches to allow transfer of water across the structure and the physical transport of impounded sediment at the causeway to adjacent locations where the protective beach cover has been lost.

Based on the results of this study, it is deemed feasible to construct and maintain oil exploration and production facilities within the Pt. Thomson study area. It should be emphasized, however, that coastal structures, once constructed, should be monitored in order to ensure minimum adverse influence on or by the dynamic processes of the Arctic coast, an environment which has just recently been subject to serious scientific scrutiny.

While the long-term coastal changes within this region are predictable, the range of short-term fluctuations are not well defined due to the absence of data collected during consecutive years. Repetitive surveying of the recently established coastal transect network will allow a more definitive view of the short-term variability of Arctic coastal processes and the resultant effects on proposed coastal facilities.

Acknowledgements

The authors are extremely grateful to a number of individuals who allowed this study to be conducted in a timely and efficient manner. We greatly appreciate the overall guidance provided by Mr. Ashley Erwin of Exxon Company U.S.A. for his efforts in directing and monitoring the progress of the study. Drs. Robert Gordon and Martin Miller of Exxon Production Research provided untiring assistance and scientific insight during the Arctic field operations. The staff of the Exxon operations center at Deadhorse, Alaska, deserves special thanks for the service which was provided in support of overall logistics, field communications, and lodging.

Members of the field team who assisted ably and enthusiastically in the Arctic data collection deserve commendation from the authors. These individuals include Mr. Ashley Erwin of Exxon Company U.S.A., Drs. Robert Gordon and Martin Miller of Exxon Production Research, and Dr. Choule Sonu and Messrs. Robert Gould and John D'Auria of Tekmarine, Inc.

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1. INTRODUCTION

This study characterizes the coastal processes that occur in the Pt. Thomson region of Northern Alaska and derives the engineering implications of these processes as they relate to the planning and design of coastal oil development facilities. More specifically, the objectives of the study program are as follows:

- Establishment of a monumented coastal survey network to allow repetitive measurements of coastal change;
- Characterization of the coastal processes on the basis of both quantitative measurements taken during the study and historical information found in the literature;
- Assessment of the implications of the coastal processes as they relate to the planning and design of coastal structures in the Pt. Thomson region.

This report describes the results of the study undertaken during the summer of 1982 in which all of the tasks listed above were accomplished. It must be cautioned, however, that the results of the data collected during a single summer may not prove to be characteristic of this complex Arctic environment. For this reason, the conclusions drawn in this report should be considered provisional, and subject to refinement as additional data becomes available.

The study area is located approximately 45 nautical miles east of Prudhoe Bay on the shores of the Beaufort Sea. As shown in the Location Map, Figure 1.1, the study area is bounded by longitude 146°45'W (two nautical miles east of Bullen Point) and longitude 146°05'W (4.5 nautical miles west of Brownlow Point).

Geographically, the study area is divided into two distinct parts. The coastal portion consists of a total of 14 nautical miles of continuous crenulated shoreline located on the mainland. A chain of barrier islands consisting of Flaxman, Mary Sachs, North Star, Duchess, and Alaska Islands, and an independent shoal located three nautical miles west of Challenge Island, comprise the offshore portion of the study region.

Two field trips were undertaken for the purposes of data collection during the summer of 1982. During the first field trip (July 19-27), a total of 67 monumented coastal transects were established, and such tasks as detailed surveying of beach profiles, sediment sampling, morphological reconnaissance, and photographic documentation were performed. During the second field trip (August 31 - September 7), each transect was recovered and re-profiled to quantify the changes associated with the intervening period between surveys.

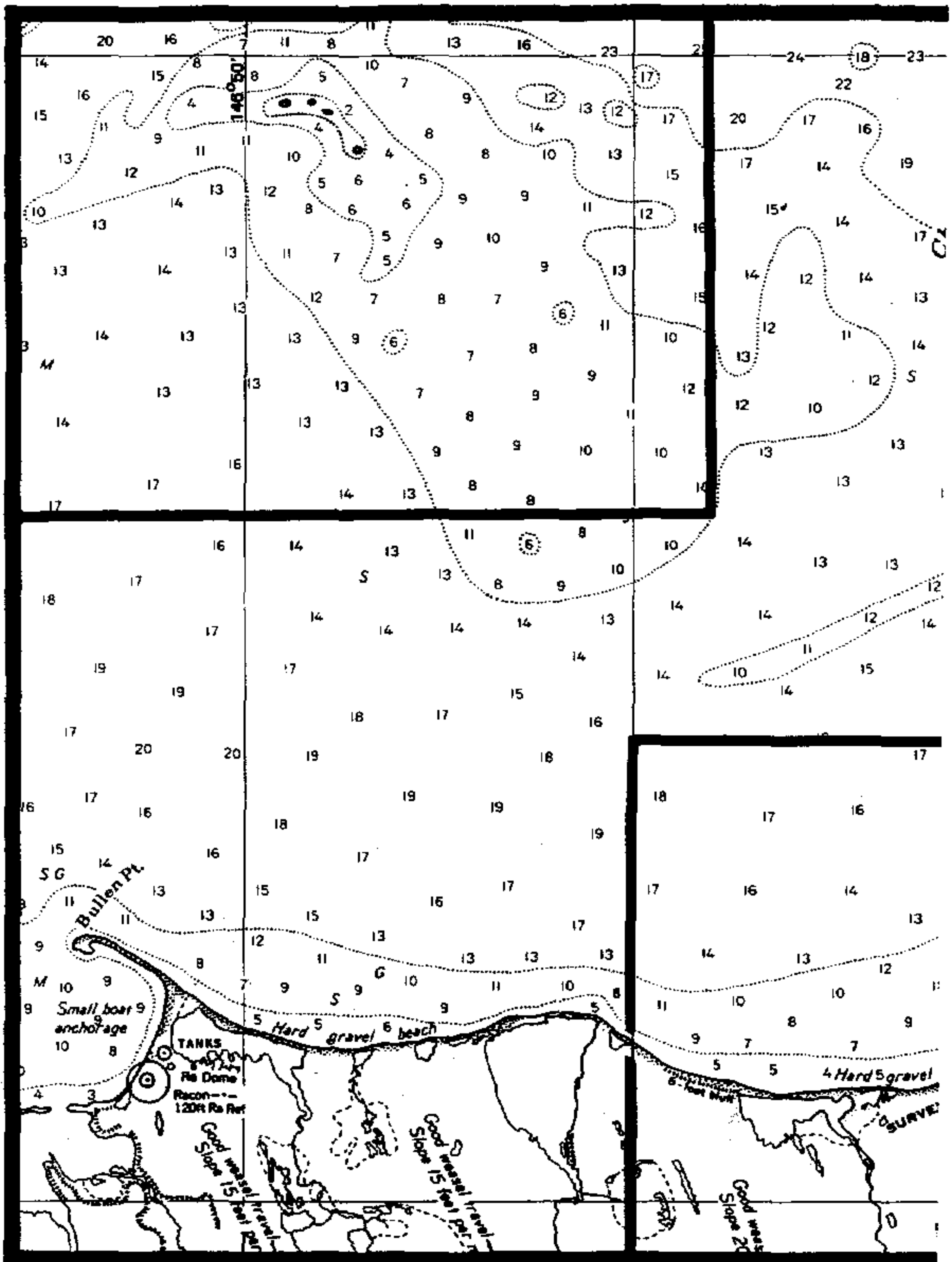

FIGURE 1.1

PT. THOMSON STUDY AREA

PT. THOMSON DEVELOPMENT PROJECT
COASTAL PROCESSES AND SEDIMENT DYNAMICS
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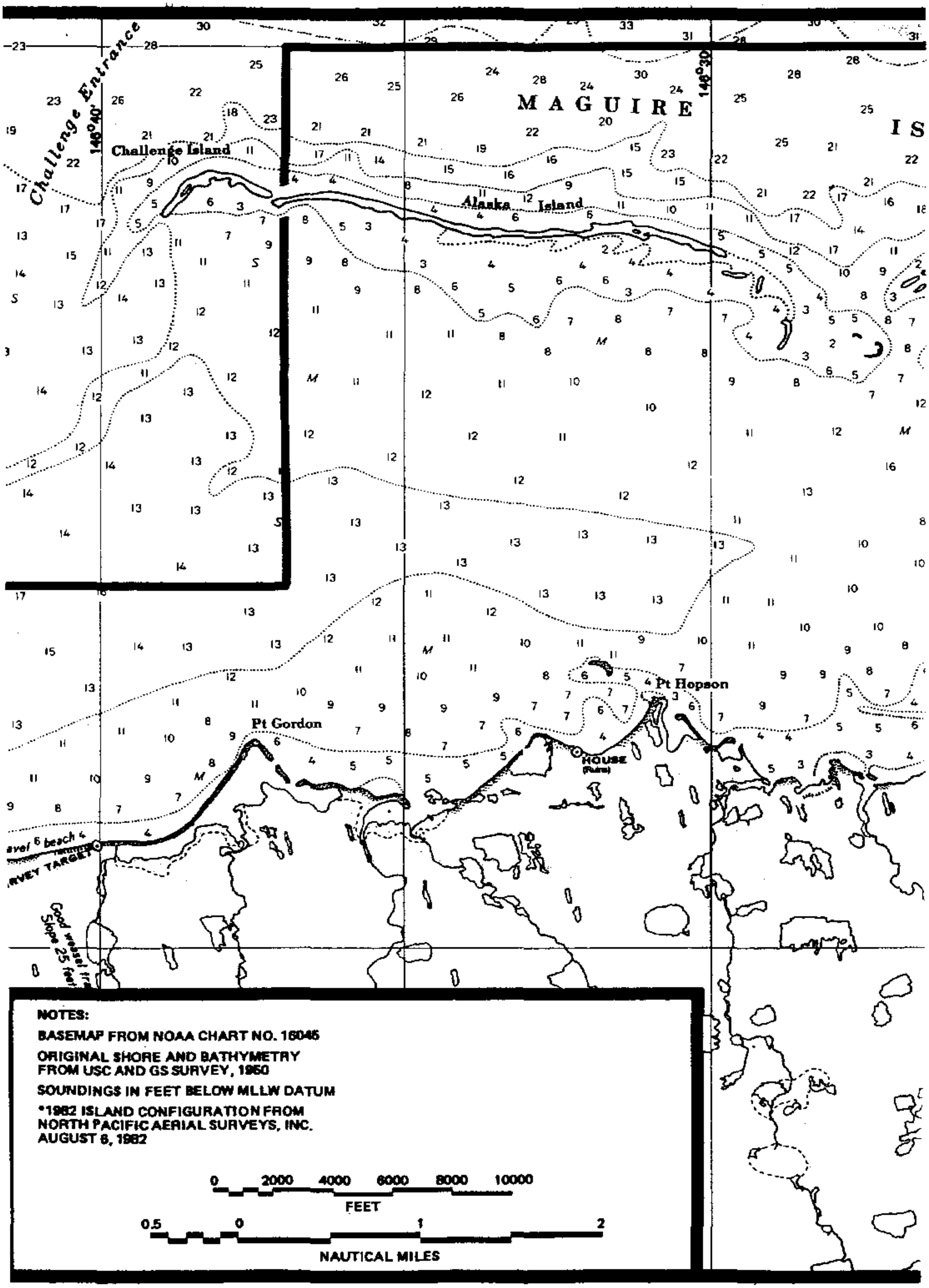
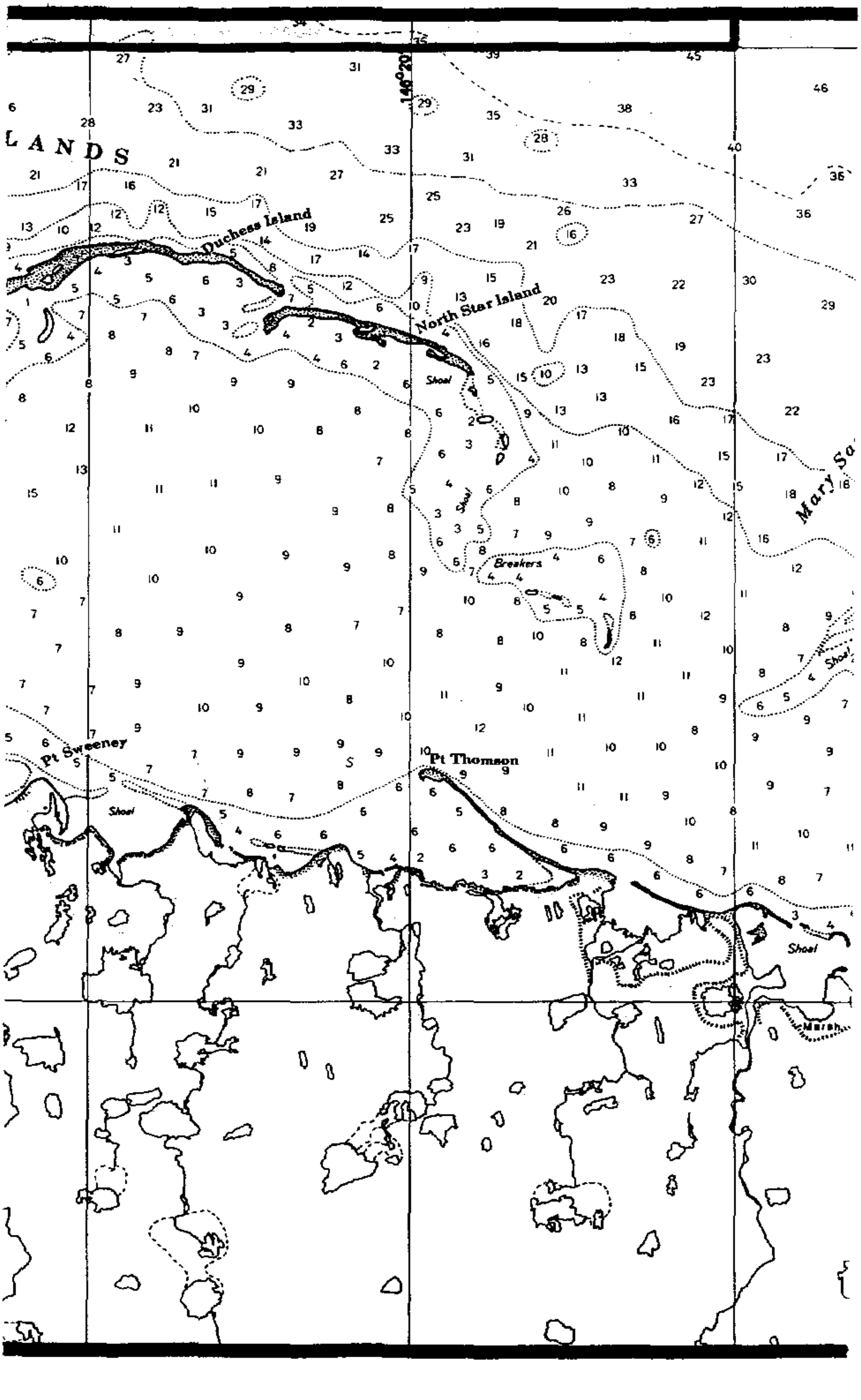
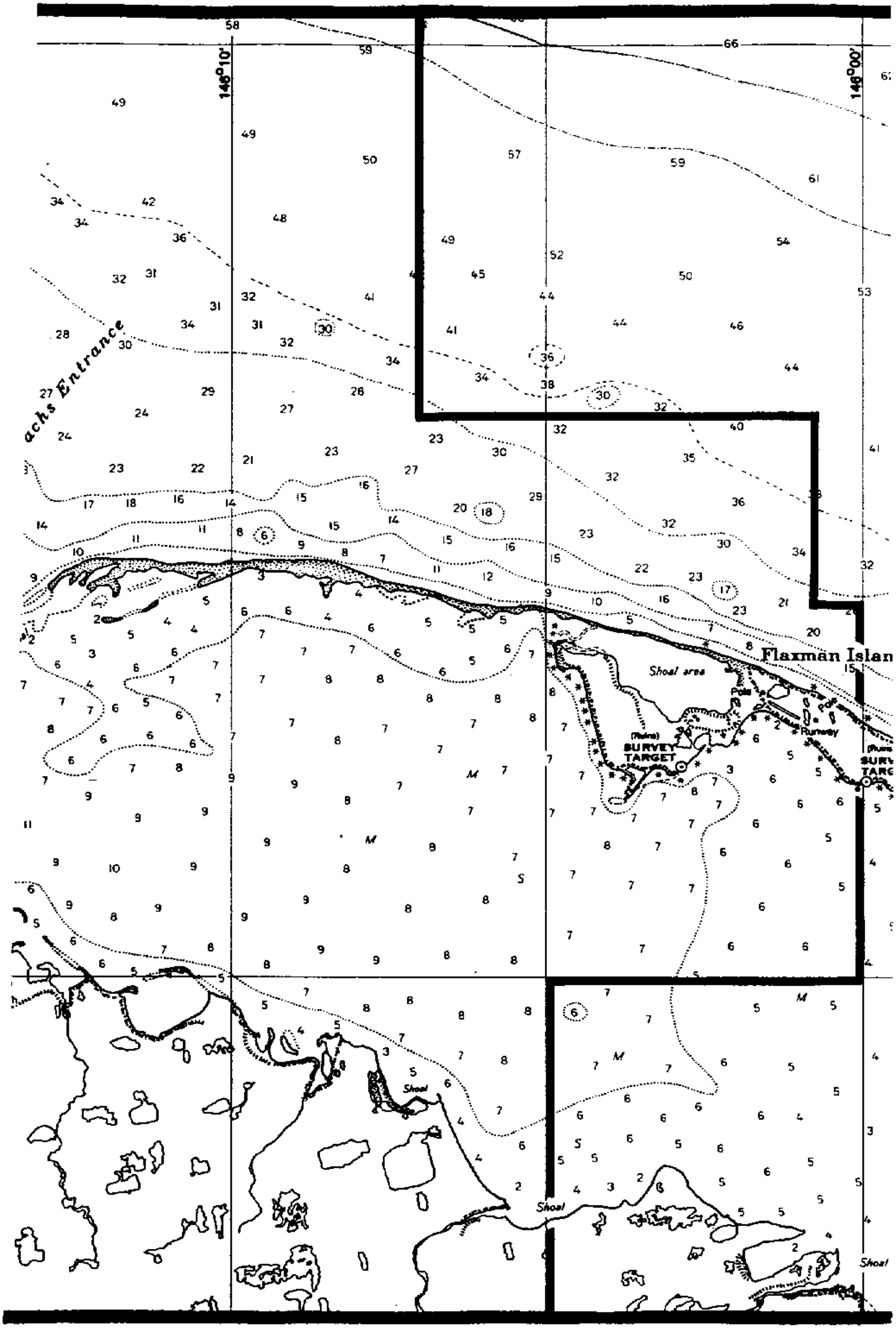
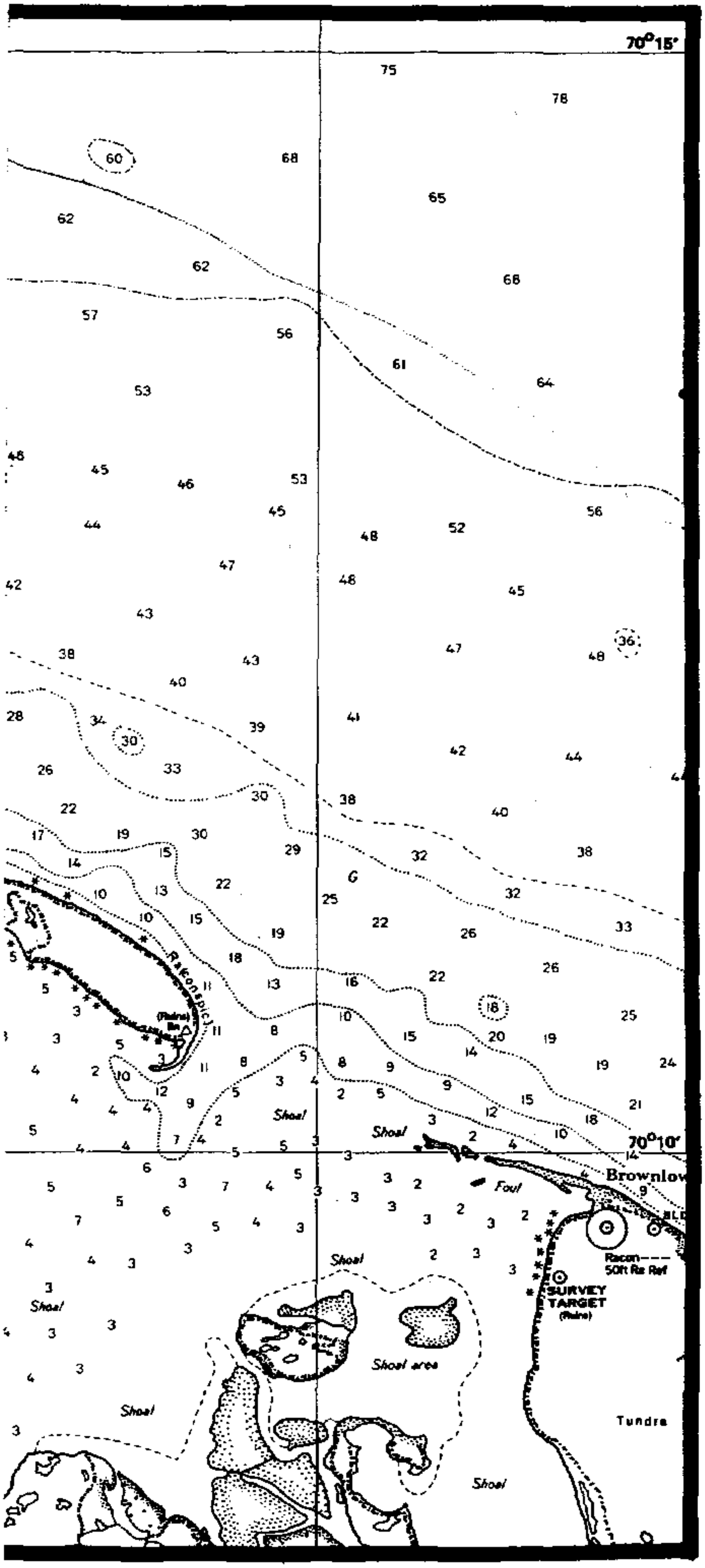


Challenge Entrance
146°40'
Challenge Island
MAGUIRE
IS
146°30'
Alaska Island
Pt Hopson
Pt Gordon
HOUSE
(Ruins)
SURVEY TARGET
NOTES:
BASEMAP FROM NOAA CHART NO. 16046
ORIGINAL SHORE AND BATHYMETRY FROM USC AND GS SURVEY, 1950
SOUNDINGS IN FEET BELOW MLLW DATUM
*1982 ISLAND CONFIGURATION FROM NORTH PACIFIC AERIAL SURVEYS, INC. AUGUST 6, 1982
0 2000 4000 6000 8000 10000
FEET
0.5 0 1 2
NAUTICAL MILES



LANDS
Duchess Island
North Star Island
146°20'
Shoal
Breakers
Pt Sweeney
Pt Thomson
Marsh


146°10'
146°00'
achs Entrance
Flaxman Islan
Shoal area
Pole
(Ruins)
SURVEY
TARGET
Runway
Shoal



70°15'
70°10'
Brownlow
Racon
Racon
50ft Rz Ref
SURVEY
TARGET
(Ruins)
Shoal
Shoal area
Foul
Tundra

2. STUDY AREA OVERVIEW

2.1 Environmental Setting

The Arctic climate has a major influence on the coastal conditions and changes of the Pt. Thomson study area. The Beaufort Sea is ice-covered for most of the year with a brief open-water season occurring usually from mid-July to early October. The astronomical tides of this region are quite small (less than a foot of total tidal range occurs) and are subordinate to sea level changes associated with high wind conditions and barometric pressure effects.

Wave energy impacting the coastline is generally small, limited by the proximity of the Arctic ice pack which remains relatively close to shore during the summer months. Infrequent northeast and northwest storms can create storm waves that can cause erosion of the mainland coast and the offshore islands. Also, high speed westerly winds can cause super-elevation of the ocean surface with the resultant waves and storm surge causing inundation of the low-lying coastal areas and overtopping of certain segments of the offshore barrier islands.

Following the ice break-up of June or July, the coastal beaches and offshore islands are disrupted by moving ice pushing onshore. Furrows and ridges 20 to 30 feet long and three to five feet high may be "bulldozed" on exposed beaches. Government surveyors reported that following the winter of 1949-1950, ridges of gravel five to eight feet high were created by ice push that extended 50 to 70 feet inshore from the water line (notes occurring on USC&GS Hydrographic Survey No. 7851, 1950). Also during early summer, the low coastal bluffs of the region begin to thaw, creating mud flows which escape from the bluff to the beach below. As the thawing continues, "thermal erosion" of the bluff occurs which is a major cause of shore recession in this area.

In late summer, high winds can affect the area creating water level fluctuations and intensified wave impact. During this period, sea ice may again be driven onshore. Most of the major sediment movement and the related coastal changes -- bluff retreat, beach erosion, sand spit elongation or truncation, island movement, and island inlet formation or closing -- occur during the late summer - early autumn period.

In the late fall, the beaches of the study area become sheathed in ice and snow thereby protecting them from the effects of waves and minor ice incursions throughout the winter months.

The Arctic coastal plain is underlain by a series of alluvial and glacial outwash fans extending northward from the Brooks Range. These fans consist mainly of sand and gravel and tend to extend to the coast. In some areas (particularly, Flaxman Island), the coastal veneer consists of a peculiar matrix of marine sandy mud which contains glaciated pebbles, cobbles, and boulders that are quite different in lithology from the gravel of Brooks Range origin that is commonly found in the alluvial fans of the region. This geologic material -- termed the "Flaxman formation" -- contains a suite of pebble types that is completely different from those found in the alluvial and glacial deposits associated with streams draining the Brooks Range (Hopkins and Hartz, 1978).

The Flaxman formation underlies Flaxman Island and large mainland areas east of the Canning River. Components of this formation, owing to the on-going erosion of Flaxman Island, are found in the sediments of the barrier islands to the west.

The mainland coast of the study area is crenulated and deeply embayed. Offshore, Flaxman Island and the Maguire Island chain provide a nearly continuous barrier to northeasterly wave energy. Thus, easterly wave energy striking the mainland coast must be generated within the lagoon located south of the island chain. To the west, no island protection exists in the immediate vicinity to limit the fetch of westerly storms.

The mainland shore is characterized by narrow, low-lying beaches backed by low coastal bluffs (commonly three to twenty feet high). The beaches are typically 25 to 75 feet wide and normally consist of a very thin veneer of clastic sediment overlying the highly organic tundra foundation.

The sand and gravel that form the beaches of the study area are derived from alluvial discharge from the rivers of the region and from the erosion of coastal bluffs. Some investigators believe that rivers of the region do not contribute significantly to the sediment budget, as most of the alluvial bedload is presumed to be deposited inland with only the finer sediment fraction being discharged at the river mouths (Hopkins and Hartz, 1978). Based on a study of the massive sediment discharge of the Colville River (Arnborg, et al., 1966), it is our belief that the sediment contributions of major rivers like the Canning River should not be disregarded in terms of beach sediment contribution to the nearshore zone.

The direction of littoral sediment drift is generally westward under the persistent easterly winds of the region. However, wave refraction and the crenulated coastline induce local reversals both onshore and on the arcuate barrier islands. Due to the generally low wave activity during the brief open-water season, the total volume of alongshore sand transport is quite small relative to beaches of more temperate latitudes.

The bluffed portions of the mainland coast and Flaxman Island are affected by thermal erosion -- a formidable erosive agent in this region. Thermal erosion is most effective and rapid along bluffs that are ice-rich, having high percentages of frozen mud, silt, and fine sand. Thawing and erosion of bluffs containing gravel and sand deliver substantial volumes of beach sediment that subsequently protect the bluff from wave-induced undercutting. The high rate of on-going erosion, particularly on Flaxman Island, provides substantial volumes of beach sediments to nourish the beaches and barrier islands of the downdrift coast.

The barrier islands of the study area extend westward from the tundra-veneered Flaxman Island. These islands, composed of unconsolidated sand and gravel, are low-lying (2 to 4 feet maximum elevations), arcuate, and exhibit major features that may change dramatically with time. The barrier islands are separated by major inlets that may be relatively deep (8 - 12 feet) and wide (1/2 to 2 nautical miles). In addition, a long, seemingly continuous barrier may be segmented by very narrow and shallow inlets, such as the one that formed between Flaxman and Mary Sachs Islands during the 1955 - 1982 period.

As these islands are attacked by the persistant easterlies, the general trend is for growth of the islands' westward extremities. This mechanism of island extension, termed "island migration", has created a long-term westward movement of the islands of the Maguire group that is judged to be on the order of 80 feet/year (Wiseman, et al., 1973). In terms of coastal processes, the rapid changes of island shape and relative location caused by island migration, development of new inlets, and filling of old inlets is the most dynamic aspect of the study area.

Hopkins and Hartz (1978) surmise that the Maguire Islands and possibly the Stockton Islands to the west were originally derived from the bluff erosion of Flaxman Island. This speculation implies that Flaxman Island was, at one time, a much larger source of sedimentary material than it is today. The discontinuous nature of the island chain at this time is due to storm-generated breaching of the narrow barrier islands which, in the case of the largest inlets, is irreversible due to tidal deepening and the diminishing supply of beach sediments generated by Flaxman Island bluff erosion.

Long-term shoreline comparisons indicate that the barrier islands are migrating with little loss of surface area (Hopkins and Hartz, 1978). During storm surge events, waves overwash the island shores thereby driving sediment at the waterline up and onto the main island body. On-shore ice motion can drag or pluck coarse lag material from deeper waters onto the island surface. It is speculated, however, that with time, as Flaxman Island continues to erode, the downdrift coast and Maguire Island chain will slowly diminish in areal extent (Hopkins and Hartz, 1978). The ultimate result will be a loss of the critical mass required to withstand the ambient wave and ice forces leading to subsequent island erosion and submergence.

2.2 Review of Pertinent Literature

The first recorded visit of a western explorer to the shores of the Beaufort Sea was described in the chronicles of the British expedition of 1826, led by Sir John Franklin. The primary focus of this and subsequent early exploration efforts was for mapping purposes and to add to the meager amount of Arctic information that existed at the time. A large number of English, American, and Canadian explorers ventured into the region during the late 1800's. A number of mapped features now bear the names of those early explorers -- Franklin Bluffs, Beechy Point, Simpson Lagoon, Dease Inlet, Maguire Islands, Stockton Islands, Steffanson Sound. Because the early exploration efforts charted land forms and islands at small scale with imprecise survey techniques, few direct comparisons with more modern data are possible. The value of the expeditions that took place prior to 1900 is in the written descriptions of the landscape and navigable passes from which some correlation to the present condition is possible.

In 1906, Ernest Leffingwell, under the auspices of the American Geographical Society, undertook the first comprehensive mapping and geological exploration effort in the Alaskan Arctic. Maps that he created are sufficiently detailed and precise to allow comparison to surveys undertaken in more recent periods. Because Leffingwell's base camp for the entire study period (1906 - 1914) was located on the south shore of Flaxman Island, the region of interest presently was discussed and mapped in detail as a portion of his study.

Leffingwell's contribution to the existing body of Arctic knowledge was formidable. His mapping efforts provided the first precise and comprehensive charts of the entire Arctic coast. His geological reconnaissance proved to be extensive and credits him with discovery of the Sadlerochit formation -- the source of the Prudhoe Bay oil field.

The literature dealing with the Pt. Thomson area becomes sparse following Leffingwell's contribution. In the late 1960's and early 1970's, following the discovery of the large Prudhoe Bay oil field, various investigators undertook significant studies of the Arctic coastal zone. Some of these studies were sponsored by the Department of Defense (Wiseman, et al., 1973) and the U.S. Geological Survey (Barnes, et al., 1977; Hartz, 1978). By the mid-1970's, the U.S. Departments of Commerce and Interior were sponsoring numerous studies to collect and assess environmental information to support oil development planning. These studies, under the program entitled "Environmental Assessment of the Alaskan Continental Shelf", contributed greatly to the oceanographic and coastal zone data base that had been developed previously. Significant contributions documenting the shoreline processes within or near the Pt. Thomson study area include Barnes and Reimnitz, 1974; Barnes, et al., 1977; Hopkins, et al., 1977, Hopkins and Hartz, 1978; Lewellen, 1977; and Reimnitz and Toimil, 1977. In the following section of the report, the results of these previous investigations will be reviewed to establish an understanding of the coastal dynamics within the study area.

In time, this information will be compared to the findings of the current study to determine the extent of conformity to the findings of earlier investigations.

2.3 Historical Data Comparison, 1826 - 1955

The majority of the most recent studies of coastal processes within the study area utilize information gleaned from the following major sources:

- The written descriptions of pre-1900's expeditions;
- The descriptions and charts prepared by Ernest Leffingwell (Leffingwell, 1919);
- The government survey data used for nautical charts and mapping purposes primarily during the 1950 - 1955 period;
- Aerial photos collected since 1950.

Thus, a large proportion of these references develop data comparisons (shoreline and bluff position, island location and form, land form elevations) that reflect the conditions which existed prior to the mid-1950's. The intent of this study is to up-date this information to the summer of 1982 and to place the recent findings in the broader perspective of the historical data.

2.3.1 Mainland Shore

As described previously, the mainland shore of the study area is scalloped with a large number of sinuous sand and gravel spits projecting from the tundra promontories.

In a number of areas, eroding coastal bluffs having heights of 3 to 20 feet are separated from the waterline by a narrow sand and gravel beach.

The erosion rates of the coastal bluffs of this region have been measured by numerous investigators. Hopkins and Hartz (1978) report an average recession rate of the bluffs between Tigvariak Island and Pt. Thomson of seven feet/year. East of Pt. Thomson, Lewellen (1977) has two survey sites which show an average erosion rate of 22 feet/year. Leffingwell calculated a high bluff recession rate of 30 feet/year on Brownlow Point based on observations by the early prospector Arey. While these retreat rates are impressive, it is curious that a number of the prominent coastal features of the mainland appear to have maintained similar shape during the period since the Leffingwell survey, conducted around 1910. Leffingwell's map of the study area, published in 1919, is presented as Figure 2.1. In comparing this chart with the most recent NOAA chart (1950-1955), displayed as Figure 1.1, it is remarkable that certain small mainland features (sand bars, spits, small islets) have exhibited little change during the 1910-1950 period. Additionally, the most recent work has indicates that the 1982 shoreline is extremely similar to that charted by NOAA in the 1950's. Therefore, one must conclude that while localized zones may exhibit high rates of change, the mainland shore generally appears to be highly stable, in part due to the sheltering effect of the offshore islands.

Leffingwell (1919) emphasizes that certain shore areas have remained stable for centuries. He refers to the ancient, decaying timber structures located near Barter Island and Collinson Point. The fact that these man-made

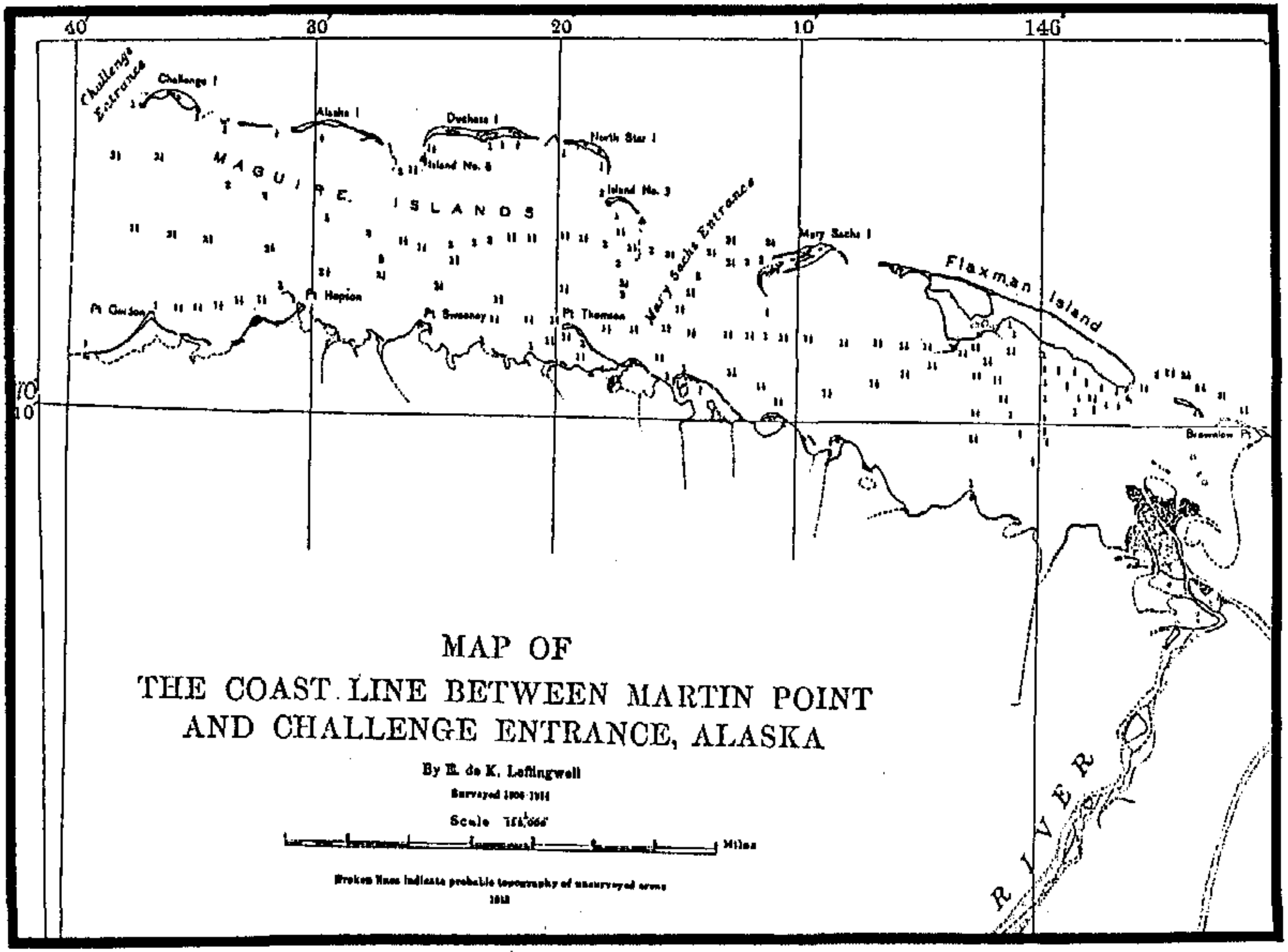


FIGURE 2.1 : EARLY CHART OF STUDY AREA, 1906-1914

features still exist is a tribute to the long-term stability of the shores on which they were constructed.

The relatively high rates of erosion seen on the bluffed portion of the coast are due primarily to thermal erosion of the exposed bluff face. On the low-lying shorelines, thermal erosion is not as dramatic due to the insulating cover of beach sand and gravel which overlies the tundra base.

2.3.2 Flaxman Island

Flaxman Island has undergone continuous change since the first observations were made of the island by Franklin in 1826. In his journal, Franklin documents the extreme difficulty with which his shallow draft vessel passed alongside the island's east end. The depth of water through this channel has continually increased since that early observation. Leffingwell (1919) describes the channel as having a depth of eighteen feet during the 1906-1914 study period. He noted the discrepancy between his findings and those of Franklin's concerning the channel depth. The 1950 bathymetric survey conducted by the U.S. Coast and Geodetic Survey (presently NOAA) reported a channel depth of 23 feet. A recent scuba investigation of the channel (Reimnitz and Toimil, 1977) found the present depth to be 34 feet. This information implies that due to the dynamics of the Flaxman Island coastal environment, this inlet is not in equilibrium with the flow regime which presently exists.

The northern shore of Flaxman Island has been actively eroding, as witnessed by various investigators dating back to the Franklin expedition of 1826. Leffingwell observed the erosion throughout the period of his investigation and noted distinct changes in the island shore when compared to the observations by Franklin. Specifically, the island width decreased by at least one-half mile during the 88-year period between 1826 and 1914. In addition, Franklin noted maximum bluff elevations of 40 feet above sea level in 1826. Leffingwell observed that at no location did the island exceed a 25 foot elevation in 1914. Further, drainage lines leading south were identified by Leffingwell that terminated at the northern bluff. This implies that in earlier times, a far greater area had been drained north of the observed shore.

In the small scale map produced by Franklin, the northern shore of Flaxman Island was convex, bulging towards the north. Leffingwell noted a straight shore, as shown in his map (Figure 2.1). The NOAA chart of 1950-1955 (Figure 1.1) shows that the central shore at that time was beginning to become concave, suggesting a process of continual erosion that is on-going to this day. It shall be shown in Section 4 of this report that the concavity of the northern shore is even more pronounced today. Table 2.1 shows the erosion rates for Flaxman Island that can be determined by the survey data spanning the 1826-1955 period.

2.3.3 Barrier Islands

The barrier islands located directly west of Flaxman Island exhibit the most dynamic nature of all the landforms in the study area. Barrier islands, in general, are regarded for the state of continual change in which they exist. Notable changes include island growth, inlet formation, inlet filling, island emergence, and island truncation. Comparison of Leffingwell's map (Figure 2.1) with the NOAA chart of 1955 (Figure 1.1) gives some indication of the magnitude of the changes of island shape and location that occurred between 1910 and 1955. In 1910, Mary Sachs Island was separated from Flaxman Island by an inlet having a width of 2000 feet. By 1955, the two islands had merged together, thereby eliminating Mary Sachs Island. As will be discussed in Section 4, at the present time a small inlet again exists which separates the Flaxman-Mary Sachs complex into two distinct islands.

TABLE 2.1

FLAXMAN ISLAND BLUFF RECESSION, 1826-1955

Year	Island Width At 146°W Longitude (feet)	Erosion (feet)	Erosion Rate (feet/year)
1826	5280		
		2640	30.0
1914	2640		
		634	15.5
1955	2006		

The changes that have occurred in the configuration of the Maguire Islands (North Star, Duchess, Alaska, and Challenge Islands) are presented in Figure 2.2 for the period 1908-1955 (Wiseman, et al., 1973). The lines of longitude indicate a general westward migration of the island group caused by erosion on the eastern shores and sediment deposition on the western island ends. Also, the distinct island shapes change dramatically with time.

Wiseman, et al. (1973) report that between 1908 and 1950, all four of the Maguire Islands migrated westward an average distance of 3,300 feet, or approximately 80 feet/year. Between 1950 and 1955, the western ends of Duchess, Alaska, and Challenge Islands were extended by 1600, 1000, and 500 feet, respectively, or an average of 600 feet/year. This fluctuation in average annual migration rate is believed to be attributed to an abnormal increase in storm activity during the 1950-1955 period.

Thus, the barrier islands of the study area have been identified as highly dynamic sedimentary structures that fluctuate in location and shape in response to the environmental forces of waves, wind, currents, and ice. These islands are bounded by dynamic inlets and are subject to sporadic, rapid, and generally westward sediment transport driven by the persistent easterly winds of the region.

The identification of changes associated with the most recent period (1955-1982) was a primary goal of the field activities of the recent summer. The following report sections will present the study results in detail.

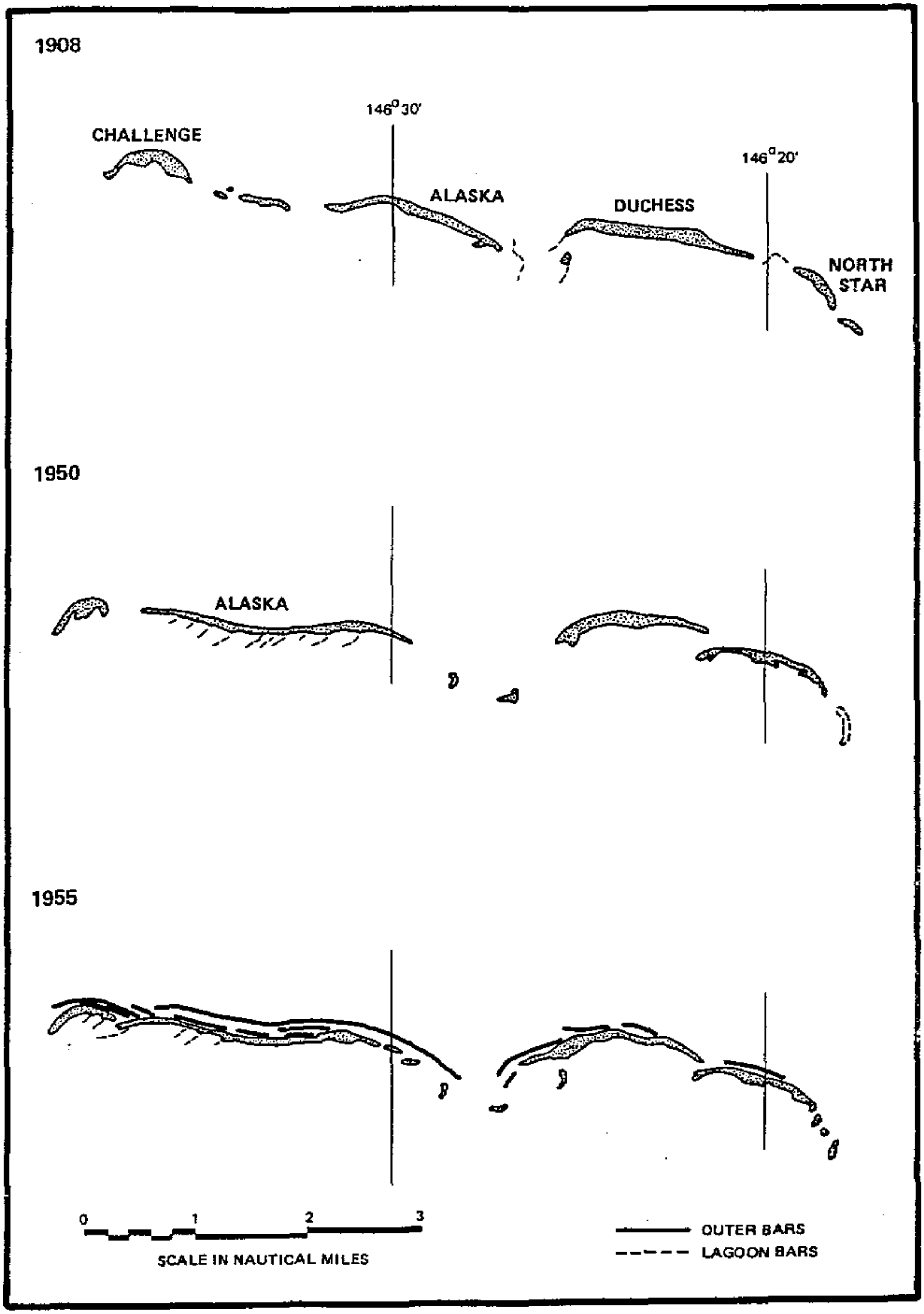


FIGURE 2.2 : MAGUIRE ISLANDS MIGRATION AND CHANGE, 1908–1955

3. SURVEYING METHODOLOGY

The data required to describe the conditions and stability of the shoreline within the study area was collected during an extensive surveying effort performed in July and September, 1982. Coastal transects were selected and profiled at sites that were judged to be representative of the local contiguous shore. In this way, the different coastal environments of the study area were studied to determine the magnitude and character of the shoreline changes which are active within this region.

The surveying tasks consisted of the profiling of beach transects established perpendicular to the shoreline throughout the study area. The initial profiling effort was conducted in late July while a repeat exercise was performed in early September during which all July transects were resurveyed. The profile data collected during the July survey represents a baseline condition of the shoreline in the study area, while the September data reflects the changes which occurred during the brief Arctic open-water season. Comparison of the baseline data with information collected during future surveys will allow multi-season monitoring of the temporal variability of the shoreline profile.

3.1 Survey Network

Prior to the July field trip, a transect location strategy was developed to ensure that all coastal environments of the study area were represented. The strategy resulted in the selection of 67 transect sites spaced at roughly 2000 foot intervals along the mainland and barrier island shorelines. The magnitude of the resultant transect density (3 transects/nautical mile) was considered sufficient to encompass the full spectrum of beach conditions existing in the study area. Beach conditions of interest included direction of exposure to wave attack, expected wave energy, shoreline composition, and coastal features.

At each transect, a permanent reference monument was established as a horizontal and vertical control point. The locations of the 67 monuments and associated transects are presented in Figure 4.6. Inspection of this map indicates that the monuments were sequentially numbered in a counter-clockwise fashion starting on the mainland shore at the western end of the study area near Bullen Point. A distribution of the monument locations by geographical area is presented in Table 3.1.

The exact location of each monument (Alaska State Plane Coordinates, Latitude/Longitude) was obtained by electronically measuring the distance to the monument from two survey control stations. A helicopter-borne electronic navigation system (Motorola Mini-Ranger Mark III) was utilized for this purpose. The positioning data developed for the coastal monuments (Mini-Ranger ranges from established triangulation stations, planar coordinates, and latitude/longitude) are presented in Table 3.2.

It should be noted that with one exception, all of the monuments were established by Tekmarine. Monument #65 is an existing NOAA triangulation station designated "Thin, 1949".

TABLE 3.1

MONUMENT PLACEMENT DISTRIBUTION

Region	Sequential Transect Nos.	Length of Coverage* (Nautical Miles)	Number of Monuments	Transect Density (Transect/Nautical Mile)
Mainland	1 - 38	13.2	38	2.9
Flaxman/Mary Sachs Island Comples	39 - 52	4.9	14	2.9
Northstar/ Duchess Island Complex	53 - 60	2.5	8	3.2
Alaska Island	61 - 67	2.3	7	3.4

*Measured along east-west axis.

TABLE 3.2
SURVEY MONUMENT LOCATIONS

PT. THOMPSON STUDY AREA

<u>ESTABLISHED CONTROL MONUMENTS:</u>

MONUMENT	CODE	X-COORD(ft)	Y-COORD(ft)	LATITUDE(dms)	LONGITUDE(dms)
PT THOMP. (EXXON PAD)	1	468591.0	5912628.0	70 10 20.417	146 50 59.391
BULLEN (KLI)	2	394446.0	5915260.0	70 10 39.703	146 15 10.103
FLAXMAN (NOAA)	3	500062.7	5916944.2	70 11 03.512	145 59 58.183
THIN (NOAA)	4	429837.1	5935231.7	70 14 00.178	146 33 59.073

<u>TEKMARINE MONUMENTS - ESTABLISHED JULY 1982:</u>

MONUMENT	X (ft)	Y (ft)	MR CODE/RANGE(m)		MR CODE/RANGE(m)		LATITUDE(dms)	LONGITUDE(dms)
1	406968	5915108	2	3817	4	9285	70 10 39.824	146 44 56.439
2	408712	5914302	2	4358	4	9064	70 10 32.106	146 44 5.614
3	410595	5913888	2	4940	4	8759	70 10 28.256	146 43 10.907
4	413378	5913963	2	5784	4	8197	70 10 29.312	146 41 50.290
5	417117	5914406	2	6915	4	7438	70 10 34.081	146 40 2.084
6	419365	5914285	2	7601	4	7138	70 10 33.130	146 38 56.901
7	422398	5917806	2	8555	4	5775	70 11 8.072	146 37 30.055
8	423304	5916235	2	8801	4	6123	70 10 52.712	146 37 3.326
9	427141	5916004	2	9968	4	5918	70 10 50.813	146 35 12.039
10	429386	5915509	2	10650	4	6013	70 10 46.154	146 34 6.831
11	431515	5917377	2	11317	4	5466	70 11 4.719	146 33 5.613
12	433499	5917559	2	11924	4	5581	70 11 6.683	146 32 8.140

MONUMENT	X (ft)	Y (ft)	MR CODE/RANGE(m)		MR CODE/RANGE(m)		LATITUDE(dms)	LONGITUDE(dms)
13	436114	5919237	2	12758	4	5237	70 11 23.409	146 30 52.735
14	438006	5917582	2	13296	4	5928	70 11 7.286	146 29 57.475
15	439545	5916880	2	13755	4	6328	70 11 .504	146 29 12.692
16	442592	5916744	2	14682	4	6846	70 10 59.400	146 27 44.328
17	444534	5916275	2	15270	4	7311	70 10 54.930	146 26 47.930
18	446890	5917561	3	16208	4	7485	70 11 7.745	146 25 39.895
19	448697	5915968	2	16537	4	8217	70 10 52.199	146 24 47.191
20	451426	5916555	4	8701	2	17372	70 10 58.150	146 23 28.193
21	453491	5915423	2	17997	4	9404	70 10 47.143	146 22 28.127
22	454571	5914638	1	4317	4	9810	70 10 39.849	146 21 56.686
23	458636	5915145	2	19565	4	10702	70 10 44.703	146 19 58.951
24	460295	5914494	4	11231	2	20072	70 10 38.387	146 19 10.767
25	460062	5916909	4	10773	2	20006	70 11 2.129	146 19 17.889
26	463552	5914448	1	1633	4	12072	70 10 38.096	146 17 36.364
27	465559	5914194	3	10550	4	12636	70 10 35.690	146 16 38.163
28	468984	5913467	3	9532	4	13652	70 10 28.685	146 14 58.815
29	470283	5911635	1	598	3	9220	70 10 10.717	146 14 20.964
30	474560	5910467	1	1935	3	8020	70 9 59.382	146 12 16.937
31	475588	5909802	1	2300	3	7771	70 9 52.874	146 11 47.097
32	476637	5908431	1	2766	3	7597	70 9 39.421	146 11 16.590
33	478762	5909871	1	3212	3	6841	70 9 53.647	146 10 15.168
34	479548	5908948	1	3523	3	6711	70 9 44.589	146 9 52.329
35	482951	5908158	1	4584	3	5863	70 9 36.902	146 8 13.720
36	485987	5906332	1	5639	3	5373	70 9 19.003	146 6 45.703
37	485747	5903452	1	5930	3	5996	70 8 50.670	146 6 52.495
38	488342	5902170	1	6812	3	5748	70 8 38.104	146 5 37.336
39							70 10 54.000	145 57 32.000
40	500600	5918124	1	9899	3	395	70 11 15.117	146 59 42.682

MONUMENT	X (ft)	Y (ft)	MR CODE/RANGE(m)		MR CODE/RANGE(m)		LATITUDE(dms)	LONGITUDE(dms)
41	498483	5919266	1	9333	3	856	70 11 26.348	146 0 43.995
42	495792	5920652	1	8644	3	1724	70 11 39.971	146 2 2.061
43	494021	5921338	1	8193	3	2277	70 11 46.707	146 2 53.447
44	490489	5922132	1	7276	3	3319	70 11 54.481	146 4 35.938
45	491262	5919413	1	7213	3	2786	70 11 27.746	146 4 13.420
46	487910	5922300	1	6585	3	4048	70 11 56.097	146 5 50.769
47	486106	5922958	1	6198	3	4632	70 12 2.539	146 6 43.143
48	484359	5923321	1	5807	3	5166	70 12 6.076	146 7 33.886
49	482226	5923848	1	5382	2	26883	70 12 11.213	146 8 35.784
50	478746	5923601	1	4557	2	25828	70 12 8.695	146 10 16.750
51	475804	5923768	1	4045	2	24933	70 12 10.250	146 11 42.136
52	474057	5923305	1	3656	2	24389	70 12 5.639	146 12 32.785
53	459061	5931279	1	6384	2	20291	70 13 23.418	146 19 49.170
54	456300	5932712	1	7177	2	19589	70 13 37.360	146 21 9.609
55	453457	5933633	1	7891	2	18838	70 13 46.252	146 22 32.369
56	451611	5934301	1	8392	2	18365	70 13 52.708	146 23 26.130
57	449363	5934773	1	8939	2	17764	70 13 57.205	146 24 31.544
58	448403	5934614	1	9098	2	17472	70 13 55.577	146 24 59.410
59	445073	5933296	1	9543	2	16381	70 13 42.382	146 26 35.897
60	443897	5932842	1	9727	2	15997	70 13 37.832	146 27 9.966
61	439020	5933521	1	11036	2	14682	70 13 44.138	146 29 31.812
62	436967	5934496	1	11719	2	14225	70 13 53.562	146 30 31.697
63	435540	5934989	1	12163	2	13894	70 13 58.292	146 31 13.285
64	432742	5935086	1	12894	2	13144	70 13 59.006	146 32 34.618
65	429836	5935232	1	13675	2	12386	70 14 .178	146 33 59.073
66	427696	5935622	1	14300	2	11884	70 14 3.818	146 35 1.403
67	425566	5936184	1	14951	2	11430	70 14 9.142	146 36 3.465

3.2 Transect Establishment

During the July field trip, the coastal transects were established and the first survey was performed. The initial task was to distribute the monument and target construction materials at the pre-determined coastal locations. Due to the weight of these supplies and the need to exactly place each transect at the desired location, a helicopter was used for this purpose.

The materials required for each transect consisted of the target and tie-down equipment, monument pipe, and witness post pipe. The target, designed to facilitate transect recognition from both the ground and during aerial overflights, was constructed from two large panels of durable orange or yellow dacron signal cloth.

The field survey crew travelled to each transect site by boat from the base camp located at Pt. Thomson. Upon recovering the transect bundle, a suitable site of relatively flat terrain was selected for target construction. Care was taken to ensure that an adequate set-back distance from the waterline was observed so that future loss of the monument caused by erosion or wave impact would be prevented. Typically, on a tundra plain fronted by a narrow gravel beach, the targeted monument would be placed on the tundra at a distance of 50 to 100 feet from the waterline.

Target construction proceeded systematically with the orientation of one signal cloth section (orange in the case of a mixed color target) on a true north-south alignment. The second signal cloth panel was positioned on an east-west alignment such that the two panels had coincident centers.

Consequently, the brightly colored target resembled a cross when viewed from the air, as shown in Photo 1.

The target material was tied down by a network of stainless steel wires that were secured by aluminum stakes driven into the soil along the edges of the signal cloth. The first season performance of the targets was excellent based on the relative ease with which the transects were recovered and re-surveyed. Remedial maintenance performed on the targets was limited to fewer than 10% of the targets. Based on this experience, it would appear that the target design will exhibit a multi-year life expectancy.

At the southeast interior corner of the target, the two-foot long steel monument pipe was driven into the ground. To aid in recovery, the length of pipe left exposed was spray-painted orange following placement.

The orientation of the profiled transect was established by the placement of the three-foot long steel pipe witness post driven into the ground at a distance of 30 to 80 feet from the monument. Using these two reference pipes to define the transect, the identical profile can be re-surveyed during future field work. The painted witness post was positioned such that the transect was approximately perpendicular to the local shoreline. A bearing of the transect relative to true north was measured using a hand bearing magnetic compass (variation = 33^{o}E) to assist in the resurvey of the transect should the witness post be removed or destroyed. The transect was identified by painting a number on the northern arm of the target (so that it could be identified from a low-flying helicopter) and securing a stamped brass disk to the monument pipe with wire. The characteristic features of the monumented transect are illustrated in Figure 3.1.

PHOTO 1. AERIAL VIEW OF TARGETS THAT IDENTIFY COASTAL TRANSECTS

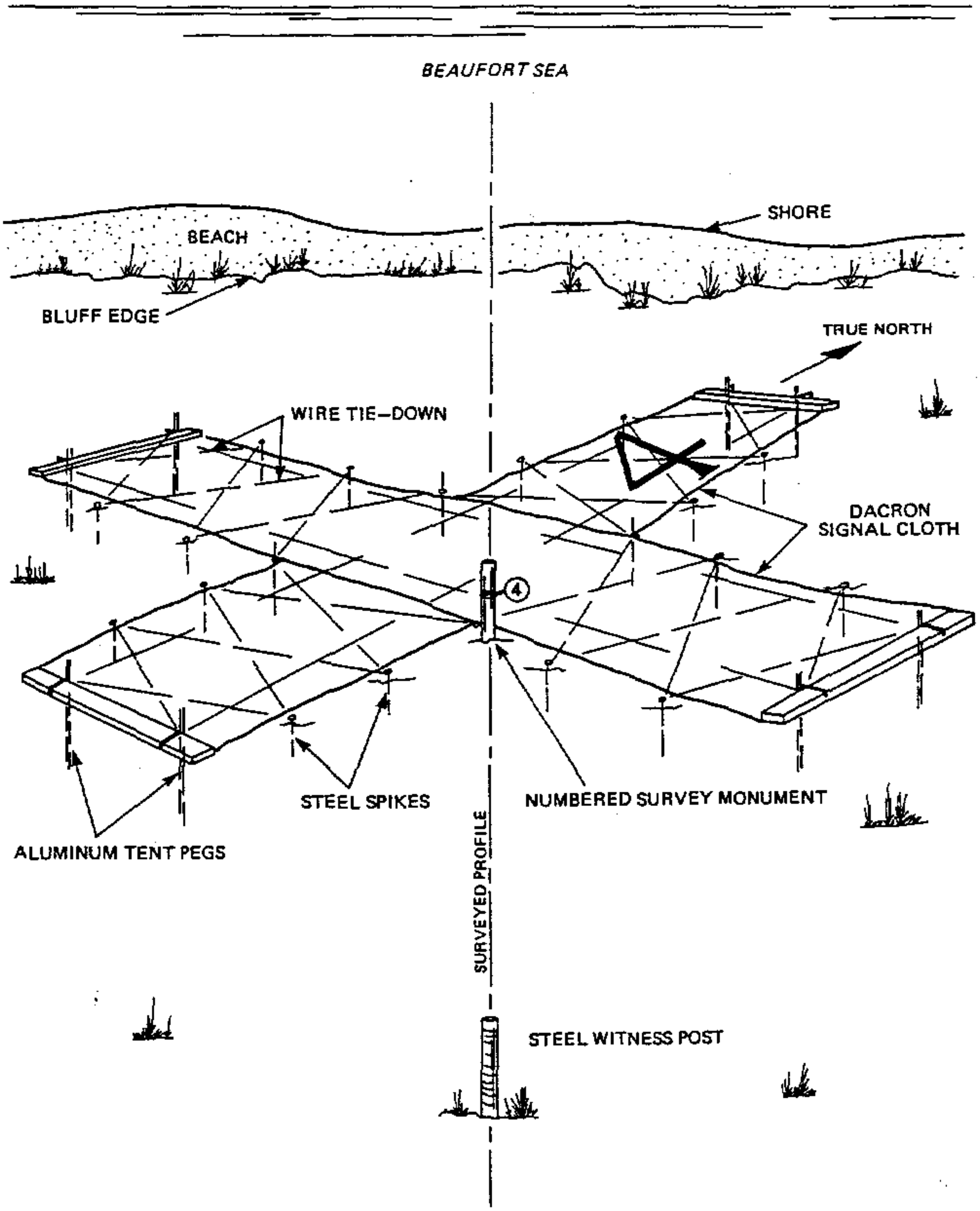


FIGURE 3.1: MONUMENTED TRANSECT LAY–OUT

The actual length of each profiled transect was a function of beach morphology and elevation of the sea level at the time of profiling. Typically, a transect on the tundra shore extended seaward from the monument to a water depth of 3-4 feet. For transects having two shorelines (spits and barrier islands), the transect was profiled from the shallow water near one shoreline to a water depth of comparable magnitude (3-4 feet) near the opposite shore.

A secondary factor affecting transect length was the still water level which prevailed at the time of the survey. Lowered water levels (which often accompanied easterly winds) increased transect lengths by exposing additional beachfront, while increased water levels reduced transect length.

3.3 Surveying

All of the 67 coastal transects that were established in July were re-surveyed during the September field trip. Based on the experience gained during the July survey, fundamental changes were made in the survey operations undertaken in September. The survey methods used for each survey are described below.

- July Survey Methods: The coastal profiling undertaken in July employed standard leveling methods and equipment which included an automatic level, leveling rod, and steel surveying tape. The profile surveyed along each transect measured elevation and distances at all prominent features, signficant changes in beach slope, and at the monument and witness post. Elevation readings were accurate to ± 0.1 foot while taped horizontal distances were measured to the nearest tenth of a foot. During each transect survey, the elevation and position of the waterline(s) were measured and the time of the measurement was recorded.

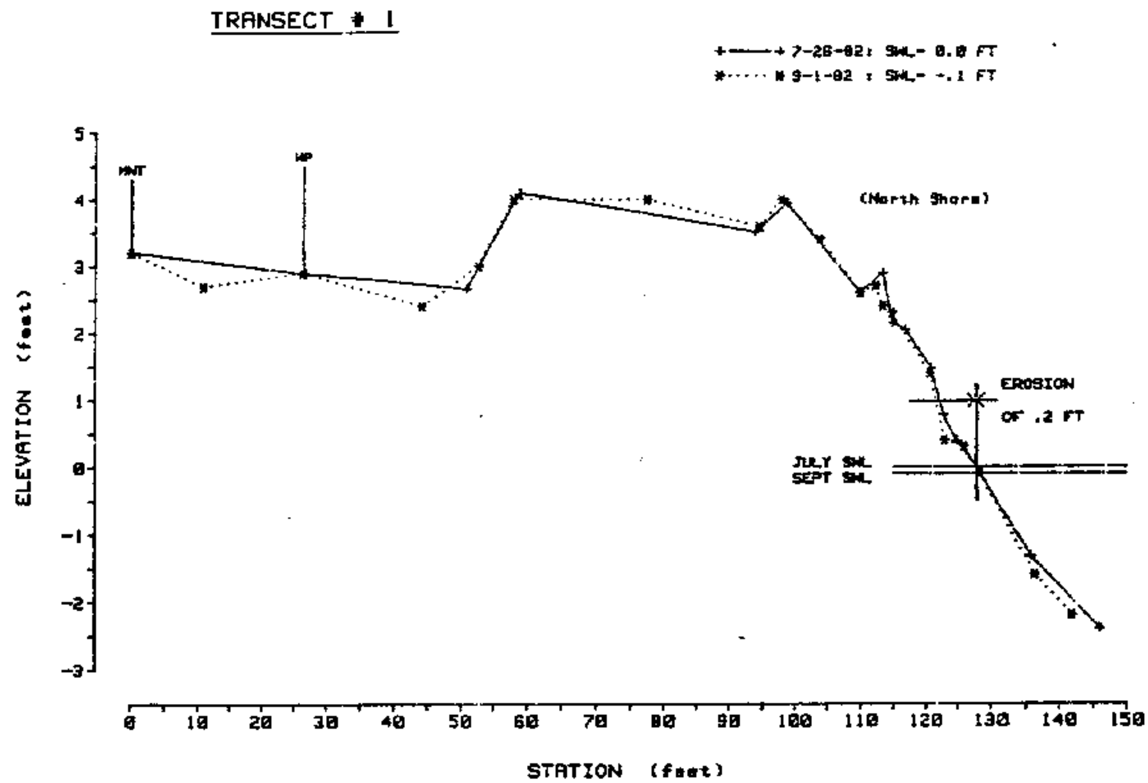
Because of the lack of an established vertical control datum in the study area, an absolute vertical datum to which the transect elevations could be referenced was not available. Consequently, a relative elevation datum for each transect was selected to be the still water elevation at the time of each survey. It should be noted that if the two waterline elevations differed for a two shoreline transect, the south waterline elevation was used for the datum by virtue of the lack of wave activity on that shore.

- <u>September Survey Methods:</u> During the July field trip, limitations were identified in the usefulness of the survey methods employed. On many of the longer transects, repetitive movement of the 300 foot long steel tape was inefficient, especially when measuring distances offshore. On the high bluffs, the transect distances were difficult to measure accurately due to the sag in the steel tape. Realizing that these limitations would incorporate errors into the surveying data thereby rendering it less valuable for future transect comparisons, an electronic surveying system was chosen for the September field trip.

  The electronic system that was used, the Hewlett-Packard Model 3810A "Total Station", measures vertical and horizontal distance using an infrared light source. This instrument greatly increased survey speed and minimized the procedural and operator inconsistencies that are common with standard leveling techniques. To verify agreement between the two survey systems, the first transect profiled in September was surveyed by two teams using the July survey techniques and the electronic system proposed for the September field trip. It was determined that both methods gave comparable results over a short, low transect, however, increased speed and efficiency was experienced with the electronic system. With the exception of the survey equipment, the method of profiling was the same for both the July and September field trips.

Because the still water level observed in September differed from that surveyed in July, a vertical datum for the survey had to be chosen. The lack of local tidal information prevented the establishment of a common datum for both surveys, therefore, all elevations were referenced to the still water level measured at each transect in July.

An example plot of the July and September surveys at Transect #1 is displayed in Figure 3.2. The profile data is also presented in tabular form below the figure.



TRANSECT # 1

LOCATION: MAINLAND-2.5 MILES EAST OF PT. BULLEN

SITE DESCRIPTION: TUNDRA PLAIN W/ SAND & GRAVEL BEACH

TRANSECT BEARING: 035.T EXPOSURE: N-NE

TARGET COLOR: ORANGE

DATE: 7-26-82

STATION (FT)	ELEVATION (FT)	REMARKS
0.0	3.2	@ MONUMENT
26.5	2.9	@ WITNESS PT
51.0	2.7	GRAVEL
59.0	4.1	
94.0	3.5	
99.0	3.9	
110.0	2.6	
113.5	2.9	
115.0	2.2	
117.0	2.1	
121.0	1.5	
123.0	.8	
125.0	.4	
128.0	0.0	No.WL @ 2045
136.0	-1.3	
146.0	-2.4	

DATE: 9-1-82

STATION (FT)	ELEVATION (FT)	REMARKS
0.0	3.2	@ MONUMENT
10.9	2.7	
26.5	2.9	@ WITNESS PT
44.3	2.4	GRAVEL
52.8	3.0	
58.1	4.0	
77.7	4.0	
94.7	3.6	
98.1	4.0	
104.0	3.4	
110.1	2.6	
112.4	2.7	
113.5	2.4	
114.9	2.3	
120.8	1.4	
123.2	.4	
126.0	.3	
128.4	-.1	No.WL @ 1200
136.5	-1.6	
141.9	-2.2	

ELEVATION ON MONUMENT = 4.3 FT

ELEVATION ON WITNESS POST = 4.5 FT

NOTES: 1) STATION DATUM OF 0.0 ASSUMED FOR MONUMENT.
NORTHERLY MEASUREMENTS TAKEN AS POSITIVE.
2) ELEVATION DATUM OF 0.0 ASSUMED FOR S.W.L. OF JULY SURVEY.
3) SEPTEMBER S.W.L. = -.1 FT

FIGURE 3.2 : SURVEY TRANSECT #1

3.4 Additional Field Data

To support the findings of the coastal survey, additional field data was collected during the course of the study, as described below.

Transect Photographs: Ground and low elevation aerial photos were taken at many survey transects to provide a visual record of the area during the survey. These photos can be used as a reference to locate monuments during future survey efforts.

Aerial Photographs: To provide a record of the shoreline at the time of each survey, high elevation aerial photos were taken in both July and September. The photos were taken from a helicopter at a sufficient altitude (5,000-7,000 feet) such that at least two targeted monuments appeared on each photo. Knowing the distance between successive monuments, photo scale could be computed.

Soil Samples: To characterize the beach sediment characteristics throughout the study area, soil samples were collected at numerous transect locations. This aspect of the study is described in detail in Section 5.4.

4. SURVEY DATA

As detailed in Section 3, sixty-seven monumented coastal transects were established and surveyed during the course of this study. In the interest of brevity, only representative transects and the summarized results of the survey data will be presented here. A complete compilation of all the survey data is contained in a separate document, the Appendix to this report.

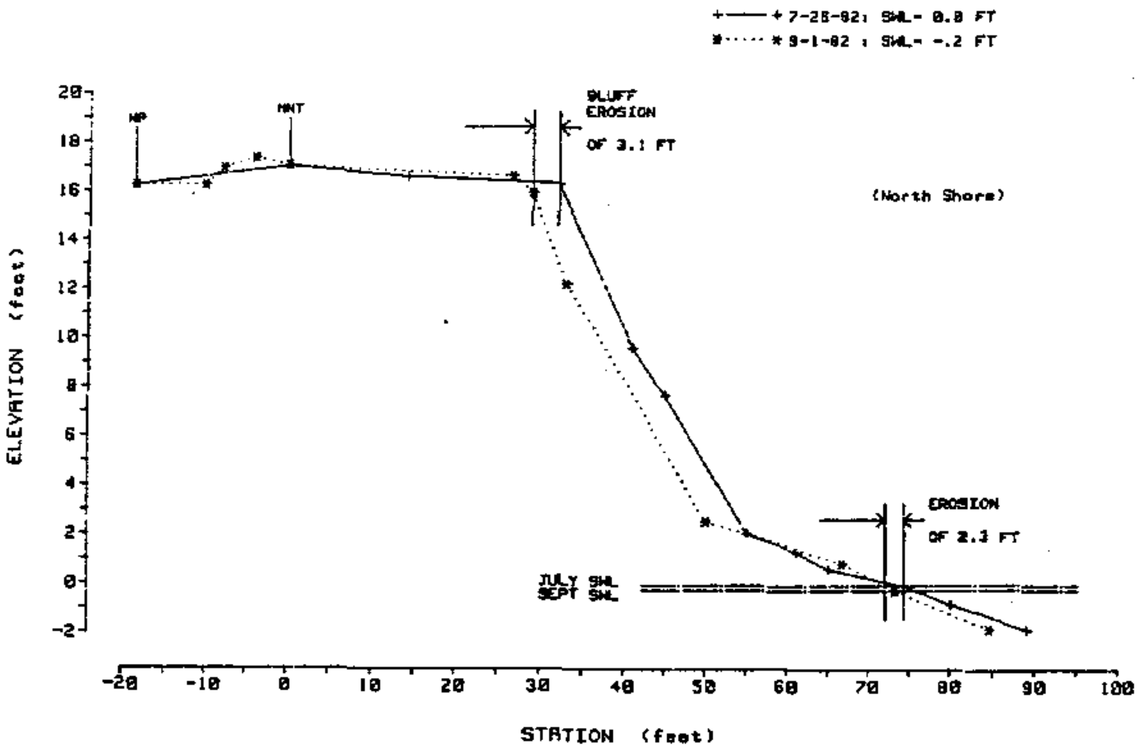
4.1 Profile Data Classification

The various surveyed transects represent the coastal profiles of five general shoreline types: the mainland bluff, the low mainland beach, the mainland gravel spits, the Flaxman Island bluff, and the barrier islands. An example of each of these profile types follows with a brief description and a listing of the applicable monument designations.

- Mainland Bluff: Only three mainland transects occupy bluffs that are higher than 9 feet above mean sea level. These are located at transects #2, #5, and #34 (Ref. Figure 4.6). Figure 4.1 shows the surveyed transect at Transect #5, which indicates bluff erosion of 3.1 feet and beach erosion of 2.3 feet during the July-September, 1982, period. Below the figure, the survey data is presented in tabular form. A narrow gravel beach having a width of 15 feet exists at the toe of the bluff.

- Low Mainland Shore: The majority of the profiles surveyed on the mainland coast attain elevations that average less than four feet. Profiles of this

TRANSECT # 5



TRANSECT # 5

LOCATION: MAINLAND-STATION "GORDON ECC,1978" EST. BY NCI

SITE DESCRIPTION: HIGH ERODING TUNRDA BLUFF W/ NARROW GRAVEL BEACH

TRANSECT BEARING: 000.T EXPOSURE: NW-N

TARGET COLOR: YELLOW/ORANGE

DATE: 7-26-82

STATION (FT)	ELEVATION (FT)	REMARKS
-18.8	16.3	@ WITNESS PT
0.0	17.1	@ MONUMENT
14.0	16.7	
32.0	16.4	BLUFF EDGE
41.0	9.7	-
45.0	7.8	
55.0	2.1	BLUFF BASE
61.0	1.4	GRAVEL
65.0	.7	
74.3	0.0	No.WL @ 1720
80.0	-.8	
89.0	-1.8	

DATE: 9-1-82

STATION (FT)	ELEVATION (FT)	REMARKS
-18.8	16.3	@ WITNESS PT
-10.3	16.3	
-8.0	17.0	
-4.1	17.4	
0.0	17.1	@ MONUMENT
26.6	16.7	
28.9	16.0	BLUFF TOP
33.0	12.3	
50.0	2.6	BLUFF TOE
66.7	.9	
73.2	-.2	No.WL @ 1437
84.5	-1.8	

ELEVATION ON MONUMENT = 19.0 FT

ELEVATION ON WITNESS POST = 18.6 FT

NOTES: 1) STATION DATUM OF 0.0 ASSUMED FOR MONUMENT. NORTHERLY MEASUREMENTS TAKEN AS POSITIVE.
2) ELEVATION DATUM OF 0.0 ASSUMED FOR S.W.L. OF JULY SURVEY.
3) SEPTEMBER S.W.L. = -.2 FT

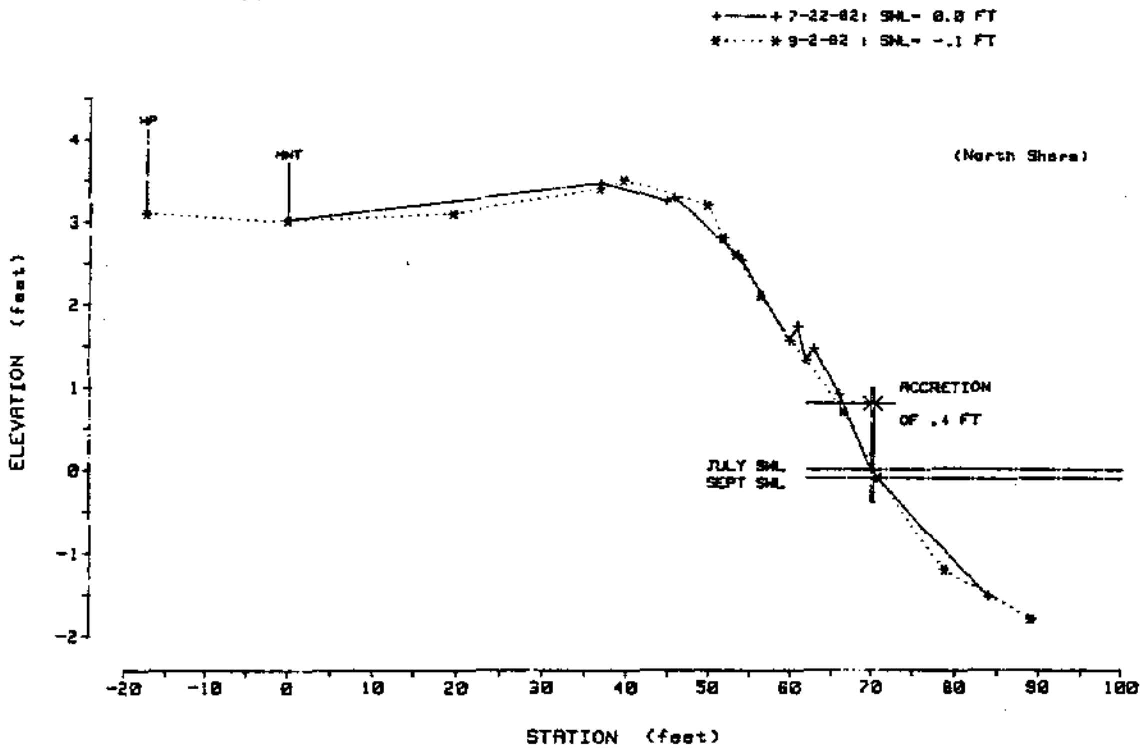
FIGURE 4.1 : MAINLAND BLUFF AT TRANSECT #5

type are located at 24 transect locations (Transects #1, 8, 10, 12-14, 16-24, 29-33, 35-38, Ref. Figure 4.6). A typical example of this type of profile is Transect #18, shown in Figure 4.2. The highest elevation of this profile is about three feet above mean sea level. The survey comparison shows that virtually no change occurred in the profile during the recent July-September period.

- Mainland Gravel Spits: Gravel spits project from a number of headlands within the study area. A total of 11 spit locations were chosen as sites for surveyed transects (Transects #3, 4, 6, 7, 9, 11, 15, 25-28, Ref. Figure 4.6). Transect #11 is presented in Figure 4.3, which documents the major features of a low spit (maximum elevation = 3.9 feet). As frequently occurred, the exposed northern shore experienced change (in this case, 3 feet of shoreline accretion) while the protected southern shore remained virtually static.

- Flaxman Island Bluff: Four transects were surveyed on the relatively high bluffs of Flaxman Island (Transects #39-41, 45, Ref. Figure 4.6). Three of the transects were placed on the northern shore of the island with Transect #41 serving as a typical example (Figure 4.4). The bluff at this location lies about 13 feet above mean sea level with a very narrow beach at its base. Bluff erosion of 6.5 feet was noted at this transect during the recent survey period.

TRANSECT # 18



TRANSECT # 18

LOCATION: MAINLAND-EAST FLANK OF PT SWEENEY

SITE DESCRIPTION: LOW TUNDRA PLAIN W/ SURFICIAL SAND & GRAVEL ON BEACH

TRANSECT BEARING: 040 T EXPOSURE: N-NE

TARGET COLOR: YELLOW/ORANGE

DATE: 7-22-82			DATE: 9-2-82		
STATION (FT)	ELEVATION (FT)	REMARKS	STATION (FT)	ELEVATION (FT)	REMARKS
0.0	3.0	@ MONUMENT	-17.3	3.1	@ WITNESS PT
37.0	3.5	@ WITNESS PT	0.0	3.0	@ MONUMENT
45.0	3.3		19.5	3.1	ROLL TRACK
46.0	3.3		36.9	3.4	
54.0	2.5		39.8	3.5	DEBRIS LINE
60.0	1.6		50.0	3.2	
61.0	1.7		51.8	2.8	
62.0	1.3		53.3	2.6	
63.0	1.5		56.4	2.1	
66.0	.9		66.5	.7	
70.0	0.0	No.WL @ 2005	71.0	-.1	No.WL @ 1012
84.0	-1.5		78.7	-1.2	
			89.1	-1.8	

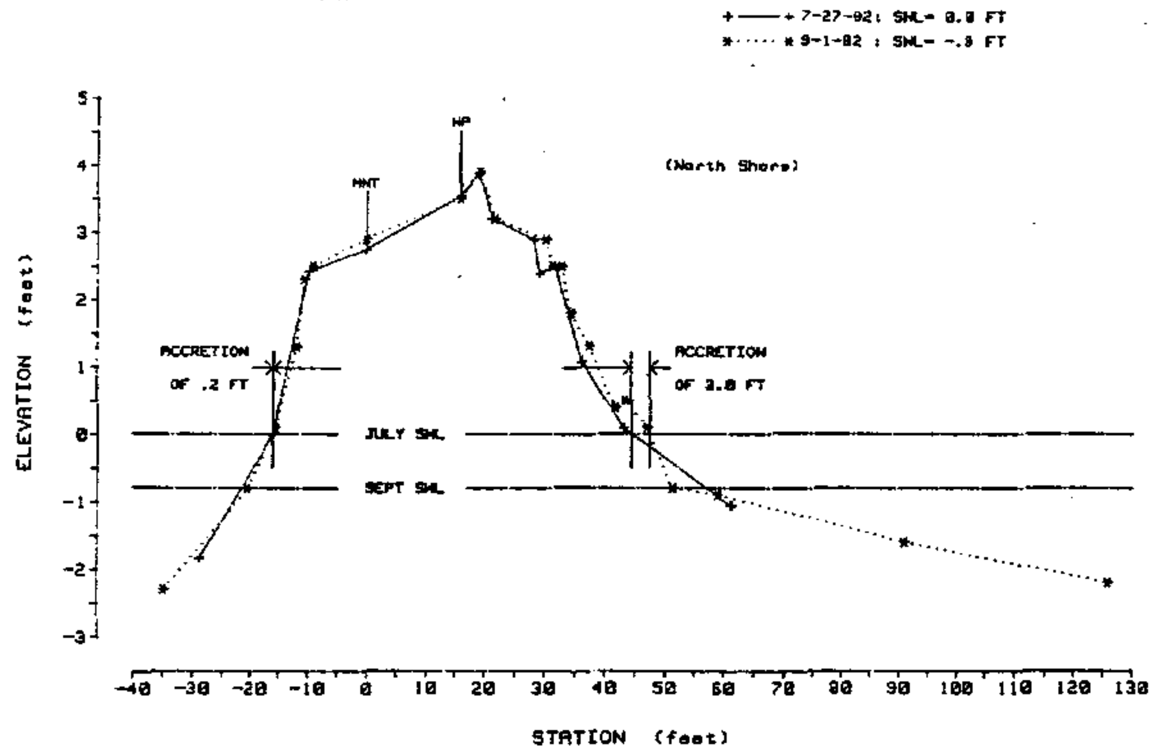
ELEVATION ON MONUMENT = 3.7 FT

ELEVATION ON WITNESS POST = 4.1 FT

NOTES: 1) STATION DATUM OF 0.0 ASSUMED FOR MONUMENT
NORTHERLY MEASUREMENTS TAKEN AS POSITIVE.
2) ELEVATION DATUM OF 0.0 ASSUMED FOR S.W.L. OF JULY SURVEY.
3) SEPTEMBER S.W.L.= -.1 FT

FIGURE 4.2 : LOW MAINLAND SHORE AT TRANSECT #18

TRANSECT # 11



LOCATION: MAINLAND-WEST SPIT FRONTING LAGOON W. OF RUINS

SITE DESCRIPTION: SMALL SAND & GRAVEL SPIT W/ SURFICIAL GRAVEL

TRANSECT BEARING: 300 T EXPOSURE: NW-N

TARGET COLOR: YELLOW/ORANGE

DATE: 7-27-82

STATION (FT)	ELEVATION (FT)	REMARKS
-28.7	-1.8	
-15.7	0.0	So.WL-LAGOON
-9.7	2.4	
0.0	2.7	@ MONUMENT
16.1	3.5	@ WITNESS PT
19.3	3.9	
21.3	3.2	
28.3	2.9	
29.3	2.4	
31.8	2.5	
36.3	1.1	
43.1	1	No.WL @ 1930
61.3	-1.1	

DATE: 9-1-82

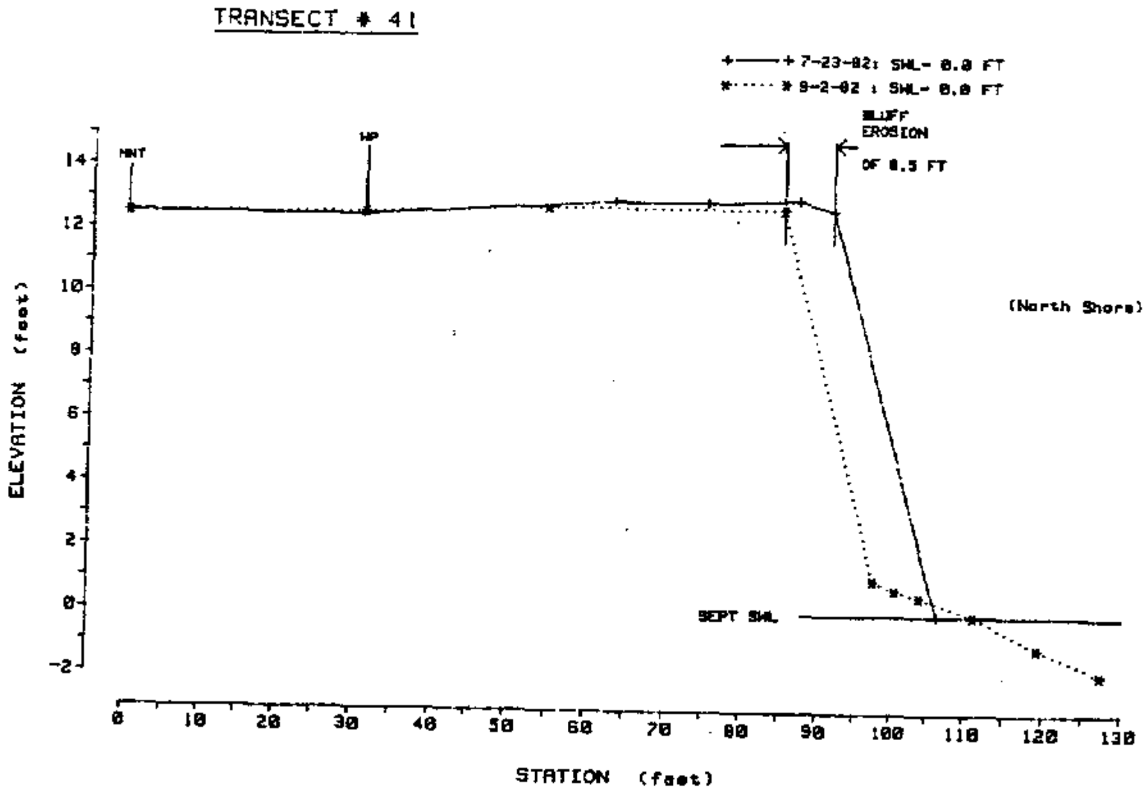
STATION (FT)	ELEVATION (FT)	REMARKS
-34.8	-2.3	
-20.3	-.8	So. WL
-15.3	.1	
-11.7	1.3	
-10.5	2.3	
-9.0	2.5	BERM
0.0	2.9	@ MONUMENT
16.1	3.5	@ WITNESS PT
19.4	3.9	
21.8	3.2	
30.3	2.9	
31.4	2.5	
32.9	2.5	
34.4	1.8	
37.5	1.3	
41.7	.4	
43.5	.5	
47.0	.1	
51.3	-.8	No.WL @ 1700
59.1	-.9	
91.1	-1.6	
126.1	-2.2	

ELEVATION ON MONUMENT = 3.6 FT

ELEVATION ON WITNESS POST = 4.5 FT

NOTES: 1) STATION DATUM OF 0.0 ASSUMED FOR MONUMENT.
NORTHERLY MEASUREMENTS TAKEN AS POSITIVE.
2) ELEVATION DATUM OF 0.0 ASSUMED FOR S.W.L. OF JULY SURVEY.
3) SEPTEMBER S.W.L.= -.8 FT

FIGURE 4.3 : MAINLAND SPIT AT TRANSECT #11



TRANSECT # 41

LOCATION: FLAXMAN ISL.-NORTH SHORE NORTH OF RUNWAY

SITE DESCRIPTION: RECEDING HIGH TUNDRA BLUFF W/ MASSIVE FAILURE @ EDGE

TRANSECT BEARING: 029.T   EXPOSURE: NW-N-NE

TARGET COLOR: YELLOW

DATE: 7-23-82

STATION (FT)	ELEVATION (FT)	REMARKS
0.0	12.5	@ MONUMENT
30.9	12.5	@ WITNESS PT
63.0	13.0	
75.0	13.0	
87.0	13.1	
91.5	12.8	BLUFF EDGE
106.5	0.0	No.WL

DATE: 9-2-82

STATION (FT)	ELEVATION (FT)	REMARKS
0.0	12.5	@ MONUMENT
31.1	12.6	@ WITNESS PT
54.5	12.8	
85.0	12.8	BLUFF EDGE
97.7	1.1	BLUFF TOE
100.7	.8	
104.1	.6	
111.3	0.0	No.WL @ 1120
119.5	-1.0	
127.6	-1.8	

ELEVATION ON MONUMENT = 13.9 FT

ELEVATION ON WITNESS POST = 14.6 FT

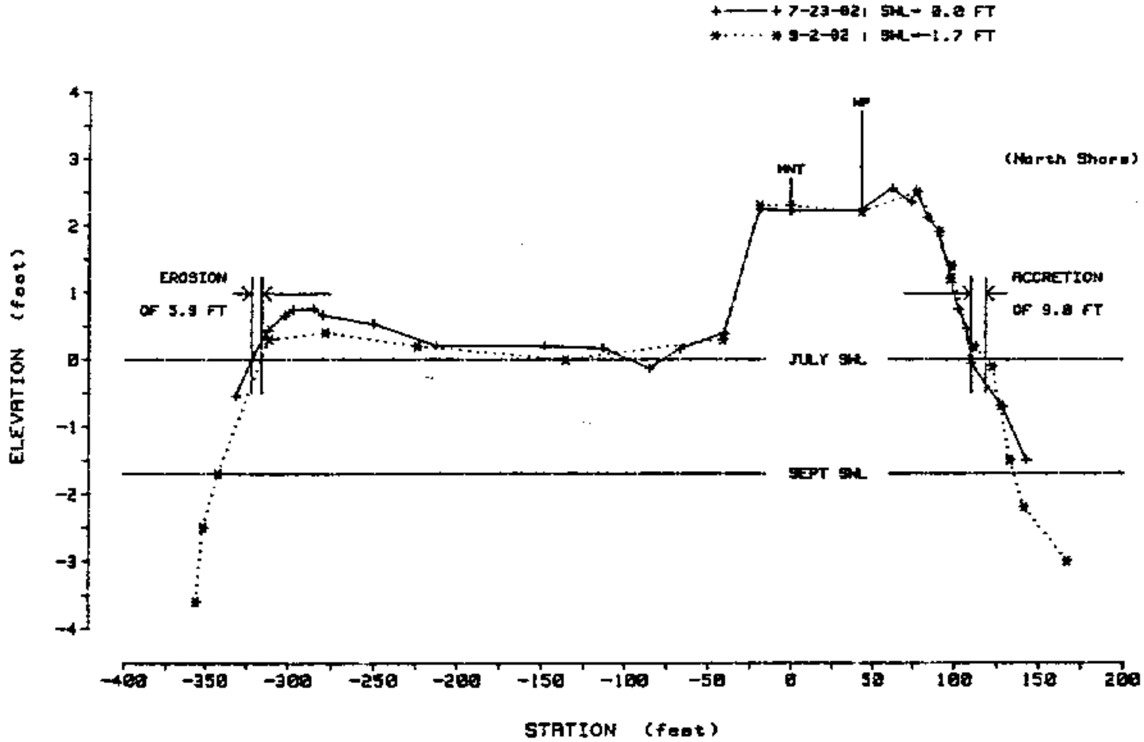
NOTES: 1) STATION DATUM OF 0.0 ASSUMED FOR MONUMENT.
NORTHERLY MEASUREMENTS TAKEN AS POSITIVE.
2) ELEVATION DATUM OF 0.0 ASSUMED FOR S.W.L. OF JULY SURVEY.
3) SEPTEMBER S.W.L.= 0.0 FT

FIGURE 4.4 : FLAXMAN ISLAND BLUFF AT TRANSECT #41

- <u>Barrier Islands:</u> Twenty-five profiles were surveyed on the barrier islands of the study area. These profiles encompass the western sand spit of Flaxman Island, Mary Sachs Island, and North Star, Duchess and Alaska Island of the Maguire group. The transects on these islands are identified by Monuments #42-44, 46-67. Transect #51 is presented in Figure 4.5 as a representative example of an island profile. Unlike the mainland spits, which tend to have a quiescent southern shore, the islands can experience major wave impact (and resulting shoreline change) on both north and south shores. In this instance, the northern shore of Transect #51 experienced accretion of 9 feet and the southern shore eroded 5.9 feet during the July-September period.

The placement strategy for the coastal transects sought to represent all of the shoreline and island types within the study area. In addition, an attempt was made to include locations that yield the full range of exposure to wave and ice conditions. It is probable that profiles with an eastern wave exposure are subject to changes resulting from the most persistant wave conditions, while transects having a western exposure evidence the effects of the less frequent westerly storm events. Table 4.1 summarizes the various coastal classifications and the exposures for the established transects. Wave exposure is listed by direction of wave approach. A number of transects experience wave approach from west clockwise through east (hence, the "W-N-E" designation). Four of the transects are located in well-protected bays resulting in negligible wave exposure during normal conditions.

TRANSECT # 51



LOCATION: MARY SACHS ISL. -.6 MI. EAST OF WESTERN END

SITE DESCRIPTION: BROAD SAND & GRAVEL PLAIN W/ STORM BERMS

TRANSECT BEARING: 358.T   EXPOSURE: W-N-NE/S

TARGET COLOR: YELLOW/ORANGE

DATE: 7-23-82

STATION (FT)	ELEVATION (FT)	REMARKS
-331.0	-.54	
-321.5	0.00	So.WL @ 1525
-312.0	.44	
-302.0	.66	
-297.0	.75	
-285.0	.76	
-280.0	.66	
-250.0	.53	
-212.0	.21	
-140.0	.20	
-113.0	.17	
-85.0	-.13	
-66.0	.16	
-40.0	.40	
-19.0	2.24	
0.0	2.22	@ MONUMENT
43.0	2.23	@ WITNESS PT
62.0	2.55	
74.0	2.35	
77.0	2.53	RIDGE
84.0	2.12	
91.0	1.91	BERM
102.0	.75	
107.0	.47	
110.6	-.05	No.WL @ 1350
128.0	-.70	
142.0	-1.50	

DATE: 9-2-82

STATION (FT)	ELEVATION (FT)	REMARKS
-355.9	-3.60	
-351.5	-2.50	
-341.0	-1.70	So.WL @ 1830
-311.0	.30	
-278.4	.40	
-223.5	.20	
-135.4	0.00	
-40.6	.30	
-18.9	2.30	
0.0	2.30	@ MONUMENT
43.4	2.20	@ WITNESS PT
78.7	2.50	
92.0	1.90	
97.9	1.20	DEBRIS
99.0	1.40	
110.4	0.00	
112.3	.20	
122.0	-.10	
127.0	-.70	
133.0	-1.50	No.WL @ 1840
141.3	-2.20	
167.1	-3.00	

ELEVATION ON MONUMENT = 2.7 FT

ELEVATION ON WITNESS POST = 3.7 FT

NOTES: 1) STATION DATUM OF 0.0 ASSUMED FOR MONUMENT. NORTHERLY MEASUREMENTS TAKEN AS POSITIVE.
2) ELEVATION DATUM OF 0.0 ASSUMED FOR S.W.L. OF JULY SURVEY.
3) SEPTEMBER S.W.L.= -1.7 FT

FIGURE 4.5 : BARRIER ISLAND PROFILE AT TRANSECT #51

TABLE 4.1

SHORELINE CLASSIFICATION AND OCEAN EXPOSURE

		PREDOMINANT WAVE EXPOSURE				
Shoreline Type	Total Transects	NW	NE	W-N-E	SOUTH	PROTECTED
Mainland Bluffs	3		2	1		
Low Mainland Shore	24	7	12	1		4
Mainland Gravel Spits	11	3	3	5		
Flaxman Island Bluff	4		3		1	
Barrier Islands*	25	4	12	9		
	TOTAL:	14	32	16	1	4

* Exposure is for northern shore. Southern shores of all islands are also monitored.

4.2 Long-Term Rates of Shoreline Change 1955-1982

Based on the results of the recent field work, Figure 4.6 has been developed which shows the 1982 coastal transect locations and island features overlying the nautical chart generated from the government (NOAA) survey of the 1950's. On the base map, the bathymetric data was determined in 1950, while the mainland shore and island configurations were based on 1955 aerial photography.

The major coastal changes that have occurred during the 1955-1982 comparison period may be summarized as follows:

- The mainland shore has remained relatively stable. The most significant change is the breach that has formed in the Pt. Thomson spit. This is due to the northeast wave energy that can proceed unimpeded to the spit through Mary Sachs Entrance. Other obvious changes include the migration of several coastal inlets (the arrows in Figure 4.6 show the present inlet locations).

- The northern bluffed coastline of Flaxman Island has retreated substantially. The concave nature of that shore is even more pronounced today than in 1955. In contrast, the southern island shore has not changed markedly. The bluff in the vicinity of Transect #45 on the southwest shore has retreated during the comparison period.

- A small inlet has formed which now separates Flaxman Island from Mary Sachs Island to the west. This inlet is located between Transects #44 and 46.

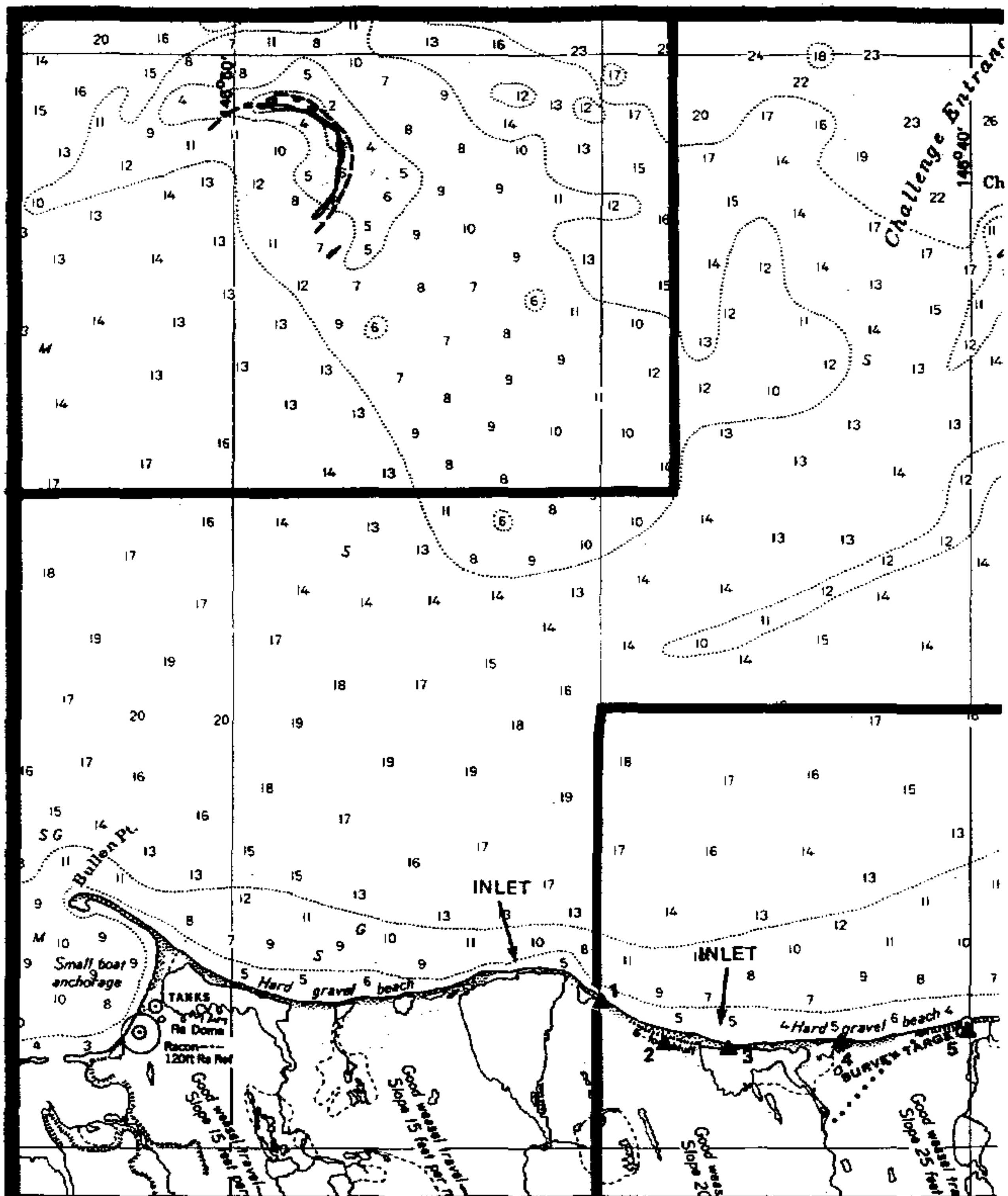


FIGURE 4.6

TRANSECT LOCATIONS AND 1982 SHORELINE

NOTES:

BASEMAP FI

ORIGINAL S
FROM USC A

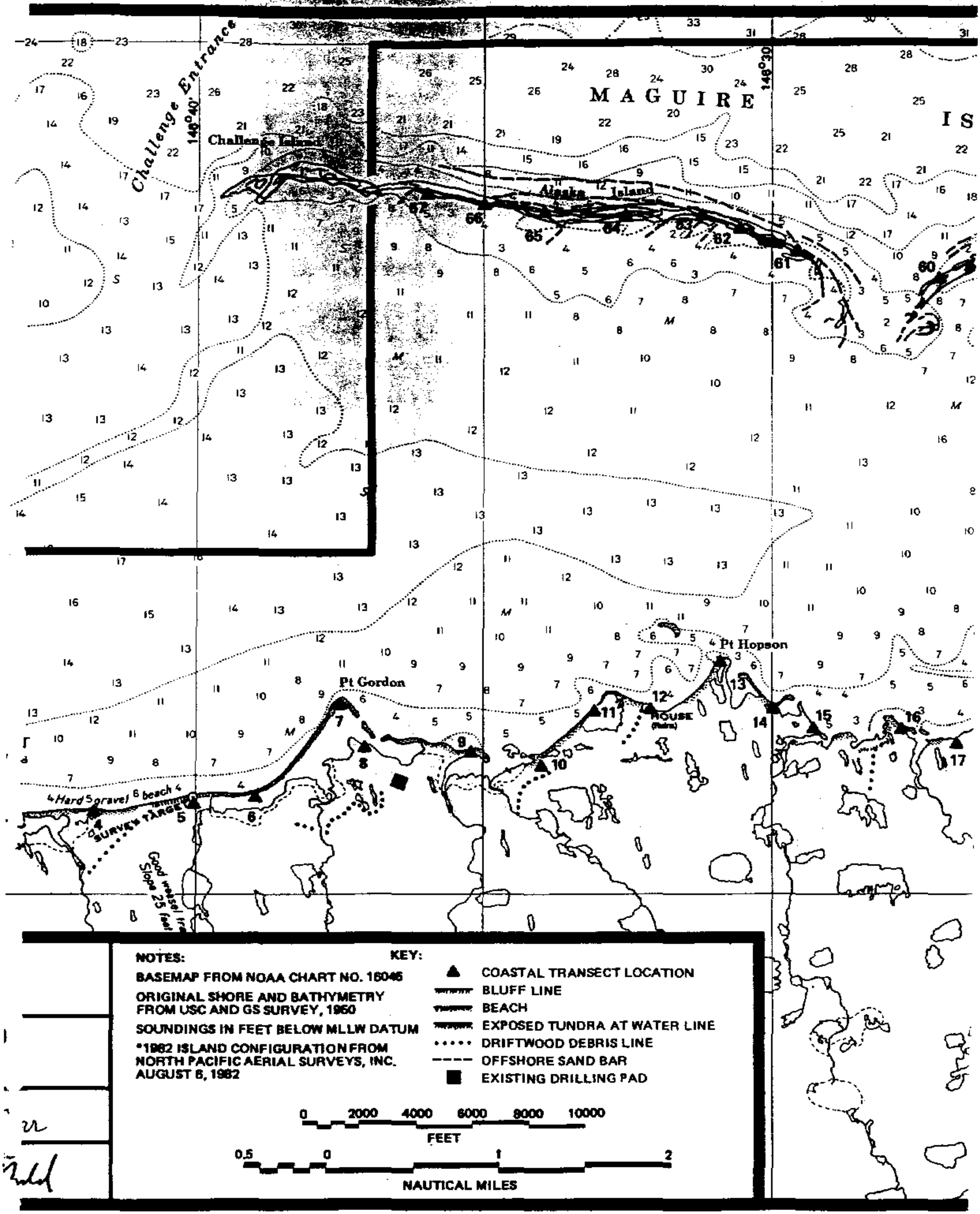
SOUNDINGS

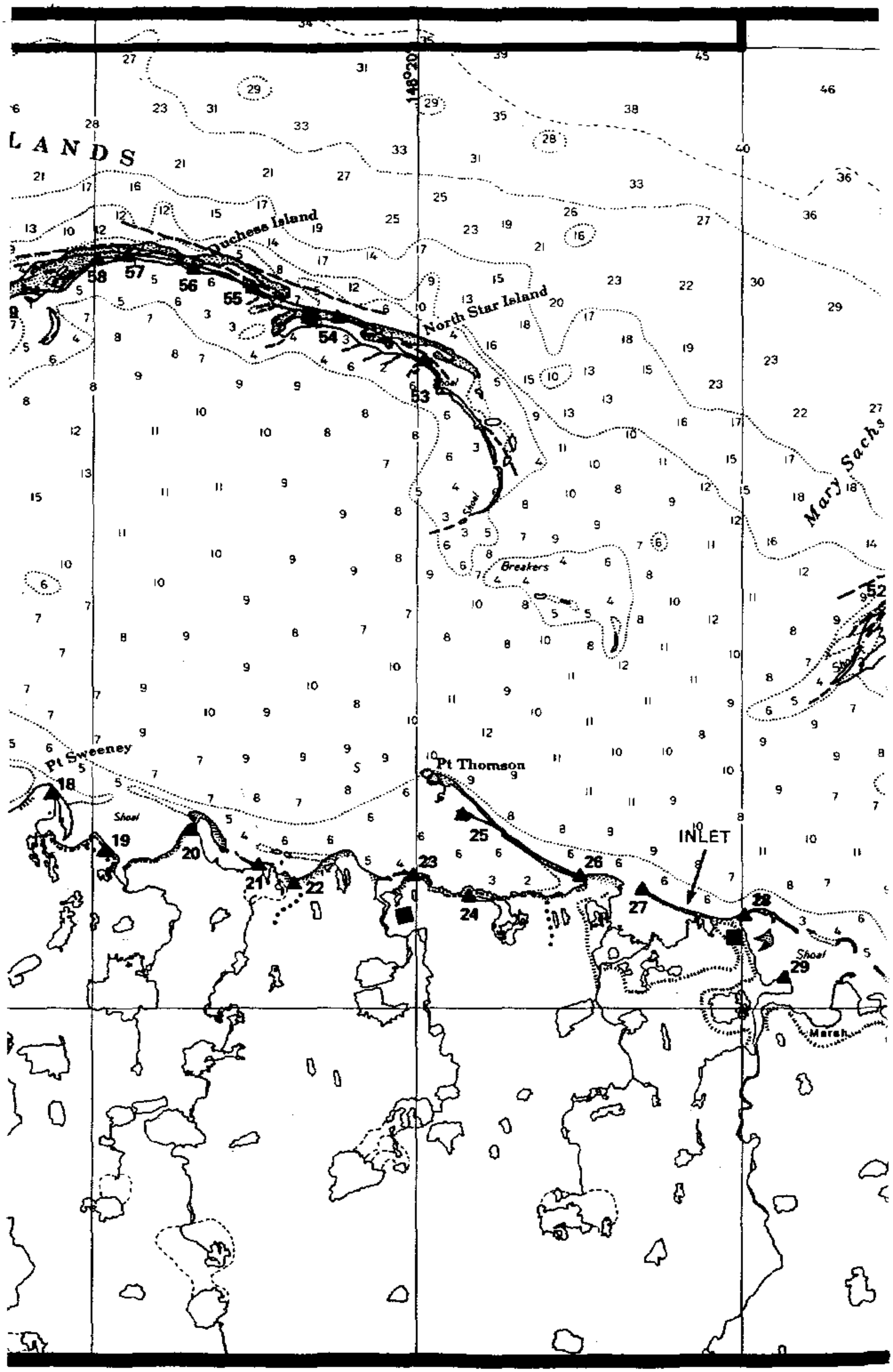
*1982 ISLAN
NORTH PAC
AUGUST 6, 1

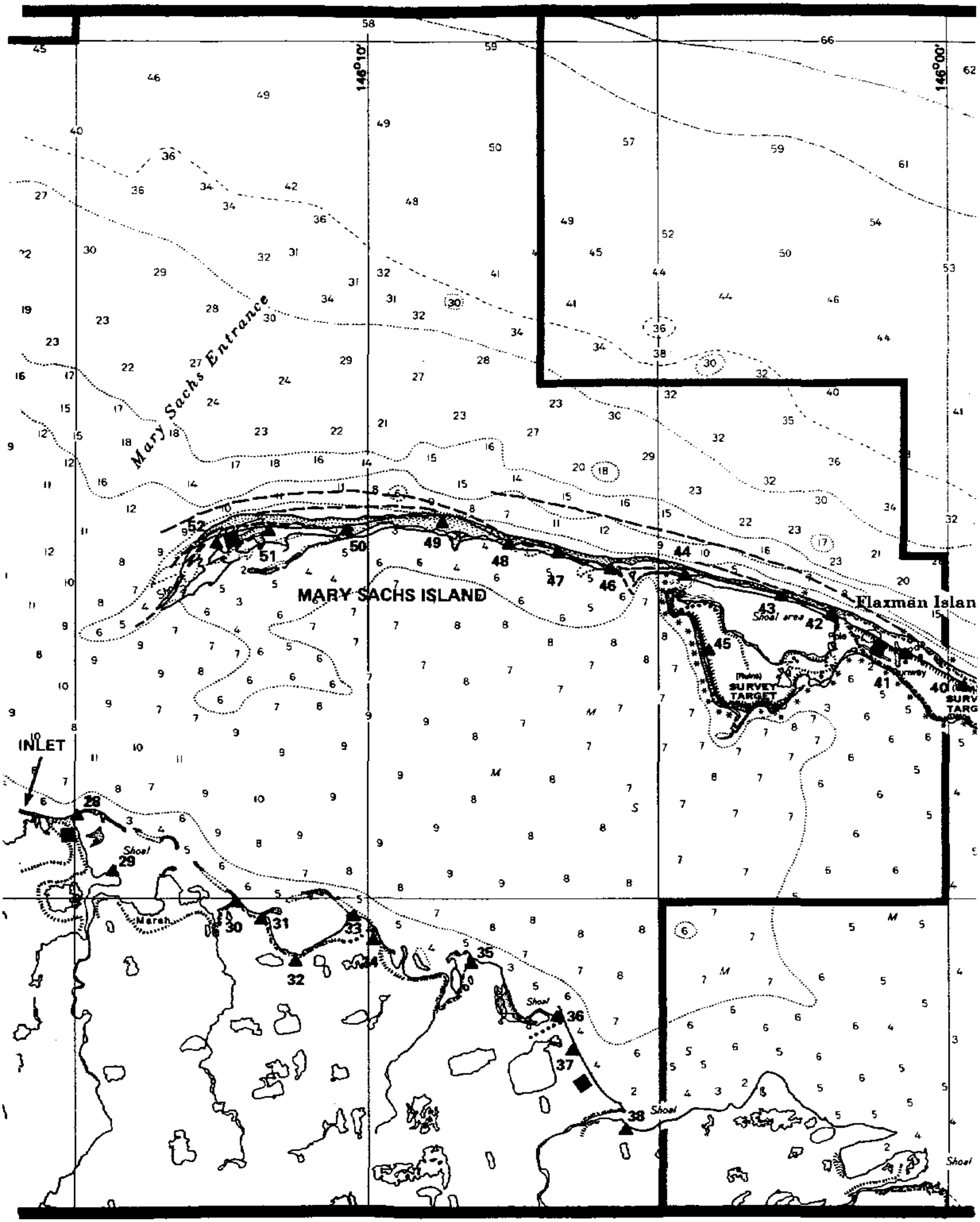
PT. THOMSON DEVELOPMENT PROJECT
COASTAL PROCESSES AND SEDIMENT DYNAMICS
CONTRACT PTD–8206
TEKMARINE, INC.

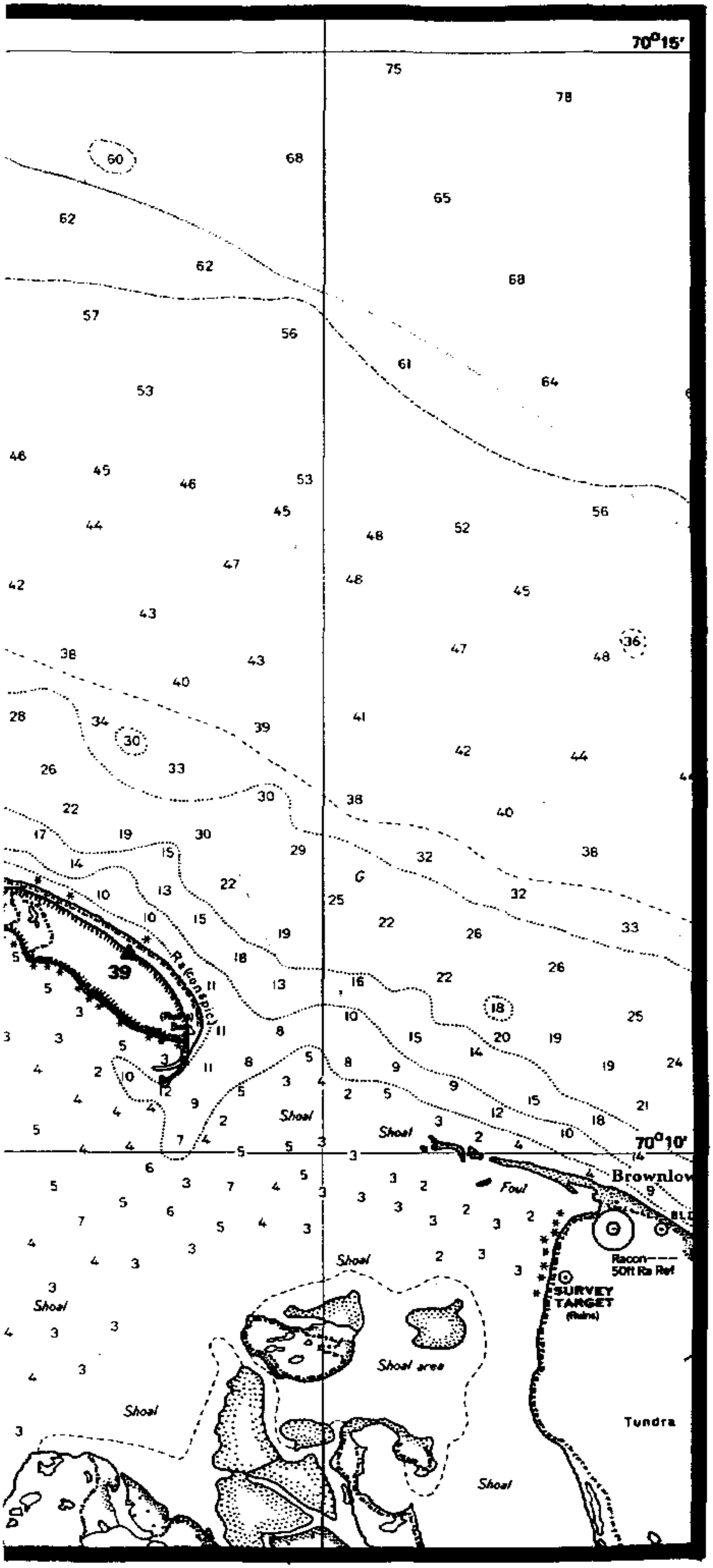
DRAWN

APPROVED


MAGUIRE
IS
Challenge Entrance
Challenge Island
Alaska Island
Pt Gordon
Pt Hopson
HOUSE (Ruin)
Hard gravel beach
SURVEY TARGET
NOTES:
BASEMAP FROM NOAA CHART NO. 16046
ORIGINAL SHORE AND BATHYMETRY FROM USC AND GS SURVEY, 1950
SOUNDINGS IN FEET BELOW MLLW DATUM
*1982 ISLAND CONFIGURATION FROM NORTH PACIFIC AERIAL SURVEYS, INC. AUGUST 6, 1982
KEY:
COASTAL TRANSECT LOCATION
BLUFF LINE
BEACH
EXPOSED TUNDRA AT WATER LINE
DRIFTWOOD DEBRIS LINE
OFFSHORE SAND BAR
EXISTING DRILLING PAD
0 2000 4000 6000 8000 10000
FEET
0.5 0 1 2
NAUTICAL MILES


LANDS
Duchess Island
North Star Island
Mary Sachs
Breakers
Shoal
Pt Sweeney
Pt Thomson
INLET
Marsh
148°20'
18
19
20
21
22
23
24
25
26
27
28
29
52
53
54
55
56
57
58


146°10'
146°00'
Mary Sachs Entrance
MARY SACHS ISLAND
Flaxman Islan
INLET
Shoal area
SURVEY TARGET
(Ruins)
Pole
Shoal
Marsh



70°15'
70°10'
Shoal
Shoal area
Foul
Brownlow
Racon
50ft Ra Ref
SURVEY TARGET
(Ruins)
Tundra

- The western ends of Mary Sachs and Duchess Islands have migrated towards the west.

- The eastern ends of North Star and Alaska Islands have migrated towards the east.

- The inlet separating North Star and Duchess Island no longer exists. These two islands have merged together.

- The inlet separating Challenge and Alaska Islands has migrated to the east a distance of approximately 1200 feet.

The results of the survey comparison between 1955 and 1982 underscore the general belief that while the mainland shore remains quite stable, the offshore islands show a high degree of change in both shape and location. The reasons for these changes and quantification of the general observations will be presented in detail in Section 5.

4.3 Short-Term Rates of Shoreline Change, July-September, 1982

As mentioned previously, a complete tabulation of all survey data collected during the recent field work is contained in the Appendix. For purposes of brevity, only the summarized results of the survey operations are contained in this report.

Table 4.2, "Summary of Transect Characteristics", lists the general location, wave exposure, target color, and survey dates for each transect. The geographic coordinates of each monument were presented previously in Section 3.

The specific findings at each transect are listed in Table 4.3, "Summary of Survey Data". For each monumented transect, the following information is presented:

- o <u>Bearing:</u> The bearing (in degrees) of the transect relative to true north.

- o <u>Transect Length:</u> The total horizontal length of the surveyed transect for both the July and September surveys. As discussed in Section 3.2, lower water levels and improved survey equipment and methods resulted in longer transect lengths during the second survey.

- o <u>South WL to MNT:</u> This quantity represents the distance between the south water line and the monument for the two surveys. Note that only the mainland spits and the offshore barrier islands have south shores.

- o <u>MNT to North WL:</u> This quantity shows the distance between the monument and the north waterline for all transects except Transect #45, located on the south shore of Flaxman Island.

- o <u>Elevations:</u> Elevations are given for both the top of each monument ("MNT") and the still water level of the September survey ("Sept SWL"). The datum has been chosen to be the water level during the July

TABLE 4.2

SUMMARY OF TRANSECT CHARACTERISTICS

TRANSECT	LOCATION	EXPOSURE	TARGET COLOR	SURVEY DATES
1	MAINLAND	N-NE	ORANGE	7-26-82 / 9-1-82
2	MAINLAND-BLUFF	N-NE	YELLOW/ORANGE	7-26-82 / 9-1-82
3	MAINLAND-SPIT	NW-N-NE	YELLOW	7-26-82 / 9-1-82
4	MAINLAND-SPIT	NW-N-NE	ORANGE	7-26-82 / 9-1-82
5	MAINLAND-BLUFF	NW-N	YELLOW/ORANGE	7-26-82 / 9-1-82
6	MAINLAND-SPIT	NW-N	YELLOW	7-26-82 / 9-1-82
7	MAINLAND-SPIT	W-N-E	ORANGE	7-26-82 / 9-1-82
8	MAINLAND	PROTECTED	YELLOW/ORANGE	7-27-82 / 9-1-82
9	MAINLAND-SPIT	NW-N-NE	YELLOW	7-27-82 / 9-1-82
10	MAINLAND	NW-N	ORANGE	7-27-82 / 9-1-82
11	MAINLAND-SPIT	NW-N	YELLOW/ORANGE	7-27-82 / 9-1-82
12	MAINLAND	N-NW	YELLOW	7-27-82 / 9-1-82
13	MAINLAND	W-N-NE	ORANGE	7-27-82 / 9-1-82
14	MAINLAND	N-NE	YELLOW/ORANGE	7-27-82 / 9-1-82
15	MAINLAND-SPIT	N-NE	YELLOW	7-27-82 / 9-1-82
16	MAINLAND	N-NW	YELLOW/ORANGE	7-22-82 / 9-2-82
17	MAINLAND	NW	YELLOW	7-22-82 / 9-2-82
18	MAINLAND	N-NE	YELLOW/ORANGE	7-22-82 / 9-2-82
19	MAINLAND	N-NE	YELLOW	7-22-82 / 9-2-82
20	MAINLAND	NW	YELLOW/ORANGE	7-22-82 / 9-2-82
21	MAINLAND	N-NE	YELLOW/ORANGE	7-27-82 / 9-2-82
22	MAINLAND	N-NE	YELLOW/ORANGE	7-22-82 / 9-2-82
23	MAINLAND	NW-N	YELLOW	7-22-82 / 9-2-82
24	MAINLAND	NW	YELLOW/ORANGE	7-22-82 / 9-2-82
25	MAINLAND-SPIT	W-N-NE	YELLOW	7-22-82 / 9-2-82
26	MAINLAND-SPIT	N-NE	ORANGE	7-22-82 / 9-2-82

TRANSECT	LOCATION	EXPOSURE	TARGET COLOR	SURVEY DATES
27	MAINLAND-SPIT	N-NE	YELLOW/ORANGE	7-22-82 / 9-2-82
28	MAINLAND-SPIT	NW-N	YELLOW	7-27-82 / 9-2-82
29	MAINLAND	PROTECTED	ORANGE	7-24-82 / 9-2-82
30	MAINLAND	N-NE	YELLOW	7-24-82 / 9-1-82
31	MAINLAND	N	YELLOW/ORANGE	7-24-82 / 9-1-82
32	MAINLAND	PROTECTED	YELLOW	7-24-82 / 9-1-82
33	MAINLAND	N-NE-E	YELLOW/ORANGE	7-24-82 / 9-1-82
34	MAINLAND-BLUFF	N-NE	YELLOW	7-24-82 / 9-1-82
35	MAINLAND	N-NE	ORANGE	7-24-82 / 9-1-82
36	MAINLAND	N-NE-E	ORANGE	7-24-82 / 9-1-82
37	MAINLAND	NE-E	YELLOW	7-24-82 / 9-1-82
38	MAINLAND	N	ORANGE	7-24-82 / 9-1-82
39	FLAXMAN IS-BLUFF	N-NE	YELLOW	7-23-82 / 9-2-82
40	FLAXMAN IS-BLUFF	N-NE	ORANGE	7-23-82 / 9-2-82
41	FLAXMAN IS-BLUFF	N-NE	YELLOW	7-23-82 / 9-2-82
42	FLAXMAN IS	N-NE	YELLOW	7-23-82 / 9-2-82
43	FLAXMAN IS	N-E	YELLOW	7-43-82 / 9-2-82
44	FLAXMAN IS	N-E	ORANGE	7-23-82 / 9-2-82
45	FLAXMAN IS-BLUFF	SW-W-NW	YELLOW/ORANGE	7-23-82 / 9-2-82
46	MARY SACHS	NE/S	YELLOW	7-23-82 / 9-2-82
47	MARY SACHS	NE/S	ORANGE	7-23-82 / 9-2-82
48	MARY SACHS	NE/S	ORANGE	7-23-82 / 9-2-82
49	MARY SACHS	NW-NE/S	YELLOW/ORANGE	7-23-82 / 9-2-82
50	MARY SACHS	NW-NE/S	ORANGE	7-23-82 / 9-2-82
51	MARY SACHS	W-N-NE/S	YELLOW/ORANGE	7-23-82 / 9-2-82
52	MARY SACHS	W-NW-N/S	ORANGE	7-23-82 / 9-7-82
53	NS/DUCH IS	N-NE/S	YELLOW/ORANGE	7-25-82 / 9-7-82
54	NS/DUCH IS	N-NE/S	YELLOW/ORANGE	7-25-82 / 9-7-82

TRANSECT	LOCATION	EXPOSURE	TARGET COLOR	SURVEY DATES
55	NS/DUCH IS	N-NE/S	ORANGE	7-25-82 / 9-7-82
56	NS/DUCH IS	NW-N-NE/S	ORANGE	7-25-82 / 9-7-82
57	NS/DUCH IS	NW-N-NE/S	ORANGE	7-25-82 / 9-7-82
58	NS/DUCH IS	NW-N-NE/S	YELLOW	7-25-82 / 9-7-82
59	NS/DUCH IS	W-N/S-SE	YELLOW/ORANGE	7-25-82 / 9-2-82
60	NS/DUCH IS	W-N/S-SE	ORANGE	7-25-82 / 9-7-82
61	ALASKA IS	N-NE/S	YELLOW/ORANGE	7-25-82 / 9-7-82
62	ALASKA IS	N-NE/S	YELLOW/ORANGE	7-25-82 / 9-7-82
63	ALASKA IS	N-NE/S	YELLOW	7-25-82 / 9-7-82
64	ALASKA IS	NW-N-NE/S	YELLOW,ORANGE	7-25-82 / 9-7-82
65	ALASKA IS	NW-N-NE/S	YELLOW	7-25-82 / 9-7-82
66	ALASKA IS	NW-N-NE/S	ORANGE	7-25-82 / 9-7-82
67	ALASKA IS	NW-N-NE/S	YELLOW	7-25-82 / 9-7-82

TABLE 4.3
SUMMARY OF SURVEY DATA

(ALL MEASUREMENTS EXPRESSED IN FEET)

TRANSECT	BEARING (Deg)	TRANSECT LENGTH		SOUTH WL TO MNT		MNT TO NORTH WL		ELEVATIONS		SHORELINE CHANGE AT JULY SWL DATUM	
		JULY	SEPT	JULY	SEPT	JULY	SEPT	ON MNT	SEPT SWL	SOUTH SHORELINE	NORTH SHORELINE
1	035.T	146	142			128	128	4.3	-.1		.2 EROSION
2	024.T	142	142			131	132	10.2	-.3		.8 EROSION
											.7 EROSION (BLUFF)
3	000.T	111	133	35	42	38	49	3.5	-.2	4.4 ACCRETION	9.3 ACCRETION
4	000.T	152	153	45	48	76	79	4.5	-.5	1.0 EROSION	.7 EROSION
5	000.T	108	103			74	73	19.0	-.2		2.3 EROSION
											3.1 EROSION (BLUFF)
6	355.T	112	115	32	35	56	58	3.4	-.3	.1 EROSION	.1 ACCRETION
7	000.T	127	143	51	54	55	67	4.2	-.5	.0 ACCRETION	10.7 ACCRETION
8	010.T	57	80			47	54	3.3	-.7		2.7 EROSION
9	350.T	82	322	21	27	31	87	3.6	-1.0	.3 ACCRETION	3.3 ACCRETION
10	334.T	160	195			144	151	4.7	-1.1		.1 ACCRETION
11	300.T	90	161	16	20	45	51	3.6	-.8	.2 ACCRETION	3.0 ACCRETION
12	000.T	125	159			113	119	7.4	-1.1		6.2 EROSION
13	000.T	115	100			100	114	5.0	-.8		4.0 ACCRETION
14	020.T	73	82			63	64	3.4	-.5		2.0 EROSION
15	030.T	72	111	19		35	36	4.3	-.7	.1 EROSION	2.0 EROSION
16	040.T	93	135			81	88	3.1	-.6		.4 EROSION
17	343.T	79	262			51	56	3.6	-.5		1.2 EROSION
18	040.T	84	106			70	71	3.7	-.1		.4 ACCRETION
19	036.T	106	139			78	79	4.1	-.3		3.0 EROSION
20	352.T	197	243			172	177	3.9	-.2		6.8 EROSION
21	300.T	92	134			53	54	3.2	-.2		0.0 ACCRETION
[illegible]	[illegible]	[illegible]	[illegible]			[illegible]	[illegible]	[illegible]	[illegible]		[illegible]

TRANSECT	BEARING (Deg)	TRANSECT LENGTH JULY	TRANSECT LENGTH SEPT	SOUTH WL TO MNT JULY	SOUTH WL TO MNT SEPT	MNT TO NORTH WL JULY	MNT TO NORTH WL SEPT	ELEVATIONS ON MNT	ELEVATIONS SEPT SWL	SHORELINE CHANGE AT JULY SWL DATUM SOUTH SHORELINE	SHORELINE CHANGE AT JULY SWL DATUM NORTH SHORELINE
23	000.T	126	195			103	118	4.2	-.3		2.0 ACCRETION
24	000.T	172	224			108	145	2.1	-.7		.4 EROSION
25	003.T	176	211	46	47	119	128	2.8	-.6	2.2 EROSION	6.0 ACCRETION
26	000.T	130	161	50	61	65	72	1.6	-.7	1.0 EROSION	.6 EROSION
27	000.T	68	81	22	25	34	34	3.0	-.7	1.1 EROSION	5.8 EROSION
28	344.T	100	102	27	29	55	57	3.4	-.7	.2 EROSION	1.3 EROSION
29	019.T	115	120			82	87	3.1	-.6		.4 EROSION
30	045.T	91	93			78	80	5.8	-.6		1.7 EROSION
31	000.T	101	105			87	92	7.8	-.6		1.5 ACCRETION
32	000.T	130	141			109	115	7.8	-.5		.4 ACCRETION
33	008.T	160	168			141	145	3.0	-.5		1.0 EROSION
34	056.T	104	107			98	101	10.0	-.6		.3 EROSION
											0.0 EROSION (BLUFF)
35	002.T	145	170			114	116	6.7	-.6		1.9 EROSION
36	062.T	150	162			142	145	3.2	-.5		.5 EROSION
37	066.T	122	126			105	112	7.5	-.5		1.6 ACCRETION
38	028.T	195	243			129	161	7.0	-.7		2.2 EROSION
39	034.T	144	161			108	108	20.3	0.0		5.2 EROSION (BLUFF)
40	023.T	177	186			120	102	16.4	0.0		20.5 EROSION (BLUFF)
41	029.T	107	128			107	111	13.9	0.0		6.5 EROSION (BLUFF)
42	018.T	207	223	78	80	101	106	4.0	-.2	1.2 ACCRETION	3.4 ACCRETION
43	014.T	171	172	63	68	71	72	3.7	-.3	3.0 ACCRETION	.9 EROSION
44	033.T	261	296	59	60	85	85	2.8	-.2	.5 EROSION	1.6 EROSION
45	080.T	115	134			69	68	8.0	-.3		2.2 EROSION
											0.0 EROSION (BLUFF)
46	000.T	214	250	41	58	146	159	1.1	-.7	8.7 ACCRETION	4.8 ACCRETION
47	020.T	151	193	42	53	61	77	2.0	-.9	5.5 EROSION	8.3 ACCRETION

TRANSECT	BEARING (Deg)	TRANSECT LENGTH		SOUTH WL TO MNT		MNT TO NORTH WL		ELEVATIONS		SHORELINE CHANGE AT JULY SWL DATUM	
		JULY	SEPT	JULY	SEPT	JULY	SEPT	ON MNT	SEPT SWL	SOUTH SHORELINE	NORTH SHORELINE
48	026.T	177	272	64	89	64	76	2.8	-1.0	3.5 EROSION	7.6 ACCRETION
49	000.T	687	723	375	384	281	292	3.9	-1.5	3.6 EROSION	9.6 EROSION
50	356.T	442	678	196	443	178	195	2.2	-1.3	4.2 EROSION	16.6 EROSION
51	358.T	474	523	322	342	110	135	2.7	-1.7	5.9 EROSION	9.0 ACCRETION
52	340.T	523	1409	225	1011	263	294	1.0	-1.9	.0 ACCRETION	5.1 EROSION
53	026.T	129	509	44	296	49	51	2.3	-.5	5.6 EROSION	2.6 EROSION
54	006.T	476	514	360	372	79	94	4.1	-1.7	1.2 EROSION	2.4 ACCRETION
55	020.T	191	334	96	179	55	69	2.7	-1.5	.4 ACCRETION	.1 EROSION
56	015.T	214	248	76	89	103	116	2.7	-1.5	.2 EROSION	.2 EROSION
57	000.T	171	194	68	78	69	86	5.7	-1.3	.3 ACCRETION	7.4 ACCRETION
58	000.T	317	336	137	147	138	150	5.2	-1.7	1.5 EROSION	.3 ACCRETION
59	340.T	388	424	205	217	127	150	2.4	-1.7	2.8 EROSION	8.8 EROSION
60	332.T	445	485	310	320	92	120	2.3	-1.7	2.8 EROSION	22.0 EROSION
61	040.T	92	236	21	97	32	55	1.7	-1.6	8.9 EROSION	5.5 EROSION
62	012.T	145	213	29	63	66	77	3.3	-1.7	1.4 ACCRETION	3.3 ACCRETION
63	015.T	141	289	61	90	52	68	3.3	-1.5	6.0 ACCRETION	4.7 ACCRETION
64	008.T	435	497	48	65	352	369	2.5	-1.5	4.5 ACCRETION	24.7 EROSION
65	012.T	273	455	132	162	92	186	4.2	-1.7	4.9 EROSION	5.0 EROSION
66	000.T	190	207	80	96	69	81	3.4	-1.5	4.3 ACCRETION	1.0 ACCRETION
67	008.T	252	477	42	245	152	171	2.7	-1.7	.2 EROSION	10.2 EROSION

survey at each profile. Due to persistent easterly winds throughout the September survey period, the water levels were lower than those during the July survey by as much as two feet.

- Shoreline Change at July SWL Datum: For each transect, the change in shoreline position at the survey datum (the July still water level) was computed. In the case of mainland spits and barrier islands, the changes at both the north and south shorelines are given. For the Flaxman Island and mainland bluffs, the change in bluff and shoreline positions are listed.

The shoreline changes associated with the July-September, 1982, survey period are summarized in Figure 4.7. Transects are designated by small numbers, while the large red numerals show the values of the beach or bluff changes. Shoreline changes are given in feet, with positive numbers representing accretion of the beach, and negative numbers representing erosion. In the case of barrier islands with north and south shorelines, the measured values of erosion and/or accretion are presented adjacent to both shorelines.

A detailed interpretation of the shoreline change data summarized in Figure 4.7 is presented in Section 5.

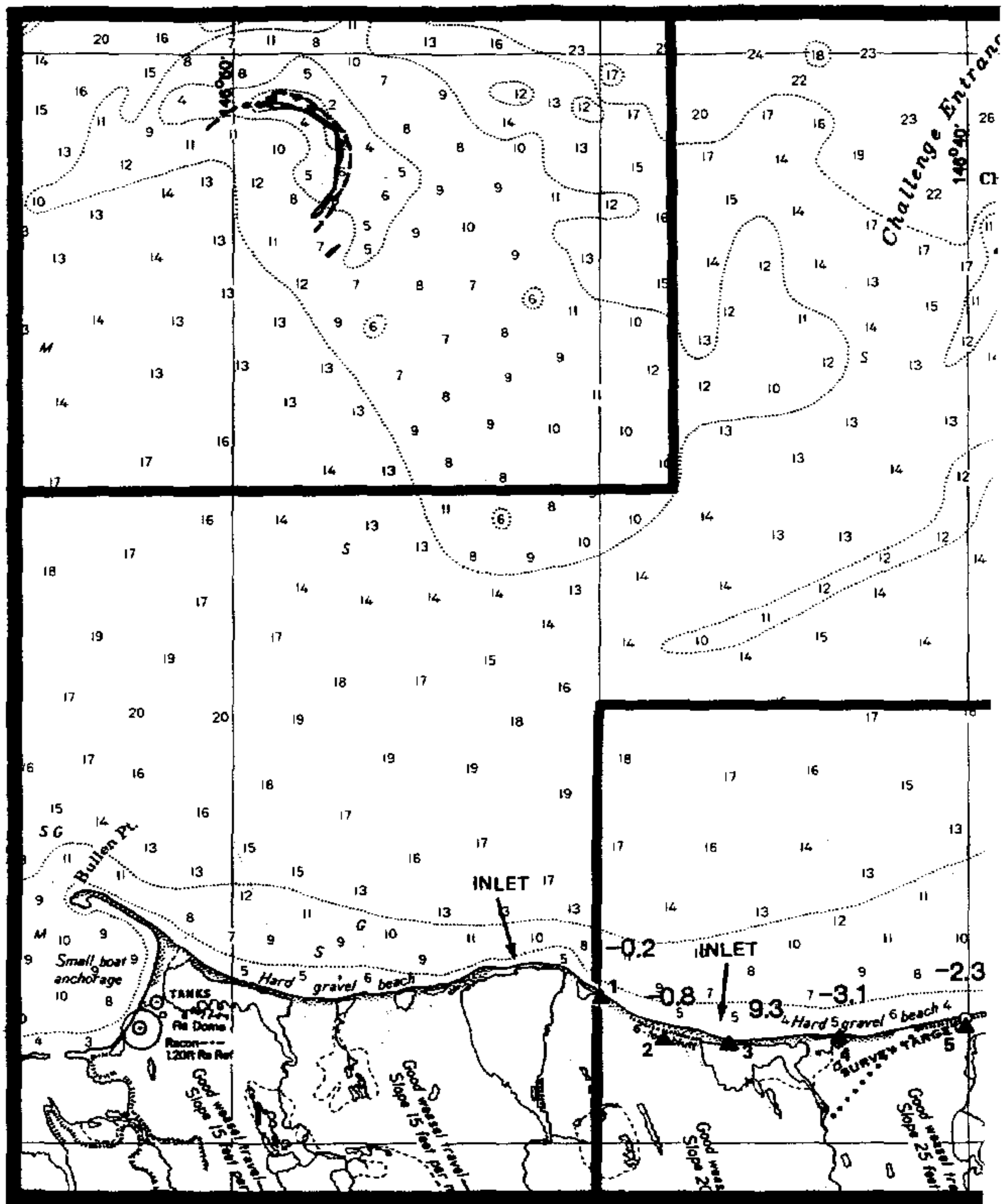


FIGURE 4.7

COASTAL CHANGES, JULY - SEPTEMBER, 1982

PT. THOMSON DEVELOPMENT PROJECT
COASTAL PROCESSES AND SEDIMENT DYNAMICS
CONTRACT PTD—8206
TEKMARINE, INC.

DRAWN

APPROVED

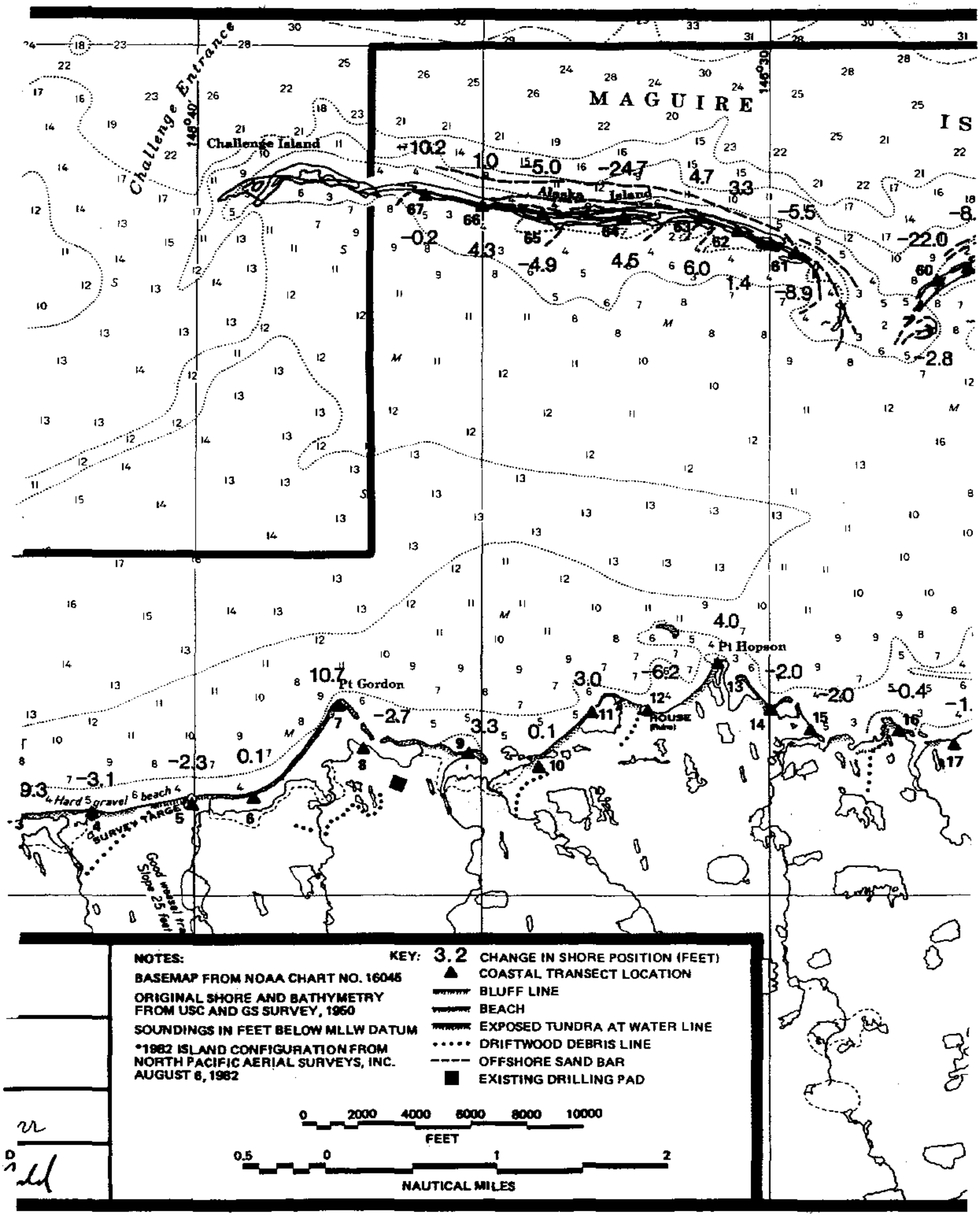
NOTES:

BASEMAP

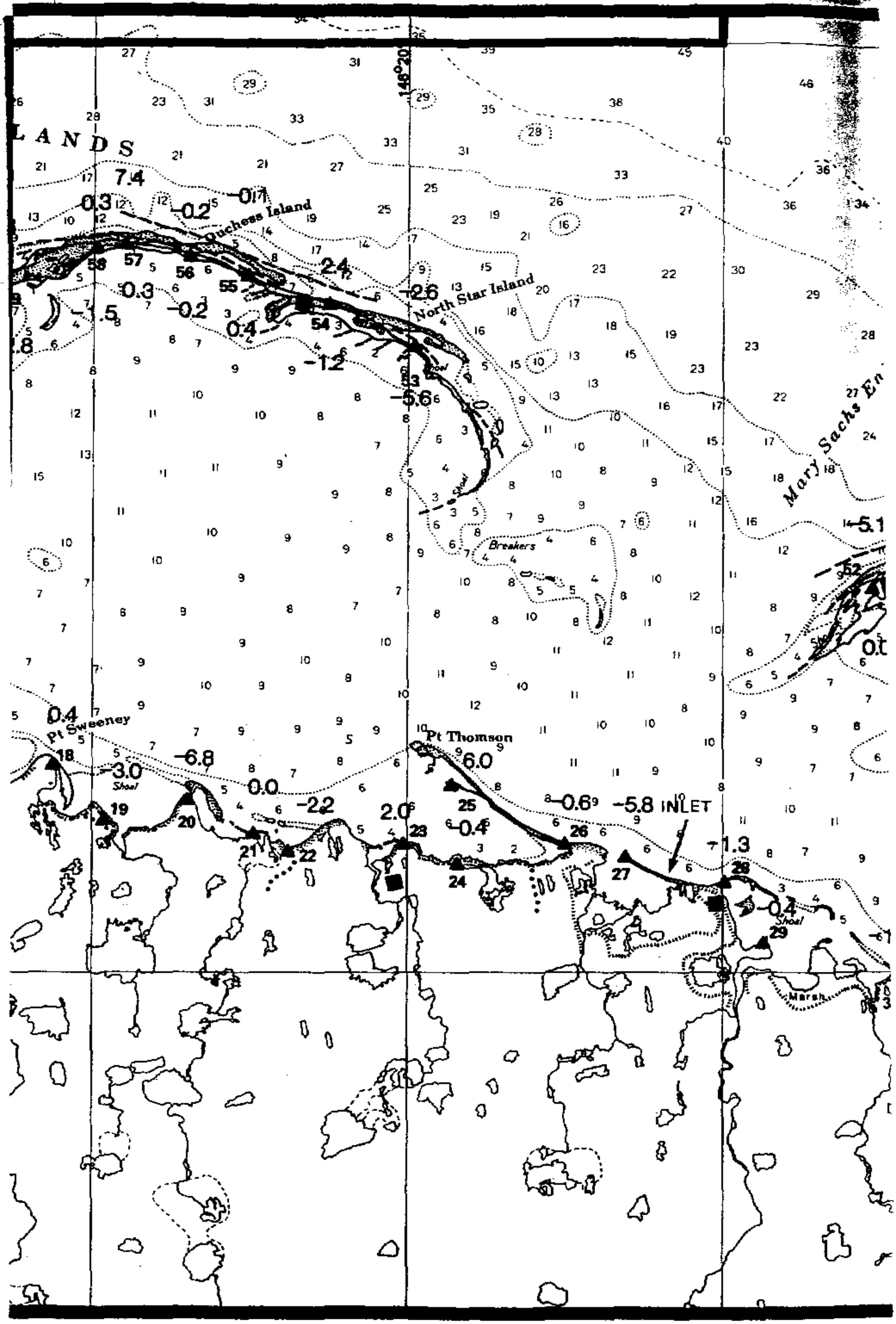
ORIGINAL
FROM USC

SOUNDINC

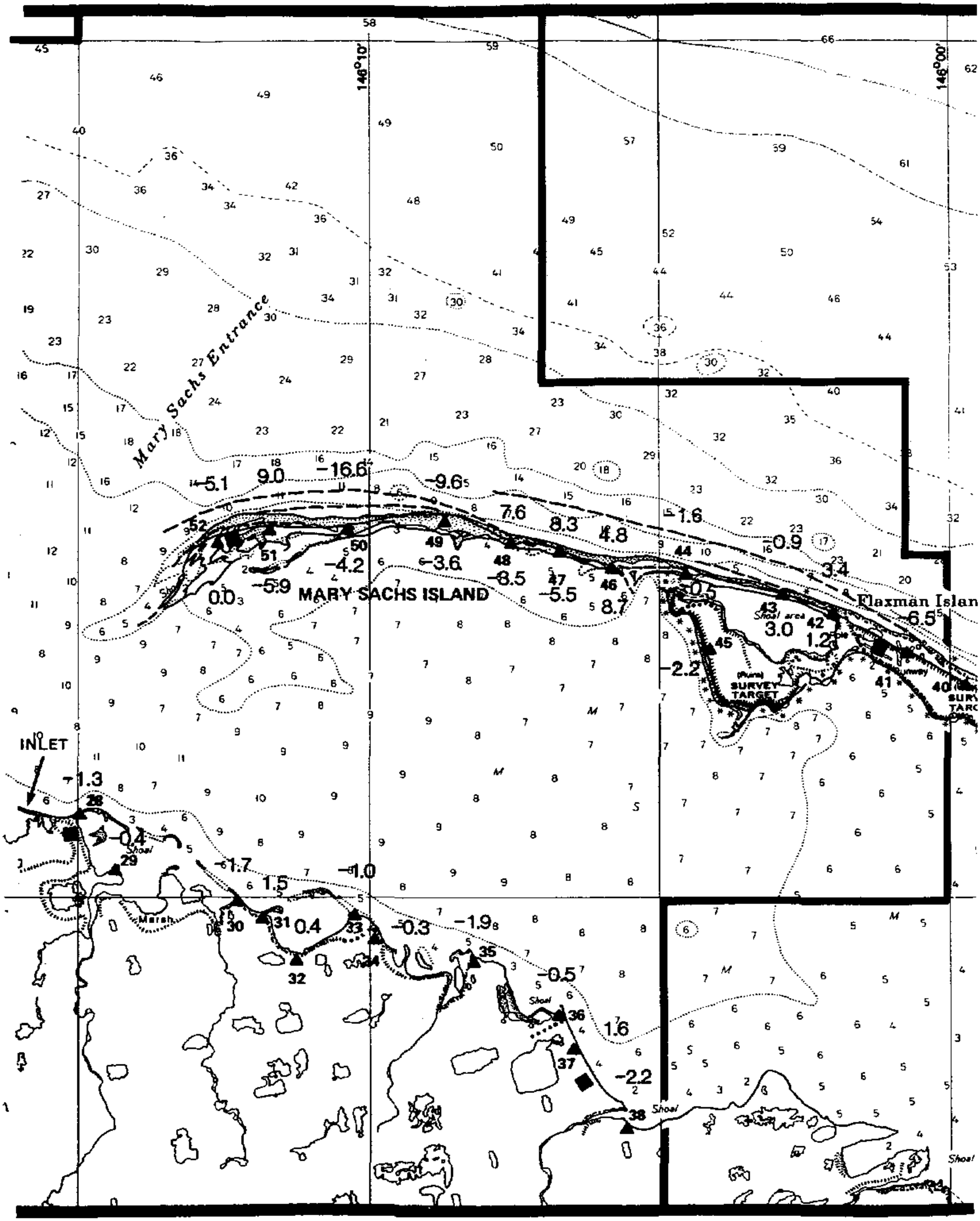
*1982 ISLA
NORTH PA
AUGUST 6



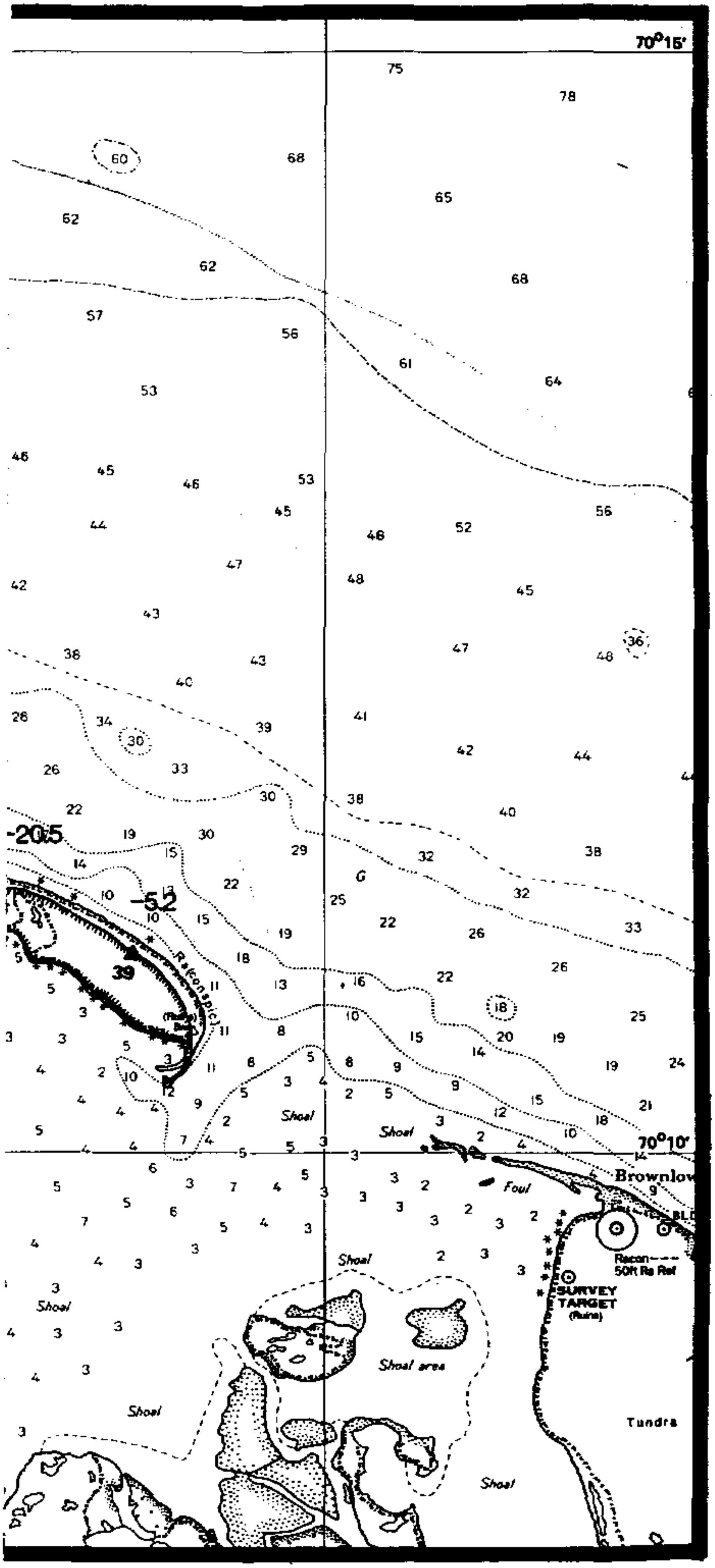
Challenge Entrance
Challenge Island
MAGUIRE
IS
Alaska Island
Pt Gordon
Pt Hopson
ROUSE
Hard gravel beach
SURVEY TARGET
Good vessel tra[...]
Slope 25 feet
148°40'
148°30'
NOTES:
BASEMAP FROM NOAA CHART NO. 16045
ORIGINAL SHORE AND BATHYMETRY FROM USC AND GS SURVEY, 1950
SOUNDINGS IN FEET BELOW MLLW DATUM
*1982 ISLAND CONFIGURATION FROM NORTH PACIFIC AERIAL SURVEYS, INC. AUGUST 6, 1982
KEY:
3.2 CHANGE IN SHORE POSITION (FEET)
COASTAL TRANSECT LOCATION
BLUFF LINE
BEACH
EXPOSED TUNDRA AT WATER LINE
DRIFTWOOD DEBRIS LINE
OFFSHORE SAND BAR
EXISTING DRILLING PAD
0 2000 4000 6000 8000 10000
FEET
0.5 0 1 2
NAUTICAL MILES



LANDS
Duchess Island
North Star Island
Shoal
Breakers
Mary Sachs
Pt Sweeney
Pt Thomson
INLET
Marsh
146°20'



146°10'
146°00'
Mary Sachs Entrance
MARY SACHS ISLAND
Flaxman Islan
Shoal area
SURVEY TARGET
INLET
Shoal
Marsh



70°15'
70°10'
Racon (conspic)
Shoal
Foul
Brownlow
Racon
50ft Ra Ref
SURVEY
TARGET
(Ruins)
Shoal area
Tundra