State of California – The Resources Agency
DEPARTMENT OF NAVIGATION AND OCEAN DEVELOPMENT

Assessment and Atlas of SHORELINE EROSION

Along the CALIFORNIA COAST

State of California – The Resources Agency
DEPARTMENT OF NAVIGATION AND OCEAN DEVELOPMENT

Assessment and Atlas of SHORELINE EROSION

Along the CALIFORNIA COAST

July 1977

STATE OF CALIFORNIA RESOURCES AGENCY
DEPARTMENT OF NAVIGATION AND OCEAN DEVELOPMENT

RECEIVED
MAY 4 1979
DOCUMENTS SECTION
CAL POLY LIBRARY

This publication was prepared with financial assistance from the Office of Coastal Zone Management, National Oceanic and Atmospheric Administration, under the provisions of the Federal Coastal Zone Management Act of 1972.

Cover Photo: Point Montara, San Mateo County

FOREWORD

Recent legislation at both the State and Federal levels has brought a new emphasis to the California coastline. The passage of the California Coastal Act established the California Coastal Commission as a permanent body to set policy for the management of the Coastal Zone, with permit authority to be given to local government under Commission guidelines. The 1976 amendments to the federal Coastal Zone Management Act required that shoreline erosion and mitigation planning be a part of the State's coastal zone management program.

With this in mind, the Department of Navigation and Ocean Development, which has carried out the State's shoreline erosion protection program since 1970, contracted with the California Coastal Commission to develop an atlas which assesses the condition of the coastline. Much information on the coastline has been accumulated by the department in carrying out its shore protection program. The information represents a valuable resource to those in the public and private sector charged with management of the shoreline.

The report, when viewed in its entirety, shows in graphic form the erosion problem and the regions where the situation is becoming more critical. Areas of particular concern can be selected where controls are needed or where restoration or preservation should be instituted. Priorities for further studies can also be established.

Local governments preparing the coastal element of their general plan can utilize the information and may wish to investigate critical areas in more detail. In some instances where common problems are shared among adjacent jurisdictions, a cooperative effort may prove more beneficial. Regional effects of potential solutions should be considered and, where appropriate, cooperation should be encouraged.

Marty Mercado

MARTY MERCADO
Director

Department of
Navigation and Ocean Development

TABLE OF CONTENTS

ASSESSMENT of Shoreline Erosion **Page**

FOREWORD iii

INTRODUCTION 1

TYPES OF SHORELINES 3

Littoral Cells Terminating in Submarine Canyons 4
Deltas Stabilized Between Headlands 4
Crescent or Crenulate Bays 6
Crenulate Spits 6
Parallel Alignments 7

LITTORAL CELLS ALONG THE CALIFORNIA COAST 9

Littoral Cell Map Index 11
Littoral Cells (Maps 1 through 12) 13

MAN'S INFLUENCE UPON SHORELINE EROSION 37

DESCRIPTION OF THE CALIFORNIA COAST 39

North Coast Region 40
North Central Coast Region 41
Central Coast Region 42
South Central Coast Region 44
South Coast Region 45
San Diego Region 47

SIGNIFICANT LOCAL PROBLEM AREAS 49

NORTH COAST REGION 51

Del Norte County 51
Humboldt County 52
Mendocino County 53

NORTH CENTRAL COAST REGION 53

Sonoma County 53
Marin County 53
San Francisco County 53

CENTRAL COAST REGION 54

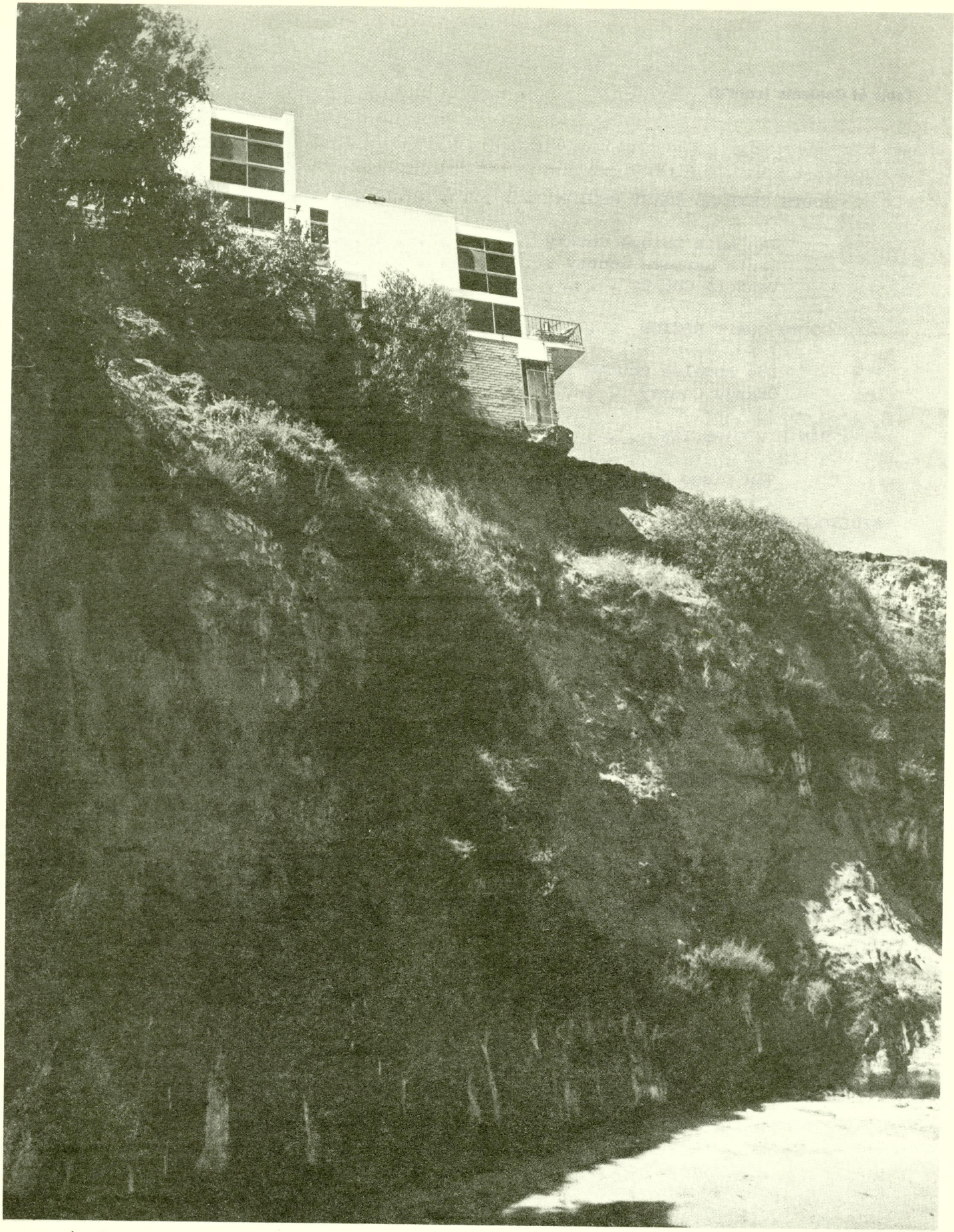
San Mateo County 54
Santa Cruz County 55
Monterey County 55

Table of Contents (cont'd)

	Page
SOUTH CENTRAL COAST REGION	56
San Luis Obispo County	56
Santa Barbara County	56
Ventura County	57
SOUTH COAST REGION	58
Los Angeles County	58
Orange County	59
SAN DIEGO REGION	60
San Diego County	60
BIBLIOGRAPHY	63

ATLAS of Shoreline Erosion

ATLAS OF SHORELINE EROSION	A-1
FORMAT OF THE ATLAS	A-3
CLASSIFICATION OF SHORELINE CONDITION	A-5
MAP INDEX TO ATLAS (Maps 1 through 5)	A-7
SHORELINE CONDITION ATLAS (Maps 1 through 129)	A-19



Capitola, Santa Cruz County

INTRODUCTION

Wave energy generated by storms throughout the Pacific Ocean is constantly being expended at the shoreline moving billions of tons of sand and eroding the unprotected bluffs. Developments built too close to this dynamic zone have been lost to an encroaching ocean.

Shoreline erosion problems have plagued California for many years, and millions of dollars have been spent in attempts to solve them. Many problems still exist, and new ones are likely to occur. Information on the extent of the problems is required for development of policies on how these problems should be handled and designation of the areas where controls or restorations should be applied.

This report and atlas presents an assessment of the erosion that is occurring along the ocean shoreline of the State. The report/atlas identifies the nature of the entire coastline and those sections of the coast which are presently subject to damage from erosion, those sections which could be subject to damage if not properly developed, and those sections where preventive measures have been taken to protect the land against wave action.

The report is based upon a mile-by-mile review of the conditions as they exist today. The data has been compiled from project reports, cooperative beach erosion studies, aerial photographs, previous inventories and on-site photographs. In addition, the authors have personally inspected most of the shoreline over a number of years.

It should be noted that while this report provides considerably more information on statewide erosion conditions than has been published before, its compilation depended a great deal upon individual interpretation and judgment. The atlas, therefore, should be used as one of a number of information sources for coastal planners and developers.

TYPES OF SHORELINES

The California shoreline is diverse and varied, consisting of sand beaches, eroding sculptured cliffs, and stalwart outcroppings. The many geological faults result in striking changes within short distances, and no single formation extends for any great length of shoreline.

Those sections of shoreline which are highly resistant to wave attack are usually distinct promontories which have withstood the ravages of the sea, while the adjacent, more erodible formations have gradually retreated. Some of the most notable examples are Point Reyes in Marin County, Bodega Head in Sonoma County, Pillar Point in San Mateo County, Point Lobos in Monterey County, Morro Rock in San Luis Obispo County, and Point Dume and Point Fermin in Los Angeles County.

On other shorelines where the land mass is not protected by a beach and is exposed to the pounding of waves, the rate at which the cliffs retreat depends on several factors. Soft rocks and unconsolidated sediments are particularly vulnerable. Some formations deteriorate rapidly where exposed to the weathering effects of air and water. If there are varying degrees of hardness, indentations or seacaves are cut into the softer formations, eventually causing collapse of harder materials. The angle at which bedding layers lie relative to the shoreline affects the probability of slides, particularly in shales, sandstone, and other sedimentary formations. Ground water seepage, either from natural sources or those induced by man (such as irrigation or septic tanks), can weaken the formation. Retreat of a shoreline will be slower if the cliffs are high and massive, for it will take longer for the waves to remove the large quantities of material. If the seacliffs are of uniform material, the waves are likely to straighten the shoreline; whereas, if there are varying degrees of hardness, indentations will be cut into the softer material leaving the harder materials as protruding points.

The rate of cliff retreat is complex and dependent upon a number of factors such as geological formation, ground water seepage, and exposure to wave energy. Cliff erosion occurs only periodically under attack of storm waves, and it may not be obvious unless it occurs next to some fixed point such as a structure or has been photographed at different points in time. Little is known about the erosion rate along most of the coast, except where development has been endangered by erosion. Only a few sections of shoreline have been monitored over a period of time.

Those sections of the coastline which have a protective beach between the ocean and the uplands are less susceptible to shoreline retreat than those directly exposed to wave forces. This natural protection is also one of the State's most valuable recreational resources, particularly in the Southern California metropolitan areas. Because of the great value of protective beaches and man's ability to alter and misuse them, special attention needs to be given to their use, and a particular awareness of their characteristics should become a part of all coastal planning.

Sand beaches can retreat up to a hundred feet in a few hours and virtually disappear in a single storm. By the same token, they may return, but at a slower rate. Within historic times, some California beach shorelines have moved over a thousand feet. Stability of a sandy beach is dependent upon the amount of wave energy and its direction, sand supply, and both short and long term sea level changes. Beaches backed by dunes do not retreat to as great an extent because of the reservoir of sand contained in the dunes which feeds the beach during storms. Removal of dunes endangers the inland area. Any modification to the natural processes of sand supply, wave action, or sand transit in the surf zone, known as littoral drift, will have an impact on a sandy beach.

The sediments on the beach are moved by waves and currents. If the gross coastal position is to be maintained, there must be some equilibrium achieved so that the sand motions somehow cancel each other. Many equilibrious configurations are possible. Because erosion or accretion occurs when the equilibrium is disturbed at a particular location, the equilibrious shapes are of utmost importance. Erosion may occur either seasonally as the shoreline adjusts to a slightly different type of wave or on a long term basis in response to changes in weather patterns. Most importantly, because this is a delicate balance, man's activities can be sufficient to seriously disturb the equilibrium. Five of the most commonly occurring configurations along California's coastline are described in the following sections.

Littoral Cells Terminating in Submarine Canyons

In its simplest form, this coastline feature consists of a major sediment input source (such as a river mouth) downcoast from a sand barrier. The sediment which has been deposited on the river delta during flood flows is carried downcoast by wave action, forming a continuous sandy beach until it reaches a sharply defined submarine trough extending from very deep water into the area of sand movement near the shore. The head of the submarine canyon acts as a sink by trapping the sand carried along the coast, effectively terminating the downcoast littoral drift. Large storms create down-canyon currents which sweep away the accumulated sand into the ocean depths and clear the trap for continued interception of the alongshore sand flow.

Because of the dominant wave direction, nearly all littoral cells in California flow from north to south. True littoral cells of this type are, therefore, more complicated. They often contain many sources of sediment from streams and rivers and may have offshore losses as well as wind-borne losses to dune fields. The significance of these systems is that they are essentially closed in the alongshore direction. That is, there is little or no source of sand from upcoast into the cell and little or no sand leaves the cell at the downcoast end. Any changes to the sources or sinks will disrupt this balance and change the equilibrious coastline shape. Therefore, the fact that the shoreline within a cell shares a common resource should be considered in coastal planning. The results would benefit the entire coastal reach.

Six major littoral cells terminating in submarine canyons have been identified:

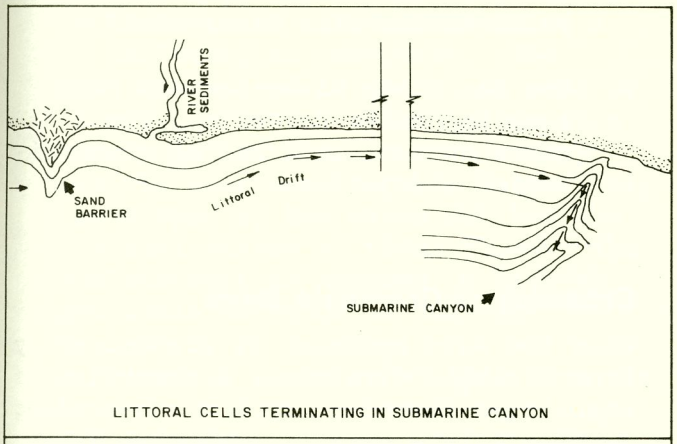
1. Point Santa Cruz to Monterey Canyon
2. Pinos Point to Monterey Canyon
3. Point Conception to Hueneme and Mugu Canyons
4. Point Dume to Redondo Canyon
5. Point Fermin to Newport Canyon
6. Dana Point to La Jolla Canyon

Three more locations appear to be this type of cell, but their function is not confirmed by observation of down-canyon losses:

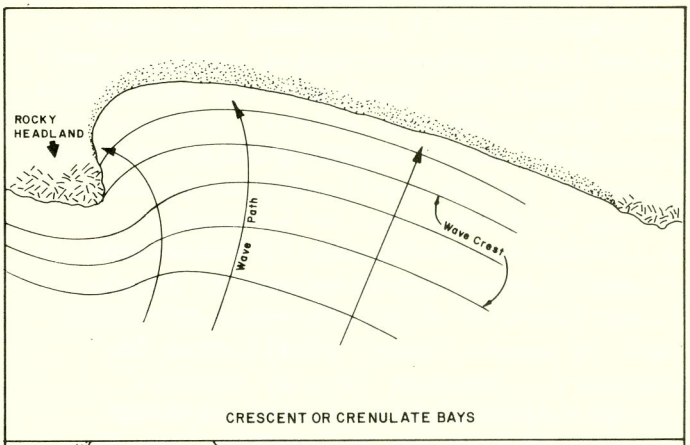
1. Cape Mendocino to Mattole Canyon
2. Punta Gorda to Delgada Canyon
3. Point Mugu to Dume Canyon

Deltas Stabilized Between Headlands

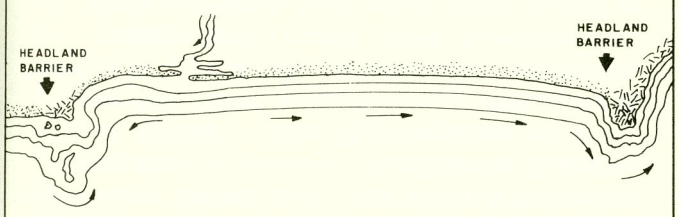
Large rivers flowing into the ocean over broad, low flood plains will characteristically form large delta areas and a terminal sandspit that points perpendicular to the dominant wave approach direction. Tidal exchange flows will tend to keep an entrance open to the lagoon behind the spit even at low river flows. When waves are energetic and sediment inputs by the river are low, the delta will be attacked and recede as sediment is carried downdrift. The delta will accrete again when floods



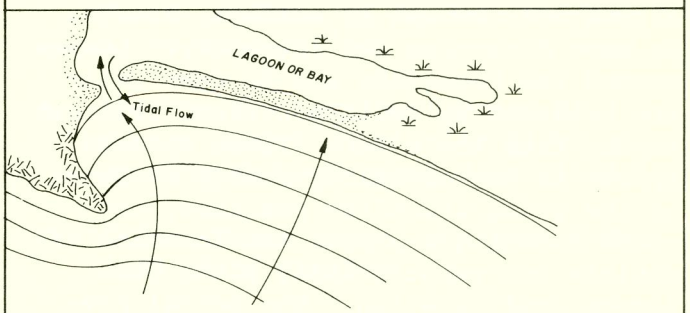
LITTORAL CELLS TERMINATING IN SUBMARINE CANYON



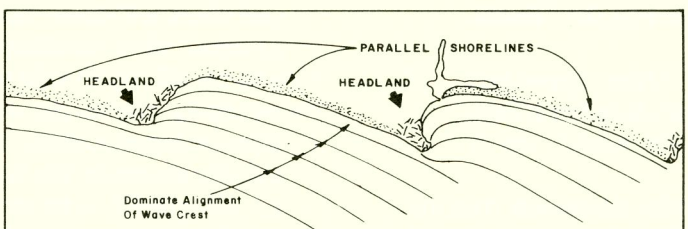
CRESCENT OR CRENULATE BAYS



DELTAS STABILIZED BETWEEN HEADLANDS



CRENULATE SPIT



PARALLEL ALIGNMENTS

carry new sediment loads to it. Along a a rocky coast, it is common for this delta flood plain to exist between two rocky headlands which provide partial wave protection and partial sediment barriers. As a result of this confinement by the headlands, an equilibrious condition can be reached in which the beach contour is reasonably fixed. Large floods result in accretion, but the sand is moved out of the cell by waves; thus, equilibrium is restored. Between floods, contour changes are largely limited to small alterations caused by seasonal changes in wave direction and intensity. Losses around the headlands and to deep water are balanced by small non-flood sediment inputs from the river. These systems appear to be reasonably stable in terms of the gross shoreline position, but river flooding can move the location of outlets and substantially alter the lagoon configuration. The normal precautions against construction on any river flood plain apply near the mouth, with the additional complications imposed by seasonal and long-term changes in the wave climate which can cause local changes in the shoreline form.

Seven major systems of this type can be identified along the California coastline:

1. The Smith River Delta between Point St. George and Pyramid Point

2. Redwood Creek Delta, including Big and Stone Lagoons, between Patricks Point and Mussel Point

3. The Humboldt Bay complex, composed of the combined deltas of the Salt, Eel and Mad Rivers and Little Creek, between False Cape and Tepona Point. The entrance has been stabilized by jetties.

4. The Bear River between Cape Mendocino and False Cape

5. The Mattole River Delta Between Punta Gorda and Mattole Point

6. The Ten Mile River Delta from Laguna Point to Ten Mile River Bluff

7. The San Diego River between Point Loma and Point La Jolla. The entrance is stabilized by channelization and jetties.

Crescent or Crenulate Bays

When the wave approach is predominantly from a single direction, a coastline is stabilized downcoast from a non-eroding feature like a rocky outcropping into a particular crescent shape. Many researchers have identified these features throughout the world and have shown that their shape conforms well to a logarithmic spiral. North of Point Conception, where the dominant waves are from the northwest, there are many such features. The coast curves sharply inward south of an outcropping and then gradually straightens to a tangential section at the extreme southerly end. The shape is well defined because it is an equilibrious configuration matching the refraction pattern of the waves as they pass around the headland. Furthermore, a state of dynamic equilibrium is maintained, and any disruption of the shoreline shape tends to be erased as soon as it occurs if the entire coast is free to respond. If a non-erodible feature is introduced, however, the profile will shift to a new equilibrious configuration.

Major examples of crenulate bays in California are:

1. Crescent City (modified by breakwater)
2. Shelter Cove at Point Delgada
3. Half Moon Bay
4. San Luis Obispo Bay

Crenulate Spits

A special case of the crenulate bay exists where tidal marshes or lagoons are situated inshore of the curving

coastline. The spirally curved coastline section now takes the form of a spit enclosing an embayment. The tidal inlets tend to stabilize near or at the protecting headland since this is the point of minimum wave energy where the shoreline form is less likely to be shaped by the waves but has the additional stress of tidal flows. The crenulate spit is assumed to have no appreciable exchange of sediment.

The principal examples of this form are:

1. Bodega Bay
2. Bolinas Bay
3. Drakes Bay

A special case of this form exists with Silver Strand, the spit formed in the lee of Point Loma. It appears possible that San Diego Bay previously may have been a stabilized mouth of the TiaJuana or San Diego Rivers, or it may simply have been a crenulate spit enclosing coastal lowlands as in the previous examples. However, it is known that this is not an equilibrious shoreline in the same sense and that substantial quantities of sand are moved north by the occasional exposure to southern swells. Thus, the basic shoreline shape of Silver Strand appears to be dominated by an equilibrious profile determined by northwest waves refracting around Point Loma. Sand from the TiaJuana River Delta has moved northward along the spit to be lost in deep water near its northern end.

Parallel Alignments

Just as the crenulate bay is the stable shape downcoast from a rocky headland, the stable upcoast feature is a straight beach aligned parallel to the predominant wave crests. In a sense, the parallel alignment is an extension of the tangential portion of the logarithmic curve of the crenulate bay. If sand is added to a section of shoreline of this form beyond the retention capacity of the headland, the excess may be carried around the headland by littoral currents. Formation of dunes may also occur wherever the land behind the coast is low and flat.

Examples of this equilibrious form include:

1. Manchester State Beach, north of Point Arena (sediment input from Garcia River at the downcoast end and dune field losses)

2. Ten Mile River Beach (input from Ten Mile River at upcoast end and large dune fields)

3. Pelican Bay, north of Point St. George (input from Smith River at upcoast end and heavy dune fields)

4. Salmon Creek Beach, north of Bodega Head (dune fields)

5. Beaches north of Point Sal and Mussel Point (input from Santa Maria River and extensive dunes)

6. Beaches north of Purisima Point (limited upcoast input and dunes)

7. Beaches north of Point Pedernales and Point Arguello (input upcoast from Santa Maria River and dunes)

It can be seen that many equilibrious forms can be readily classified in more than one of the five categories. For example, the Smith and Ten Mile River Deltas have been considered above as deltas stabilized between headlands and as parallel alignments. Either or both assignments are correct, but it is most significant to recognize that they are equilibrious systems and in balance only if the natural influences are not disturbed.

LITTORAL CELLS ALONG THE CALIFORNIA COAST

The movement of sediment along the California coastline can best be understood in terms of littoral cells. A littoral cell can be defined as a segment of coastline that encompasses a complete cycle of sediment supply, littoral transport, and ultimate loss of sediment from the coastal environment. The losses from the littoral cell can be offshore transport into submarine canyons, deep sinks at rocky headlands, or offshore transport into deeper water at headlands and/or an artificial barrier. The California coast has numerous littoral cells which can fall into several classifications, i.e. (1) long stretches of coastline beginning at a rocky headland and terminating at a submarine canyon, (2) cells confined by prominent rocky headlands with onshore, offshore, and possible deep water losses at the promontory, and (3) closed cells with confining headlands with possible onshore, offshore and deep water losses. The prime sources of sediment within any one littoral cell are the rivers and streams that empty into the ocean and eroding cliffs within its limits.

The littoral cells delineated on the attached maps have been defined by compiling information from available literature, and studies and reports published by the U. S. Army Corps of Engineers and universities. The determination of each littoral cell is a very speculative and uncertain venture because little is known about the littoral transport, net longshore transport quantities of sediment transported around rocky headlands, offshore sand losses into submarine canyons and sinks, losses to dunes and sand mining, the effect of wave and tidal action on sediment transport, and the input of sediment from coastal rivers and streams. In general, the littoral cells defined and delineated on the attached maps can be used for general planning studies but should not be used to set coastal management criteria or as a basis for the final coastal plan for any specific area within the littoral cell without additional and more detailed studies.

Terminology used in the study of littoral cells follows:

1. Littoral Zone - In beach terminology is an indefinite zone extending seaward from the shoreline to just beyond the breaker zone.

2. Littoral Transport - The movement of littoral drift in the littoral zone by waves and currents which includes movement parallel (longshore transport) and perpendicular (on-offshore transport) to the shore.

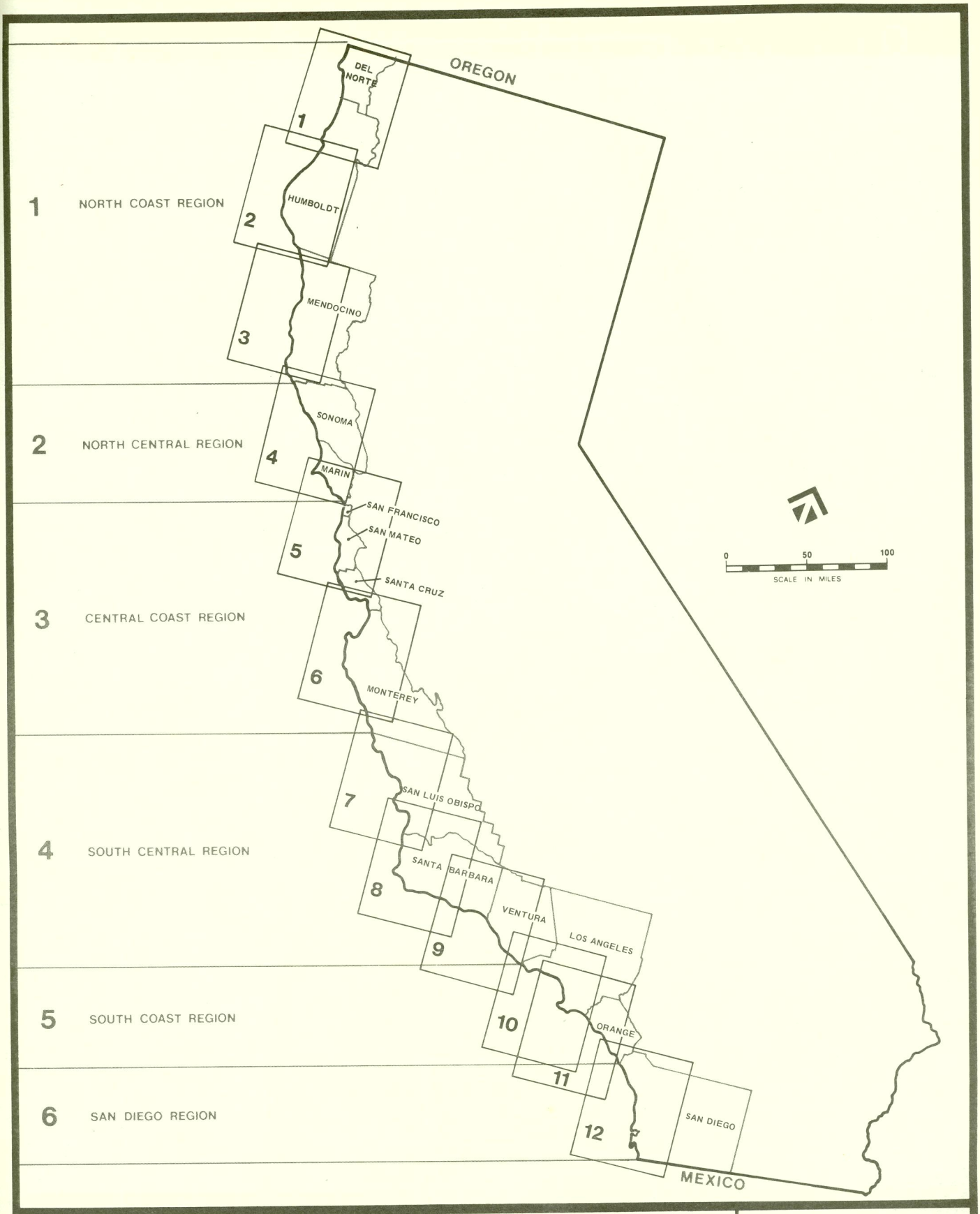
3. Littoral Current - A current moving parallel to shore, usually developed by wave fronts that have angular approach to the shore. The current causes shifting of beach sand along the shore.

4. Sand Budget - The rate of inputs of sediment to the cell from streams and cliff erosion balanced against the rate of losses occurring to onshore transport down submarine canyons and into sinks, and downcoast transport into the next littoral cell.

It should again be stressed that little is known about the quantities of sand which are lost in most of the California littoral cells because accurate measurements have not been made. However, where accurate measurements have been made through sand-bypassing dredging near harbor entrances (Southern California), they are found to concur reasonably with rates of sediment influx and transport through the littoral cell. Before any meaningful determination of sand

budget for individual cells can be made and used for coastal planning and regulatory criteria/procedures, it is essential that detailed studies of the littoral processes be made over an extended period of time (5 years) to document the total littoral environment.

A bibliography of references used in the compilation of the maps is attached for a more detailed analysis of a particular littoral cell.



LITTORAL CELL MAP INDEX

STATE OF CALIFORNIA — THE RESOURCES AGENCY

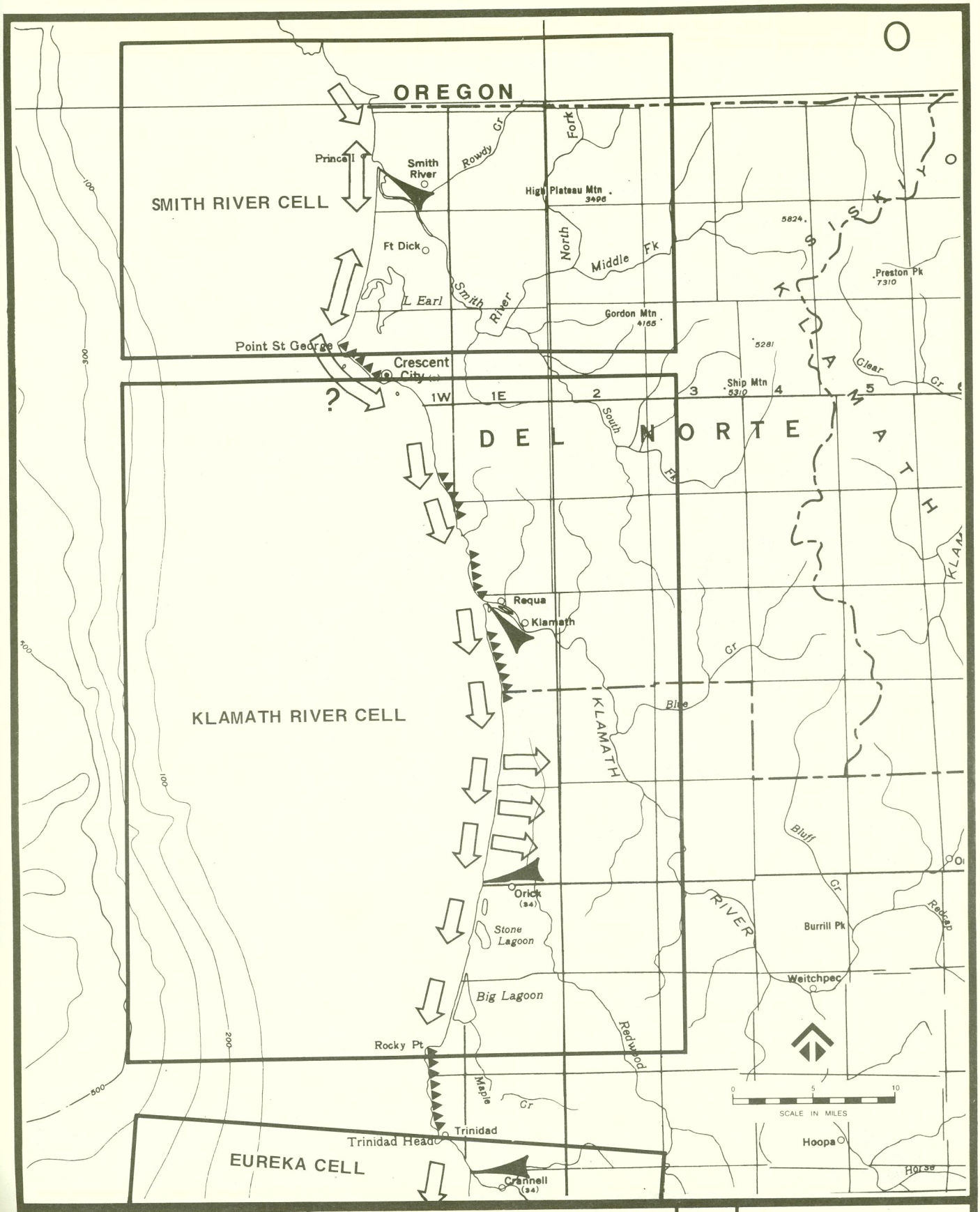
DEPARTMENT OF NAVIGATION & OCEAN DEVELOPMENT

11

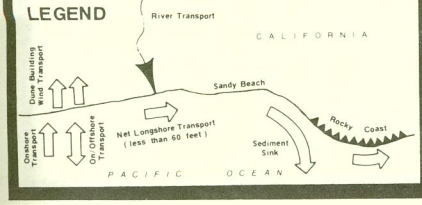
DNOD

1977

Point St. George
Del Norte County



LEGEND



LITTORAL CELLS

MAP NUMBER 1

STATE OF CALIFORNIA — THE RESOURCES AGENCY

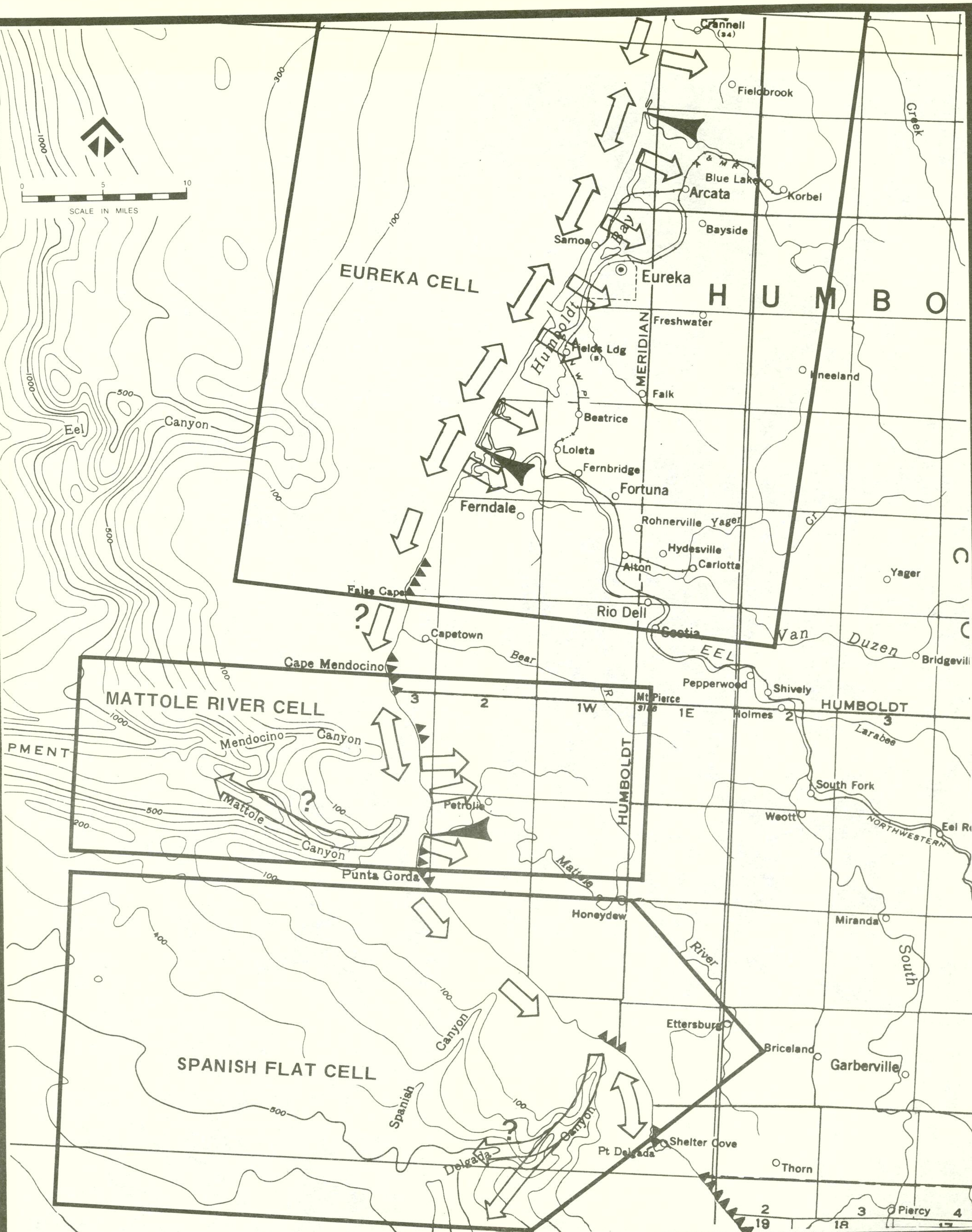
DEPARTMENT OF NAVIGATION & OCEAN DEVELOPMENT

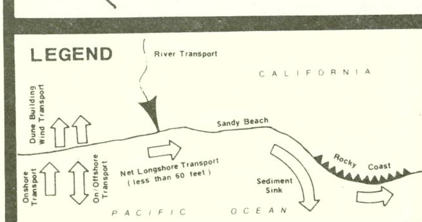
13

DNOD

1977

Southern Section - Spanish Flat Cell
Humboldt County





LITTORAL CELLS

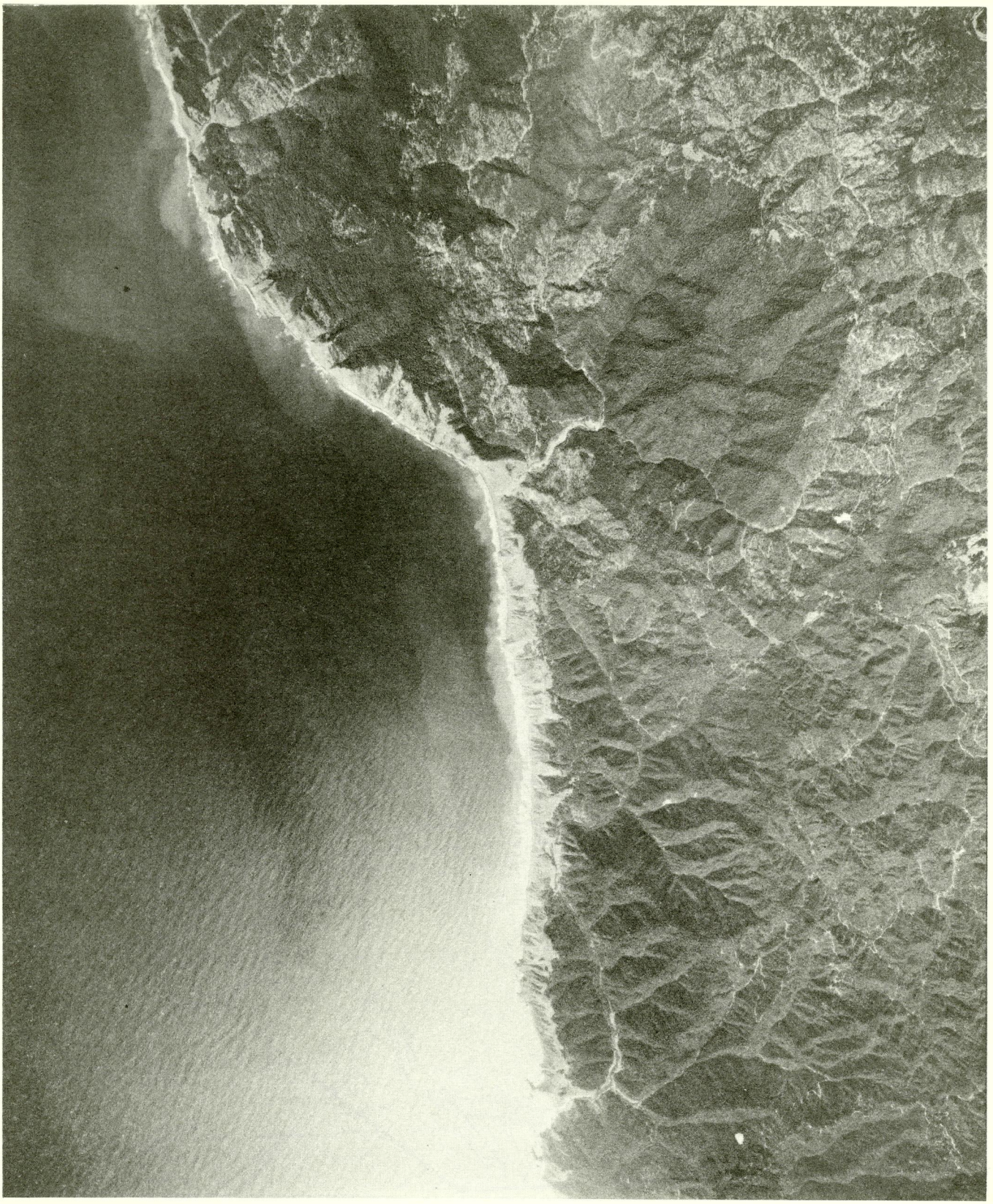
MAP NUMBER 2

STATE OF CALIFORNIA — THE RESOURCES AGENCY

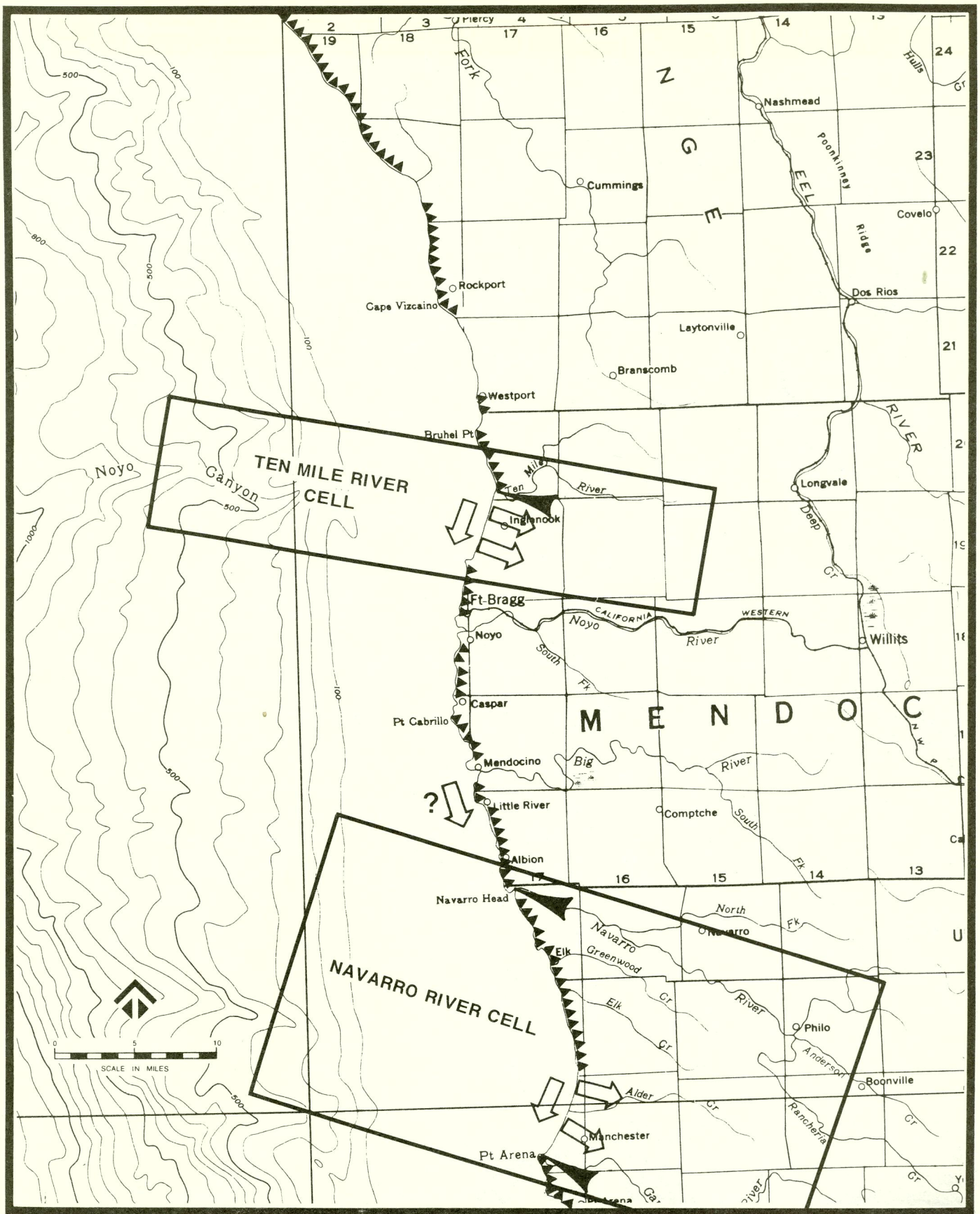
DEPARTMENT OF NAVIGATION & OCEAN DEVELOPMENT

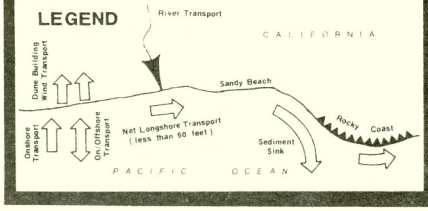
DNOD

1977



Ten Mile River Cell
Mendocino County





LITTORAL CELLS

MAP NUMBER 3

STATE OF CALIFORNIA — THE RESOURCES AGENCY

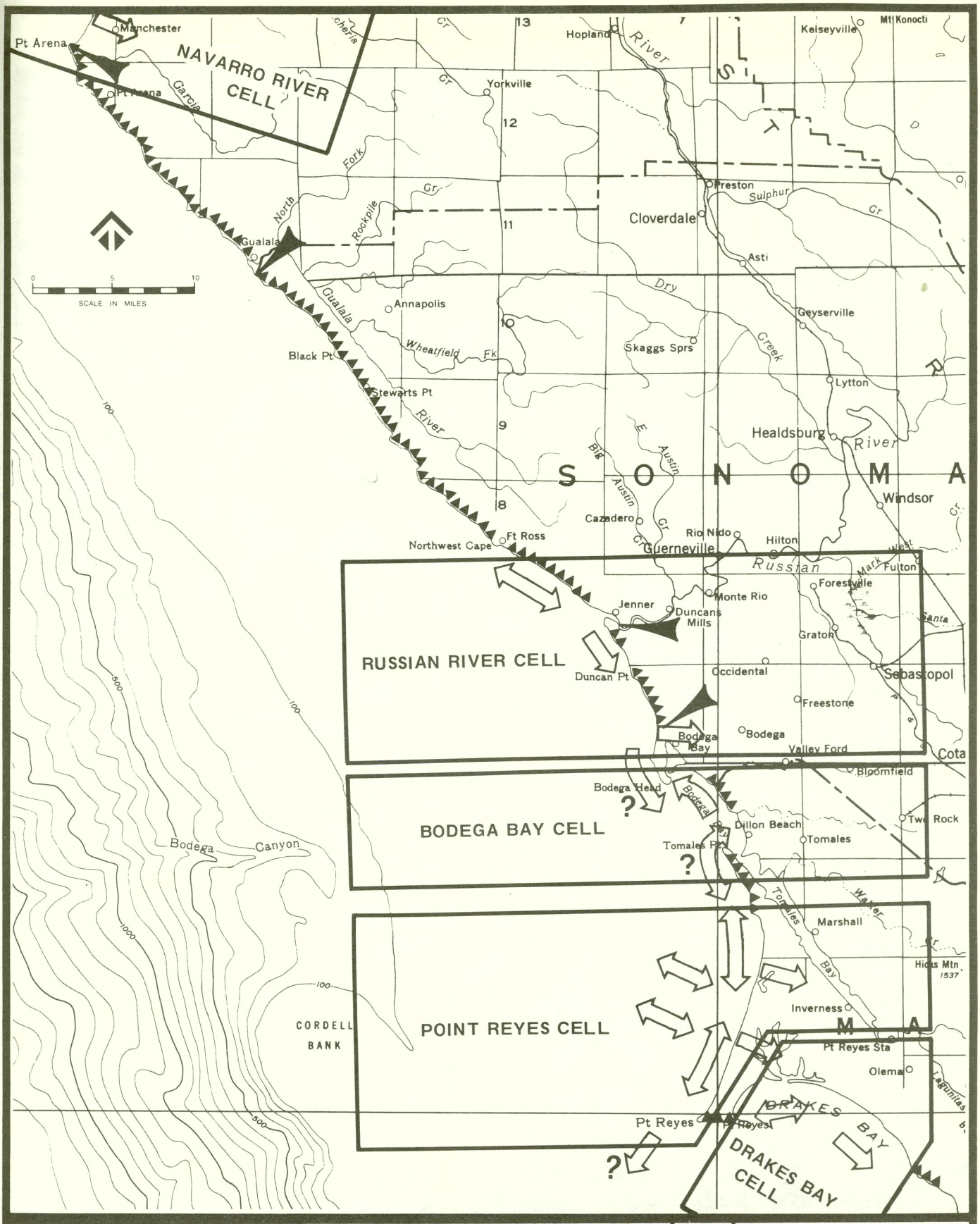
DEPARTMENT OF NAVIGATION & OCEAN DEVELOPMENT

17

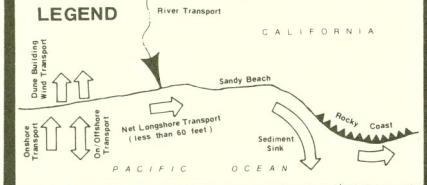
DNOD

1977

Bodega Bay Cell
Sonoma-Marin County



LEGEND



LITTORAL CELLS

MAP NUMBER 4

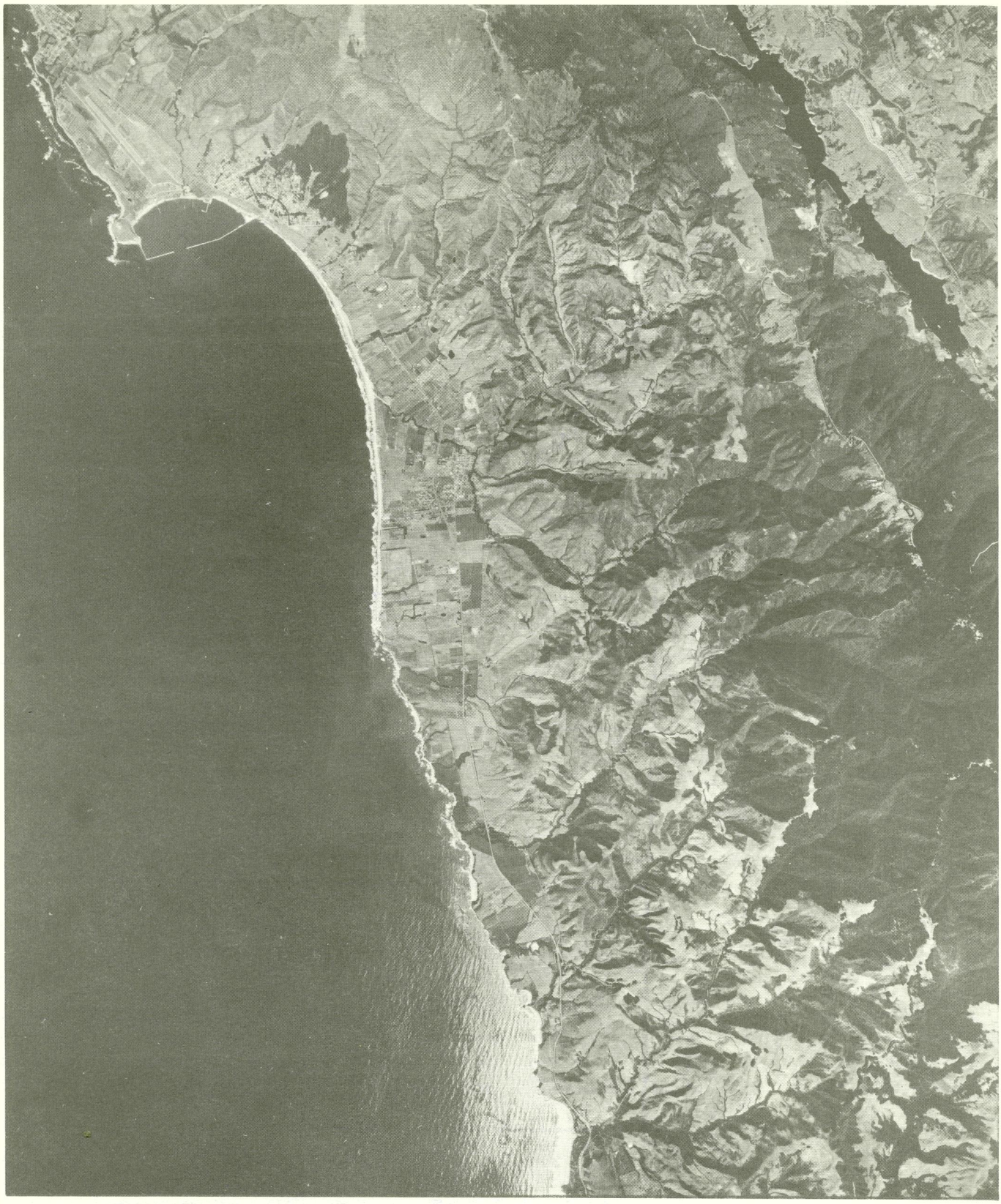
STATE OF CALIFORNIA — THE RESOURCES AGENCY

DEPARTMENT OF NAVIGATION & OCEAN DEVELOPMENT

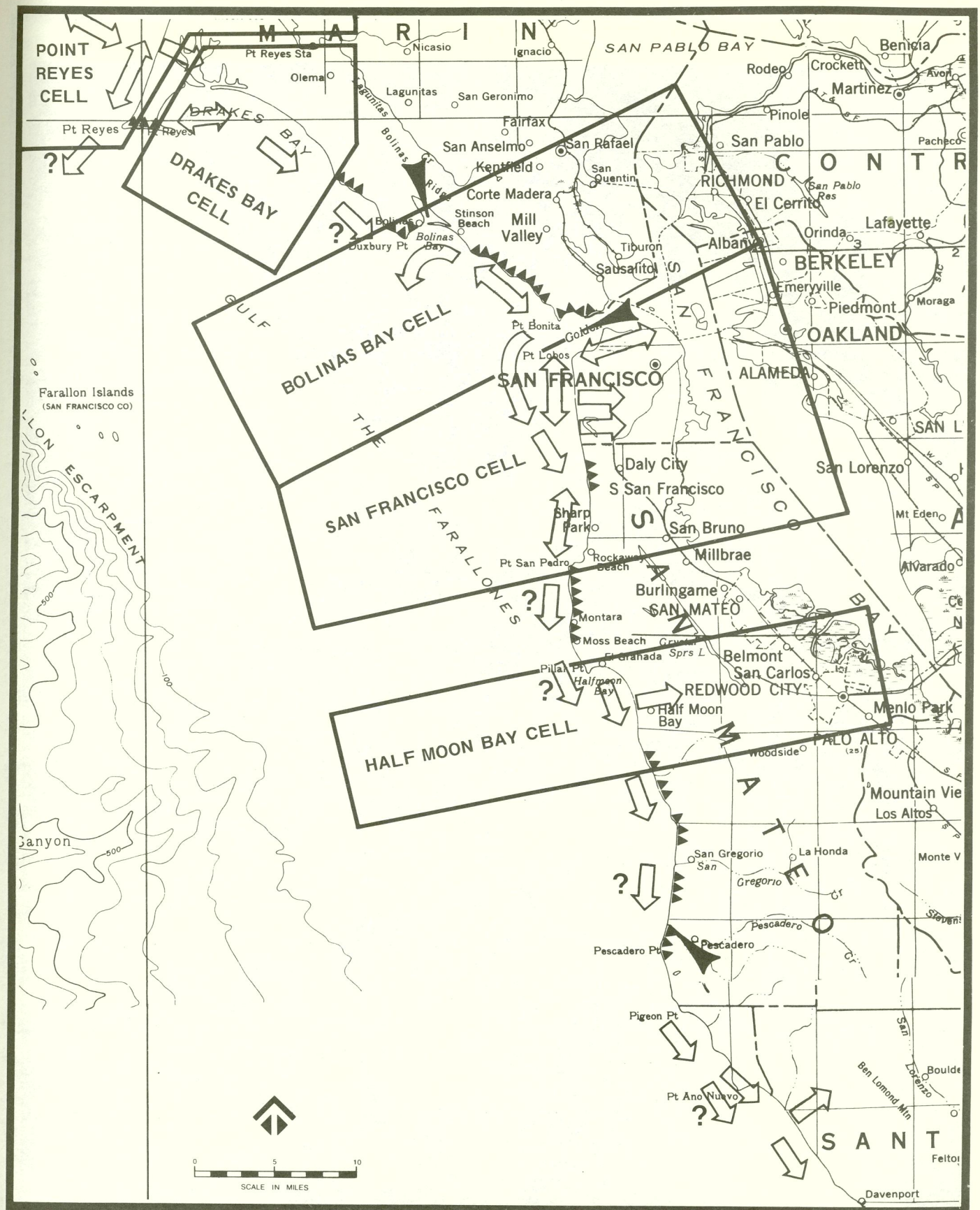
19

DNOD

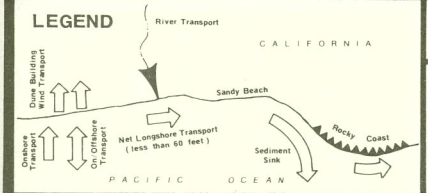
1977



Half Moon Bay Cell
San Mateo County



LEGEND



LITTORAL CELLS

MAP NUMBER 5

STATE OF CALIFORNIA — THE RESOURCES AGENCY

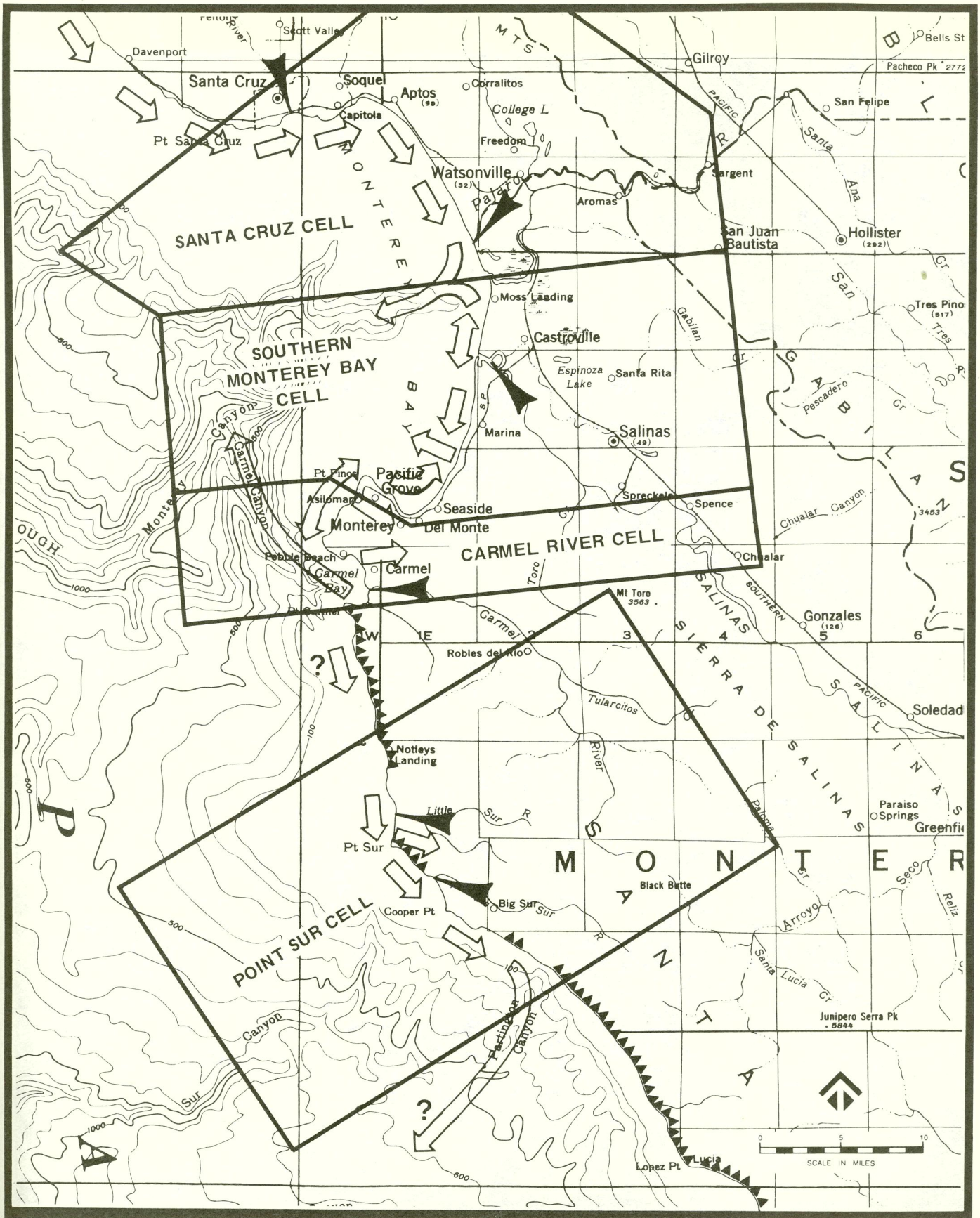
DEPARTMENT OF NAVIGATION & OCEAN DEVELOPMENT

21

DND

1977

Monterey Peninsula
Monterey County



LITTORAL CELLS

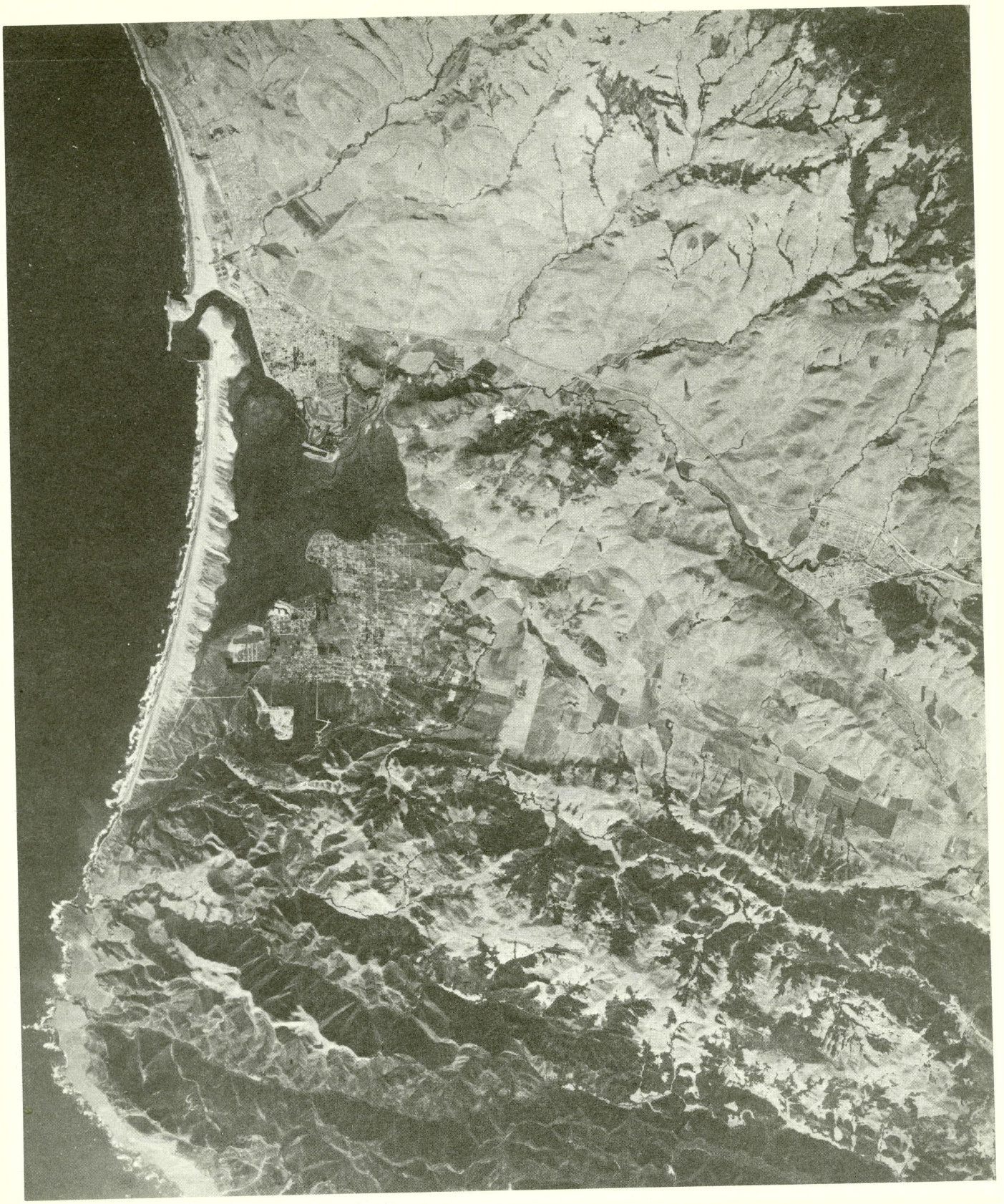
MAP NUMBER 6

STATE OF CALIFORNIA — THE RESOURCES AGENCY

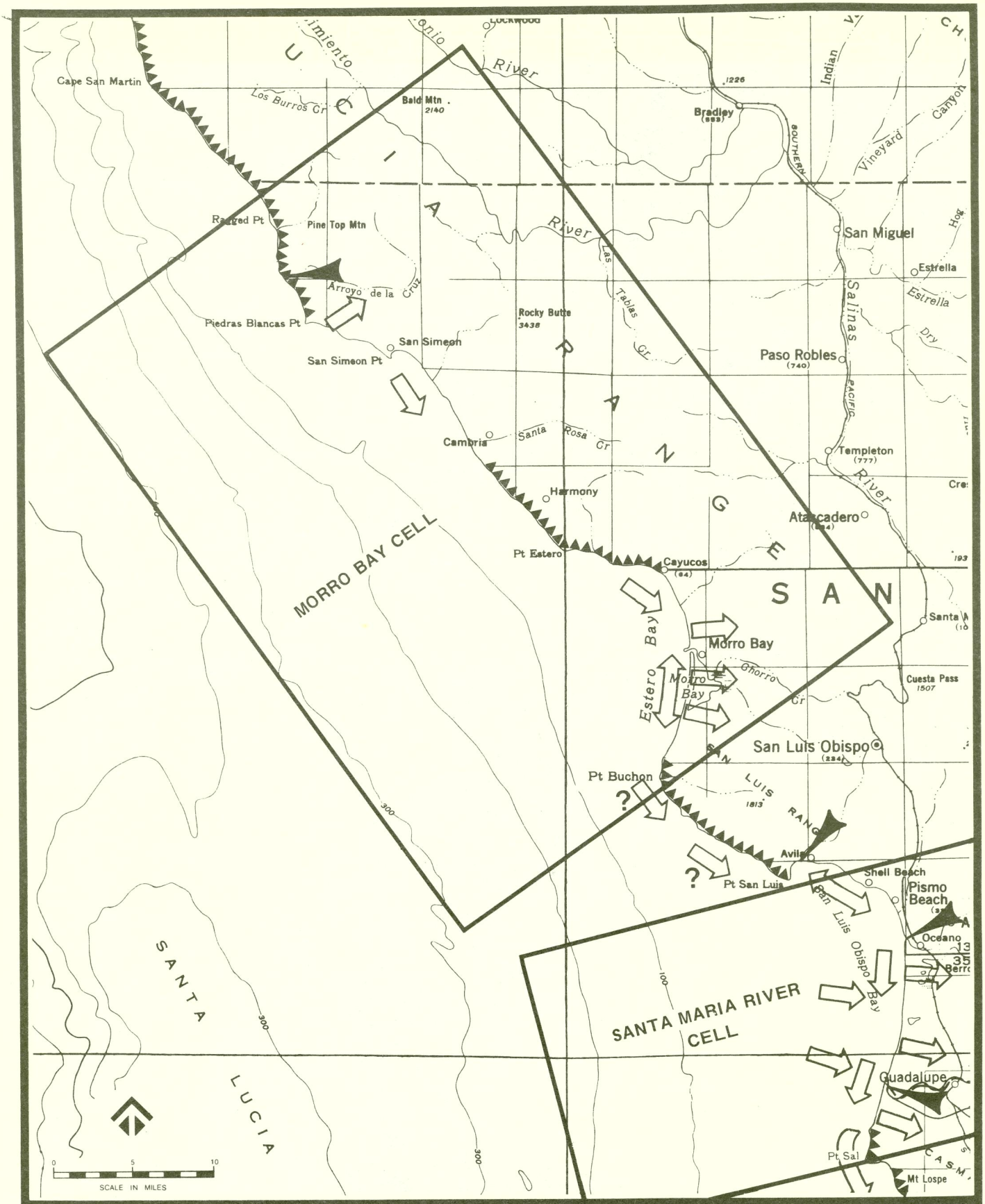
DEPARTMENT OF NAVIGATION & OCEAN DEVELOPMENT

23

1977



Morro Bay
San Luis Obispo County



LITTORAL CELLS

MAP NUMBER 7

STATE OF CALIFORNIA — THE RESOURCES AGENCY

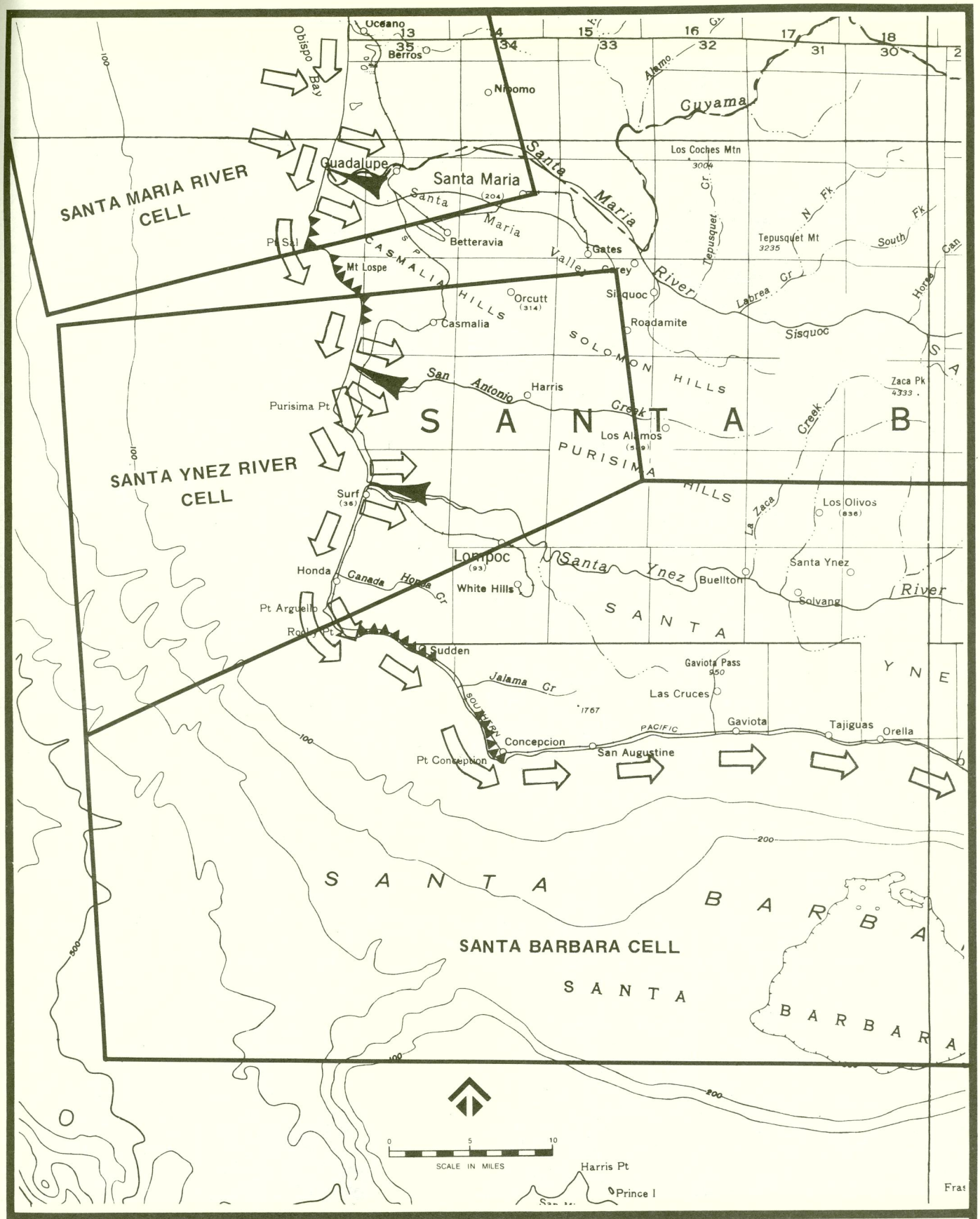
DEPARTMENT OF NAVIGATION & OCEAN DEVELOPMENT

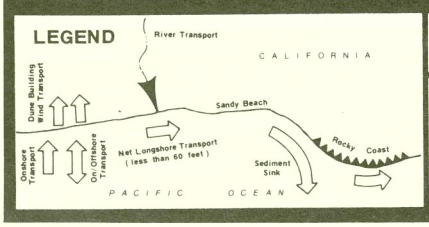
25

DNOD

1977

Pt. Arguello
Santa Barbara County





LITTORAL CELLS

MAP NUMBER 8

STATE OF CALIFORNIA — THE RESOURCES AGENCY

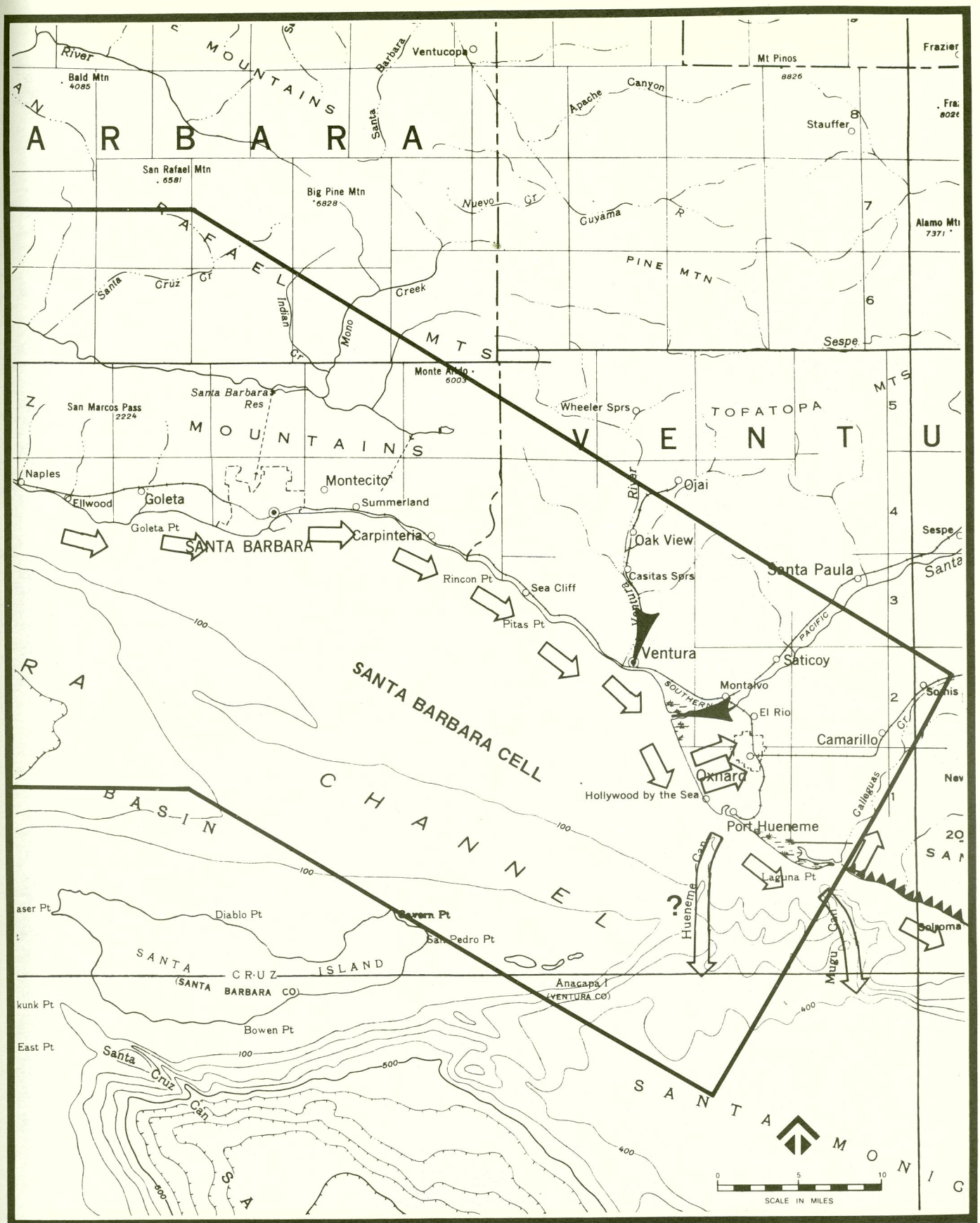
DEPARTMENT OF NAVIGATION & OCEAN DEVELOPMENT

27

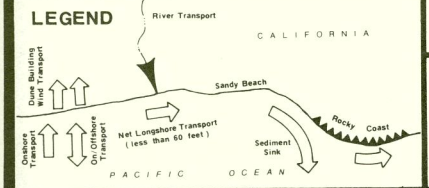
DNOD

1977

Ventura-Oxnard Coast
Ventura County



LEGEND



LITTORAL CELLS

MAP NUMBER **9**

STATE OF CALIFORNIA — THE RESOURCES AGENCY

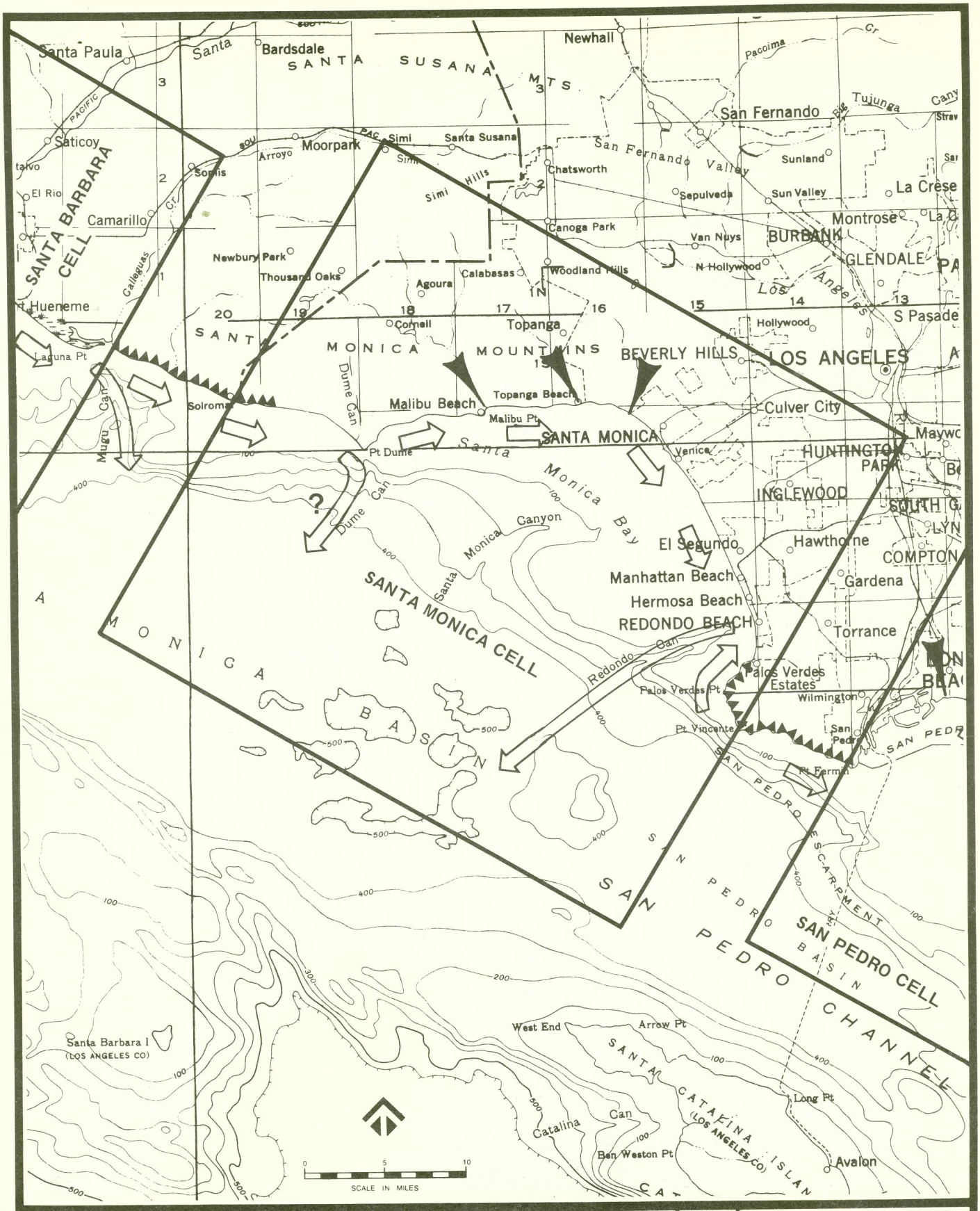
DEPARTMENT OF NAVIGATION & OCEAN DEVELOPMENT

29

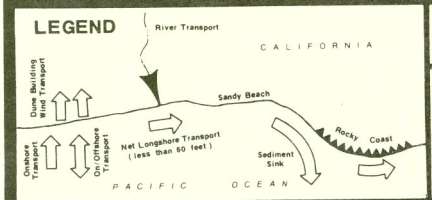
DNOD

1977

Santa Monica to Redondo Beach
Los Angeles County



LEGEND



LITTORAL CELLS

MAP NUMBER **10**

STATE OF CALIFORNIA — THE RESOURCES AGENCY

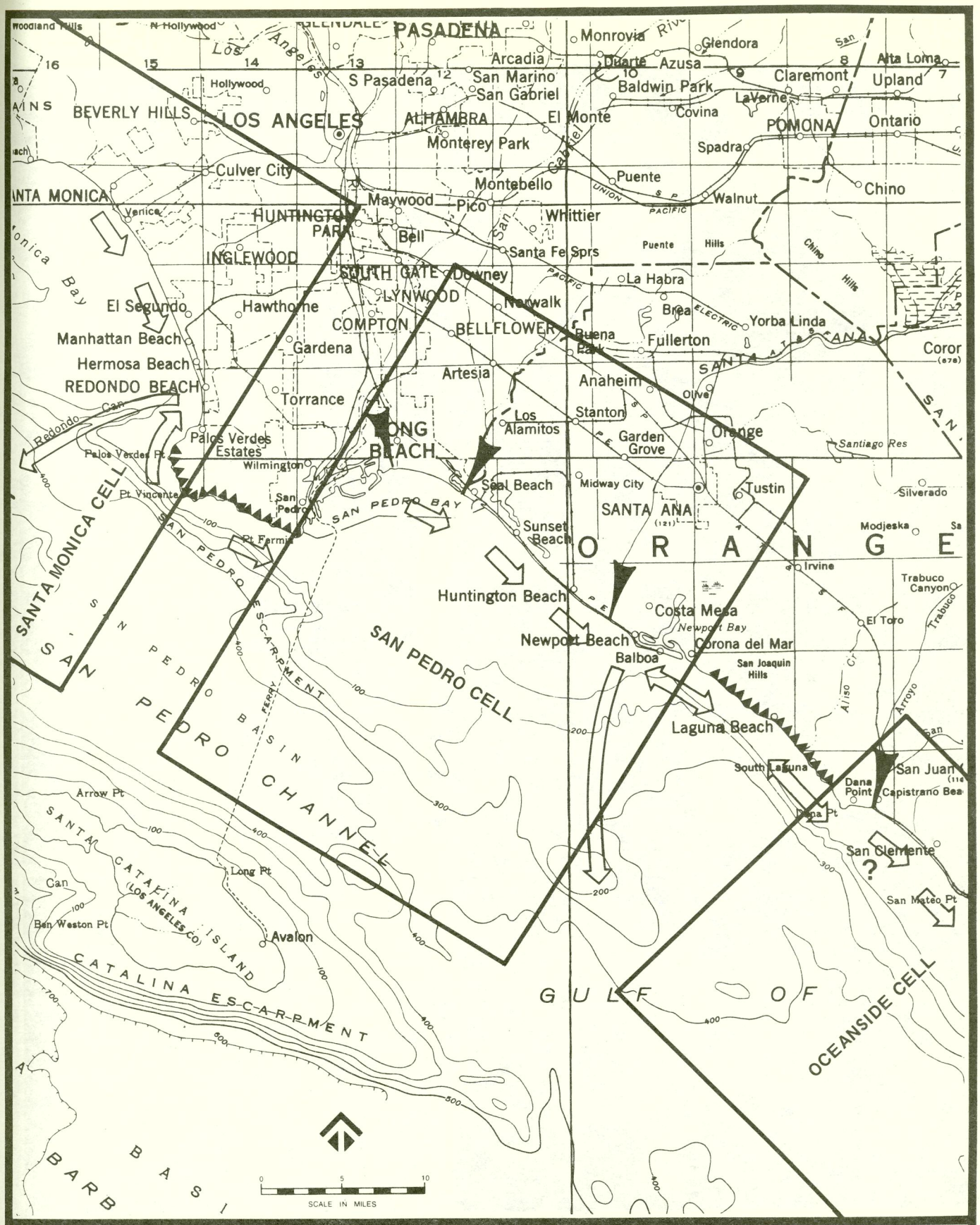
DEPARTMENT OF NAVIGATION & OCEAN DEVELOPMENT

31

DNOD

1977

San Pedro Bay
Los Angeles and Orange Counties



LITTORAL CELLS

MAP NUMBER 11

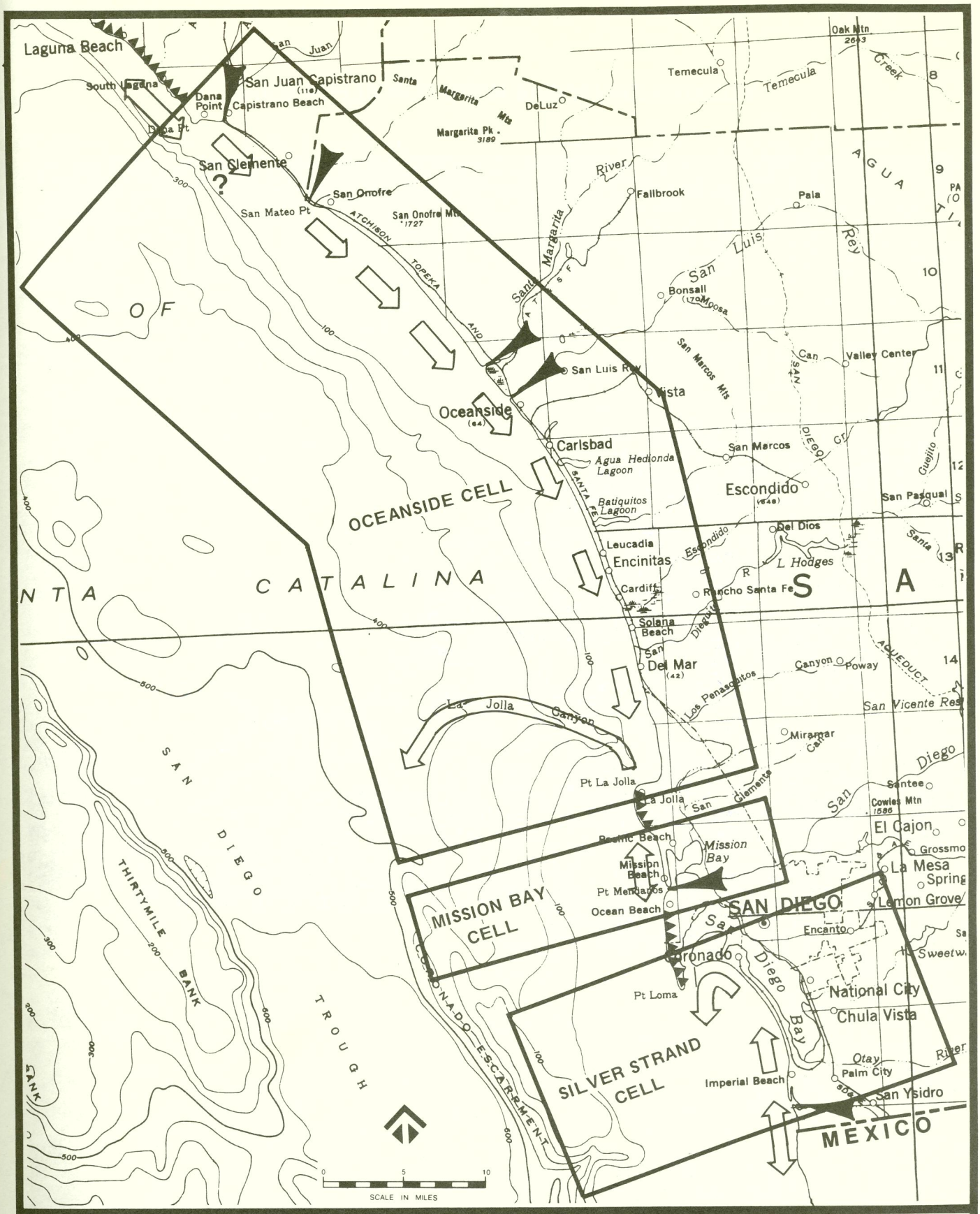
STATE OF CALIFORNIA — THE RESOURCES AGENCY

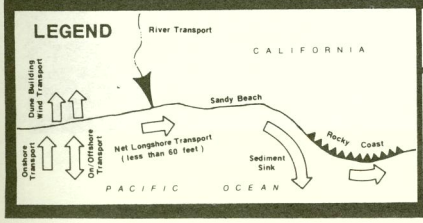
DEPARTMENT OF NAVIGATION & OCEAN DEVELOPMENT

33

1977

Silver Strand Cell
San Diego County





LITTORAL CELLS

MAP NUMBER 12

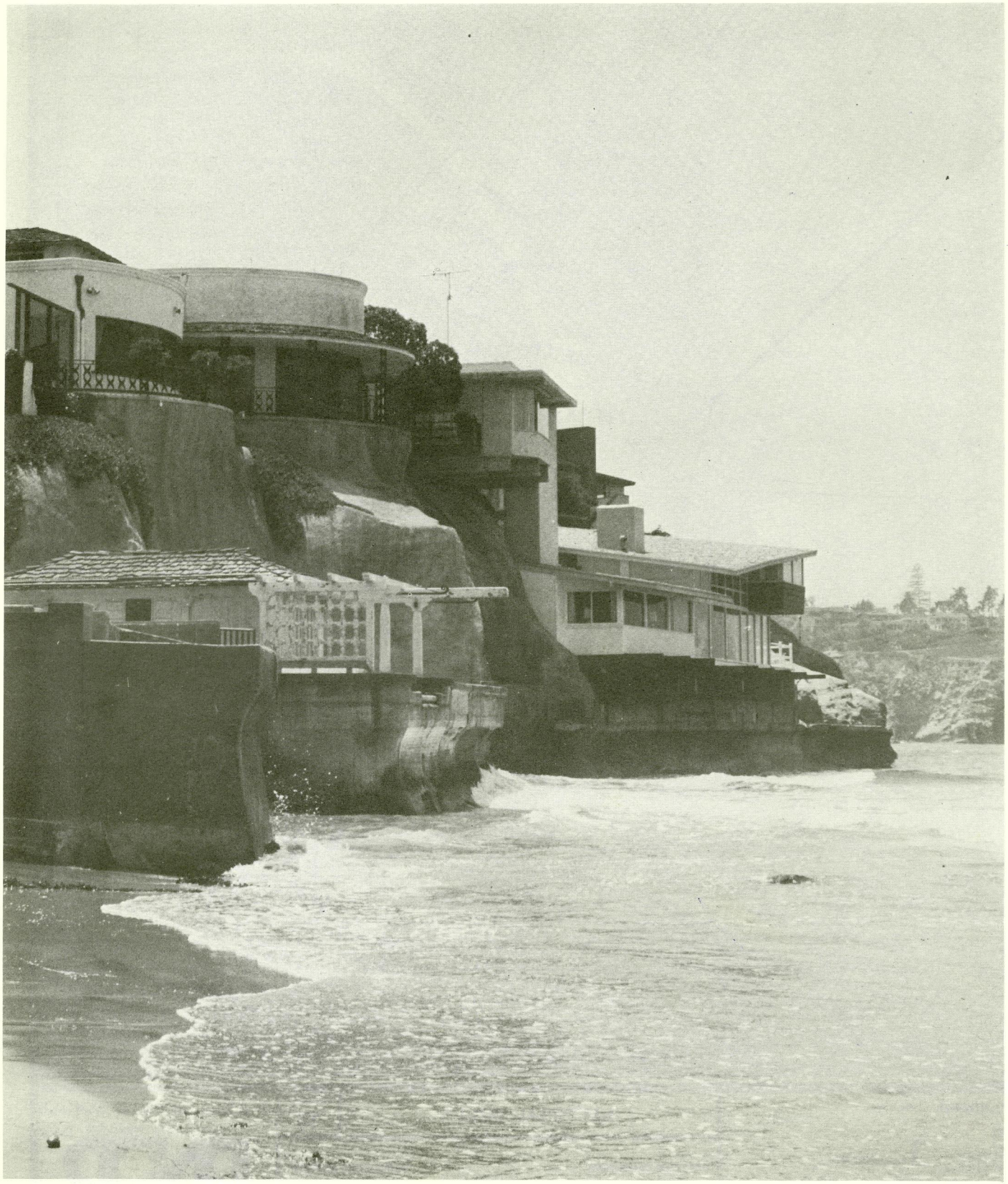
STATE OF CALIFORNIA — THE RESOURCES AGENCY

DEPARTMENT OF NAVIGATION & OCEAN DEVELOPMENT

35

DNOD

1977



La Jolla Shores Beach, San Diego County

MAN'S INFLUENCE UPON SHORELINE EROSION

Shoreline erosion is only a problem when it conflicts with manmade developments or man's use of the shoreline. North of San Francisco Bay few problems exist, for the shoreline is little used and development has occurred in only a few places. South of Santa Barbara, however, the shoreline has been extensively developed and is heavily used for recreation on nearly a year-round basis. There are only a few reaches of the shoreline that have not been developed for housing, industry, railroads, highways, harbors, military installations, or recreational facilities.

In many instances, the developments have purposely intruded into an area subject to wave action where erosion damage can occur. If properly protected against the wave forces, little damage will be sustained. However, in many instances the design has been inadequate either because the owner was not willing to make a sufficient initial investment or because he did not realize the magnitude of the wave forces that were likely to occur during the life of the development. In other cases, the developments were constructed sufficiently inland to not be subject to wave action at the time. A naturally retreating shoreline soon allowed the waves to impinge upon the developments, causing damage and the need for protection. In both of these circumstances, a greater understanding of coastal processes and historical records would have helped to prevent the problems.

While most erosion that threatens or damages valuable property is from natural causes and man's ignorance of them, some of man's activities have altered natural processes to increase the danger. Two of the most serious actions have been harbor development for commerce and recreation and flood control systems to protect the flood plains of coastal streams.

Breakwaters and jetties designed to provide safe navigation in and out of harbors have altered the natural movement of sand along the shore. The sand may be trapped either within or outside the harbor or redirected into an offshore sink. If an adequate system to bypass sand around the harbor entrance is not provided, the nearby beaches that depend on a natural supply will be eroded. These structures can also alter the wave patterns by reflecting or diffracting the waves so that the adjacent shoreline will be modified until it reaches a new equilibrious shape.

Flood control measures in coastal streams reduce the sediment supply to the beach by trapping sediments in reservoirs and reducing the flood flows necessary to move large quantities of sand from the streambed to the shoreline. The degree to which a flood control system affects a beach can vary. If more sediments are supplied by a river than are needed to sustain a dependent beach, the excess sediment may drop into a natural sink or be blown into a dune field. On the other hand, if the beach is dependent on a certain quantity of sand to sustain its size and shape, a small reduction in supply can have serious effects. At this time, it is not known how much sand is needed to sustain a particular beach except in a few isolated areas where replenishment systems have been established.

Not all of the manmade shoreline developments have increased shoreline erosion or adversely altered the natural state. The beach formed by the sand trapped between the Santa Cruz Harbor and the San Lorenzo River, which runs through the City of Santa Cruz, protects the roads and structures on top of the cliffs that formerly had been seriously damaged by retreating cliffs. So serious was the problem, that plans for armoring the cliffs with rocks had been prepared before the harbor jetties

were built. Shoreline improvement programs and beach restoration projects have also been successfully undertaken. For example, the Los Angeles County coast from Santa Monica to the Palos Verdes Peninsula, one of the most heavily used recreational beaches in the State, was created by importing sand from nearby dune fields and offshore underwater sources. The groins and harbor structures within this section of the coast have added to the stability by segmenting this long reach of coast and preventing the loss of sand into submarine canyons.

While the purpose of this report is only to assess the erosion problems rather than suggest solutions, it should be pointed out that a number of methods have been used successfully to prevent, correct, and mitigate erosion problems. However, each particular situation is different and no particular system can be applied successfully in all situations.

Prevention of shoreline erosion and wave damage is undoubtedly the most practical and advantageous method of handling the matter. Through zoning of erosion-prone areas and proper design of new shoreline structures, a great deal of damage from erosion can be prevented.

Where the development has already taken place and erosion is occurring, measures to reduce the rate of erosion can also be helpful. Beyond that, some other alternative action must be taken such as abandonment, modification of shoreline use, or protection of existing structures. Abandonment usually is unsightly and results in an economic and social loss. It eventually is corrected by modification of shoreline use, but the aesthetic impact to the coastline and the loss of public or private benefit over a period of time make this alternative undesirable in many cases. Modifying the usage of the shoreline to guard against further erosion usually requires reducing the intensity of its use. This can be difficult from an economic standpoint. The change itself will cost something, and the prospect of an economic gain to cover this cost by reducing the intensity of use is remote. Justification for this alternative is usually based on the high social benefits and public financing.

Protection against erosion requires a modification to the shoreline itself. This can be done by creating a protective beach (as in the case at Santa Cruz mentioned earlier), changing the shore alignment to reduce littoral drift, or armoring the eroding section with a more durable material. The latter method is the most common, particularly for short sections of shoreline, and is usually done by constructing seawalls or bulkheads of concrete, steel, or wood. Rock revetments are also used. Changing the shoreline alignment is accomplished by the construction of groins or other types of artificial headlands and filling the compartments between with sand. The sand movement due to littoral currents is limited to a small compartment, and sufficient sand is contained in each so that a protective beach always exists to dissipate the wave energy. Reducing the wave energy that causes the erosion is another possibility. Offshore breakwaters or artificial reefs on which the waves can break before reaching the shore are usually expensive but are being considered and model-tested for a number of applications. Artificial dunes to provide a reservoir of sand for the beaches during storm periods have been used in some sections of the country. Both artificial and natural dunes can be stabilized against wind erosion by introducing and cultivating suitable vegetation.

Shoreline modifications which most closely resemble the natural processes will have the greatest success. For example, supplementing a natural sand source that has been depleted by urbanization or flood control systems will be more successful and have fewer adverse side effects than armoring the eroding shoreline because it has lost its protective beach.

DESCRIPTION OF THE CALIFORNIA COAST

General

A large part of the California shoreline is experiencing erosion from natural causes. Waves generated in the Pacific Ocean expend their energy on the coastline in an effort to level and straighten the land mass they encounter. This is opposed to some degree by the sediments brought to the shoreline by coastal streams and rivers that create deltas encroaching into the ocean. Erosion, however, is predominant. A gradual but continuing trend in the rise of the sea level and subsidence of the land mass in localized areas are contributing factors to erosion.

The degree or rate of erosion at any time is dependent upon climatic conditions and varies both seasonally and over periods of years. In addition, the major erosion takes place only during periods of heavy wave action that occur for a few days a year or during a major storm that occurs only once in 10 to 25 years. Protection against shoreline erosion is similar to protection against river flooding. Damage can occur at any time, but the frequency and time of occurrence is uncertain.

The California coast is composed of two significantly different segments: one north of Point Conception, and the other to the south. This point in Santa Barbara County where the coastline changes alignment by about 90 degrees makes a decided change in the physical environment. The northern segment has direct exposure to storm waves generated in the North Pacific. The southern segment is protected from this wave energy by the Point Conception headland and the offshore islands. Storm waves in Southern California are about half the height of those north of Point Conception.

The climatic difference between the two segments also has a marked effect upon the coastal processes. In Southern California, as in other parts of the world where the annual rainfall is between 10 and 20 inches, more sediments are carried to beaches than where rainfall is greater. In this arid region, floods are infrequent but devastating.

The land which has little protective vegetative covering is easily eroded, and during times of heavy rainfall great quantities of sediments are carried by the rivers to the shore, forming large deltas. The deltas are gradually eroded by wave action between times of floods, supplying nourishment to adjacent beaches. The shoreline will advance seaward during periods of heavy flooding only to retreat again under the erosive effects of wave action. This advancing and retreating may be characteristically seasonal or may occur over a period of years or even centuries as climatic changes take place.

For the most part, the alignment of the coast in relationship to wave direction from the North Pacific causes sand in transit in the surf zone to move from north to south. This sand transport, known as littoral drift, is particularly important to the nourishment of many recreational beaches. There have been a number of dramatic cases of erosion occurring south of large structures constructed through the surf zone which have impeded the natural movement of sand from north to south.

There are exceptions, of course, to the north-to-south sand movement due to seasonal variations in wave direction and local conditions such as offshore islands and submarine canyons.

The major source of beach sand in California is from coastal streams rather than offshore sources or bluff erosion, although the latter makes some contribution. Most of the long, straight beaches north of Point Conception are nourished by a major river with a large watershed. The beaches are aligned with the crests of

the waves generated in the North Pacific Ocean. Sediments brought to the ocean by the river during floods are distributed along the beach by wave action. If there is a surplus of sand, some of it is carried out of the beach area past the headlands at its extremities to move offshore or along the coast. Some of the surplus is blown inland to form dune fields.

Coastal streams are also the major source of sand in Southern California, but only a few of the beaches are compartmentalized by headlands. Sediments may travel many miles while contributing to the total makeup of a section of beach. Eventually, the sand is lost offshore or into a submarine canyon.

The submarine canyons that extend from the ocean floor through the continental shelf act as sand traps if the head of the canyon reaches close enough to the zone where littoral drift occurs. Millions of cubic yards of sand are lost each year to the ocean depths in this manner. Studies have shown that this occurs in Monterey Bay, Point Mugu, Redondo Beach, and La Jolla. It may also be true near Cape Mendocino, Point Dume, and other locations. These submarine canyons also modify the waves which travel over the sides of the canyon, generally reducing their height and changing their direction of travel.

North Coast Region

The North Coast Region (composed of Del Norte, Humboldt and Mendocino Counties) contains 250 miles of ocean coastline, one of the State's major natural harbors, and a variety of shoreline types. The shoreline, with only minor exceptions, is still in a natural state, eroding and accreting from natural causes. Only at Crescent City (where breakwaters have been constructed) and at the entrance to Humboldt Bay (where jetties and maintenance dredging have ensured a navigable channel) has there been any notable manmade changes in the shoreline. In both these instances the influence has been localized.

This section of the California coast has the greatest exposure to waves generated by the violent winter storms of the North Pacific Ocean. Waves up to 13.5 meters have been recorded near Crescent City. Forty-two ton armor units (the largest in the world) designed specifically for their stability against wave action have been broken and displaced on the Humboldt Bay entrance jetties. Heavy wave action is common from November through March as major storms sweep across the North Pacific Ocean. Waves 4 to 5 meters high can be generated any time of the year from local disturbances.

The tidal range in the North Coast Region is the highest in the State, with a mean range of 4.0 to 5.1 feet and a diurnal range of 5.7 to 7.0 feet. This results in large tidal flows through all of the tidal inlets and in large alongshore tidal currents between inlets.

The mean position of the California current is well offshore of this region in the winter but moves closer inshore in the summer. The offshore currents are dominantly towards the south, but large scale counter-clockwise eddies can persist which will reverse the nearshore currents near Cape Mendocino.

The 50-fathom depth lies at an average of about ten miles offshore north of Cape Mendocino. South of Cape Mendocino it narrows to an average of about four miles. Four submarine canyons penetrate the shelf in the reach between Cape Mendocino and Point Delgada--Mendocino, Mattole, Spanish, and Delgada Canyons--producing deep water only a few miles from shore. The narrow shelves have only a minimum effect on attenuating the large waves. The complex geometry

of the canyons, however, results in the focusing or spreading of wave energy at certain locations along the shore.

There has been little development along the shoreline and long stretches are inaccessible by road. Only Crescent City, Trinidad, and the southern Mendocino coast have been developed to any degree. As a result, there are erosion problems of a serious nature in only a few isolated spots, even though a great deal of this region's shoreline is in an eroding state.

The rivers which discharge into the ocean have few controls, and most of their sediment load reaches the shore. They continue to supply the long stretches of beaches and dune fields uninhibited by flood control structures. The beaches formed by the sediments are aligned normally to the predominant northwesterly wave direction and compartmentalized by headlands. Once the compartments are full, the surplus sediments spill around the headlands to move downcoast or offshore to the ocean depths.

The estuaries of the major rivers are subject to significant change during flood times in the reaches where sandy beaches and dunes predominate. In some cases, the river mouth will move a number of miles by breaking through the beach in a new location in flood times, only to be modified later by the creation of a gradually moving spit that is subject to change from wave action.

In summary, the coastline of the North Coast Region is subjected to a great deal of wave energy and continues, in essence, to be under the natural forces of erosion and accretion. Sediments from the rivers, however, maintain long stretches of beaches which are essentially stable, for a dynamic stability has been reached. Man's intrusion has been minor, and only where developments have been unwittingly placed near a naturally eroding shoreline has there been any erosion of a critical nature.

North Central Coast Region

The North Central Coast Region (which includes the Counties of Sonoma, Marin, and San Francisco) is about 140 miles long. Within it are four small natural embayments, which have been used as harbors, and the entrance to the State's greatest natural harbor - San Francisco Bay. With the exception of the City of San Francisco, little development has occurred that has affected the shoreline. Of the four harbors, only Bodega Bay has been modified to improve its ability to handle small craft navigation. Recent interest in recreational activities and vacation homes in Sonoma County has brought erosion problems into focus in that area. However, most of the region is undeveloped near the coast. A combination of limited highway access and federal control of sections of the shoreline has limited growth despite the region's proximity to the San Francisco metropolitan area. The City of San Francisco has erosion problems of a serious nature along its ocean frontage and at certain locations along its north shore. Some of the more serious situations have been corrected.

In general, the shoreline is rugged and steep with some pocket beaches. The San Andreas Fault has created an anomaly to the normal shoreline configuration forming Bodega and Tomales Bays and Bolinas Lagoon with beach formations somewhat different than the rest of the State. The San Francisco shoreline, south of the Golden Gate, was originally a long straight beach with headlands at each end backed by a great dune field. It was nourished by the sediments brought by the Sacramento and San Joaquin Rivers of the great inland valley. The dune fields have since been developed

into a high density residential area, and a mile of the shoreline is stabilized with a massive concrete seawall.

Wave intensity in this region is heavy as it is exposed to waves generated by North Pacific storms. Bodega Head, Point Reyes, and Duxbury Reef do provide some shelter to the shoreline within their lee from the predominant wave direction, but they are exposed to southwesterly waves. These headlands also tend to create a counter current or gyre, and littoral currents move northerly at times rather than the predominant southerly direction along most of the coast. The San Francisco Bay Bar, seaward of the Golden Gate and lying at about 30 feet below MLLW, plays an important role in littoral transport. Studies have shown that sand is transported along the bar. It is also a potential source of beach nourishment.

The shelf width at the 50-fathom curve is relatively narrow in the north, averaging about six miles. It broadens dramatically at Bodega Head, however, and is 30 miles from shore off the Golden Gate. The broad, shallow shelf and the presence of the Farallon Islands and their associated shoals result in an attenuation of the deep water waves from the west as they approach the southern limit of this region.

The tidal range is moderately high, with a mean range of about 4.0 feet and a diurnal range of about 5.7 feet.

The main flow of the California current tends to remain offshore near San Francisco. The nearcoast current is dominated by large-scale eddies which can produce either northern or southern flows at any time of the year.

The major rivers that feed into this coastal region, the Russian and the Sacramento-San Joaquin system, have been harnessed by flood control works. The Russian River is only partially controlled and does bring a heavy sediment load to the ocean. No significant beach changes have been noted as a result, however. The Sacramento-San Joaquin system which eventually discharges through the Golden Gate has been extensively controlled. It may be, however, that geological changes such as subsidence (some currently going on) may have as great an effect on the sediment load as flood control projects, although sediment supply is not as important a factor in shoreline erosion in this region as it is in Southern California.

Shoreline erosion problems in this region are localized and probably will tend to be in the future. Much of the shoreline is unsuitable for development and about one-third of it is federally controlled, such as the Point Reyes National Seashore, the Golden Gate Parkway, or military reservations.

Although not included as a part of this study, a word or two should be said about San Francisco Bay. Erosion has not been as great a problem for this inland body of water as it has been in many other parts of the nation. The bay's shape limits the distances over which waves can be generated so they do not contain a great deal of energy by the time they reach shore. In addition, much of the nearshore waters are shallow so waves break and lose energy before reaching the shoreline.

Presently, very little of the bay is fronted with small private holdings, which in other areas suffer the greatest economic loss from erosion damage. If additional development is planned for this area, erosion may become more of a problem. For example, there is a development planned for Alameda Beach which is already suffering erosion damage.

Central Coast Region

The Central Coast Region (containing San Mateo, Santa Cruz, and Monterey Counties) is about 209 miles long. Population spillover from the San Francisco Bay Area has increased residential

development and recreational activities in this coastal region. The erosion to this portion of the shoreline has received more attention by governmental agencies than any other north of Point Conception. Severe natural erosion is occurring in the northern part of the region between San Francisco and Monterey Bays. The older established communities have been faced with erosion problems for many years, some of which have been successfully solved. Many problems still exist, however, and there is a potential for new ones unless provisions are made for their prevention.

There are basically three different coastal conditions which exist in this region. Between San Francisco and the north end of Monterey Bay near Aptos, the shoreline consists of eroding bluffs and cliffs with pocket beaches. A few prominent noneroding headlands exist which control the general local shoreline configuration. Although not substantiated by study, except at Santa Cruz, it appears that beach sediments move predominantly from north to south. There are many slides, sea caves, and nearshore sea stacks that indicate a continuing erosion process.

Between Aptos and Monterey, the shoreline is a fairly wide, sandy beach that conforms very closely to the crest of waves entering Monterey Bay. The beach is backed by dunes, some are active and others are covered with vegetation. Except for severe erosion of the backshore at Fort Ord, the beaches have been relatively stable. At Moss Landing, the Monterey submarine canyon extends shoreward to the harbor entrance. The Pajaro River enters the ocean north of Moss Landing, and the Salinas River enters to the south. In times past, both of these rivers have been the greatest sediment suppliers of the region.

South of Monterey, the shoreline is rugged, with a few beaches as far as Point Sur. From there to the San Luis Obispo County line the land rises high out of the sea, providing virtually no access to the shore and no beaches.

The average wave intensity is reduced somewhat from that found in the area to the north. The alignment of the coast varies widely, and the local wave climate is moderated wherever the coast turns parallel to the storm advance direction from the northwest.

The 50-fathom curve of the shelf narrows from 30 miles offshore at San Francisco to 10 miles at Santa Cruz. It narrows to an average of only three miles south of Monterey. Monterey Bay is broad and shallow, except for the Monterey submarine canyon which bisects it. The headlands which delineate the bay and the bay's underwater geometry result in a substantially moderated wave climate in this reach. Large waves here tend to be very well sorted swells. Carmel Bay is similar in character to Monterey Bay but is much smaller. Northern flowing coastal counter currents dominate in this region, but fluctuating eddies and even southern flows can exist.

Dams in the higher reaches of the Pajaro and Salinas Rivers have reduced the flooding capacities of these major rivers of the region, and more flood control systems are now under consideration. The effects of such measures are limited to the Monterey Bay shoreline which is an enclosed system of sand movement. Sediment for the other sections of the region is supplied by erosion of nearby bluffs and by local coastal streams which have few controls.

Severe erosion problems exist in Pacifica, Half Moon Bay, and at Santa Cruz-Capitola. In addition, continuous maintenance is required along State Highway 1 where slides initiated by wave action at their base endanger the road and sections have been lost to the sea. Federal studies on the erosion problems have been made for Pacifica, Half Moon Bay, and Santa Cruz. Projects to protect the Santa Cruz cliffs have been constructed and have

been effective. Numerous seawalls and revetments have been constructed by private property owners in these locations with varied success.

The region is experiencing erosion problems which are endangering existing developments, and correction measures are needed. The pressures of population growth and increased recreational activities are heightening the danger of potential losses from erosion. There is a need to develop a better understanding of the coastal processes in this region to solve some of the existing problems and to prevent future ones.

South Central Coast Region

The South Central Coast Region (containing the Counties of San Luis Obispo, Santa Barbara, and Ventura) is 244 miles long. The shoreline of San Luis Obispo and western Santa Barbara County stretches in a north-south direction while the remainder from Point Conception to the Ventura-Los Angeles County line lies largely east and west. These two segments are quite different in their physical characteristics and development patterns.

The northern subregion has a wave climate only slightly reduced from that of the Central Region to the north. The distance from shore to the 50-fathom depth varies from about two miles in the north near Point Sur to an average of six miles near Point Arguello. The coastal alignment is in a series of steps formed by headlands in which there are alternating partially sheltered and unsheltered reaches. The offshore bathymetry is quite regular and free of shoals, islands, or other wave protection features.

At Point Conception, the southern subregion shoreline changes alignment sharply, running almost east for about 60 miles and forming a lee shore from the dominant northwestern storm waves. The 50-fathom depth lies a few miles offshore at Point Conception extending to ten miles at Ventura. The distance narrows again to less than one mile at Port Hueneme where Hueneme and Mugu submarine canyons penetrate close to shore. The Channel Islands offshore and their associated shoals and banks provide a protective barrier against waves from the west or south. As a result, the wave climate in this reach is very sharply reduced from that of the northern subregion.

Tides are average for Southern California with a mean range of about 3.7 feet and a diurnal range of 5.3 feet. Morro Bay is the only significant tidal inlet in this region. Coastal currents are weak, but a northern flowing counter current dominates during most of the year.

Except for the first 20-25 miles of rugged bluffs and pocket beaches, the western shoreline consists of a series of long sandy beaches backed by dunes separated by prominent headlands. The beaches, fed by coastal streams and rivers, have aligned themselves with the crests of the predominant waves out of the North Pacific. The two existing harbors, Morro Bay and Port San Luis, have had little effect upon the adjacent shorelines although some minor changes were made to construct the Morro Bay entrance. With the exception of cliff undermining which has threatened structures at Pismo Beach, little has been required to protect the limited coastal development from erosion in this segment.

South and east of Point Conception, where the wave climate changes, the direction of sand movement is unilateral from west to east. Large quantities are moved, however, ranging from about 300,000 cubic yards per year at Santa Barbara to 1.2 million cubic yards at Oxnard.

The shoreline from Santa Barbara to Point Mugu has suffered extensive

erosion damage. Many of the beaches to the east of Santa Barbara have never fully recovered from the initial blockage of easterly sand movement by the construction of the Santa Barbara Harbor. Where there were once wide beaches, there are now revetted slopes. Highway construction has also modified sand movement patterns, resulting in serious beach loss. Construction of the Port Hueneme Harbor caused the erosion of millions of cubic yards of shoreline. This has been corrected by artificially nourishing the beach and mechanically bypassing the sand on a regular basis.

Serious damage from wave action is a potential threat throughout the region during storm periods. Numerous studies have been made and projects constructed to reduce the erosion problems. While a number of projects have been successful, serious conditions still remain along much of the shoreline.

A number of major rivers enter the ocean in this region. The Santa Maria and Santa Ynez flow into the western segment, contributing sediments to beaches and dune fields. Flood control measures have been constructed, but no detrimental effects have been noted either to the beaches near their mouths or adjacent areas. However, changes in these relatively remote locations may not have been noted. The Ventura and Santa Clara Rivers, on the other hand, are important contributors of sediment to the Ventura-Oxnard shore, which is rapidly becoming an urban area. The shoreline stability is dependent upon sediment supply. If flood flows carrying sediments do not periodically feed the beach, wave action which consistently moves the sand southeasterly will denude the shore, and mitigative measures will be required.

That section of coast between Santa Barbara and Point Mugu of the South Central Region is probably the most critical within the State with regard to future development and beach erosion. Its stability is particularly dependent upon a sand supply to nourish the beaches. Long periods of drought or projects reducing flood flows could have serious detrimental effects upon the shoreline.

South Coast Region

The South Coast Region (composed of Los Angeles and Orange Counties) is the most urbanized within the State. Consequently, the shore has been, and is, the most seriously affected by man's activities. Major modifications of the shoreline have been made by the creation of artificial beaches and the construction of groins and breakwaters between the north end of Santa Monica and the entrance to Newport Bay. The condition of this shoreline is primarily under man's control. Its stability is more dependent upon man's activities than nature's. In addition, many miles of other sections of the region's shoreline have been armored with riprap, seawalls, or bulkheads to protect either the natural shoreline or man's encroachment seaward. At the extreme ends of the region and at the Palos Verdes Peninsula the natural shoreline processes are occurring with only minor influence from man.

The major rivers of the region which historically nourished the beaches with sediments brought to the shoreline during periodic floods have been dammed and channelized. This has depleted the natural sand supply. Additionally, petroleum extraction has caused subsidence of the shoreline. Only by diking or the artificial building of beaches has the shoreline been preserved.

The wave climate in this region is moderate, as it is protected by Point Conception from waves generated by storms in the North Pacific. The Channel Islands provide very substantial wave protection to the entire coastline from Pacific Basin storms. The fetch inside the islands is great enough,

however, to allow the generation of energetic shorter period waves. The island chain does not provide complete shadow from deep ocean waves. Ocean swells from a particular direction can penetrate the islands and cause an increase in the local wave height. Long period waves out of the Southern Hemisphere or from tropical cyclones off the Mexican coast have eroded the beaches and caused some damage to shoreline structures. This type of wave usually occurs in the summer and will move the sand northward, while the waves generated locally in the North Pacific usually occur in the winter and move the sand southerly. The average wave climate, however, is much reduced from that of Central California.

The 50-fathom depth lies about ten miles offshore in Santa Monica Bay and San Pedro Bay but narrows to less than two miles elsewhere. Tidal ranges are average for Southern California with a mean range of about 3.7 feet and a diurnal range of 5.3 feet. Los Angeles/Long Beach Harbors and Newport Bay have the most significant tidal flows.

The main stream of the California current is well offshore. The near-shore current environment is dominated by large-scale eddies. Flows tend to be southerly in winter and spring months, and northerly in summer and fall.

Three submarine canyons in the region extend close enough to shore to have an effect upon sand movement. The head of Dume Canyon lies very close to Point Dume, and it is doubtful that much sand passes it or the Mugu Canyon in Ventura County. Only minor sediments are contributed by coastal streams between the two canyons. Dume Canyon, therefore, limits the sand entering this region from the west. The Redondo Canyon, located just off the pier at Redondo Beach, acts as a sand sink for sand contributed by local streams along the shoreline north of the Palos Verdes Peninsula. The King Harbor breakwater just to the north of the canyon acts as a barrier to sands moving southerly toward the canyon and stabilizes the beaches to the north. A groin to the south of the canyon, which was constructed as part of a federally authorized beach nourishment project, reduces the sand losses into the canyon from the beaches between Redondo Beach and Palos Verdes. The Newport Canyon, which lies about a mile north of the Newport Bay Harbor entrance, acts as a sink for sands moving southerly along the reach between it and Long Beach. This canyon also has a noticeable effect upon waves impinging upon the beach in the immediate area, particularly those waves from the south.

The seven-mile long Los Angeles/Long Beach breakwater protecting that large port complex also reduces the wave action along the beaches fronting the City of Long Beach. Sediments brought to shore by the Los Angeles River are not moved by wave action to supply the adjacent beaches. They have been used instead to build land areas within the harbor complex.

The three major rivers of the region, the Santa Ana, San Gabriel, and Los Angeles, which once provided the bulk of the coastal sediments to this region, have been so modified by flood control measures that they no longer adequately feed the beaches. The Los Angeles River which originally entered Santa Monica Bay and the San Gabriel and Santa Ana which fed the southern beaches did, however, deposit vast quantities of materials offshore which may be utilized for artificial nourish-ment. As terrestial sources are extremely limited, these submarine reserves will be needed in the near future.

The South Coast Region has been subject to more activities concerning shoreline erosion than any other region of the State. This is due in part to the unique natural conditions that exist,

but also to the many pressures created by population growth. While the shoreline has been changed dramatically from its natural state, many of the modifications, such as increasing the beach widths, provide greater public use of the resource. The experience gained from the success or failure of tried solutions is useful in meeting the problems of other regions that are experiencing increased urbanization and related shoreline problems.
shoreline problems.

San Diego Region

The San Diego Region, limited to the County of San Diego, is 76 miles long and extends from San Clemente to the Mexican Border. The region is experiencing severe erosion problems over much of its length, and a number of segments are being intensely investigated.

The region contains three harbors. San Diego Bay, one of the State's best natural harbors, is a major naval base of the West Coast and also a commercial harbor. Improvements to the harbor and the flood control measures on the TiaJuana River have modified the adjacent natural shoreline processes to the extent that the shoreline south of the entrance is influenced more by man than by nature. Mission Bay, an outstanding recreational harbor, was created out of the estuary of the San Diego River, known as False Bay. The entrance jetties have compartmentalized the beach between the headlands of Point Loma and La Jolla into two segments. Camp Pendleton-Oceanside Harbor, which was initiated as a wartime installation at the beginning of World War II, has segmented the coastline between the northern boundary and La Jolla. Its effect upon the beaches has resulted in serious erosion at Oceanside.

The Channel Islands, and offshore shoals, and banks provide significant shading from Pacific Basin storms from the west and northwest. The fetch inside the islands is of sufficient length to allow energetic short period waves to be generated locally by northwest winds. The distance to the 50-fathom depth varies from two miles at the northern edge of the County to about ten miles at the Mexican border, except where the La Jolla submarine canyon penetrates close to shore. The coastline is reasonably open to swells from the Southern Hemisphere and, on rare occasions, warm water will counter-flow north close to shore and allow the movement of tropical storms (hurricanes) close to San Diego. These conditions can produce large waves from the south. While the average wave climate in this region is more severe than in the South Coast Region, it is moderate compared to the wave climate in the central or northern regions.

Tidal ranges are average for Southern California with a mean range of 3.7 feet and a diurnal range of 5.3 feet. San Diego Bay has the only significant tidal flows in the region. Nearcoast currents are weak and mixed and can flow either north or south at any time of the year.

A number of rivers have historically supplied sediments to the beaches. San Mateo and San Onofre Creeks at the northern boundary, the Santa Margarita and San Luis Rey Rivers at Oceanside, the San Diego River at Mission Bay, and the TiaJuana River near the Mexican Border all have been major contributors. Smaller coastal streams have also supplied sediments, but most of their load has been trapped in the six lagoons between Oceanside and La Jolla and will only be released if major floods occur.

The combination of a lack of intensive rainfall over the past 40 years and the construction of flood control dams and other structures which have restricted flows bearing sediment has deprived the beaches of an adequate supply of sand. This has been somewhat mitigated at a few locations by

artificially nourishing beaches with material dredged to improve harbor navigation. Unfortunately, this man-made supply is not always applied at the point of greatest need.

In addition to the erosion problems created by a lack of sand, a number of serious situations exist due to erosion of the relatively softer rock formations along Sunset Cliffs and in the vicinity of La Jolla. Protection has been given to portions of both segments, but additional work is needed if the existing developments are to be protected from wave damage.

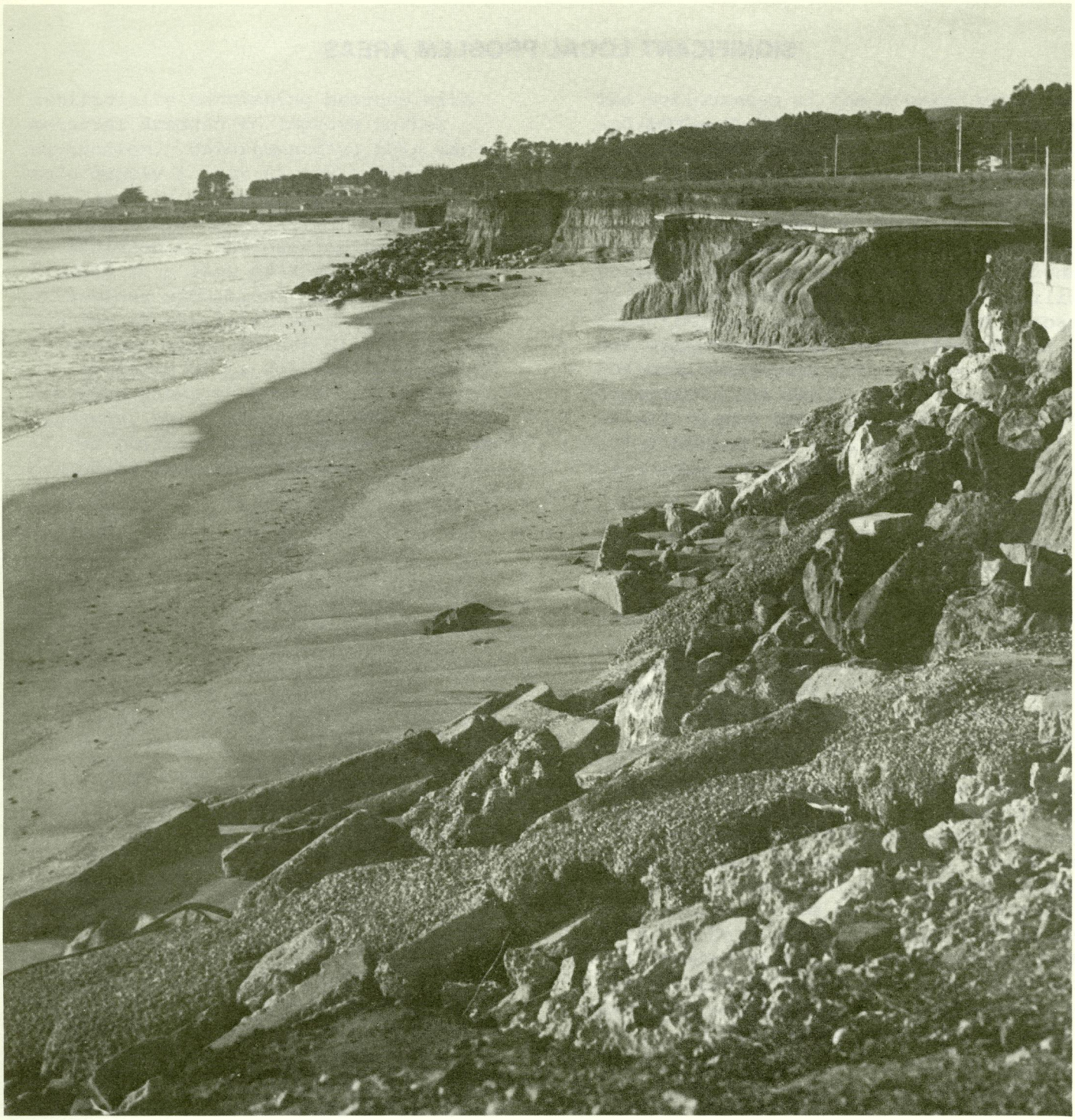
The seriousness of the erosion problems and imminent danger to valuable property requires that preventive measures be taken prior to the inevitable storm that will cause the damage. Solutions to the problems where damage is occurring at Oceanside and Imperial Beach are currently under investigation by the Corps of Engineers and at Sunset Cliffs by the City of San Diego. Because the problem is region-wide, regional solutions rather than localized ones may be more cost effective and environmentally acceptable.

SIGNIFICANT LOCAL PROBLEM AREAS

Some sections of the State's shoreline are particularly sensitive to erosion problems because of their physical characteristics such as a beach that is subject to cyclic changes or easily erodible bluffs. Other sections have been intensely developed with valuable facilities bordering the shoreline, and a protective beach has been created and maintained by the efforts of man. In addition, still other sections continue to be developed that are adversely affected by a depleted sand supply due to flood control systems and harbor developments, but no mitigative solution has been initiated.

In many cases, the problem areas, the causes, and the solutions extend beyond the jurisdictional boundaries of the local cities and counties and, therefore, are regional in nature. Local Coastal Plans need to take into account these conditions, but the solutions and effects of any local plan are of statewide significance.

The following brief summary of the more significant areas where erosion problems exist and that should be investigated in more detail is presented to alert local planners to problems that may require cooperative efforts of more than one governmental agency. While control of future development can reduce potential erosion damage, many existing facilities may be lost unless some measures are taken to provide shoreline protection.



Vallejo Beach, San Mateo County

North Coast Region

Del Norte County

Mi 10-12 This section of shoreline, which is undergoing development, is subject to cyclic changes of accretion and erosion as is all of the shoreline between the Smith River and Point St. George. Very little is known about the extent of shoreline changes that can be expected, but extreme changes are possible. The dunes should be left intact and development limited to areas shoreward of the dunes.

Mi 16-21 Heavy wave action and little protective beach results in an eroding situation for this scenic section of coastline. Private property and public roads have been damaged. Studies have recently been made by the Corps of Engineers on protection of the hospital at Mile 20.8.

Mi 21-22.4 Crescent City Harbor, a significant factor in the area's economy, provides shelter for a fleet of fishing vessels, lumber loading wharves, and petroleum barges that serve the County. The breakwaters have disrupted the natural littoral processes and trapped 2-3 million cubic yards of sediments in transit from wave action. Maintenance dredging of the sediments and their disposal to maintain navigation is a serious problem that needs a solution. The issue is being studied by local authorities and the Corps of Engineers. The harbor is particularly sensitive to tsunamis. In March 1964, a tsunami caused $11 million

damage and eight lives were lost. A protection plan was developed by the Corps of Engineers but not constructed.

Humboldt County

Mi 42-60 This stretch of shore between the mouth of the Mad River and Table Bluff at the south end of Humboldt Bay remains in a natural stable state only disturbed by the Humboldt Bay entrance jetties. The jetties appear to have helped stabilize the shoreline by fixing the Humboldt Bay channel. Sediment supplied by the Mad and Eel Rivers (Miles 42 and 65) as well as those streams entering into Humboldt Bay balances offshore losses. Developments encroaching into the dunes on either the North or South Spit could upset the present balance along the shore, and changes in the major river systems could also be disruptive; proposals for both have been suggested.

Mi 55-56 (Inside Humboldt Bay) The shoreline opposite the entrance to Humboldt Bay from the mouth of the Elk River to Buhne Point has experienced serious erosion. The Northwestern Pacific Railroad and the Pacific Gas & Electric Company have armored 7,000 feet of shoreline to protect their facilities. Erosion continues on Buhne Point, endangering the King Salmon development. Protection is provided on an emergency basis to the county road immediately to the west of King Salmon. A federal project was authorized by Congress to protect this area but has never been developed. Erosion is also occurring on the North Spit caused by the reflected waves from this armoring and tidal flows.

Mendocino County

No particularly sensitive reaches of coast are noted that appear to have development potential. In those areas which have been developed, the setbacks have generally been adequate. The local geology of much of the shoreline has resulted in numerous small headlands and embayments, indicating a variety of sensitivity of the shore to erosion. Geology of the shore is more important than littoral processes.

North Central Coast Region

Sonoma County

The shoreline conditions of Sonoma County are similar to Mendocino.

Marin County

Mi 52-54 Serious erosion has occurred along the bluffs that border the town of Bolinas. Federal studies have been made in an effort to correct the problem, but local government has chosen to let the natural erosion continue rather than take corrective action. Both public and private facilities have suffered serious damage and in all probability will continue to do so.

San Francisco County

The entire ocean shoreline of San Francisco County is sensitive to erosion problems. The Corps of Engineers is working with the National Park Service and the City of San Francisco to find solutions. The current work on a new sewage treatment plant and ocean outfall line will include modifications and shore protection features.

Mi 0-3.5 The section between the Golden Gate Bridge and Point Lobos near the Cliff House is steep and rugged. Erosion and cliff failures have caused roads to be abandoned and private property damaged.

Mi 3.5-4.5 Concrete seawall adequately stabilizes shoreline.

Mi 4.5-6.5 Dune field with wind-blown sand is creating sand removal problems. This section is at the southern terminal of the San Francisco Bay.

Mi 6.5-7.0 Eroding shoreline requires continuing maintenance by imported fill.

Mi 7.0-8.4 Narrow beach with high bluffs is subject to slides.

Central Coast Region

San Mateo County

Mi 0-8.5 The City of Pacifica has a series of serious erosion problems with retreating bluff endangering housing and commercial buildings or flooding in the low-lying areas. Corps of Engineers studies have not produced a viable project as federal program does not include protection for private property.

Mi 19-20 Extensive retreat of shoreline downcoast of Pillar Point Harbor since construction of breakwater. County road has been abandoned, and State highway and public utilities endangered. Investigation made by Corps of Engineers but

no viable project resulted. County and private property owners have installed rock protections.

Santa Cruz County

Mi 21-24 Cliff erosion has endangered homes and roads. Protective rock rubble seawall was constructed in most serious section through federal-state-local shore protection program nearly 20 years ago. Situation should be reviewed. Similar type shoreline in the 10-15 miles upcoast from this location but undeveloped and, therefore, non-critical.

Mi 24-26 This section is influenced by Santa Cruz Harbor operation and San Lorenzo River flows. Following jetty construction, the beach to the west of the harbor accreted and now protects the cliffs. Beach to the east dependent upon sand bypassing at harbor entrance.

Mi 26-30 Serious cliff erosion has endangered private buildings and public roads. Variety of protective structures have been constructed, but many sections are still critical. Problems have been studied by the Corps of Engineers, but no projects have been authorized. Groin and beach fill constructed by City of Capitola has proven effective.

Mi 30-41.8 Developing shoreline that is dependent upon protective beach which is subject to cyclic changes of wave climate and sediment supply.

Monterey County

Mi 0-19 Developing shoreline that is dependent upon protective

beach which is subject to cyclic changes of wave climate and sediment supply particularly from the Salinas River. Sand mining may have local effect upon shoreline changes. Neither Moss Landing nor Monterey Harbors appear to have any significant effect upon littoral processes.

South Central Coast Region

San Luis Obispo County

Mi 41.5-45 Developing shoreline with critical erosion and various types of shore protection. Continuing development will bring additional problems unless adequate controls are established.

Mi 76-81 Developing shoreline with critical cliff erosion. Shore protection structures in some locations inadequate. Continuing development needs adequate controls.

Santa Barbara County

Mi 84.5-95.4 Coal Oil Point to Santa Barbara Harbor - critical cliff erosion endangering development in growing areas. Narrow beach due to limited sand supply. Continuing cliff retreat but little data on historic rate.

Mi 95-98 Santa Barbara Harbor and adjacent beaches - West Beach was formed from sand trapped upcoast from the harbor breakwater and is essentially stable. The harbor requires periodic maintenance dredging (approximately 300,000 cubic yards annually) to prevent the sand bar at the easterly tip of the breakwater from extending to shore. This is now a responsibility of the Corps of Engineers. The dredging

program is based upon navigation needs rather than beach nourishment. The sand bar is essential to the protection of the harbor and must remain intact. The stability of the beach immediately to the east of the harbor and for a number of miles downcoast is dependent upon the sand bypassed at Santa Barbara Harbor. Serious erosion has occurred and protective works have been constructed due to the initial harbor construction extending to the County line.

Ventura County

A County-wide beach erosion study is nearing completion by the Los Angeles District Corps of Engineers.

Mi 0-12 County line to Ventura River - The narrow beach dependent on sand supply bypassed at Santa Barbara Harbor and contribution from local streams is very sensitive to man's interference in the coastal processes. Much of the shoreline has been artificially protected either by the highway department or the railroad.

Mi 12-18 This section, which includes the mouths of the Ventura and Santa Clara Rivers, is subject to large fluctuations in shoreline alignment due to the periodic sediment flows in the Rivers. Serious erosion is occurring at Surfers Point (Mi 13.2). The shoreline between there and the Ventura Marina (Mi 15.8) has been stabilized by a groin field constructed by the Corps of Engineers. Sand bypassing is required at Ventura Marina (in excess of 400,000 cubic yards) but the influence of this operation on adjacent

beaches is overshadowed by the effect of the extremely high sediment flows in the Santa Clara River.

Mi 18-21 Shoreline subject to extreme changes due to cyclic wave climate and sediment supply of nearby rivers.

Mi 21-24 Shoreline under influence of Channel Islands and Port Hueneme Harbor. About 1.2 million cubic yards of sand trapped annually at Channel Islands is bypassed semi-annually to point south of Port Hueneme with periodic nourishment as required to beaches between.

Mi 34-41.2 Narrow or limited pocket beaches with various sections eroding or artificially protected.

South Coast Region

Los Angeles County

Mi 0-5.2 Narrow and pocket beaches. Development requires careful control.

Mi 5.2-9.2 Wide sandy beaches subject to cyclic changes and control structures at Point Dume.

Mi 9.2-25.8 Narrow beach requiring numerous artificial protections for numerous developments. Development requires careful control.

Mi 25.8-33.3 Wide sandy beach stabilized by rock groins, offshore breakwaters, and harbor jetties.

Mi 33.3-33.5 Marina Del Rey Harbor entrance channel and jetties do not appear to adversely affect the littoral process. Periodic maintenance of channel entrance provides some

nourishment for adjacent beaches.

Mi 33.5-42 Wide beach created by artificial nourishment and stabilized by groins and King Harbor breakwater. A retreating shoreline at Mi 38-39 is threatened, but project to artificially nourish and stabilize is being developed by Los Angeles County.

Mi 42-42.8 King Harbor breakwater has acted as a groin to stabilize upcoast beaches and reduce sand loss into Redondo submarine canyon near harbor entrance.

Mi 42.8-45.5 Artificially nourished beach stabilized by groin at Topaz Street. Erosion at southern end of segment will increase until beach is renourished.

Mi 45.5-61 Palos Verdes Peninsula subject to cliff erosion and landslides with few pocket beaches. Protective structures planned at Whites Point (Mi 58.8) by Los Angeles County. Development needs to be strictly controlled.

Mi 61-73.8 Los Angeles/Long Beach Harbors sheltered by breakwater. Shoreline no longer subject to natural littoral processes but subject to effects of flood control measures, subsidence from oil extraction, and dredging.

Orange County

Mi 0-1.2 Seal Beach shoreline stabilized by San Gabriel River jetty and Anaheim Harbor and groin but requires periodic maintenance.

Mi 1.2-2 Anaheim Harbor - Has provided sand for beach nourishment in past, but polluted sediments now prevent this.

Mi 2-12.2 Federal project of periodic beach nourishment maintains beach stability. Current plans to obtain sand from offshore sources. Extreme erosion has occurred in past due to elimination of sand supply and subsidence.

Mi 12.2-18 Portion of shoreline developed from creation of Newport Harbor. Shoreline maintained through federal program of periodic nourishment and groin fields. Damage has occurred periodically in the vicinity of Mi 14 near head of Newport submarine canyon.

Mi 18-32.8 Newport Harbor to Dana Point Harbor - Narrow pocket beaches with rocky points and bluffs require careful control of shoreside developments.

Mi 32.8-34 Dana Point Harbor does not appear to have any detrimental effects upon natural coastal processes.

Mi 34-41.9 Shoreline has sustained severe damage and contains a lot of artificial protective structures. Requires careful control of shoreside developments.

San Diego Region

San Diego County

Mi 0-16.7 Camp Pendleton - A shoreline in a natural state. Eroding bluffs and coastal streams contribute sediments to littoral process.

Mi 16.7-18 Del Mar/Oceanside Harbor - World War II emergency harbor has obstructed natural flow of sand assisted by groin at San Luis Rey River. Periodic harbor maintenance provides some nourishment for downcoast beaches.

Mi 18-20 Serious erosion of beaches under investigation by Corps of Engineers.

Mi 20-39 Fast-developing shoreline with numerous points of serious erosion and artificial protection requires careful development control.

Mi 39-43.2 Beach backed by bluffs with active slides is subject to seasonal changes and requires careful development control.

Mi 43.2-44.3 Wide sandy beach with artificial protection.

Mi 44.3-49.5 Pocket beaches and eroding cliffs with fully developed shoreline. Artificial protection may be required in some locations. Careful controls should be exercised.

Mi 49.5-53.5 Sandy beach stabilized by rocky headlands, Mission Bay jetties, and groin. Periodic nourishment may be required if San Diego River does not supply sediments.

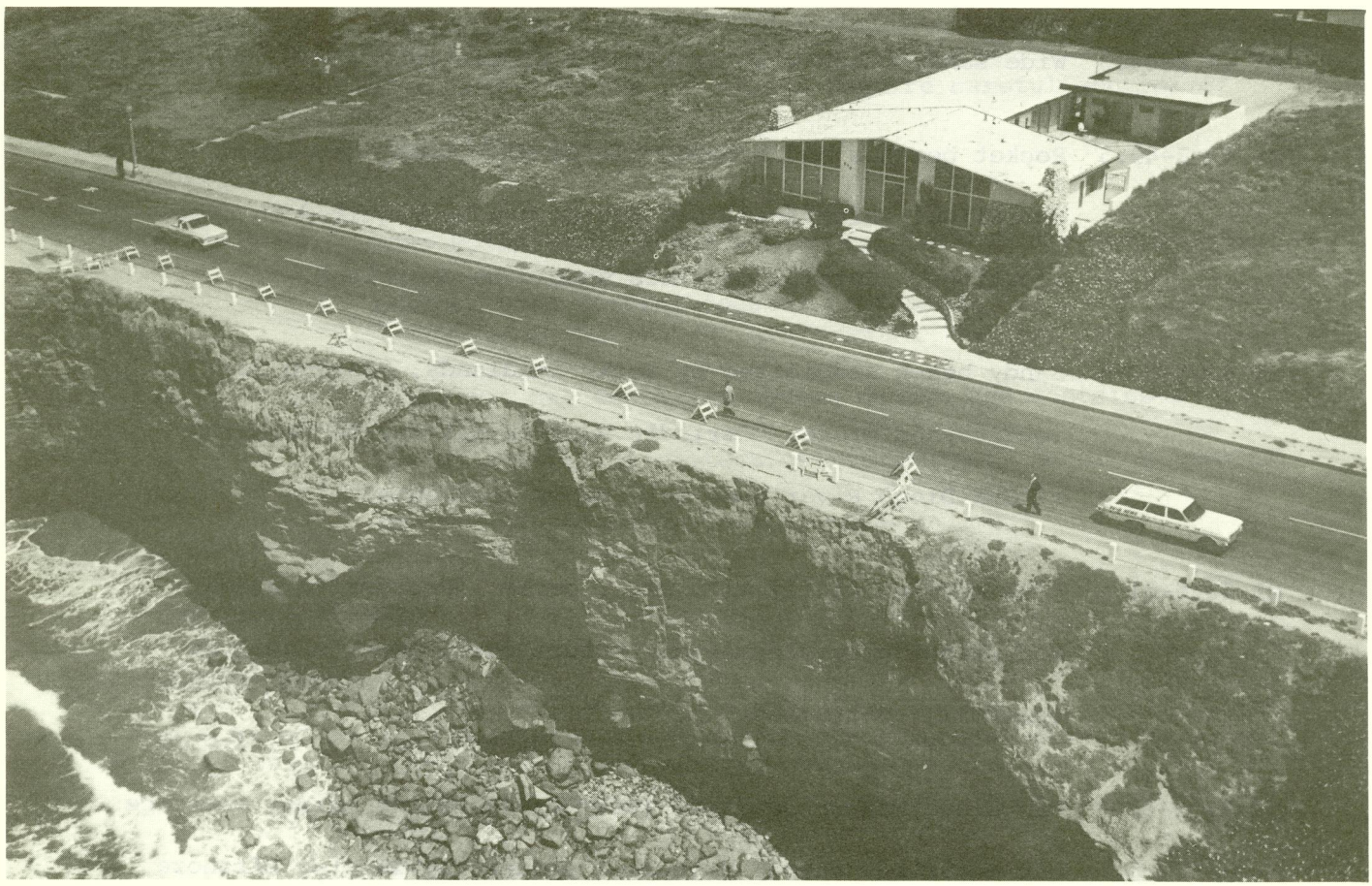
Mi 53.5-61.5 High eroding cliffs with small coves. Protection needed for existing developments. Future development should be carefully controlled.

Mi 61.5-62.3 San Diego Harbor entrance jetty to stabilize harbor entrance has modified natural processes apparently causing offshore losses of sand.

Mi 62.3-72.5 Shoreline nourished with dredging spoils from navigation improvements in San Diego Bay. Certain sections (i.e. Mi 64-65) have experienced severe erosion in the past. Development encroachments into area of changing shoreline have required construction of protective structure. Recent nourishment from San Diego Bay channel improvements provides added protection.

Mi 72.5-73.5 Imperial Beach - Federal shore protection project design near completion with construction to be underway soon.

Mi 73.5-75.1 TiaJuana River Delta - Subject to erosion as river flows severely reduced by flood control measures.



Sunset Cliffs, San Diego County

BIBLIOGRAPHY

Bascom, Willard, Waves and Beaches, Garden City, New York: Anchor Books, Doubleday & Co., Inc., 1964.

Belly, Pierre-Yves, Sand Movement by Wind (Technical Memorandum No. 1), U. S. Army Coastal Engineering Research Center, Washington, D.C., January, 1964.

Bowen, A. J. and D. L. Inman, Budget of Littoral Sands in the Vicinity of Point Arguello, California (Technical Memorandum No. 19), U. S. Army Coastal Engineering Research Center, Washington, D.C., December, 1966.

Byerly, John Robert, The Relationship Between Watershed Geology and Beach Radioactivity (Technical Report HEL-5-1), University of California, Hydraulic Engineering Laboratory, Berkeley, December, 1962.

Caldwell, Joseph M., Wave Action and Sand Movement Near Anaheim Bay, California (Technical Memorandum No. 68), U. S. Army Corps of Engineers, Beach Erosion Board, February, 1956.

California Department of Navigation and Ocean Development, Shore Protection in California, April, 1976.

California Department of Navigation and Ocean Development, Comprehensive Ocean Area Plan, Shoreline Use and Protection, Appendix VII, March, 1972.

California Department of Public Works, Division of Highways, Bank and Shore Protection in California Highway Practice, Sacramento: Office of State Printing, 1960.

California Department of Water Resources, San Francisco Bay District, Beach Erosion Investigation Program, Progress Report, December, 1967.

California Department of Water Resources, Southern District, Interim Report on Study of Beach Nourishment Along the Southern California Coastline, July, 1969.

Channel Islands Longshore Transport Study - Interim Report, U. S. Army Coastal Engineering Research Center, Ft. Belvoir, Virginia, September 10, 1974.

Cherry, John, Sand Movement Along a Portion of the Northern California Coast (Technical Memorandum No. 14), U. S. Army Coastal Engineering Research Center, Washington, D.C., October, 1965/(Technical Report HEL-4-3) University of California, Hydraulic Engineering Laboratory, Berkeley, April, 1964.

Cherry, John, et al., Beach Sand Radioactivity, Source, Transportation, and Deposition Studies (Technical Report HEL-5-2), University of California, Hydraulic Engineering Laboratory, Berkeley, July, 1963.

Coastal Engineering - Santa Barbara Specialty Conference - October 1965, American Society of Civil Engineers, New York, 1966.

Comprehensive Framework Study, California Region, Appendix XVI, Shoreline Protection and Development, California Region Framework Study Committee, November, 1970.

Cottonaro, William F., Sea Cliff Erosion, Isla Vista, California, California Geology, Division of Mines & Geology, Vol. 28, No. 6, June, 1975.

Das, M. M., Longshore Sediment Transport Rates: A Compilation of Data (Miscellaneous Paper No. 1-71), U. S. Army Coastal Engineering Research Center, Washington, D.C., September, 1971.

DeGrace, Henry M., and Richard M. Ecker, Sediment Transport, Coast of Northern California, American Society of Civil Engineers.

Duane, David B., Tracing Sand Movement in the Littoral Zone: Progress in the Radioisotopic Sand Tracer (RIST) Study, July 1968-February 1969 (Miscellaneous Paper No. 4-70), U. S. Army Coastal Engineering Research Center, Washington, D.C., August, 1970.

Duane, David B. and Charles W. Judge, Radioisotopic Sand Tracer Study Point Conception, California, Preliminary Report on Accomplishments, July 1966-June 1968 (Miscellaneous Paper No. 2-69), U. S. Army Coastal Engineering Research Center, Washington, D.C., May, 1969.

Einstein, Hans Albert, A Basic Description of Sediment Transport on Beaches (Technical Report HEL-2-34), University of California, Hydraulic Engineering Laboratory, Berkeley, August, 1971.

Glogoczowski, M. and P. Wilde, River Mouth and Beach Sediments - Russian River, California, to Rogue River, Oregon - Part A. Introduction and Grain Size Analyses (Technical Report HEL-2-36), University of California, Hydraulic Engineering Laboratory, Berkeley, November, 1971.

Glogoczowski, M., et al., Recent Sediments of the Central California Continental Shelf - Pillar Point to Pigeon Point - Part B. Mineralogical Data (Technical Report HEL-2-30), University of California, Hydraulic Engineering Laboratory, Berkeley, June, 1971.

Inman, Douglas L., Areal and Seasonal Variations in Beach and Nearshore Sediments at La Jolla, California (Technical Memorandum No. 39), U. S. Army Corps of Engineers, Beach Erosion Board, Washington, D.C., March, 1953.

Inman, Douglas L., Man's Impact on the California Coastal Zone, Summary Report for Department of Navigation and Ocean Development, November, 1976.

Inman, Douglas L. and G. S. Rusnak, Changes in Sand Level on the Beach and Shelf at La Jolla, California (Technical Memorandum No. 82), U. S. Army Corps of Engineers, Beach Erosion Board, Washington, D.C., July, 1956.

Inman, Douglas L., and F. P. Shepard, Sand Movement on the Shallow Inter-Canyon Shelf at La Jolla, California (Technical Memorandum No. 26), U. S. Army Corps of Engineers, Beach Erosion Board, Washington, D.C., November, 1951.

Inman, Douglas L., et al., Dispersion of Water and Sediment in the Surf Zone, University of California, Scripps Institution of Oceanography, La Jolla, California, December 31, 1968.

Intersea Research Corp., Nearshore Processes Along the Silver Strand Littoral Cell, Report for U. S. Army Corps of Engineers, Los Angeles District, August, 1974.

Isselhardt, C., et al., Recent Sediments of Bolinas Bay, California - Part A. Introduction and Grain Size Analyses (Technical Report HEL-2-19), University of California, Hydraulic Engineering Laboratory, Berkeley, November, 1968.

Isselhardt, C. et al., Recent Sediments of Bolinas Bay, California - Part B. Mineralogical Data (Technical Report HEL-2-22), University of California, Hydraulic Engineering Laboratory, Berkeley, April, 1969.

Isselhardt, C., et al., Recent Sediments of Bolinas Bay, California - Part C. Interpretation and Summary of Results (Technical Report HEL-2-23), University of California, Hydraulic Engineering Laboratory, Berkeley, December, 1969.

Isselhardt, C., et al., Recent Sediments of the Central California Continental Shelf - Pillar Point to Pigeon Point - Part A. Introduction and Grain Size Data (Technical Report HEL-2-26), University of California, Hydraulic Engineering Laboratory, Berkeley, July, 1970.

Judge, C. W., Heavy Minerals in Beach and Stream Sediments as Indicators of Shore Processes Between Monterey and Los Angeles, California (Technical Memorandum No. 33), U. S. Army Coastal Engineering Research Center, Washington, D.C., November, 1970.

Kalkanis, George, Transportation of Bed Material Due to Wave Action (Technical Memorandum No. 2), U. S. Army Coastal Engineering Research Center, Washington, D.C., February, 1964.

Kamel, Adel M., Littoral Studies Near San Francisco Using Tracer Techniques (Technical Memorandum No. 131), U. S. Army Corps of Engineers, Beach Erosion Board, Washington, D.C., November, 1962.

Kamel, Adel M., Transportation of Coastal Sediments (Technical Report Series 185, Issue 1), University of California, Hydraulic Engineering Laboratory, Berkeley, January, 1962.

Keith, James M., and Roger E. Skjei, Engineering and Ecological Evaluation of Artificial-Island Design, Rincon Island, Punta Gorda, California (Technical Memorandum No. 43), U. S. Army Coastal Engineering Research Center, Ft. Belvoir, Virginia, March, 1974.

Lee, J., et al., Recent Sediments of the Central California Continental Shelf - Pigeon Point to Sand Hills Bluffs - Part A. Introduction and Grain Size Data (Technical Report HEL-2-28), University of California, Hydraulic Engineering Laboratory, Berkeley, October, 1970.

Minard, Claud R., Jr., Quaternary Beaches and Coasts Between the Russian River and Drakes Bay, California (Technical Report HEL-2-35), University of California, Hydraulic Engineering Laboratory, Berkeley, August, 1971.

Moore, D. B., Recent Coastal Sediments, Double Point to Point San Pedro, California (Technical Report HEL-2-14), University of California, Hydraulic Engineering Laboratory, Berkeley, June, 1965.

Nearshore Processes Along the Silver Strand Littoral Cell (Contract No. DACW09-74-C-0062), Intersea Research Corporation, La Jolla, California, August 15, 1974.

Noble, R. M. Shoreline Changes, Humboldt Bay, California (Technical Report HEL-24-2), University of California, Hydraulic Engineering Laboratory, Berkeley, February, 1971.

Norris, Robert M., Sea Cliff Retreat Near Santa Barbara, California, Mineral Information Service, Division of Mines & Geology, Vol. 21, No. 6, June, 1968.

Proceedings of Eleventh Conference on Coastal Engineering, London, England, September, 1968, Volume 1, American Society of Civil Engineers, New York, 1969.

San Diego City, Sunset Cliffs (Newport Avenue to Osprey Street) Shoreline Protection Study, December, 1976.

San Diego City, Engineering Department, Beach Erosion Problems Within the City of San Diego, June, 1970.

Savage, Rudolph P., Sand Bypassing at Port Hueneme, California (Technical Memorandum No. 92), U. S. Army Corps of Engineers, Beach Erosion Board, Washington, D.C., March, 1957.

Sayles, Frederick L., A Reconnaissance Heavy Mineral Study of Monterey Bay Beach Sediment (Technical Report HEL-2-16), University of California, Hydraulic Engineering Laboratory, Berkeley, August, 1966.

Scott, Theodore, Sand Movement by Waves (Technical Memorandum No. 48), U. S. Army Corps of Engineers, Beach Erosion Board, Washington, D.C., August, 1954.

Shepard, Francis P., Beach Cycles in Southern California (Technical Memorandum No. 20), U. S. Army Corps of Engineers, Beach Erosion Board, Washington, D.C., July, 1950.

Shepard, Francis P. and Harold R. Wanless, Our Changing Coastlines, McGraw-Hill, Inc., 1971.

Snow, David T., Beaches in Northwestern California, University of California, Hydraulic Engineering Laboratory, Berkeley, August, 1962, Series 14, Issue 25.

Stokes, A. P., Beach Erosion and Damages to the Ventura County Shoreline, Department of Public Works, Ventura County, June, 1972.

Sullivan, Raymond, Geological Hazards Along the Coast South of San Francisco, California Geology, Division of Mines & Geology, Vol. 28, No. 3, February, 1975.

Szuwalski, Andre, Littoral Environment Observation Program in California, Preliminary Report, February-December 1968 (Miscellaneous Paper 2-70) U. S. Army Coastal Engineering Research Center, Washington, D.C.

Trask, Parker D., Beaches Near San Francisco, California, 1956-1957, University of California, College of Engineering, Berkeley, November, 1958, Series 14, Issue 21/(Technical Memorandum No. 110), U. S. Army Corps of Engineers, Beach Erosion Board, Washington, D.C., April, 1959.

Trask, Parker D., Changes in Configuration of Point Reyes Beach, California, 1955-1956, University of California, College of Engineering, Berkeley, October, 1956, Series 14, Issue 20/(Technical Memorandum No. 91), U. S. Army Corps of Engineers, Beach Erosion Board, Washington, D.C., November, 1956.

Trask, Parker D., Movement of Sand Around Southern California Promontories, University of California, College of Engineering, Berkeley, February, 1955, Series 14, Issue 16/(Technical Memorandum No. 76), U. S. Army Corps of Engineers, Beach Erosion Board, Washington, D.C., June, 1955.

Trask, Parker D., Source of Beach Sand at Santa Barbara, California as Indicated by Mineral Grain Studies (Technical Memorandum No. 28), U. S. Army Corps of Engineers, Beach Erosion Board, Washington, D.C., October, 1952.

Trask, Parker D. and Charles A. Johnson, Sand Variation at Point Reyes Beach, California (Technical Memorandum No. 65), U. S. Army Corps of Engineers, Beach Erosion Board, Washington, D.C., October, 1955.

U. S. Army Corps of Engineers, Los Angeles District, Beach Erosion Control Report on Cooperative Study of Orange County, California, March, 1962.

U. S. Army Corps of Engineers, Los Angeles District, Cooperative Research and Data Collection Program Coast of Southern California, December, 1974.

U. S. Army Corps of Engineers, Los Angeles District, Cooperative Study of Southern California, Point Conception to Mexican Boundary, Interim Report, 1960.

U. S. Army Corps of Engineers, Los Angeles District, Detail Project Report Small Beach Erosion Control Project, Las Tunas Park, Los Angeles County, California, November, 1974.

U. S. Army Corps of Engineers, Los Angeles District, General Design Memorandum for Beach Protection and Widening from Redondo Beach Breakwater to Malaga Cove, December, 1966.

U. S. Army Corps of Engineers, Los Angeles District, Progress Report on Beach Erosion Control Study, San Diego County, California, in Vicinity of Oceanside, January, 1977.

U. S. Army Corps of Engineers, Los Angeles District, Shore Protection Report on Survey of Anaheim Bay Harbor, California, July, 1952.

U. S. Army Corps of Engineers, Los Angeles District, Special Interim Report on Ventura Area Beach Erosion Control Report on Coast of Southern California, August, 1961.

U. S. Army Corps of Engineers, Los Angeles District, Special Study of City of Long Beach (Alamitos Bay), September, 1967.

U. S. Army Corps of Engineers, Los Angeles District, Special Study of City of San Diego Beach Erosion Control Report on Coast of Southern California, June, 1964.

U. S. Army Corps of Engineers, San Francisco District, Beach Erosion Control Report on Cooperative Study of Santa Cruz Area, Pacific Coastline of California, January, 1956.

U. S. Army Corps of Engineers, San Francisco District, Cooperative Beach Erosion Study of Coast of Northern California, Point Delgada to Point Ano Nuevo, 1965.

U. S. Army Corps of Engineers, San Francisco District, Cooperative Beach Erosion Study of Northern California, Point St. George to Point Lobos, November, 1975.

U. S. Army Corps of Engineers, South Pacific Division, National Shoreline Study, California Regional Inventory, 1971.

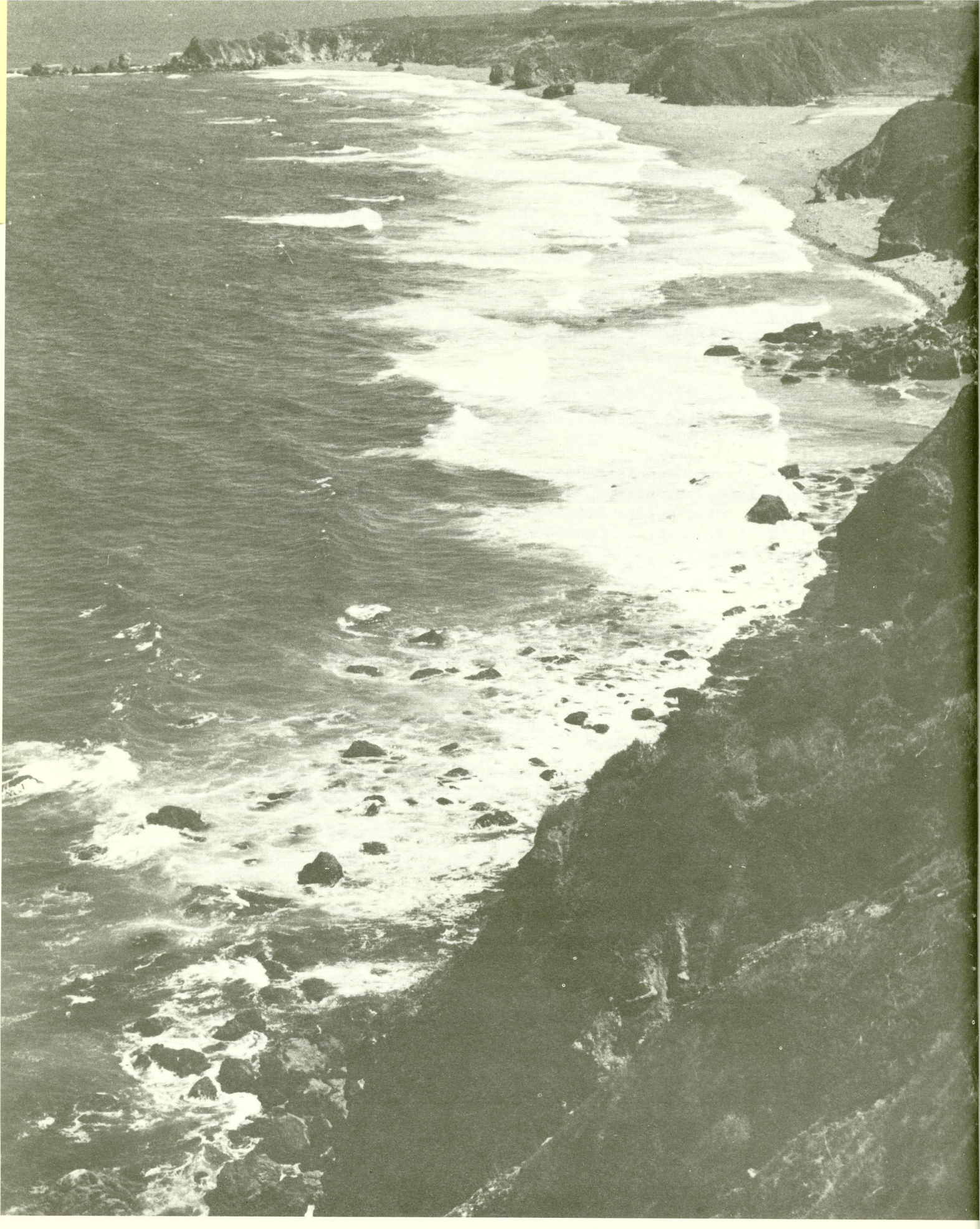
Water Resources Council, Comprehensive Framework Study, California Region, Shoreline Protection and Development, Appendix XVI, 1971.

Wilde, Pat, Recent Sediments of the Monterey Deep-Sea Fan (Technical Report HEL-2-13), University of California, Hydraulic Engineering Laboratory, Berkeley, May, 1965.

Wilde, P. and T. Yancey, Recent Sediments of the Monterey Bay, Additional Mineralogical Data (Technical Report HEL-2-33), University of California, Hydraulic Engineering Laboratory, Berkeley, September, 1971.

Woodward-Clyde Consultants, Reconnaissance Study Blacks Beach and Sunset Cliffs Area, San Diego, California, Report for City of San Diego, August, 1976.

Zeller, R. P., A General Reconnaissance of Coastal Dunes of California, University of California, Hydraulic Engineering Laboratory, Berkeley, August 1961, Series 72, Issue 6/(Miscellaneous Paper No. 1-62), U. S. Army Corps of Engineers, Beach Erosion Board, Washington, D.C., June, 1962.



Ragged Point Beach, San Luis Obispo County

ATLAS
of
Shoreline Erosion

FORMAT OF THE ATLAS

The base maps used in the atlas were prepared from U. S. Geological Survey 7-1/2 minute quad sheets with a scale of 1:24000 (1 inch equals 2000 feet). The final map is in black and white with elevation contours, roads, buildings, section lines, rivers, etc., but without the usual color overlays showing urban areas, forests, U. S. Forest Service lands, etc. Each map covers a somewhat smaller area than the USGS quad sheet in order to reproduce them at half scale (1:48000) on an 8-1/2 x 11 standard sheet. The maps have been laid out with the shoreline approximately along the vertical center line of the sheet with information on the erosion conditions on the left or seaward side. The landside features remain intact for ease of identification and the reader's orientation and vary from one to three miles in width which, in most cases, covers the California coastal zone. As a result, some maps are a composite of two or three USGS maps and may have an orientation other than north at the top of the sheet.

The map numbers run from north to south beginning at the Oregon border. Shoreline mileage is given for each county beginning at each northern county boundary. It is the same shoreline location identification system first used by the Department of Parks and Recreation in the preparation of their California Coastline Preservation & Recreation Plan of 1971 and is in common usage by others in identifying shoreline locations, particularly where there are no other identifiable features. Shoreline conditions are given symbolically on the left side of the map opposite the location. While the symbols are not true scale, the length of any specific condition can be located by following the guidelines and then measuring the true distance along the shoreline. In addition, a brief description of the character of nearshore, beach,and backshore is given for each segment where the conditions change, noting the type of facilities which may be subject to damage.

The erosion conditions and shoreline characteristics were determined by interpretation of vertical color aerial photos taken in 1976-77 and black and white aerial photos taken in 1970. This was augmented by aerial oblique slides taken in 1972. Ground truth has been developed from a continuing surveillance program carried on by the Department of Navigation and Ocean Development and the data bank of onsite ground photographs collected in carrying out the program.

Every effort has been made to be consistent and uniform in describing the special characteristics and in delineating the shoreline conditions. The California shoreline, however, varies greatly over its length so that judgment on what constitutes a serious erosion problem in one region may vary somewhat from that in another. Within coastal regions of similar physical conditions, the assessments are uniform.

With time, the shoreline conditions will change and additional information will become available or gain new importance. Even the USGS base maps will be updated and published. It is anticipated that the atlas will be periodically published to meet current needs and to provide the results of a continuing assessment of the erosion and wave damage problems.

Time restraints in producing the atlas and the lack of reliable data precluded the preparation of maps for the offshore islands and the inland waters of San Francisco, Humboldt, and San Diego Bays. So little development has been done on the offshore islands and there is so little prospect for future development that an assessment of those shorelines under these conditions is not warranted.

While some minor erosion is occurring in both Humboldt and San Diego Bays, it is not significant compared with

the coastal problems and can be handled within the jurisdiction of the port districts. San Francisco Bay also has some erosion problems, but it falls under the control of the San Francisco Bay Conservation and Development Commission rather than the California Coastal Commission. The physical conditions that exist are quite different from those existing on the Pacific Ocean and should be treated in a different manner.

CLASSIFICATION OF SHORELINE CONDITION

In order to plan and manage future shoreline development and to reduce the effect of shoreline erosion on existing facilities, the California shoreline has been classified into six types of shoreline conditions. The classifications may be grouped into the two primary categories of developed and undeveloped shorelines.

Along those shorelines which have been developed, the existing facilities may: (1) be in danger of sustaining damage from erosion or wave forces; (2) have some type of artificial protection against damage that may or may not be effective; or (3) not be in danger. Damage from wave action can be from the direct impact of wave forces; erosion of the supporting ground such as a beach, embankment or cliff; or flooding caused by wave runup overtopping a barrier. The types of waves considered in these classifications are those which could reasonably be expected during the facilities' useful economic life.

Along shorelines which are not yet developed, the classifications are related to the existing erosion conditions. Most of California's shoreline is eroding and is subject to heavy wave action at one time or another. Past experience has shown that critical situations arise, resulting in damage either from a retreating shoreline that exposes a facility to wave damage or the construction of a facility without adequate protection in a shoreline area that is exposed to storm waves. The three classifications of natural shoreline conditions are: (1) an eroding shoreline where future development may be critical; (2) a protective beach; and (3) stable rock. These classifications provide a guide to the types of controls needed in shoreline erosion planning.

The selection of the classification for each section of the California shoreline was made through a review of the published reports on shoreline changes and erosion problems coupled with analyzing aerial and ground photographs taken in different time periods of the entire coastline. In addition, much of the shoreline has been personally inspected by the staff of the Department of Navigation and Ocean Development over a number of years. However, because finite data on dates of erosion, geology, littoral drift, and wave climate are extremely limited, the delineation of shoreline by each classification is necessarily subjective and somewhat arbitrary. The selection of the classification appropriate for any specific section of shoreline is a matter of judgment. This is particularly true when either the effect of erosion or wave damage is not clearly evident or the shoreline has characteristics common to two classifications.

Descriptive notes are provided to give the reader additional information regarding the erosion conditions and existing physical characteristics not specifically covered by the classifications or apparent on the base maps.

A description and explanation of each shoreline classification is as follows:

Present Use Critical

Shoreline facilities exist which are subject to damage from wave action. They may be buildings, roads, recreational facilities, parking lots, or other works of man that are in danger of suffering economic loss. Damage may not have occurred recently, but there is evidence that a danger exists.

Present Use Non-Critical

Shoreline development has occurred, but the existing facilities are not now in danger of wave damage. Additional improvements could be subject to damage if proper precautions are not exercised.

Artificial Protection

The shoreline has been modified with some type of shore protection such as seawalls, rock revetment, bulkheads, or artificial nourishment of beach sand. The shoreline is subject to wave damage and the protection system may require maintenance, reinforcement, or complete reconstruction to protect the existing facilities.

Future Use Critical

The shoreline is undeveloped and is eroding. The present use may be agriculture, grazing, or forests that are not significantly being economically damaged under existing conditions. An investigation of the danger of erosion, shoreline stability, and wave climate should be made before an economic investment is made in a more intensive land use.

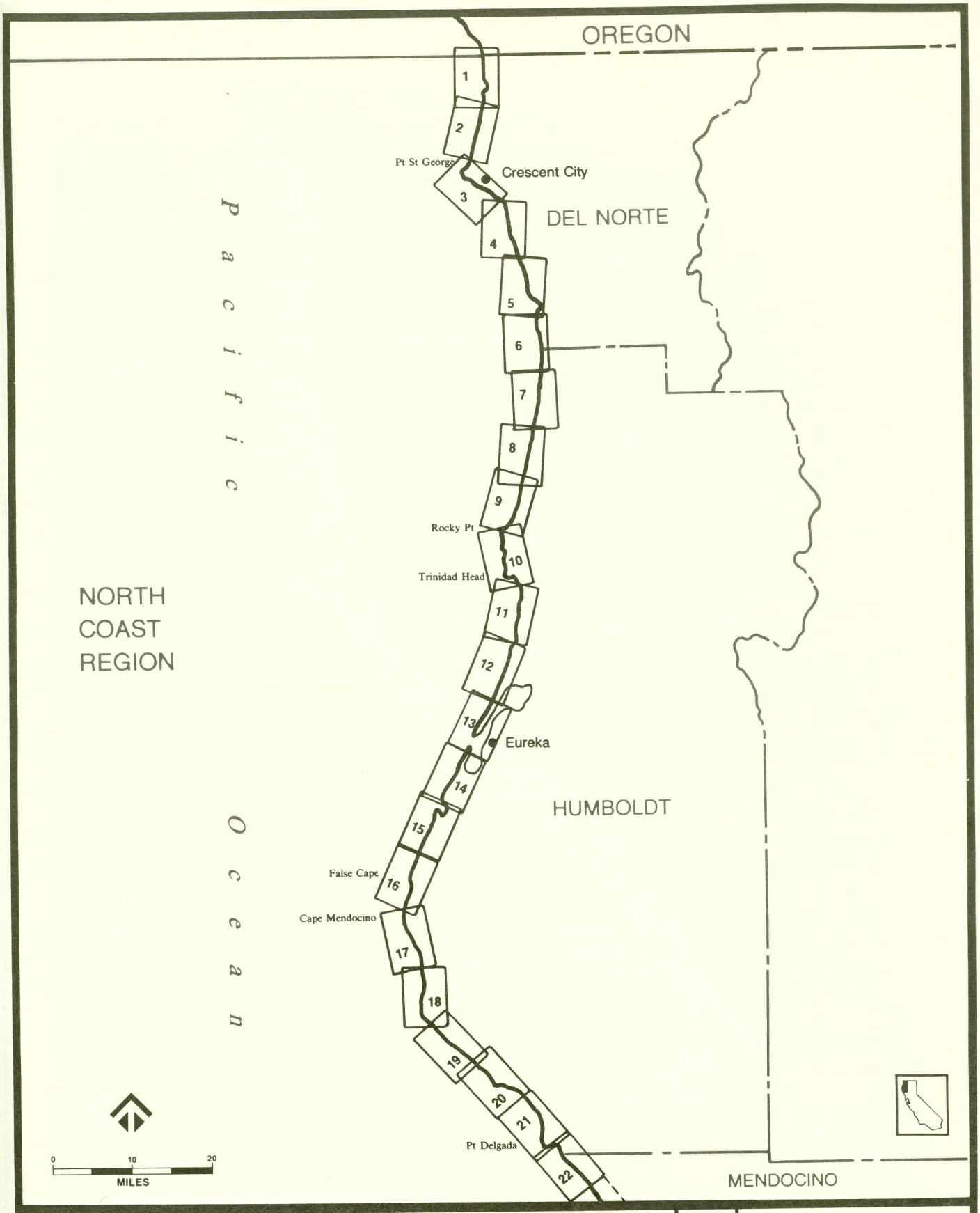
Protective Beach

The shoreline consists of a sandy beach which advances and retreats on a seasonal basis but has sufficient width to protect the backshore against wave damage through one or two storm periods. These beaches are usually dependent upon a natural supply of sand to maintain their alignment and position under the prevailing wave climate. If the sand supply is significantly reduced or the wave climate altered either naturally or artificially, the shoreline may change, thereby losing its protective characteristics.

Stable Rock

The shoreline is a rock formation which shows little or no sign of wave damage.

MAP INDEX TO ATLAS



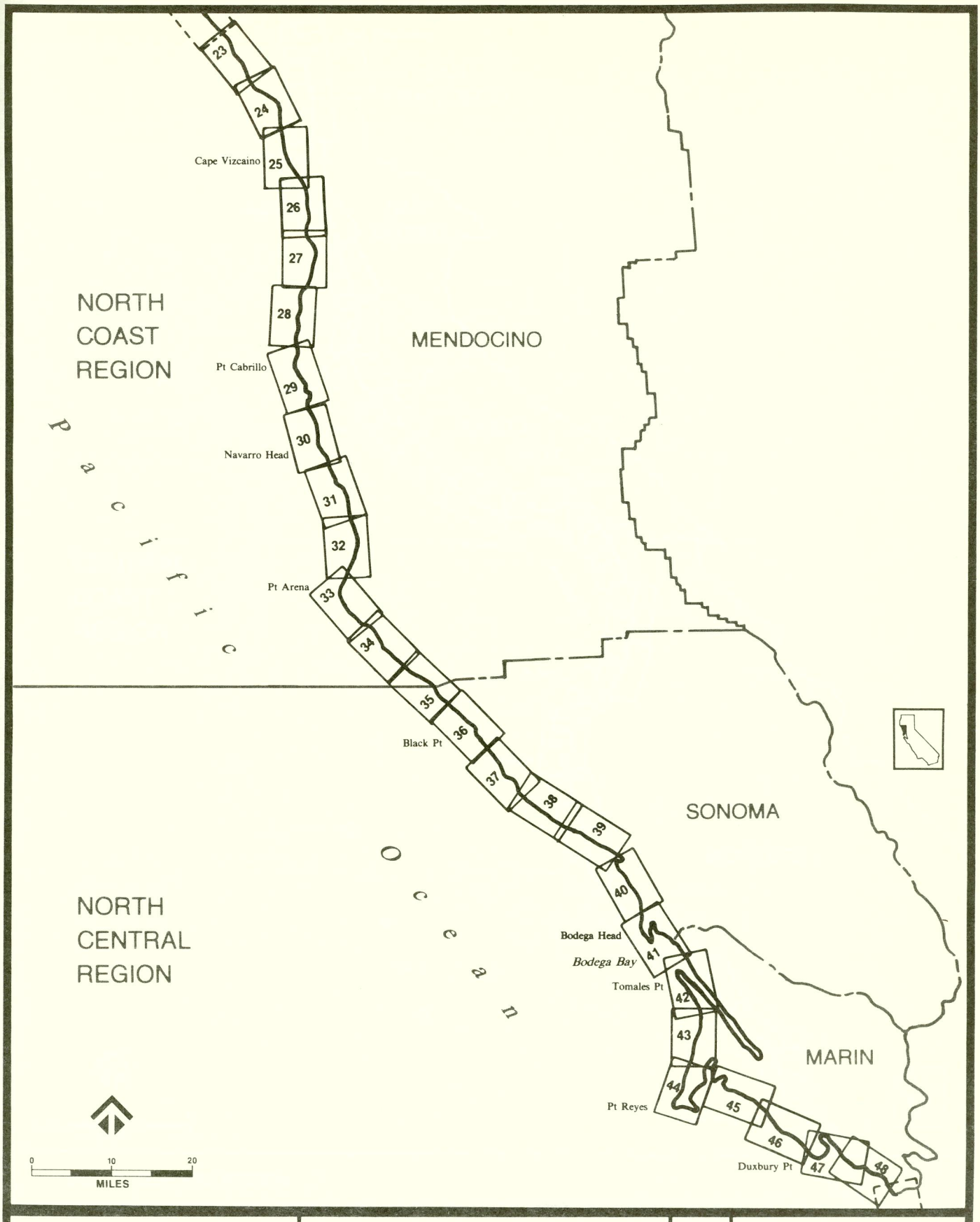
MAP INDEX

MAP NUMBER 1

STATE OF CALIFORNIA — THE RESOURCES AGENCY

DEPARTMENT OF NAVIGATION & OCEAN DEVELOPMENT

1977



MAP INDEX

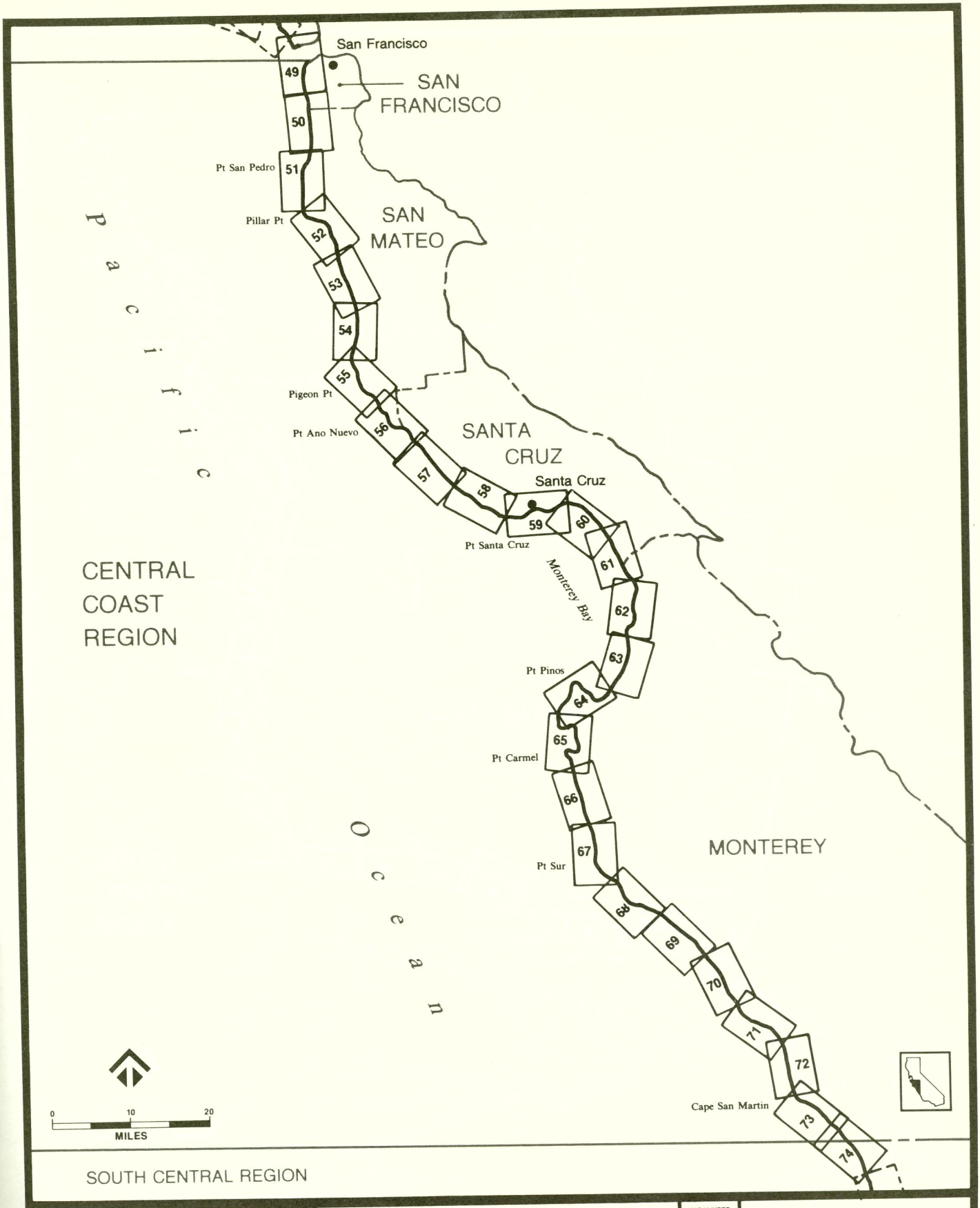
MAP NUMBER 2

STATE OF CALIFORNIA THE RESOURCES AGENCY

DEPARTMENT OF NAVIGATION & OCEAN DEVELOPMENT

DNOD

1977



SOUTH CENTRAL REGION

MAP INDEX

MAP NUMBER 3

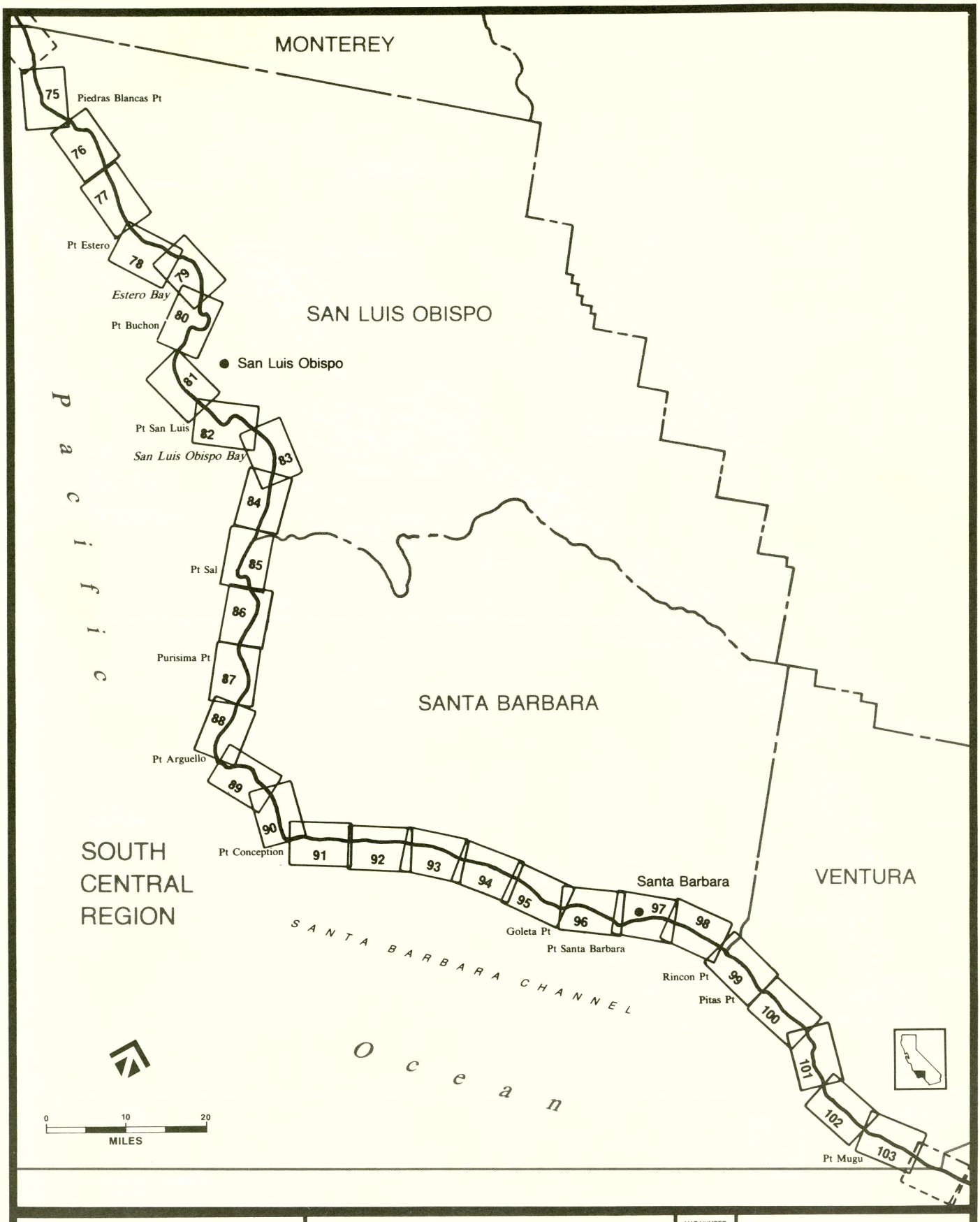
STATE OF CALIFORNIA — THE RESOURCES AGENCY

DEPARTMENT OF NAVIGATION & OCEAN DEVELOPMENT

A–13

DNOD

1977



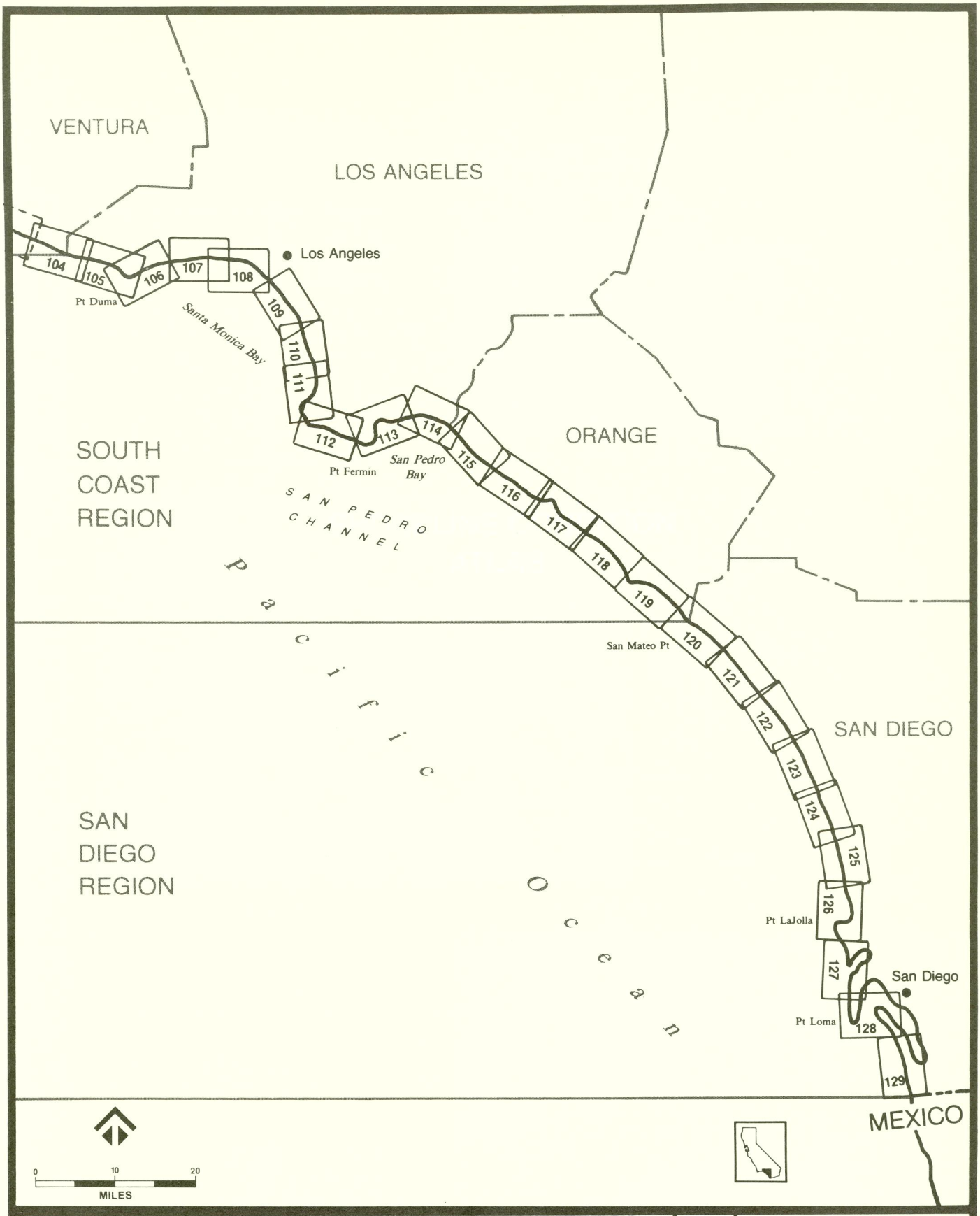
MAP INDEX

MAP NUMBER 4

STATE OF CALIFORNIA THE RESOURCES AGENCY

DEPARTMENT OF NAVIGATION & OCEAN DEVELOPMENT

1977



MAP INDEX

MAP NUMBER 5

STATE OF CALIFORNIA THE RESOURCES AGENCY

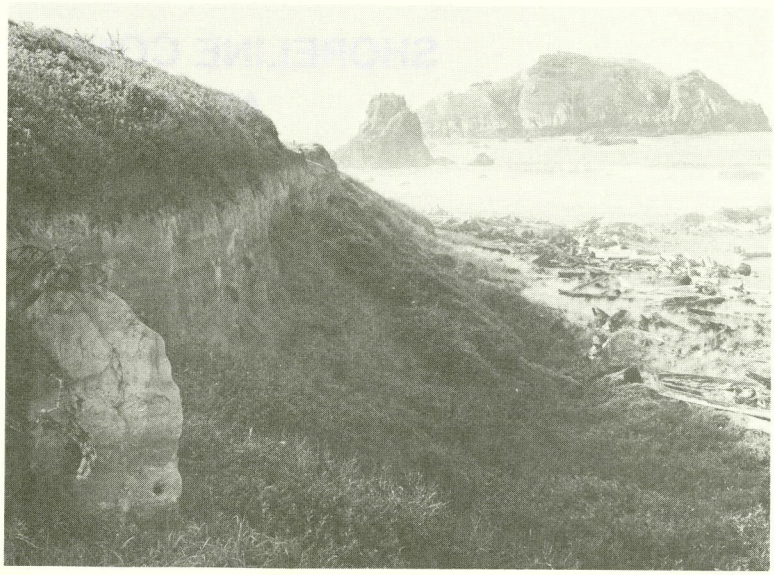
DEPARTMENT OF NAVIGATION & OCEAN DEVELOPMENT

1977

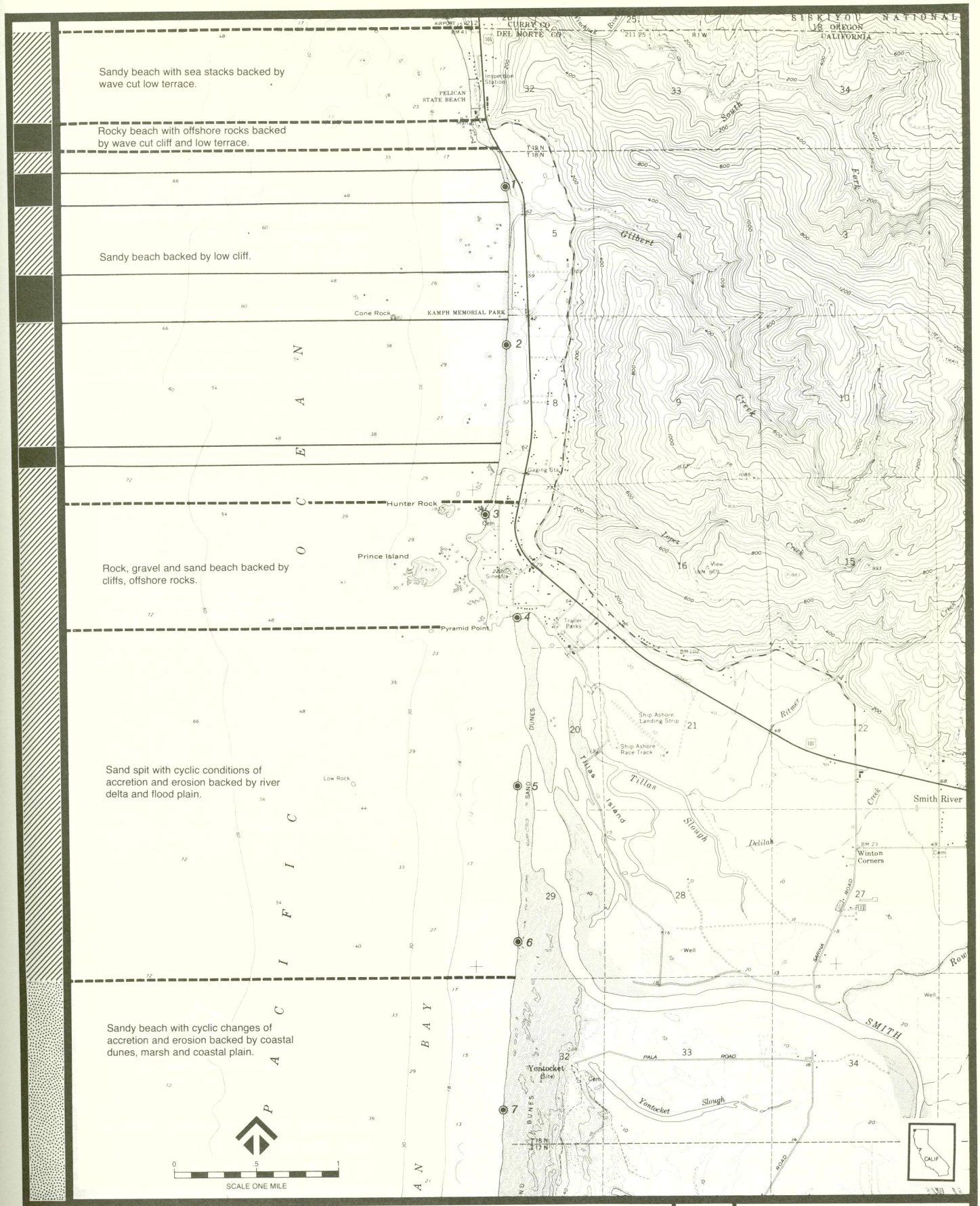
SHORELINE CONDITION ATLAS

Kamph County Memorial Park Beach
Del Norte Mi. 1.8
9/28/76 Tide +3.3

Hunter Rock Beach
Del Norte Mi. 3.0
9/28/76 Tide +3.45



Smith River Mouth
Del Norte Mi. 3.8
9/28/76 Tide +4.2



▪ SHORELINE CONDITION ▪

- PRESENT DEVELOPMENT CRITICAL
- PRESENT DEVELOPMENT NON-CRITICAL
- FUTURE DEVELOPMENT CRITICAL
- ARTIFICIAL PROTECTION
- PROTECTIVE BEACH
- STABLE ROCK

DEL NORTE CO. — MI. 0 - 7

MAP NUMBER **1**

STATE OF CALIFORNIA — THE RESOURCES AGENCY

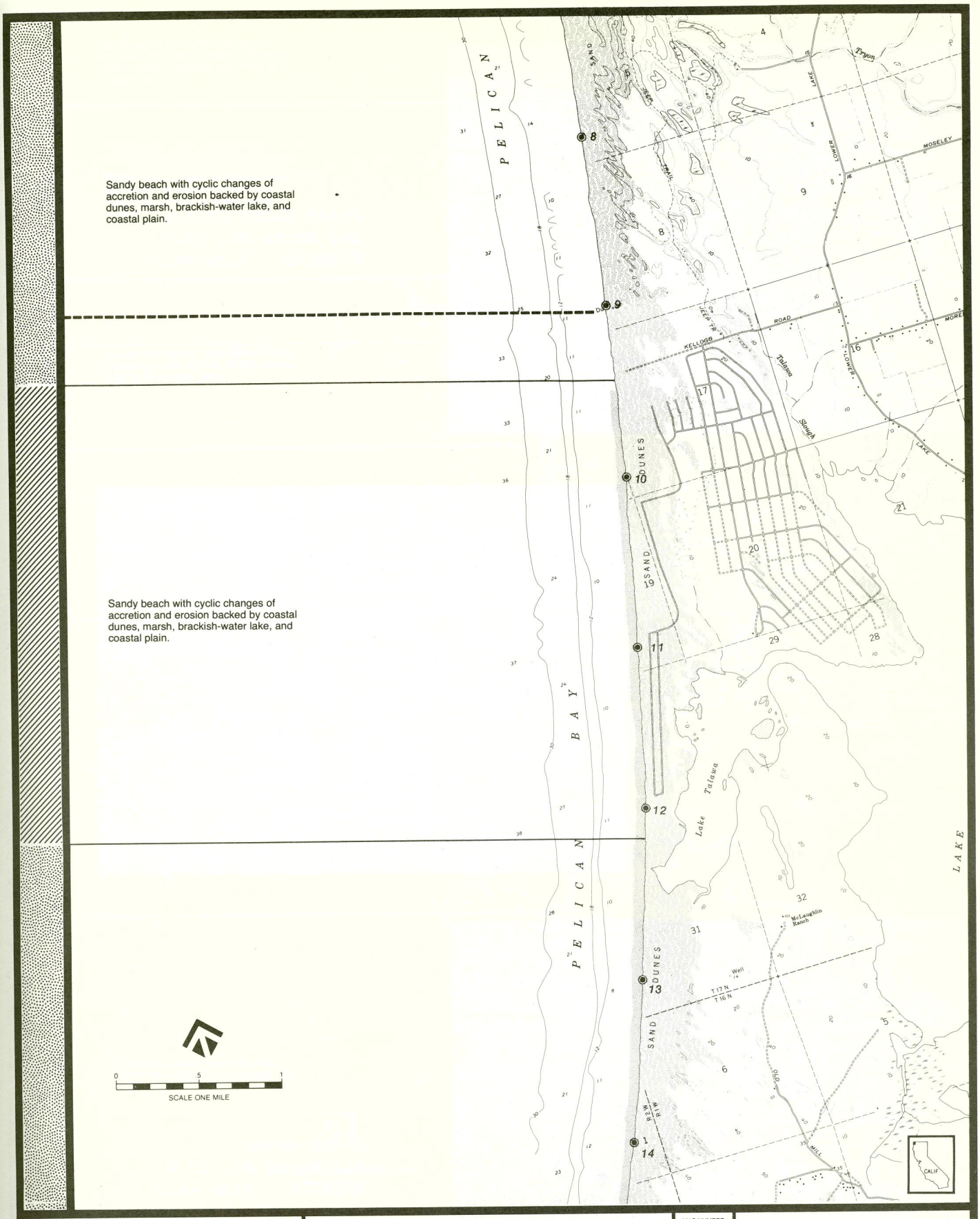
DEPARTMENT OF NAVIGATION & OCEAN DEVELOPMENT

DNOD

1977

Kellogg Road County Beach
Del Norte Mi. 9.4
7/15/75 Tide +3.7

Kellogg Road County Beach
Del Norte Mi. 9.4
7/15/75 Tide +3.7



▪ SHORELINE CONDITION ▪

- PRESENT DEVELOPMENT CRITICAL
- PRESENT DEVELOPMENT NON-CRITICAL
- FUTURE DEVELOPMENT CRITICAL
- ARTIFICIAL PROTECTION
- PROTECTIVE BEACH
- STABLE ROCK

DEL NORTE CO. — MI. 8-14

MAP NUMBER **2**

STATE OF CALIFORNIA — THE RESOURCES AGENCY

DEPARTMENT OF NAVIGATION & OCEAN DEVELOPMENT

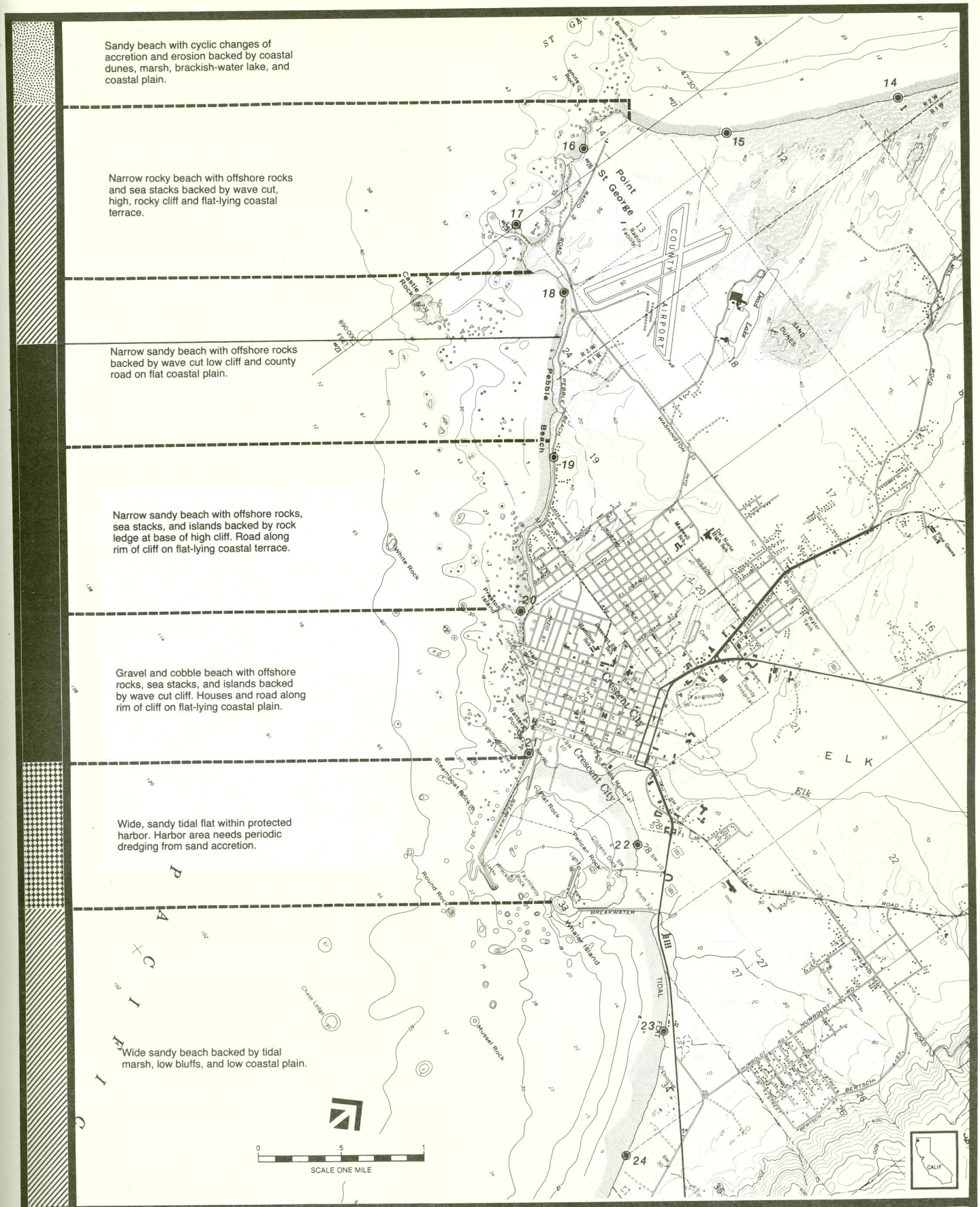
DNOD

1977

Point Saint George
Del Norte Mi. 15.7
9/28/76 Tide +6.3

Pebble Beach
Del Norte Mi. 18.9
9/28/76 Tide +6.8

South Beach
Del Norte Mi. 22.4
9/29/76 Tide +6.4



▪ SHORELINE CONDITION ▪

- PRESENT DEVELOPMENT CRITICAL
- PRESENT DEVELOPMENT NON-CRITICAL
- FUTURE DEVELOPMENT CRITICAL
- ARTIFICIAL PROTECTION
- PROTECTIVE BEACH
- STABLE ROCK

DEL NORTE CO. — MI. 14-24

MAP NUMBER **3**

STATE OF CALIFORNIA — THE RESOURCES AGENCY

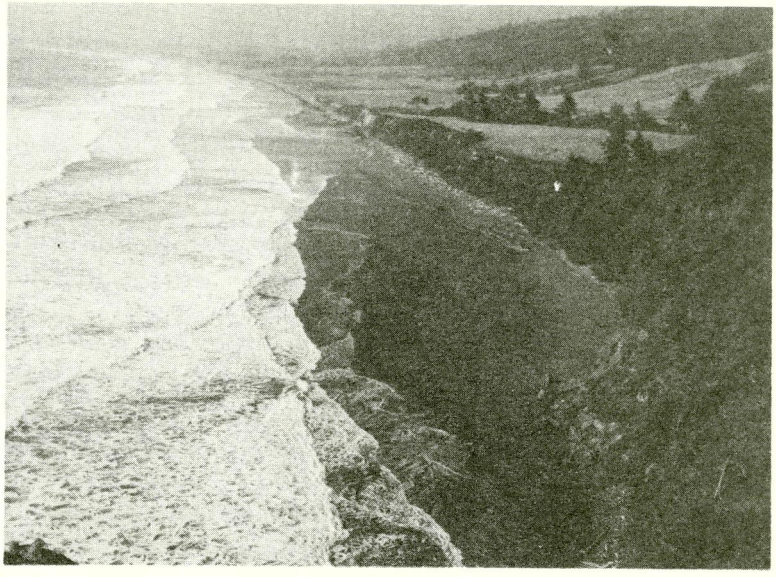
DEPARTMENT OF NAVIGATION & OCEAN DEVELOPMENT

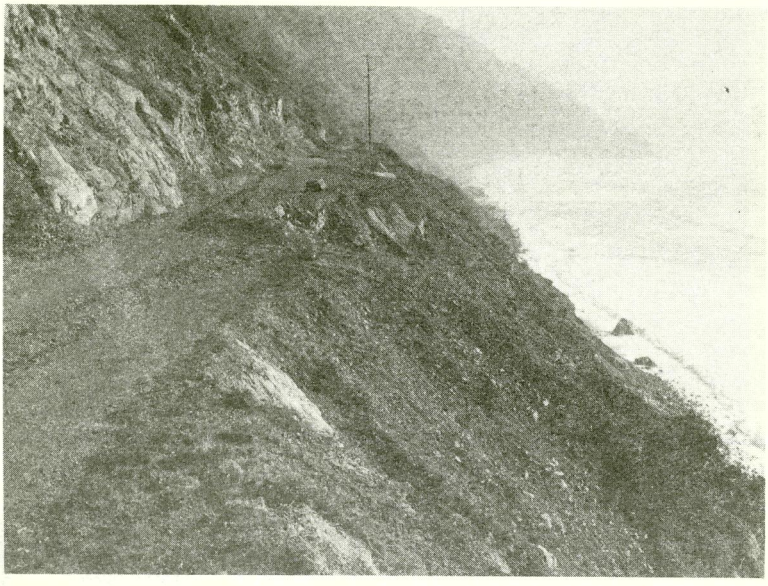
DNOD

1977

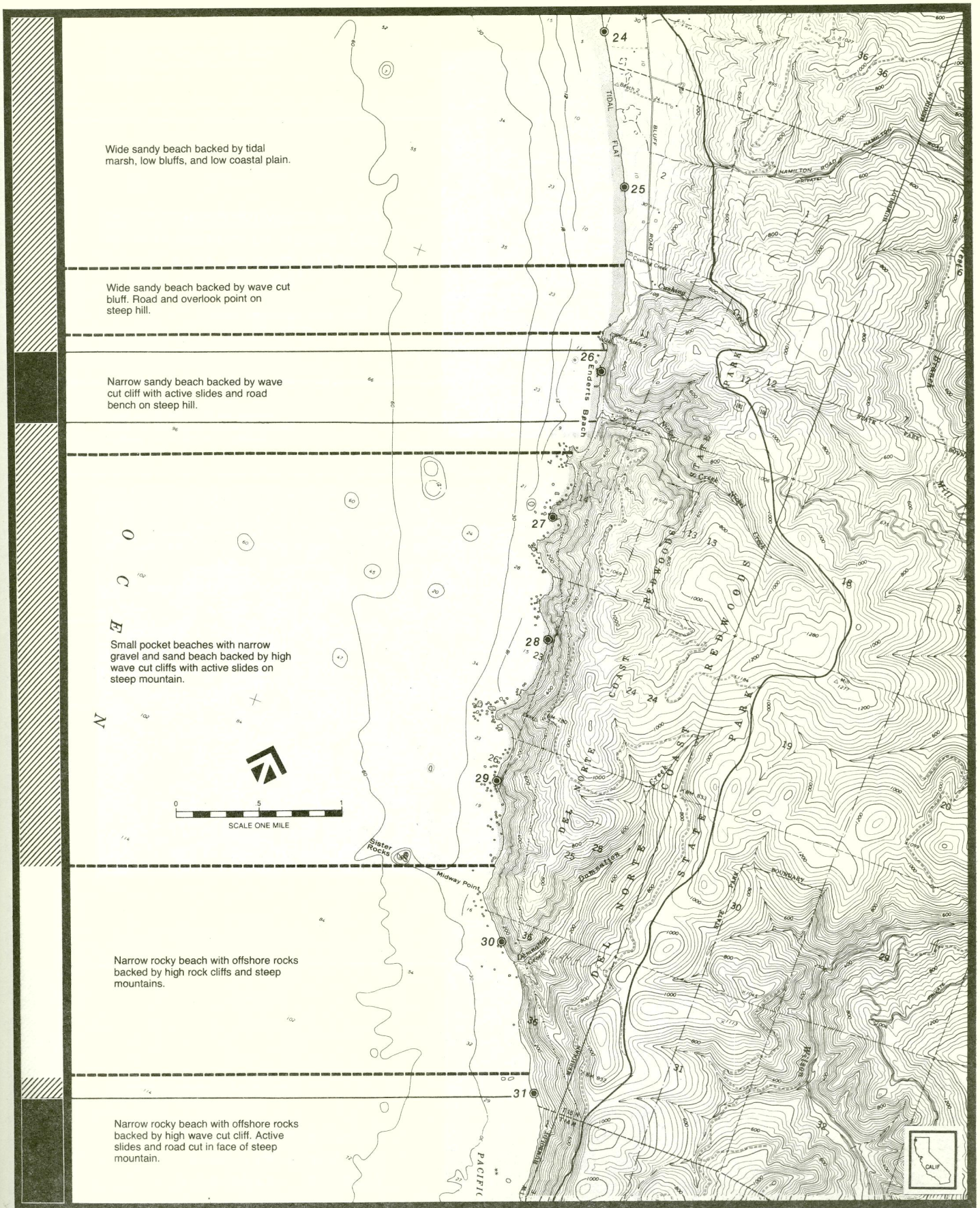
Crescent Beach,
South Beach
Del Norte Mi. 24.0
7/16/75 Tide +1.9

Crescent Beach,
South Beach
Del Norte Mi. 25.7
9/29/76 Tide +6.5





Enderts Beach
Del Norte Mi. 25.9
9/29/76 Tide +6.5



▪ SHORELINE CONDITION ▪

PRESENT DEVELOPMENT CRITICAL	ARTIFICIAL PROTECTION
PRESENT DEVELOPMENT NON-CRITICAL	PROTECTIVE BEACH
FUTURE DEVELOPMENT CRITICAL	STABLE ROCK

DEL NORTE CO. — MI. 24-31

MAP NUMBER **4**

STATE OF CALIFORNIA — THE RESOURCES AGENCY

DEPARTMENT OF NAVIGATION & OCEAN DEVELOPMENT

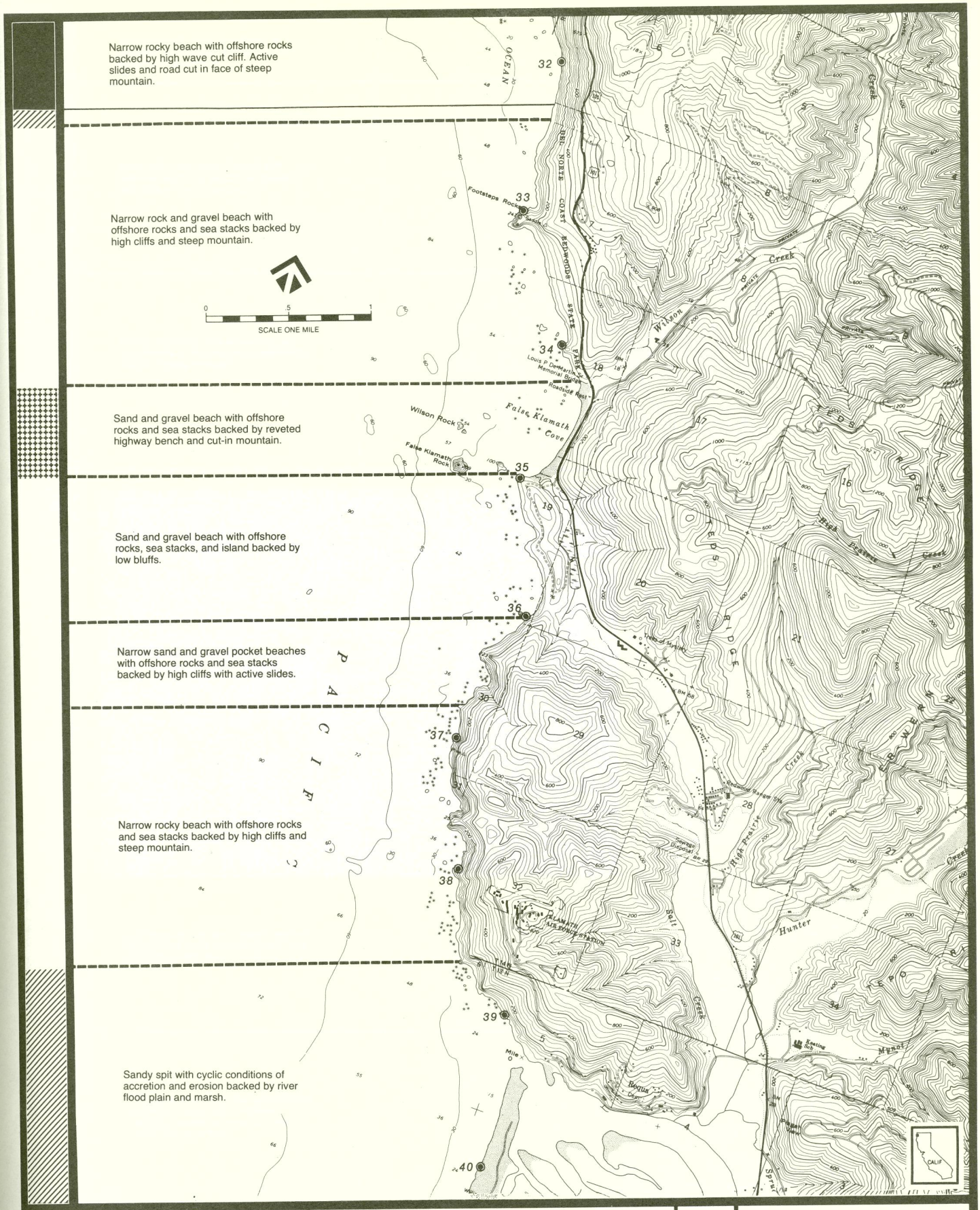
DNOD

1977

False Klamath Cove
Del Norte Mi. 35.2
9/30/76 Tide +5.2

False Klamath Rock
Del Norte Mi. 35.3
7/16/75 Tide +2.3

Klamath River Mouth
Del Norte Mi. 38.8
7/16/75 Tide +3.0



• SHORELINE CONDITION •

- PRESENT DEVELOPMENT CRITICAL
- PRESENT DEVELOPMENT NON-CRITICAL
- FUTURE DEVELOPMENT CRITICAL
- ARTIFICIAL PROTECTION
- PROTECTIVE BEACH
- STABLE ROCK

DEL NORTE CO. — MI. 32 - 40

MAP NUMBER **5**

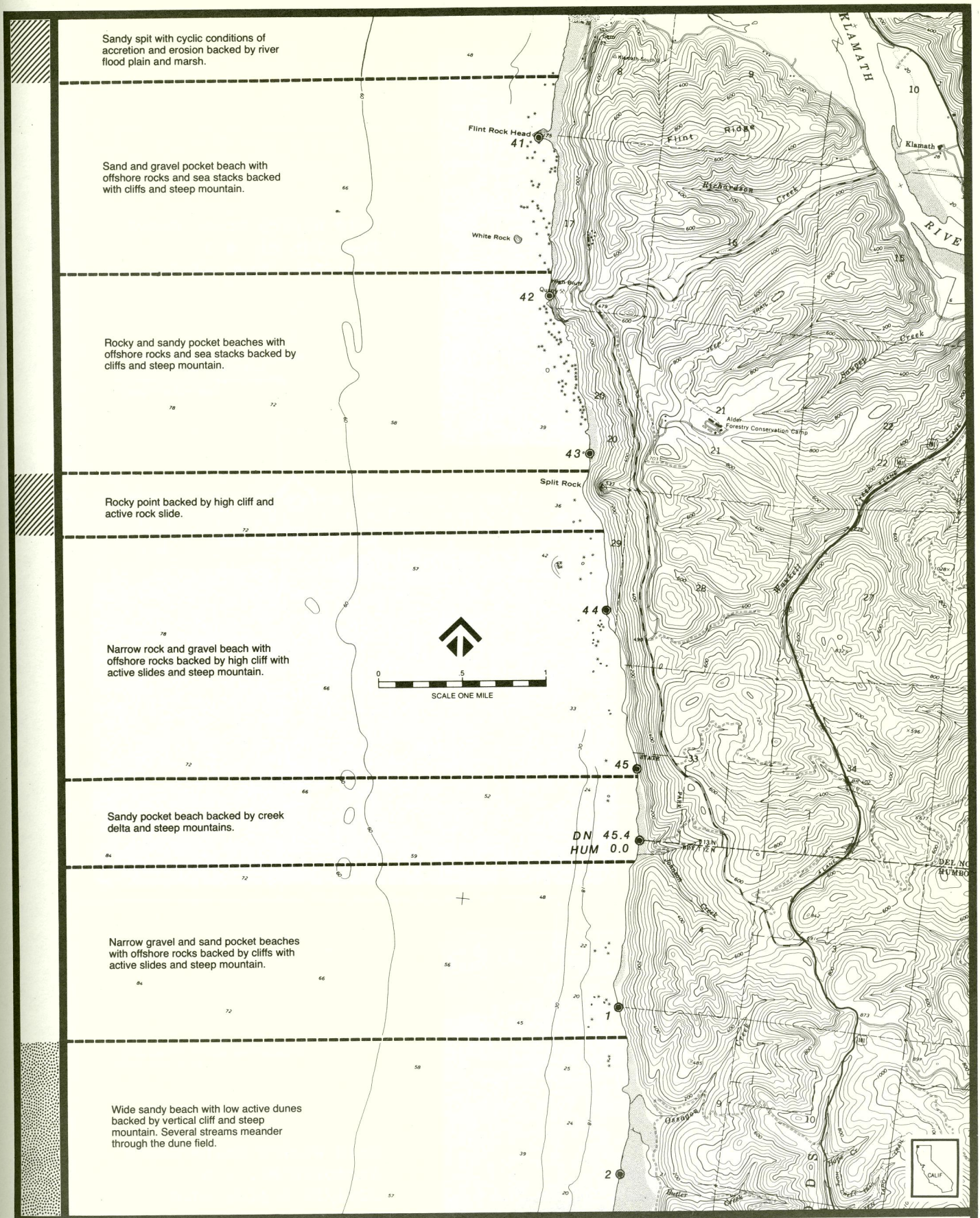
STATE OF CALIFORNIA — THE RESOURCES AGENCY

DEPARTMENT OF NAVIGATION & OCEAN DEVELOPMENT

DNOD

1977

White Rock Beach
Del Norte Mi. 41.3
7/16/75 Tide +4.0



▪ SHORELINE CONDITION ▪

- PRESENT DEVELOPMENT CRITICAL
- PRESENT DEVELOPMENT NON-CRITICAL
- FUTURE DEVELOPMENT CRITICAL
- ARTIFICIAL PROTECTION
- PROTECTIVE BEACH
- STABLE ROCK

DEL NORTE CO. — MI. 41 - 45.4
HUMBOLDT CO. — MI. 0 - 2

MAP NUMBER **6**

STATE OF CALIFORNIA — THE RESOURCES AGENCY

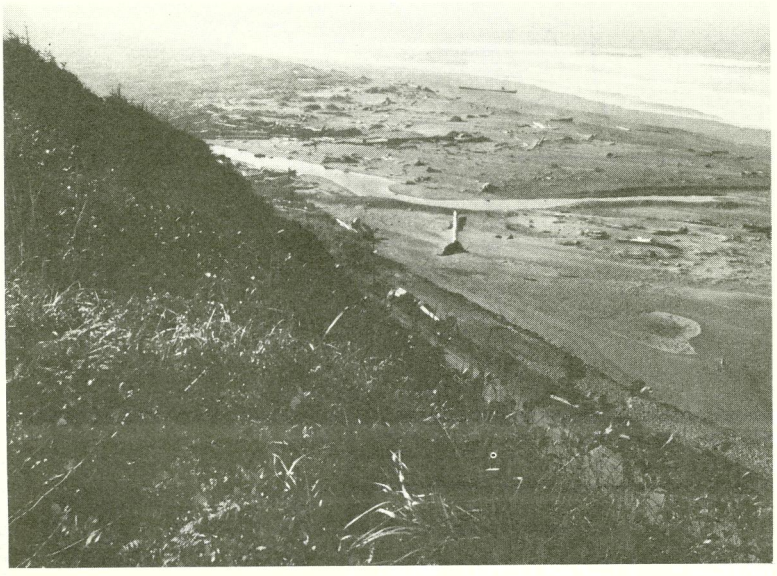
DEPARTMENT OF NAVIGATION & OCEAN DEVELOPMENT

DNOD

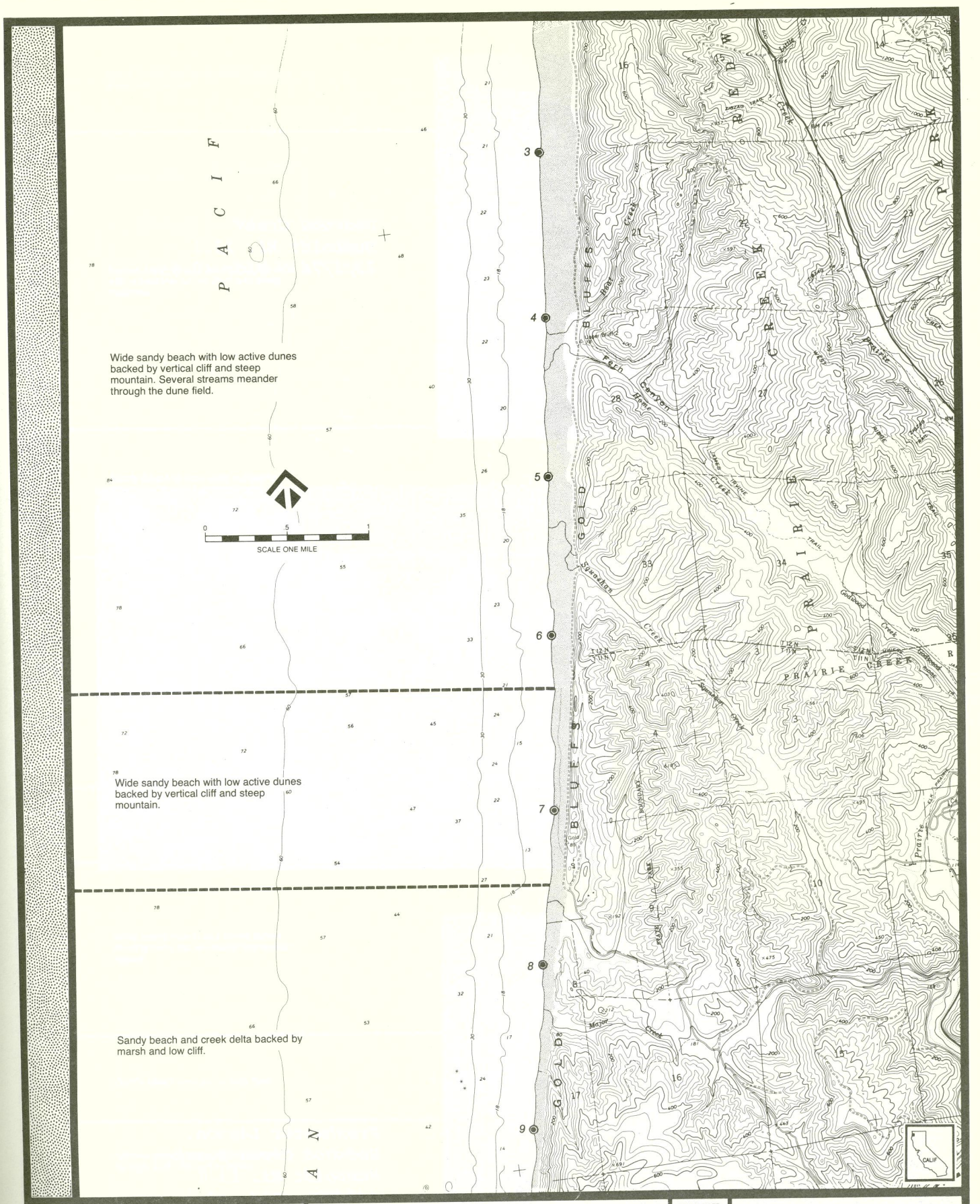
1977

Gold Bluffs State Beach
Humboldt Mi. 4.5
12/1/76 Tide +5.0

Gold Bluffs State Beach
Humboldt Mi. 5.9
12/1/76 Tide +4.4



Gold Bluffs State Beach
Humboldt Mi. 7.5
12/1/76 Tide +4.0



▪ SHORELINE CONDITION ▪

- PRESENT DEVELOPMENT CRITICAL
- PRESENT DEVELOPMENT NON-CRITICAL
- FUTURE DEVELOPMENT CRITICAL
- ARTIFICIAL PROTECTION
- PROTECTIVE BEACH
- STABLE ROCK

HUMBOLDT CO. — MI. 3-9

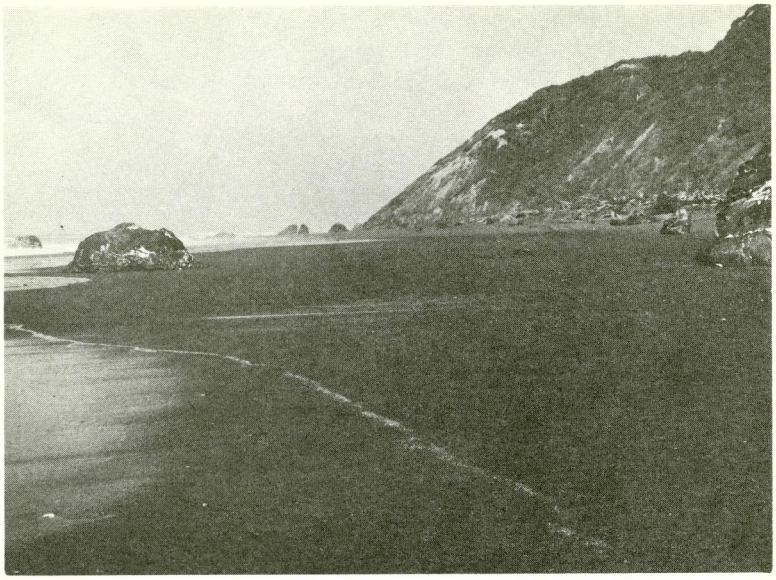
MAP NUMBER **7**

STATE OF CALIFORNIA — THE RESOURCES AGENCY

DEPARTMENT OF NAVIGATION & OCEAN DEVELOPMENT

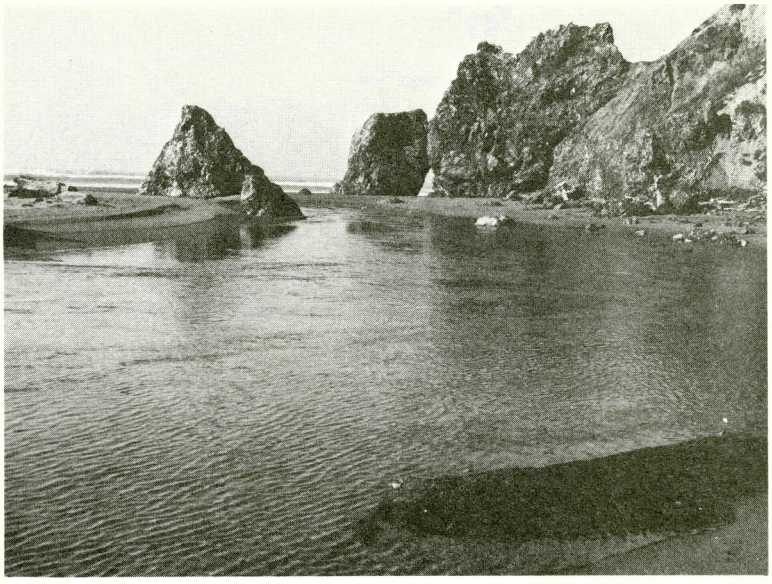
DNOD

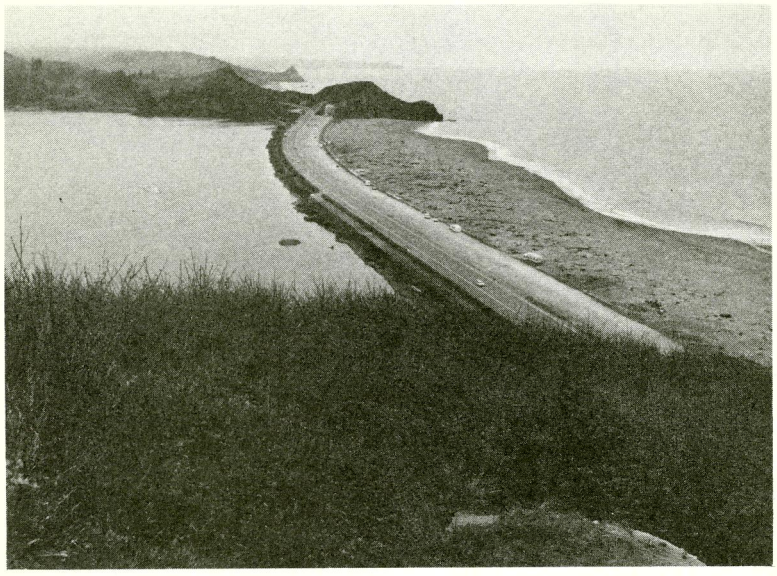
1977



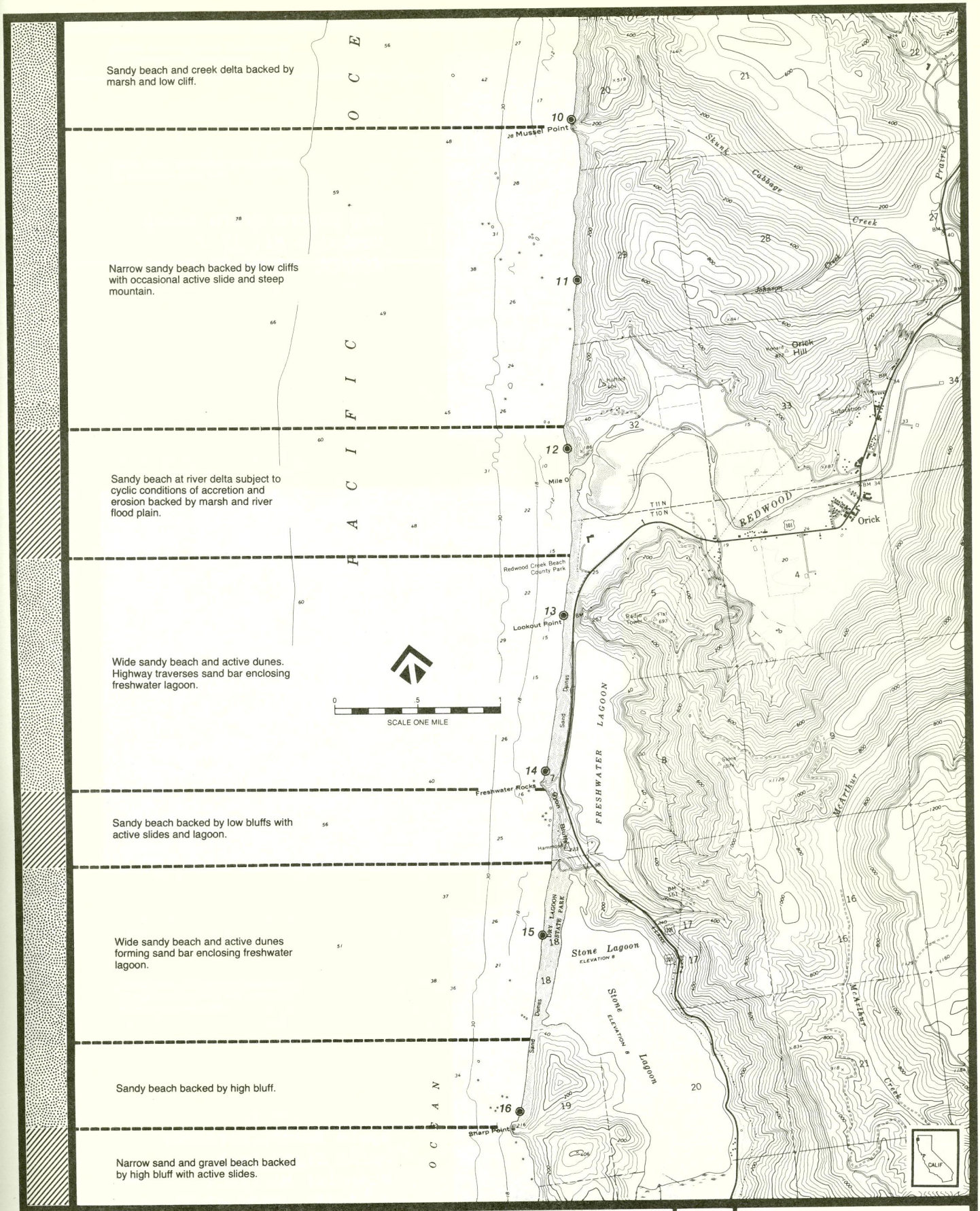
Redwood Creek
Humboldt Mi. 12.1
12/1/76 Tide +2.6

Redwood Creek
Humboldt Mi. 12.1
12/1/76 Tide +2.3





Freshwater Lagoon,
Redwood Creek Beach
Humboldt Mi. 13.0
4/5/77 Tide +5.1



▪ SHORELINE CONDITION ▪

- PRESENT DEVELOPMENT CRITICAL
- PRESENT DEVELOPMENT NON-CRITICAL
- FUTURE DEVELOPMENT CRITICAL
- ARTIFICIAL PROTECTION
- PROTECTIVE BEACH
- STABLE ROCK

HUMBOLDT CO. — MI. 10-16

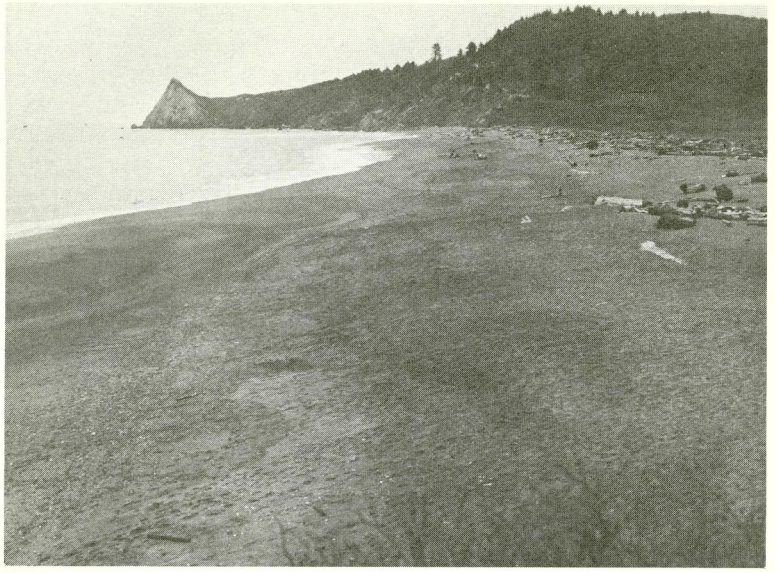
MAP NUMBER **8**

STATE OF CALIFORNIA — THE RESOURCES AGENCY

DEPARTMENT OF NAVIGATION & OCEAN DEVELOPMENT

DNOD

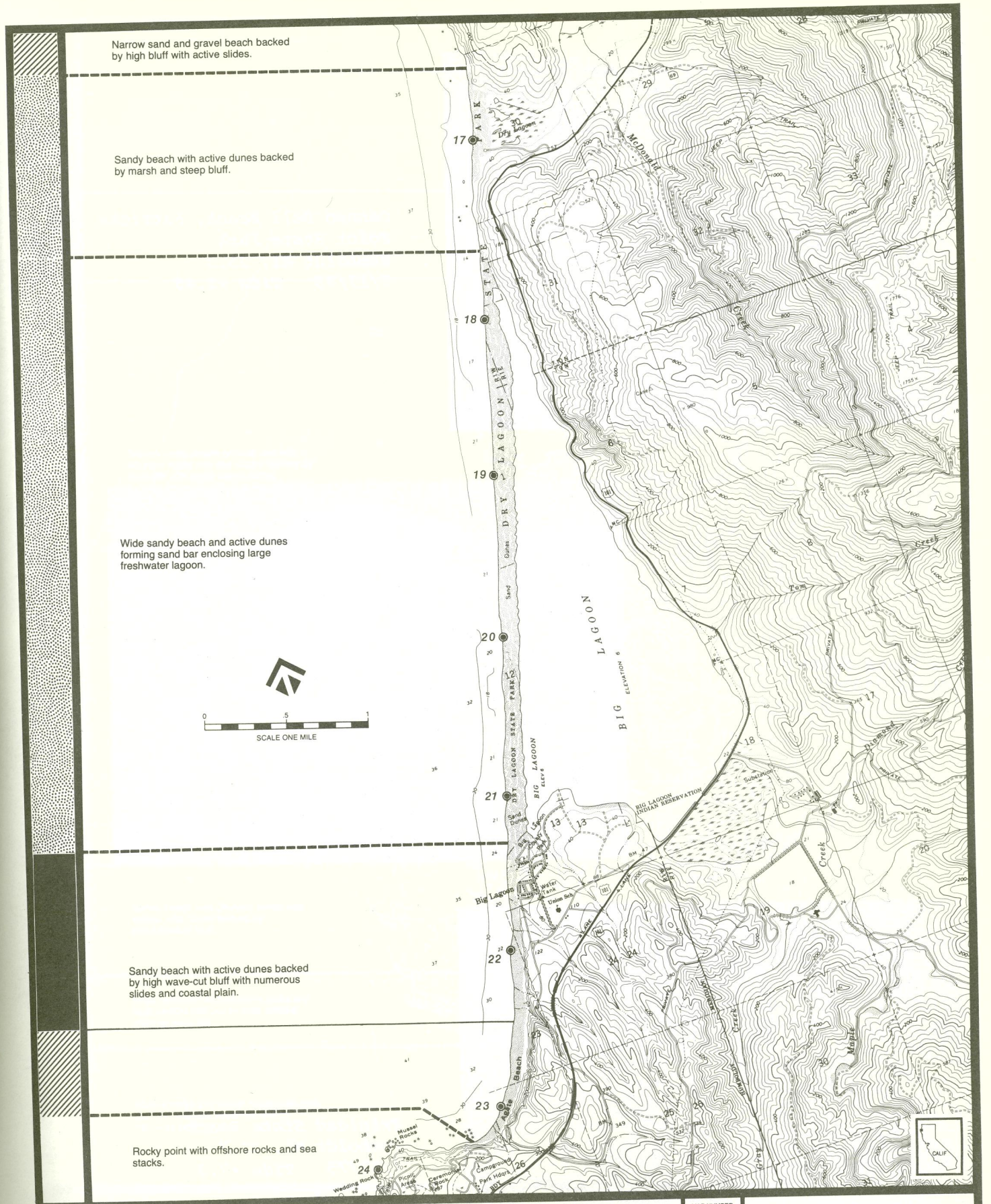
1977



Dry Lagoon State Beach
Humboldt Mi. 17.2
4/5/76 Tide +3.2

Big Lagoon Village
Humboldt Mi. 21.6
7/17/75 Tide +2.95

Agate Beach, Patricks Point State Park
Humboldt Mi. 23.2
7/17/75 Tide +2.55



▪ SHORELINE CONDITION ▪

- PRESENT DEVELOPMENT CRITICAL
- PRESENT DEVELOPMENT NON-CRITICAL
- FUTURE DEVELOPMENT CRITICAL
- ARTIFICIAL PROTECTION
- PROTECTIVE BEACH
- STABLE ROCK

HUMBOLDT CO. — MI. 17-24

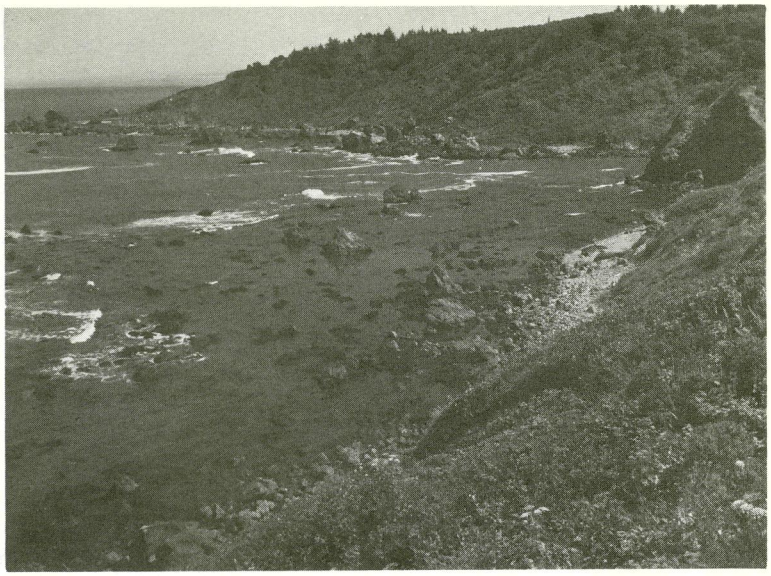
MAP NUMBER **9**

STATE OF CALIFORNIA — THE RESOURCES AGENCY

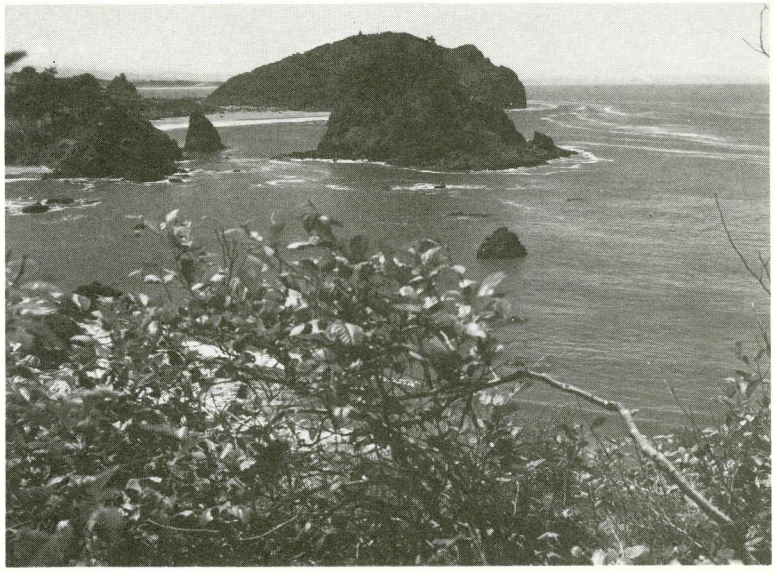
DEPARTMENT OF NAVIGATION & OCEAN DEVELOPMENT

DNOD

1977

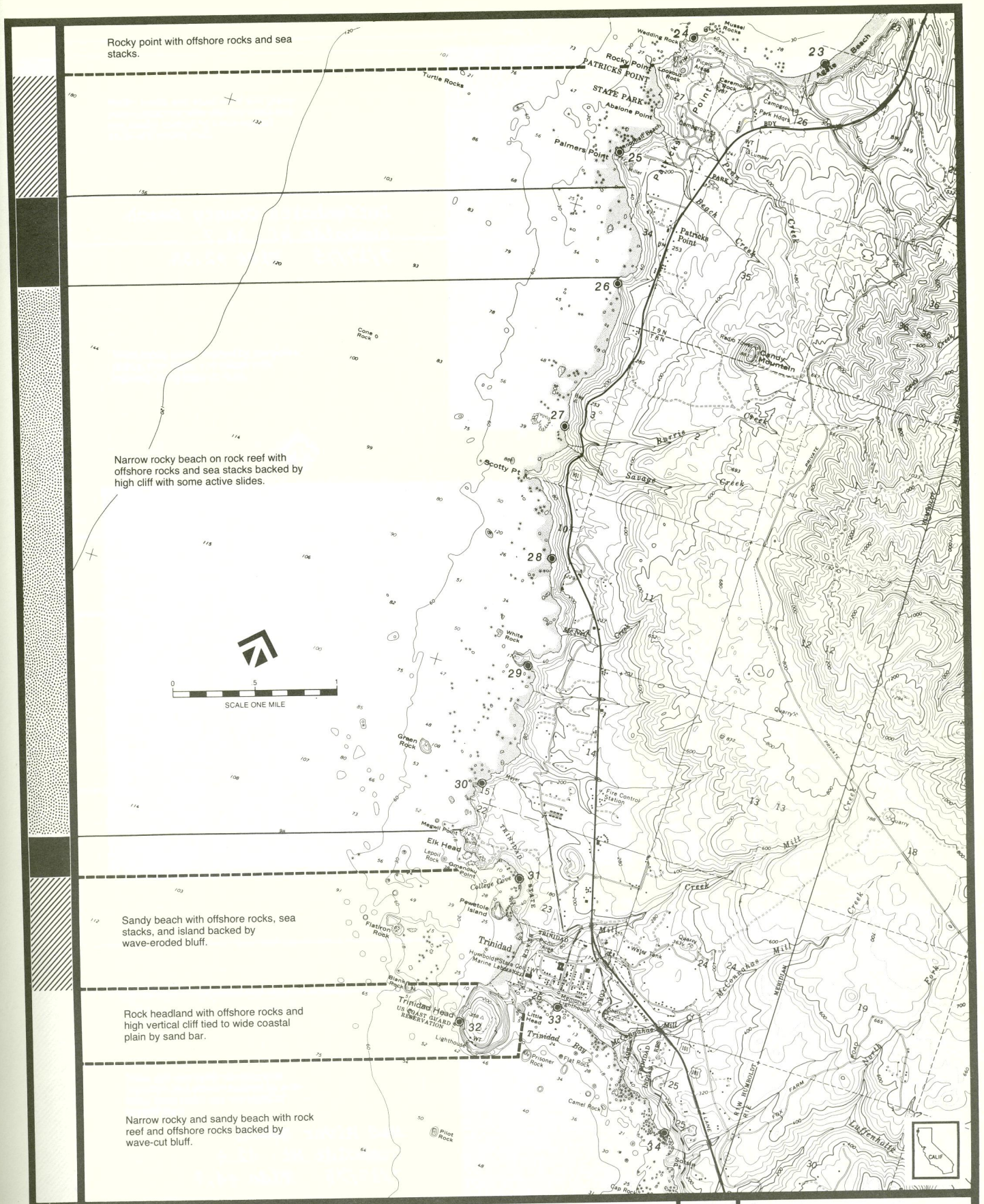


Cannon Ball Beach, Patricks Point State Park
Humboldt Mi. 25.0
7/17/75 Tide +2.45



Trinidad State Beach
Humboldt Mi. 30.6
7/17/75 Tide +2.3

Trinidad State Beach
Humboldt Mi. 31.7
7/17/75 Tide +2.3



▪ SHORELINE CONDITION ▪

- PRESENT DEVELOPMENT CRITICAL
- PRESENT DEVELOPMENT NON-CRITICAL
- FUTURE DEVELOPMENT CRITICAL
- ARTIFICIAL PROTECTION
- PROTECTIVE BEACH
- STABLE ROCK

HUMBOLDT CO. — MI. 23 - 34

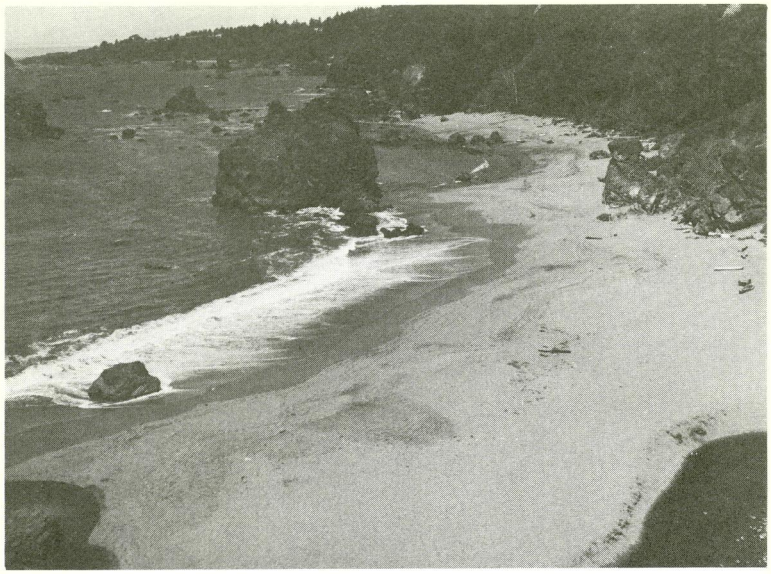
MAP NUMBER **10**

STATE OF CALIFORNIA — THE RESOURCES AGENCY

DEPARTMENT OF NAVIGATION & OCEAN DEVELOPMENT

DNOD

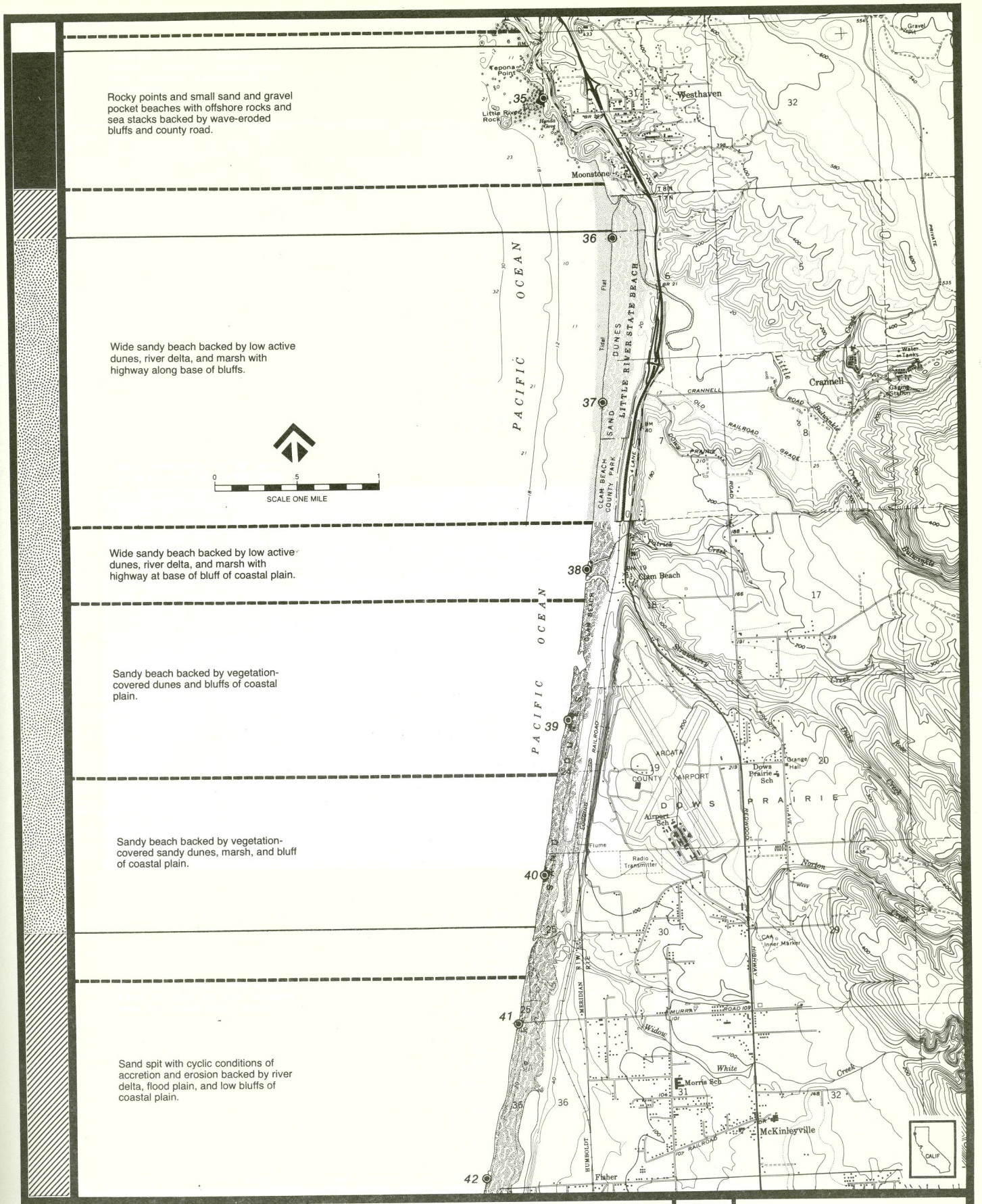
1977



Luffenholtz County Beach
Humboldt Mi. 34.7
7/17/75 Tide +2.55

Little River State Beach
Humboldt Mi. 37.5
7/17/75 Tide +2.8

Mad River Beach
Humboldt Mi. 42.6
7/17/75 Tide +4.9



▪ SHORELINE CONDITION ▪

- PRESENT DEVELOPMENT CRITICAL
- PRESENT DEVELOPMENT NON-CRITICAL
- FUTURE DEVELOPMENT CRITICAL
- ARTIFICIAL PROTECTION
- PROTECTIVE BEACH
- STABLE ROCK

HUMBOLDT CO. — MI. 35-42

MAP NUMBER **11**

STATE OF CALIFORNIA — THE RESOURCES AGENCY

DEPARTMENT OF NAVIGATION & OCEAN DEVELOPMENT

DNOD

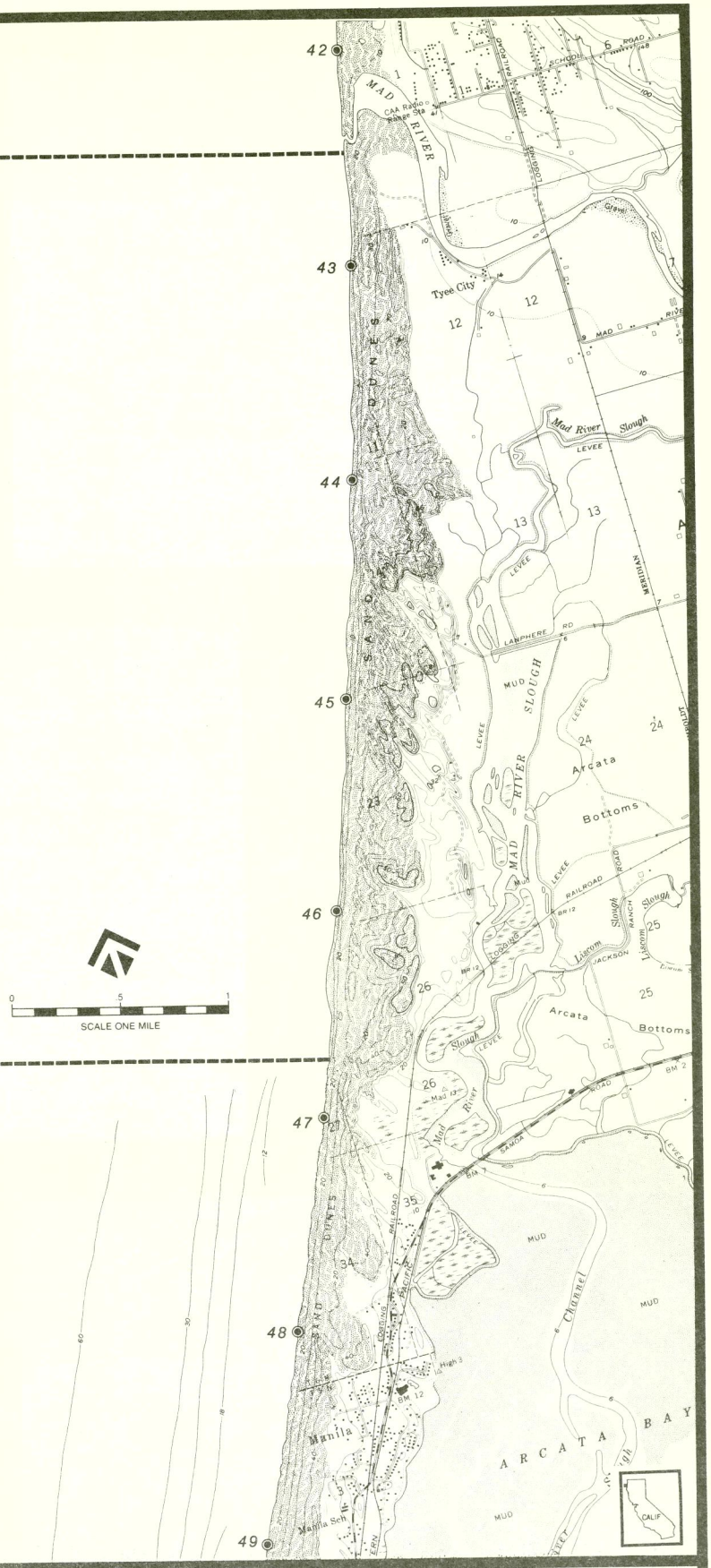
1977

Mad River Beach
Humboldt Mi. 42.6
7/17/75 Tide +4.9

Sand spit with cyclic conditions of accretion and erosion backed by river delta, flood plain, and low bluffs of coastal plain.

Sandy beach backed by high active dunes and marsh of river flood plain.

Sandy beach backed by high active dunes with marsh and some vegetation cover on landward edge of dunes.



SCALE ONE MILE

SHORELINE CONDITION

- PRESENT DEVELOPMENT CRITICAL
- PRESENT DEVELOPMENT NON-CRITICAL
- FUTURE DEVELOPMENT CRITICAL
- ARTIFICIAL PROTECTION
- PROTECTIVE BEACH
- STABLE ROCK

HUMBOLDT CO. — MI. 42 - 49

MAP NUMBER **12**

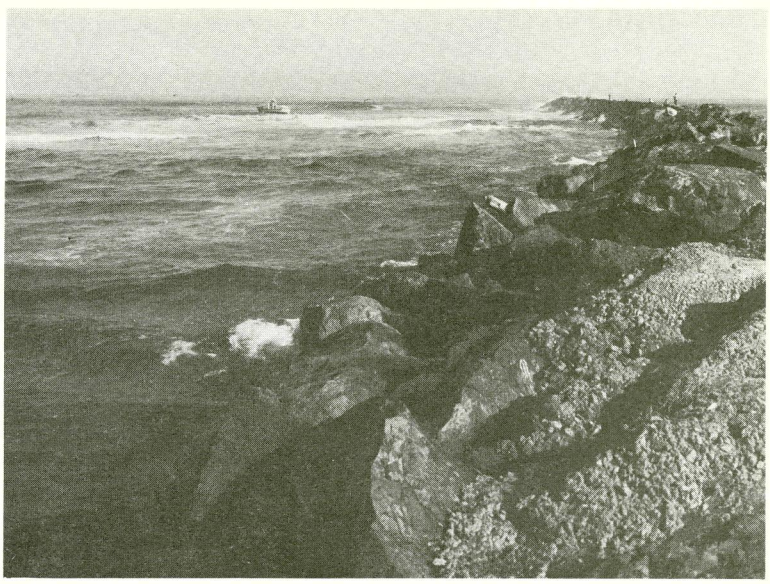
STATE OF CALIFORNIA — THE RESOURCES AGENCY

DEPARTMENT OF NAVIGATION & OCEAN DEVELOPMENT

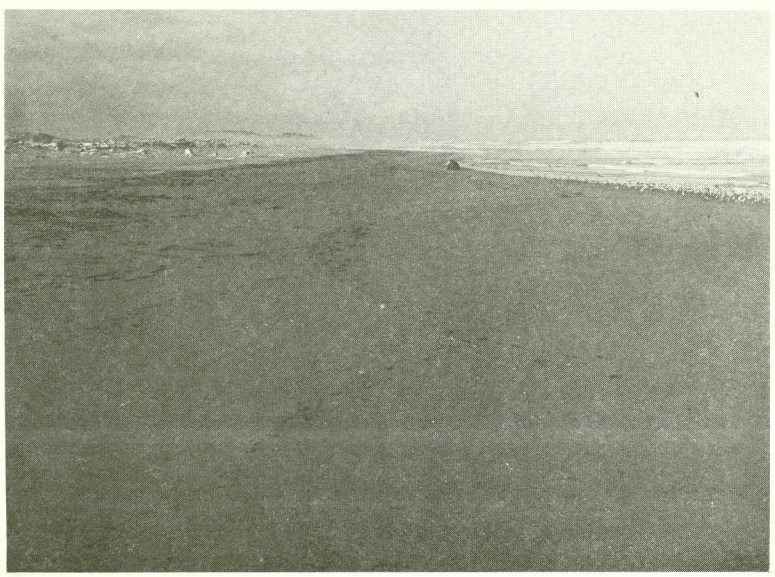
DNOD

1977

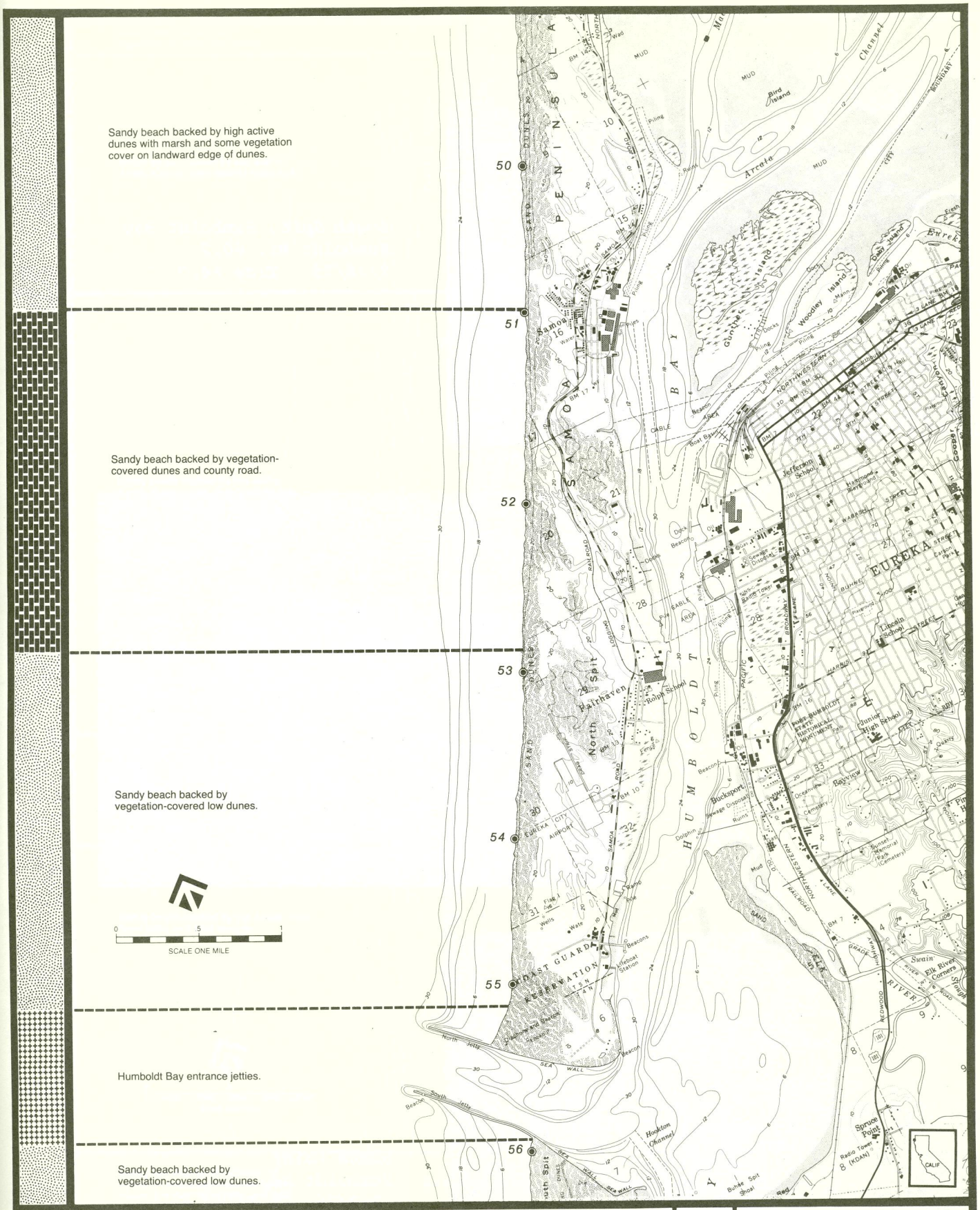
Humboldt Bay South Jetty
Humboldt Mi. 55.8
7/18/75 Tide +3.8



Humboldt Bay South Jetty
Humboldt Mi. 55.8
7/18/75 Tide +3.8



South Spit Beach
Humboldt Mi. 55.8
7/18/75 Tide +3.8



▪ SHORELINE CONDITION ▪

- PRESENT DEVELOPMENT CRITICAL
- PRESENT DEVELOPMENT NON-CRITICAL
- FUTURE DEVELOPMENT CRITICAL
- ARTIFICIAL PROTECTION
- PROTECTIVE BEACH
- STABLE ROCK

HUMBOLDT CO. — MI. 50-56

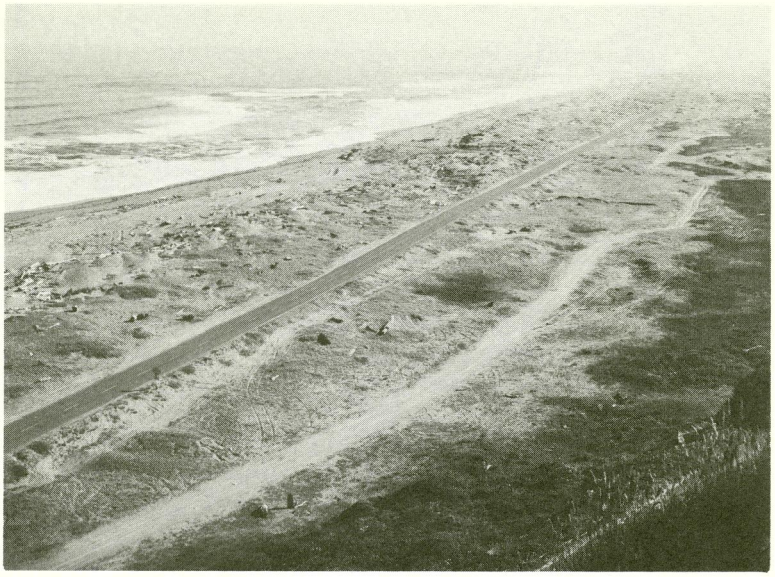
MAP NUMBER **13**

STATE OF CALIFORNIA — THE RESOURCES AGENCY

DEPARTMENT OF NAVIGATION & OCEAN DEVELOPMENT

DNOD

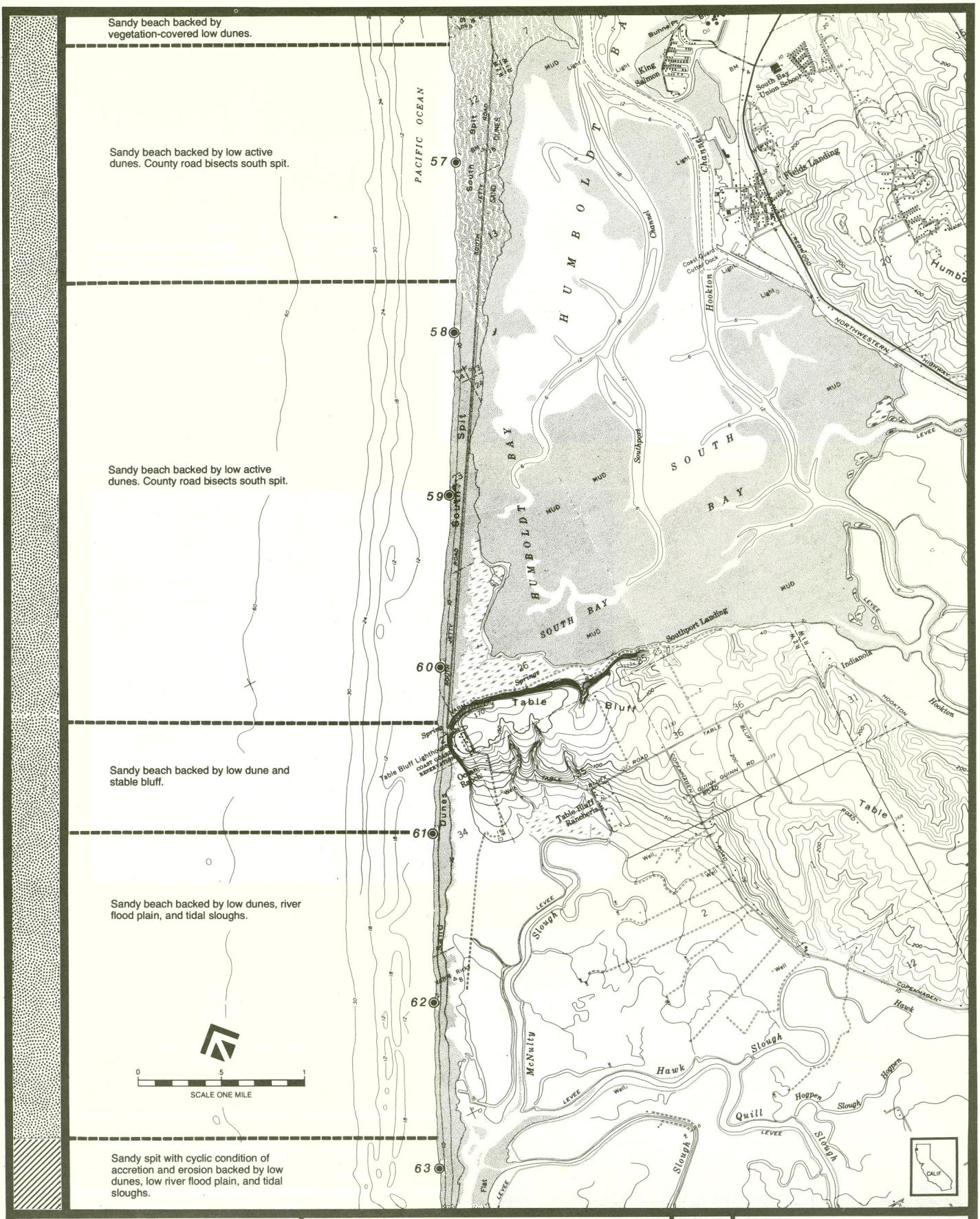
1977



South Spit, Humboldt Bay
Humboldt Mi. 60.2
7/18/75 Tide +4.0

Humboldt Bay
Humboldt Mi. 60.2
7/18/75 Tide +3.6

Buhne Point
Humboldt Bay
12/3/76 Tide +0.4



▪ SHORELINE CONDITION ▪

- PRESENT DEVELOPMENT CRITICAL
- PRESENT DEVELOPMENT NON-CRITICAL
- FUTURE DEVELOPMENT CRITICAL
- ARTIFICIAL PROTECTION
- PROTECTIVE BEACH
- STABLE ROCK

HUMBOLDT CO. — MI. 57-63

MAP NUMBER **14**

STATE OF CALIFORNIA — THE RESOURCES AGENCY

DEPARTMENT OF NAVIGATION & OCEAN DEVELOPMENT

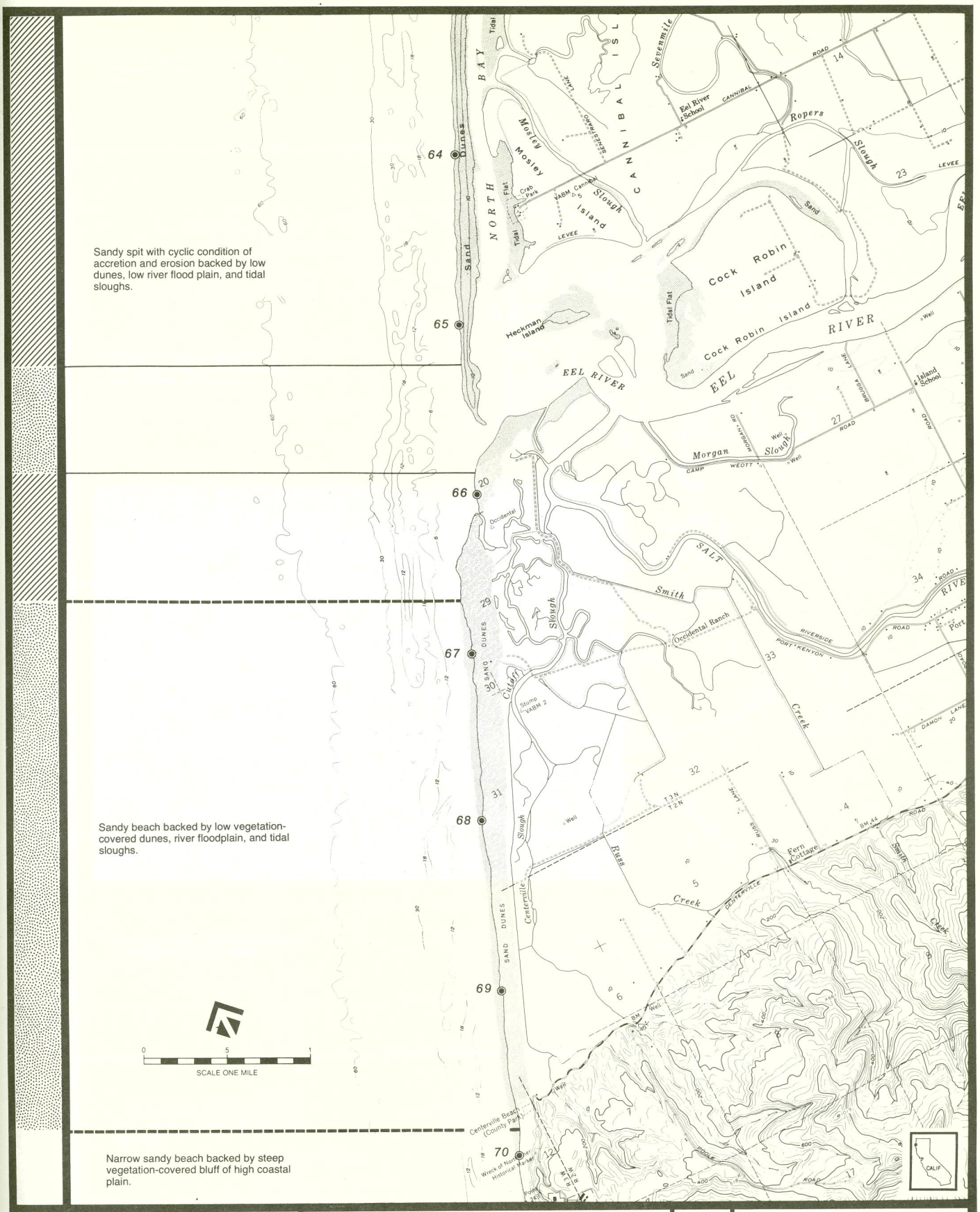
DNOD

1977

Centerville Beach
Humboldt Mi. 68.8
7/18/75 Tide +4.0

Centerville Beach
Humboldt Mi. 68.8
7/18/75 Tide +4.0

Centerville Beach
Humboldt Mi. 70.0
7/18/75 Tide +3.9



▪ SHORELINE CONDITION ▪

- PRESENT DEVELOPMENT CRITICAL
- PRESENT DEVELOPMENT NON-CRITICAL
- FUTURE DEVELOPMENT CRITICAL
- ARTIFICIAL PROTECTION
- PROTECTIVE BEACH
- STABLE ROCK

HUMBOLDT CO. — MI. 64-70

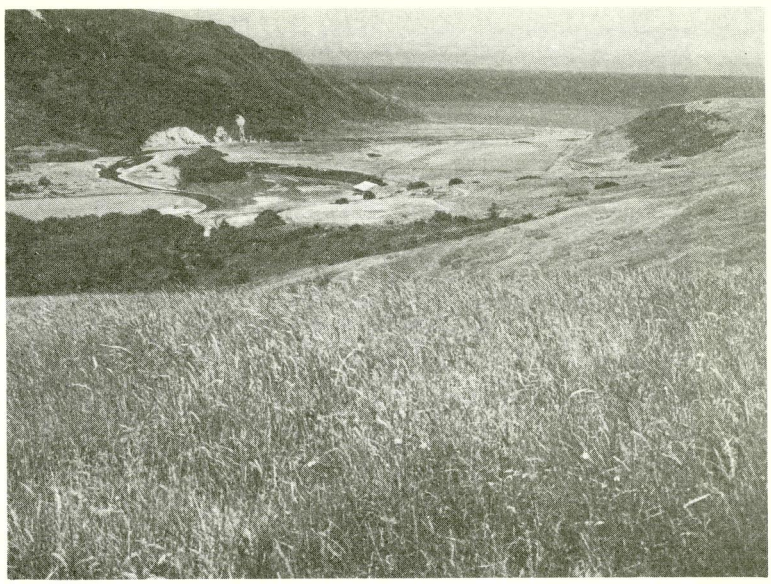
MAP NUMBER **15**

STATE OF CALIFORNIA — THE RESOURCES AGENCY

DEPARTMENT OF NAVIGATION & OCEAN DEVELOPMENT

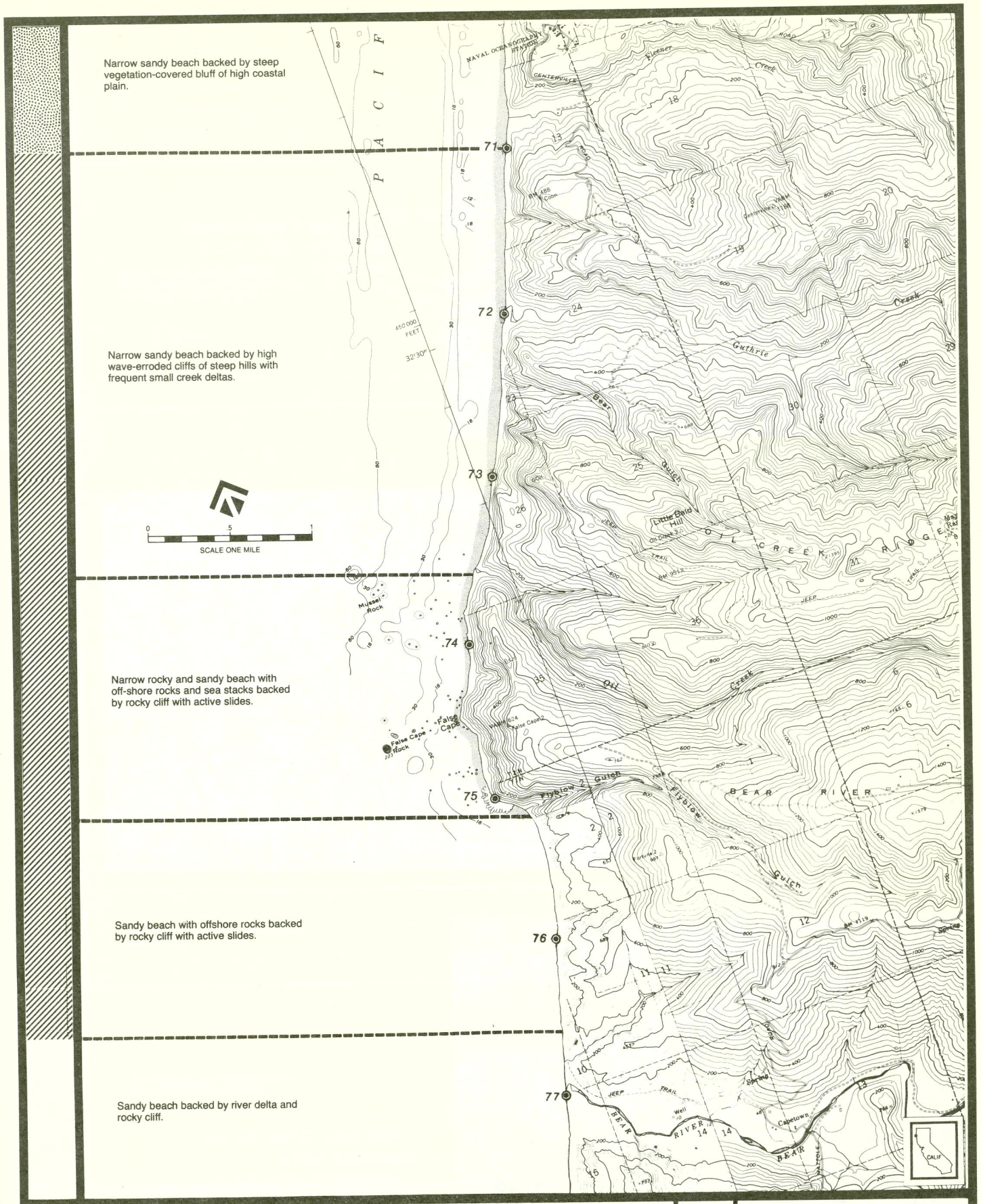
DNOD

1977



Bear Creek Beach
Humboldt Mi. 77.0
7/18/75 Tide +3.75

Cer
Hun
7/1



▪ SHORELINE CONDITION ▪

- PRESENT DEVELOPMENT CRITICAL
- PRESENT DEVELOPMENT NON-CRITICAL
- FUTURE DEVELOPMENT CRITICAL
- ARTIFICIAL PROTECTION
- PROTECTIVE BEACH
- STABLE ROCK

HUMBOLDT CO. — MI. 71 - 77

MAP NUMBER **16**

STATE OF CALIFORNIA — THE RESOURCES AGENCY

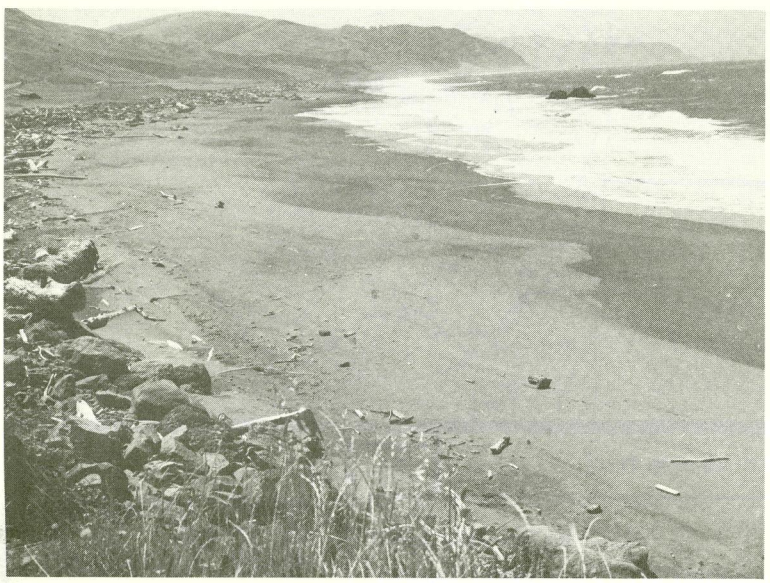
DEPARTMENT OF NAVIGATION & OCEAN DEVELOPMENT

DNOD

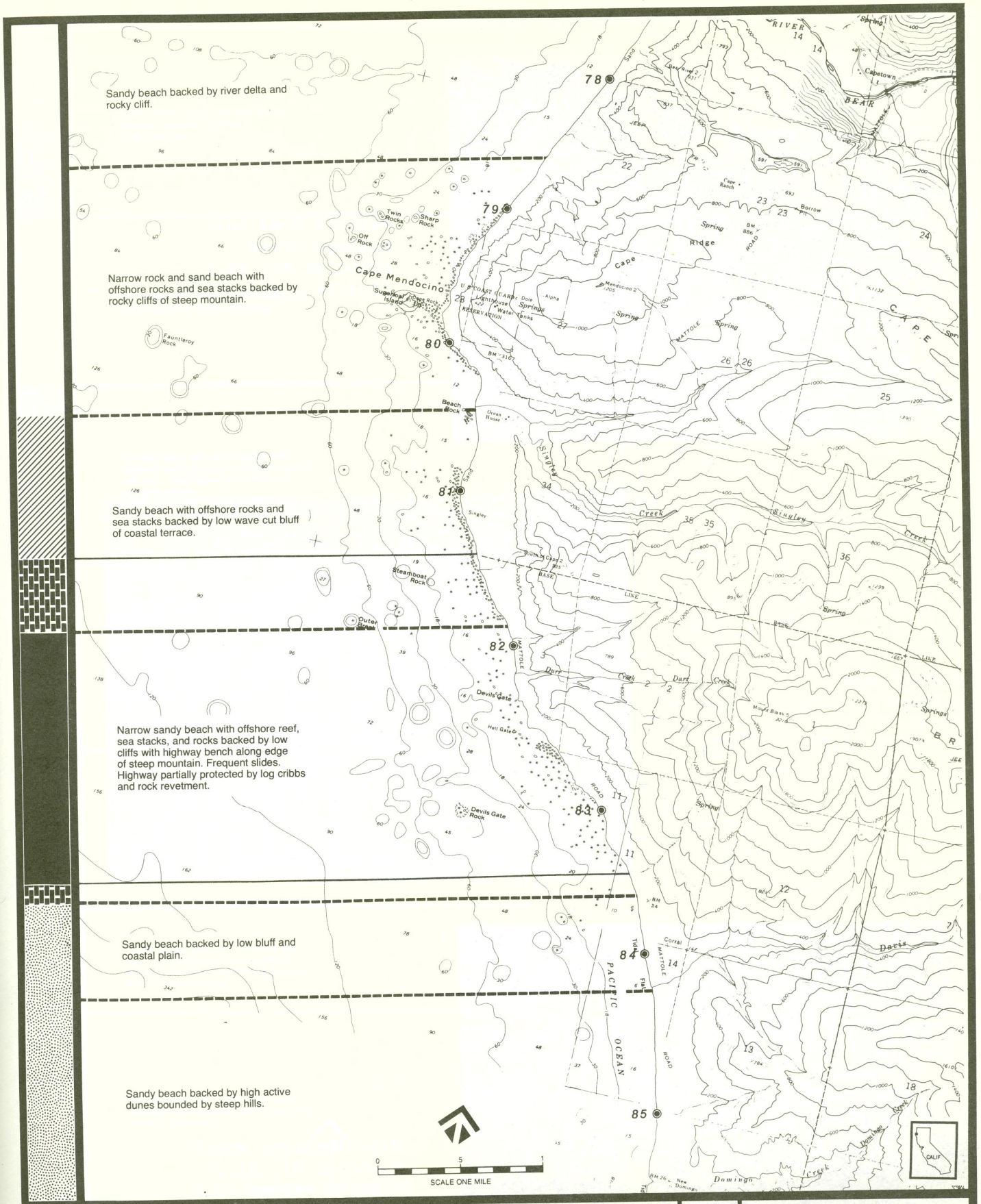
1977

Singley Creek Beach
Humboldt Mi. 80.3
7/18/75 Tide +3.6

Mattole Road at
Devils Gate
Humboldt Mi. 82.4
7/18/75 Tide +3.5



Mattole Road below
Devils Gate
Humboldt Mi. 83.6
7/18/75 Tide +3.4



▪ SHORELINE CONDITION ▪

- PRESENT DEVELOPMENT CRITICAL
- PRESENT DEVELOPMENT NON-CRITICAL
- FUTURE DEVELOPMENT CRITICAL
- ARTIFICIAL PROTECTION
- PROTECTIVE BEACH
- STABLE ROCK

HUMBOLDT CO. — MI. 78-85

MAP NUMBER **17**

STATE OF CALIFORNIA — THE RESOURCES AGENCY

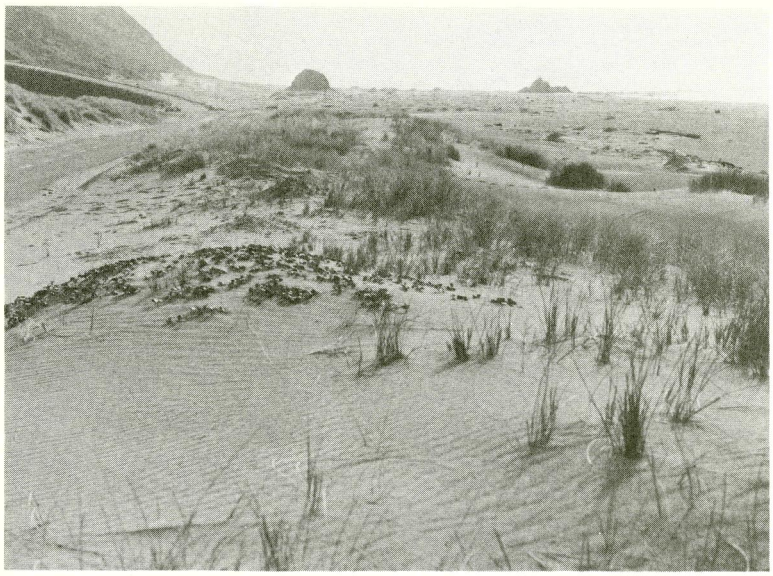
DEPARTMENT OF NAVIGATION & OCEAN DEVELOPMENT

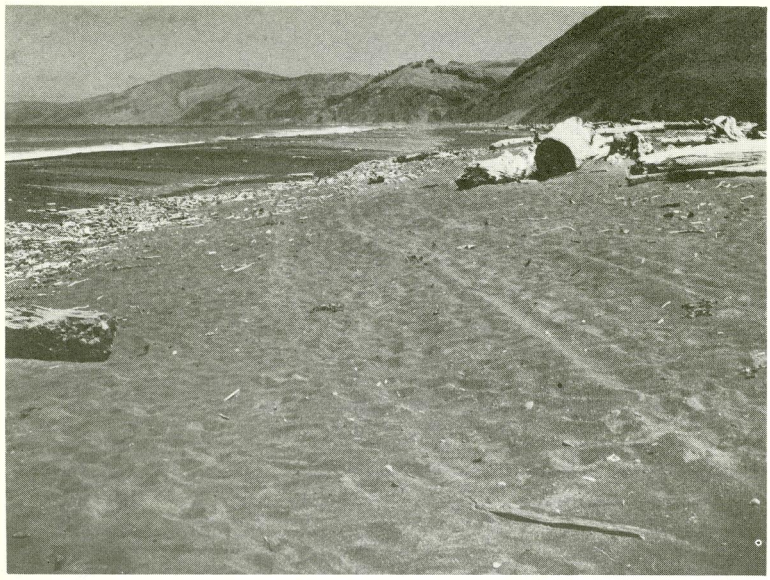
DNOD

1977

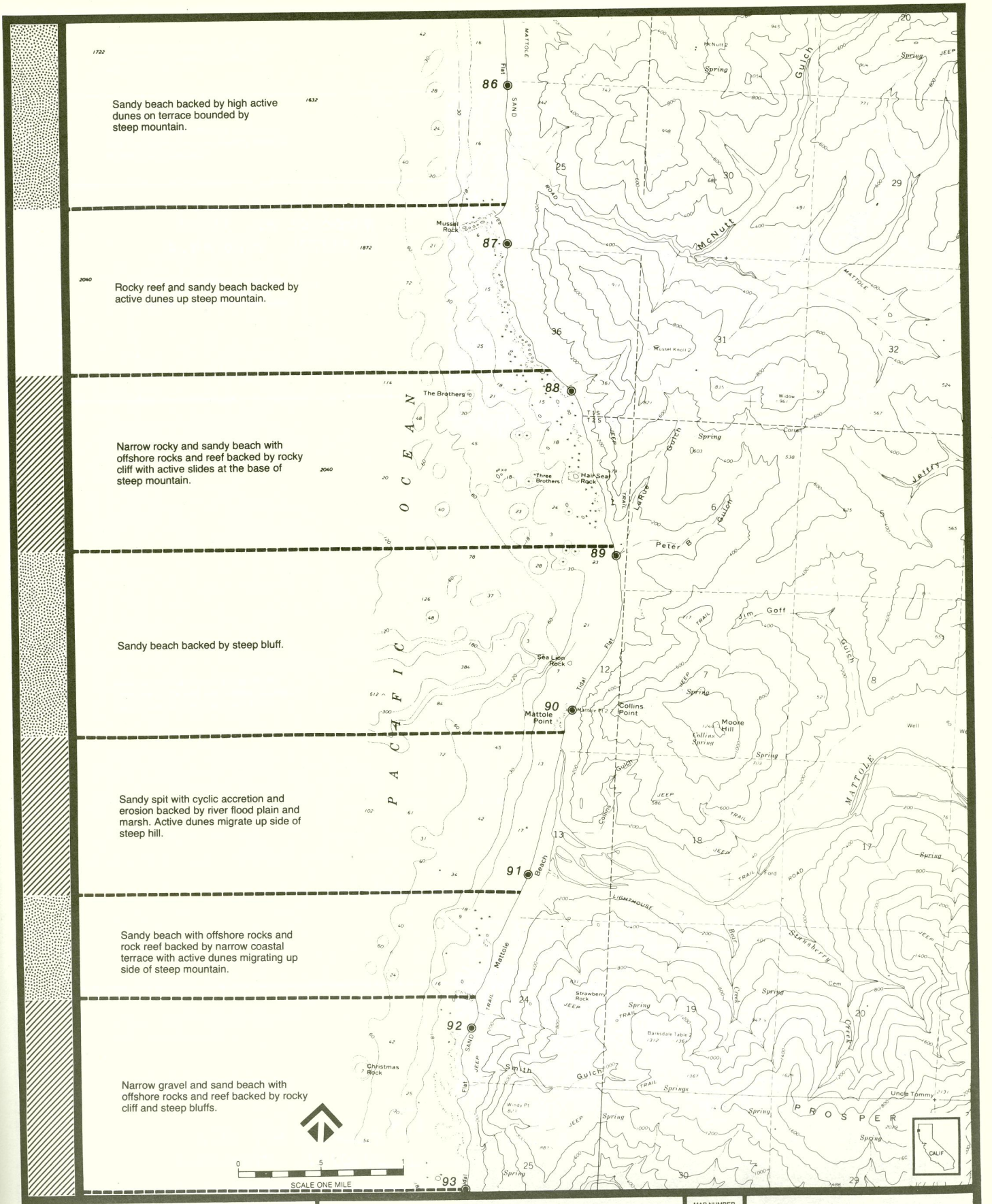
Mattole Road near
Domingo Creek
Humboldt Mi. 85.2
12/3/76 Tide +1.7

Mattole Road near
Domingo Creek
Humboldt Mi. 85.2
12/3/76 Tide +1.7





Mattole River Mouth
Humboldt Mi. 91.2
7/18/75 Tide +3.0



▪ SHORELINE CONDITION ▪

PRESENT DEVELOPMENT CRITICAL	ARTIFICIAL PROTECTION
PRESENT DEVELOPMENT NON-CRITICAL	PROTECTIVE BEACH
FUTURE DEVELOPMENT CRITICAL	STABLE ROCK

HUMBOLDT CO. — MI. 86-93

MAP NUMBER 18

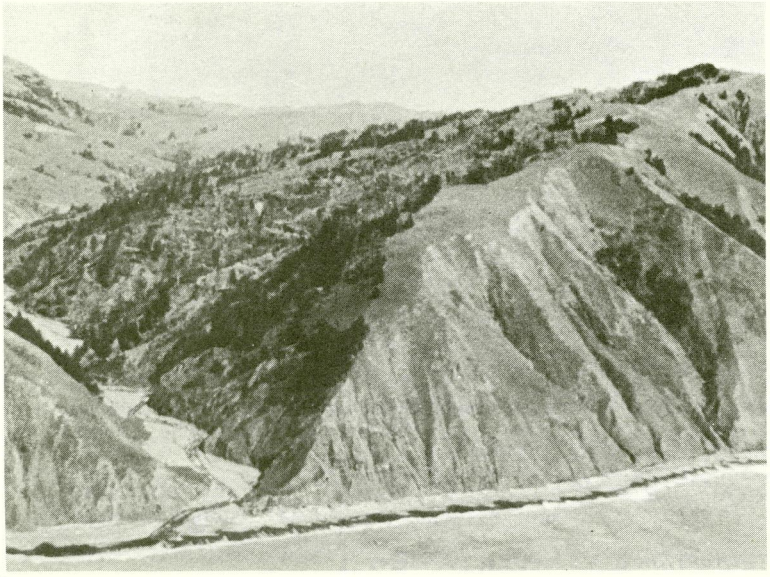
STATE OF CALIFORNIA — THE RESOURCES AGENCY

DEPARTMENT OF NAVIGATION & OCEAN DEVELOPMENT

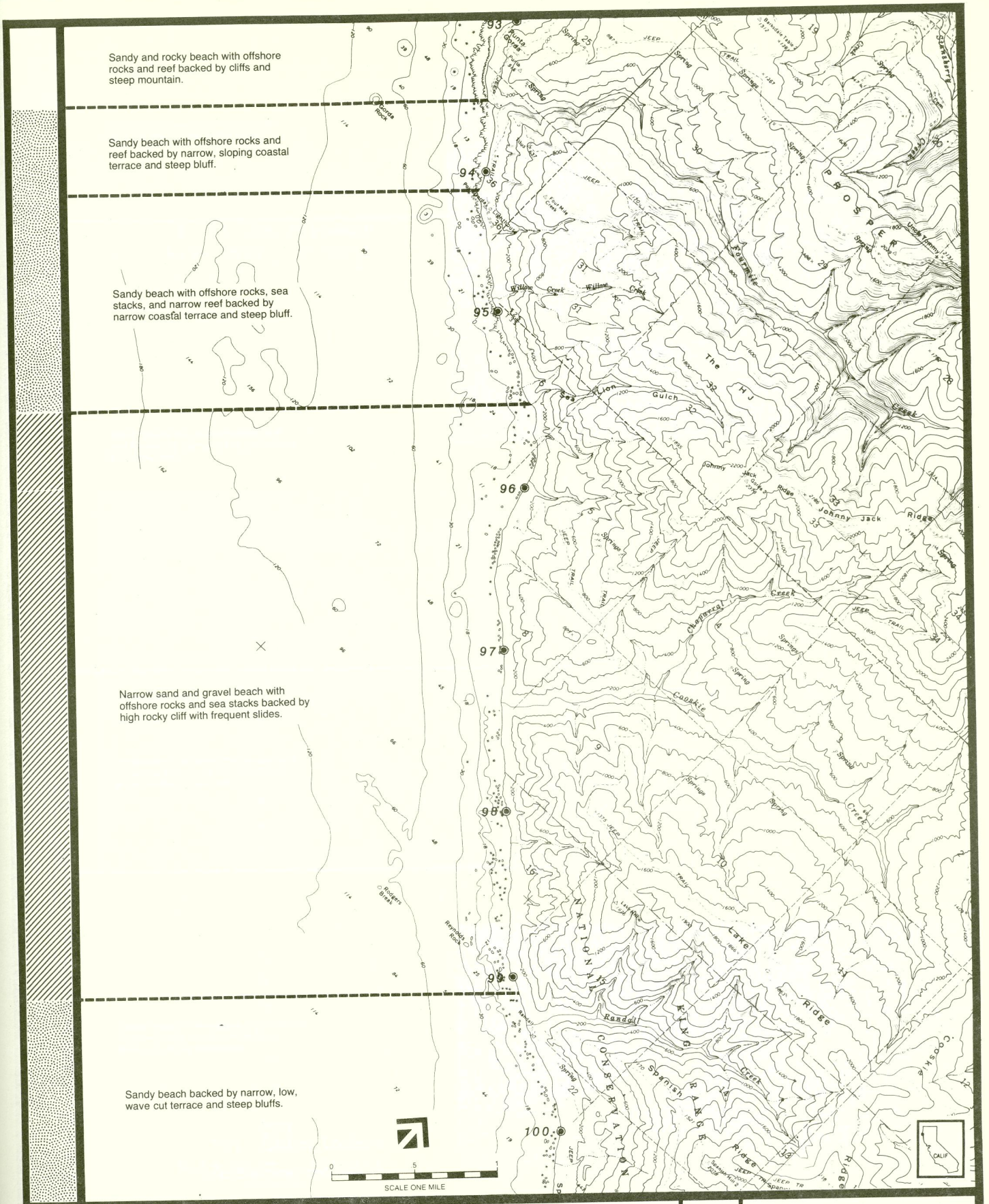
DNOD

1977

Humboldt Mi. 95.00
3/30/72 Tide +4.4



Humboldt Mi. 97.2
3/30/72 Tide +4.4



▪ SHORELINE CONDITION ▪

- PRESENT DEVELOPMENT CRITICAL
- PRESENT DEVELOPMENT NON-CRITICAL
- FUTURE DEVELOPMENT CRITICAL
- ARTIFICIAL PROTECTION
- PROTECTIVE BEACH
- STABLE ROCK

HUMBOLDT CO. — MI. 93 - 100

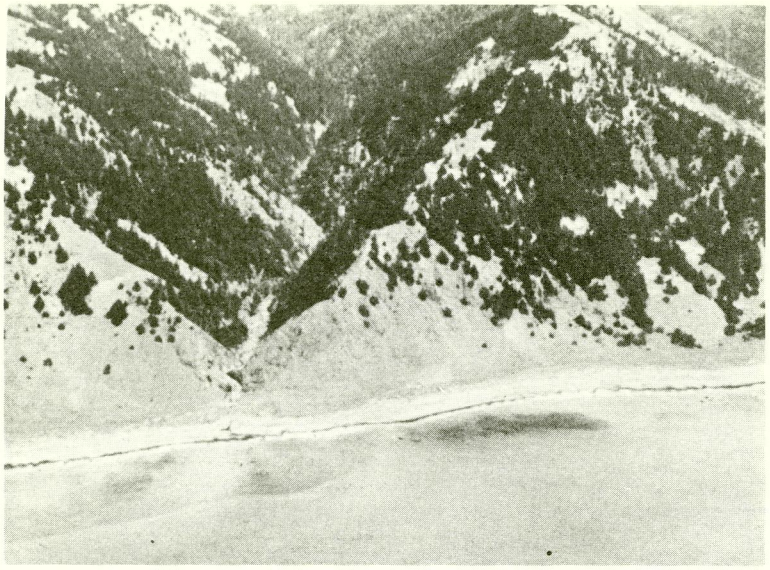
MAP NUMBER **19**

STATE OF CALIFORNIA — THE RESOURCES AGENCY

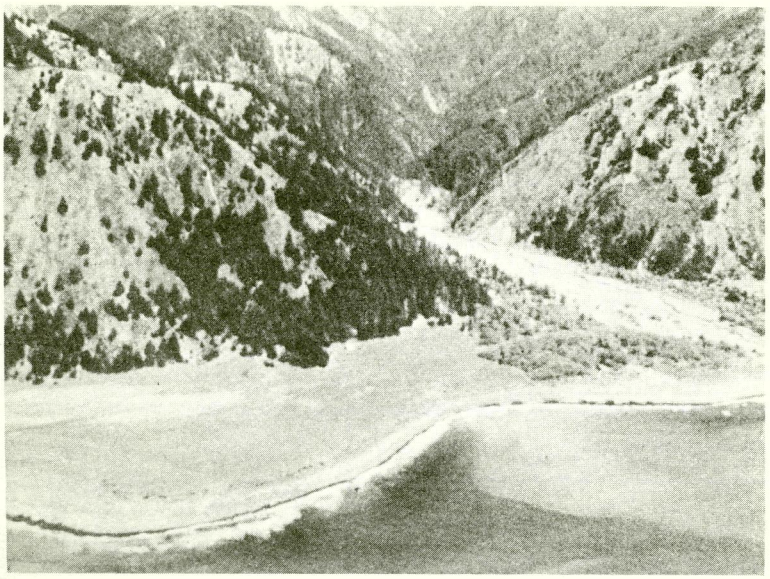
DEPARTMENT OF NAVIGATION & OCEAN DEVELOPMENT

DNOD

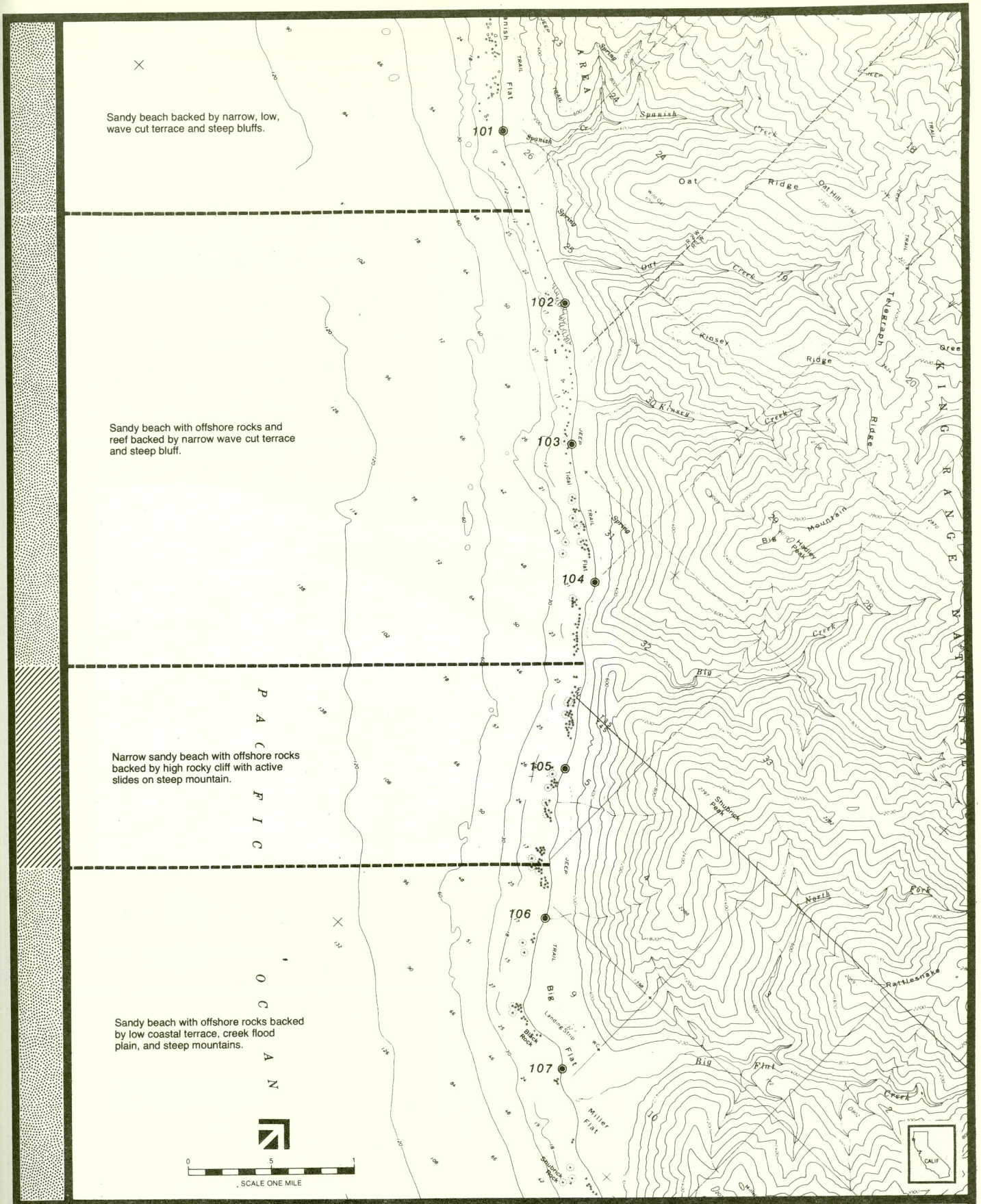
1977



Humboldt Mi. 101.8
3/30/72 Tide +4.4



Humboldt Mi. 107
3/30/72 Tide +4.4



▪ SHORELINE CONDITION ▪

- PRESENT DEVELOPMENT CRITICAL
- PRESENT DEVELOPMENT NON-CRITICAL
- FUTURE DEVELOPMENT CRITICAL
- ARTIFICIAL PROTECTION
- PROTECTIVE BEACH
- STABLE ROCK

HUMBOLDT CO. — MI. 101 - 107

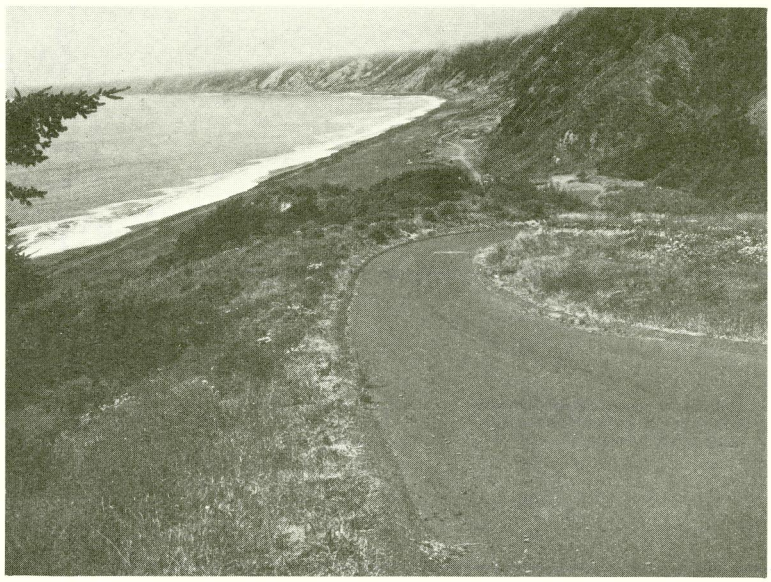
MAP NUMBER **20**

STATE OF CALIFORNIA — THE RESOURCES AGENCY

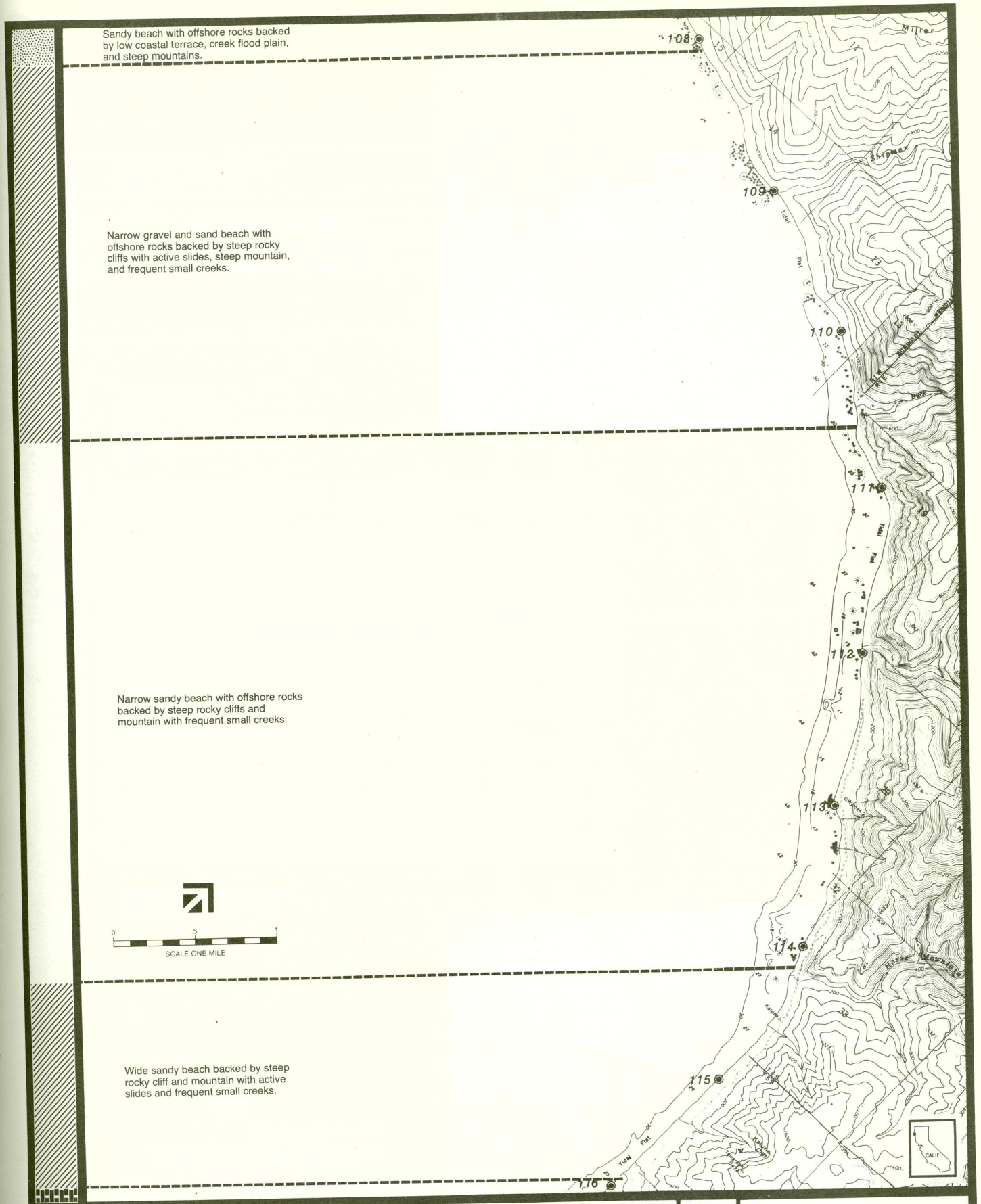
DEPARTMENT OF NAVIGATION & OCEAN DEVELOPMENT

DNOD

1977



Kaluna Cliffs & Beach
Humboldt Mi. 115.9
7/18/75 Tide +2.5



▪ SHORELINE CONDITION ▪

- PRESENT DEVELOPMENT CRITICAL
- PRESENT DEVELOPMENT NON-CRITICAL
- FUTURE DEVELOPMENT CRITICAL
- ARTIFICIAL PROTECTION
- PROTECTIVE BEACH
- STABLE ROCK

HUMBOLDT CO. — MI. 108 - 116

MAP NUMBER **21**

STATE OF CALIFORNIA — THE RESOURCES AGENCY

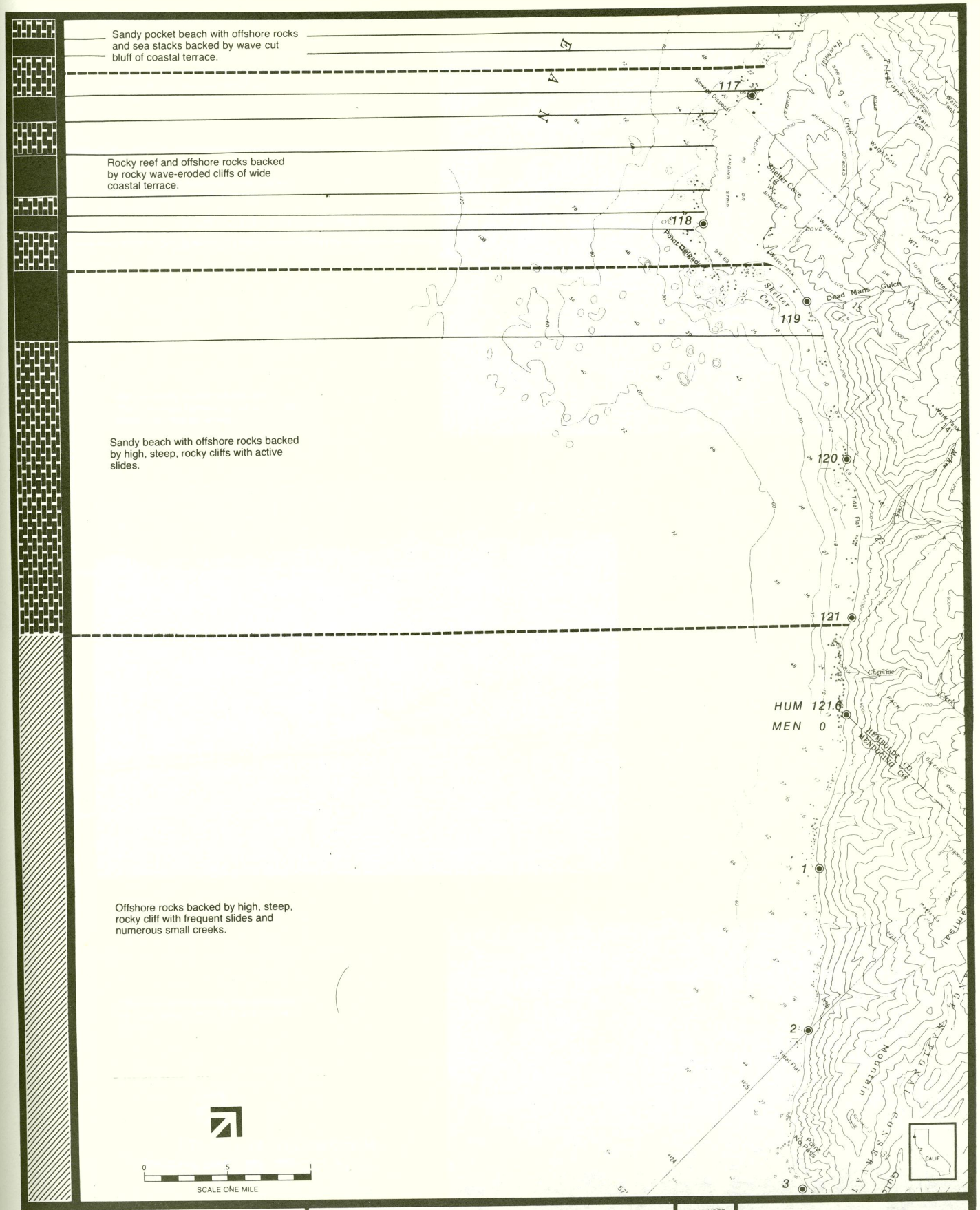
DEPARTMENT OF NAVIGATION & OCEAN DEVELOPMENT

DNOD

1977

Point Delgada
Humboldt Mi. 116.5
7/18/75 Tide +2.5

Shelter Cove
Humboldt Mi. 118.4
7/18/75 Tide +2.5



▪ SHORELINE CONDITION ▪

- PRESENT DEVELOPMENT CRITICAL
- PRESENT DEVELOPMENT NON-CRITICAL
- FUTURE DEVELOPMENT CRITICAL
- ARTIFICIAL PROTECTION
- PROTECTIVE BEACH
- STABLE ROCK

HUMBOLDT CO. — MI. 117 - 121.6
MENDOCINO CO. — MI. 0 - 3

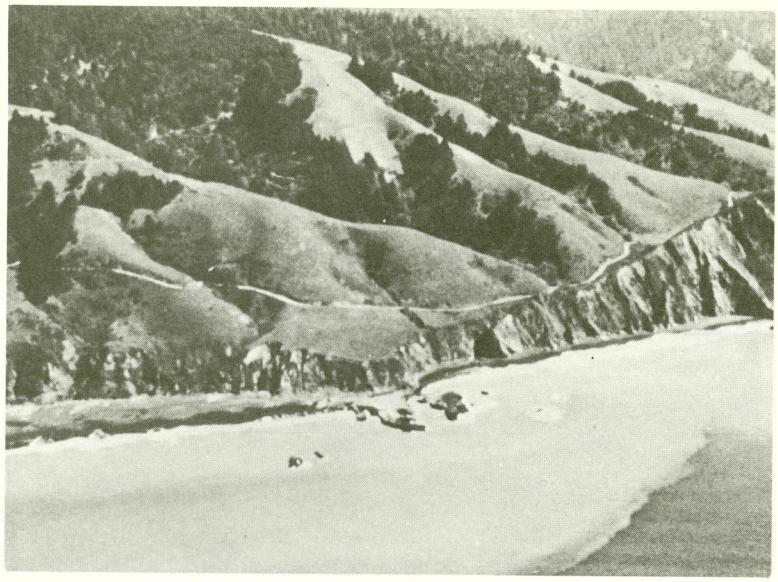
MAP NUMBER 22

STATE OF CALIFORNIA — THE RESOURCES AGENCY

DEPARTMENT OF NAVIGATION & OCEAN DEVELOPMENT

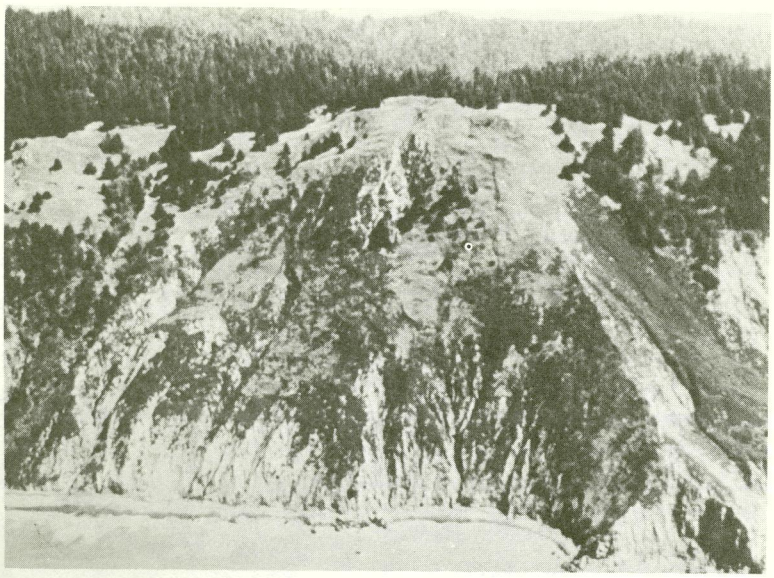
DNOD

1977

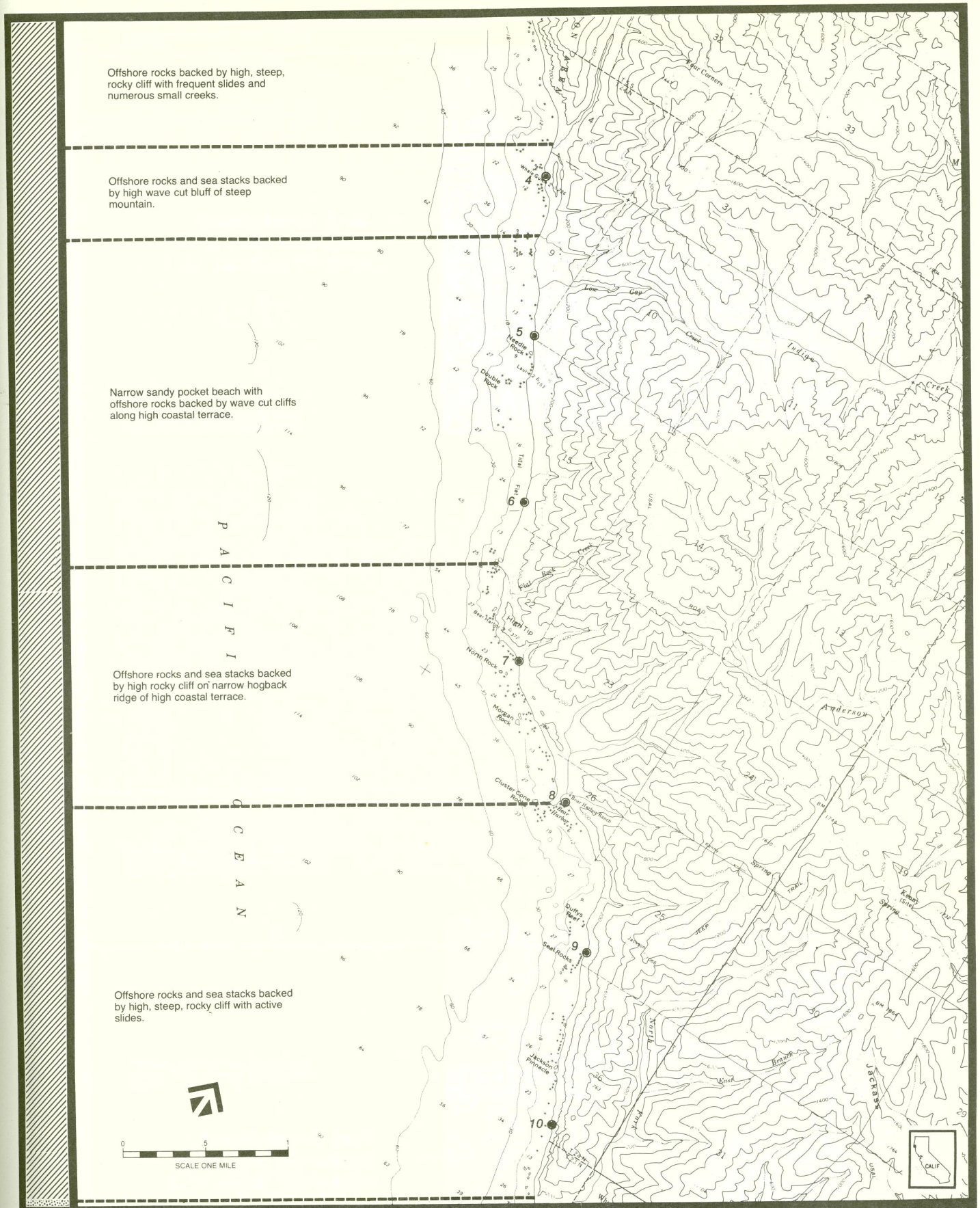


Mendocino Mi. 6.6
3/30/72 Tide +4.4

Mendocino Mi. 6.9
3/30/72 Tide +4.4



Mendocino Mi. 7.00
3/30/72 Tide +4.4



▪ SHORELINE CONDITION ▪

- PRESENT DEVELOPMENT CRITICAL
- PRESENT DEVELOPMENT NON-CRITICAL
- FUTURE DEVELOPMENT CRITICAL
- ARTIFICIAL PROTECTION
- PROTECTIVE BEACH
- STABLE ROCK

MENDOCINO CO. — MI. 4-10

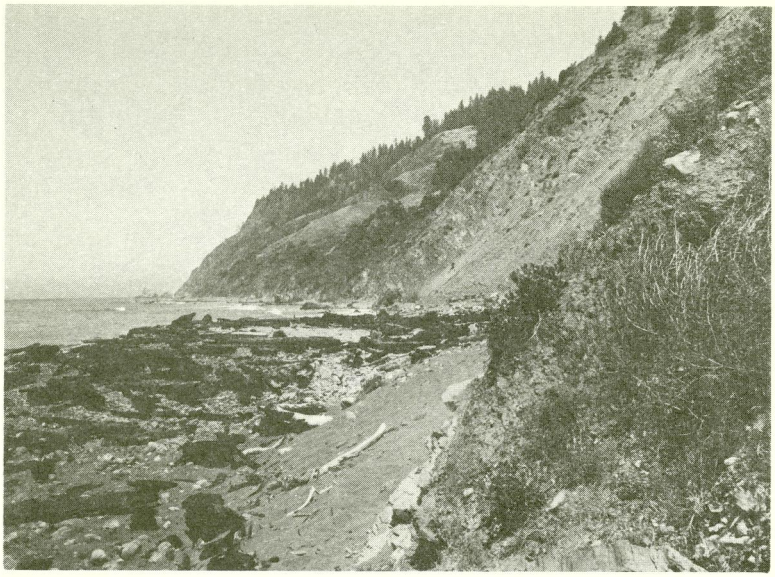
MAP NUMBER 23

STATE OF CALIFORNIA — THE RESOURCES AGENCY

DEPARTMENT OF NAVIGATION & OCEAN DEVELOPMENT

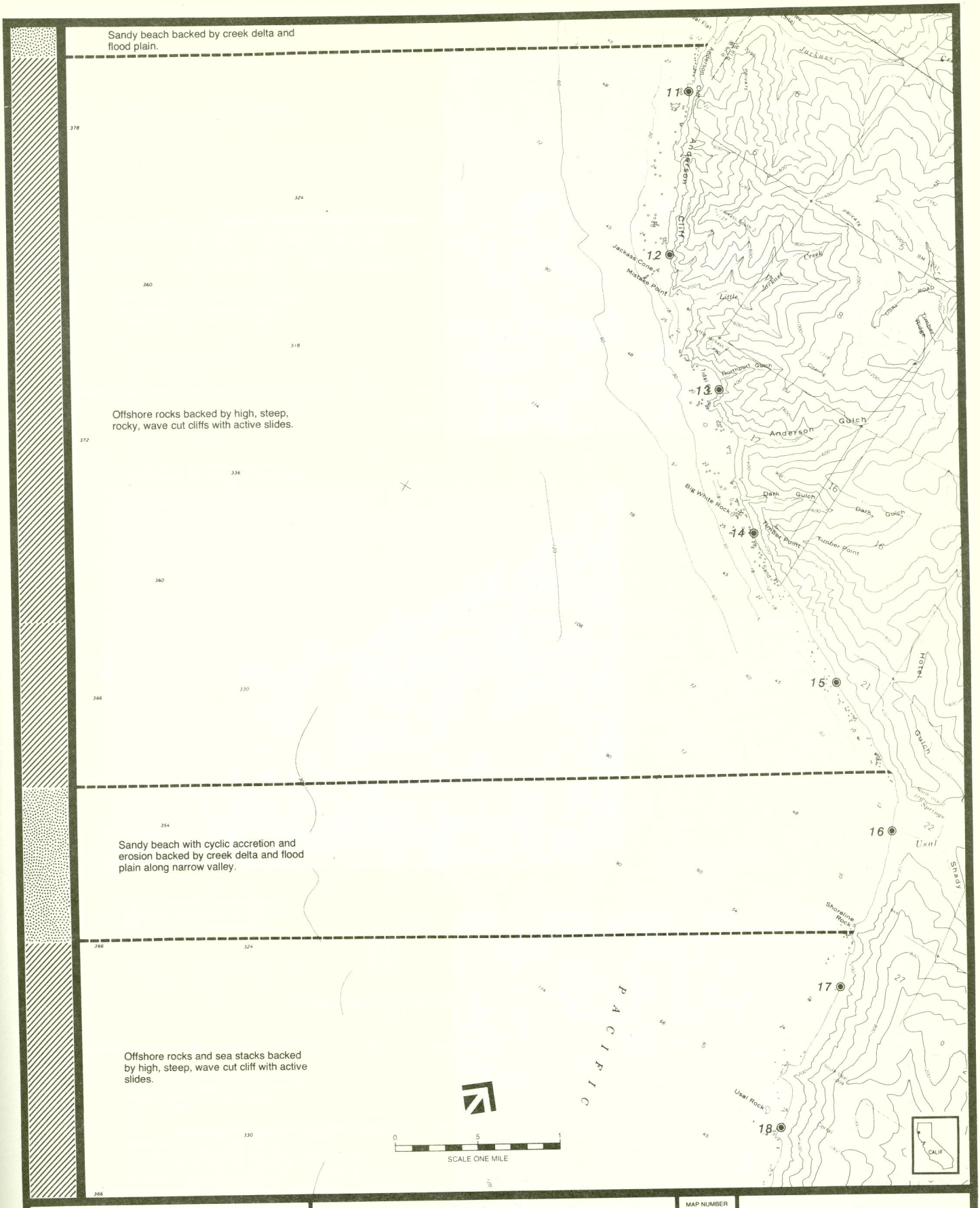
DNOD

1977



Usal Creek Beach
Mendocino Mi. 15.8
6/19/75 Tide +2.8

Usal Creek Beach
Mendocino Mi. 15.8
6/19/75 Tide +2.8



▪ SHORELINE CONDITION ▪

- PRESENT DEVELOPMENT CRITICAL
- PRESENT DEVELOPMENT NON-CRITICAL
- FUTURE DEVELOPMENT CRITICAL
- ARTIFICIAL PROTECTION
- PROTECTIVE BEACH
- STABLE ROCK

MENDOCINO CO. — MI. 11 - 18

MAP NUMBER **24**

STATE OF CALIFORNIA — THE RESOURCES AGENCY

DEPARTMENT OF NAVIGATION & OCEAN DEVELOPMENT

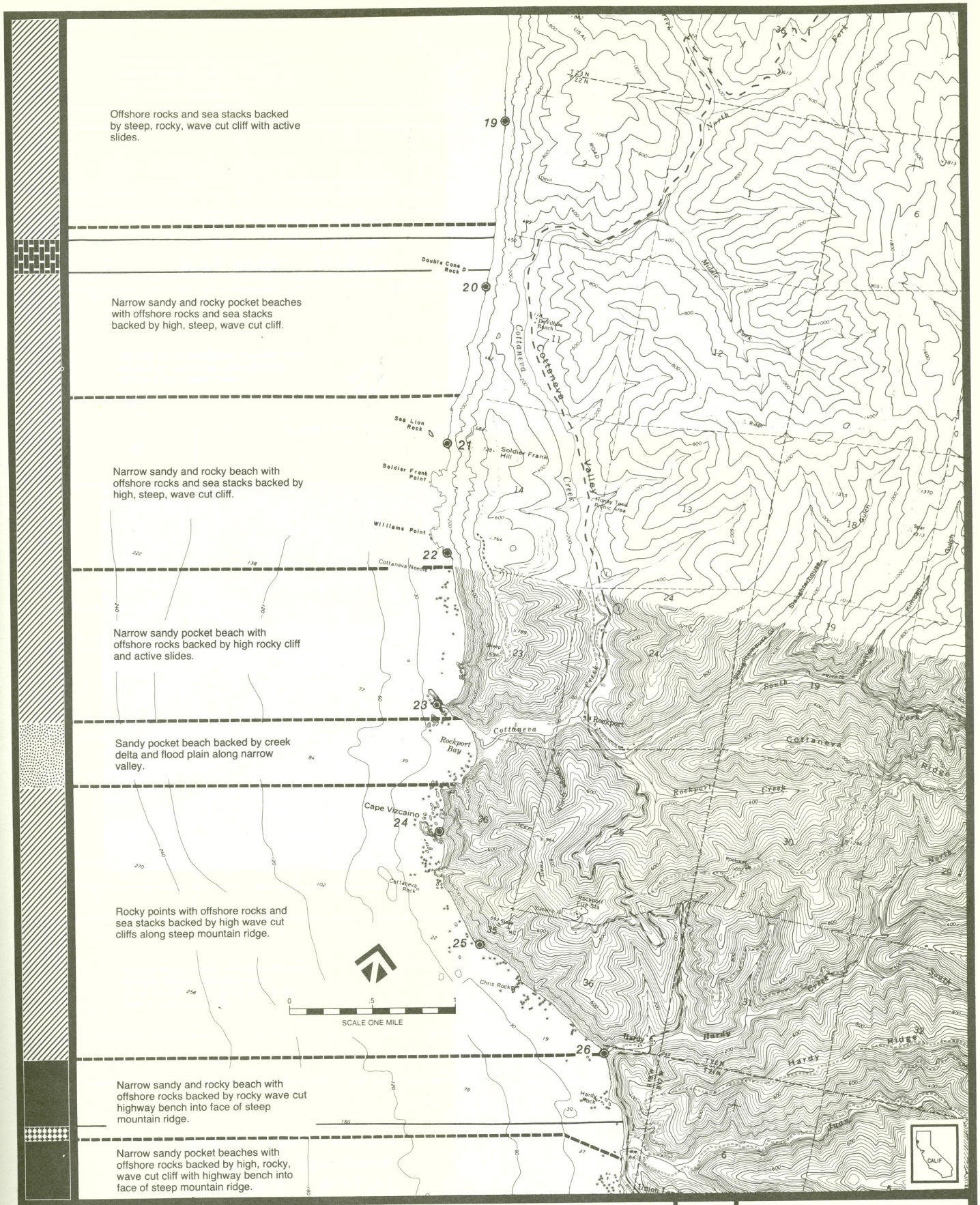
DNOD

1977

Hardy Rock Area
Mendocino Mi. 26.2
12/4/76 Tide +4.8

Hardy Rock Area
Mendocino Mi. 26.2
6/19/75 Tide +3.7

San Juan Creek Beach
Mendocino Mi. 26.6
12/4/76 Tide +4.4



▪ SHORELINE CONDITION ▪

- PRESENT DEVELOPMENT CRITICAL
- PRESENT DEVELOPMENT NON-CRITICAL
- FUTURE DEVELOPMENT CRITICAL
- ARTIFICIAL PROTECTION
- PROTECTIVE BEACH
- STABLE ROCK

MENDOCINO CO. — MI. 19-26

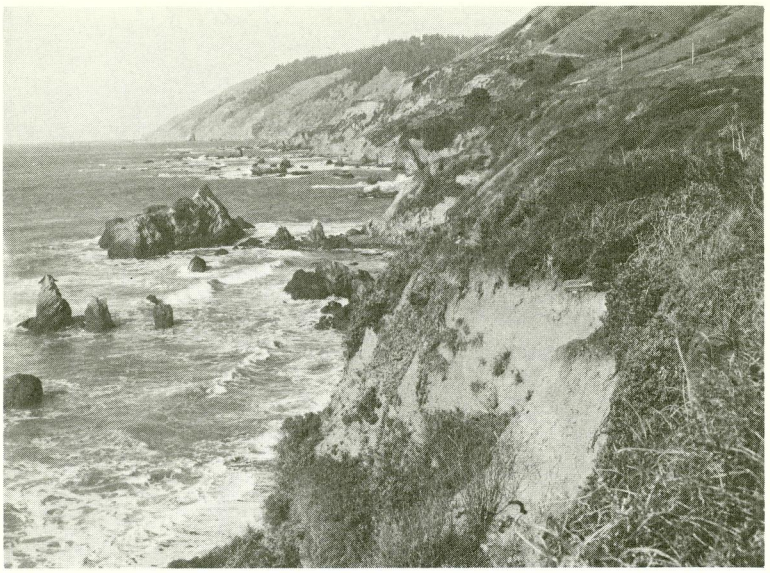
MAP NUMBER **25**

STATE OF CALIFORNIA — THE RESOURCES AGENCY

DEPARTMENT OF NAVIGATION & OCEAN DEVELOPMENT

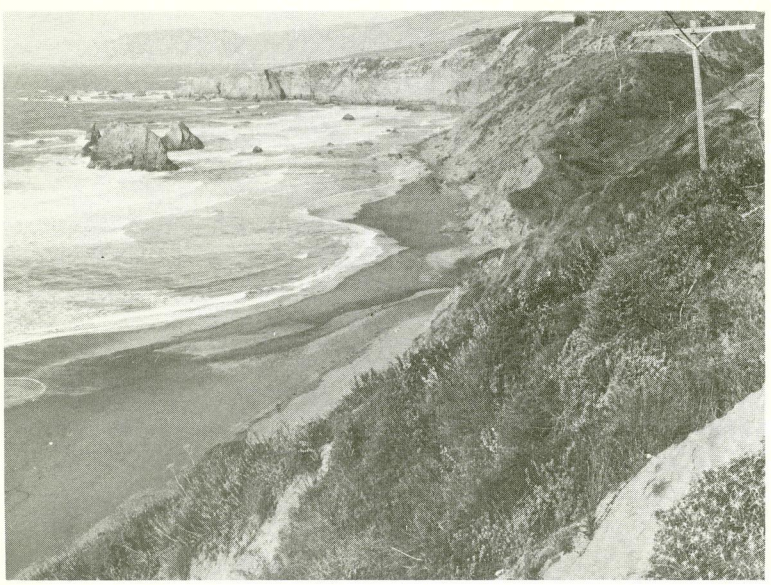
DNOD

1977

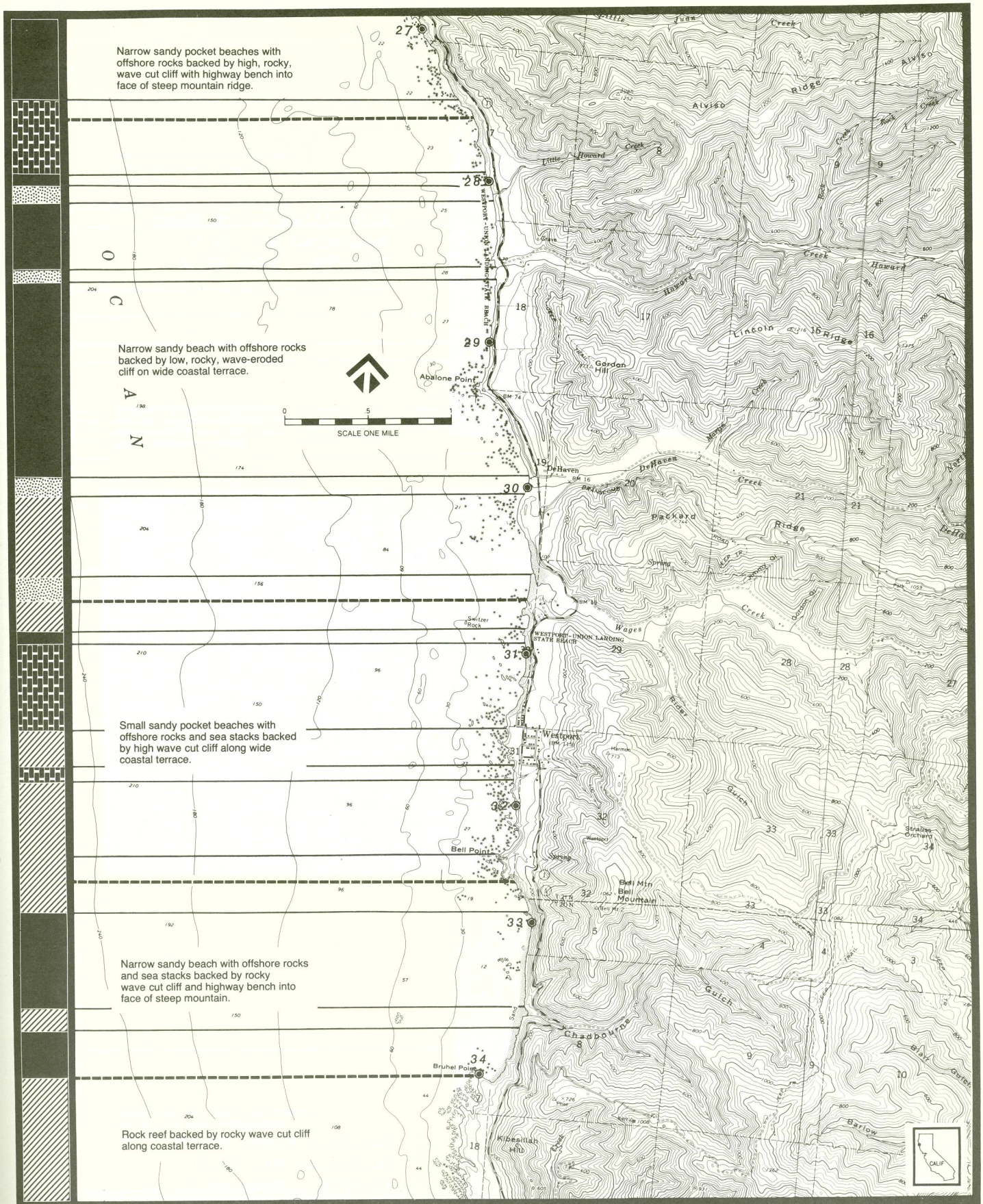


Union Landing Area
Mendocino Mi. 28.0
12/4/76 Tide +3.6

Westport State Beach
Mendocino Mi. 29.9
6/19/75



Chagman Gulch Beach
Mendocino Mi. 33.6
12/4/76 Tide +1.7



SHORELINE CONDITION

- PRESENT DEVELOPMENT CRITICAL
- PRESENT DEVELOPMENT NON-CRITICAL
- FUTURE DEVELOPMENT CRITICAL
- ARTIFICIAL PROTECTION
- PROTECTIVE BEACH
- STABLE ROCK

MENDOCINO CO. — MI. 27-34

MAP NUMBER **26**

STATE OF CALIFORNIA — THE RESOURCES AGENCY

DEPARTMENT OF NAVIGATION & OCEAN DEVELOPMENT

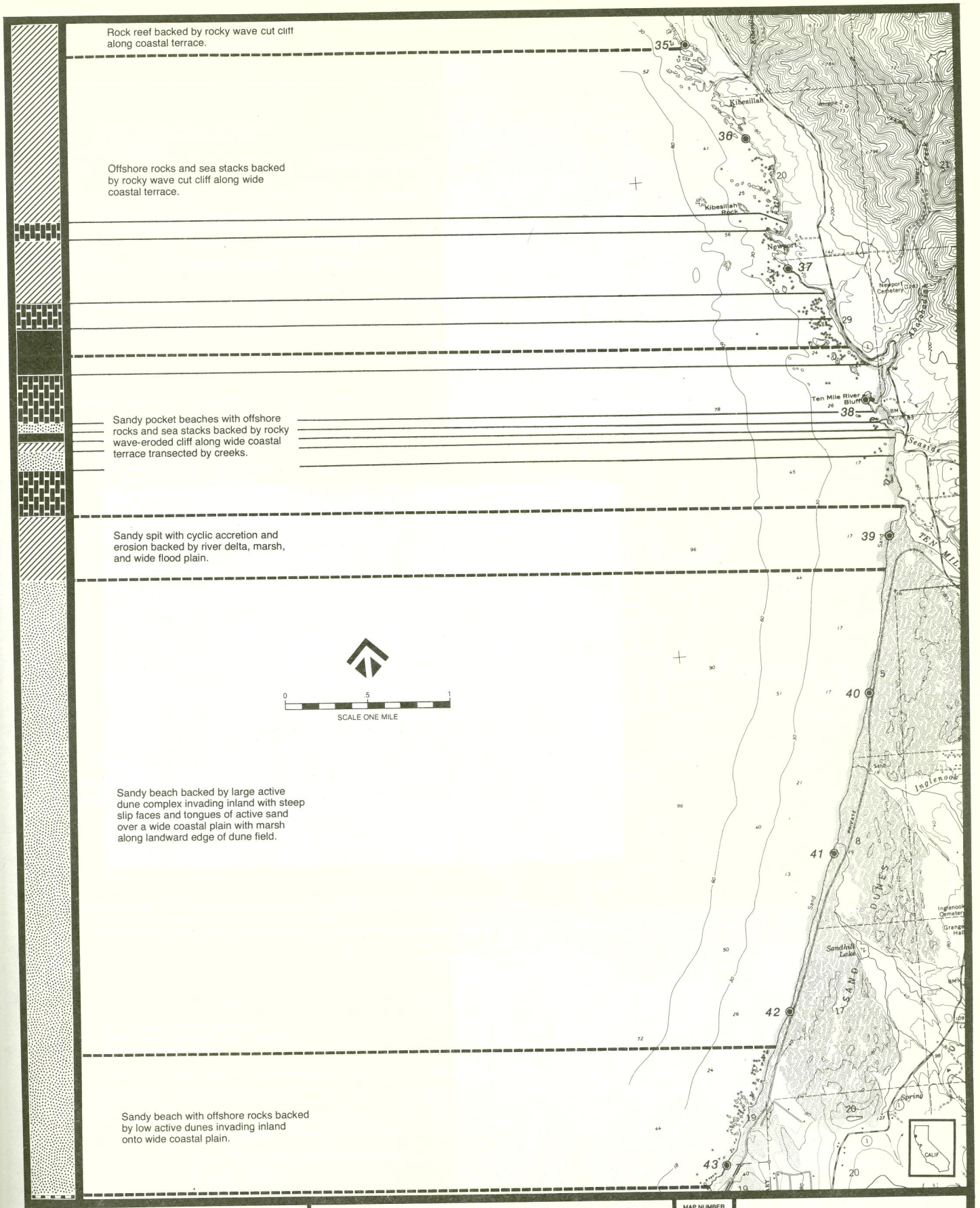
DNOD

1977

Kibesillah Gulch Beach
Mendocino Mi. 35.5
12/4/76 Tide +1.4

Ten Mile River Beach
Mendocino Mi. 38.7
12/4/76 Tide +0.7

Ten Mile River Beach
Mendocino Mi. 38.7
12/4/76 Tide +0.7



▪ SHORELINE CONDITION ▪

- PRESENT DEVELOPMENT CRITICAL
- PRESENT DEVELOPMENT NON-CRITICAL
- FUTURE DEVELOPMENT CRITICAL
- ARTIFICIAL PROTECTION
- PROTECTIVE BEACH
- STABLE ROCK

MENDOCINO CO. — MI. 35-43

MAP NUMBER 27

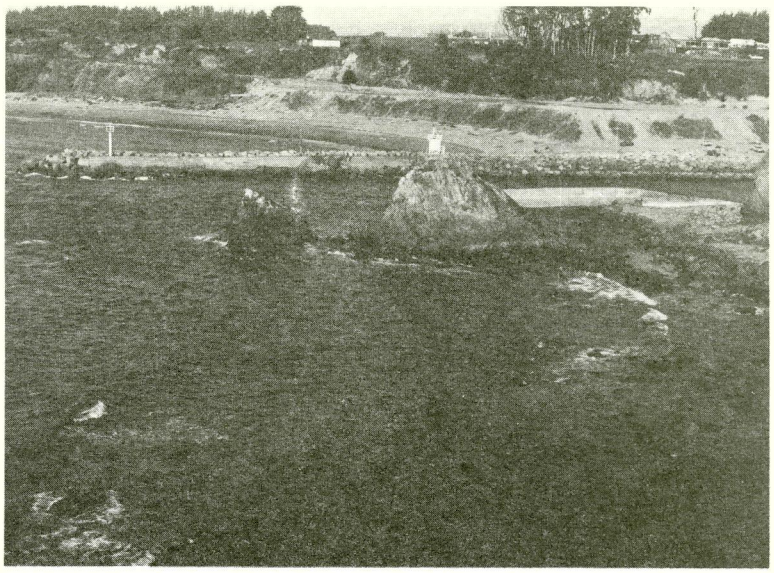
STATE OF CALIFORNIA — THE RESOURCES AGENCY

DEPARTMENT OF NAVIGATION & OCEAN DEVELOPMENT

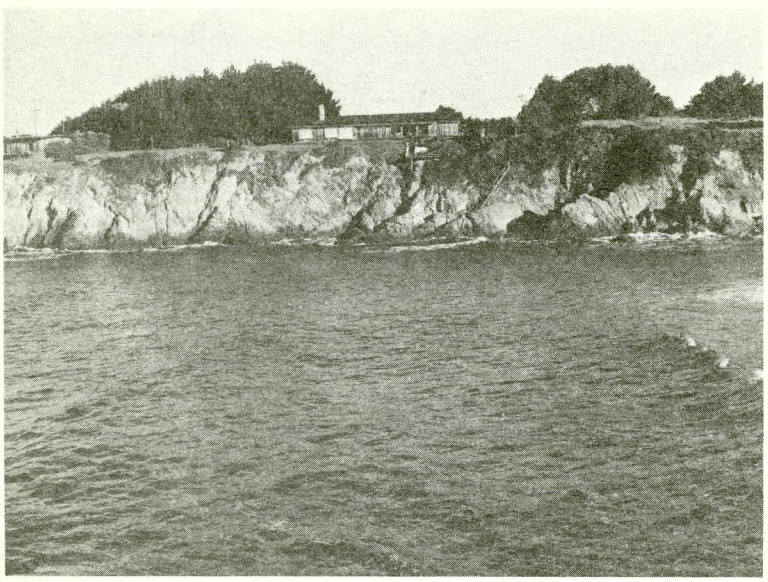
DNOD

1977

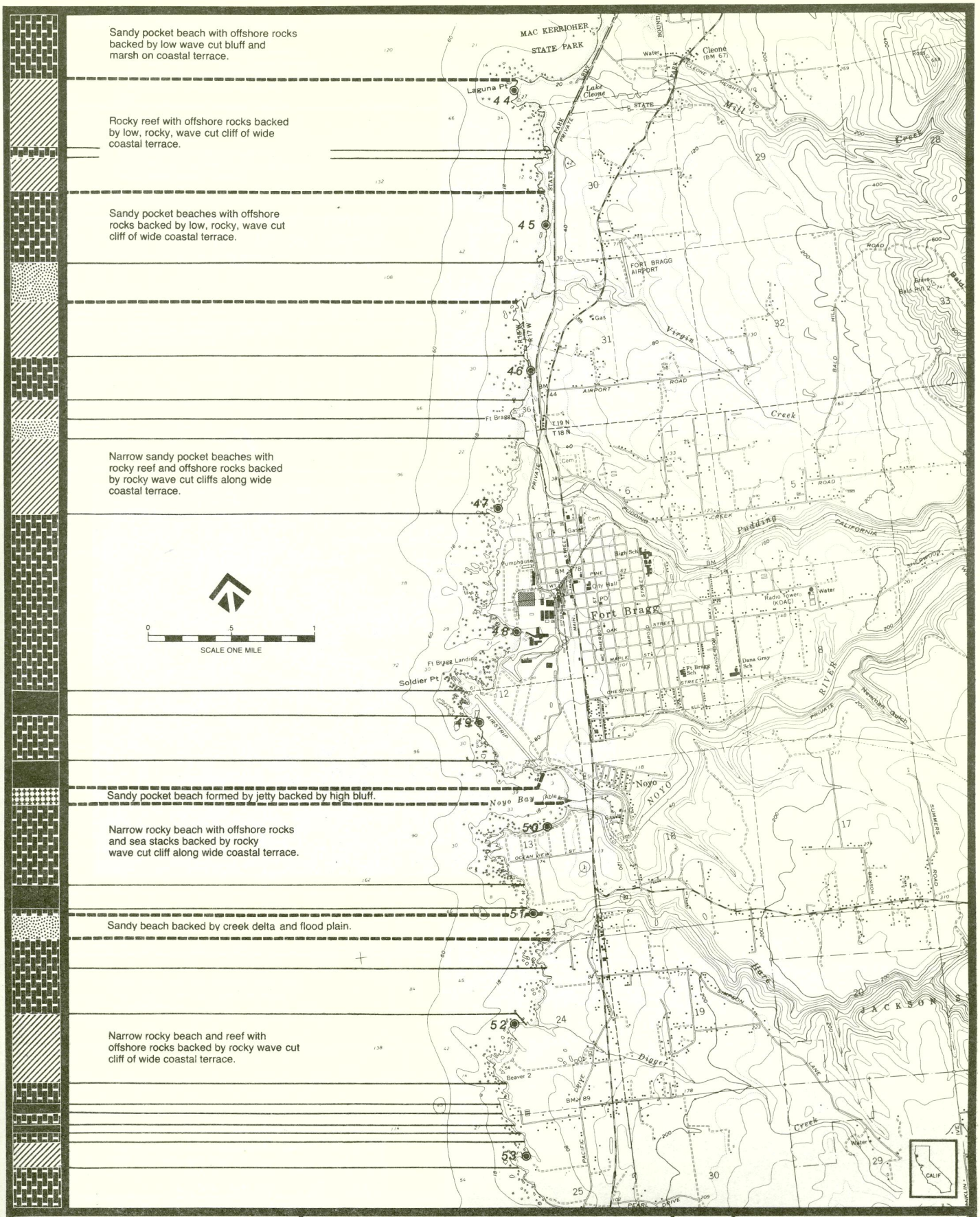
MacKerricher State Beach
Mendocino Mi. 43.6
6/19/75 Tide +4.1



Noyo River Harbor Entrance
Mendocino Mi. 50.0
12/4/76 Tide +0.0



Hare Creek Beach
Mendocino Mi. 51.2
12/5/76 Tide +5.9



SHORELINE CONDITION

- PRESENT DEVELOPMENT CRITICAL
- PRESENT DEVELOPMENT NON-CRITICAL
- FUTURE DEVELOPMENT CRITICAL
- ARTIFICIAL PROTECTION
- PROTECTIVE BEACH
- STABLE ROCK

MENDOCINO CO. — MI. 44 - 53

MAP NUMBER **28**

STATE OF CALIFORNIA — THE RESOURCES AGENCY

DEPARTMENT OF NAVIGATION & OCEAN DEVELOPMENT

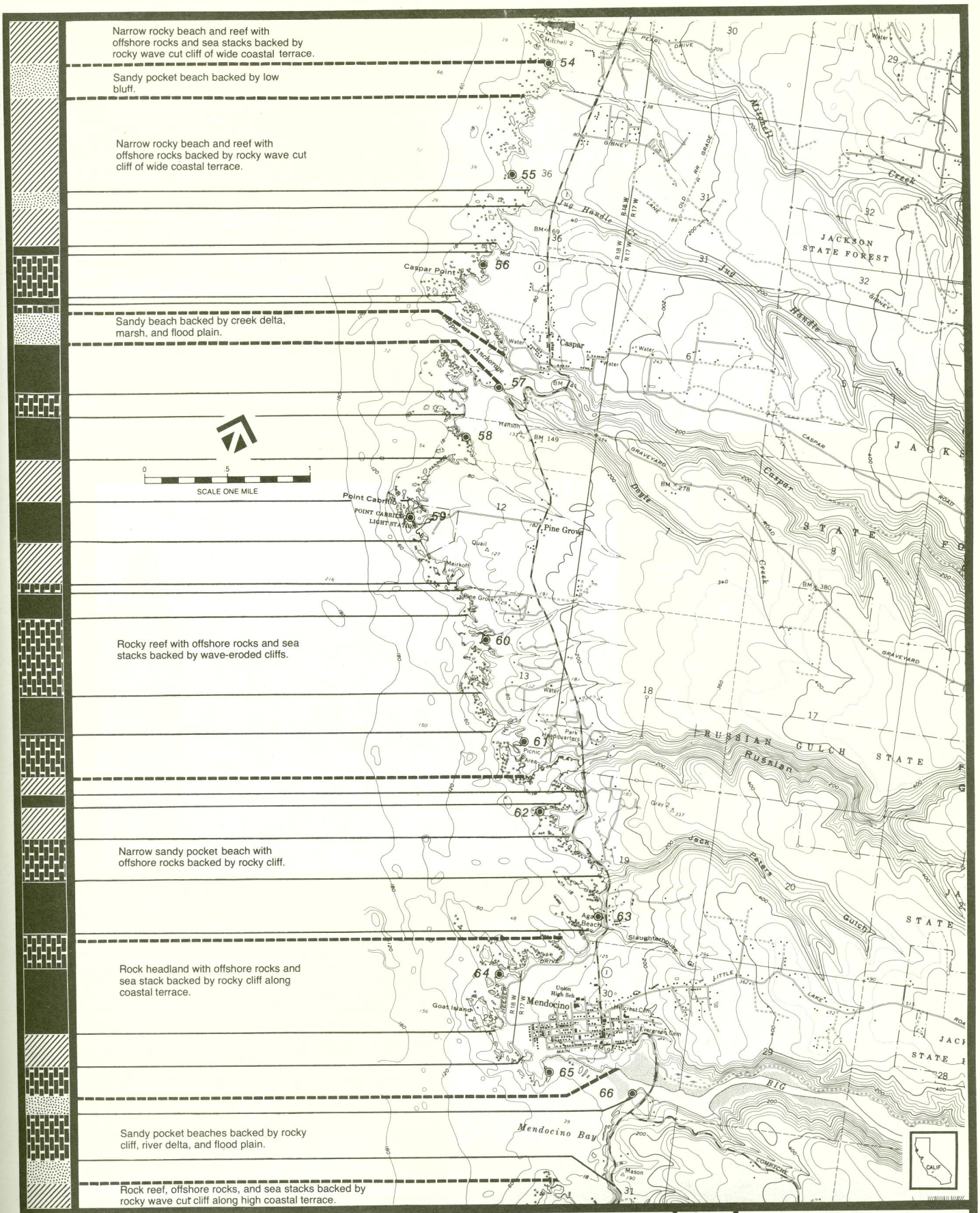
DNOD

1977

Casper Creek Beach
Mendocino Mi. 57.0
6/18/75 Tide +5.0

Point Cabrillo
Mendocino Mi. 59.0
12/5/76 Tide +5.9

Big River Beach
Mendocino Mi. 65.5
12/5/76 Tide +4.4



▪ SHORELINE CONDITION ▪

PRESENT DEVELOPMENT CRITICAL	ARTIFICIAL PROTECTION
PRESENT DEVELOPMENT NON-CRITICAL	PROTECTIVE BEACH
FUTURE DEVELOPMENT CRITICAL	STABLE ROCK

MENDOCINO CO. — MI. 54-66

MAP NUMBER **29**

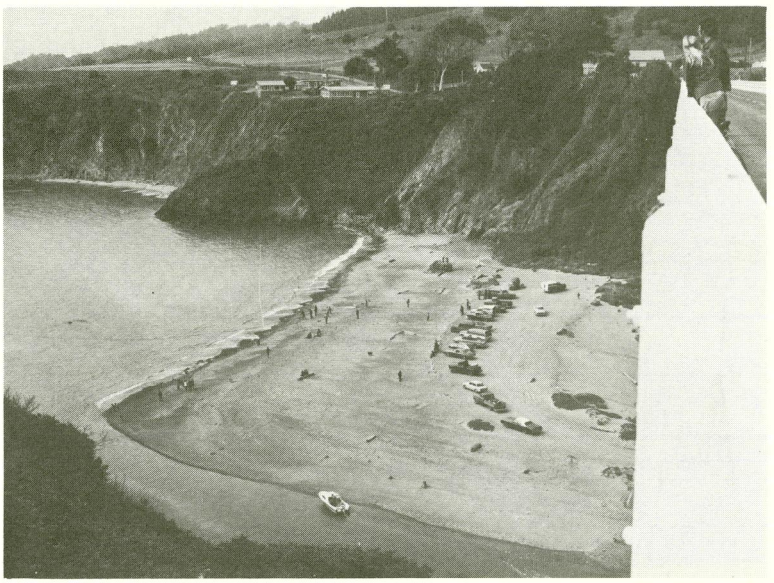
STATE OF CALIFORNIA — THE RESOURCES AGENCY

DEPARTMENT OF NAVIGATION & OCEAN DEVELOPMENT

DNOD

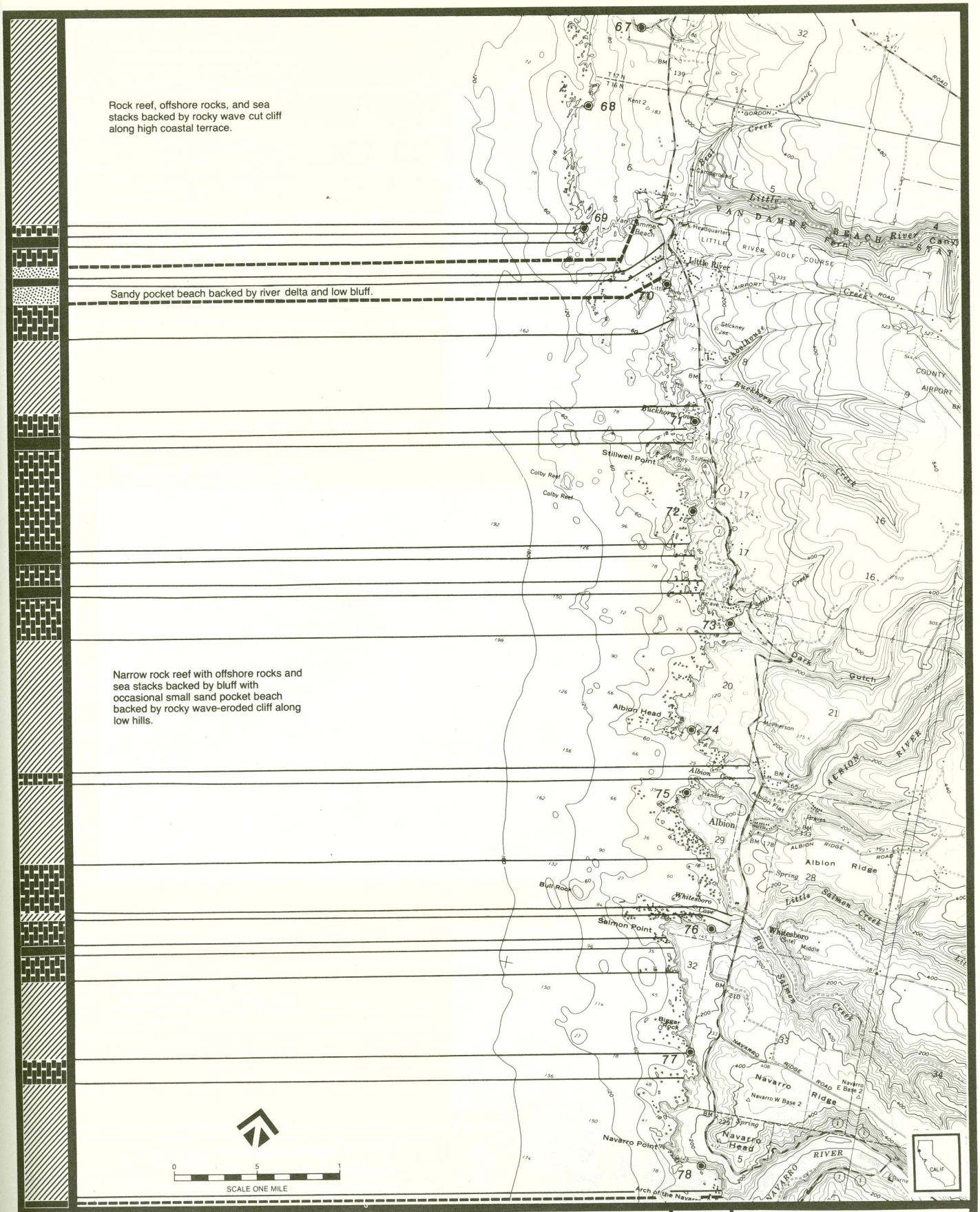
1977

Van Damme State Beach
Mendocino Mi. 69.6
6/18/75 Tide +3.3



Albion River Beach
Mendocino Mi. 74.5
6/18/75 Tide +4.1

Navarro River Mouth
Mendocino Mi. 78.3
6/18/75 Tide +1.9



▪ SHORELINE CONDITION ▪

PRESENT DEVELOPMENT CRITICAL	ARTIFICIAL PROTECTION
PRESENT DEVELOPMENT NON-CRITICAL	PROTECTIVE BEACH
FUTURE DEVELOPMENT CRITICAL	STABLE ROCK

MENDOCINO CO. — MI. 67 - 78

MAP NUMBER 30

STATE OF CALIFORNIA — THE RESOURCES AGENCY

DEPARTMENT OF NAVIGATION & OCEAN DEVELOPMENT

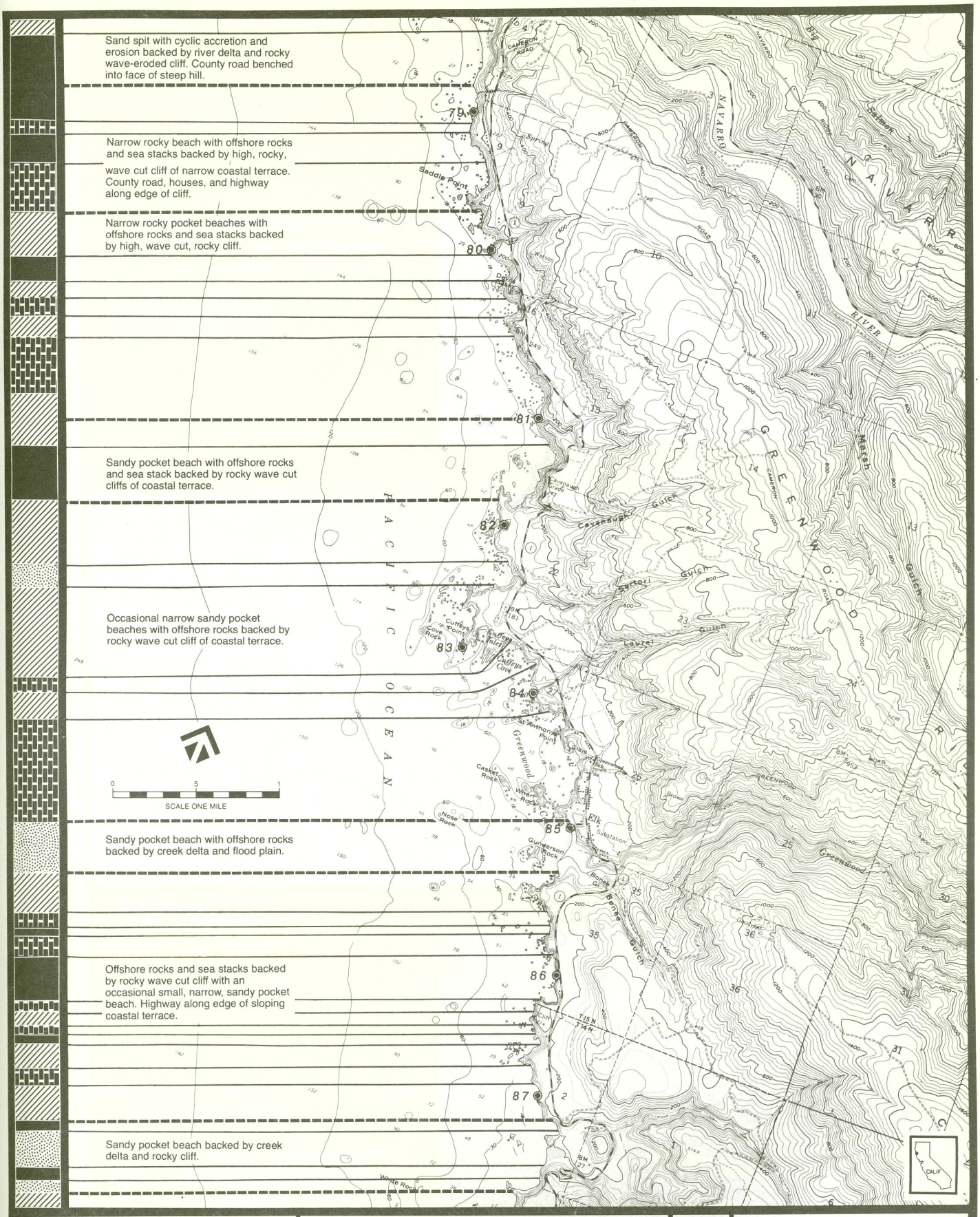
DND

1977

Cavanaugh Gulch Beach
Mendocino Mi. 80.7
6/18/75 Tide +1.8

Bonee Gulch Beach
Mendocino Mi. 85.0
6/18/75 Tide +1.7

Elk Creek Beach
Mendocino Mi. 87.3
6/18/75 Tide +1.9



▪ SHORELINE CONDITION ▪

PRESENT DEVELOPMENT CRITICAL	ARTIFICIAL PROTECTION
PRESENT DEVELOPMENT NON-CRITICAL	PROTECTIVE BEACH
FUTURE DEVELOPMENT CRITICAL	STABLE ROCK

MENDOCINO CO. — MI. 79-87

MAP NUMBER 31

STATE OF CALIFORNIA — THE RESOURCES AGENCY

DEPARTMENT OF NAVIGATION & OCEAN DEVELOPMENT

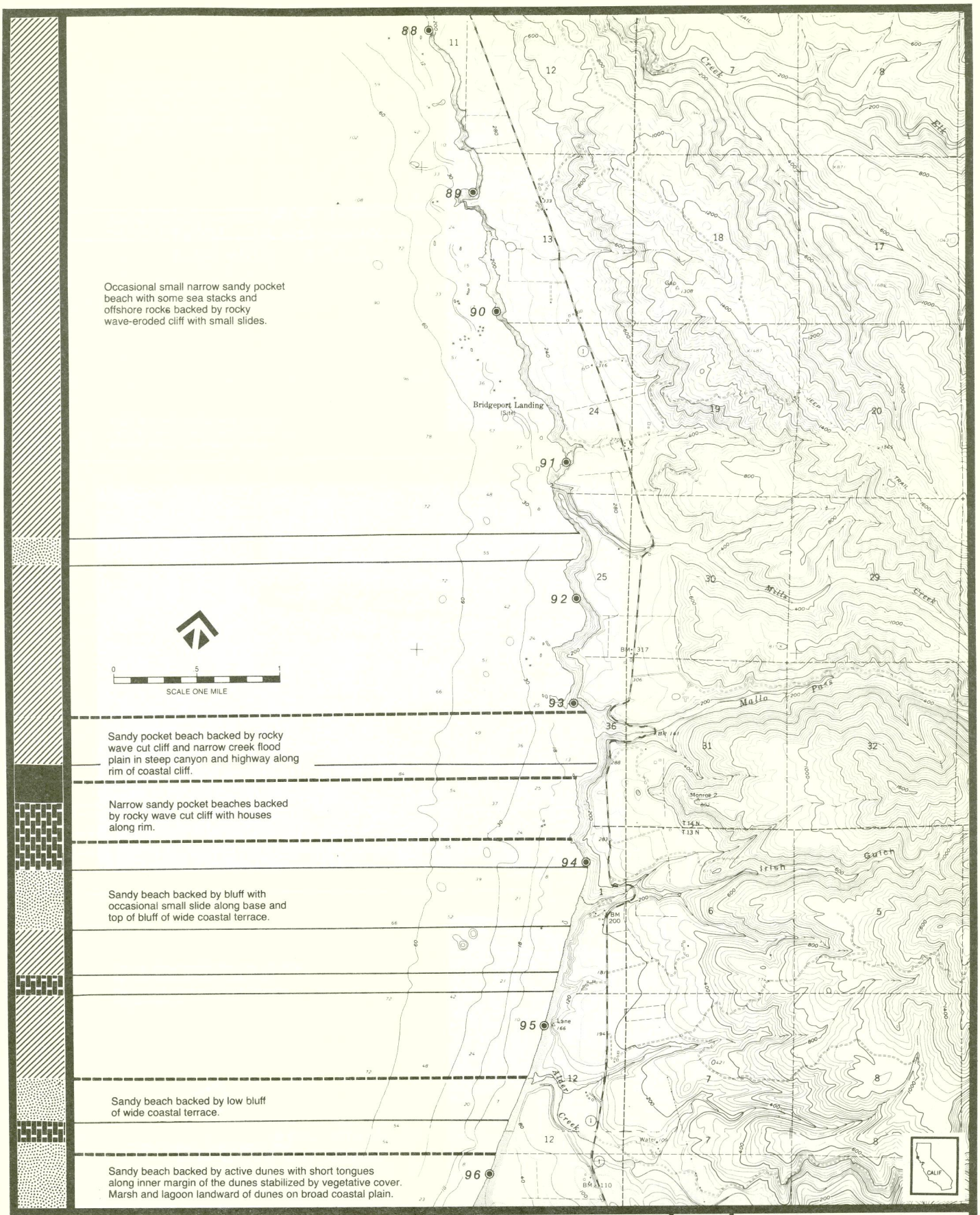
DNOD

1977

Mallo Pass Creek Beach
Mendocino Mi. 93.4
12/5/76 Tide +0.2

Manchester State Beach
Mendocino Mi. 96.9
6/18/75 Tide +1.8

Manchester State Beach
Mendocino Mi. 96.9
6/18/75 Tide +1.8



▪ SHORELINE CONDITION ▪

- PRESENT DEVELOPMENT CRITICAL
- PRESENT DEVELOPMENT NON-CRITICAL
- FUTURE DEVELOPMENT CRITICAL
- ARTIFICIAL PROTECTION
- PROTECTIVE BEACH
- STABLE ROCK

MENDOCINO CO. — MI. 88-96

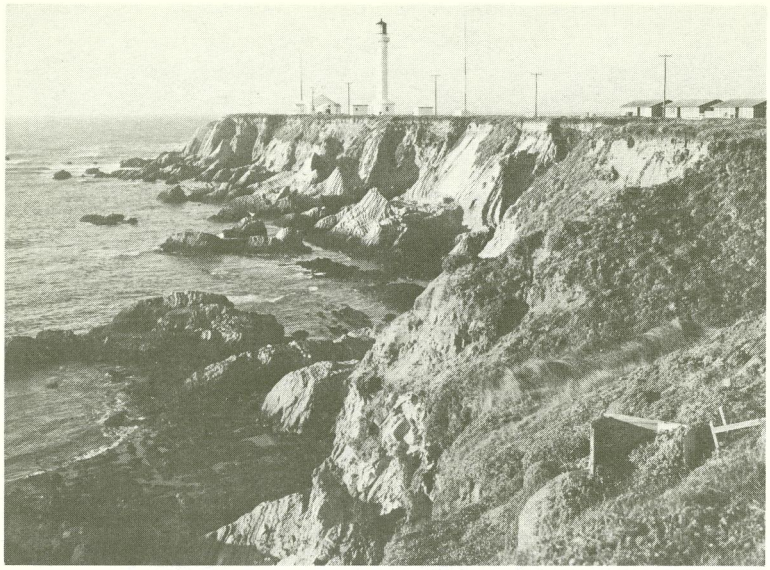
MAP NUMBER **32**

STATE OF CALIFORNIA — THE RESOURCES AGENCY

DEPARTMENT OF NAVIGATION & OCEAN DEVELOPMENT

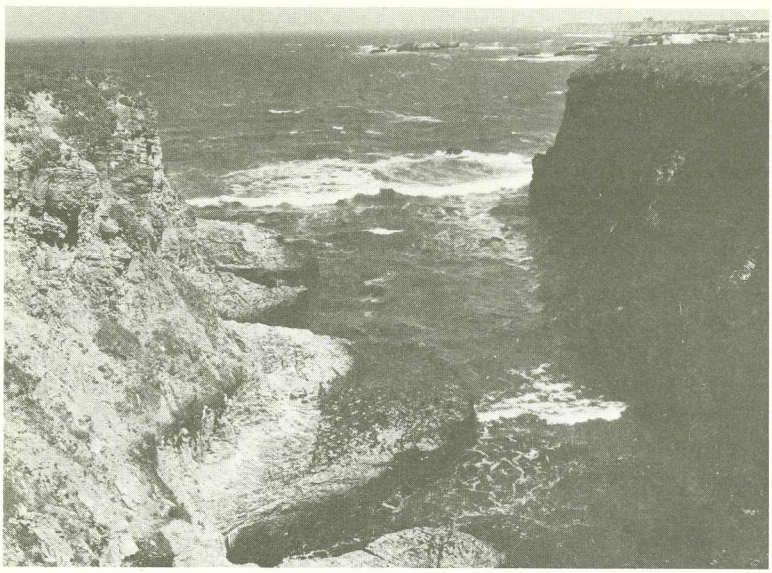
DNOD

1977

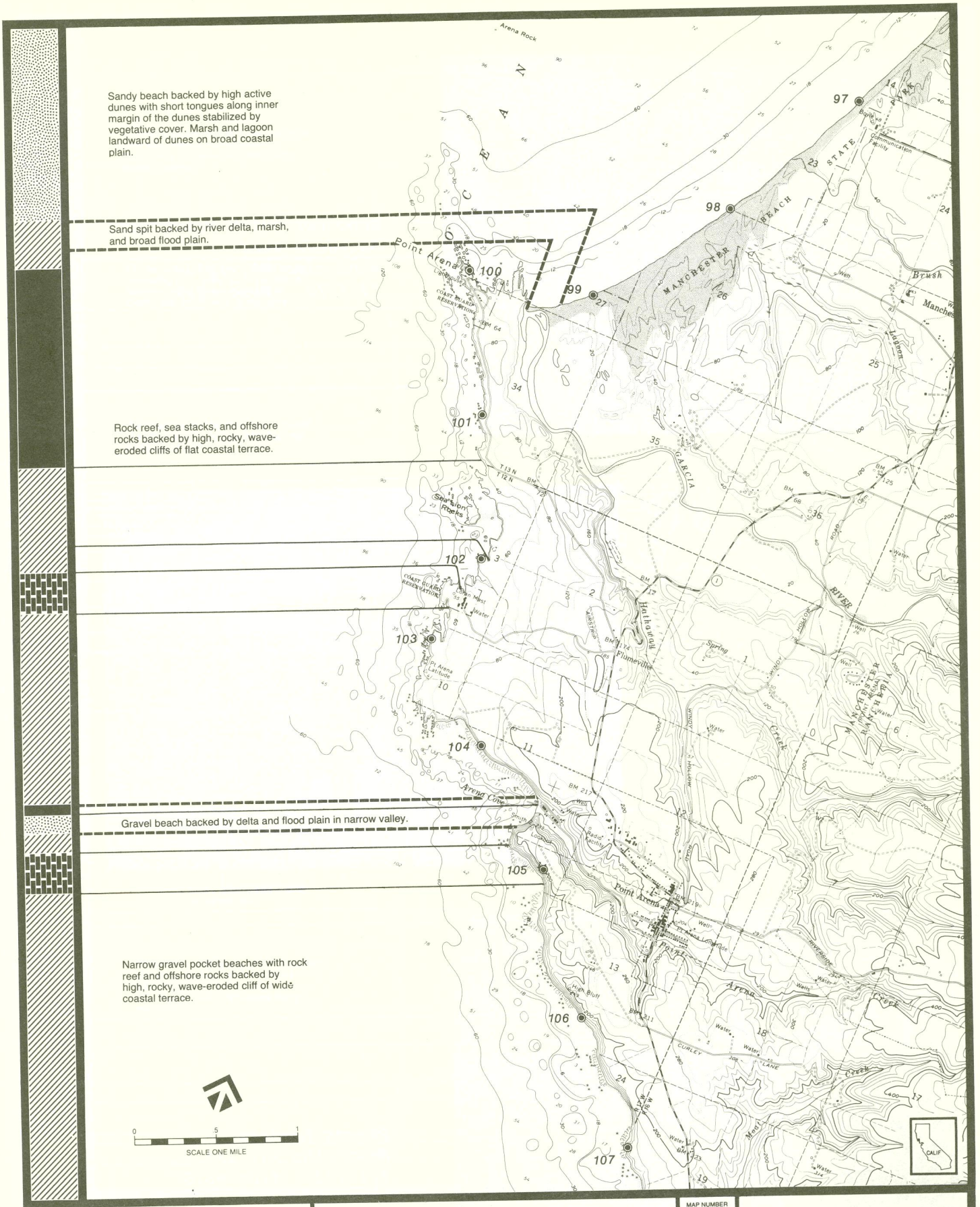


Point Arena
Mendocino Mi. 100.4
12/5/76 Tide -0.3

Sea Lion Rock,
Point Arena
Mendocino Mi. 102.2
6/18/75 Tide +2.1



Arena Cove
Mendocino Mi. 104.5
12/6/76 Tide +5.6



▪ SHORELINE CONDITION ▪

- PRESENT DEVELOPMENT CRITICAL
- PRESENT DEVELOPMENT NON-CRITICAL
- FUTURE DEVELOPMENT CRITICAL
- ARTIFICIAL PROTECTION
- PROTECTIVE BEACH
- STABLE ROCK

MENDOCINO CO. — MI. 97-107

MAP NUMBER **33**

STATE OF CALIFORNIA — THE RESOURCES AGENCY

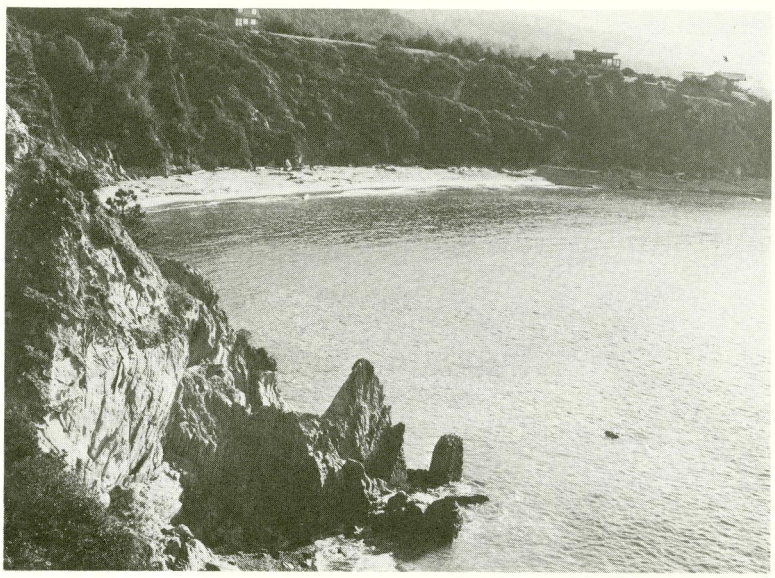
DEPARTMENT OF NAVIGATION & OCEAN DEVELOPMENT

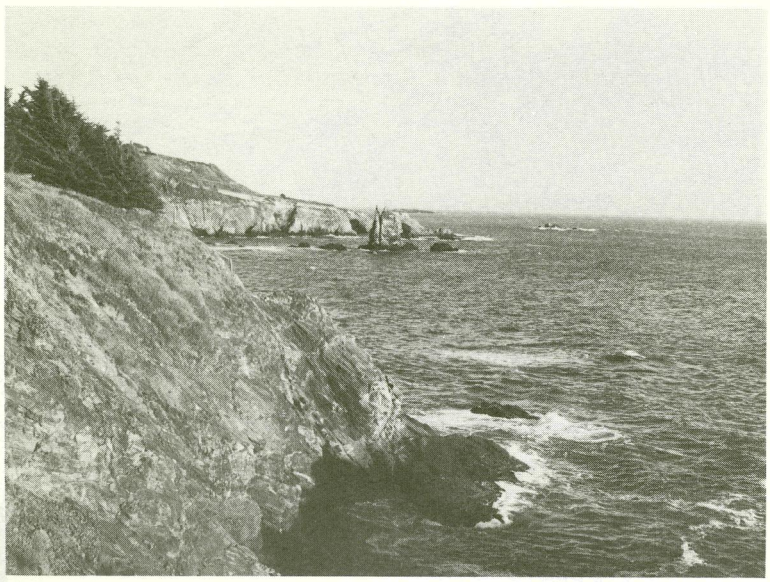
DNOD

1977

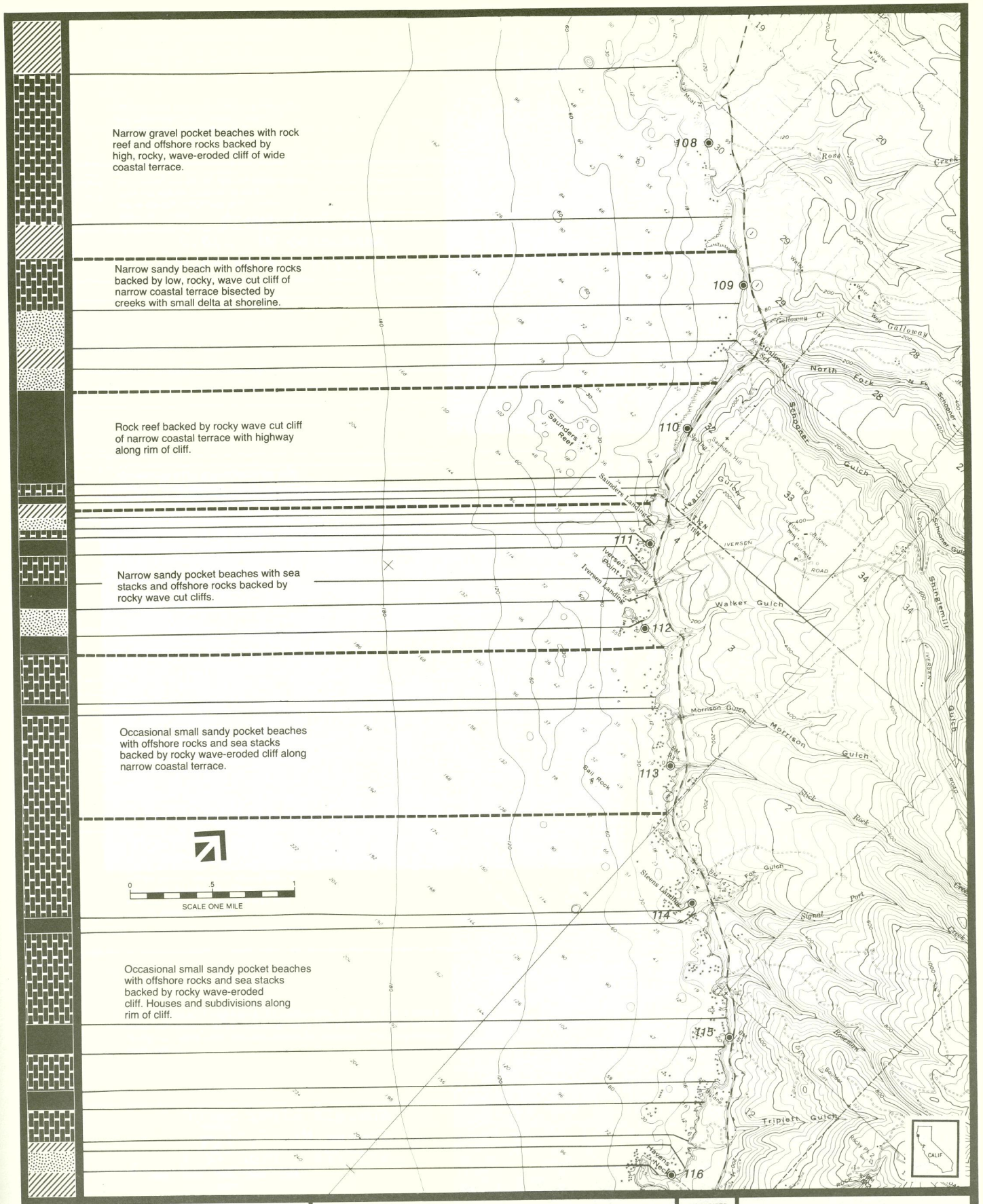
Schooner Gulch Beach and
Saunders Reef
Mendocino Mi. 110.0
12/5/76 Tide -0.5

Iverson Landing Beach
Mendocino Mi. 111.6
12/6/76 Tide +5.7





Steens Landing
Mendocino Mi. 114.0
6/17/75 Tide +5.0



▪ SHORELINE CONDITION ▪

- PRESENT DEVELOPMENT CRITICAL
- PRESENT DEVELOPMENT NON-CRITICAL
- FUTURE DEVELOPMENT CRITICAL
- ARTIFICIAL PROTECTION
- PROTECTIVE BEACH
- STABLE ROCK

MENDOCINO CO. — MI. 108-116

MAP NUMBER 34

STATE OF CALIFORNIA — THE RESOURCES AGENCY

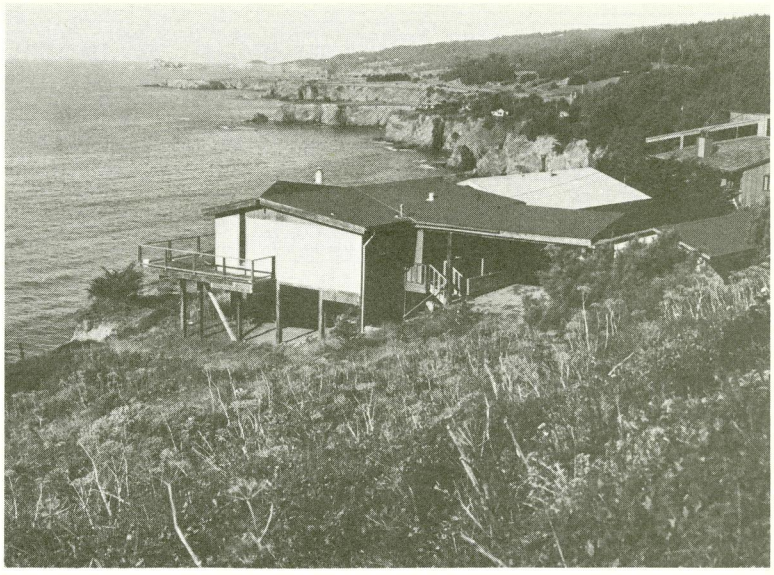
DEPARTMENT OF NAVIGATION & OCEAN DEVELOPMENT

DNOD

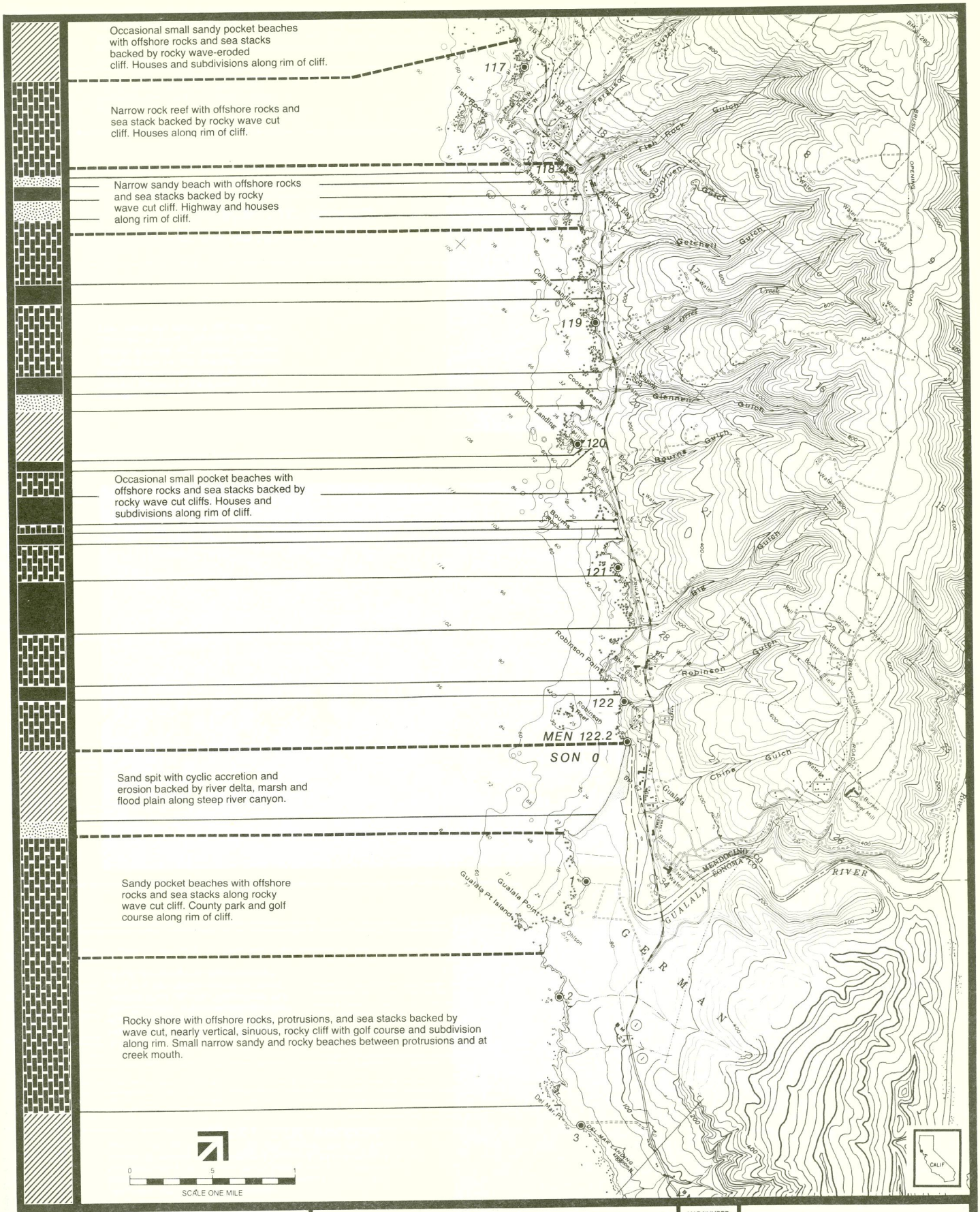
1977

Fish Rock Beach
Mendocino Mi. 118.0
6/17/75 Tide +5.0

Robinson Point
Mendocino Mi. 121.8
12/6/76 Tide +5.3



Gualala River Beach
Sonoma Mi. 0.0
6/17/75 Tide +4.4



▪ SHORELINE CONDITION ▪

- PRESENT DEVELOPMENT CRITICAL
- PRESENT DEVELOPMENT NON-CRITICAL
- FUTURE DEVELOPMENT CRITICAL
- ARTIFICIAL PROTECTION
- PROTECTIVE BEACH
- STABLE ROCK

MENDOCINO CO. — MI. 117 - 122.2
SONOMA CO. — MI. 0 - 3

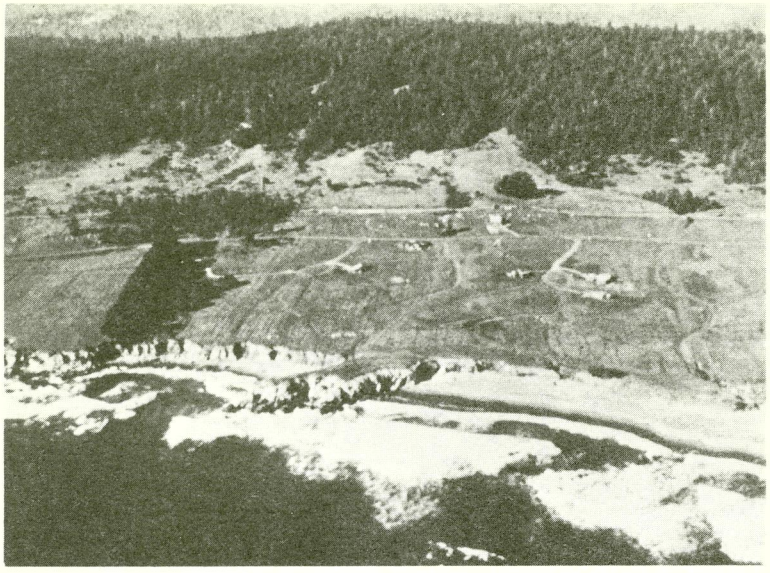
MAP NUMBER **35**

STATE OF CALIFORNIA — THE RESOURCES AGENCY

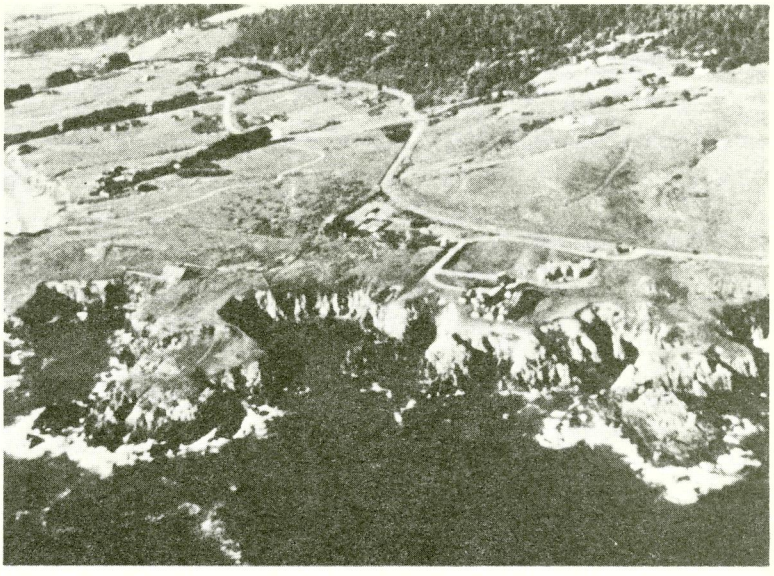
DEPARTMENT OF NAVIGATION & OCEAN DEVELOPMENT

DNOD

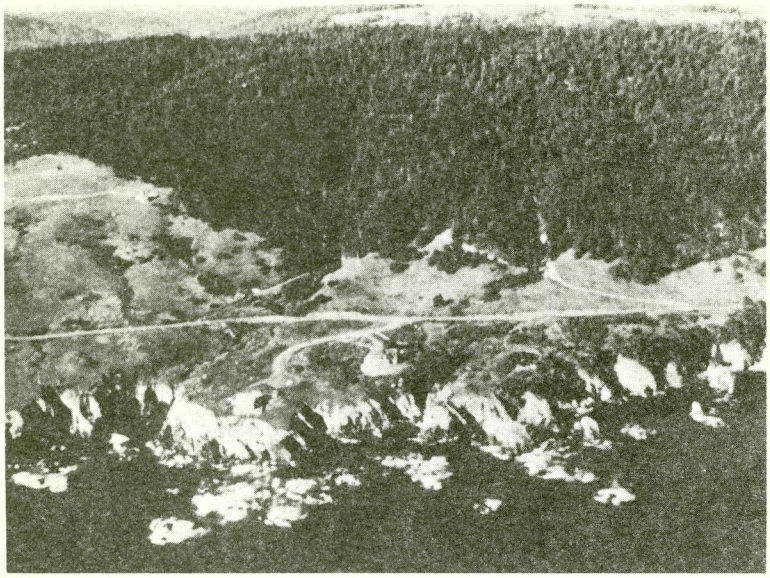
1977



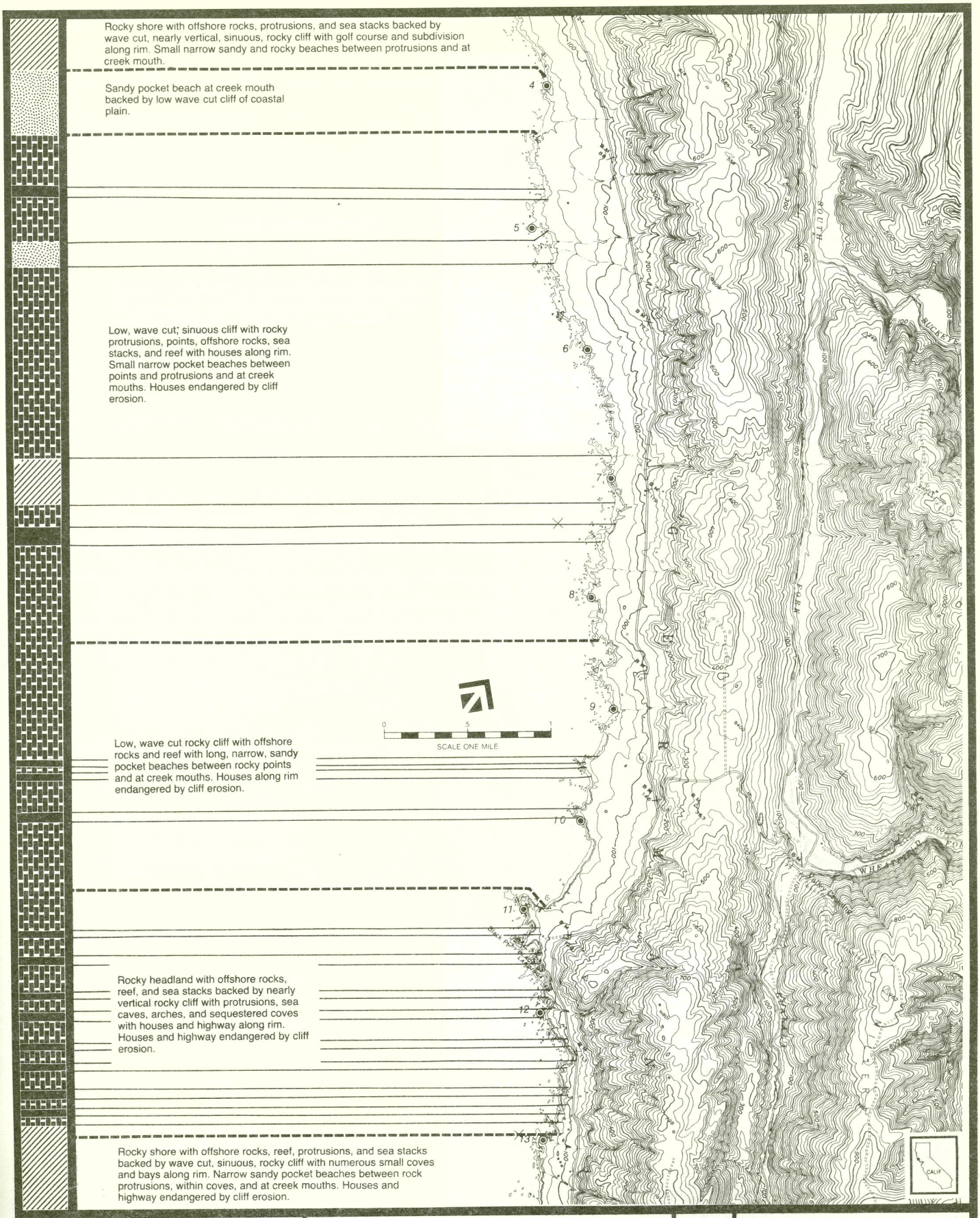
Sonoma Mi. 4.4
5/2/72 Tide +3.5



Sonoma Mi. 11.5
5/2/72 Tide +3.5



Sonoma Mi. 12.00
5/2/72 Tide +3.5



• SHORELINE CONDITION •

PRESENT DEVELOPMENT CRITICAL	ARTIFICIAL PROTECTION
PRESENT DEVELOPMENT NON-CRITICAL	PROTECTIVE BEACH
FUTURE DEVELOPMENT CRITICAL	STABLE ROCK

SONOMA CO. — MI. 4-13

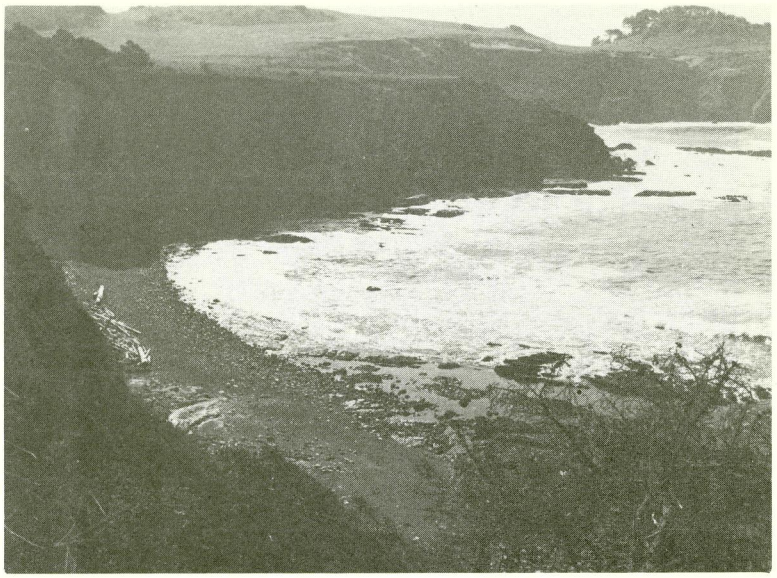
MAP NUMBER 36

STATE OF CALIFORNIA — THE RESOURCES AGENCY

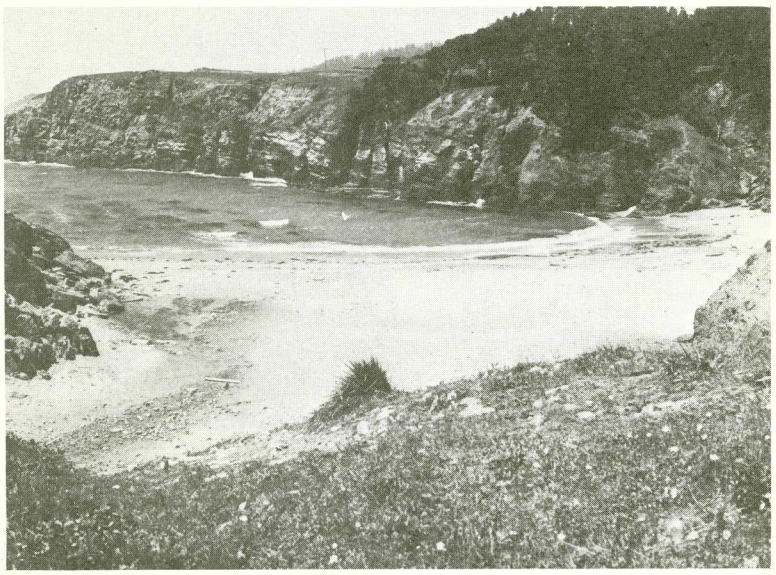
DEPARTMENT OF NAVIGATION & OCEAN DEVELOPMENT

DNOD

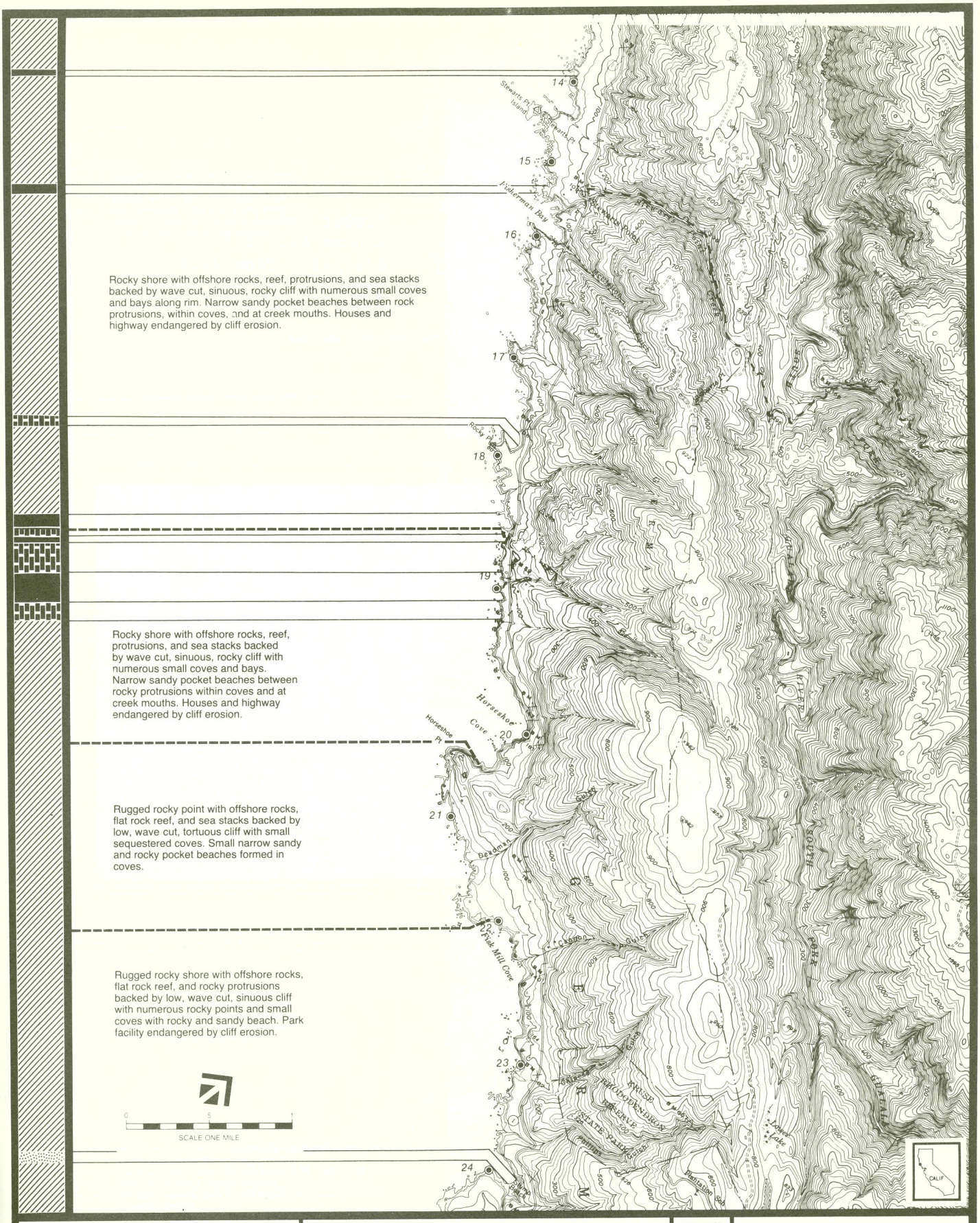
1977



Horseshoe Cove
Sonoma Mi. 19.8
2/10/76 Tide +1.2



Salt Point State Park
Sonoma Mi. 23.7
6/17/75 Tide +2.6



• SHORELINE CONDITION •

- PRESENT DEVELOPMENT CRITICAL
- PRESENT DEVELOPMENT NON-CRITICAL
- FUTURE DEVELOPMENT CRITICAL
- ARTIFICIAL PROTECTION
- PROTECTIVE BEACH
- STABLE ROCK

SONOMA CO. — MI. 14 - 24

MAP NUMBER **37**

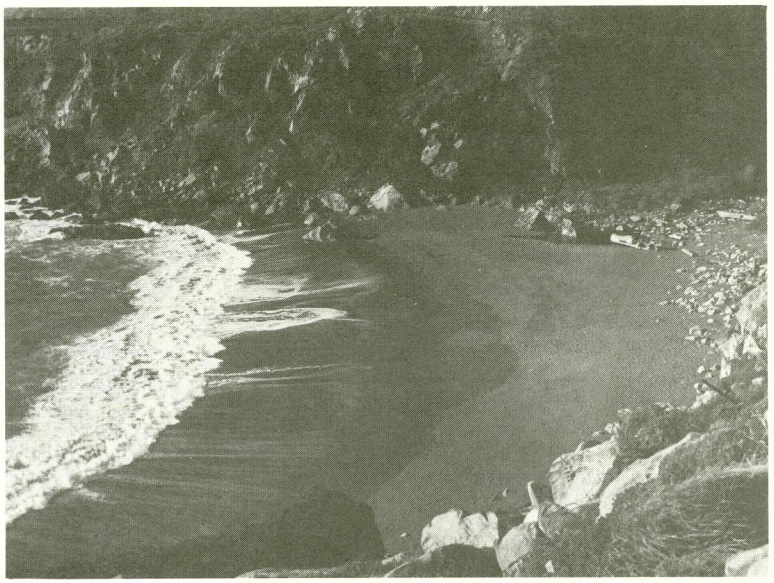
STATE OF CALIFORNIA — THE RESOURCES AGENCY

DEPARTMENT OF NAVIGATION & OCEAN DEVELOPMENT

DNOD

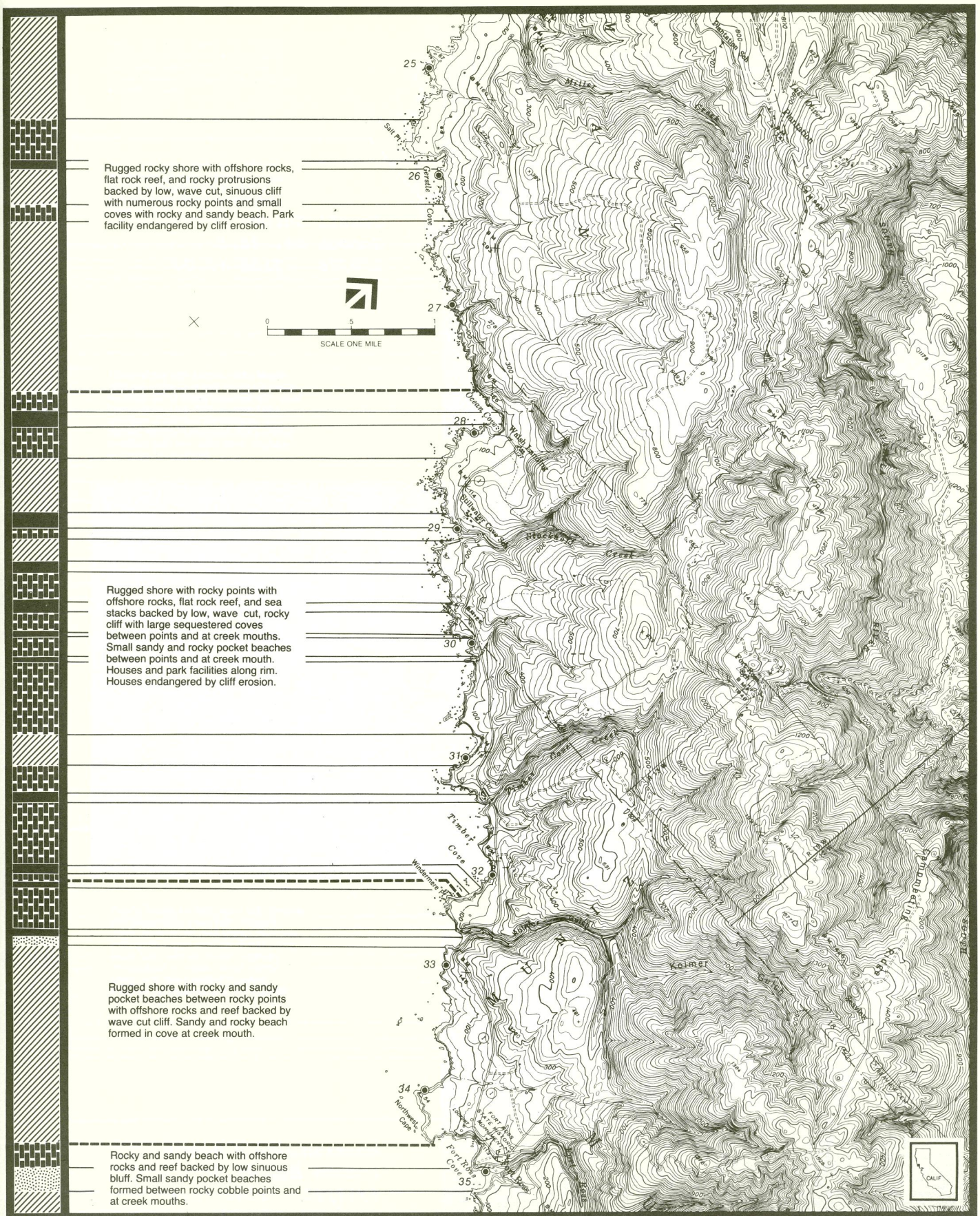
1977

Timber Cove
Sonoma Mi. 31.5
6/17/75 Tide +1.9



Kolmer Gulch Beach
Sonoma Mi. 32.8
2/9/76 Tide +1.8

Fort Ross Cove
Sonoma Mi. 34.9
2/9/76 Tide +1.5



▪ SHORELINE CONDITION ▪

- PRESENT DEVELOPMENT CRITICAL
- PRESENT DEVELOPMENT NON-CRITICAL
- FUTURE DEVELOPMENT CRITICAL
- ARTIFICIAL PROTECTION
- PROTECTIVE BEACH
- STABLE ROCK

SONOMA CO. — MI. 25-35

MAP NUMBER **38**

STATE OF CALIFORNIA — THE RESOURCES AGENCY

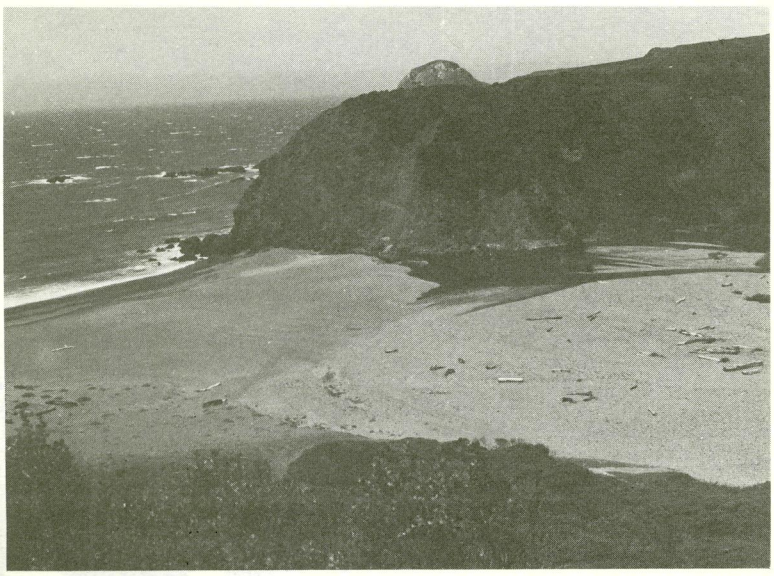
DEPARTMENT OF NAVIGATION & OCEAN DEVELOPMENT

DNOD

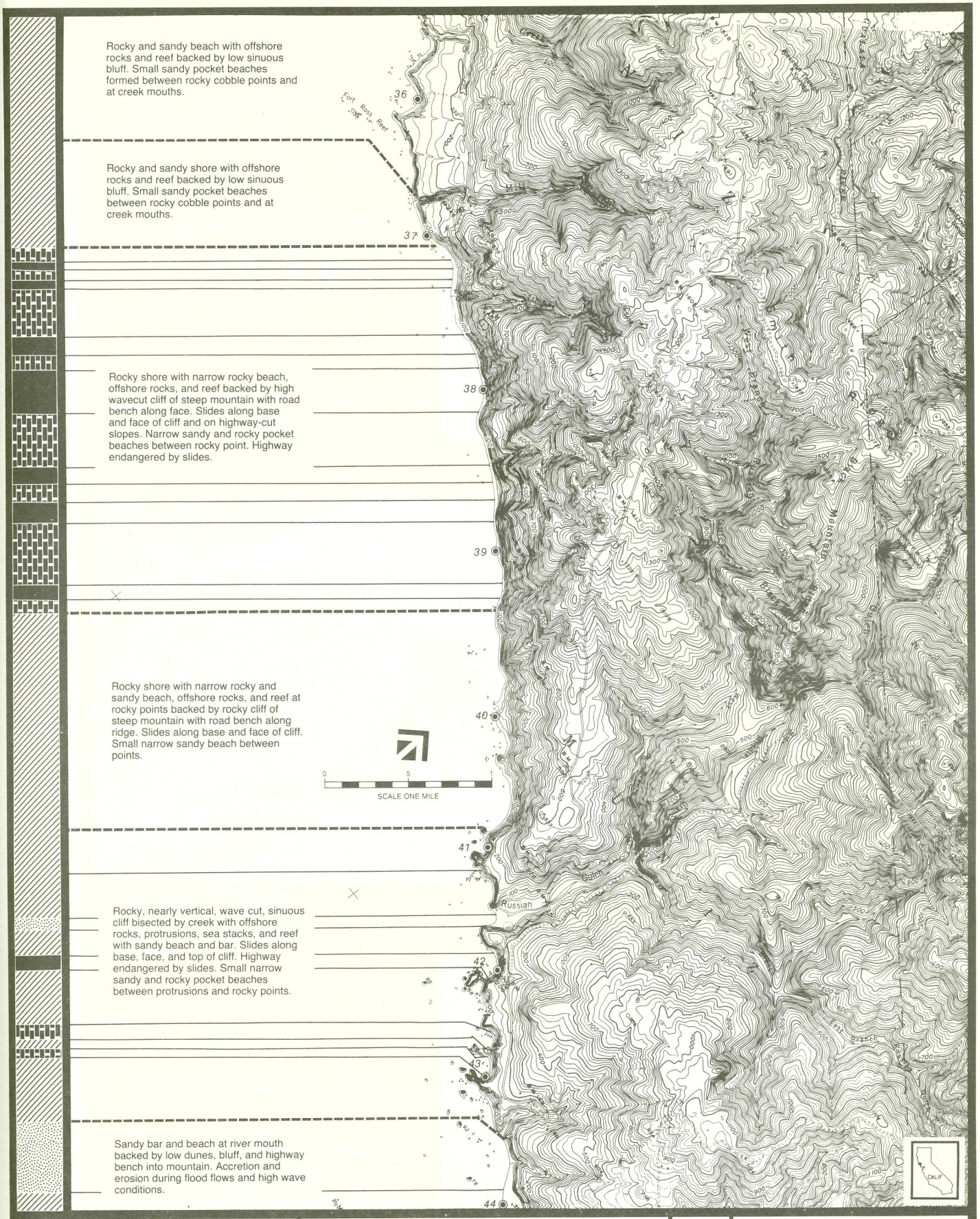
1977

Jewell Gulch
Sonoma Mi. 38.5
2/9/76 Tide +1.00

Jewell Canyon Area
Sonoma Mi. 38.7
2/10/76 Tide +0.4



Russian Gulch Beach
Sonoma Mi. 41.5
6/17/75 Tide +1.1



▪ SHORELINE CONDITION ▪

- PRESENT DEVELOPMENT CRITICAL
- PRESENT DEVELOPMENT NON-CRITICAL
- FUTURE DEVELOPMENT CRITICAL
- ARTIFICIAL PROTECTION
- PROTECTIVE BEACH
- STABLE ROCK

SONOMA CO. — MI. 36 - 44

MAP NUMBER 39

STATE OF CALIFORNIA — THE RESOURCES AGENCY

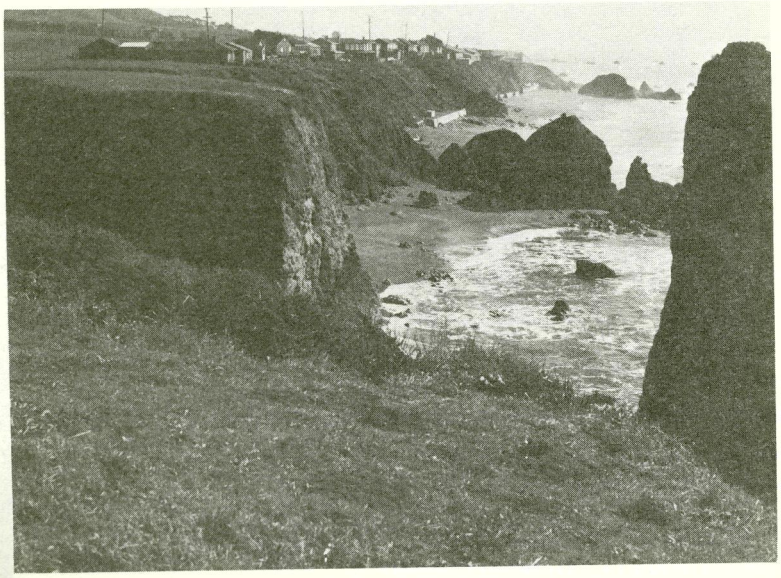
DEPARTMENT OF NAVIGATION & OCEAN DEVELOPMENT

DNOD

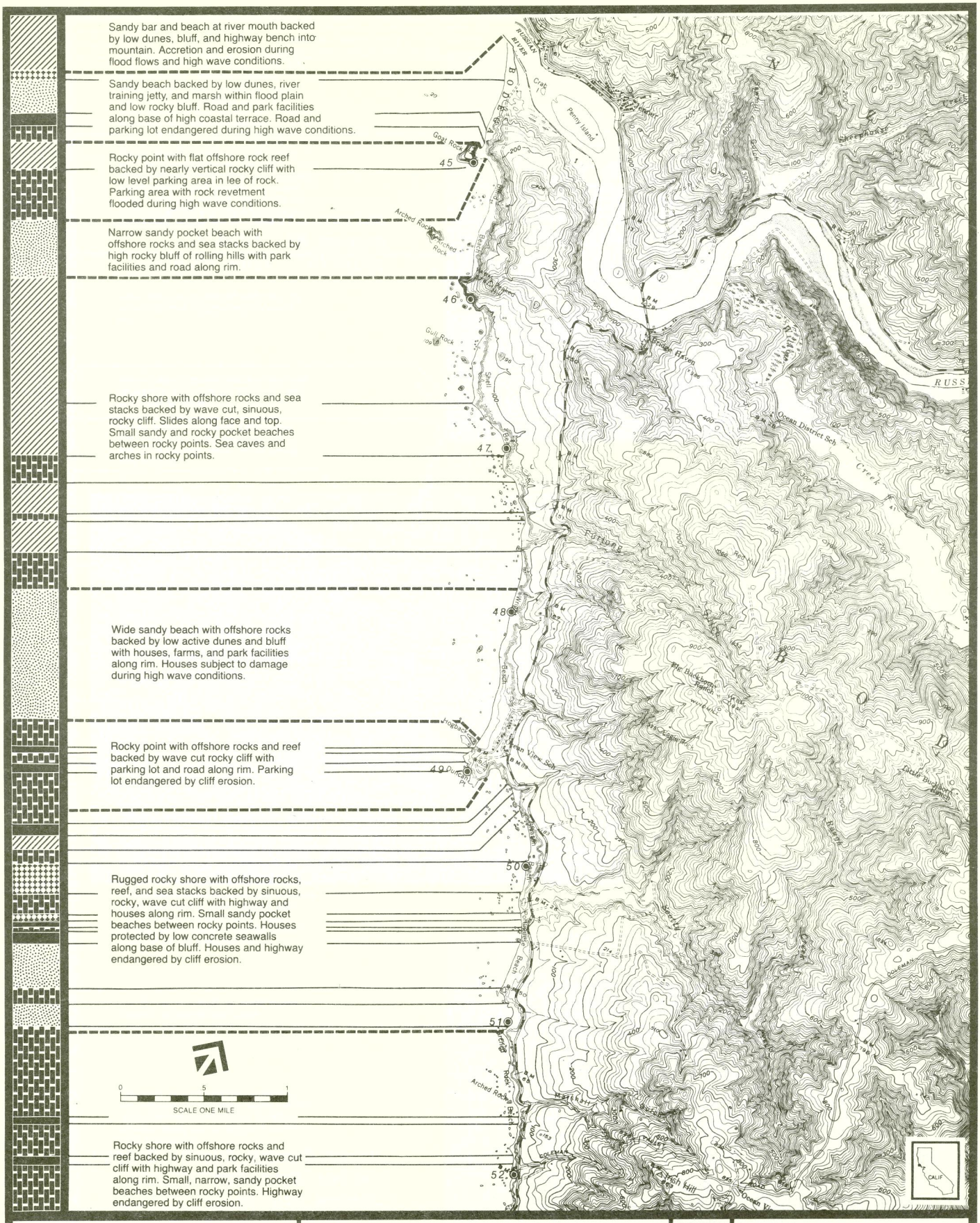
1977

Russian River Mouth
and Jetty
Sonoma Mi. 43.9
6/17/75 Tide +1.1

Blind Beach, Goat
Rock State Park
Sonoma Mi. 44.8
6/2/76 Tide +1.40



Gleason Beach,
Portuguese Beach
Sonoma Mi. 49.8
2/10/76 Tide +0.4



• SHORELINE CONDITION •

- PRESENT DEVELOPMENT CRITICAL
- PRESENT DEVELOPMENT NON-CRITICAL
- FUTURE DEVELOPMENT CRITICAL
- ARTIFICIAL PROTECTION
- PROTECTIVE BEACH
- STABLE ROCK

SONOMA CO. — MI. 45 - 52

MAP NUMBER 40

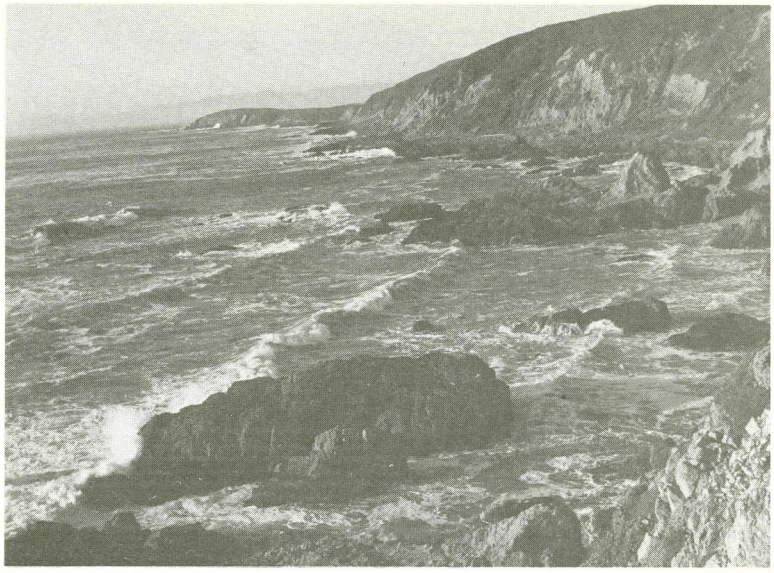
STATE OF CALIFORNIA — THE RESOURCES AGENCY

DEPARTMENT OF NAVIGATION & OCEAN DEVELOPMENT

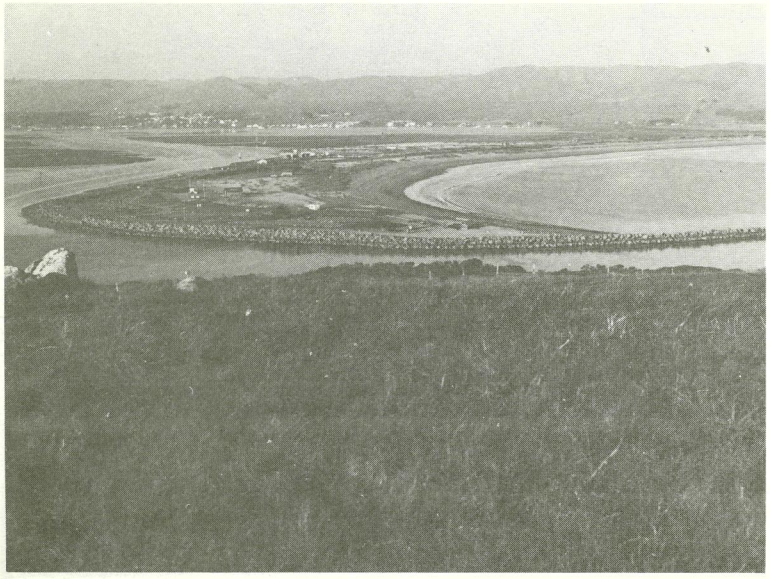
DNOD

1977

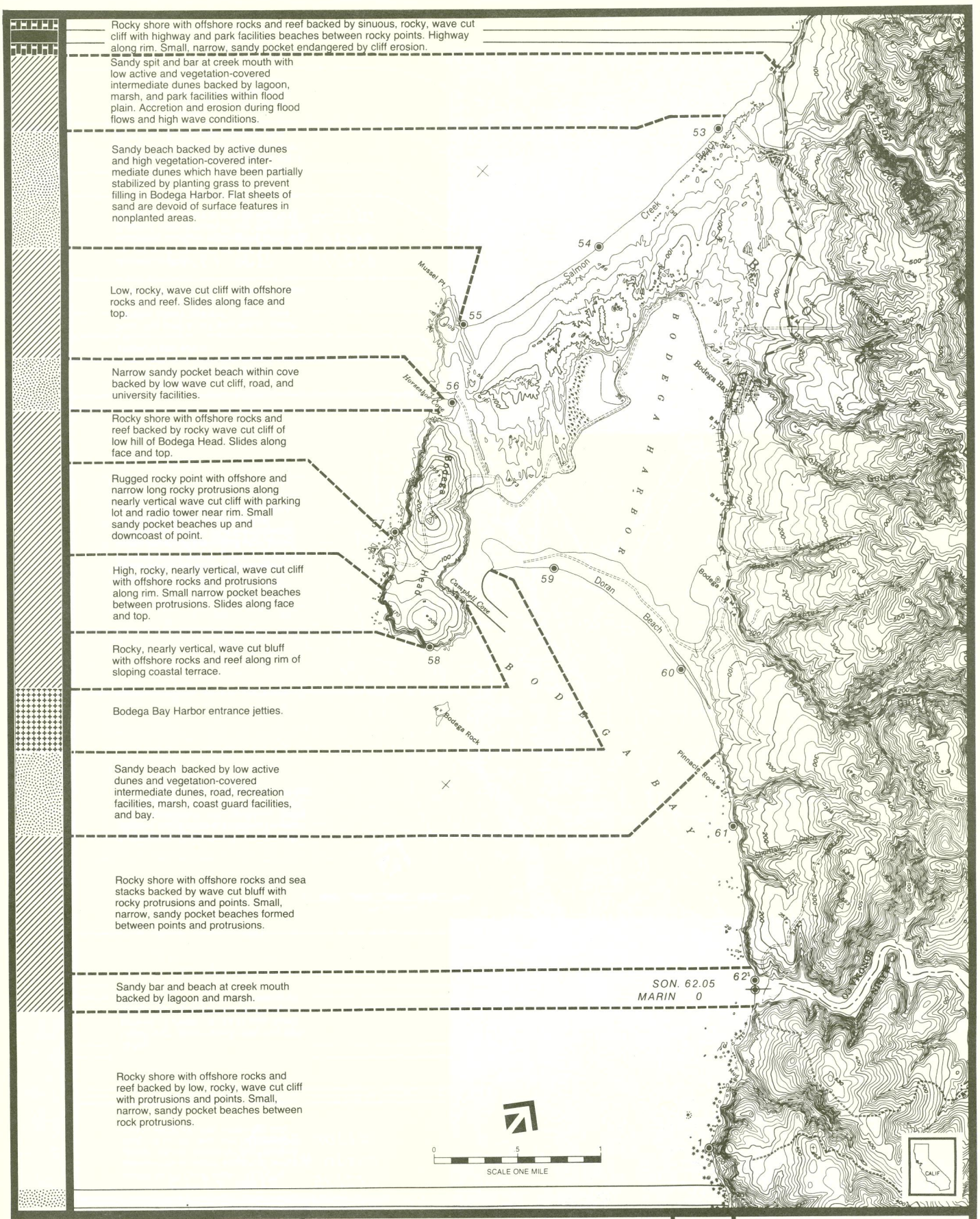
Salmon Creek State Beach
Sonoma Mi. 52.4
2/10/76 Tide +0.6



Bodega Head
Sonoma Mi. 57.5
2/10/76 Tide +2.0



Doran County Beach, Bodega Harbor Entrance
Sonoma Mi. 58.5
2/10/76 Tide +1.6



▪ SHORELINE CONDITION ▪

- PRESENT DEVELOPMENT CRITICAL
- PRESENT DEVELOPMENT NON-CRITICAL
- FUTURE DEVELOPMENT CRITICAL
- ARTIFICIAL PROTECTION
- PROTECTIVE BEACH
- STABLE ROCK

SONOMA CO. — MI. 53 - 62.5
MARIN CO. — MI. 0 - 1

MAP NUMBER **41**

STATE OF CALIFORNIA — THE RESOURCES AGENCY

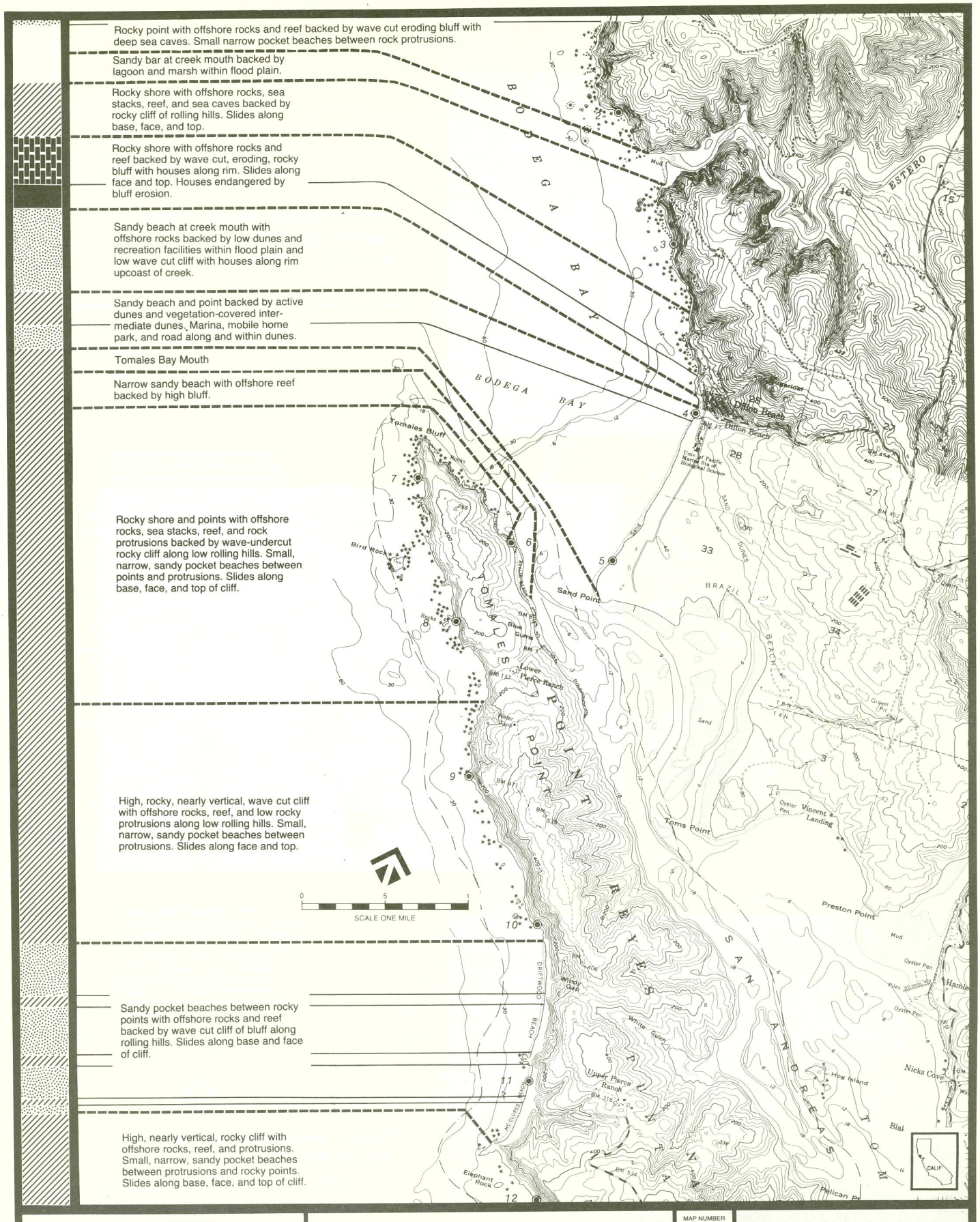
DEPARTMENT OF NAVIGATION & OCEAN DEVELOPMENT

DNOD

1977

Dillon Beach
Marin Mi. 3.9
6/2/75 Tide +3.13

Dillon Beach
Marin Mi. 3.9
6/2/75 Tide +3.13



▪ SHORELINE CONDITION ▪

- PRESENT DEVELOPMENT CRITICAL
- PRESENT DEVELOPMENT NON-CRITICAL
- FUTURE DEVELOPMENT CRITICAL
- ARTIFICIAL PROTECTION
- PROTECTIVE BEACH
- STABLE ROCK

MARIN CO. — MI. 2-12

MAP NUMBER 42

STATE OF CALIFORNIA — THE RESOURCES AGENCY

DEPARTMENT OF NAVIGATION & OCEAN DEVELOPMENT

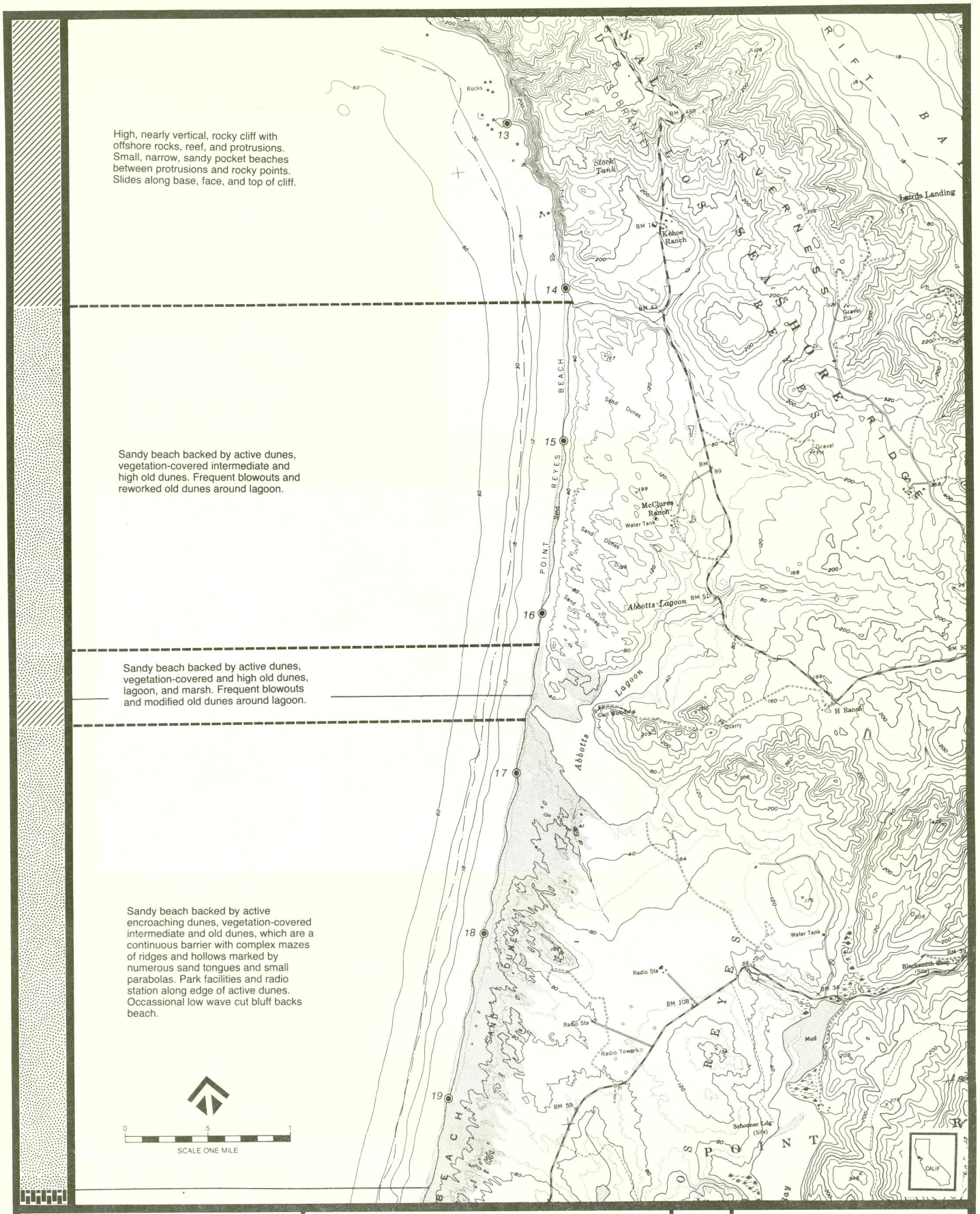
DNOD

1977

Point Reyes Beach North
Marin Mi. 19.5
6/2/75 Tide +4.16

Point Reyes Beach North
Marin Mi. 19.5
2/11/76 Tide +2.7

Point Reyes Beach North
Marin Mi. 19.5
2/11/76 Tide +2.4



▪ SHORELINE CONDITION ▪

- PRESENT DEVELOPMENT CRITICAL
- PRESENT DEVELOPMENT NON-CRITICAL
- FUTURE DEVELOPMENT CRITICAL
- ARTIFICIAL PROTECTION
- PROTECTIVE BEACH
- STABLE ROCK

MARIN CO. — MI. 13 - 19

MAP NUMBER 43

STATE OF CALIFORNIA — THE RESOURCES AGENCY

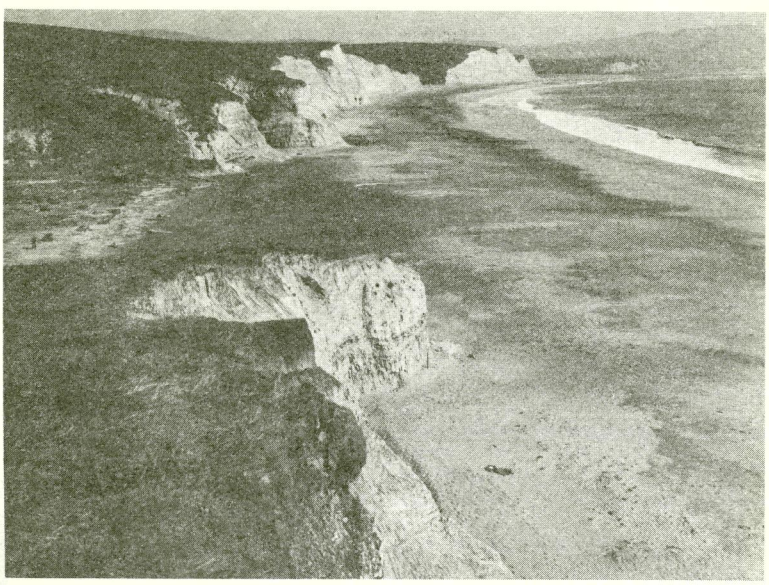
DEPARTMENT OF NAVIGATION & OCEAN DEVELOPMENT

DNOD

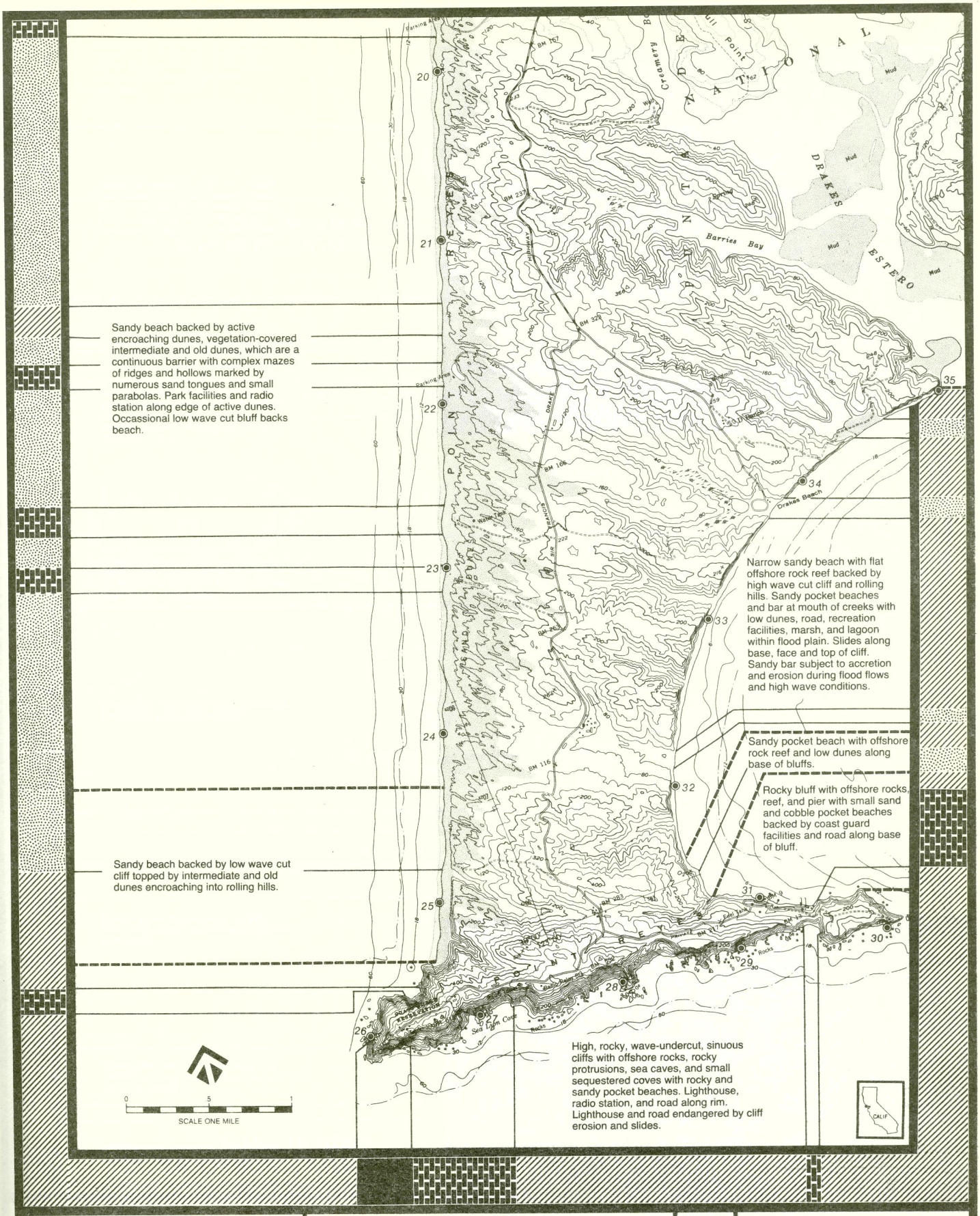
1977

Point Reyes Beach South
Marin Mi. 21.8
2/11/76 Tide +1.9

Point Reyes Beach
Marin Mi. 25.5
2/11/76 Tide +1.5



Drakes Bay Beach
Marin Mi. 33.6
2/11/76 Tide +0.7



▪ SHORELINE CONDITION ▪

- PRESENT DEVELOPMENT CRITICAL
- PRESENT DEVELOPMENT NON-CRITICAL
- FUTURE DEVELOPMENT CRITICAL
- ARTIFICIAL PROTECTION
- PROTECTIVE BEACH
- STABLE ROCK

MARIN CO. — MI. 20 - 35

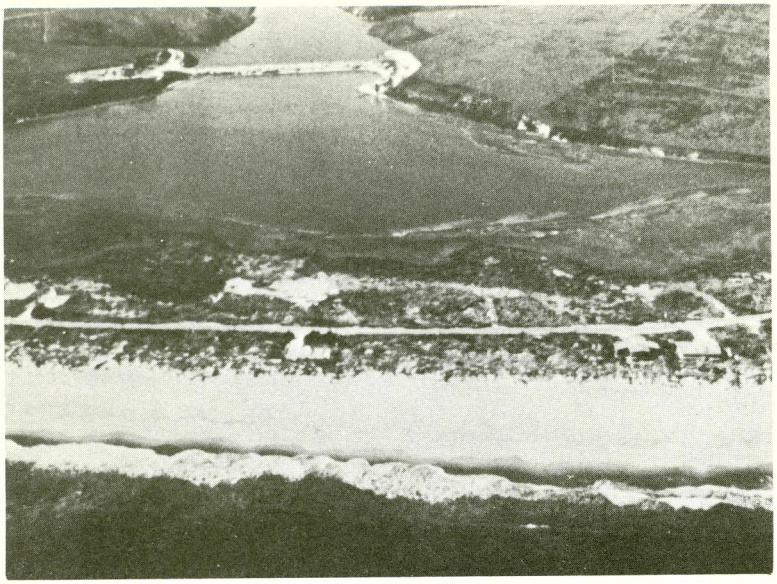
MAP NUMBER **44**

STATE OF CALIFORNIA — THE RESOURCES AGENCY

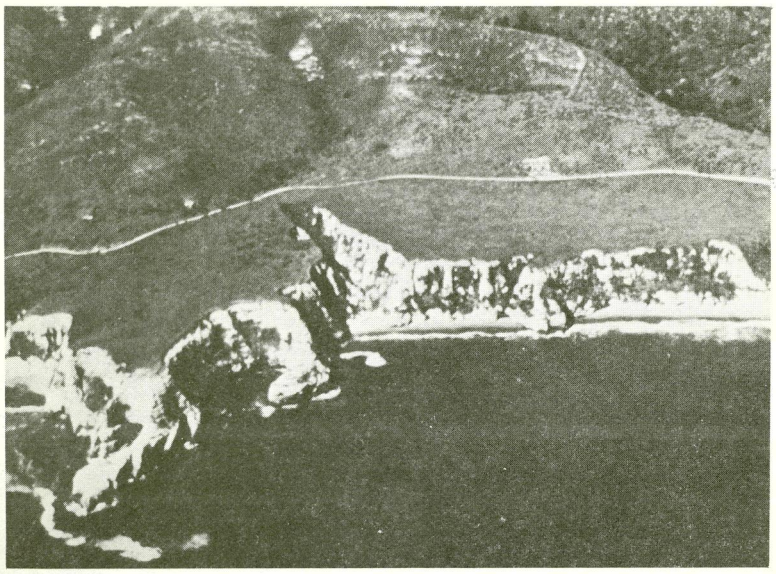
DEPARTMENT OF NAVIGATION & OCEAN DEVELOPMENT

DNOD

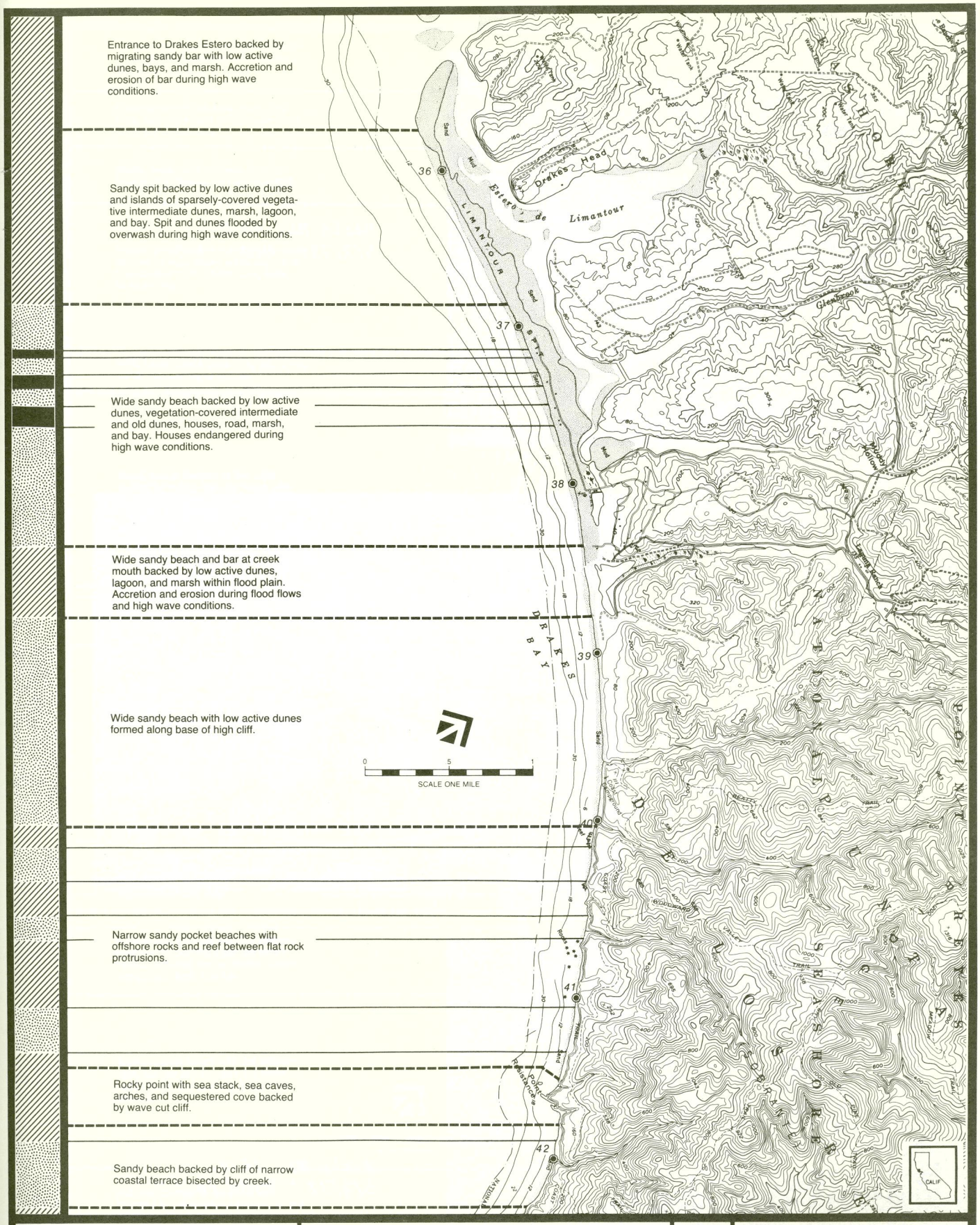
1977



Marin Mi. 37.7
5/2/72 Tide +4.0



Marin Mi. 41.2
5/2/72 Tide +4.0



▪ SHORELINE CONDITION ▪

- PRESENT DEVELOPMENT CRITICAL
- PRESENT DEVELOPMENT NON-CRITICAL
- FUTURE DEVELOPMENT CRITICAL
- ARTIFICIAL PROTECTION
- PROTECTIVE BEACH
- STABLE ROCK

MARIN CO. — MI. 36 - 42

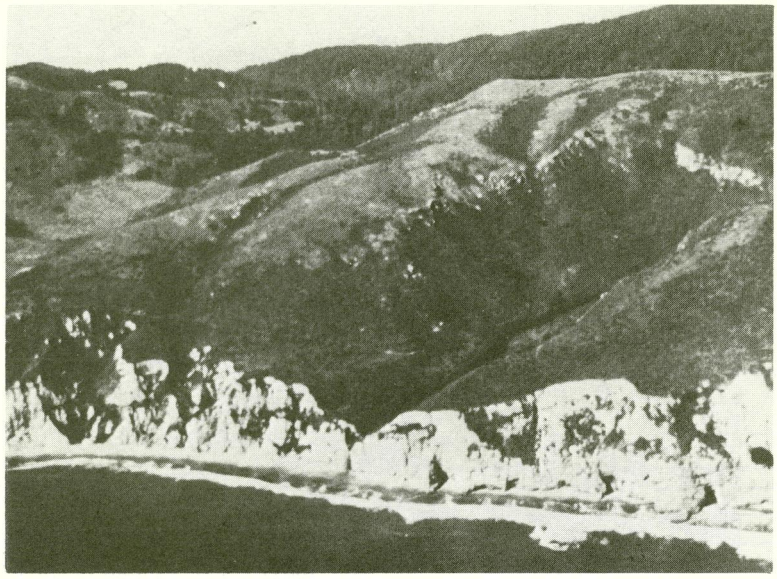
MAP NUMBER **45**

STATE OF CALIFORNIA — THE RESOURCES AGENCY

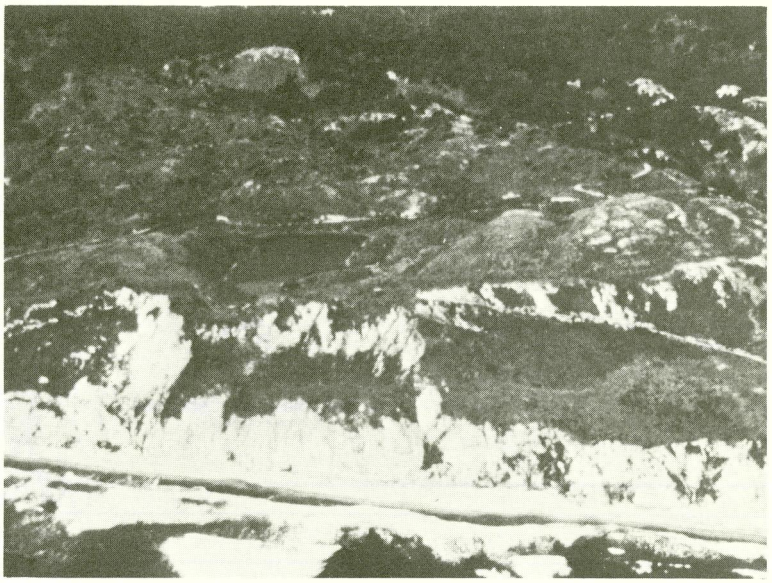
DEPARTMENT OF NAVIGATION & OCEAN DEVELOPMENT

DNOD

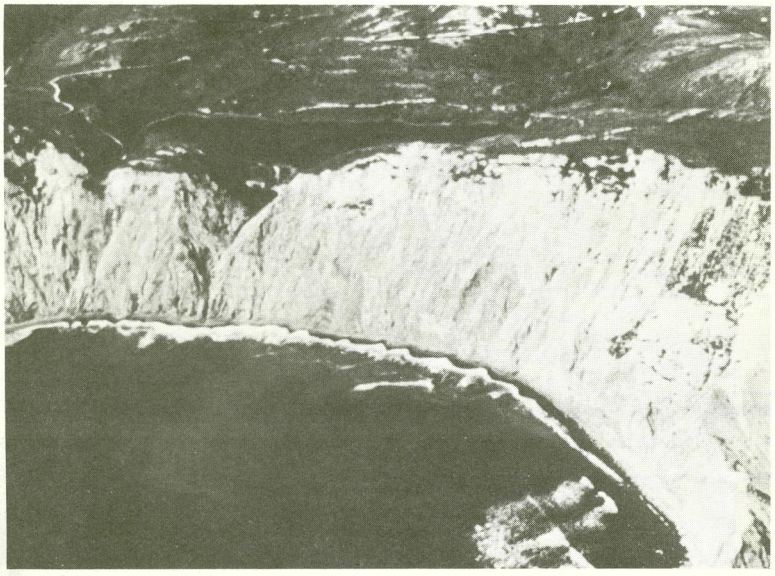
1977



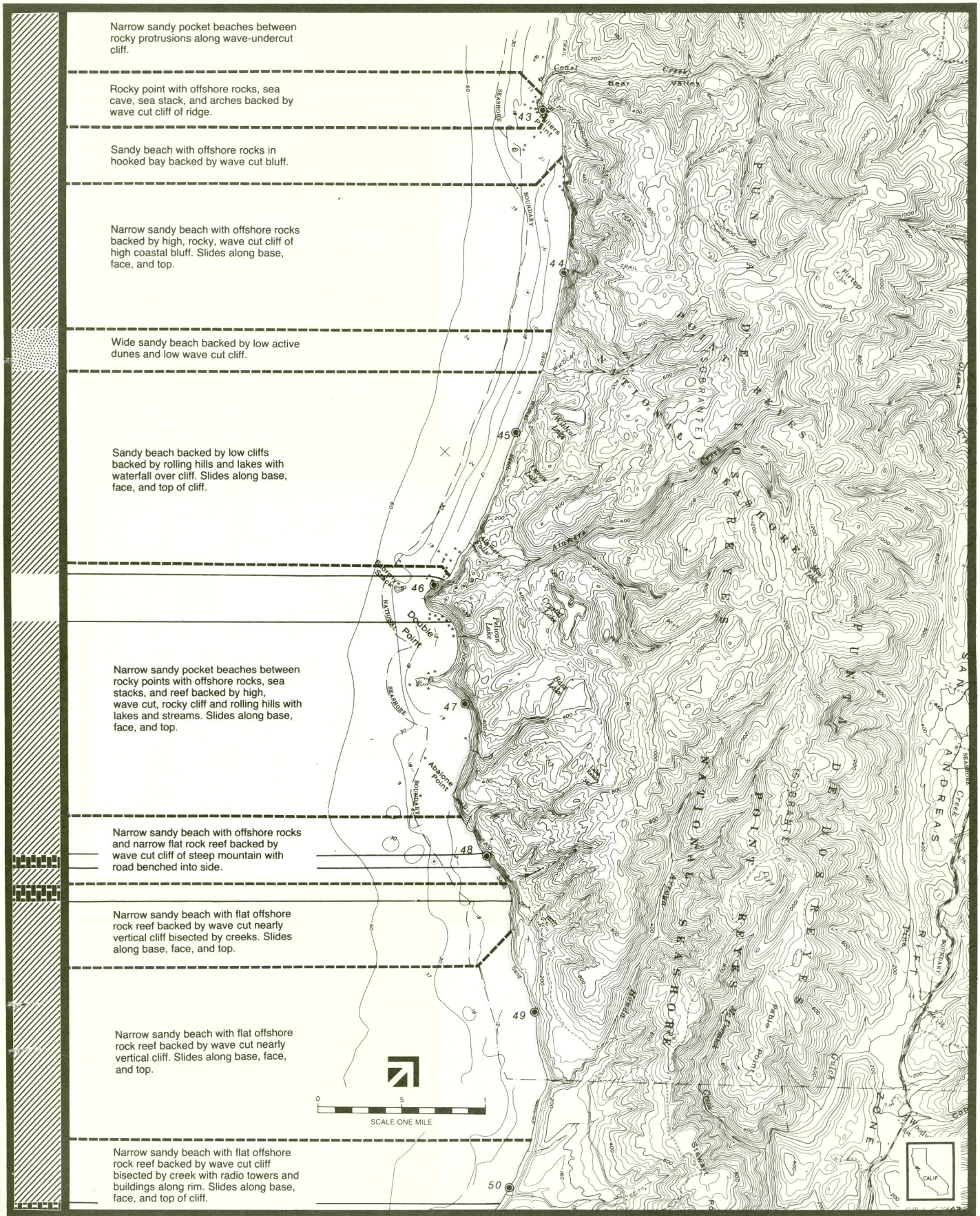
Marin Mi. 43.3
5/2/72 Tide +4.0



Marin Mi. 45.00
5/2/72 Tide +4.0



Marin Mi. 46.5
5/2/72 Tide +4.0



• SHORELINE CONDITION •

- PRESENT DEVELOPMENT CRITICAL
- PRESENT DEVELOPMENT NON-CRITICAL
- FUTURE DEVELOPMENT CRITICAL
- ARTIFICIAL PROTECTION
- PROTECTIVE BEACH
- STABLE ROCK

MARIN CO. — MI. 43 - 50

MAP NUMBER **46**

STATE OF CALIFORNIA — THE RESOURCES AGENCY

DEPARTMENT OF NAVIGATION & OCEAN DEVELOPMENT

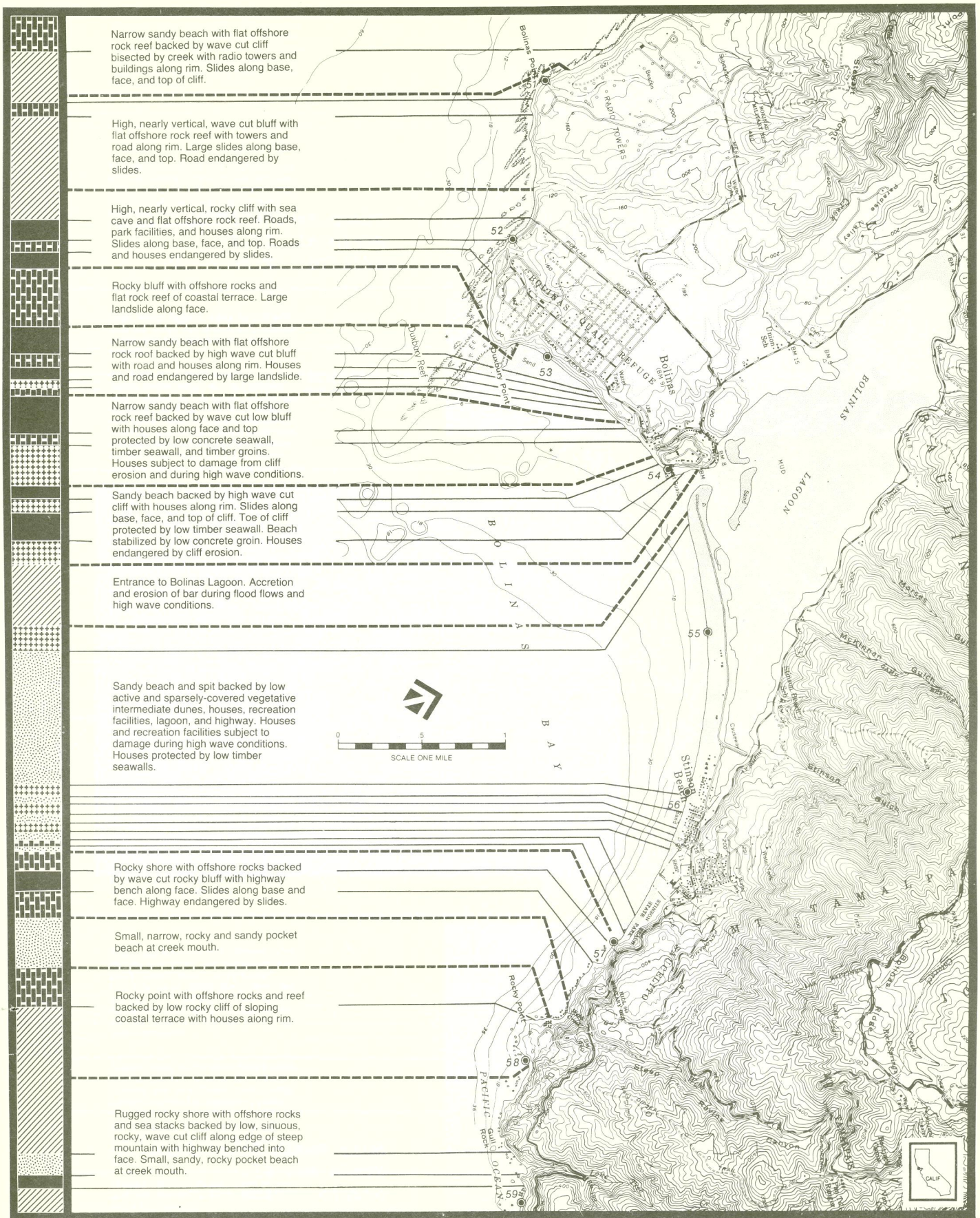
DNOD

1977

Duxbury Reef
Marin Mi. 52.2
2/11/76 Tide -0.1

Bolinas Beach
Marin Mi. 52.8
2/11/76 Tide -0.2

Stinson State Beach
Marin Mi. 57.0
2/11/76 Tide +0.30



▪ SHORELINE CONDITION ▪

- PRESENT DEVELOPMENT CRITICAL
- ARTIFICIAL PROTECTION
- PRESENT DEVELOPMENT NON-CRITICAL
- PROTECTIVE BEACH
- FUTURE DEVELOPMENT CRITICAL
- STABLE ROCK

MARIN CO. — MI. 51 - 59

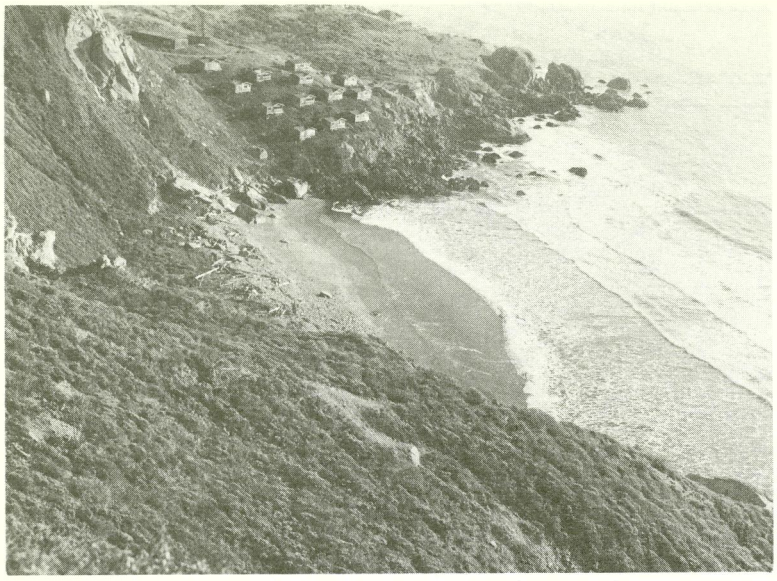
MAP NUMBER 47

STATE OF CALIFORNIA — THE RESOURCES AGENCY

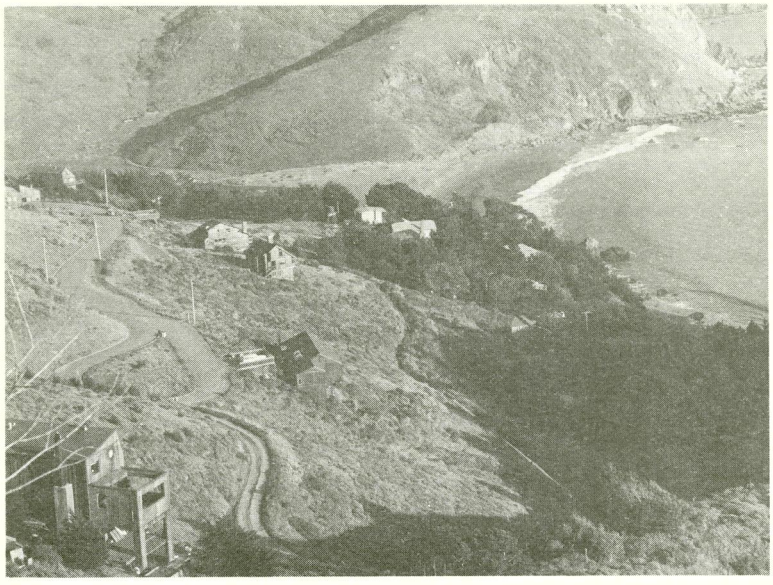
DEPARTMENT OF NAVIGATION & OCEAN DEVELOPMENT

DNOD

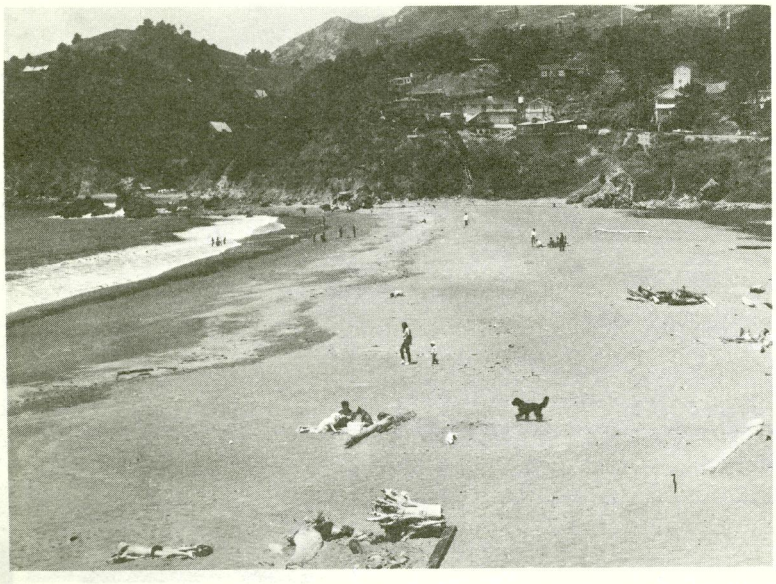
1977



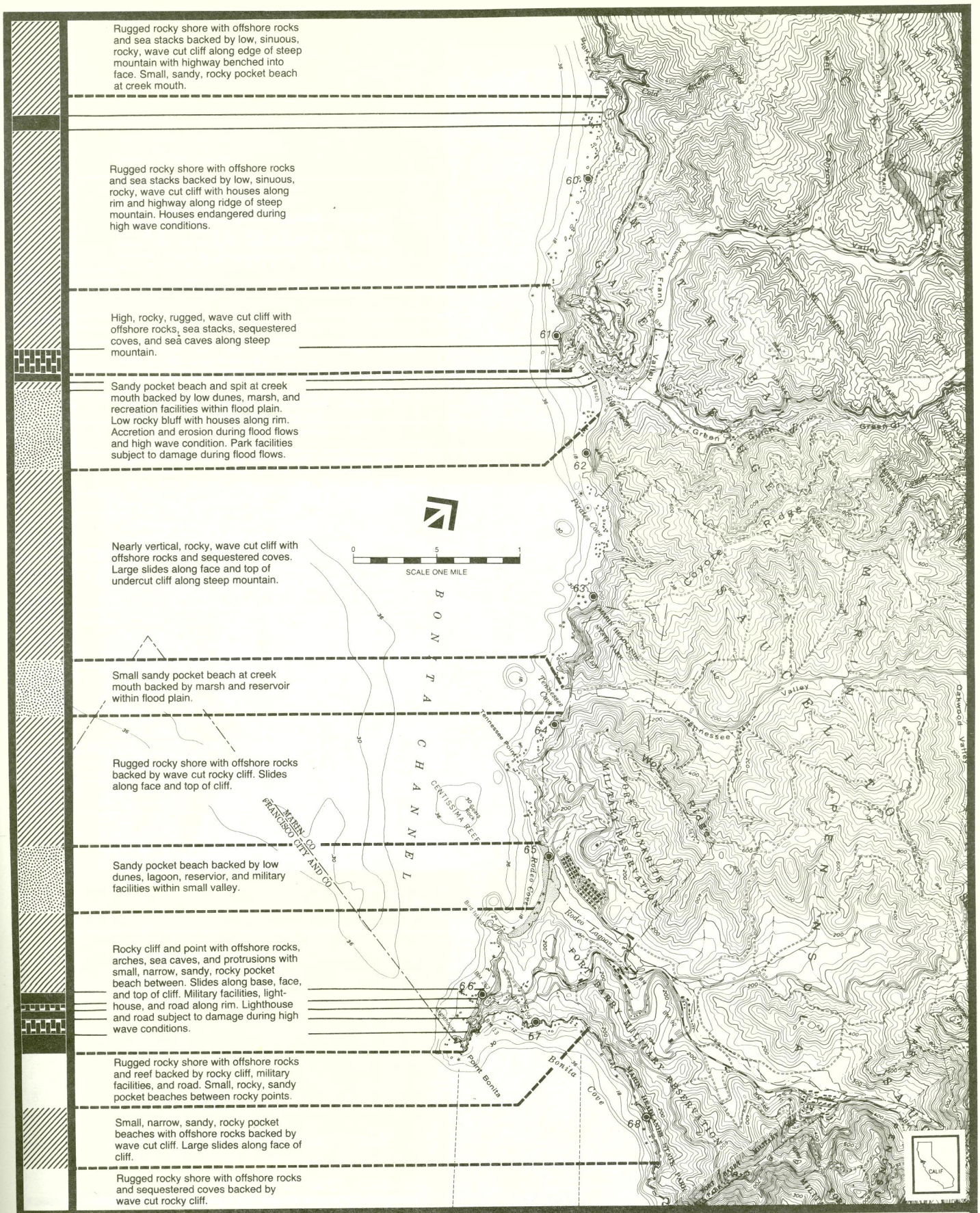
Steep Ravine Beach
Marin Mi. 57.4
2/11/76 Tide +0.35



Muir Beach
Marin Mi. 60.8
2/11/76 Tide +0.50



Muir Beach State Park
Marin Mi. 61.7
6/3/75 Tide +1.55



• SHORELINE CONDITION •

- PRESENT DEVELOPMENT CRITICAL
- PRESENT DEVELOPMENT NON-CRITICAL
- FUTURE DEVELOPMENT CRITICAL
- ARTIFICIAL PROTECTION
- PROTECTIVE BEACH
- STABLE ROCK

MARIN CO. — MI. 60 - 68

MAP NUMBER **48**

STATE OF CALIFORNIA — THE RESOURCES AGENCY

DEPARTMENT OF NAVIGATION & OCEAN DEVELOPMENT

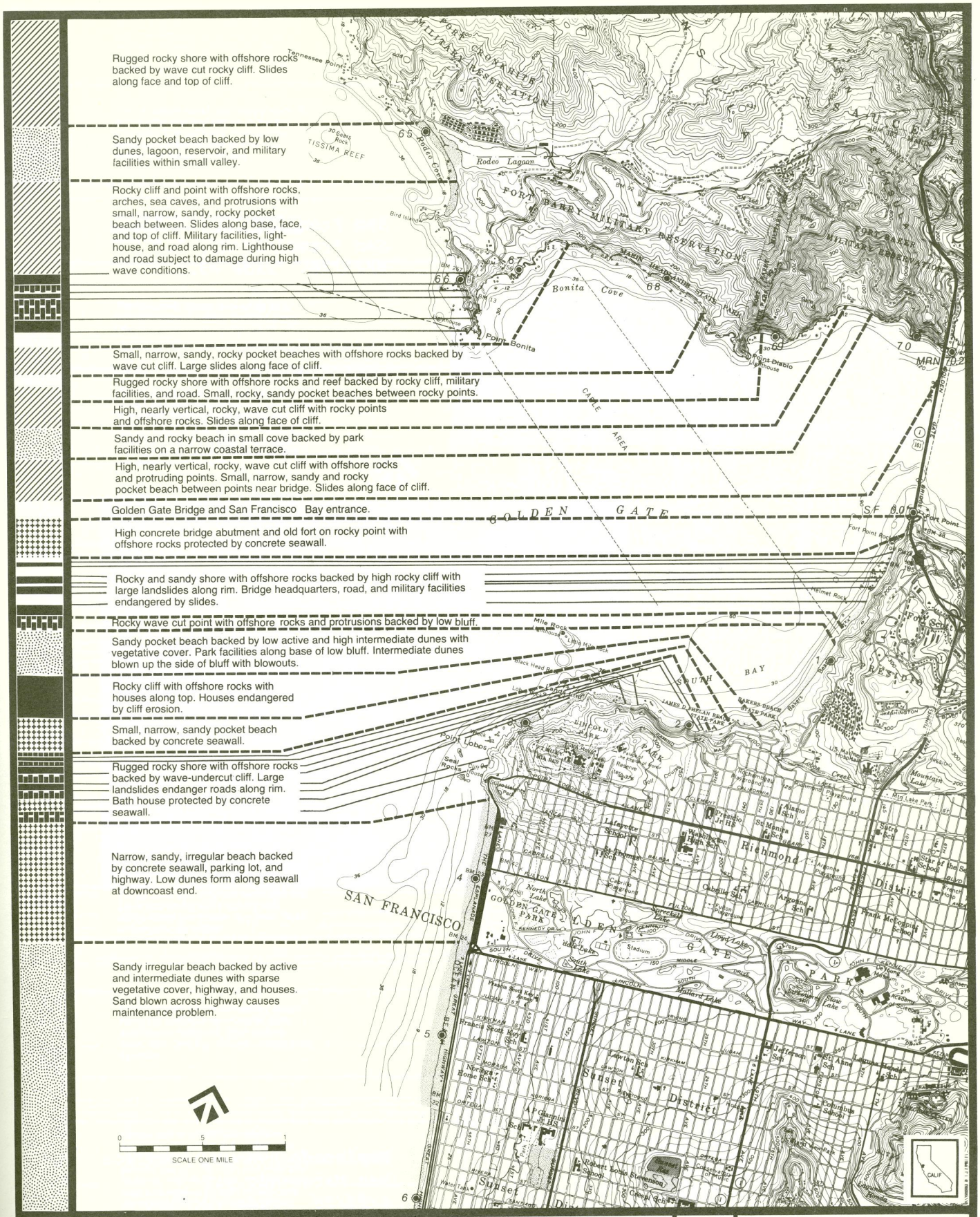
DNOD

1977

Baker Beach National Park
San Francisco Mi. 1.4
6/23/76 Tide +4.1

San Francisco Beach
San Francisco Mi. 3.6
6/3/75 Tide +2.0

San Francisco North Beach
Ocean Beach
San Francisco Mi. 4.5
6/23/76 Tide +3.6



▪ SHORELINE CONDITION ▪

- PRESENT DEVELOPMENT CRITICAL
- PRESENT DEVELOPMENT NON-CRITICAL
- FUTURE DEVELOPMENT CRITICAL
- ARTIFICIAL PROTECTION
- PROTECTIVE BEACH
- STABLE ROCK

MARIN CO. — MI. 65 - 70.2
SAN FRANCISCO CO. — MI. 0 - 6

MAP NUMBER **49**

STATE OF CALIFORNIA — THE RESOURCES AGENCY

DEPARTMENT OF NAVIGATION & OCEAN DEVELOPMENT

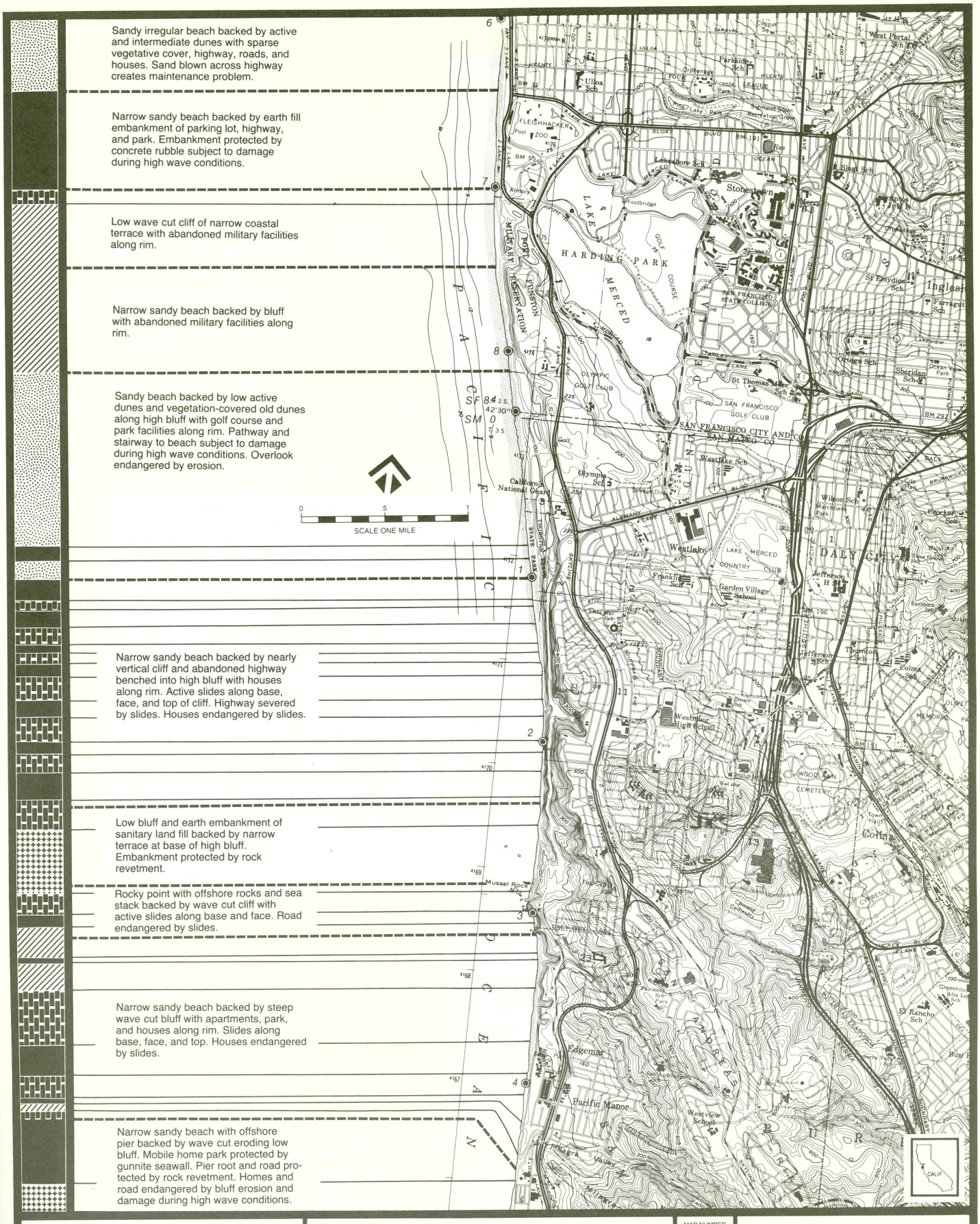
DNOD

1977

San Francisco South Beach
San Francisco Mi. 7.0
6/23/76 Tide +3.7

Thornton Beach State Park
San Mateo Mi. 0.9
6/23/76 Tide +3.4

Esplanade Avenue, Pacifica
San Mateo Mi. 4.2
6/23/76 Tide +2.8



▪ SHORELINE CONDITION ▪

PRESENT DEVELOPMENT CRITICAL	ARTIFICIAL PROTECTION
PRESENT DEVELOPMENT NON-CRITICAL	PROTECTIVE BEACH
FUTURE DEVELOPMENT CRITICAL	STABLE ROCK

SAN FRANCISCO CO. — MI. 6 - 8.4
SAN MATEO CO. — MI. 0 - 4.9

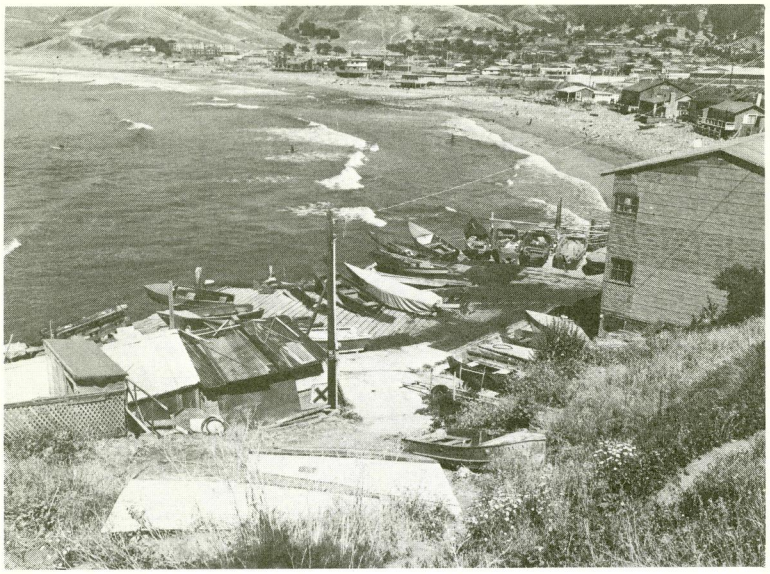
MAP NUMBER **50**

STATE OF CALIFORNIA — THE RESOURCES AGENCY

DEPARTMENT OF NAVIGATION & OCEAN DEVELOPMENT

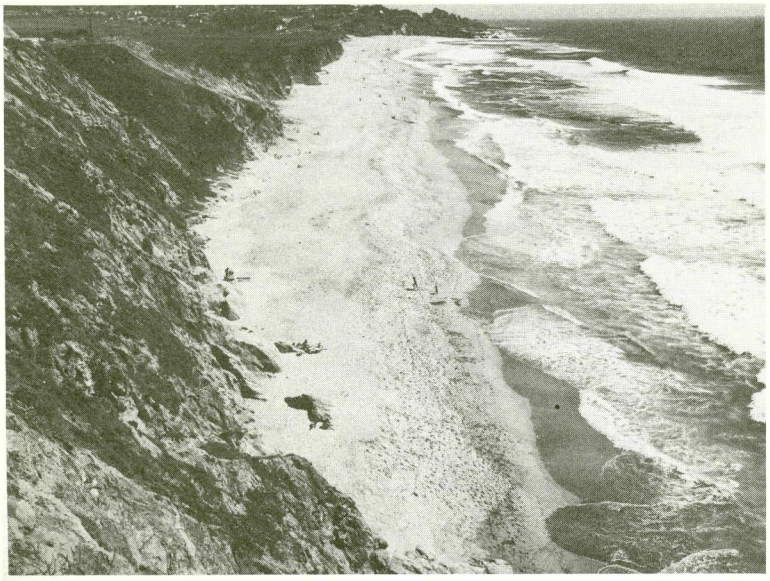
DNOD

1977

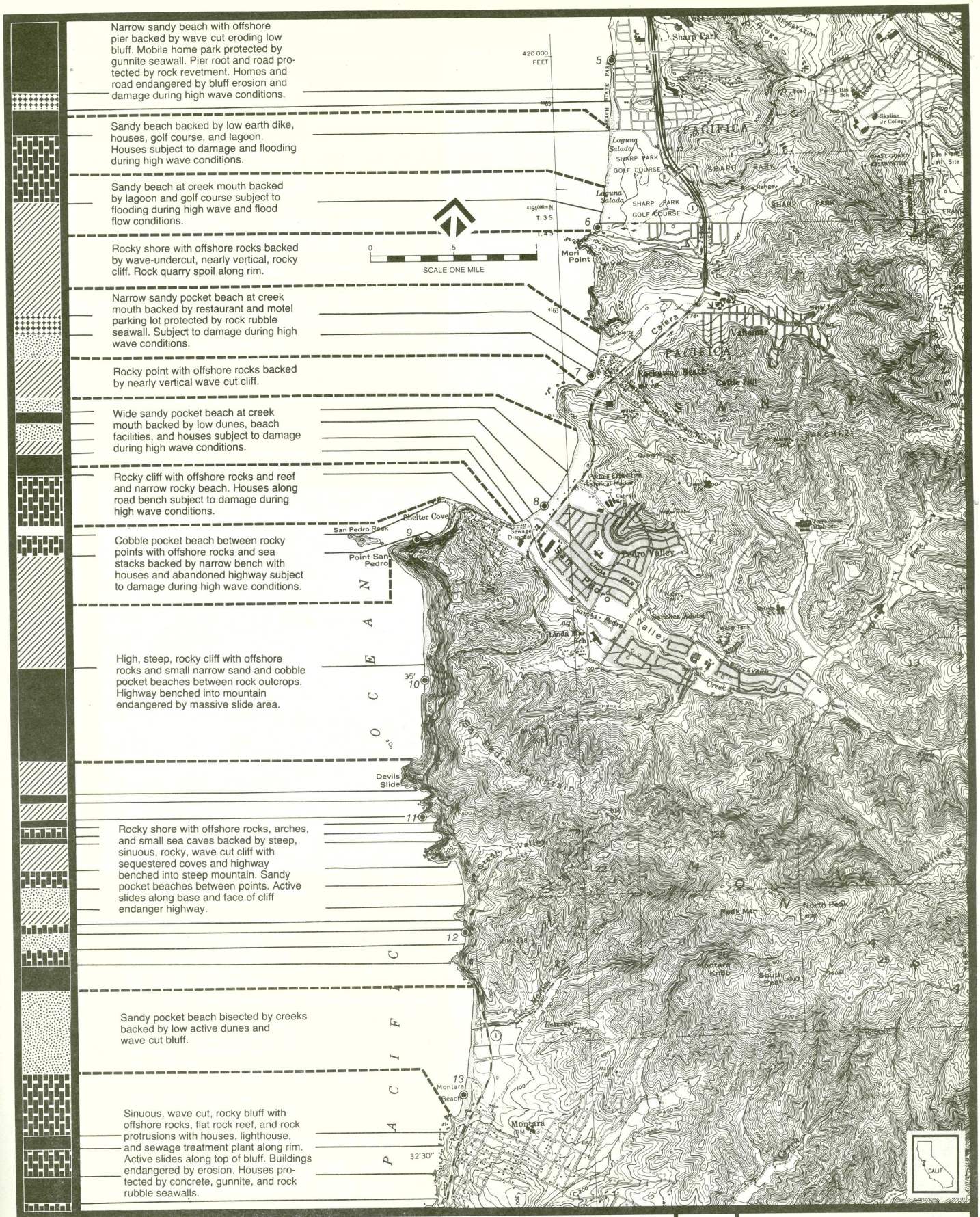


Pedro Point, Linda Mar Beach, Pacifica
San Mateo Mi. 8.3
6/23/76 Tide +2.8

Green Valley Beach
San Mateo Mi. 11.6
6/24/76 Tide +3.5



Montara State Beach
San Mateo Mi. 12.4
6/23/76 Tide +3.3



▪ SHORELINE CONDITION ▪

- PRESENT DEVELOPMENT CRITICAL
- PRESENT DEVELOPMENT NON-CRITICAL
- FUTURE DEVELOPMENT CRITICAL
- ARTIFICIAL PROTECTION
- PROTECTIVE BEACH
- STABLE ROCK

SAN MATEO CO. — MI. 5-13

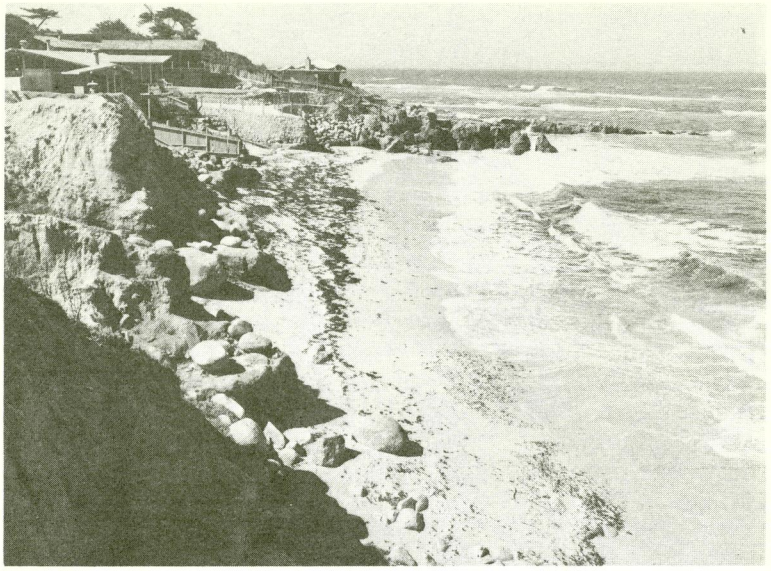
MAP NUMBER 51

STATE OF CALIFORNIA — THE RESOURCES AGENCY

DEPARTMENT OF NAVIGATION & OCEAN DEVELOPMENT

DNOD

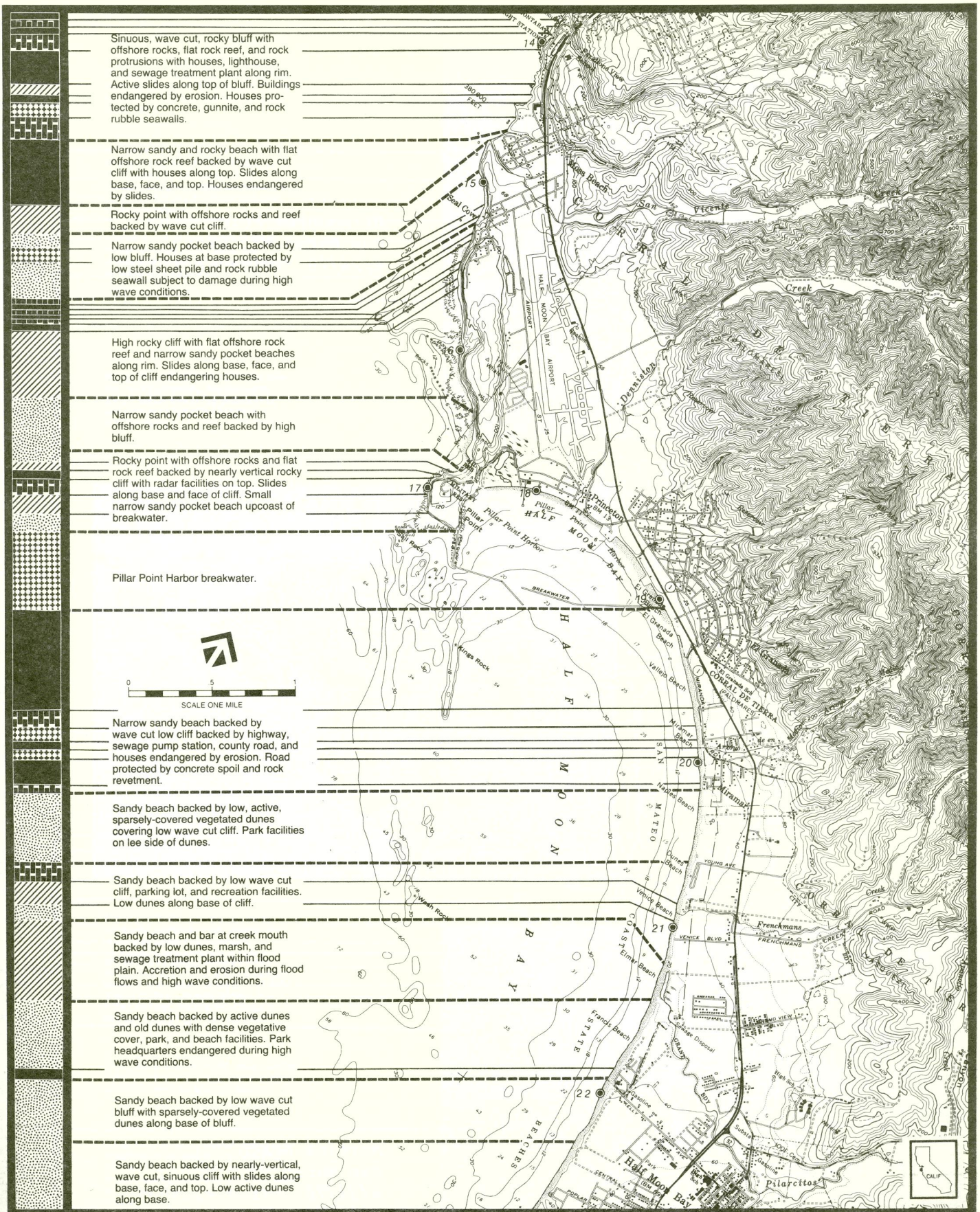
1977



Moss Beach
San Mateo Mi. 14.3
6/24/76 Tide +3.9

El Granada/Vallejo Beach
San Mateo Mi. 19.5
6/24/76 Tide +3.2

Half Moon Bay State Beach
San Mateo Mi. 21.7
6/24/76 Tide +2.7



• SHORELINE CONDITION •

PRESENT DEVELOPMENT CRITICAL	ARTIFICIAL PROTECTION
PRESENT DEVELOPMENT NON-CRITICAL	PROTECTIVE BEACH
FUTURE DEVELOPMENT CRITICAL	STABLE ROCK

SAN MATEO CO. — MI. 14 - 22

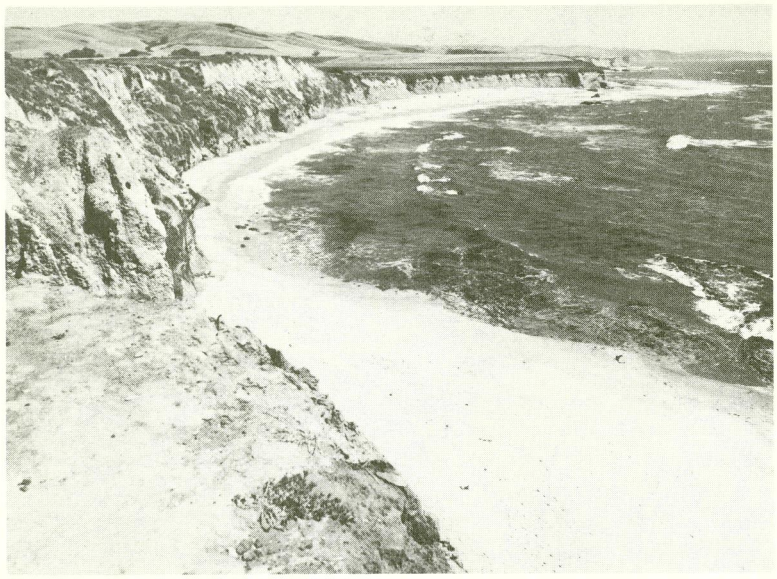
MAP NUMBER 52

STATE OF CALIFORNIA — THE RESOURCES AGENCY

DEPARTMENT OF NAVIGATION & OCEAN DEVELOPMENT

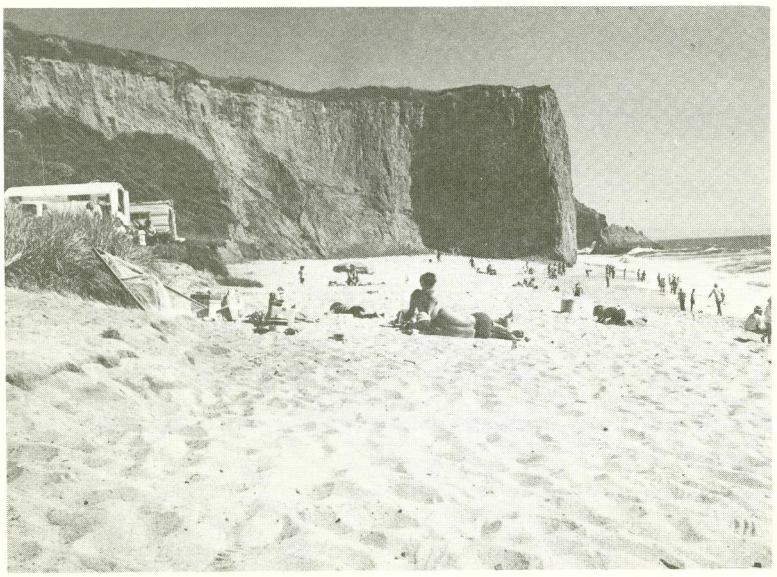
DNOD

1977

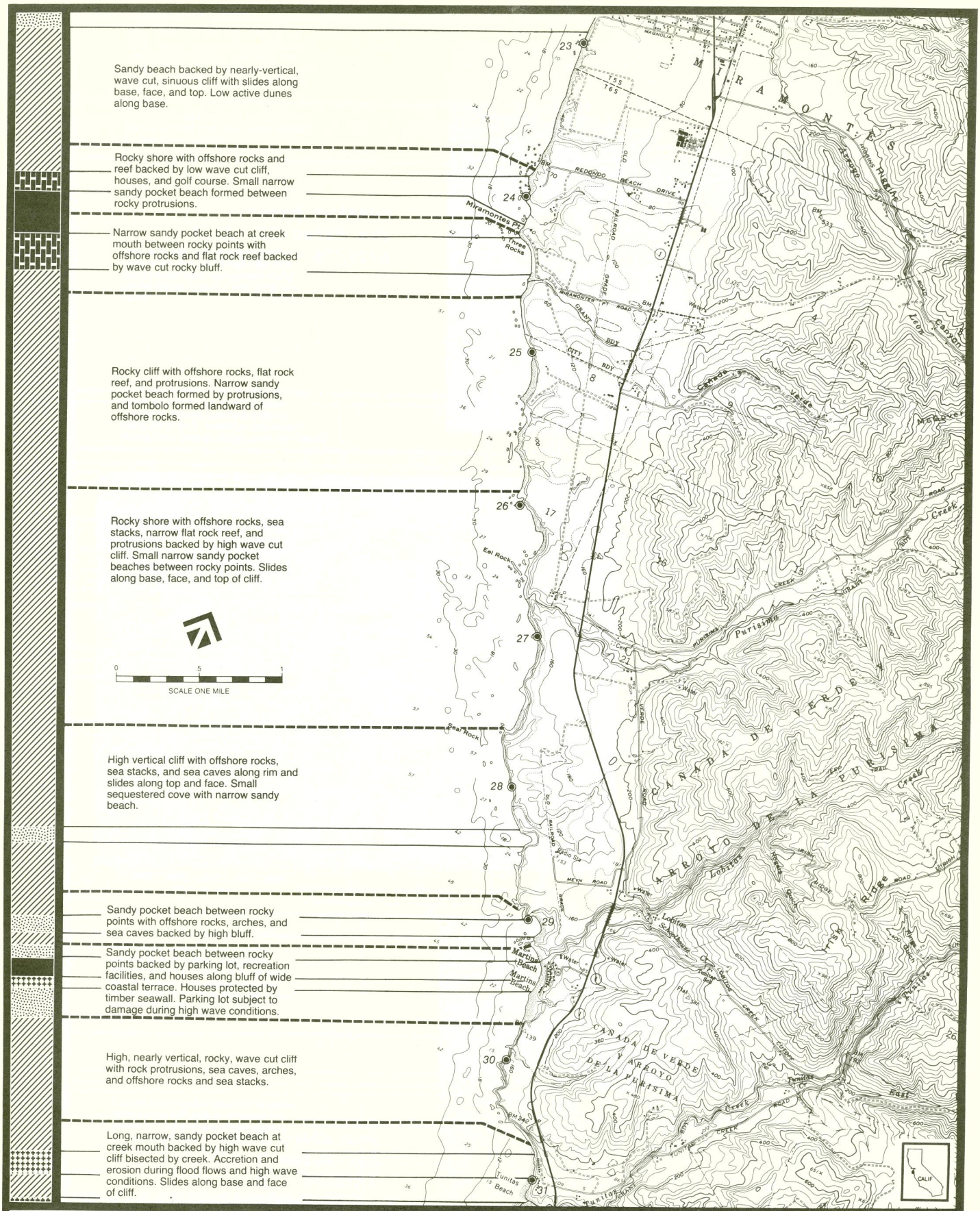


Miramontes Point Beach
San Mateo Mi. 24.3
6/24/76 Tide +2.9

Martins Beach
San Mateo Mi. 29.6
6/24/76 Tide +3.4



Martins Beach
San Mateo Mi. 29.7
6/24/76 Tide +3.3



▪ SHORELINE CONDITION ▪

- PRESENT DEVELOPMENT CRITICAL
- PRESENT DEVELOPMENT NON-CRITICAL
- FUTURE DEVELOPMENT CRITICAL
- ARTIFICIAL PROTECTION
- PROTECTIVE BEACH
- STABLE ROCK

SAN MATEO CO. — MI. 23 - 31

MAP NUMBER **53**

STATE OF CALIFORNIA — THE RESOURCES AGENCY

DEPARTMENT OF NAVIGATION & OCEAN DEVELOPMENT

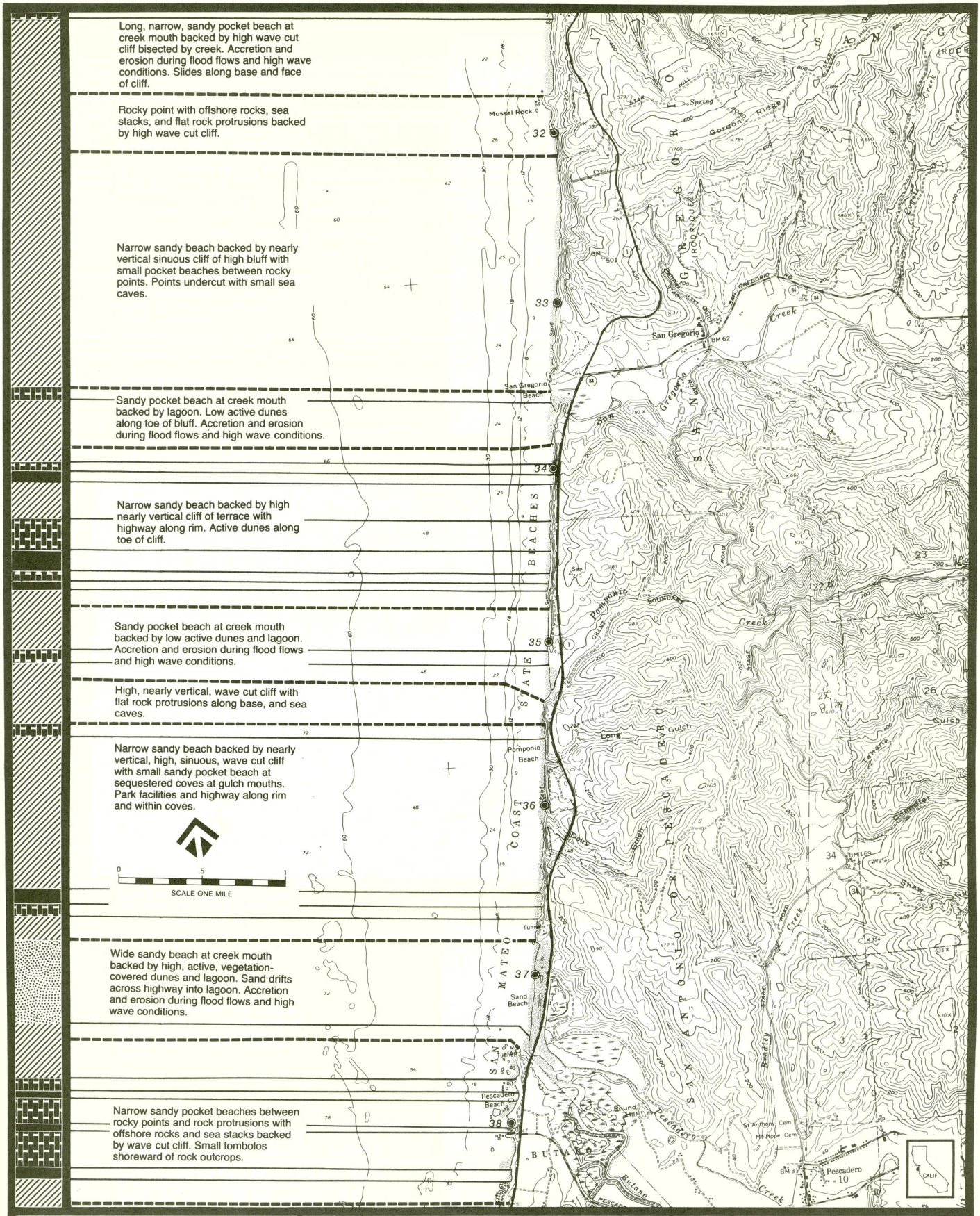
DNOD

1977

Tunitas Beach
San Mateo Mi. 31.4
6/25/76 Tide +3.4

Pomponio State Beach
San Mateo Mi. 34.9
6/25/76 Tide +3.7

Pescadero State Beach
San Mateo Mi. 37.6
6/25/76 Tide +3.6



▪ SHORELINE CONDITION ▪

PRESENT DEVELOPMENT CRITICAL	ARTIFICIAL PROTECTION
PRESENT DEVELOPMENT NON-CRITICAL	PROTECTIVE BEACH
FUTURE DEVELOPMENT CRITICAL	STABLE ROCK

SAN MATEO CO. — MI. 32-38

MAP NUMBER **54**

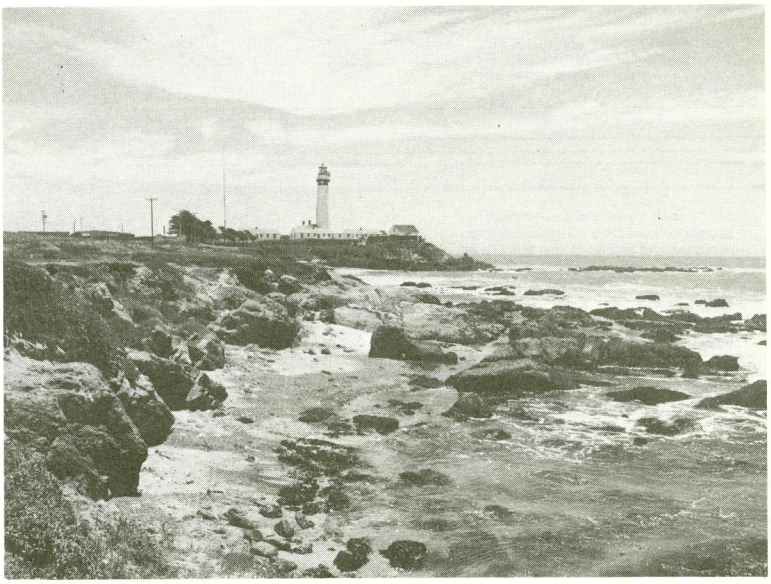
STATE OF CALIFORNIA — THE RESOURCES AGENCY

DEPARTMENT OF NAVIGATION & OCEAN DEVELOPMENT

DNOD

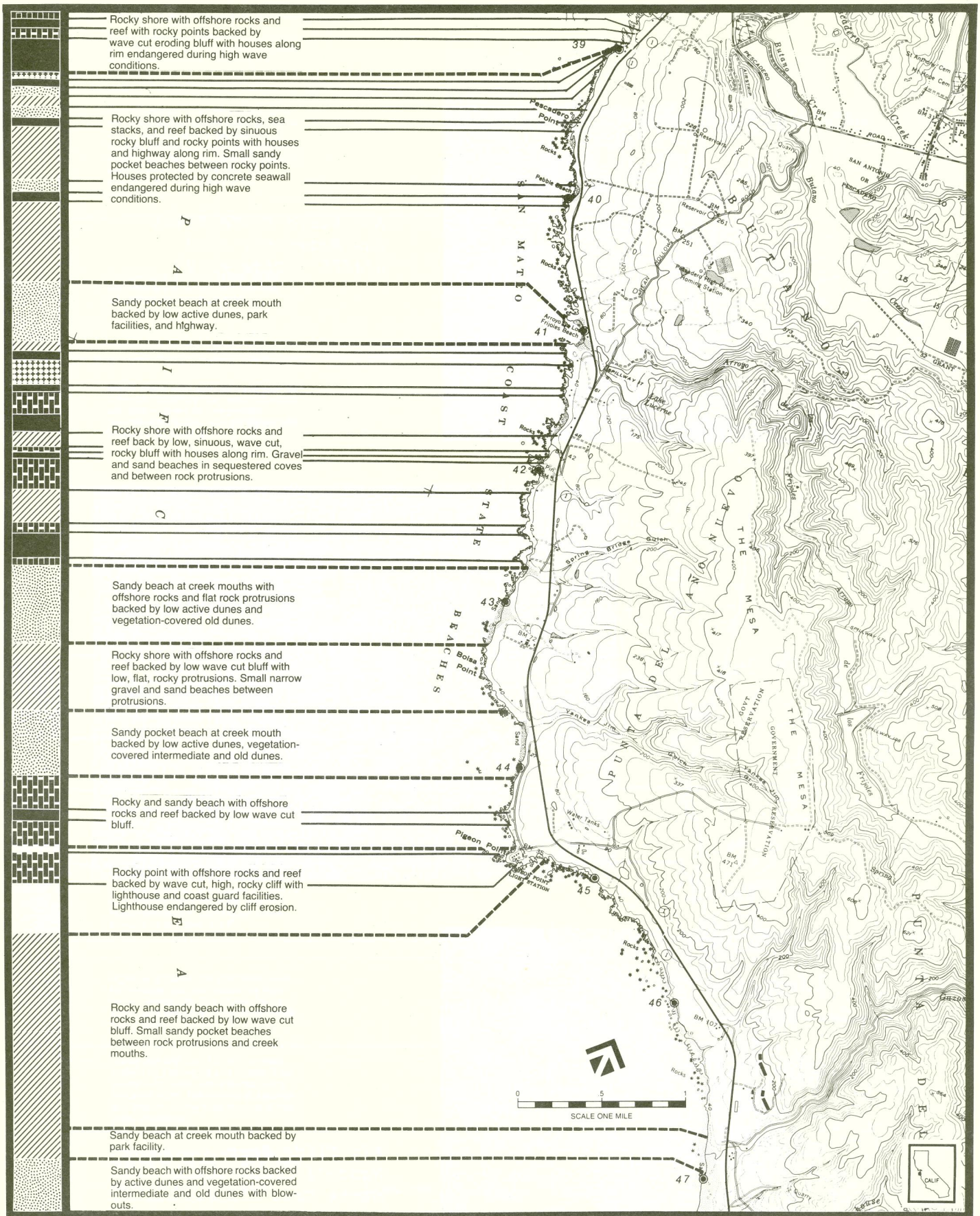
1977

Bean Hollow State Beach
San Mateo Mi. 41.0
6/25/76 Tide +3.3



Pigeon Point
San Mateo Mi. 44.7
6/25/76 Tide +3.1

Grazo Creek County Beach
San Mateo Mi. 46.8
6/25/76 Tide +2.85



▪ SHORELINE CONDITION ▪

- PRESENT DEVELOPMENT CRITICAL
- PRESENT DEVELOPMENT NON-CRITICAL
- FUTURE DEVELOPMENT CRITICAL
- ARTIFICIAL PROTECTION
- PROTECTIVE BEACH
- STABLE ROCK

SAN MATEO CO. — MI. 39-47

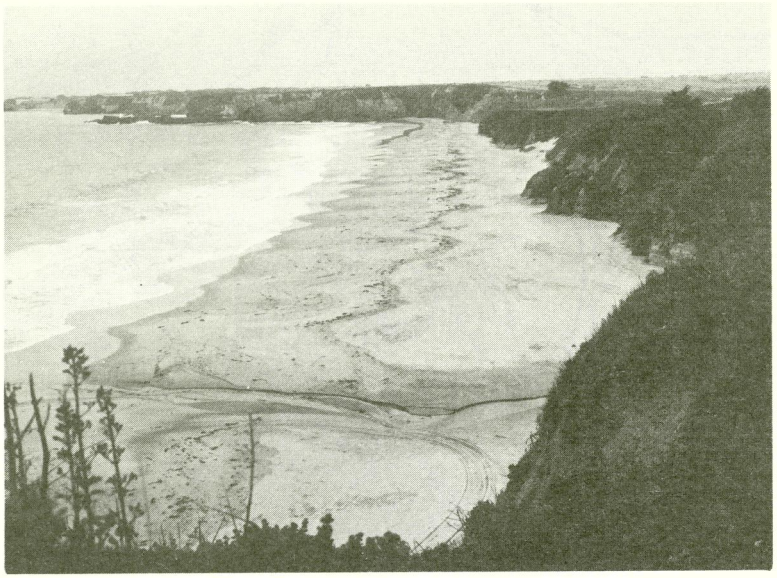
MAP NUMBER 55

STATE OF CALIFORNIA — THE RESOURCES AGENCY

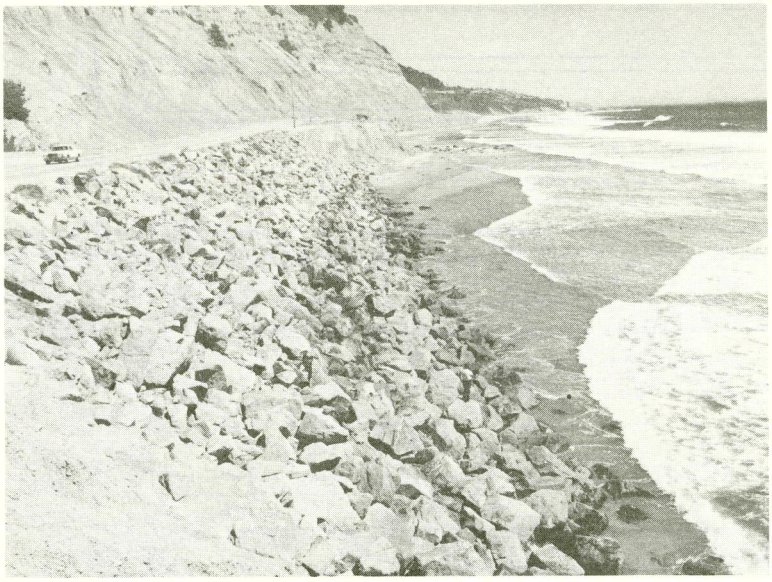
DEPARTMENT OF NAVIGATION & OCEAN DEVELOPMENT

DNOD

1977

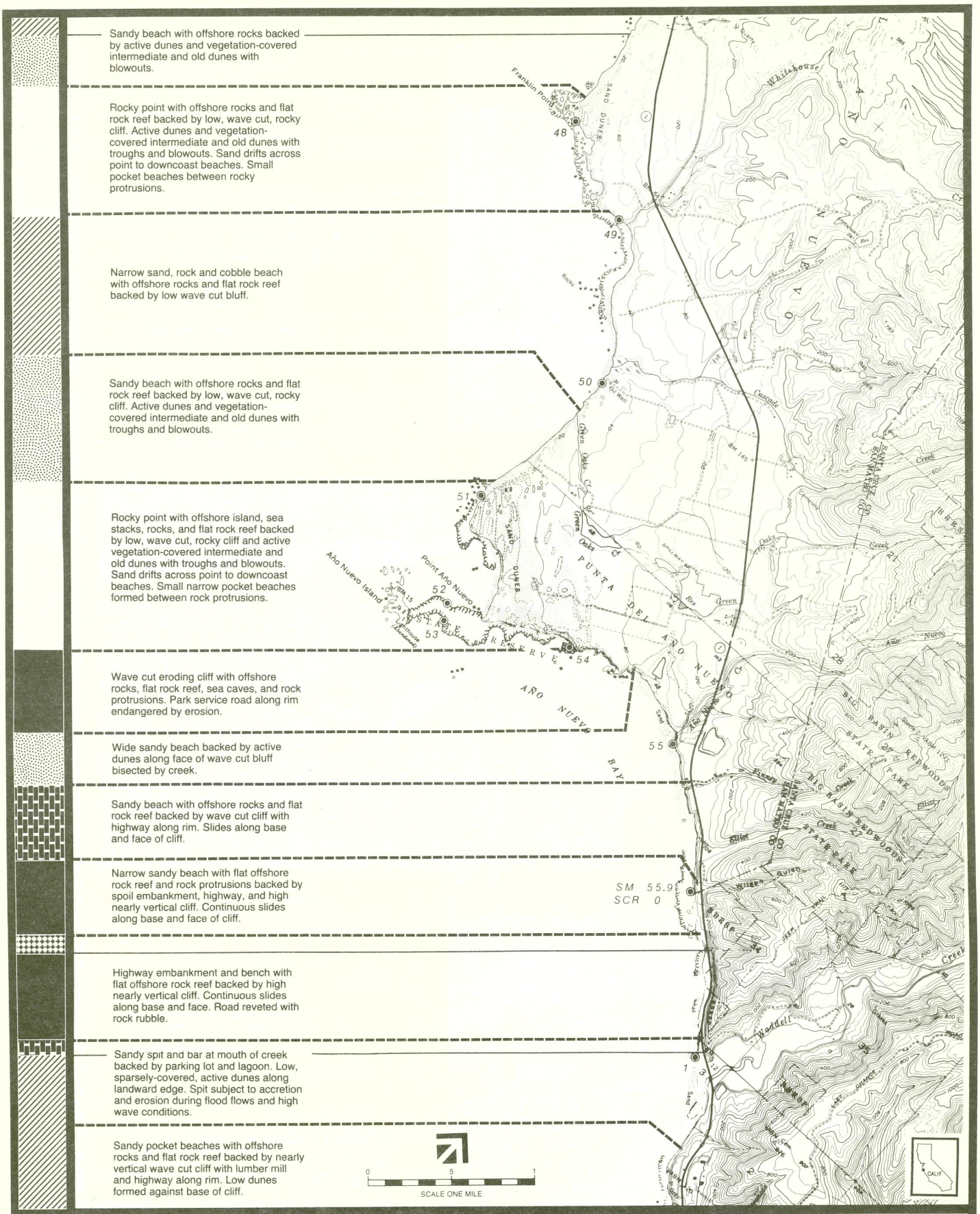


Ano Nuevo State Beach
San Mateo Mi. 55.0
6/4/75 Tide +1.93



Big Slide Area
Waddell Creek Beach
Santa Cruz Mi. 0.3
6/25/76 Tide +2.75

Big Slide Area
Waddell Creek Beach
Santa Cruz Mi. 0.4
6/25/76 Tide +2.75



▪ SHORELINE CONDITION ▪

- PRESENT DEVELOPMENT CRITICAL
- PRESENT DEVELOPMENT NON-CRITICAL
- FUTURE DEVELOPMENT CRITICAL
- ARTIFICIAL PROTECTION
- PROTECTIVE BEACH
- STABLE ROCK

SAN MATEO CO. — MI. 48 - 55.9
SANTA CRUZ CO. — MI. 0 - 1

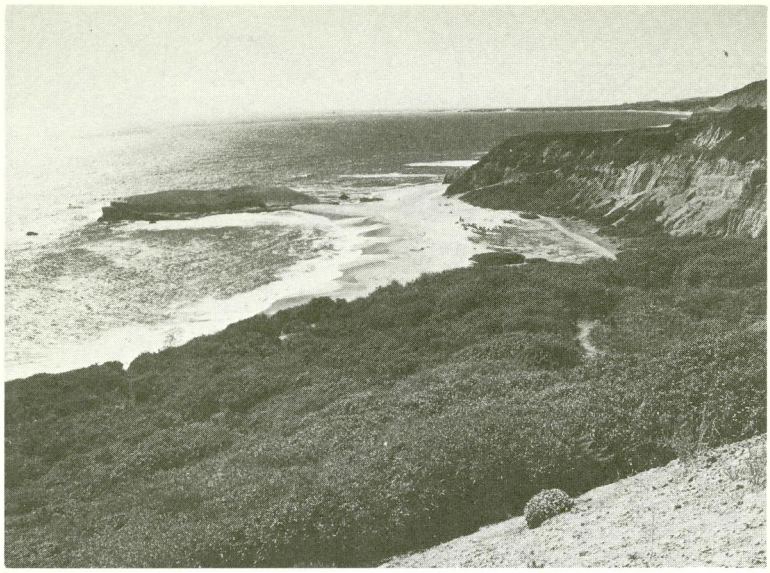
MAP NUMBER **56**

STATE OF CALIFORNIA — THE RESOURCES AGENCY

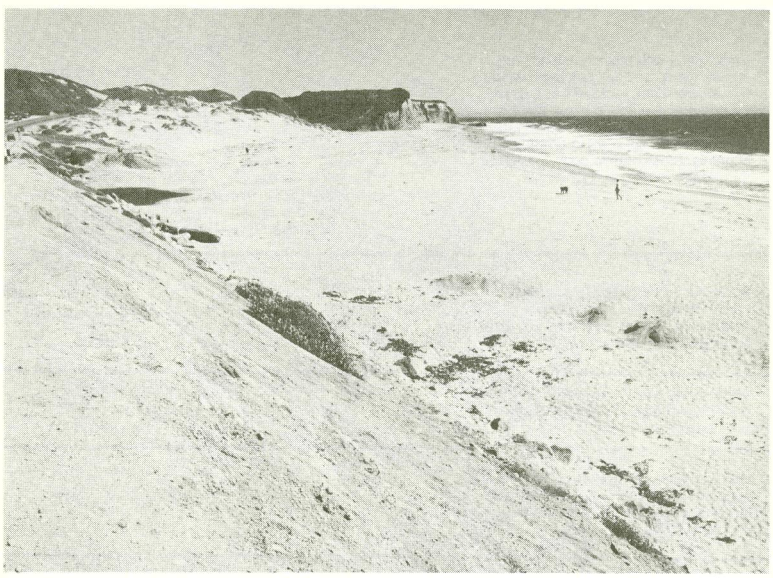
DEPARTMENT OF NAVIGATION & OCEAN DEVELOPMENT

DNOD

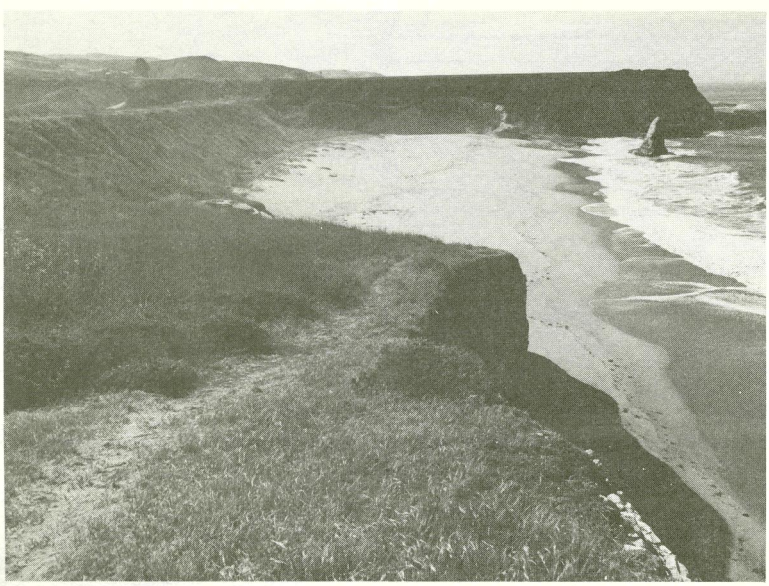
1977



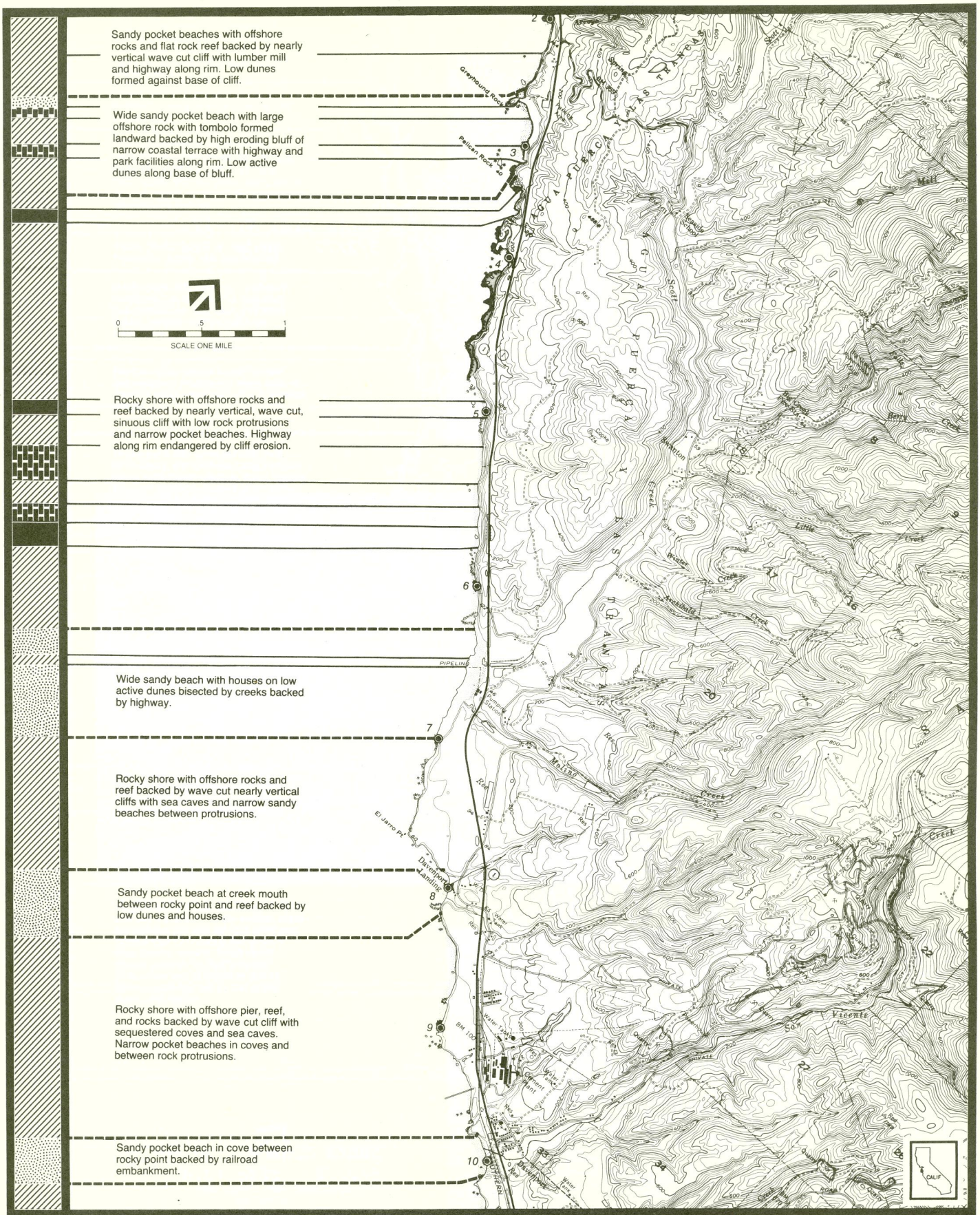
Greyhound Rock Beach
Santa Cruz Mi. 2.8
6/25/76 Tide +2.9



Scotts Creek Beach
Santa Cruz Mi. 6.5
6/25/76 Tide +3.0



Liddell Creek Beach
Santa Cruz Mi. 9.85
6/26/76 Tide +2.6



• SHORELINE CONDITION •

- PRESENT DEVELOPMENT CRITICAL
- PRESENT DEVELOPMENT NON-CRITICAL
- FUTURE DEVELOPMENT CRITICAL
- ARTIFICIAL PROTECTION
- PROTECTIVE BEACH
- STABLE ROCK

SANTA CRUZ CO. — MI. 2-10

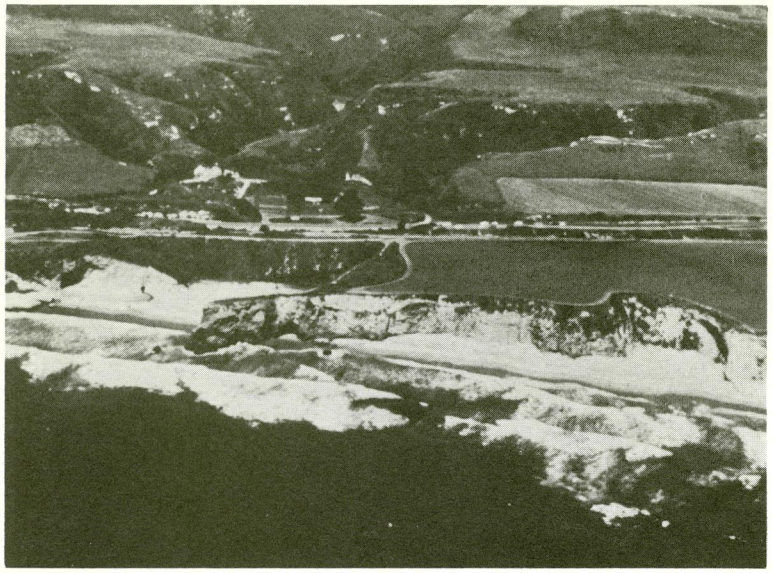
MAP NUMBER **57**

STATE OF CALIFORNIA — THE RESOURCES AGENCY

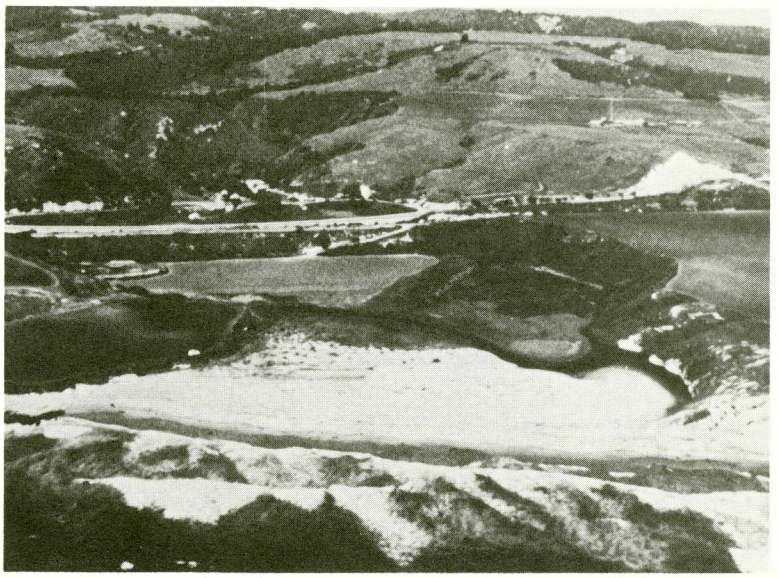
DEPARTMENT OF NAVIGATION & OCEAN DEVELOPMENT

DNOD

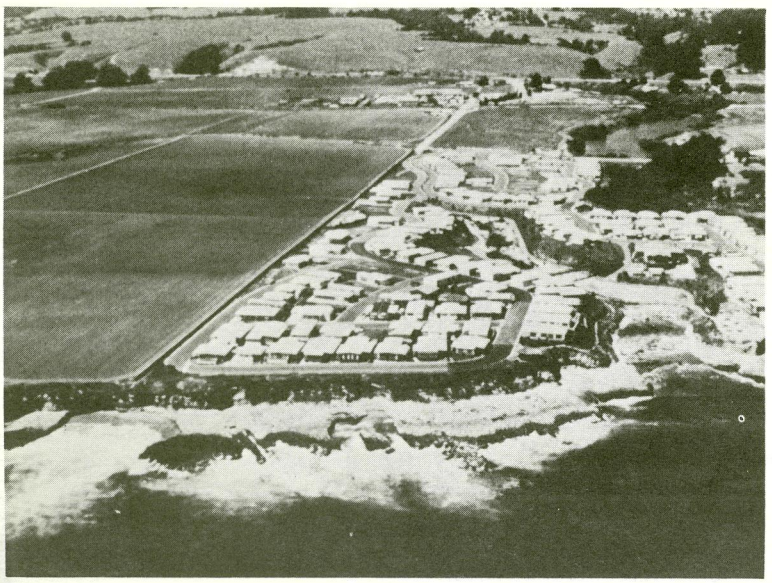
1977



Santa Cruz Mi. 12.5
5/2/72 Tide +3.4



Santa Cruz Mi. 14.00
5/2/72 Tide +3.4



Santa Cruz Mi. 20.00
5/2/72 Tide +3.4

High, rocky, wave cut, sinuous cliff with sea caves, offshore rocks, and sandy beaches between rock protrusions. Railroad endangered by cliff undercutting.

Sandy pocket beach at creek mouth backed by low active dunes along cliff and railroad.

Rocky nearly vertical cliff with offshore rocks and reef, flat rock shelf, rock protrusions, and sea caves along rim of narrow coastal terrace. Cliff undercutting endangering railroad.

Sandy pocket beach at creek mouth backed by dunes, cliff, and railroad.

Rocky point with wave cut, scalloped, nearly vertical cliff with flat rock shelf and protrusions. Sea cave and small pocket beaches formed between protrusions.

Narrow sandy pocket beach formed between rock protrusions along base of nearly vertical wave cut cliff and at creek mouth.

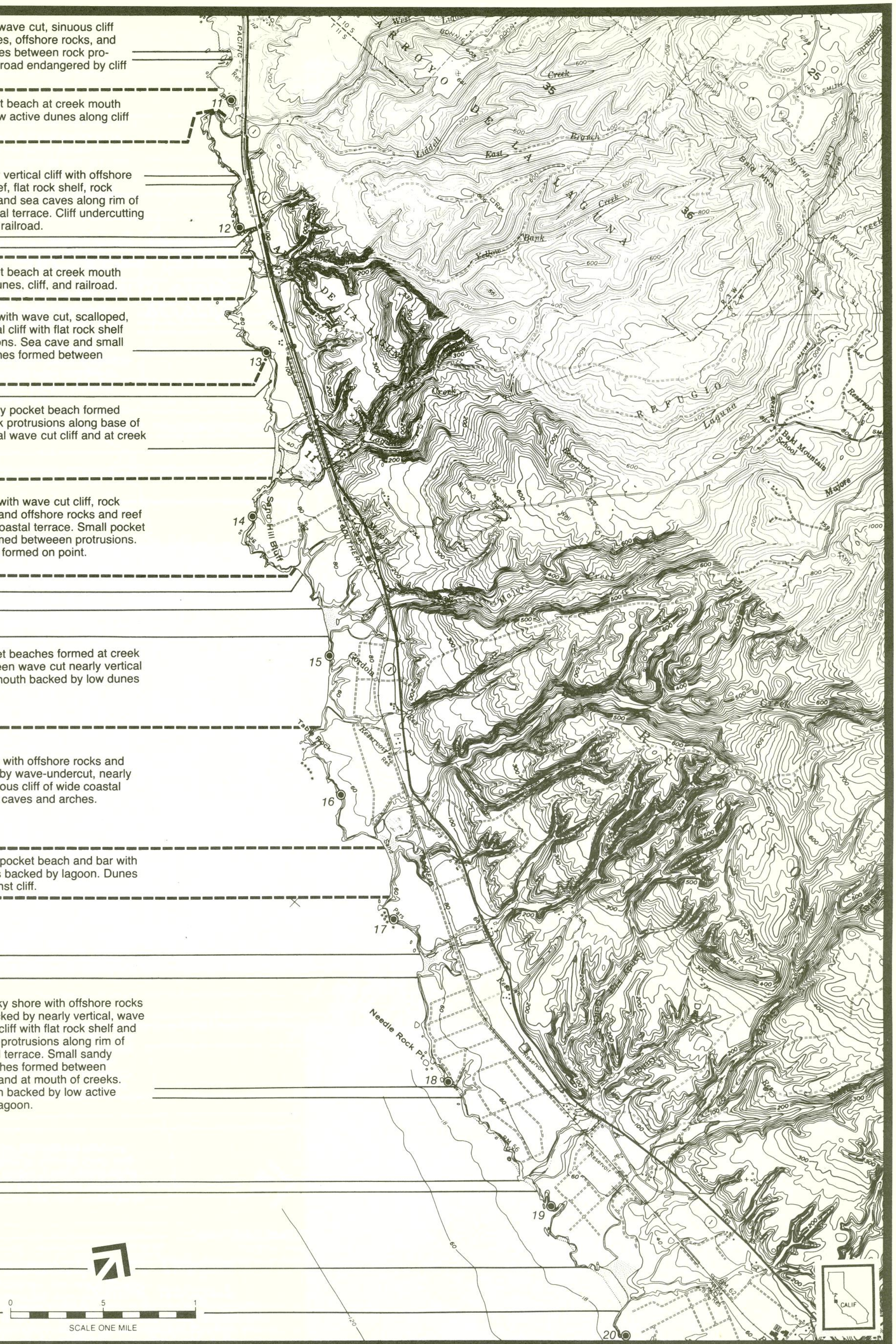
Rocky point with wave cut cliff, rock protrusions, and offshore rocks and reef along wide coastal terrace. Small pocket beaches formed betweeen protrusions. Old dune hill formed on point.

Sandy pocket beaches formed at creek mouth between wave cut nearly vertical cliff. Creek mouth backed by low dunes and marsh.

Rocky shore with offshore rocks and reef backed by wave-undercut, nearly vertical, sinuous cliff of wide coastal terrace. Sea caves and arches.

Wide sandy pocket beach and bar with active dunes backed by lagoon. Dunes formed against cliff.

Rugged rocky shore with offshore rocks and reef backed by nearly vertical, wave cut sinuous cliff with flat rock shelf and narrow rock protrusions along rim of wide coastal terrace. Small sandy pocket beaches formed between protrusions and at mouth of creeks. Creek mouth backed by low active dunes and lagoon.



• SHORELINE CONDITION •

PRESENT DEVELOPMENT CRITICAL	ARTIFICIAL PROTECTION
PRESENT DEVELOPMENT NON-CRITICAL	PROTECTIVE BEACH
FUTURE DEVELOPMENT CRITICAL	STABLE ROCK

SANTA CRUZ CO. — MI. 11-20

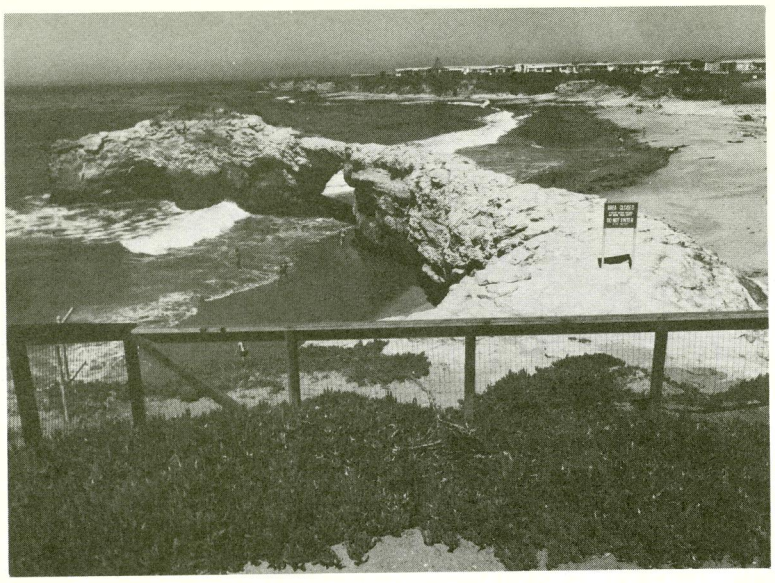
MAP NUMBER
58

STATE OF CALIFORNIA THE RESOURCES AGENCY

DEPARTMENT OF NAVIGATION & OCEAN DEVELOPMENT

DNOD

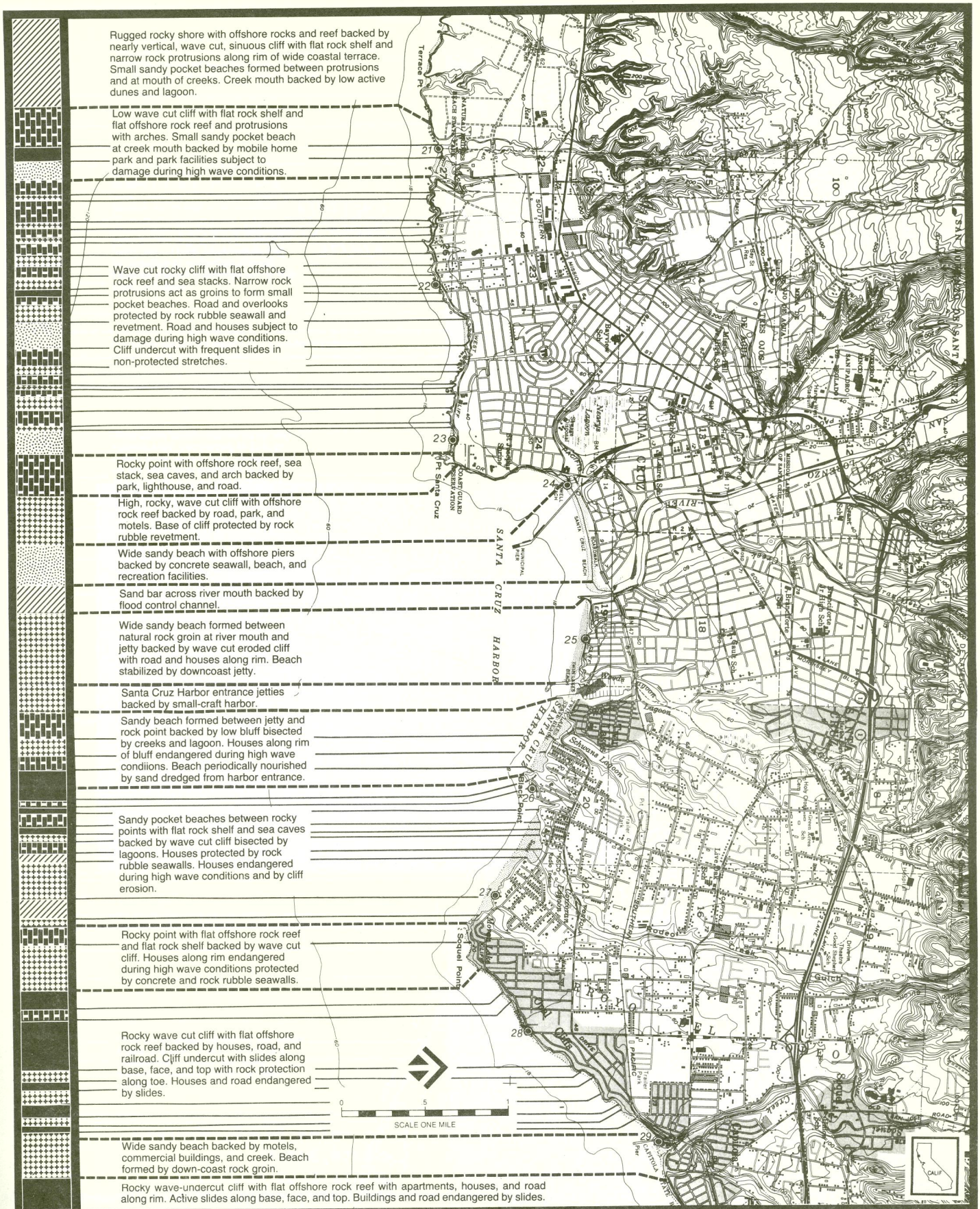
1977



Natural Bridges State Beach, Santa Cruz
Santa Cruz Mi. 21.1
6/26/76 Tide +3.7

Santa Cruz City Beach
Santa Cruz Mi. 24.85
6/26/76 Tide +3.9

Soquel Point/Corocran Lagoon Beach
Santa Cruz Mi. 27.6
6/26/76 Tide +3.2



▪ SHORELINE CONDITION ▪

- PRESENT DEVELOPMENT CRITICAL
- PRESENT DEVELOPMENT NON-CRITICAL
- FUTURE DEVELOPMENT CRITICAL
- ARTIFICIAL PROTECTION
- PROTECTIVE BEACH
- STABLE ROCK

SANTA CRUZ CO. — MI. 21-29

MAP NUMBER 59

STATE OF CALIFORNIA — THE RESOURCES AGENCY

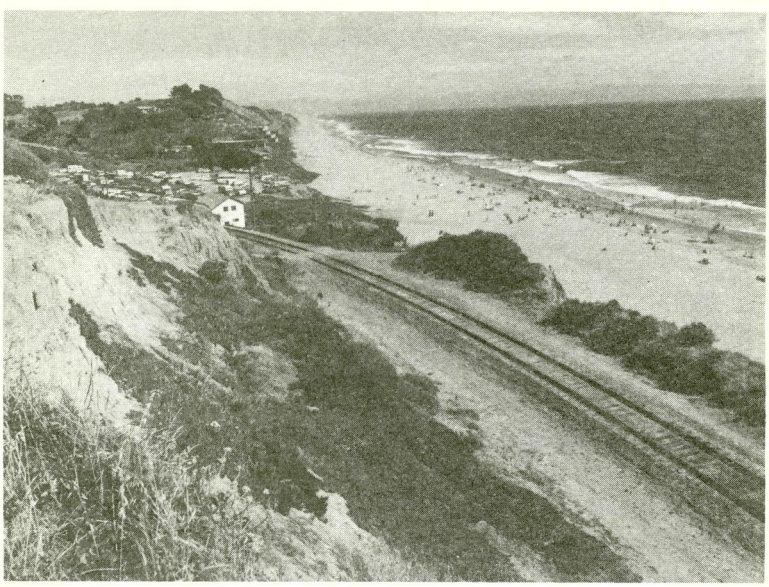
DEPARTMENT OF NAVIGATION & OCEAN DEVELOPMENT

DNOD

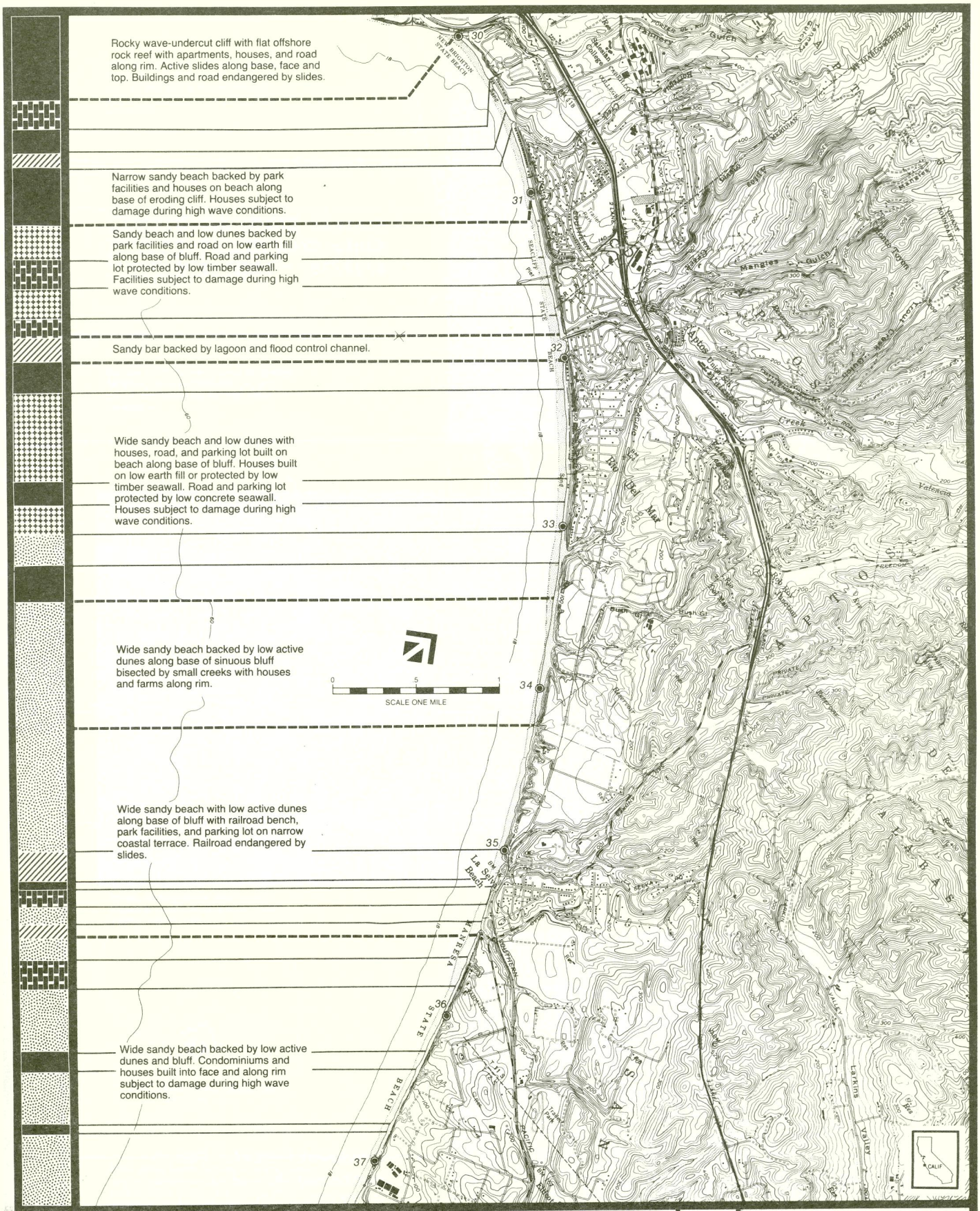
1977

Capitola
Santa Cruz Mi. 29.3
6/6/76 Tide +1.6

Rio Del Mar Beach
Seacliff State Beach
Santa Cruz Mi. 32.12
6/26/76 Tide +2.8



La Selva Beach, Manresa
State Beach
Santa Cruz Mi. 35.3
6/26/76 Tide +2.9



▪ SHORELINE CONDITION ▪

- PRESENT DEVELOPMENT CRITICAL
- PRESENT DEVELOPMENT NON-CRITICAL
- FUTURE DEVELOPMENT CRITICAL
- ARTIFICIAL PROTECTION
- PROTECTIVE BEACH
- STABLE ROCK

SANTA CRUZ CO. — MI. 30 - 37

MAP NUMBER 60

STATE OF CALIFORNIA — THE RESOURCES AGENCY

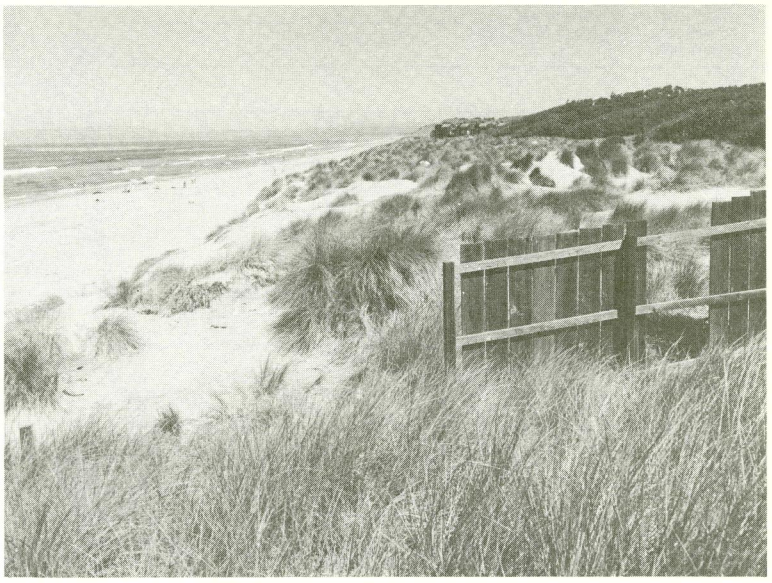
DEPARTMENT OF NAVIGATION & OCEAN DEVELOPMENT

DNOD

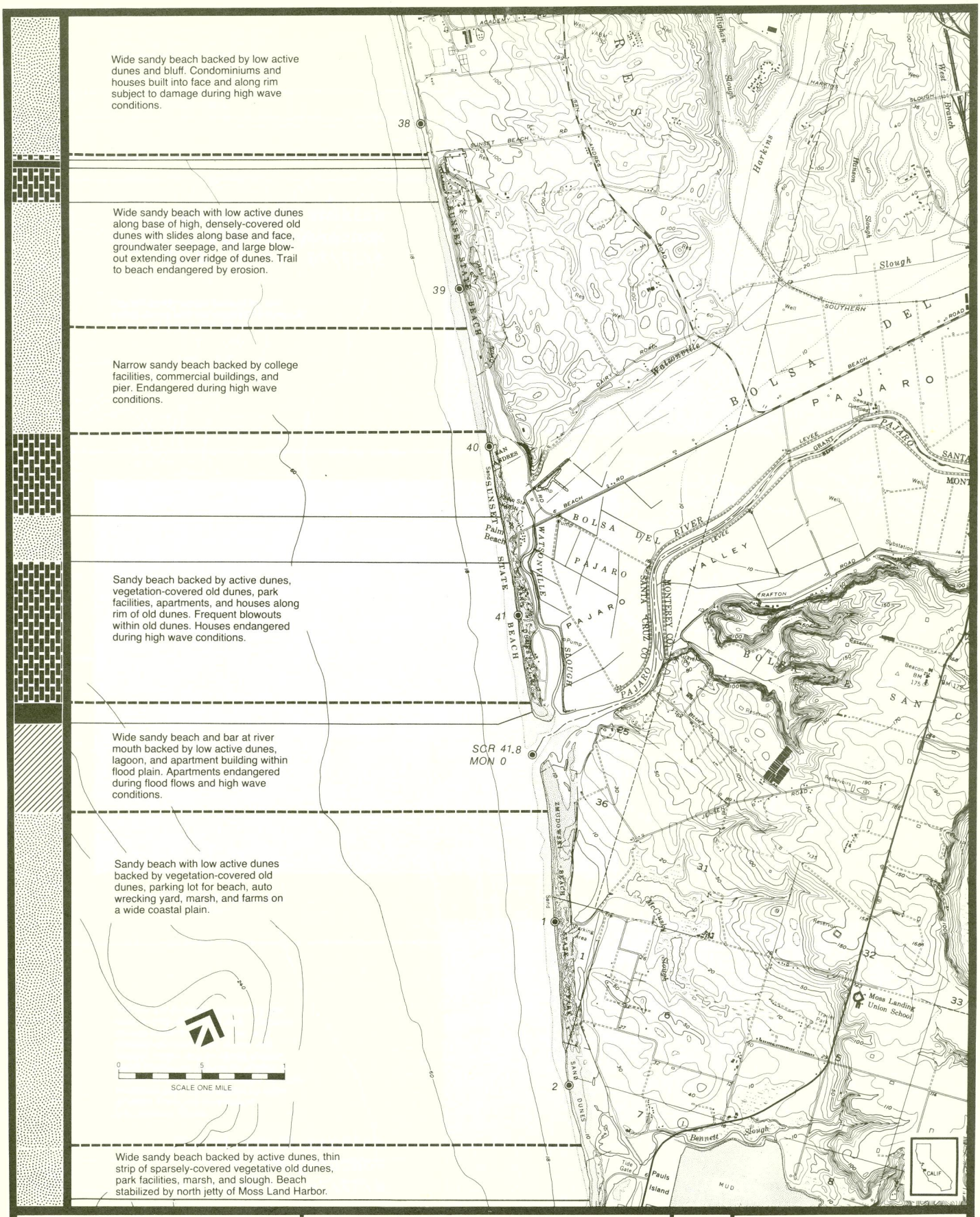
1977

Manresa State Beach
Santa Cruz Mi. 36.3
6/27/76 Tide +2.4

Pajaro Dunes, Sunset
State Beach
Santa Cruz Mi. 40.55
6/27/76 Tide +3.9



Zmudowski State Beach
Monterey Mi. 1.1
6/27/76 Tide +4.1



• SHORELINE CONDITION •

- PRESENT DEVELOPMENT CRITICAL
- PRESENT DEVELOPMENT NON-CRITICAL
- FUTURE DEVELOPMENT CRITICAL
- ARTIFICIAL PROTECTION
- PROTECTIVE BEACH
- STABLE ROCK

SANTA CRUZ CO. — MI. 38 - 41.8
MONTEREY CO. — MI. 0 - 2

MAP NUMBER **61**

STATE OF CALIFORNIA — THE RESOURCES AGENCY

DEPARTMENT OF NAVIGATION & OCEAN DEVELOPMENT

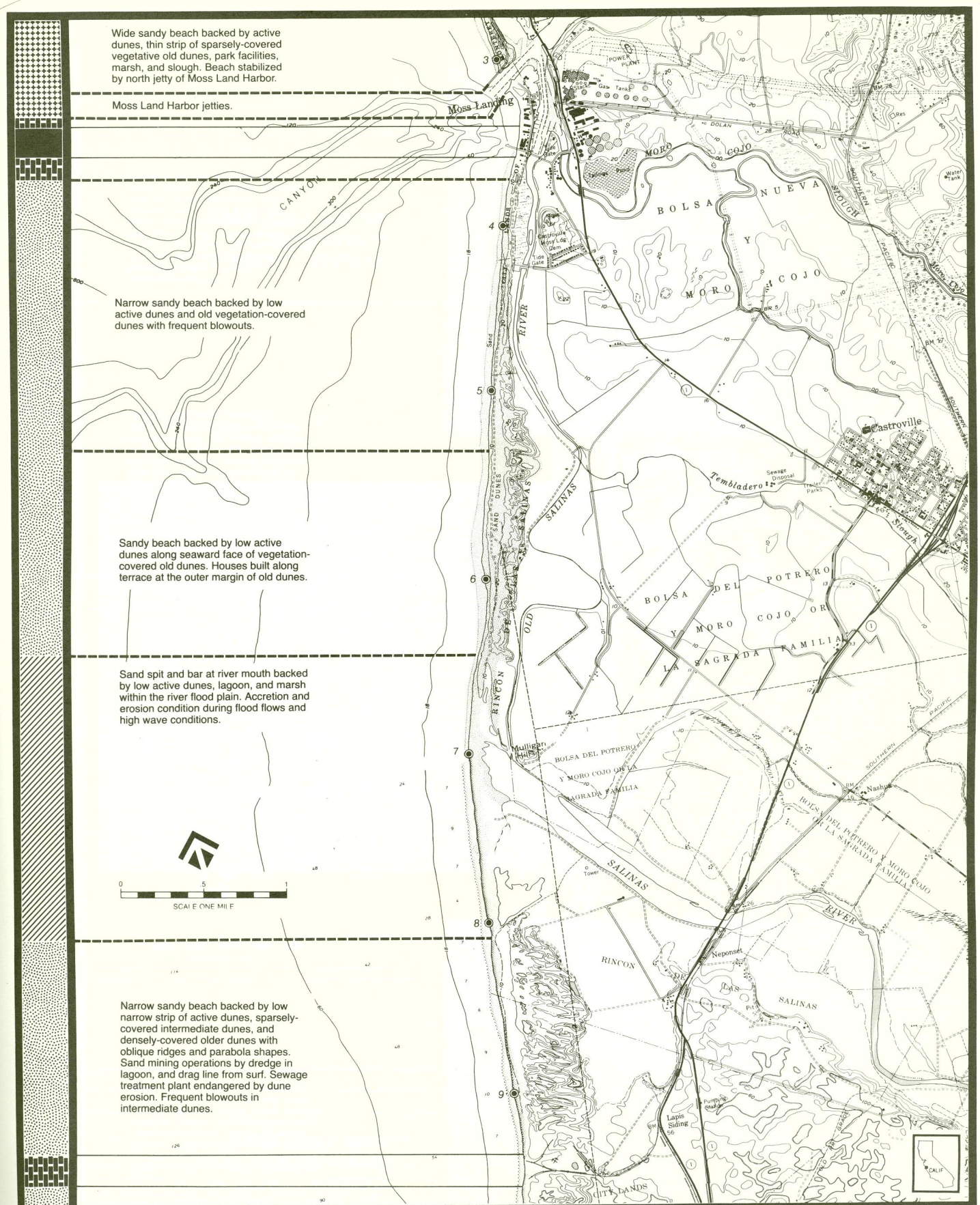
DNOD

1977

Salinas River Beach
Monterey Mi. 4.2
6/27/76 Tide +4.05

Salinas River Beach
Monterey Mi. 4.2
6/27/76 Tide +4.05

Salinas River Beach
Monterey Mi. 8.0
6/27/76 Tide +3.6



• SHORELINE CONDITION •

- PRESENT DEVELOPMENT CRITICAL
- PRESENT DEVELOPMENT NON-CRITICAL
- FUTURE DEVELOPMENT CRITICAL
- ARTIFICIAL PROTECTION
- PROTECTIVE BEACH
- STABLE ROCK

MONTEREY CO. — MI. 3 - 9

MAP NUMBER **62**

STATE OF CALIFORNIA — THE RESOURCES AGENCY

DEPARTMENT OF NAVIGATION & OCEAN DEVELOPMENT

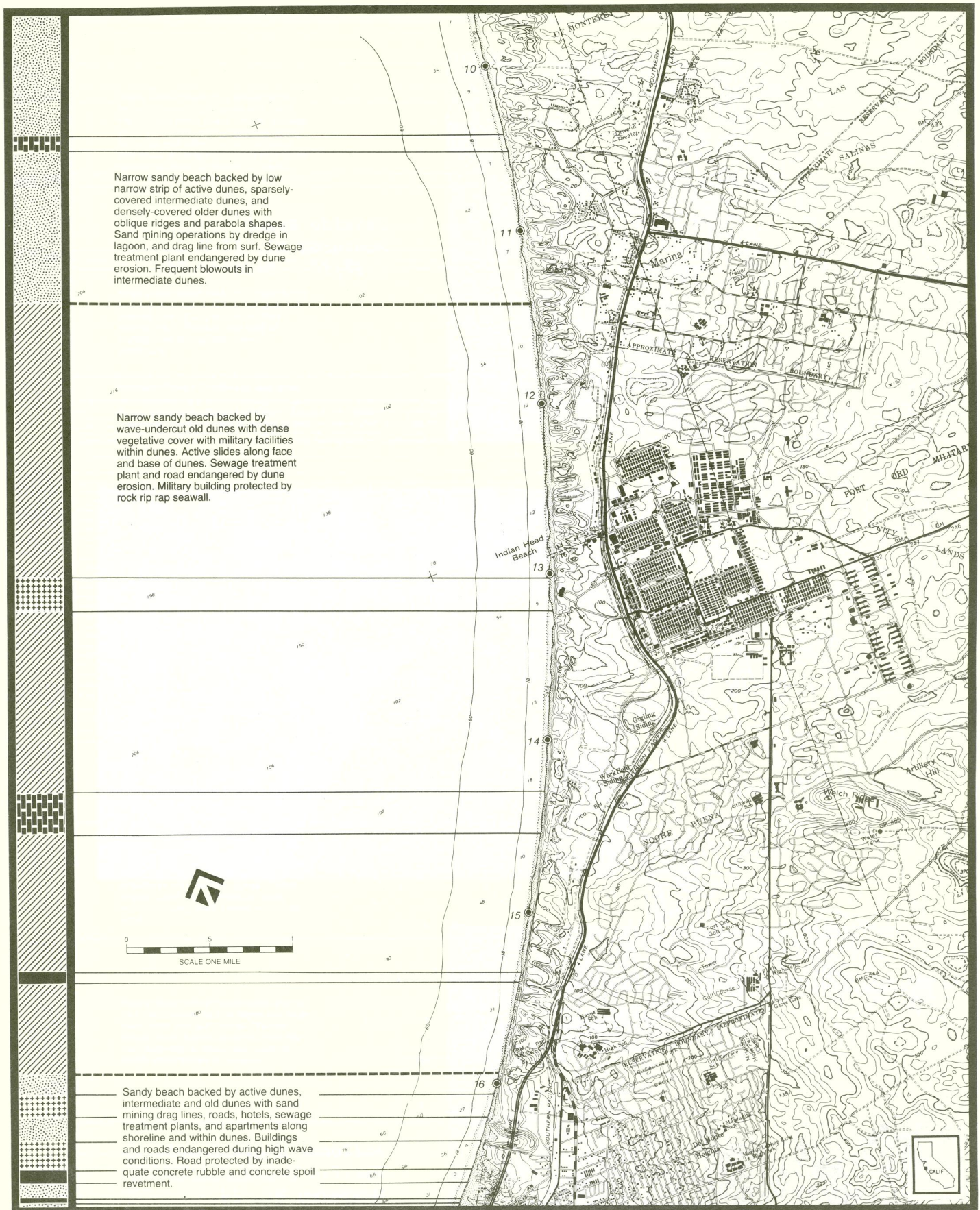
DNOD

1977

Marina City Beach
Monterey Mi. 10.5
6/27/76 Tide +3.2

Marina City Beach
Monterey Mi. 10.5
6/27/76 Tide +3.2

Sand City Beach
Monterey Mi. 16.4
6/27/76 Tide +2.9



▪ SHORELINE CONDITION ▪

- PRESENT DEVELOPMENT CRITICAL
- PRESENT DEVELOPMENT NON-CRITICAL
- FUTURE DEVELOPMENT CRITICAL
- ARTIFICIAL PROTECTION
- PROTECTIVE BEACH
- STABLE ROCK

MONTEREY CO. — MI. 10 - 16

MAP NUMBER 63

STATE OF CALIFORNIA — THE RESOURCES AGENCY

DEPARTMENT OF NAVIGATION & OCEAN DEVELOPMENT

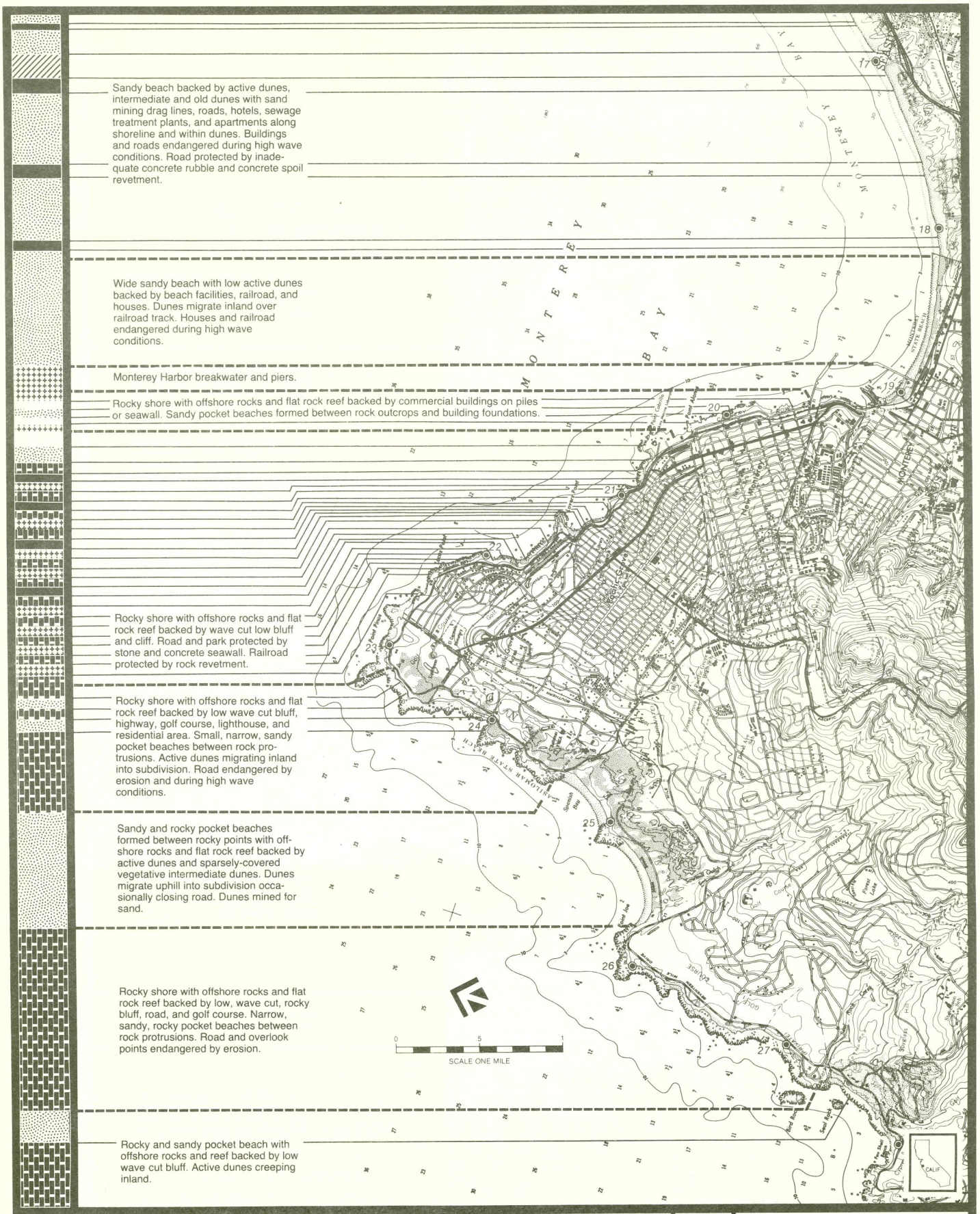
DNOD

1977

Seaside Beach
Monterey Mi. 17.2
6/27/76 Tide +2.85

Otter Point, Pacific Grove
Monterey Mi. 22.05
6/28/76 Tide +3.2

Asilomar State Beach,
Pacific Grove
Monterey Mi. 24.5
6/28/76 Tide +1.8



▪ SHORELINE CONDITION ▪

- PRESENT DEVELOPMENT CRITICAL
- PRESENT DEVELOPMENT NON-CRITICAL
- FUTURE DEVELOPMENT CRITICAL
- ARTIFICIAL PROTECTION
- PROTECTIVE BEACH
- STABLE ROCK

MONTEREY CO. — MI. 17 - 28

MAP NUMBER 64

STATE OF CALIFORNIA — THE RESOURCES AGENCY

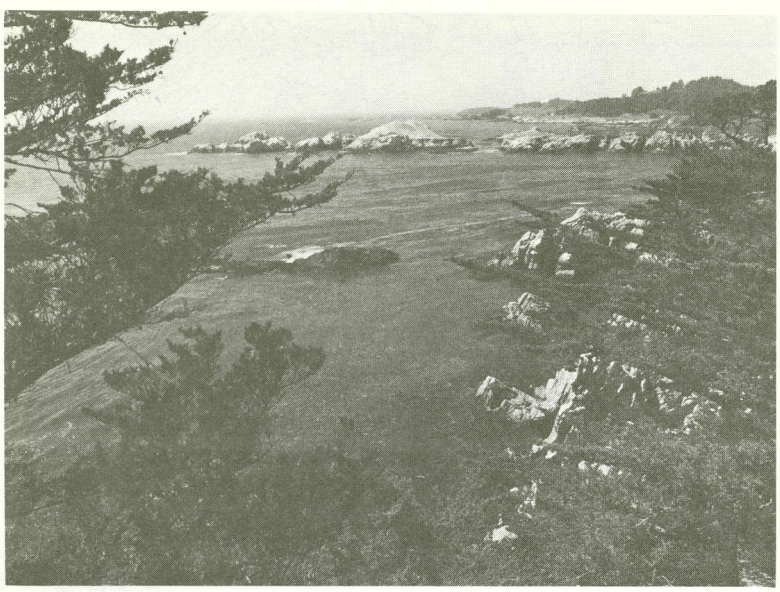
DEPARTMENT OF NAVIGATION & OCEAN DEVELOPMENT

DNOD

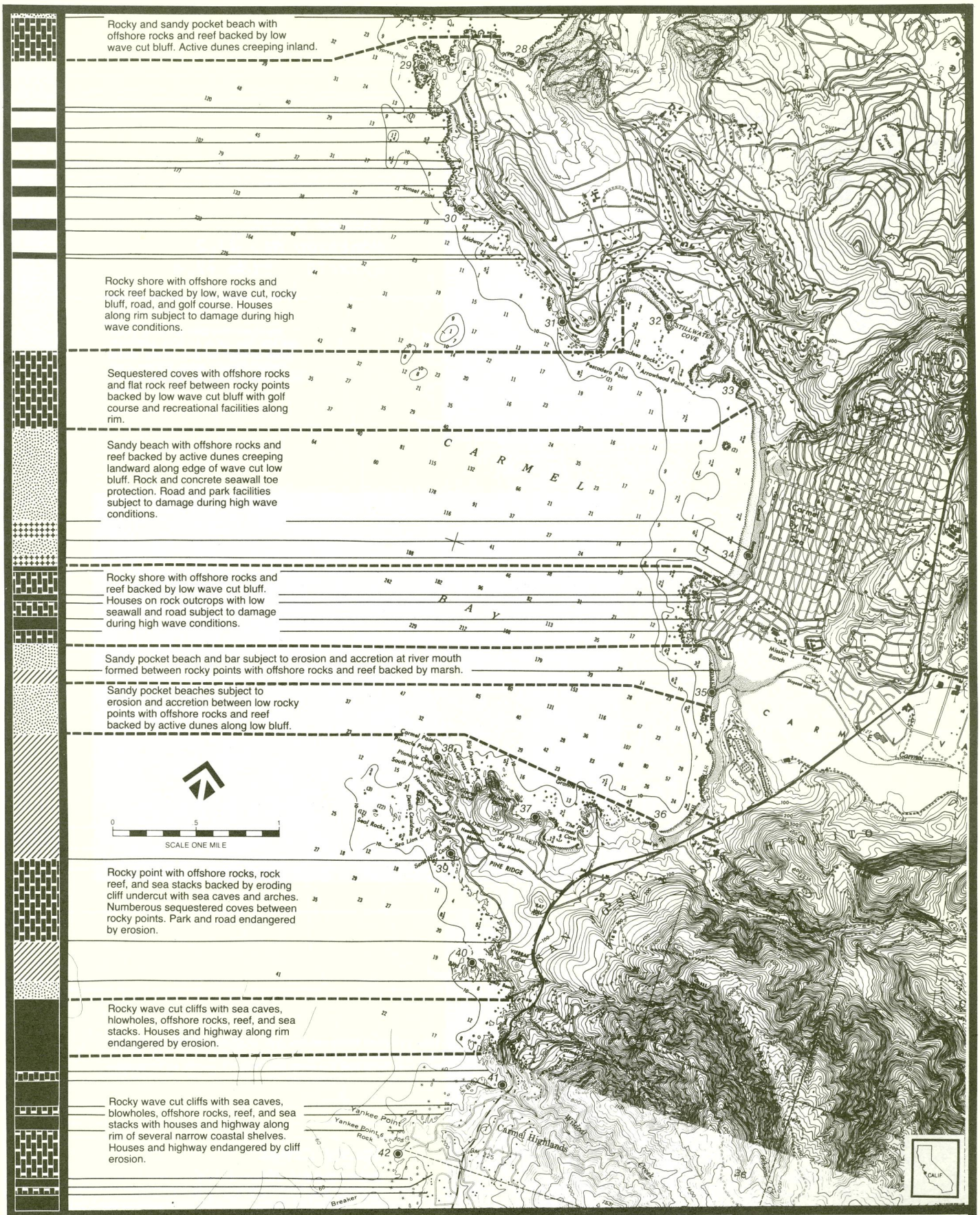
1977

Carmel City Beach
Monterey Mi. 33.5
6/28/76 Tide +3.4

Scenic Drive, Carmel
Monterey Mi. 34.6
6/28/76 Tide +3.2



Carmel Highlands, China
Cove, Bird Island
Monterey Mi. 40.5
6/28/76 Tide +2.4



• SHORELINE CONDITION •

- PRESENT DEVELOPMENT CRITICAL
- PRESENT DEVELOPMENT NON-CRITICAL
- FUTURE DEVELOPMENT CRITICAL
- ARTIFICIAL PROTECTION
- PROTECTIVE BEACH
- STABLE ROCK

MONTEREY CO. — MI. 28 - 42

MAP NUMBER **65**

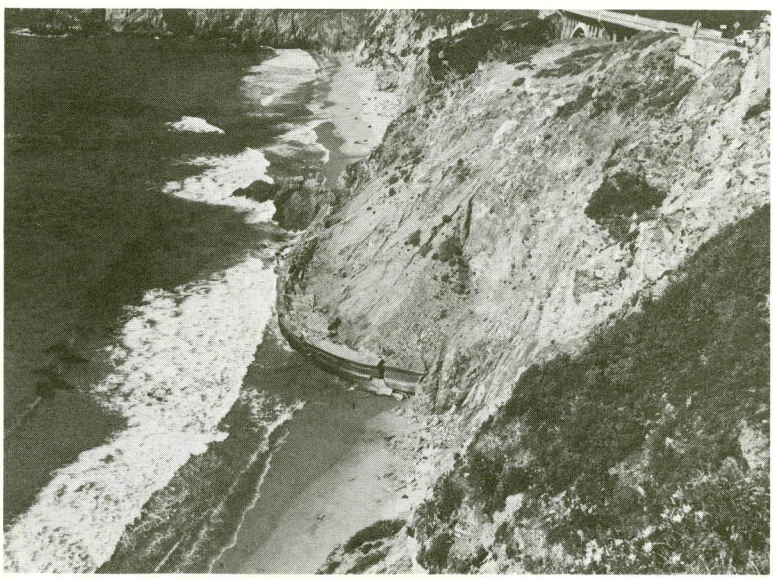
STATE OF CALIFORNIA — THE RESOURCES AGENCY

DEPARTMENT OF NAVIGATION & OCEAN DEVELOPMENT

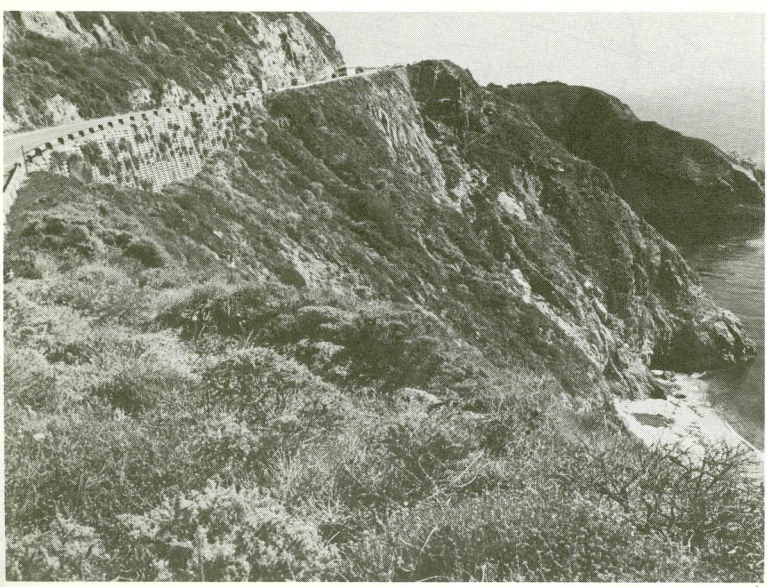
DNOD

1977

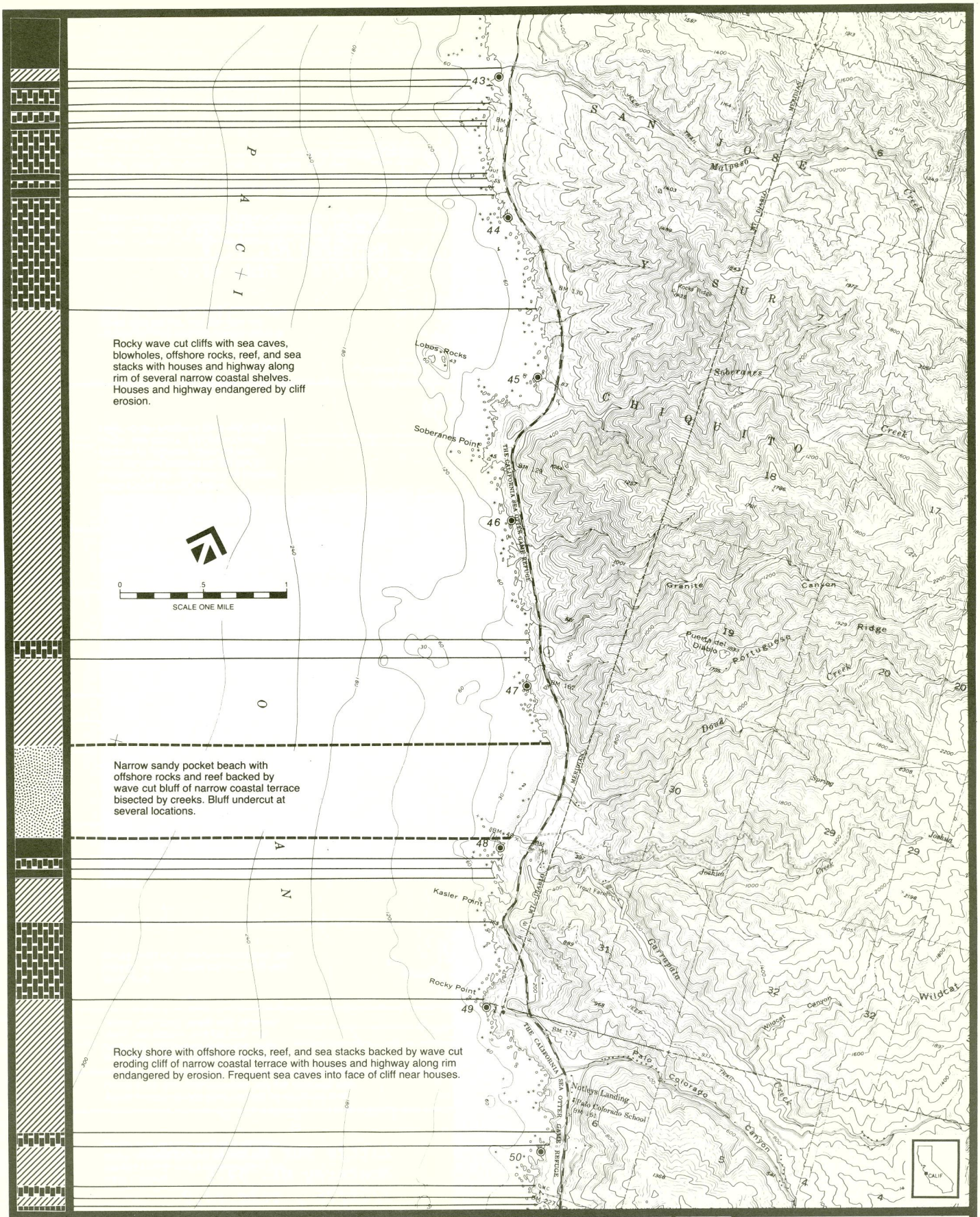
Yankee Point
Monterey Mi. 43.2
6/28/76 Tide +2.4



Rocky Creek Seawall
Monterey Mi. 49.9
6/28/76 Tide +2.1



Rocky Creek
Monterey Mi. 50.0
6/28/76 Tide +2.1



• SHORELINE CONDITION •

- PRESENT DEVELOPMENT CRITICAL
- PRESENT DEVELOPMENT NON-CRITICAL
- FUTURE DEVELOPMENT CRITICAL
- ARTIFICIAL PROTECTION
- PROTECTIVE BEACH
- STABLE ROCK

MONTEREY CO. — MI. 43 - 50

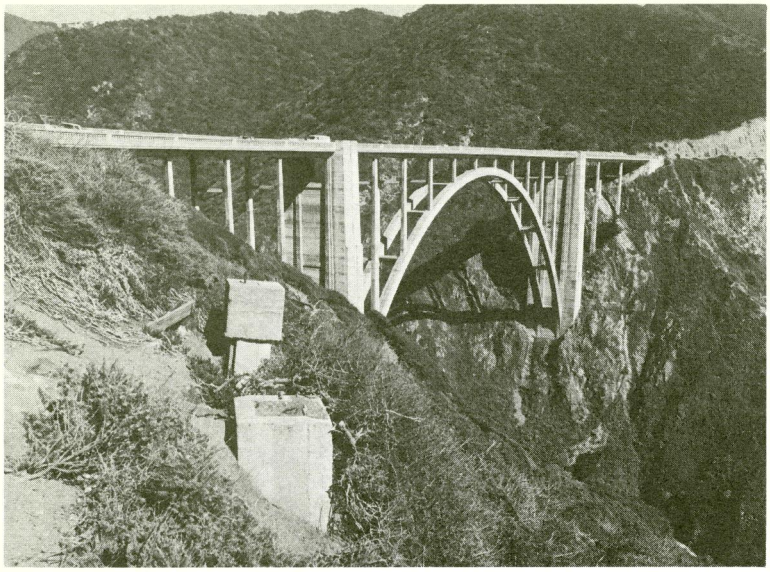
MAP NUMBER 66

STATE OF CALIFORNIA — THE RESOURCES AGENCY

DEPARTMENT OF NAVIGATION & OCEAN DEVELOPMENT

DNOD

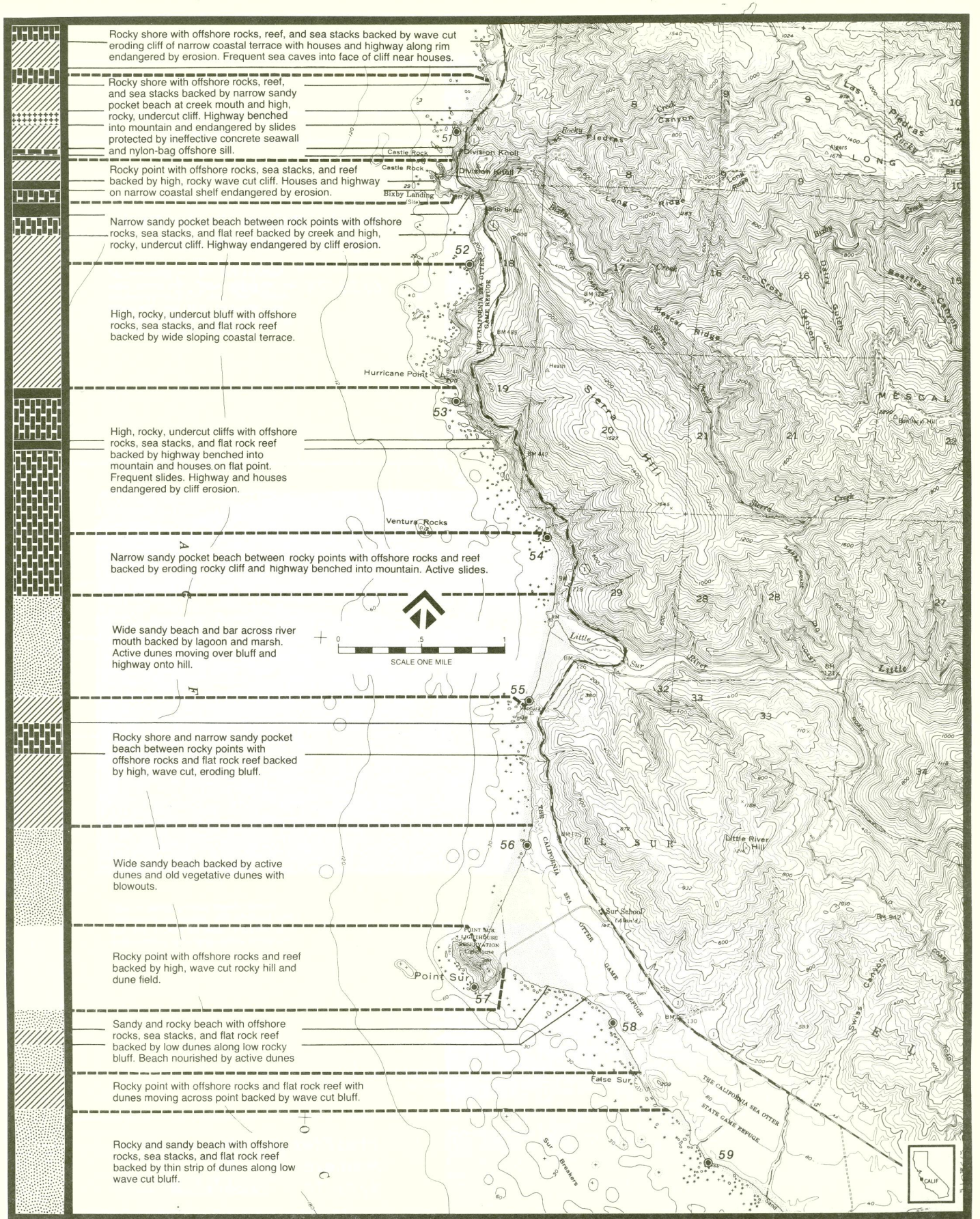
1977



Bixby Creek Bridge
Monterey Mi. 51.4
6/28/76 Tide +2.0

Little Sur River Beach
Monterey Mi. 53.8
6/28/76 Tide +2.0

Little Sur River Lagoon
Monterey Mi. 54.6
6/28/76 Tide +2.2



▪ SHORELINE CONDITION ▪

- PRESENT DEVELOPMENT CRITICAL
- PRESENT DEVELOPMENT NON-CRITICAL
- FUTURE DEVELOPMENT CRITICAL
- ARTIFICIAL PROTECTION
- PROTECTIVE BEACH
- STABLE ROCK

MONTEREY CO. — MI. 51 - 59

MAP NUMBER 67

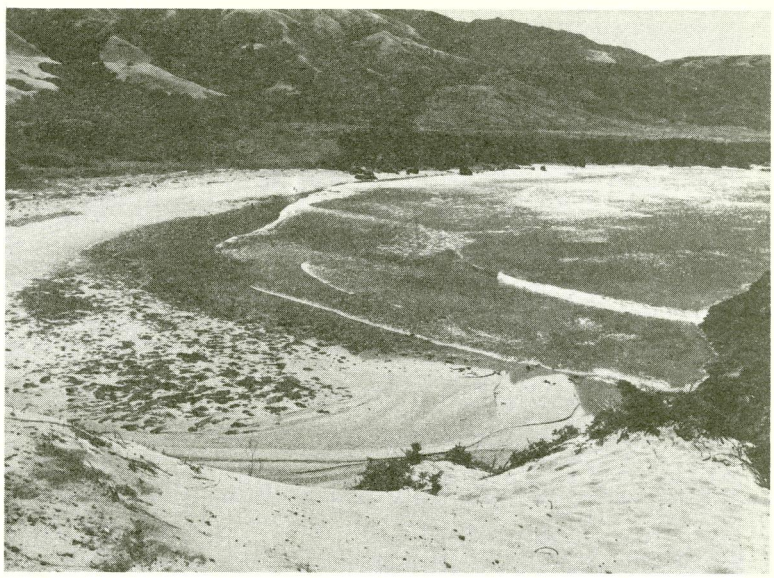
STATE OF CALIFORNIA — THE RESOURCES AGENCY

DEPARTMENT OF NAVIGATION & OCEAN DEVELOPMENT

DNOD

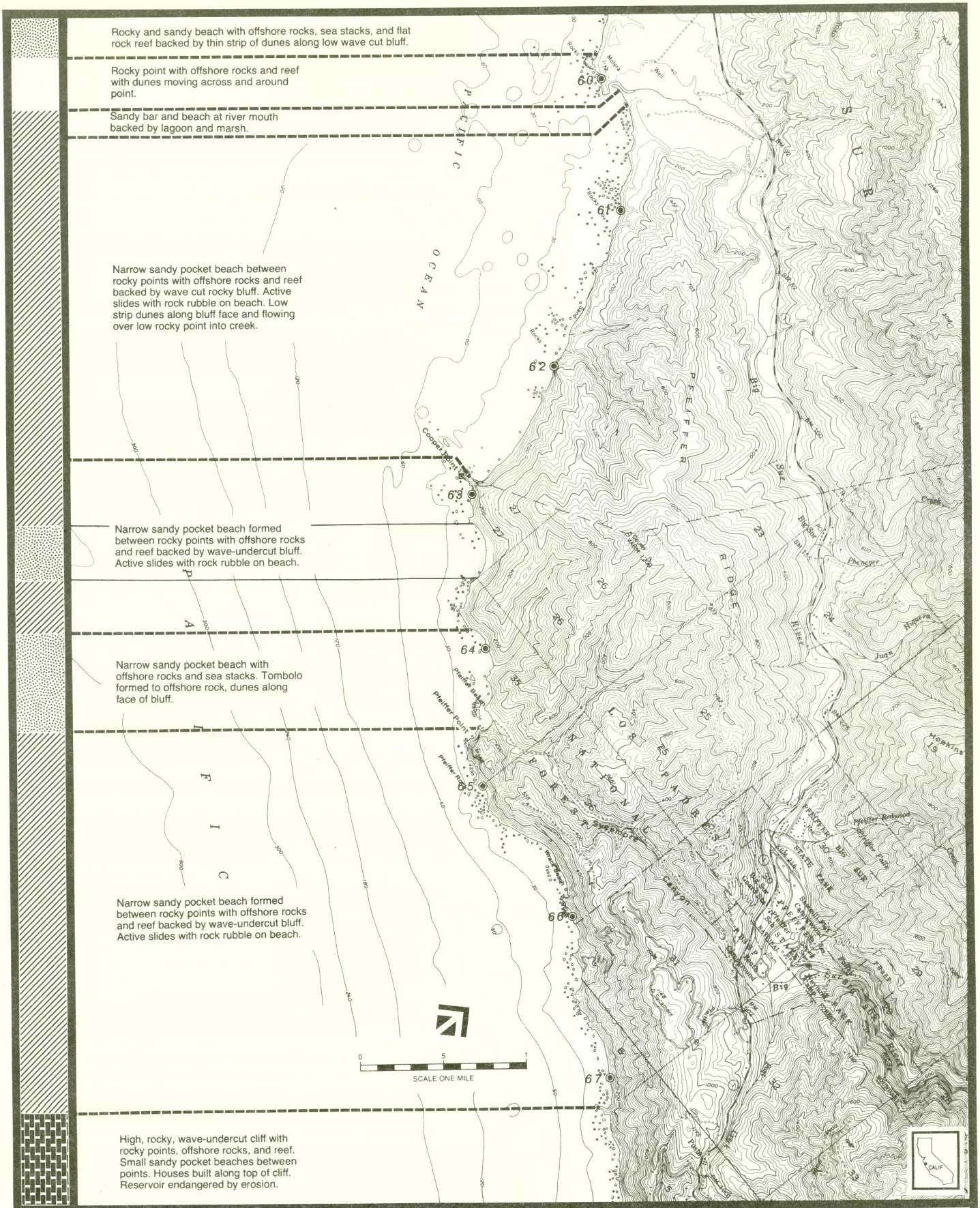
1977

Andrew Molera State Park
Big Sur River Mouth
Monterey Mi. 60.2
6/29/76 Tide +2.1



Andrew Molera State Park
Big Sur River Mouth
Monterey Mi. 60.2
6/29/76 Tide +2.1

Pfeiffer Beach
Monterey Mi. 64.3
6/29/76 Tide +3.9



• SHORELINE CONDITION •

- PRESENT DEVELOPMENT CRITICAL
- PRESENT DEVELOPMENT NON-CRITICAL
- FUTURE DEVELOPMENT CRITICAL
- ARTIFICIAL PROTECTION
- PROTECTIVE BEACH
- STABLE ROCK

MONTEREY CO. — MI. 60 - 67

MAP NUMBER **68**

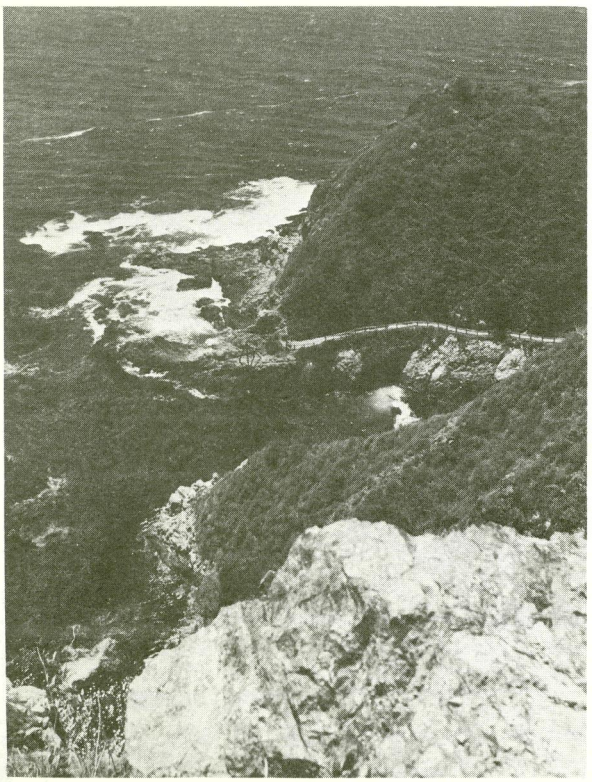
STATE OF CALIFORNIA — THE RESOURCES AGENCY

DEPARTMENT OF NAVIGATION & OCEAN DEVELOPMENT

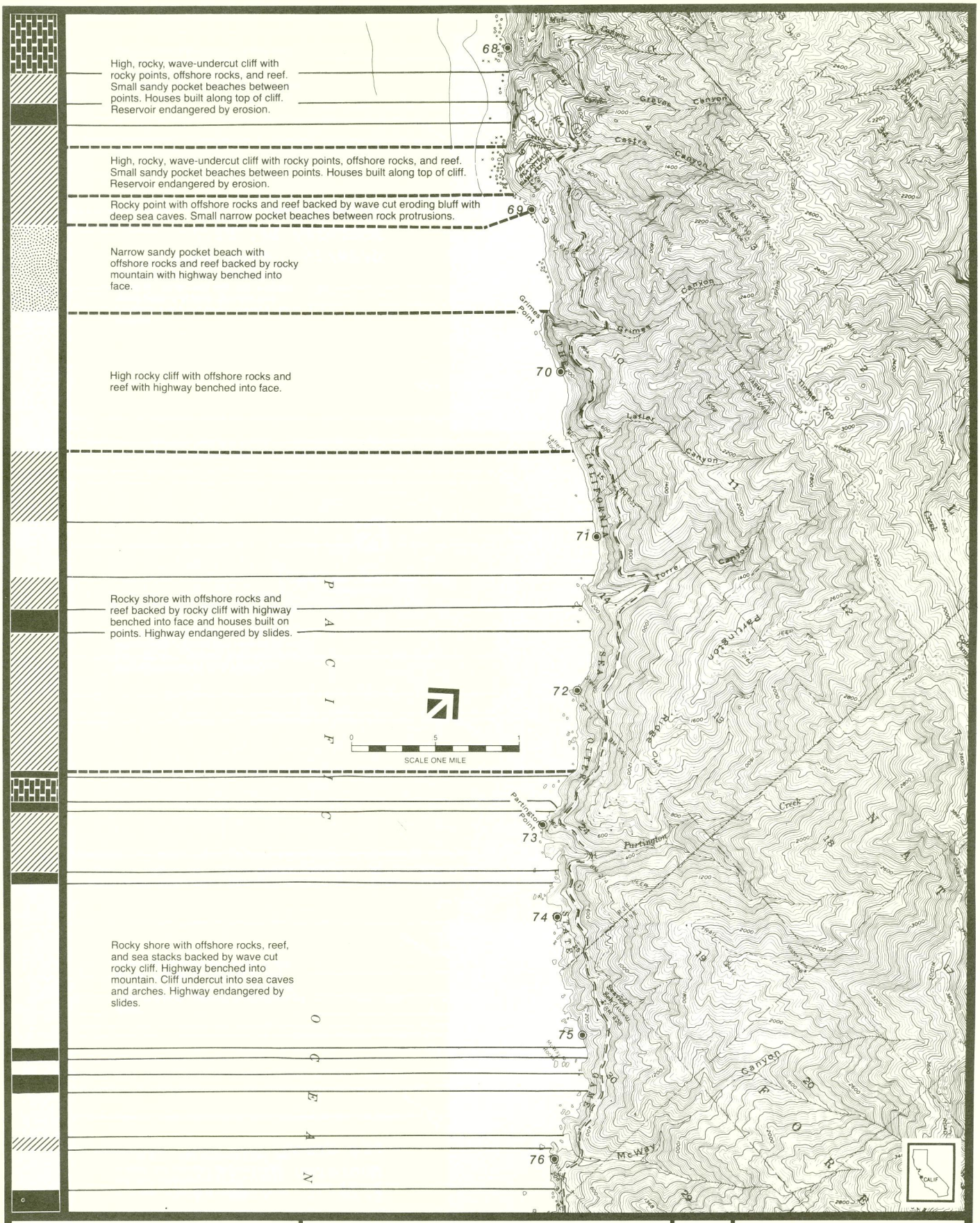
DNOD

1977

Grimes Point
Monterey Mi. 70.4
6/29/76 Tide +3.8



Partington Point
Monterey Mi. 73.4
6/29/76 Tide +3.55



▪ SHORELINE CONDITION ▪

- PRESENT DEVELOPMENT CRITICAL
- ARTIFICIAL PROTECTION
- PRESENT DEVELOPMENT NON-CRITICAL
- PROTECTIVE BEACH
- FUTURE DEVELOPMENT CRITICAL
- STABLE ROCK

MONTEREY CO. — MI. 68 - 76

MAP NUMBER **69**

STATE OF CALIFORNIA — THE RESOURCES AGENCY

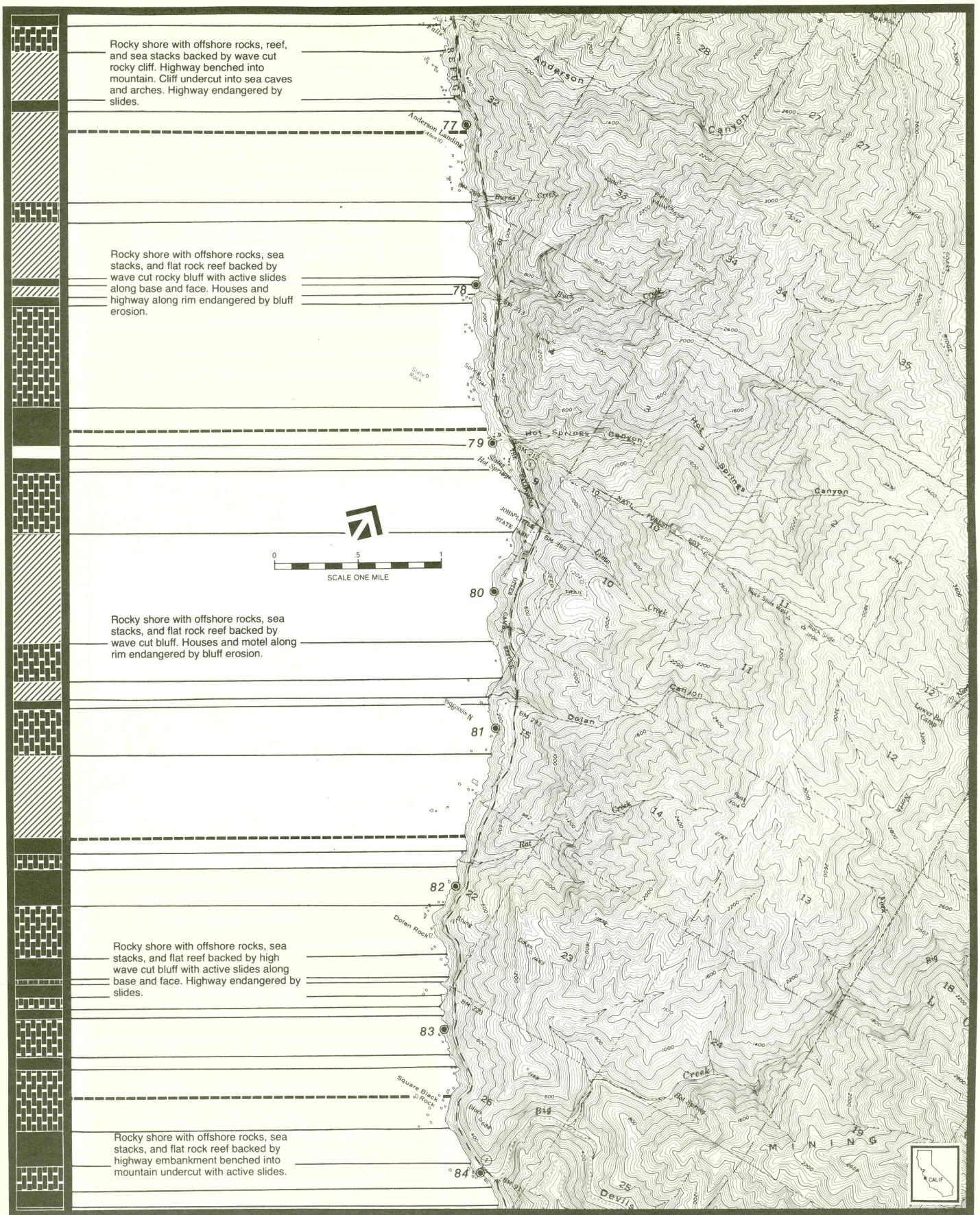
DEPARTMENT OF NAVIGATION & OCEAN DEVELOPMENT

DNOD

1977

Dolan Rock
Monterey Mi. 82.2
6/29/76 Tide +3.4

Big Creek
Monterey Mi. 84.0
6/29/76 Tide +3.1



▪ SHORELINE CONDITION ▪

PRESENT DEVELOPMENT CRITICAL	ARTIFICIAL PROTECTION
PRESENT DEVELOPMENT NON-CRITICAL	PROTECTIVE BEACH
FUTURE DEVELOPMENT CRITICAL	STABLE ROCK

MONTEREY CO. — MI. 77 - 84

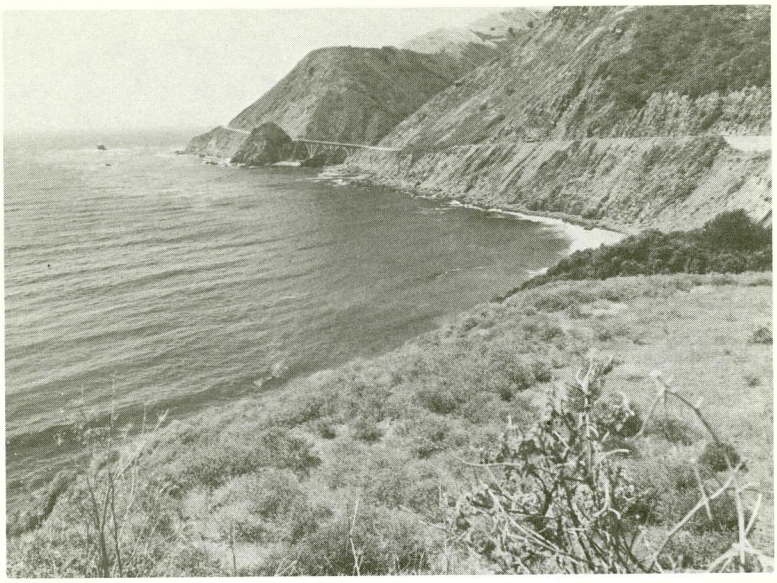
MAP NUMBER 70

STATE OF CALIFORNIA — THE RESOURCES AGENCY

DEPARTMENT OF NAVIGATION & OCEAN DEVELOPMENT

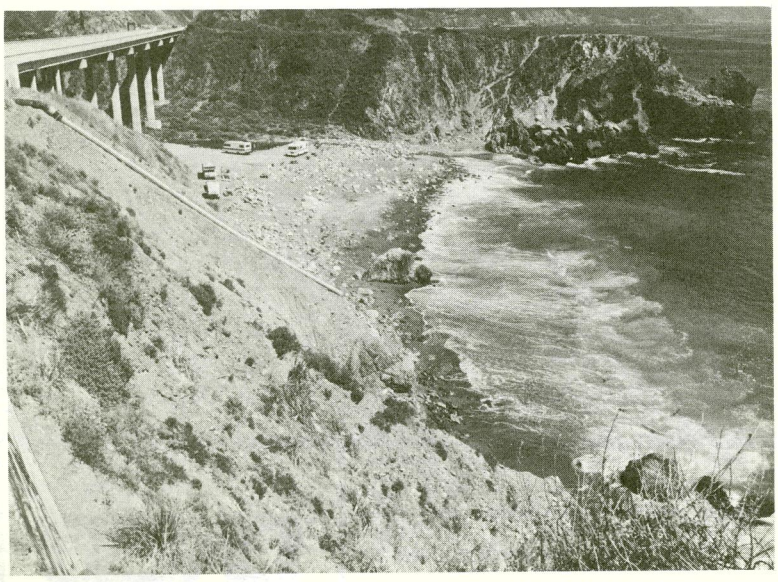
DNOD

1977

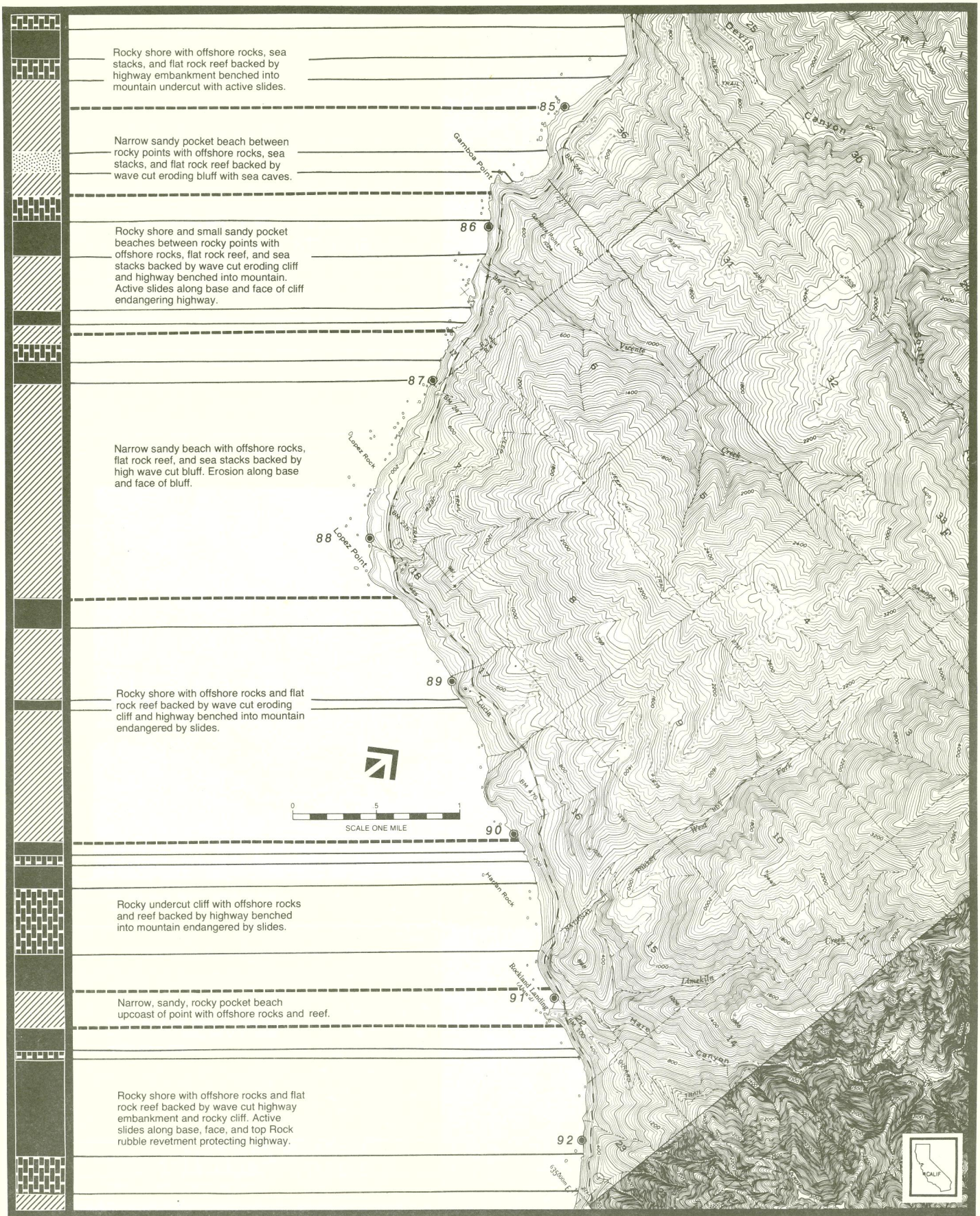


Big Creek Bridge
Monterey Mi. 84.3
6/29/76 Tide +3.0

Harlan Rock
Monterey Mi. 90.5
6/29/76 Tide +2.8



Rockland Landing,
Limekiln Creek
Monterey Mi. 91.0
6/29/76 Tide +2.8



• SHORELINE CONDITION •

- PRESENT DEVELOPMENT CRITICAL
- PRESENT DEVELOPMENT NON-CRITICAL
- FUTURE DEVELOPMENT CRITICAL
- ARTIFICIAL PROTECTION
- PROTECTIVE BEACH
- STABLE ROCK

MONTEREY CO. — MI. 85 - 92

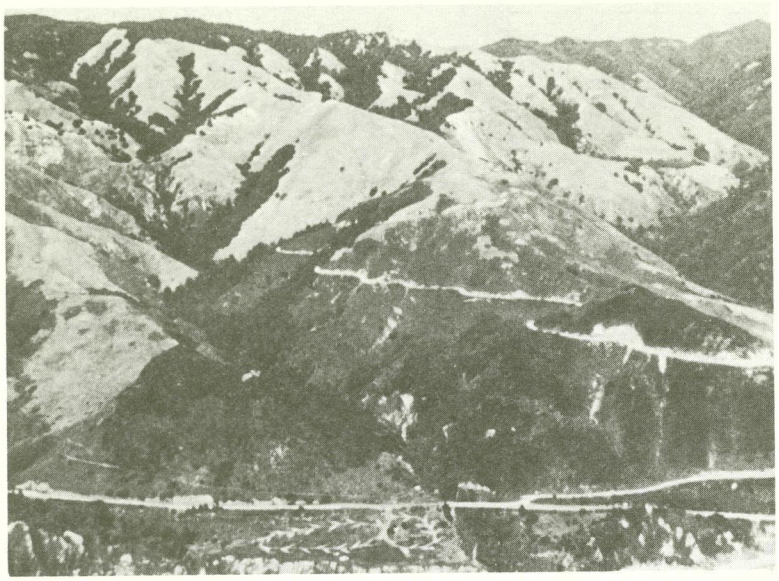
MAP NUMBER 71

STATE OF CALIFORNIA — THE RESOURCES AGENCY

DEPARTMENT OF NAVIGATION & OCEAN DEVELOPMENT

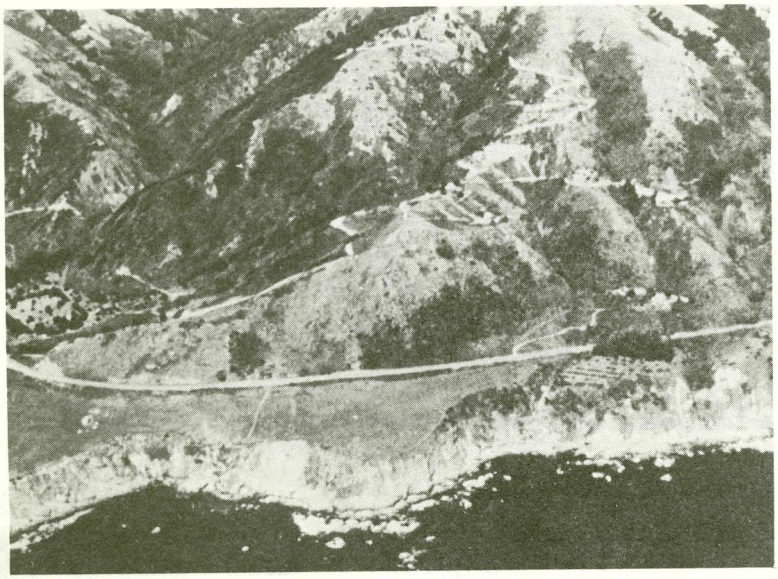
DNOD

1977

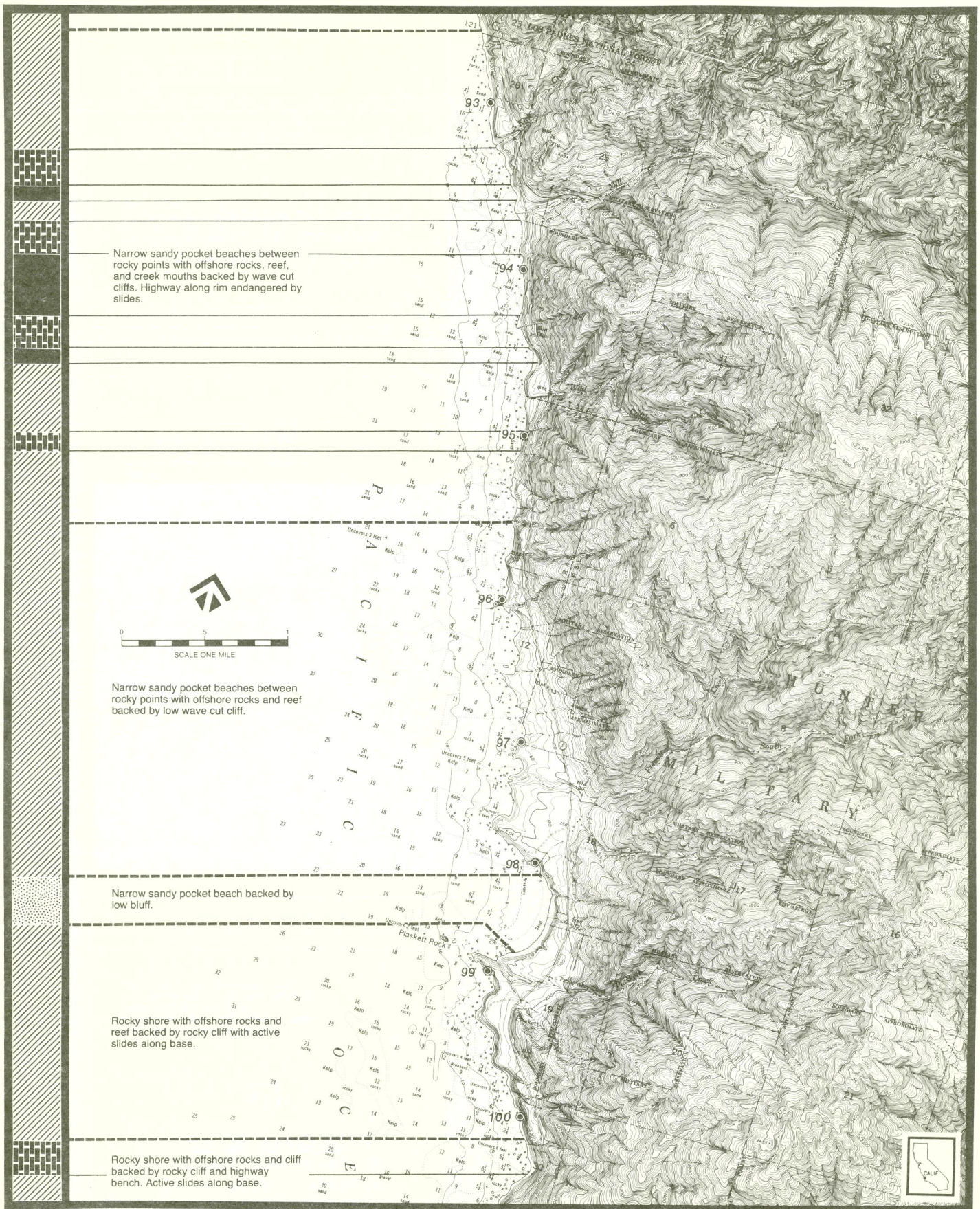


Monterey Mi. 93.00
5/11/72 Tide +1.2

Monterey Mi. 99.1
5/11/72 Tide +1.2



Monterey Mi. 99.2
5/11/72 Tide +1.2



▪ SHORELINE CONDITION ▪

- PRESENT DEVELOPMENT CRITICAL
- PRESENT DEVELOPMENT NON-CRITICAL
- FUTURE DEVELOPMENT CRITICAL
- ARTIFICIAL PROTECTION
- PROTECTIVE BEACH
- STABLE ROCK

MONTEREY CO. — MI. 93-100

MAP NUMBER **72**

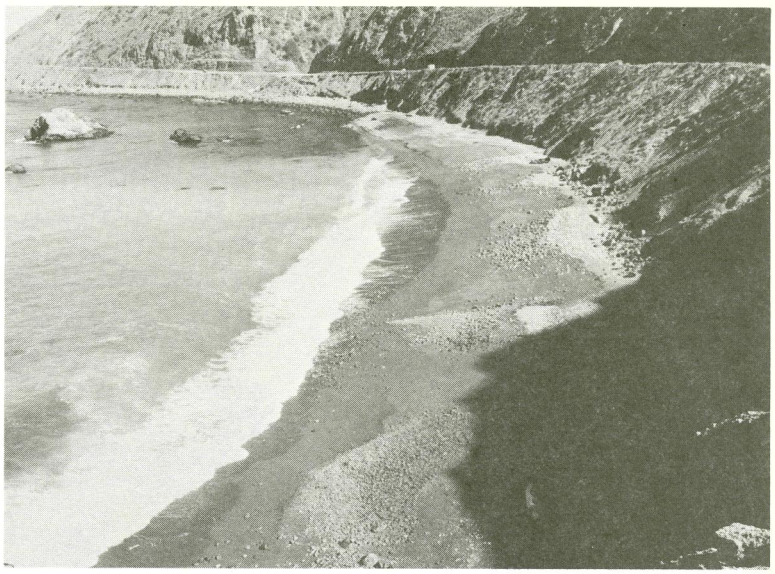
STATE OF CALIFORNIA — THE RESOURCES AGENCY

DEPARTMENT OF NAVIGATION & OCEAN DEVELOPMENT

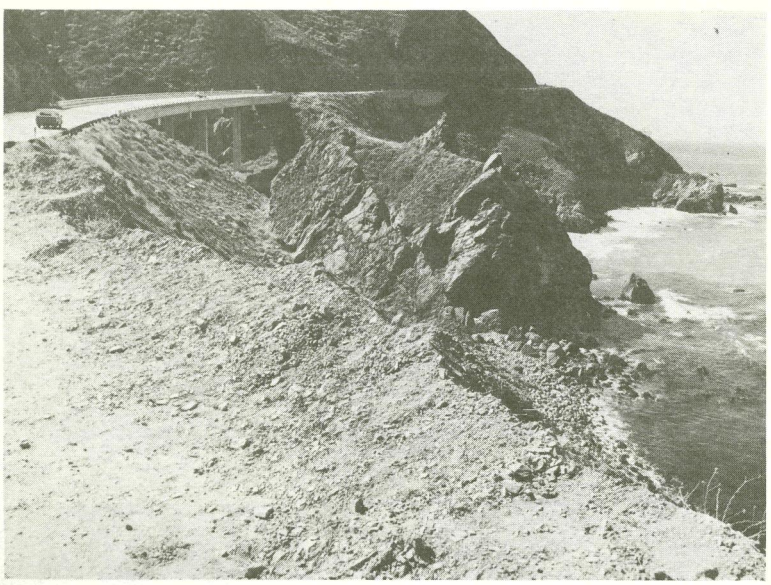
DNOD

1977

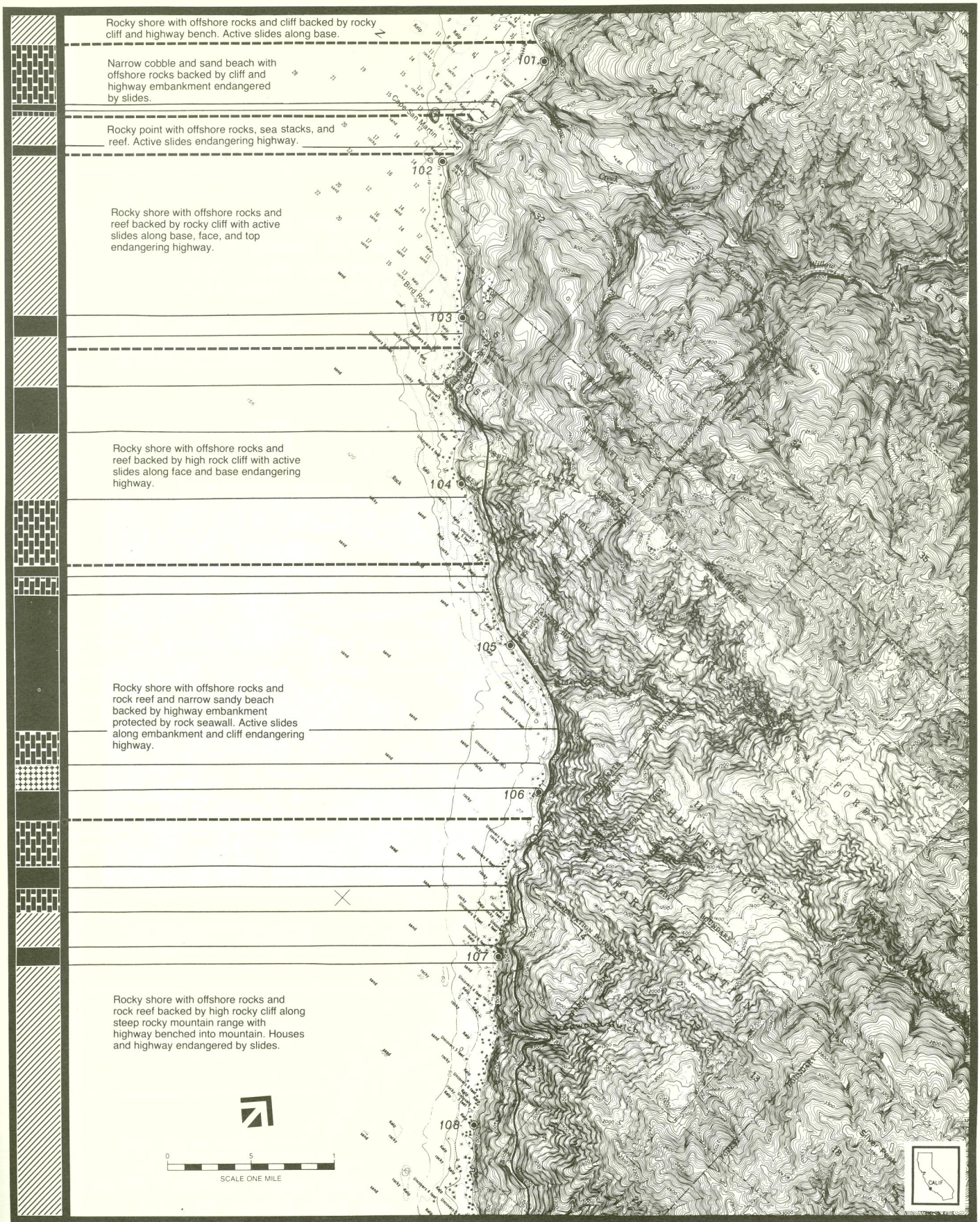
Cape San Martin
Monterey Mi. 101.1
6/29/76 Tide +2.2



Alder Creek
Monterey Mi. 105.8
6/30/76 Tide +0.7



Villa Creek Bridge
Monterey Mi. 106.1
6/30/76 Tide +0.95



• SHORELINE CONDITION •

- PRESENT DEVELOPMENT CRITICAL
- PRESENT DEVELOPMENT NON-CRITICAL
- FUTURE DEVELOPMENT CRITICAL
- ARTIFICIAL PROTECTION
- PROTECTIVE BEACH
- STABLE ROCK

MONTEREY CO. — MI. 101 - 108

MAP NUMBER 73

STATE OF CALIFORNIA — THE RESOURCES AGENCY

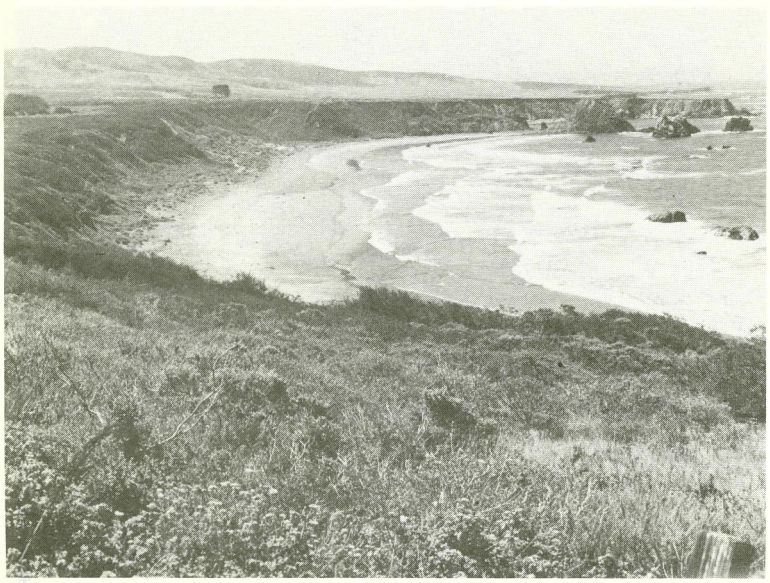
DEPARTMENT OF NAVIGATION & OCEAN DEVELOPMENT

DNOD

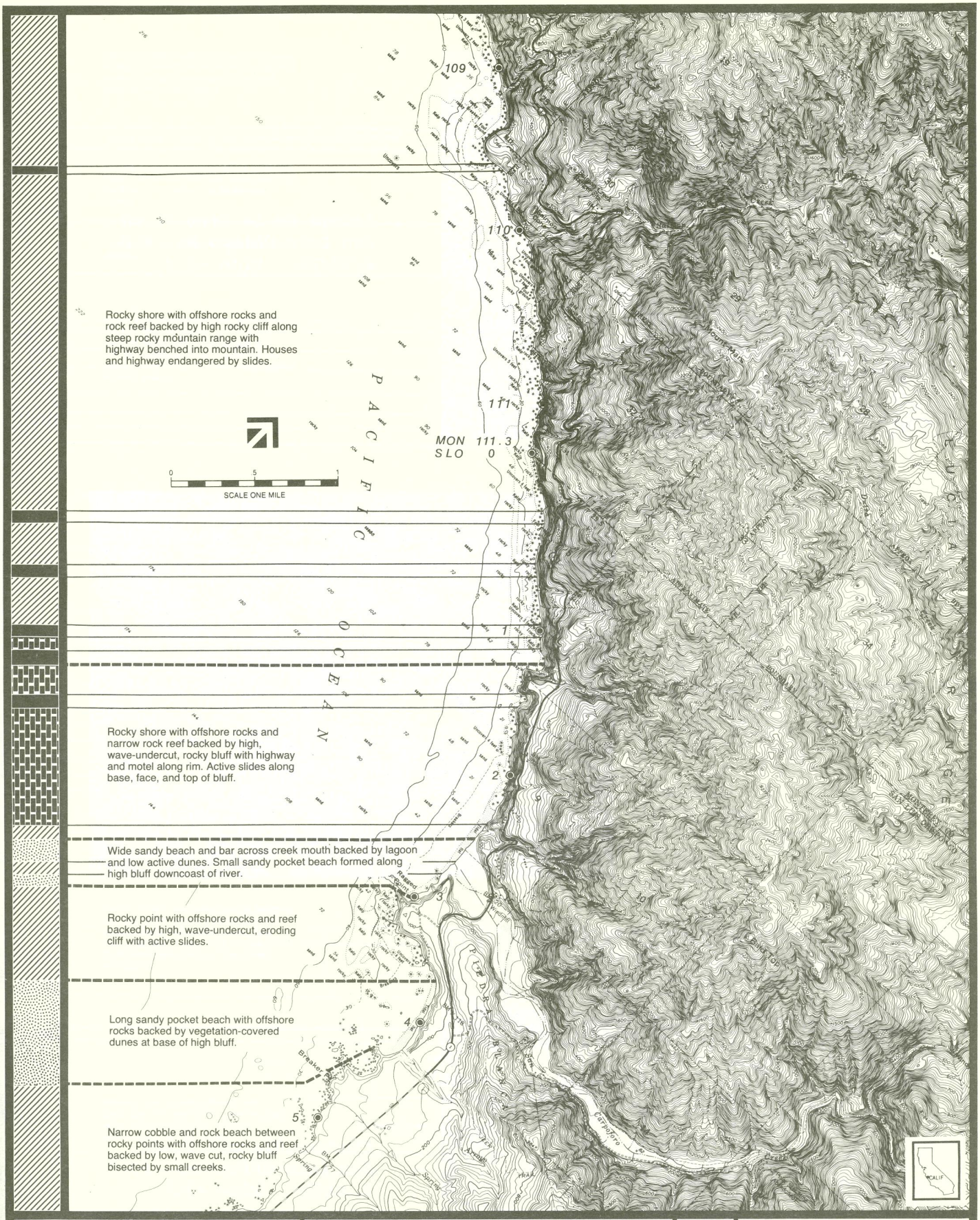
1977

Monterey and San Luis
Obispo County Line
Monterey Mi. 111.3
6/30/76 Tide +1.5

Ragged Point Beach,
San Carpoforo Creek
San Luis Obispo Mi. 2.3
6/30/76 Tide +2.4



Ragged Point, Breaker Point
San Luis Obispo Mi. 3.7
6/30/76 Tide +2.75



▪ SHORELINE CONDITION ▪

- PRESENT DEVELOPMENT CRITICAL
- PRESENT DEVELOPMENT NON-CRITICAL
- FUTURE DEVELOPMENT CRITICAL
- ARTIFICIAL PROTECTION
- PROTECTIVE BEACH
- STABLE ROCK

MONTEREY CO. — MI. 109-111.3
SAN LUIS OBISPO CO. — MI. 0-5

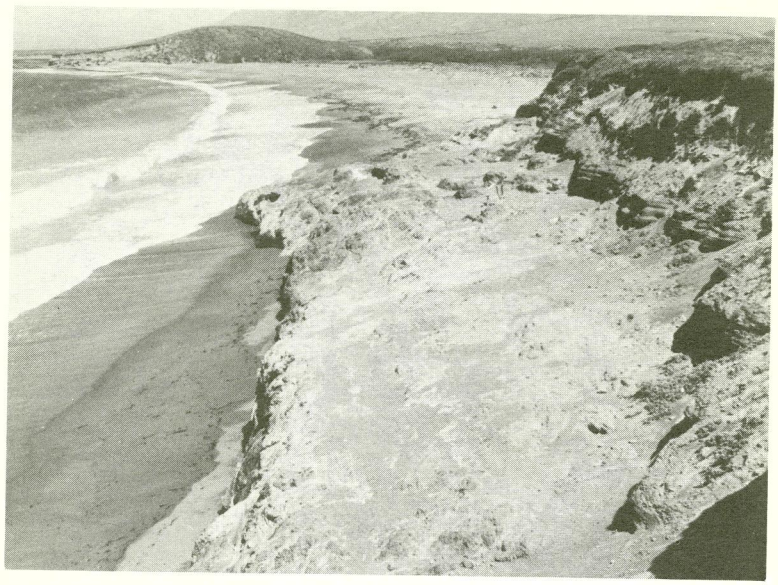
MAP NUMBER **74**

STATE OF CALIFORNIA — THE RESOURCES AGENCY

DEPARTMENT OF NAVIGATION & OCEAN DEVELOPMENT

DNOD

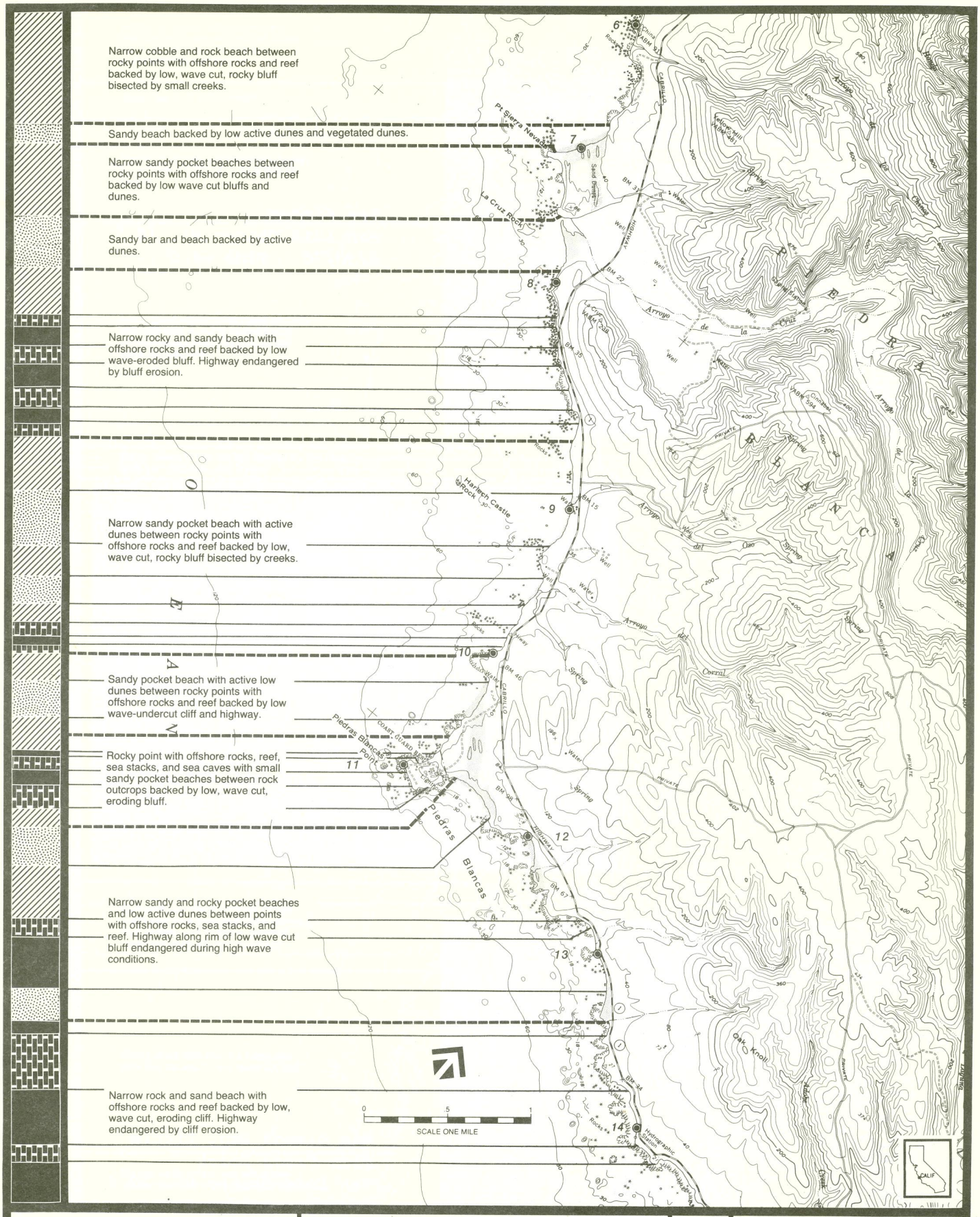
1977



Arroyo De La Cruz Beach
San Luis Obispo Mi. 8.0
6/30/76 Tide +3.4

Piedras Blancas Beach
San Luis Obispo Mi. 13.0
6/30/76 Tide +3.7

Piedras Blancas Beach
San Luis Obispo Mi. 13.0
6/30/76 Tide +3.7



▪ SHORELINE CONDITION ▪

- PRESENT DEVELOPMENT CRITICAL
- PRESENT DEVELOPMENT NON-CRITICAL
- FUTURE DEVELOPMENT CRITICAL
- ARTIFICIAL PROTECTION
- PROTECTIVE BEACH
- STABLE ROCK

SAN LUIS OBISPO CO. — MI. 6-14

MAP NUMBER **75**

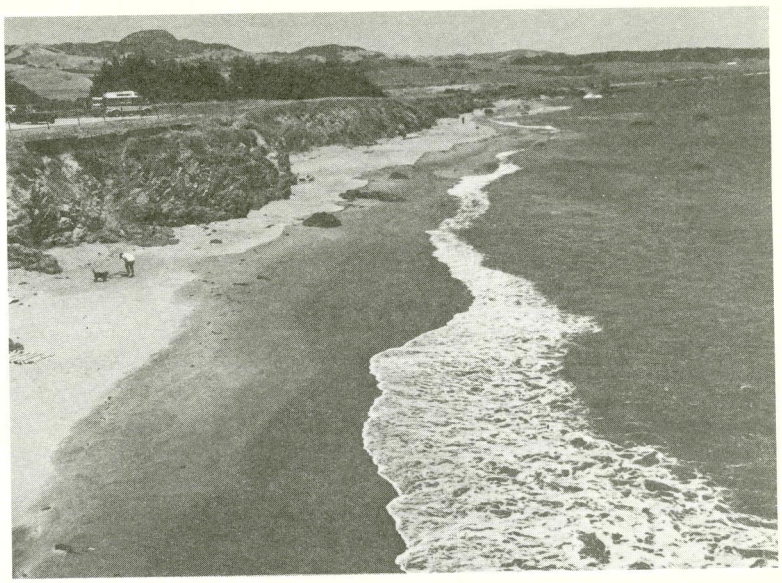
STATE OF CALIFORNIA — THE RESOURCES AGENCY

DEPARTMENT OF NAVIGATION & OCEAN DEVELOPMENT

DNOD

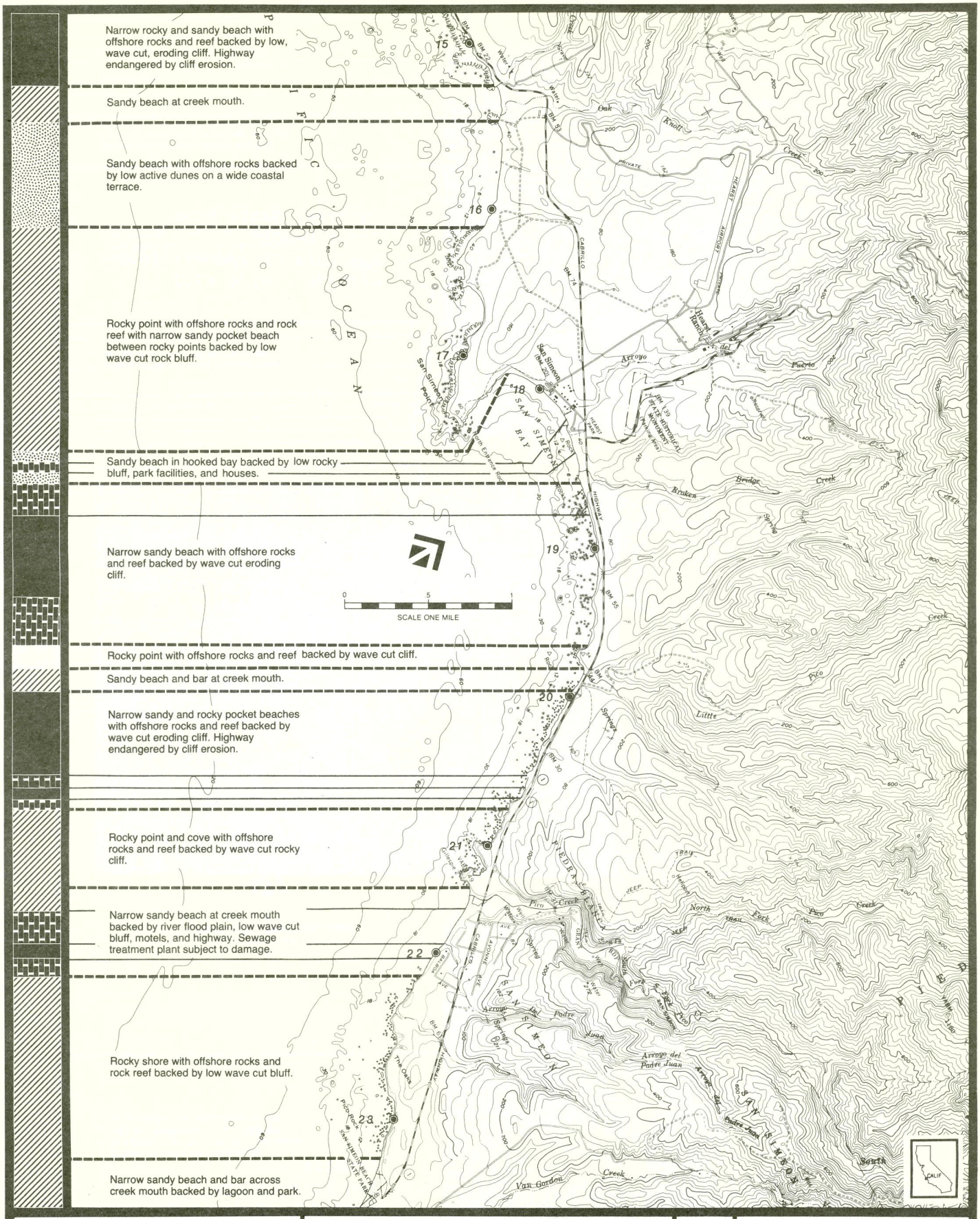
1977

San Simeon
San Luis Obispo Mi. 18.5
6/30/76 Tide +4.0



San Simeon
San Luis Obispo Mi. 18.5
6/30/76 Tide +4.0

San Simeon Bay, Little
Pico Creek Beach
San Luis Obispo Mi. 20.4
6/30/76 Tide +3.8



SHORELINE CONDITION

- PRESENT DEVELOPMENT CRITICAL
- PRESENT DEVELOPMENT NON-CRITICAL
- FUTURE DEVELOPMENT CRITICAL
- ARTIFICIAL PROTECTION
- PROTECTIVE BEACH
- STABLE ROCK

SAN LUIS OBISPO CO. — MI. 15 - 23

MAP NUMBER **76**

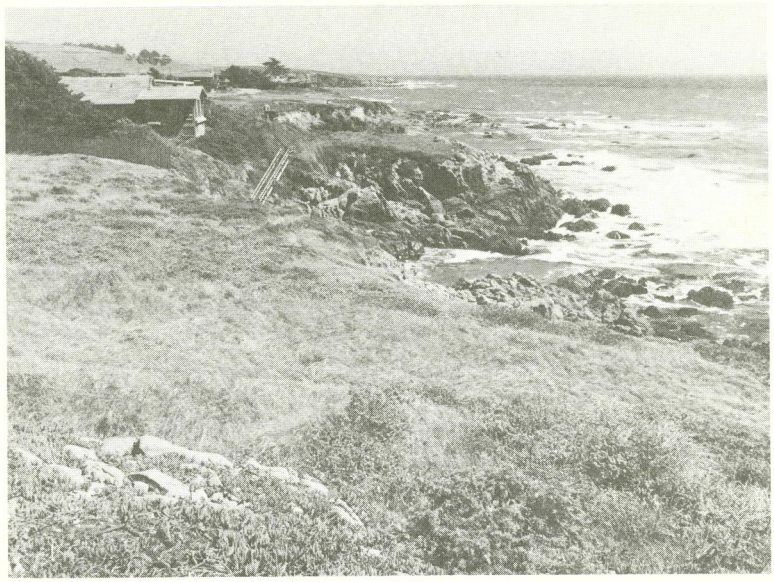
STATE OF CALIFORNIA — THE RESOURCES AGENCY

DEPARTMENT OF NAVIGATION & OCEAN DEVELOPMENT

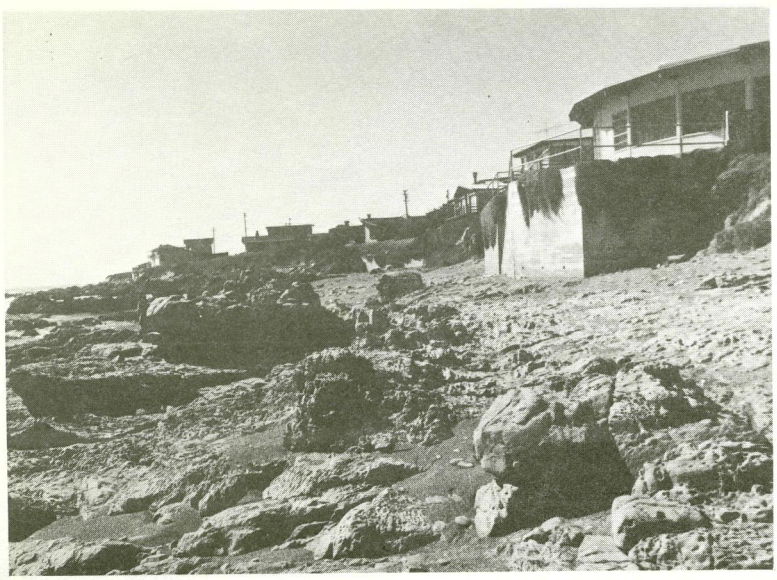
DNOD

1977

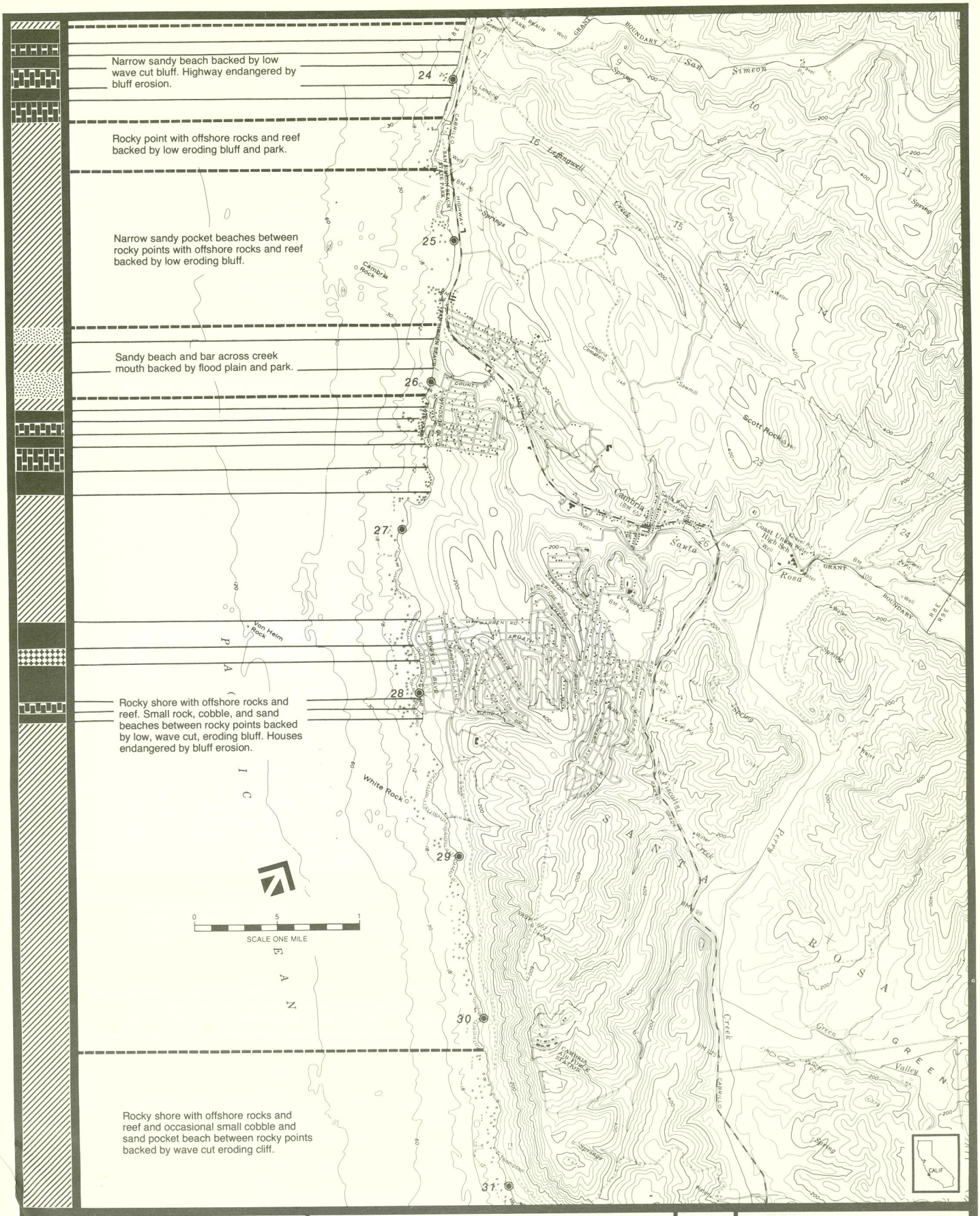
Cambria, Santa Rosa Creek Beach
San Luis Obispo Mi. 26.1
6/30/76 Tide +3.2



Cambria
San Luis Obispo Mi. 26.1
6/30/76 Tide +3.2



Cambria
San Luis Obispo Mi. 27.8
6/30/76 Tide +2.8



▪ SHORELINE CONDITION ▪

- PRESENT DEVELOPMENT CRITICAL
- PRESENT DEVELOPMENT NON-CRITICAL
- FUTURE DEVELOPMENT CRITICAL
- ARTIFICIAL PROTECTION
- PROTECTIVE BEACH
- STABLE ROCK

SAN LUIS OBISPO CO. — MI. 24-31

MAP NUMBER 77

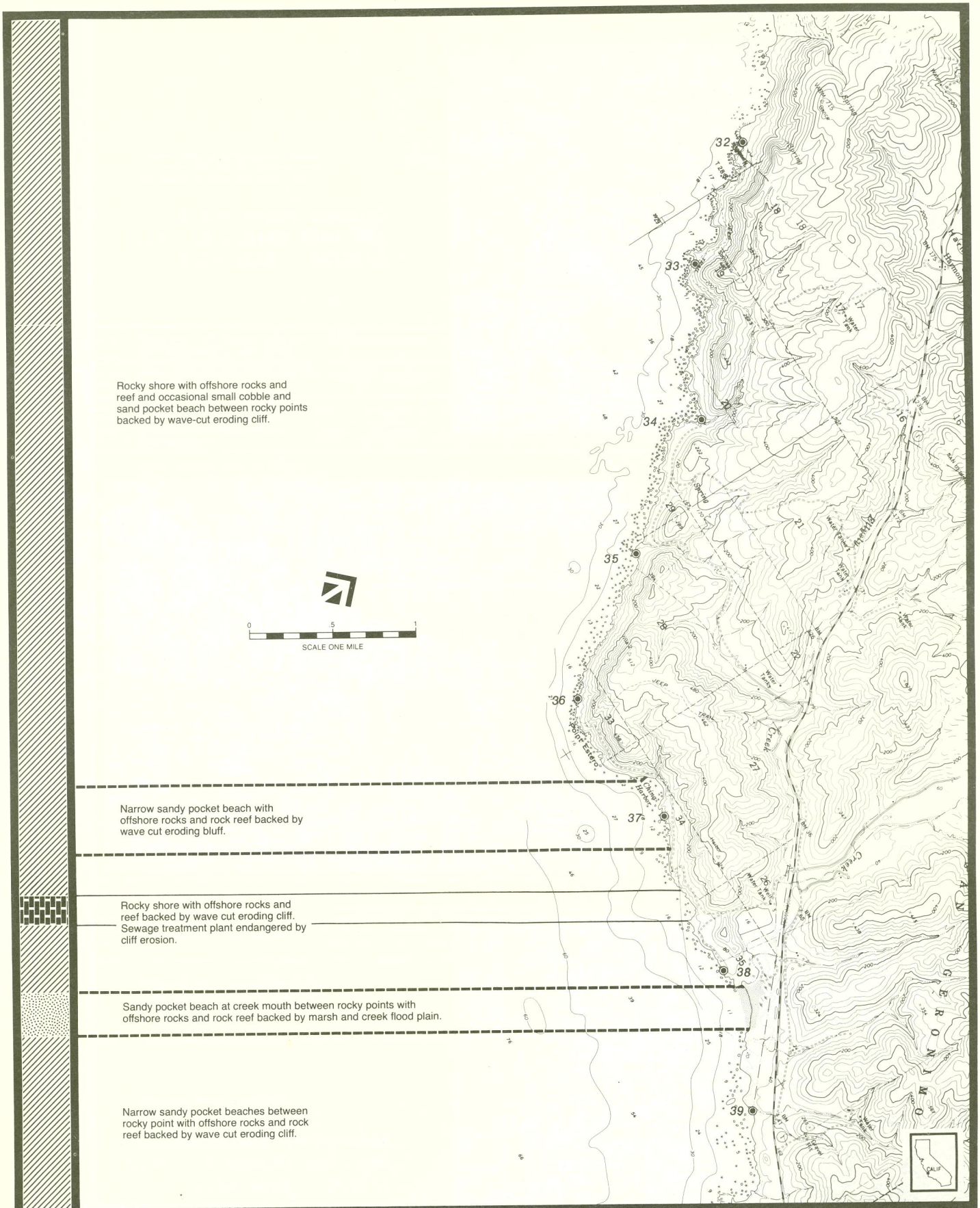
STATE OF CALIFORNIA — THE RESOURCES AGENCY

DEPARTMENT OF NAVIGATION & OCEAN DEVELOPMENT

DNOD

1977

Villa Creek Beach
San Luis Obispo Mi. 38.7
6/30/76 Tide +2.6



▪ SHORELINE CONDITION ▪

- PRESENT DEVELOPMENT CRITICAL
- PRESENT DEVELOPMENT NON-CRITICAL
- FUTURE DEVELOPMENT CRITICAL
- ARTIFICIAL PROTECTION
- PROTECTIVE BEACH
- STABLE ROCK

SAN LUIS OBISPO CO. — MI. 32-39

MAP NUMBER **78**

STATE OF CALIFORNIA — THE RESOURCES AGENCY

DEPARTMENT OF NAVIGATION & OCEAN DEVELOPMENT

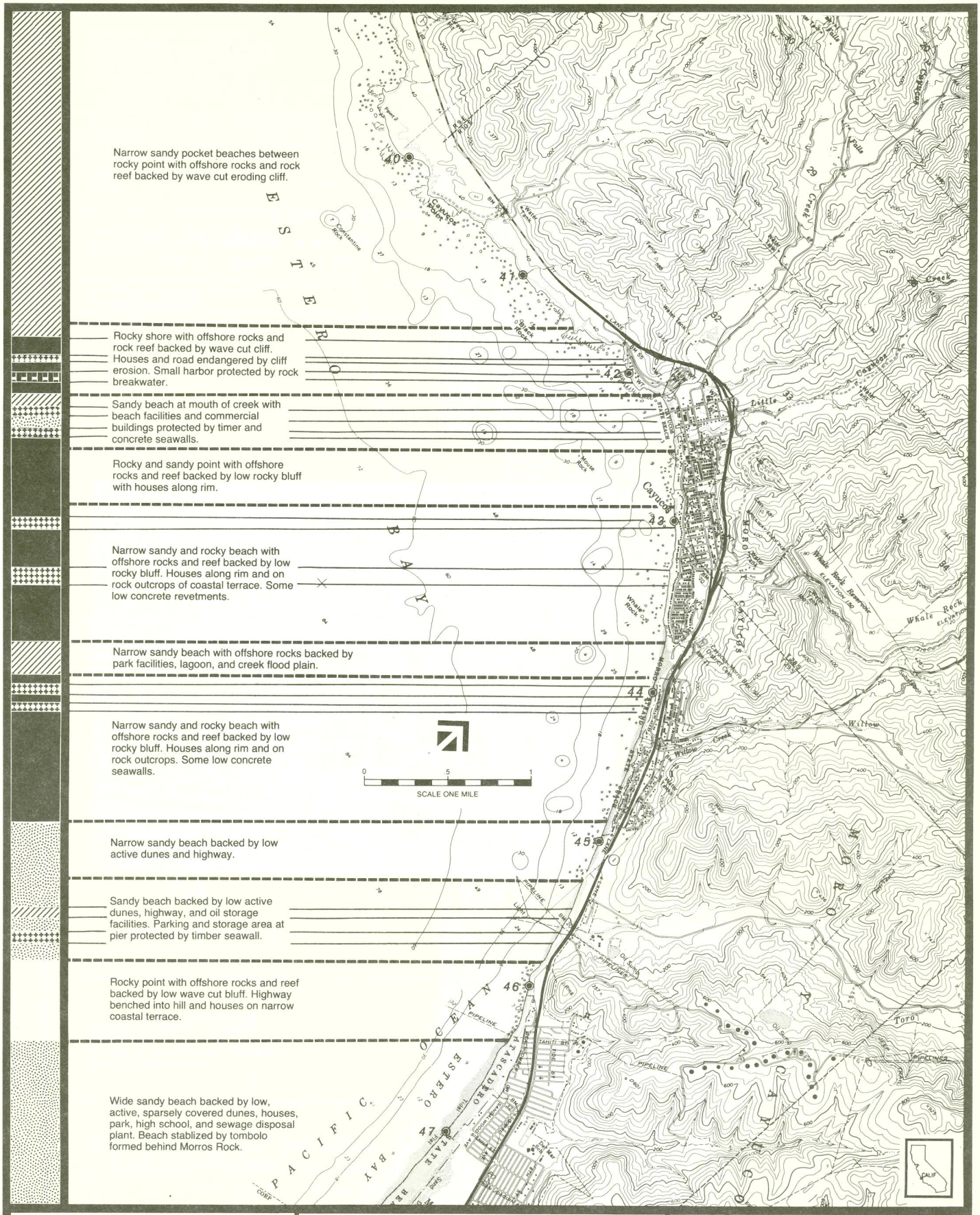
DNOD

1977

Cayucos State Beach
San Luis Obispo Mi. 42.1
6/30/76 Tide +2.5

Morro Strand State Beach
San Luis Obispo Mi. 44.1
7/1/76 Tide +0.3

Atascadero State Beach
San Luis Obispo Mi. 47.0
7/1/76 Tide +1.3



▪ SHORELINE CONDITION ▪

- PRESENT DEVELOPMENT CRITICAL
- PRESENT DEVELOPMENT NON-CRITICAL
- FUTURE DEVELOPMENT CRITICAL
- ARTIFICIAL PROTECTION
- PROTECTIVE BEACH
- STABLE ROCK

SAN LUIS OBISPO CO. — MI. 40 - 47

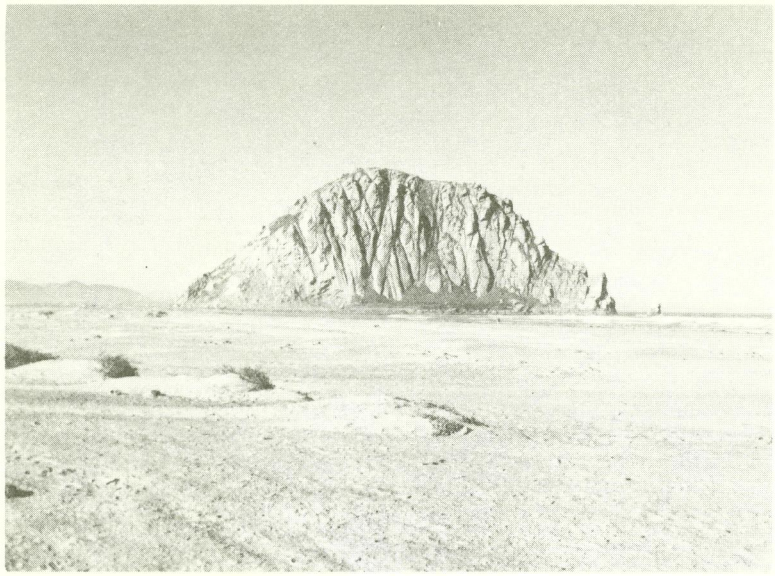
MAP NUMBER **79**

STATE OF CALIFORNIA — THE RESOURCES AGENCY

DEPARTMENT OF NAVIGATION & OCEAN DEVELOPMENT

DNOD

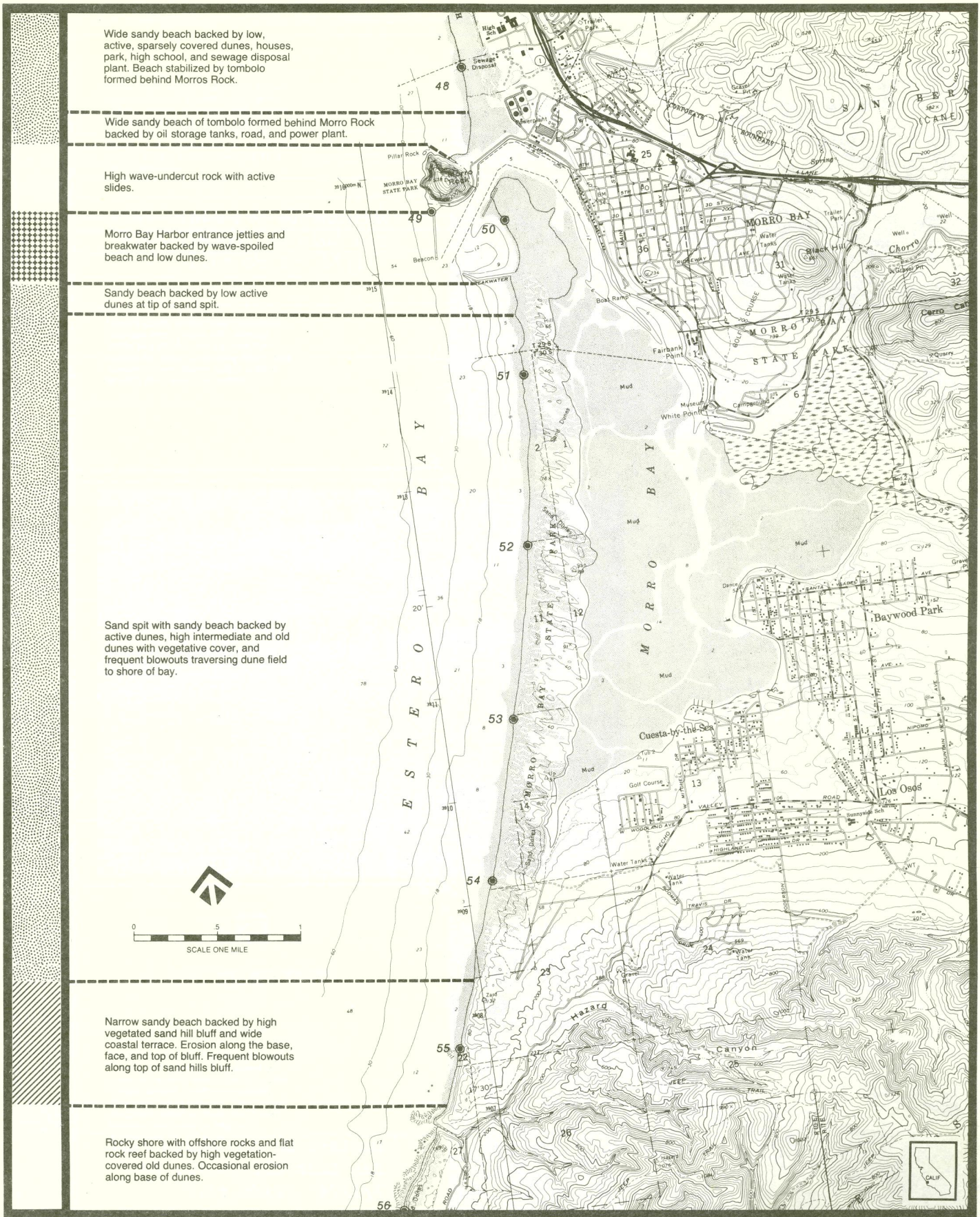
1977



Morro Rock
San Luis Obispo Mi. 48.2
6/30/76 Tide -0.15

Morro Bay Public Harbor
San Luis Obispo Mi. 54.4
7/1/76 Tide +1.7

Morro Bay
San Luis Obispo Mi. 56.7
7/1/76 Tide +4.2



SHORELINE CONDITION

- PRESENT DEVELOPMENT CRITICAL
- PRESENT DEVELOPMENT NON-CRITICAL
- FUTURE DEVELOPMENT CRITICAL
- ARTIFICIAL PROTECTION
- PROTECTIVE BEACH
- STABLE ROCK

SAN LUIS OBISPO CO. — MI. 48 - 56

MAP NUMBER **80**

STATE OF CALIFORNIA — THE RESOURCES AGENCY

DEPARTMENT OF NAVIGATION & OCEAN DEVELOPMENT

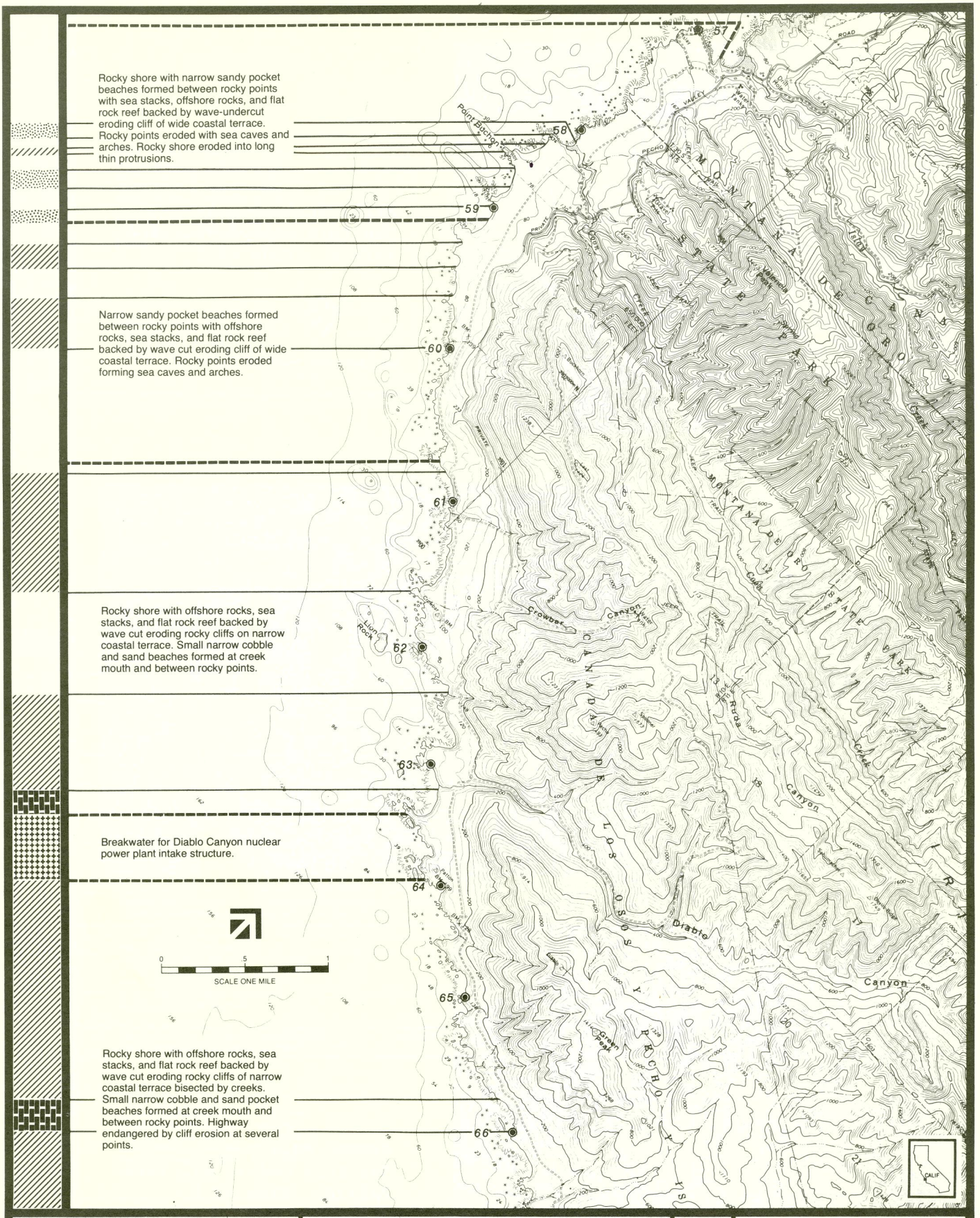
DNOD

1977

Montana De Oro State Park
San Luis Obispo Mi. 56.6
7/1/76 Tide +3.1

Montana De Oro State Park
San Luis Obispo Mi. 56.65
7/1/76 Tide +3.5

Montana De Oro State Park
San Luis Obispo Mi. 56.7
7/1/76 Tide +3.7



▪ SHORELINE CONDITION ▪

- PRESENT DEVELOPMENT CRITICAL
- PRESENT DEVELOPMENT NON-CRITICAL
- FUTURE DEVELOPMENT CRITICAL
- ARTIFICIAL PROTECTION
- PROTECTIVE BEACH
- STABLE ROCK

SAN LUIS OBISPO CO. — MI. 57 - 66

MAP NUMBER **81**

STATE OF CALIFORNIA — THE RESOURCES AGENCY

DEPARTMENT OF NAVIGATION & OCEAN DEVELOPMENT

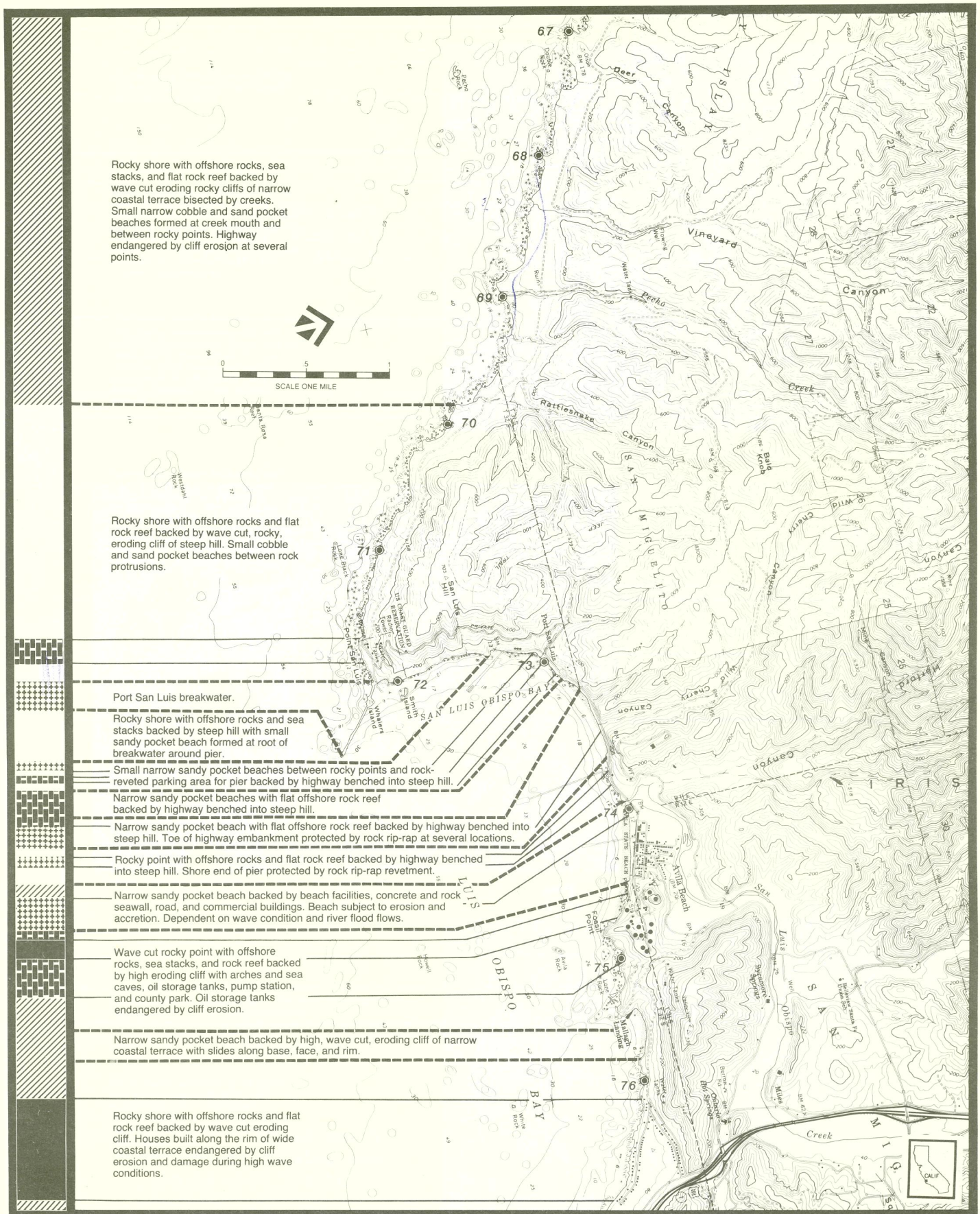
DNOD

1977

Avila State Beach
San Luis Obispo Mi. 74.2
7/1/76 Tide +4.1

Avila State Beach
San Luis Obispo Mi. 74.2
7/1/76 Tide +4.1

Sunset Palisade
San Luis Obispo Mi. 76.2
7/1/76 Tide +3.9



▪ SHORELINE CONDITION ▪

PRESENT DEVELOPMENT CRITICAL	ARTIFICIAL PROTECTION
PRESENT DEVELOPMENT NON-CRITICAL	PROTECTIVE BEACH
FUTURE DEVELOPMENT CRITICAL	STABLE ROCK

SAN LUIS OBISPO CO. — MI. 67 - 76

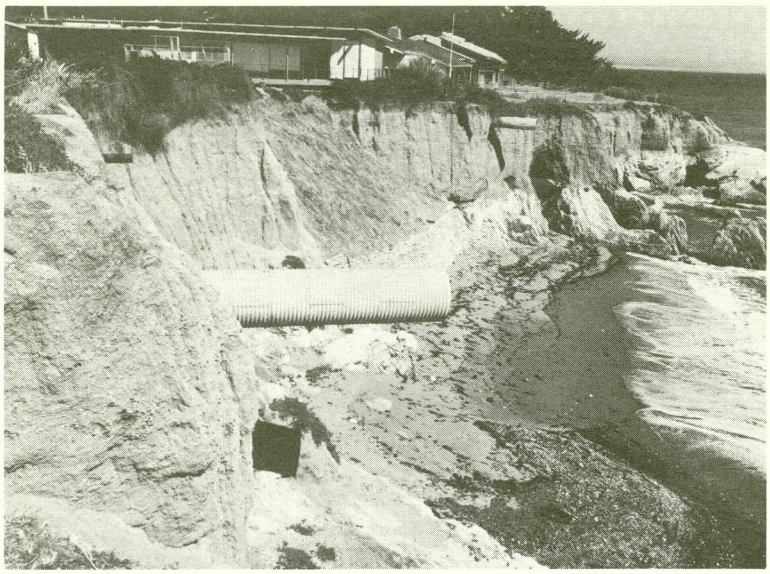
MAP NUMBER **82**

STATE OF CALIFORNIA — THE RESOURCES AGENCY

DEPARTMENT OF NAVIGATION & OCEAN DEVELOPMENT

DNOD

1977



Shell Beach
San Luis Obispo Mi. 77.8
7/1/76 Tide +3.5

Pismo Beach
San Luis Obispo Mi. 79.7
7/1/76 Tide +2.5

Pismo Beach
San Luis Obispo Mi. 82.2
7/13/76 Tide +4.0

Narrow sandy pocket beaches with flat offshore rock reef backed by highway benched into steep hill.

Rock, cobble, and sand beach with flat offshore rock reef, rocks, and sea stacks backed by wave cut eroding cliff with park, road, and houses along rim of wide coastal terrace. Park and houses endangered by cliff erosion. Cliff partially protected by concrete seawall and concrete bag revetment.

High, rocky, wave-undercut cliff with offshore rocks and reef, arches, and sea caves cut into face. Motels and road along rim of narrow coastal terrace endangered by cliff erosion. Base of cliff partially protected by low concrete seawall.

Narrow sandy beach backed by low wave cut cliff, houses, motels, and commercial buildings. Pier and structures subject to damage during high wave conditions. Motel endangered by cliff erosion. Pier and business area protected by concrete seawall.

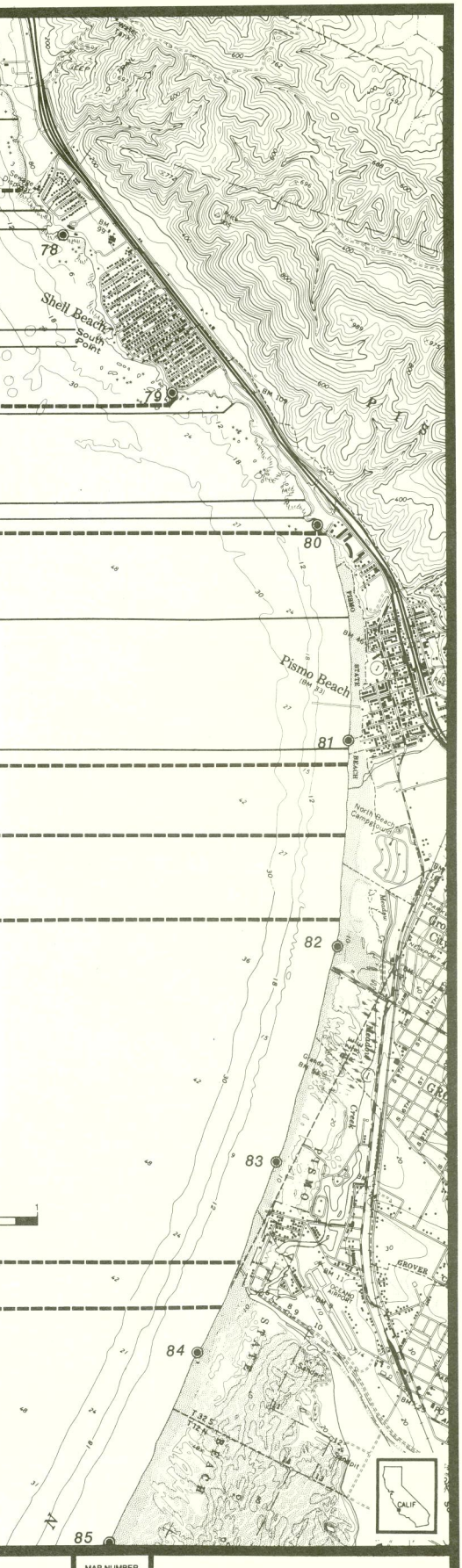
Sand bar across creek mouth backed by lagoon, flood control channel, and bridge.

Sandy beach backed by low active dunes, narrow intermediate and old dunes with dense vegetative cover, golf course, parks, mobile home parks, and roads on wide coastal plain. Timber beach access ramps subject to damage during high wave conditions.

Wide sandy beach backed by active dunes, houses, intermediate and old dunes with dense vegetative cover, marsh, lake, and highway. Timber ramps for beach access subject to damage during high wave conditions.

Sand bar and low active dunes across creek mouth backed by lagoon, marsh, and flood control channel.

Sandy beach backed by active dunes with sparse vegetative cover, high intermediate and old dunes with vegetative cover, marshes, and lakes. Dune face wave eroded with frequent active slides.



• SHORELINE CONDITION •

- PRESENT DEVELOPMENT CRITICAL
- PRESENT DEVELOPMENT NON-CRITICAL
- FUTURE DEVELOPMENT CRITICAL
- ARTIFICIAL PROTECTION
- PROTECTIVE BEACH
- STABLE ROCK

SAN LUIS OBISPO CO. — MI. 77 - 85

MAP NUMBER 83

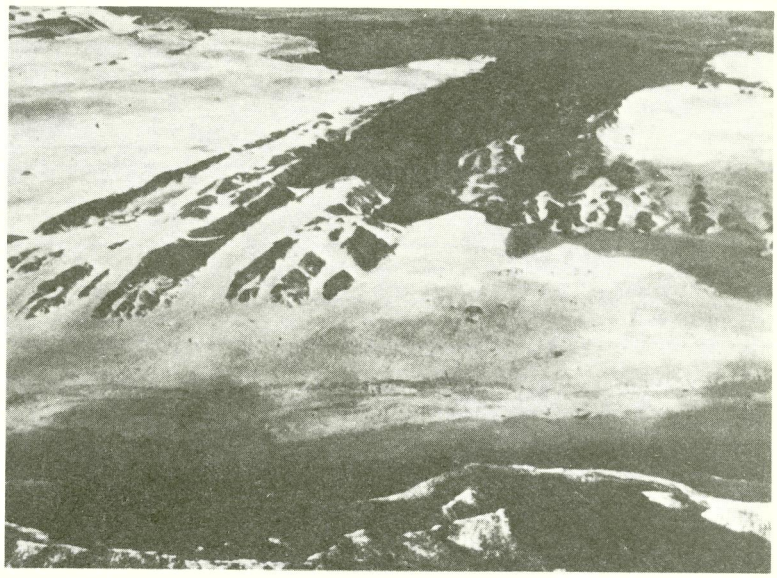
STATE OF CALIFORNIA — THE RESOURCES AGENCY

DEPARTMENT OF NAVIGATION & OCEAN DEVELOPMENT

DNOD

1977

San Luis Obispo Mi. 88.3
5/11/72 Tide +1.4

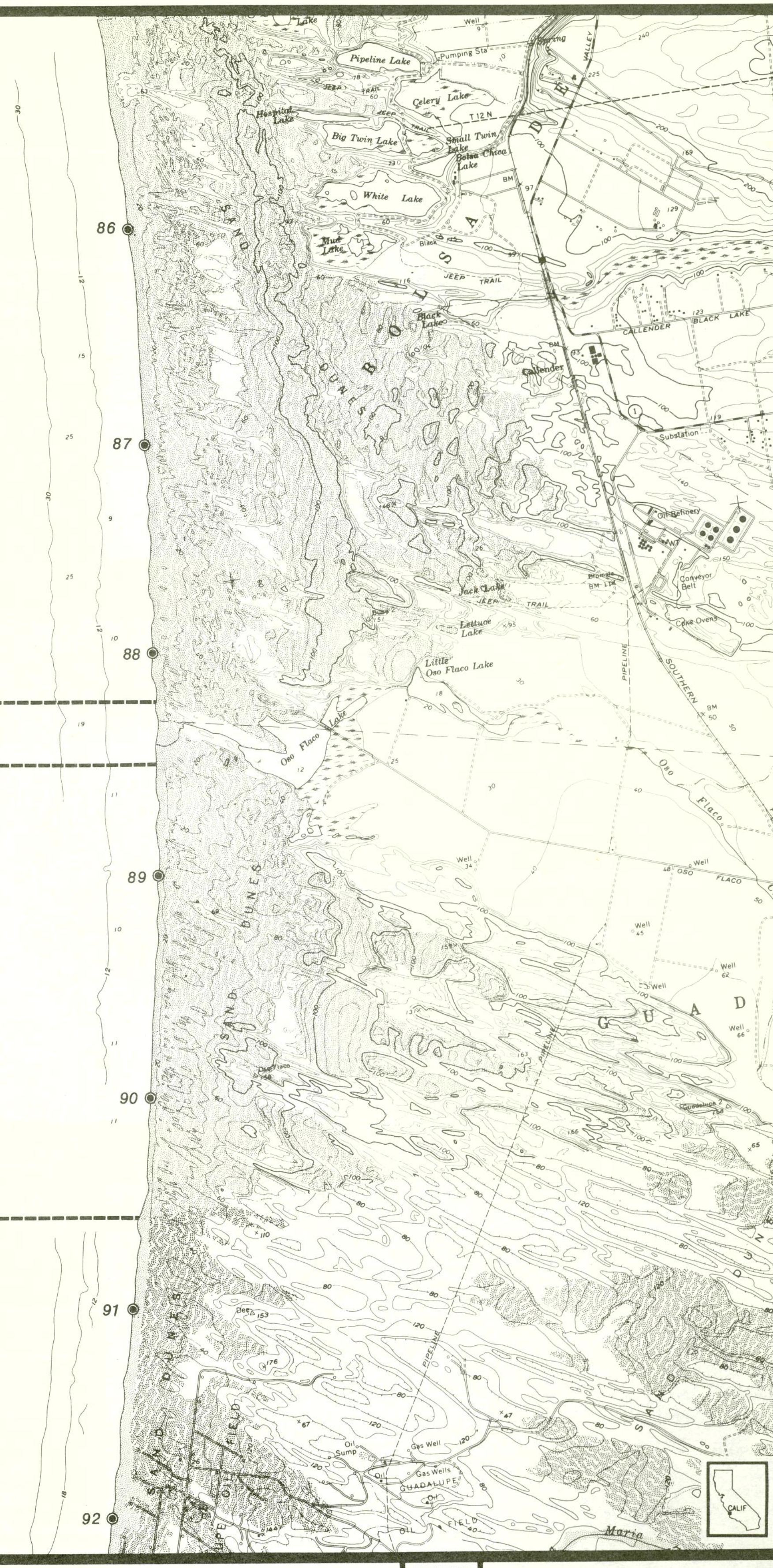


Sandy beach backed by active dunes with sparse vegetative cover, high intermediate and old dunes with vegetative cover, marshes, and lakes. Dune face wave eroded with frequent active slides.

Sand spit and bar across creek mouth backed by flood plain cut through active dunes, lake, and marsh.

Narrow sandy beach backed by active dunes with sparse vegetative cover, high intermediate and old dunes with vegetative cover, and marshes. Dune face wave cut with frequent active slides.

Narrow sandy beach backed by active dunes with sparse vegetation, oil wells, marsh, and high intermediate and old dunes with vegetative cover. Dune face wave cut with frequent slides.



• SHORELINE CONDITION •

- PRESENT DEVELOPMENT CRITICAL
- ARTIFICIAL PROTECTION
- PRESENT DEVELOPMENT NON-CRITICAL
- PROTECTIVE BEACH
- FUTURE DEVELOPMENT CRITICAL
- STABLE ROCK

SAN LUIS OBISPO CO. — MI. 86-92

MAP NUMBER **84**

STATE OF CALIFORNIA THE RESOURCES AGENCY

DEPARTMENT OF NAVIGATION & OCEAN DEVELOPMENT

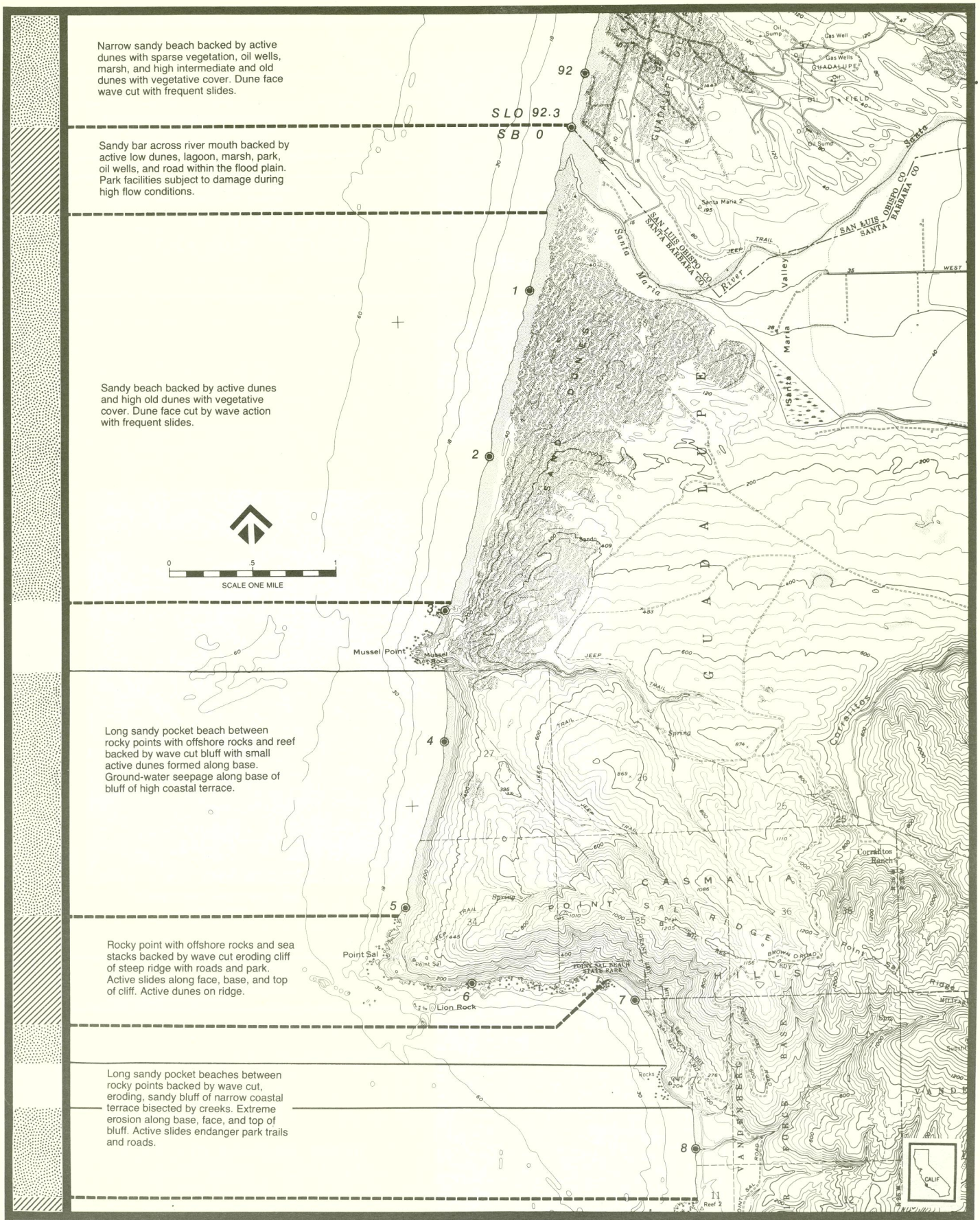
DNOD

1977

Santa Maria River Mouth
Santa Barbara Mi. 0.5
7/15/76 Tide +3.9

Santa Maria River Mouth
Santa Barbara Mi. 0.5
7/15/76 Tide +3.9

Point Sal State Beach
Santa Barbara Mi. 7.8
7/14/76 Tide +3.0



▪ SHORELINE CONDITION ▪

- PRESENT DEVELOPMENT CRITICAL
- PRESENT DEVELOPMENT NON-CRITICAL
- FUTURE DEVELOPMENT CRITICAL
- ARTIFICIAL PROTECTION
- PROTECTIVE BEACH
- STABLE ROCK

SAN LUIS OBISPO CO. — MI. 92 - 92.3
SANTA BARBARA CO. — MI. 0 - 8

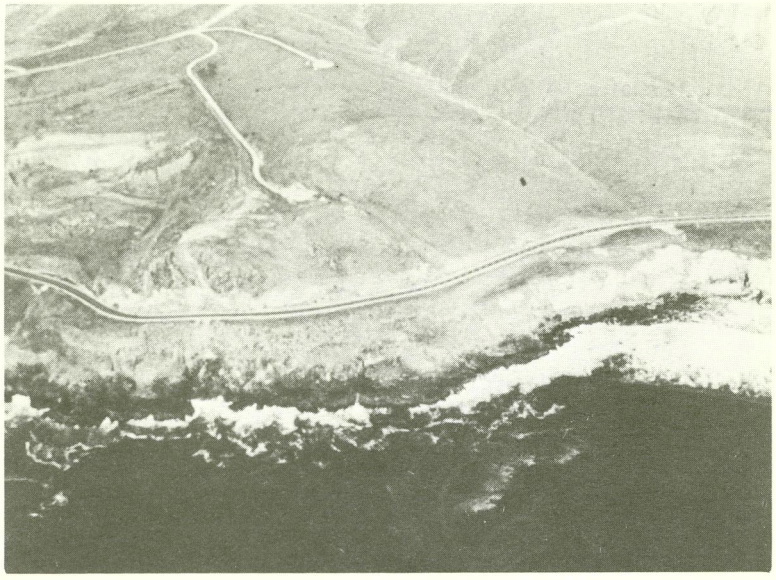
MAP NUMBER **85**

STATE OF CALIFORNIA — THE RESOURCES AGENCY

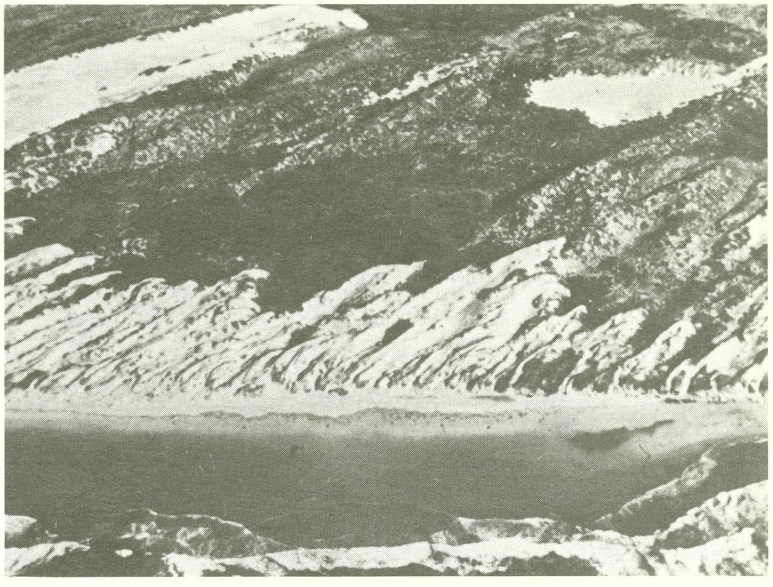
DEPARTMENT OF NAVIGATION & OCEAN DEVELOPMENT

DNOD

1977

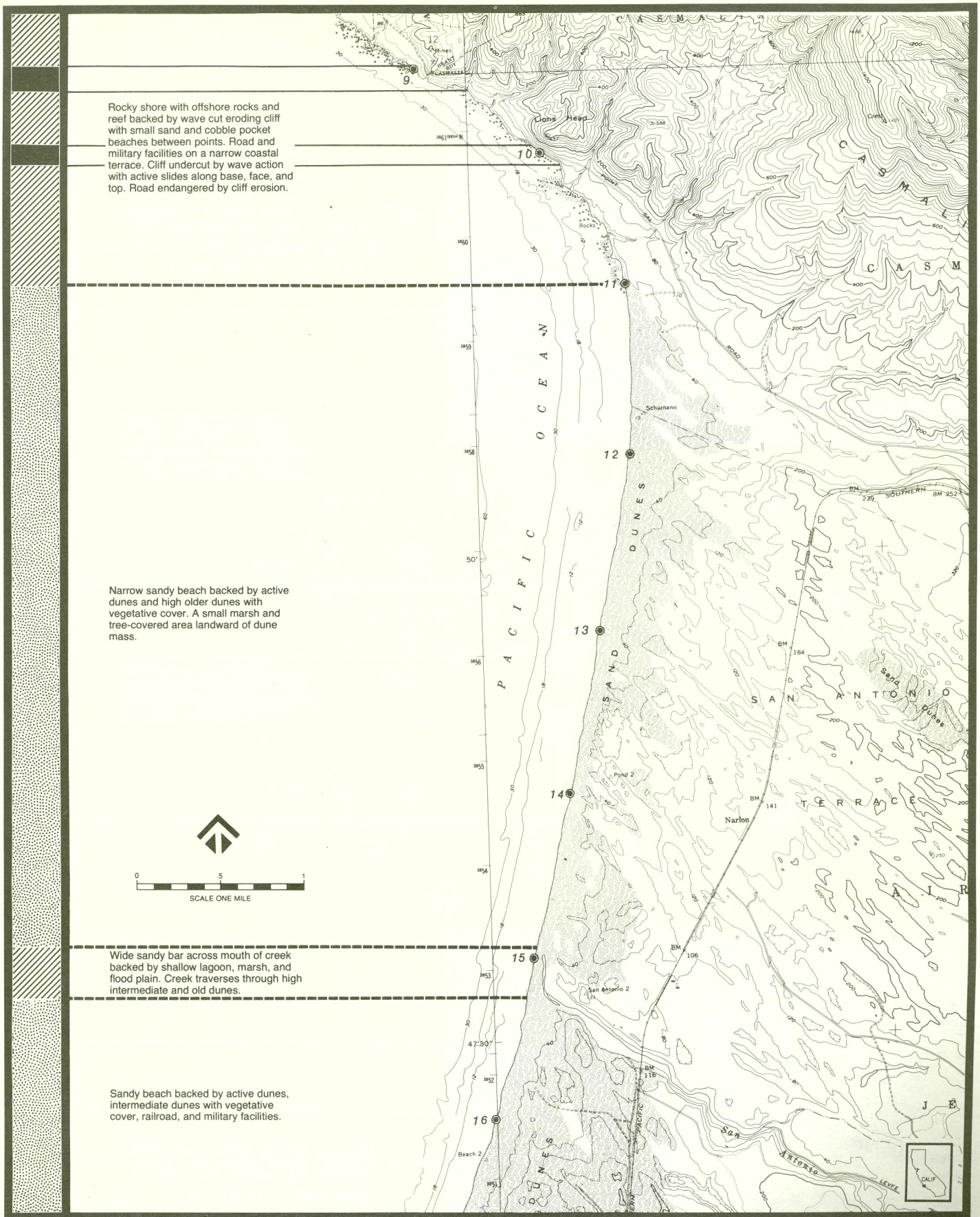


Santa Barbara Mi. 9.1
5/11/72 Tide +3.7



Santa Barbara Mi. 13.5
5/11/72 Tide +3.7

Santa Barbara Mi. 13.5
5/11/72 Tide +3.7



▪ SHORELINE CONDITION ▪

- PRESENT DEVELOPMENT CRITICAL
- PRESENT DEVELOPMENT NON-CRITICAL
- FUTURE DEVELOPMENT CRITICAL
- ARTIFICIAL PROTECTION
- PROTECTIVE BEACH
- STABLE ROCK

SANTA BARBARA CO. — MI. 9-16

MAP NUMBER **86**

STATE OF CALIFORNIA — THE RESOURCES AGENCY

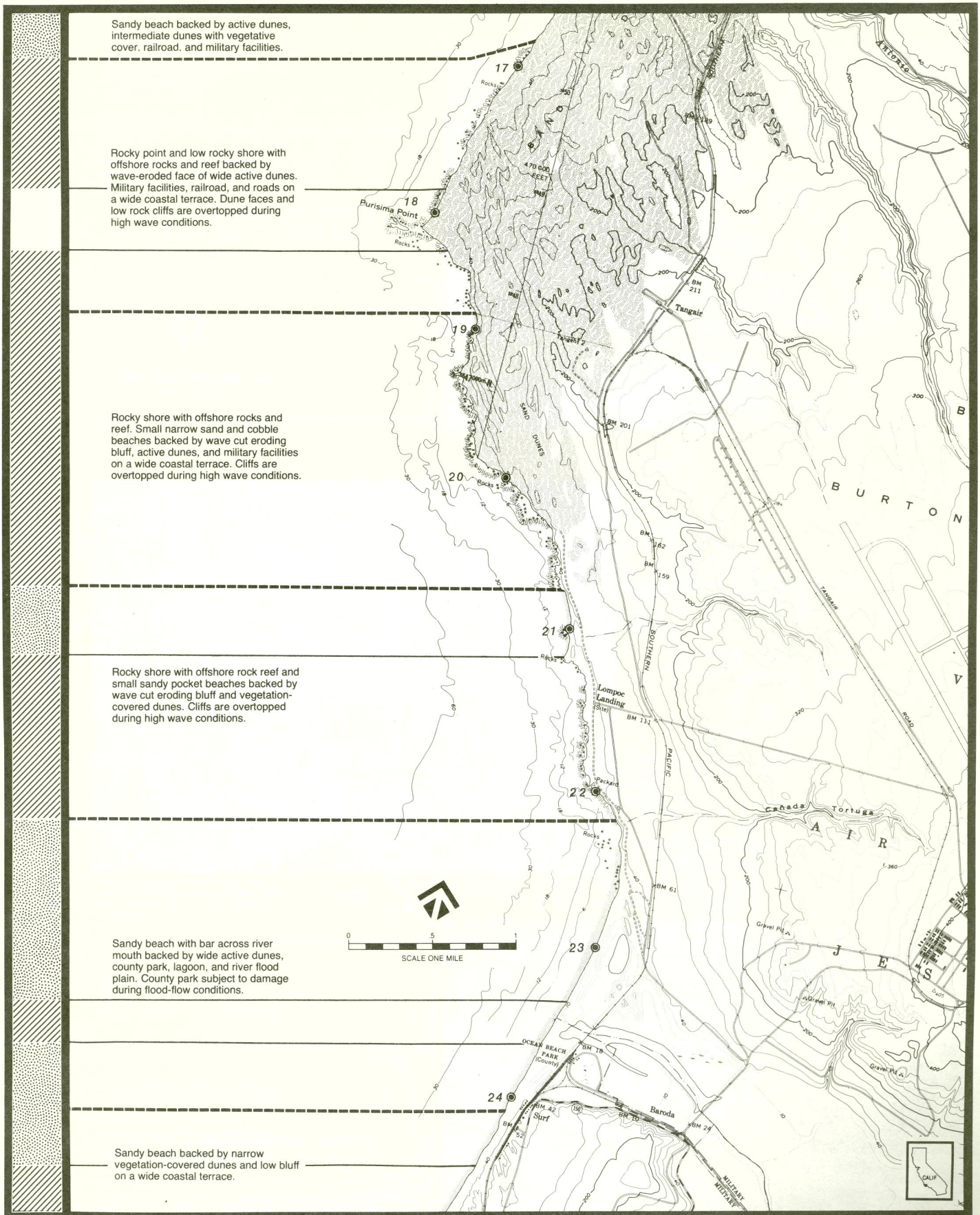
DEPARTMENT OF NAVIGATION & OCEAN DEVELOPMENT

DNOD

1977

Santa Ynez River Mouth
Santa Barbara Mi. 23.5
7/14/76 Tide +4.3

Santa Ynez River Mouth
Santa Barbara Mi. 23.5
7/14/76 Tide +4.3



▪ SHORELINE CONDITION ▪

- PRESENT DEVELOPMENT CRITICAL
- ARTIFICIAL PROTECTION
- PRESENT DEVELOPMENT NON-CRITICAL
- PROTECTIVE BEACH
- FUTURE DEVELOPMENT CRITICAL
- STABLE ROCK

SANTA BARBARA CO. — MI. 17-24

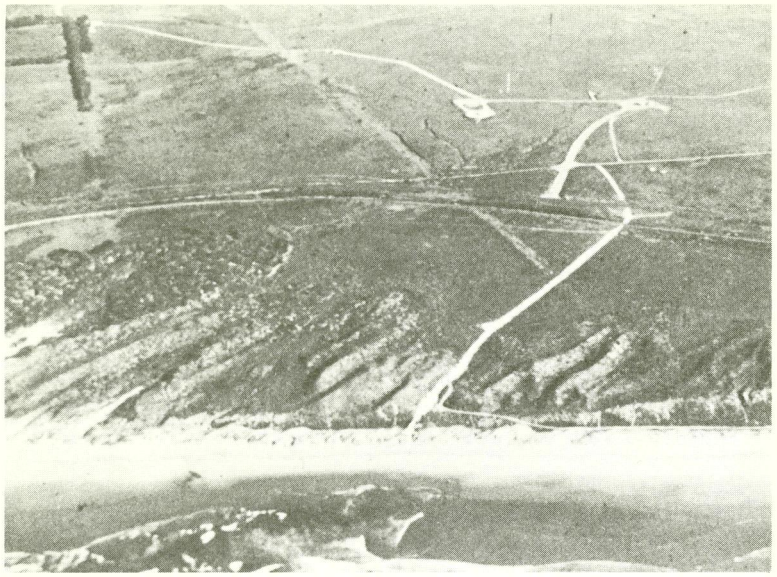
MAP NUMBER **87**

STATE OF CALIFORNIA — THE RESOURCES AGENCY

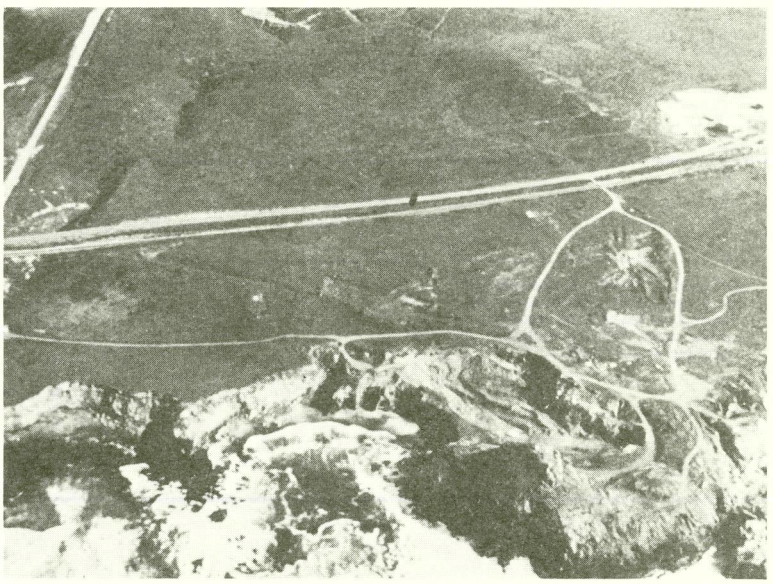
DEPARTMENT OF NAVIGATION & OCEAN DEVELOPMENT

DNOD

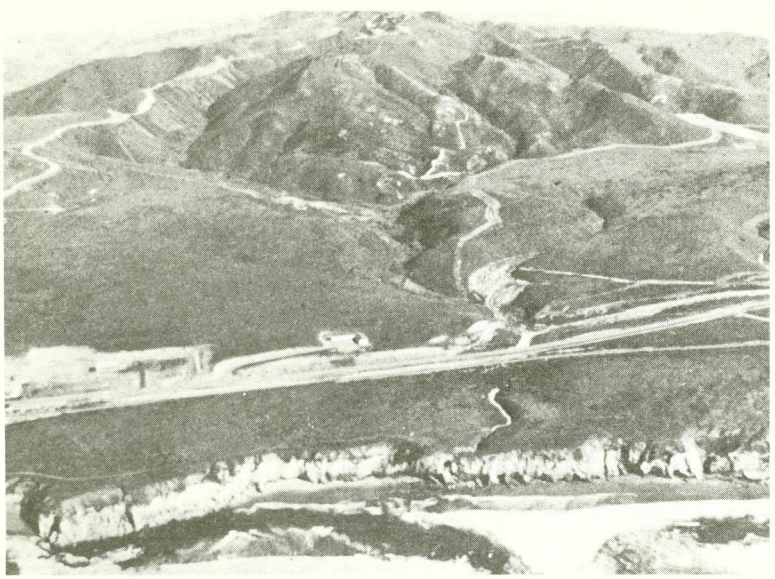
1977



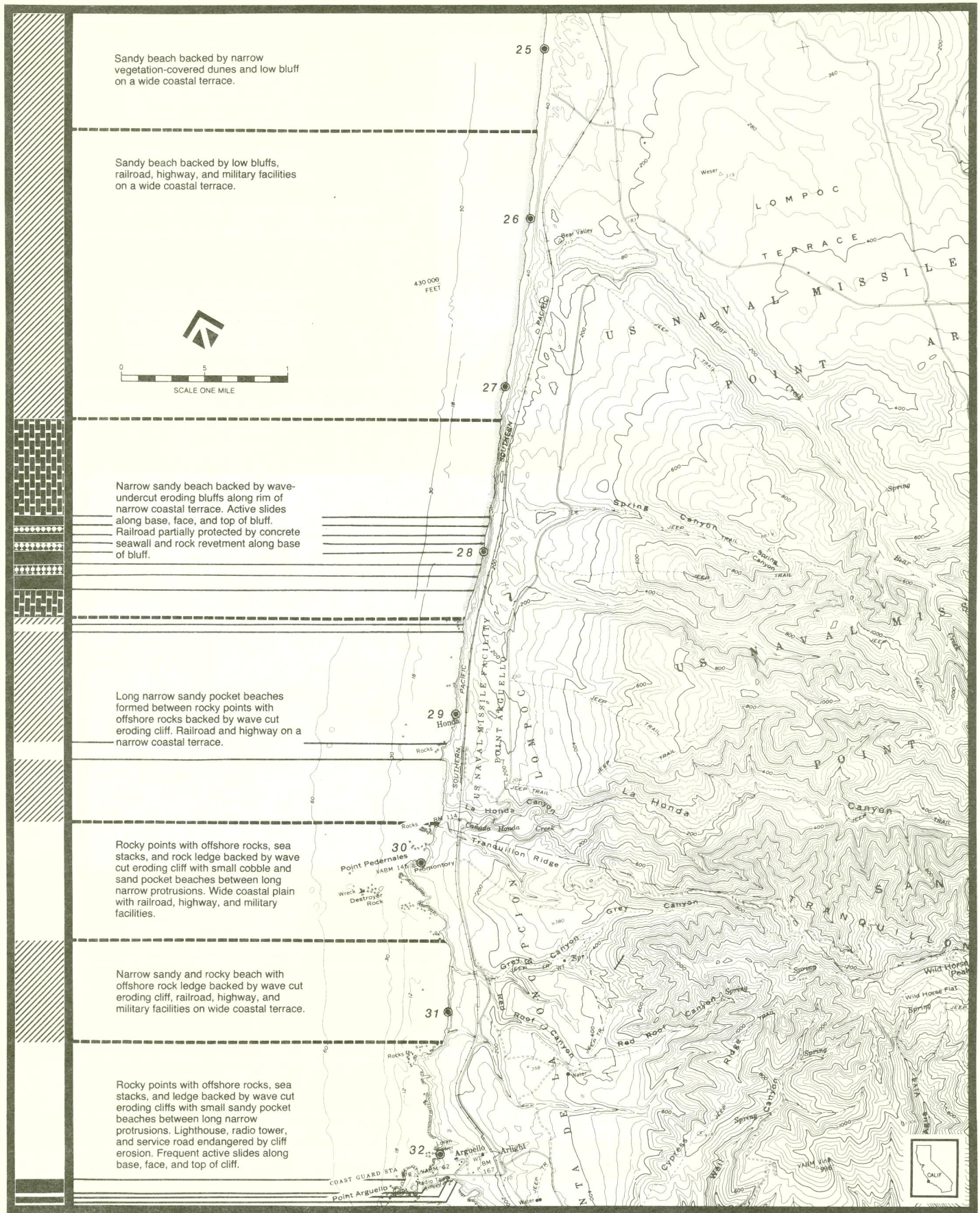
Santa Barbara Mi. 25.1
5/11/72 Tide +3.7



Santa Barbara Mi. 30.00
5/11/72 Tide +3.7



Santa Barbara Mi. 30.8
5/11/72 Tide +3.7



▪ SHORELINE CONDITION ▪

PRESENT DEVELOPMENT CRITICAL	ARTIFICIAL PROTECTION
PRESENT DEVELOPMENT NON-CRITICAL	PROTECTIVE BEACH
FUTURE DEVELOPMENT CRITICAL	STABLE ROCK

SANTA BARBARA CO. — MI. 25-32

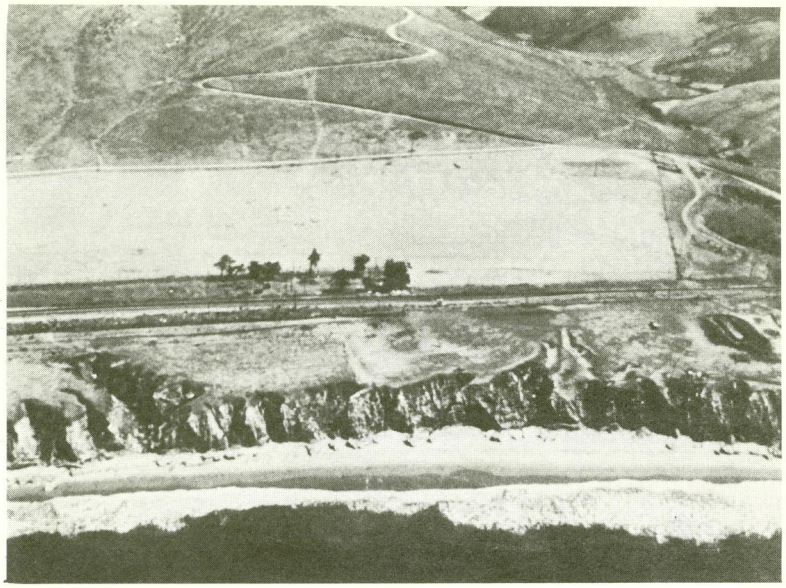
MAP NUMBER 88

STATE OF CALIFORNIA — THE RESOURCES AGENCY

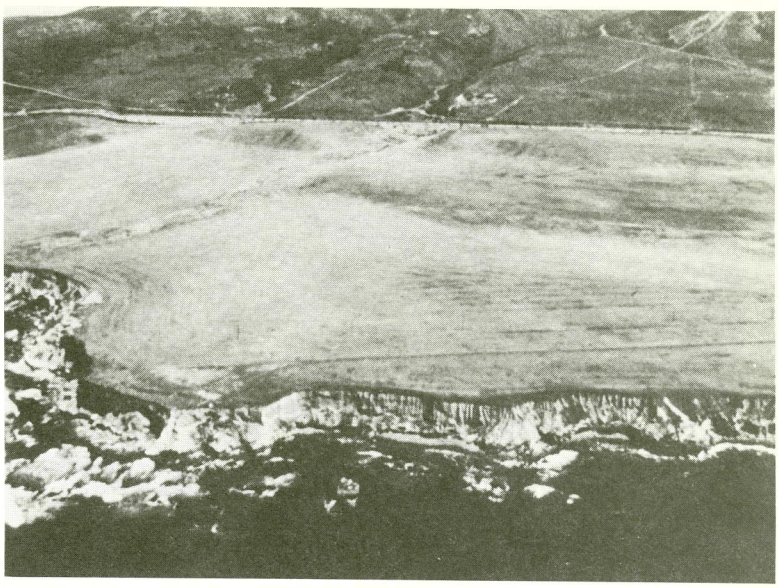
DEPARTMENT OF NAVIGATION & OCEAN DEVELOPMENT

DNOD

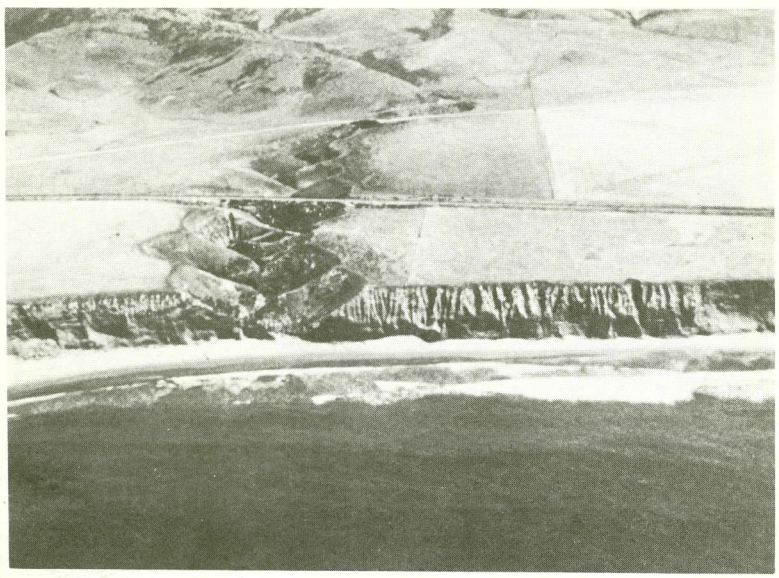
1977



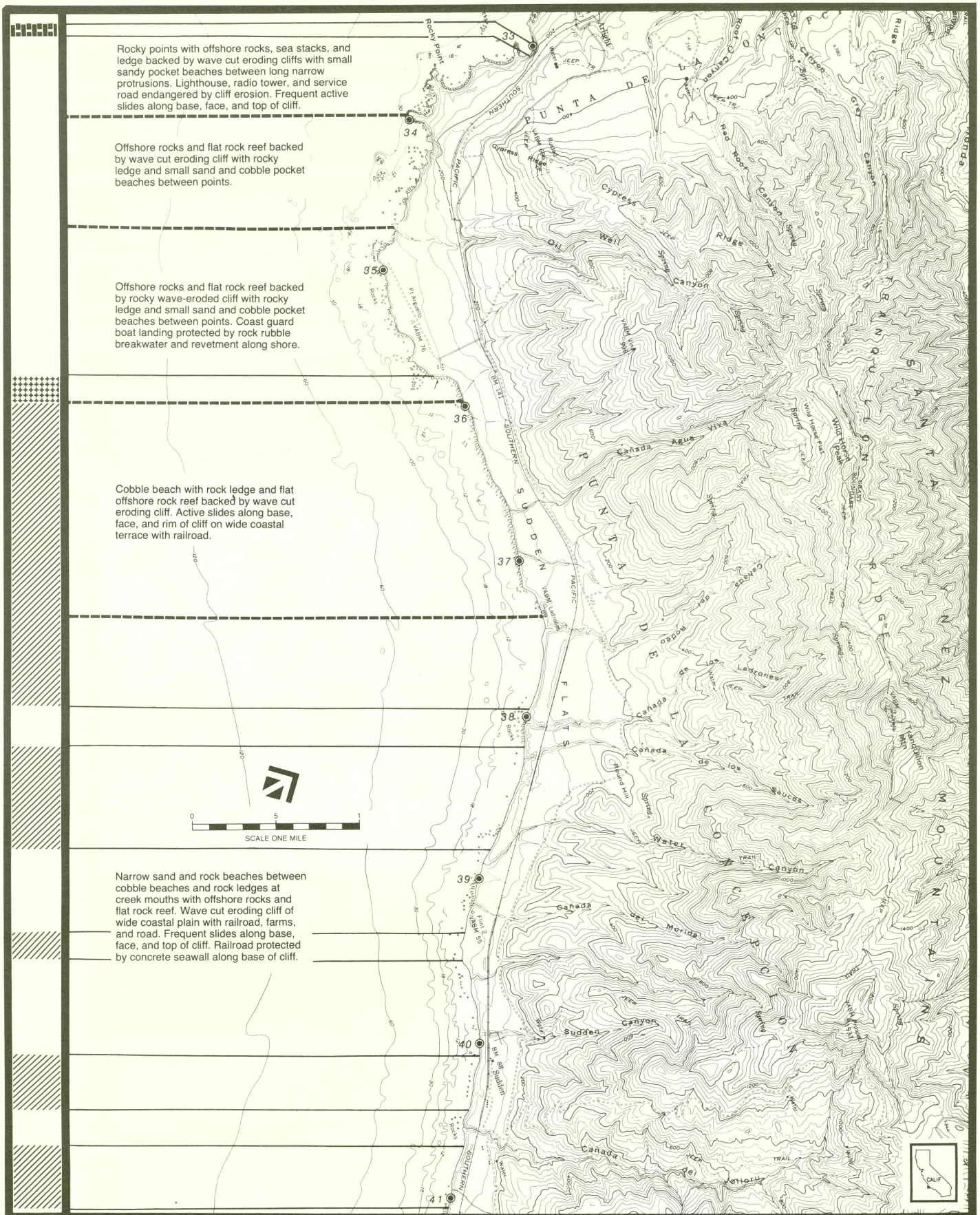
Santa Barbara Mi. 35.00
5/11/72 Tide +3.7



Santa Barbara Mi. 37.5
5/11/72 Tide +3.7



Santa Barbara Mi. 40.1
5/11/72 Tide +3.7



▪ SHORELINE CONDITION ▪

- PRESENT DEVELOPMENT CRITICAL
- PRESENT DEVELOPMENT NON-CRITICAL
- FUTURE DEVELOPMENT CRITICAL
- ARTIFICIAL PROTECTION
- PROTECTIVE BEACH
- STABLE ROCK

SANTA BARBARA CO. — MI. 33 - 41

MAP NUMBER 89

STATE OF CALIFORNIA — THE RESOURCES AGENCY

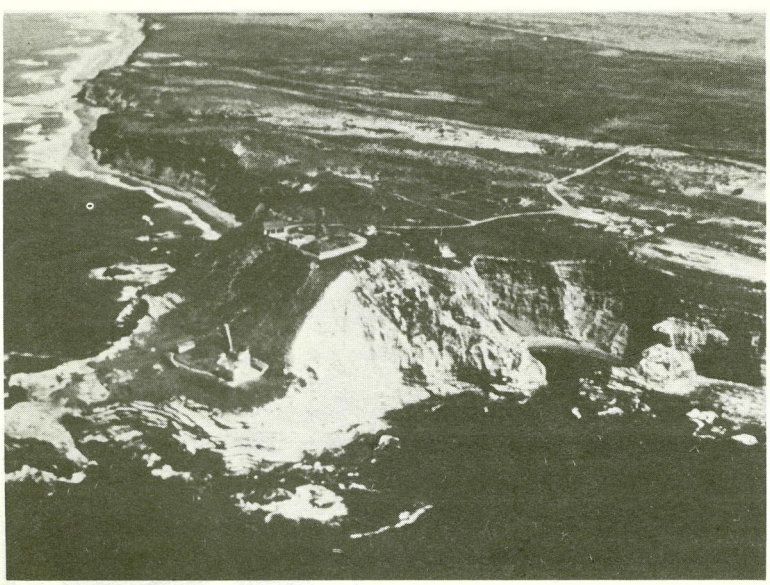
DEPARTMENT OF NAVIGATION & OCEAN DEVELOPMENT

DNOD

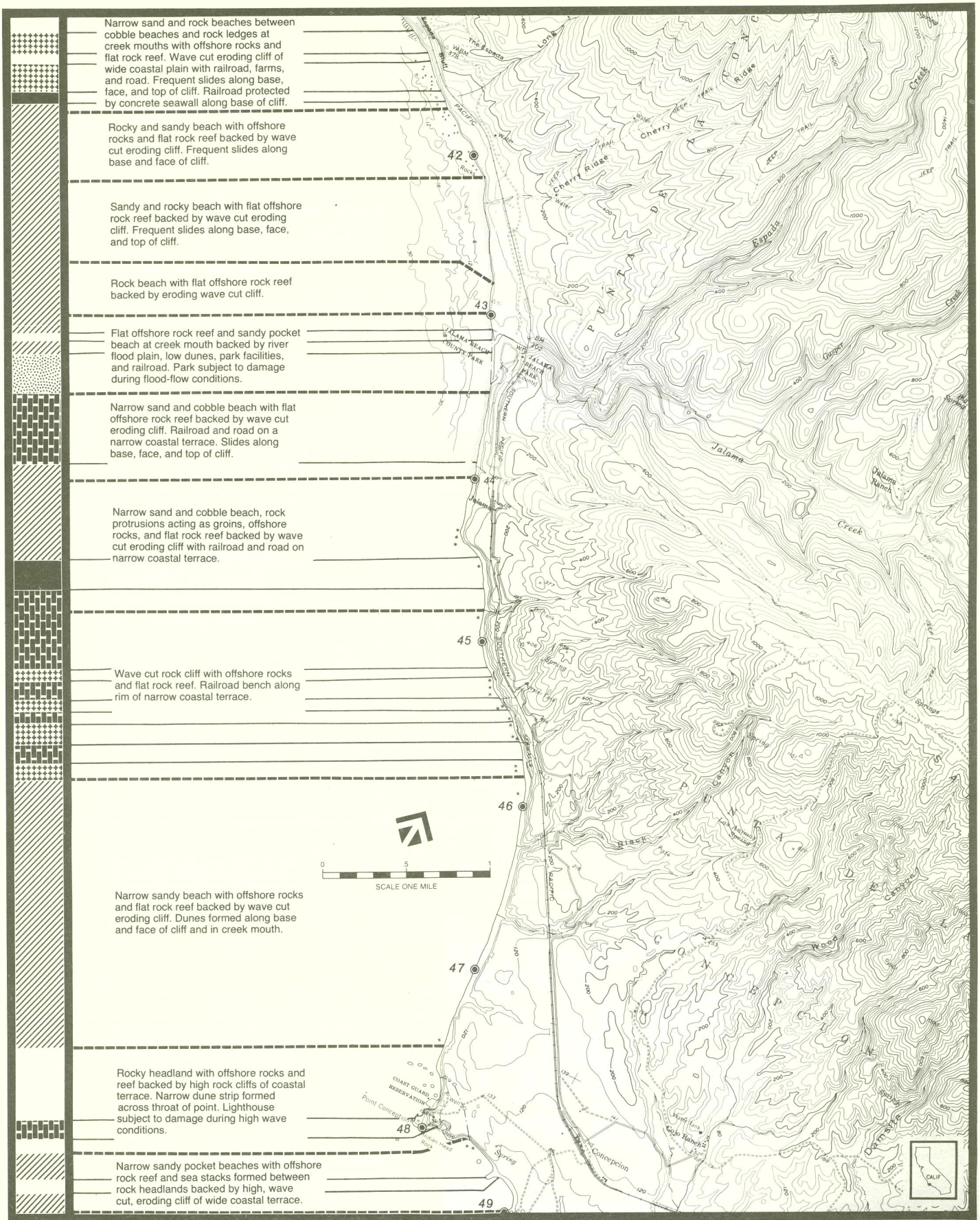
1977

Jalama Creek Beach
Santa Barbara Mi. 43.1
7/14/76 Tide +3.1

Jalama Beach County Park
Santa Barbara Mi. 43.6
7/14/76 Tide +2.7



Point Conception
Santa Barbara Mi. 48.0
5/11/72 Tide +3.7



▪ SHORELINE CONDITION ▪

PRESENT DEVELOPMENT CRITICAL	ARTIFICIAL PROTECTION
PRESENT DEVELOPMENT NON-CRITICAL	PROTECTIVE BEACH
FUTURE DEVELOPMENT CRITICAL	STABLE ROCK

SANTA BARBARA CO. — MI. 42 - 49

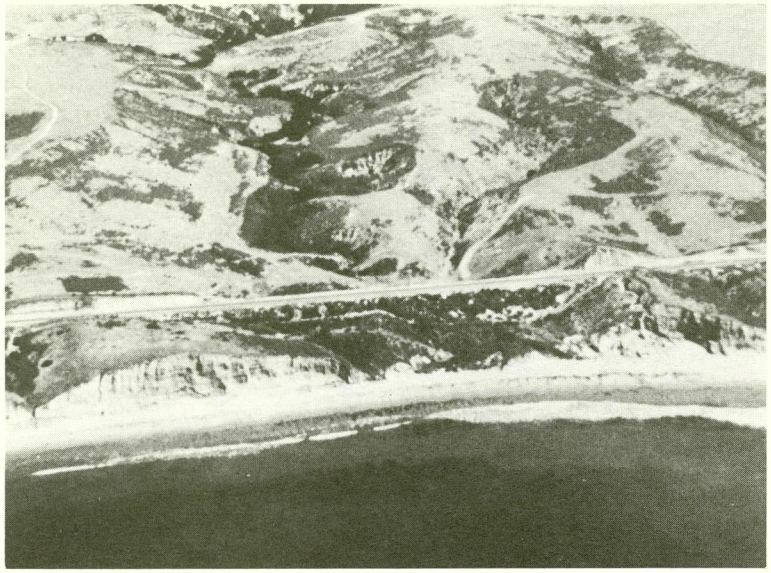
MAP NUMBER **90**

STATE OF CALIFORNIA — THE RESOURCES AGENCY

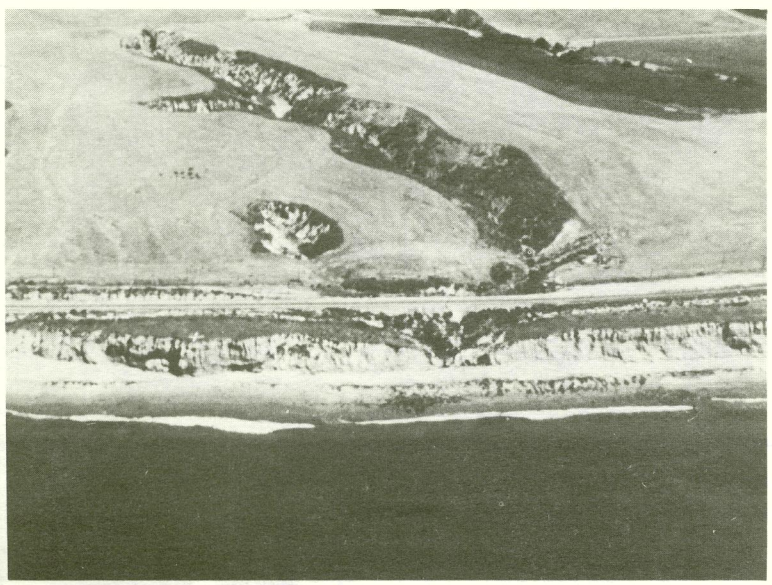
DEPARTMENT OF NAVIGATION & OCEAN DEVELOPMENT

DNOD

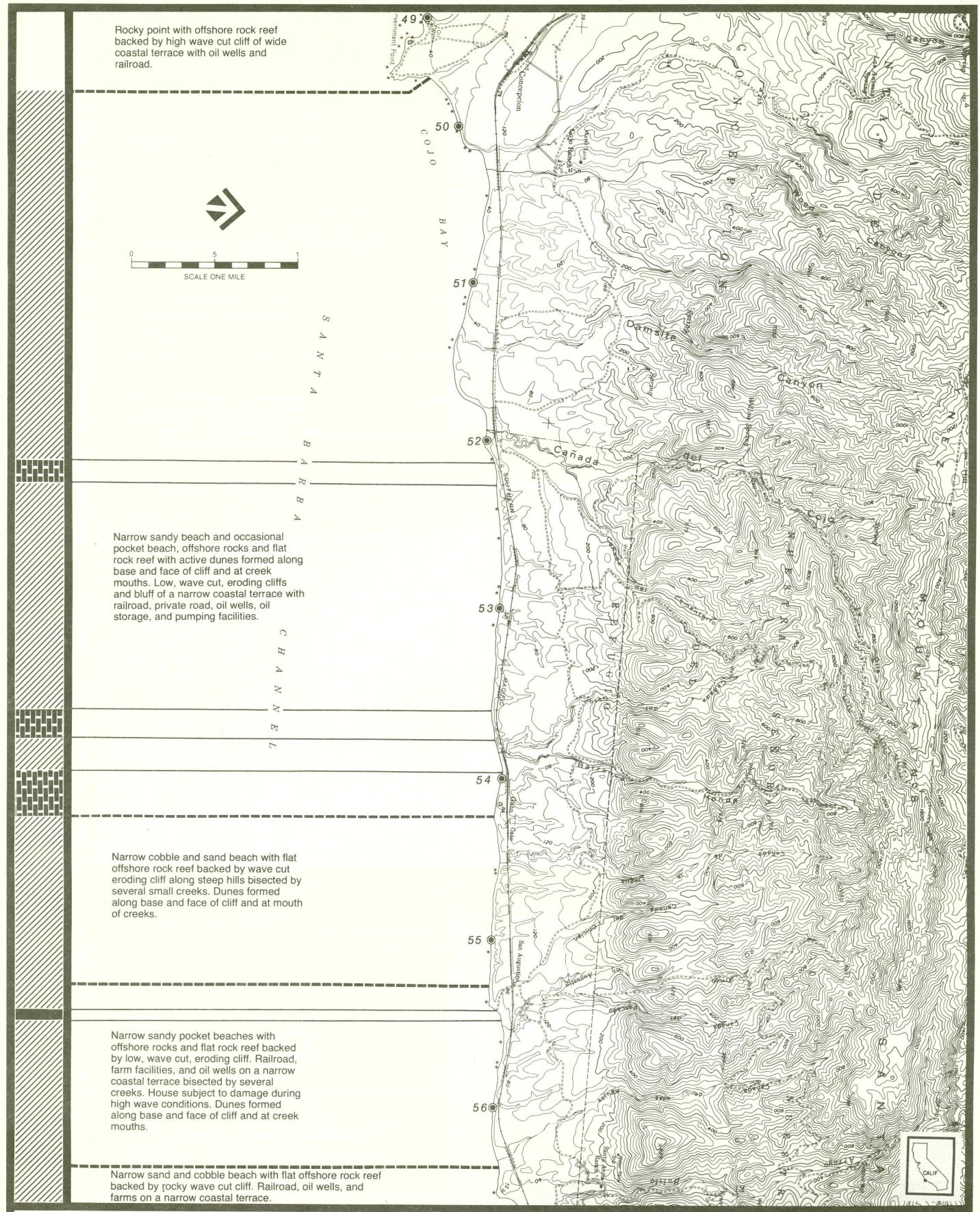
1977



Santa Barbara Mi. 54.5
5/11/72 Tide +3.7



Santa Barbara Mi. 56.00
5/11/72 Tide +3.7



▪ SHORELINE CONDITION ▪

- PRESENT DEVELOPMENT CRITICAL
- PRESENT DEVELOPMENT NON-CRITICAL
- FUTURE DEVELOPMENT CRITICAL
- ARTIFICIAL PROTECTION
- PROTECTIVE BEACH
- STABLE ROCK

SANTA BARBARA CO. — MI. 49-56

MAP NUMBER **91**

STATE OF CALIFORNIA — THE RESOURCES AGENCY

DEPARTMENT OF NAVIGATION & OCEAN DEVELOPMENT

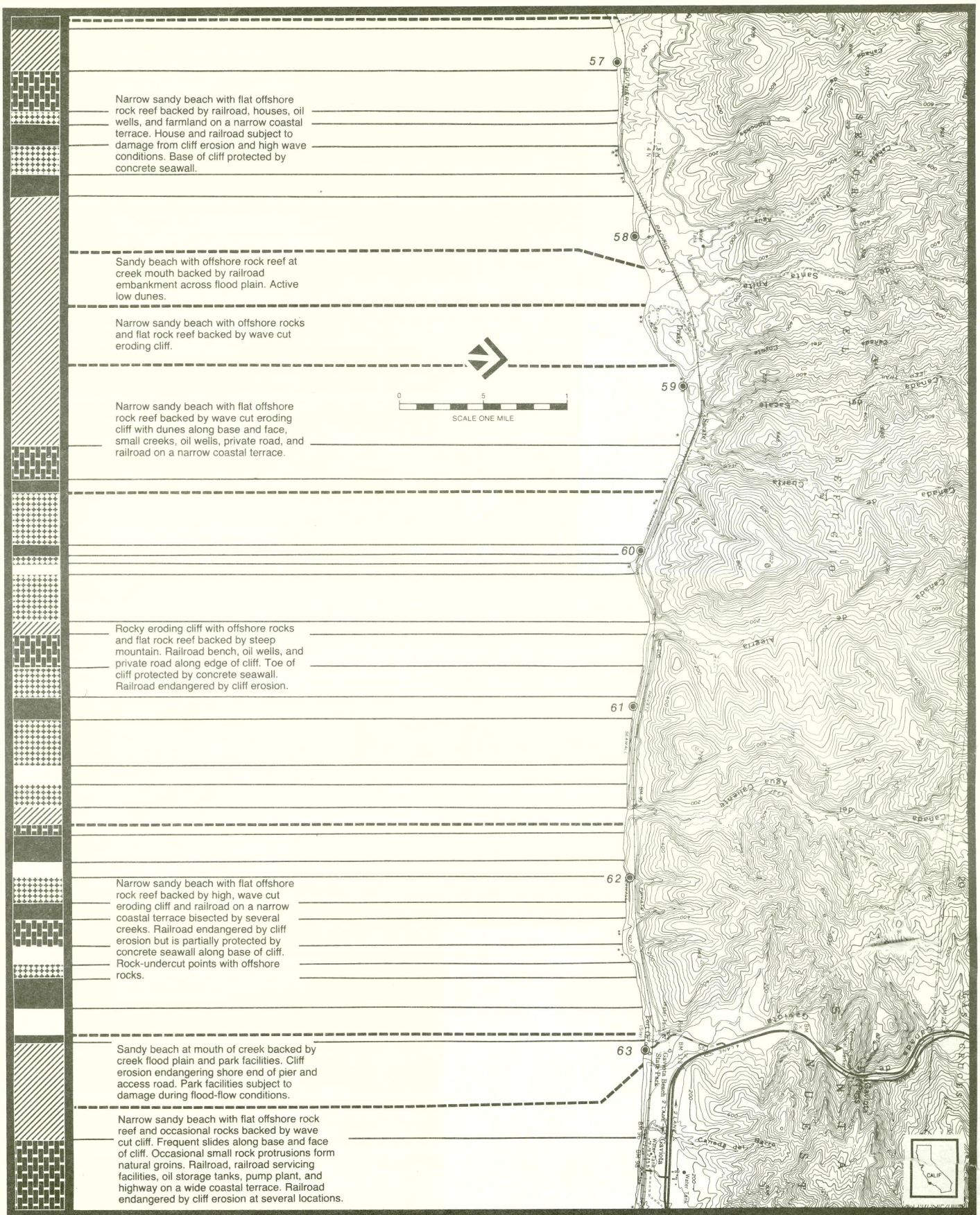
DNOD

1977

Gaviota State Beach
Santa Barbara Mi. 63.0
3/9/76 Tide +1.9

Gaviota State Beach
Santa Barbara Mi. 63.0
3/9/76 Tide +1.9

Gaviota State Beach
Santa Barbara Mi. 63.0
3/9/76 Tide +1.7



▪ SHORELINE CONDITION ▪

- PRESENT DEVELOPMENT CRITICAL
- PRESENT DEVELOPMENT NON-CRITICAL
- FUTURE DEVELOPMENT CRITICAL
- ARTIFICIAL PROTECTION
- PROTECTIVE BEACH
- STABLE ROCK

SANTA BARBARA CO. — MI. 57 - 63

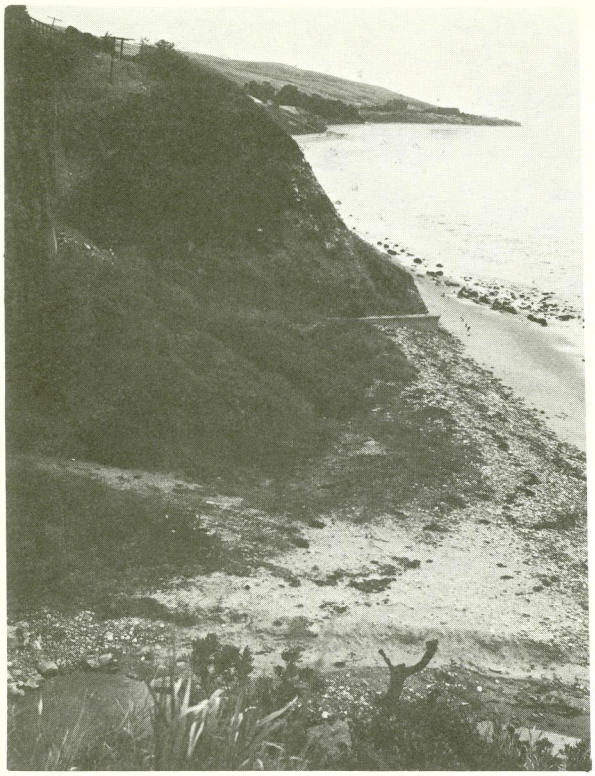
MAP NUMBER **92**

STATE OF CALIFORNIA — THE RESOURCES AGENCY

DEPARTMENT OF NAVIGATION & OCEAN DEVELOPMENT

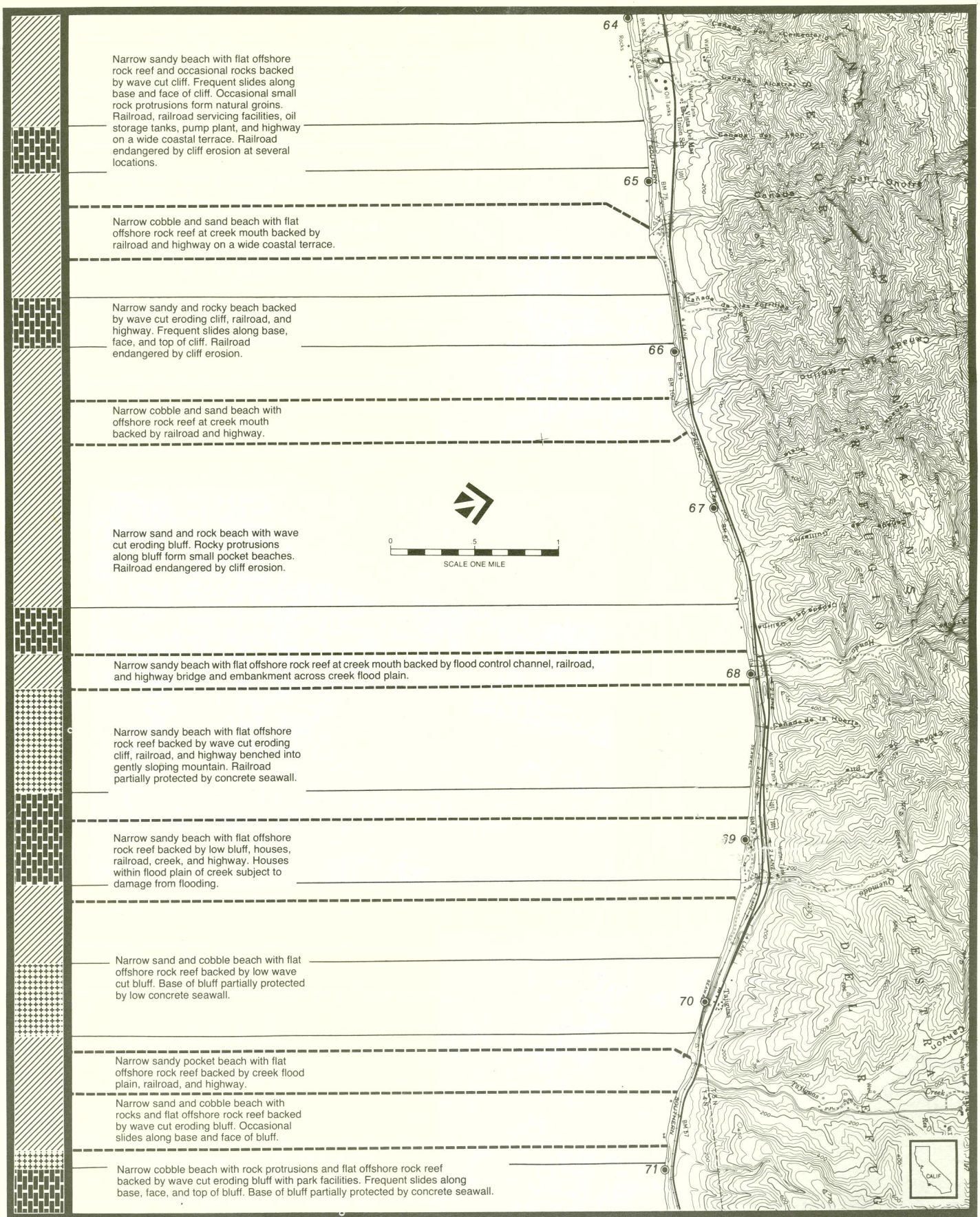
DNOD

1977



Arroyo Hondo Creek
Santa Barbara Mi. 67.2
3/9/76 Tide +1.6

Arroyo Hondo Creek
Santa Barbara Mi. 67.2
3/9/76 Tide +1.6



▪ SHORELINE CONDITION ▪

- PRESENT DEVELOPMENT CRITICAL
- PRESENT DEVELOPMENT NON-CRITICAL
- FUTURE DEVELOPMENT CRITICAL
- ARTIFICIAL PROTECTION
- PROTECTIVE BEACH
- STABLE ROCK

SANTA BARBARA CO. — MI. 64 - 71

MAP NUMBER 93

STATE OF CALIFORNIA — THE RESOURCES AGENCY

DEPARTMENT OF NAVIGATION & OCEAN DEVELOPMENT

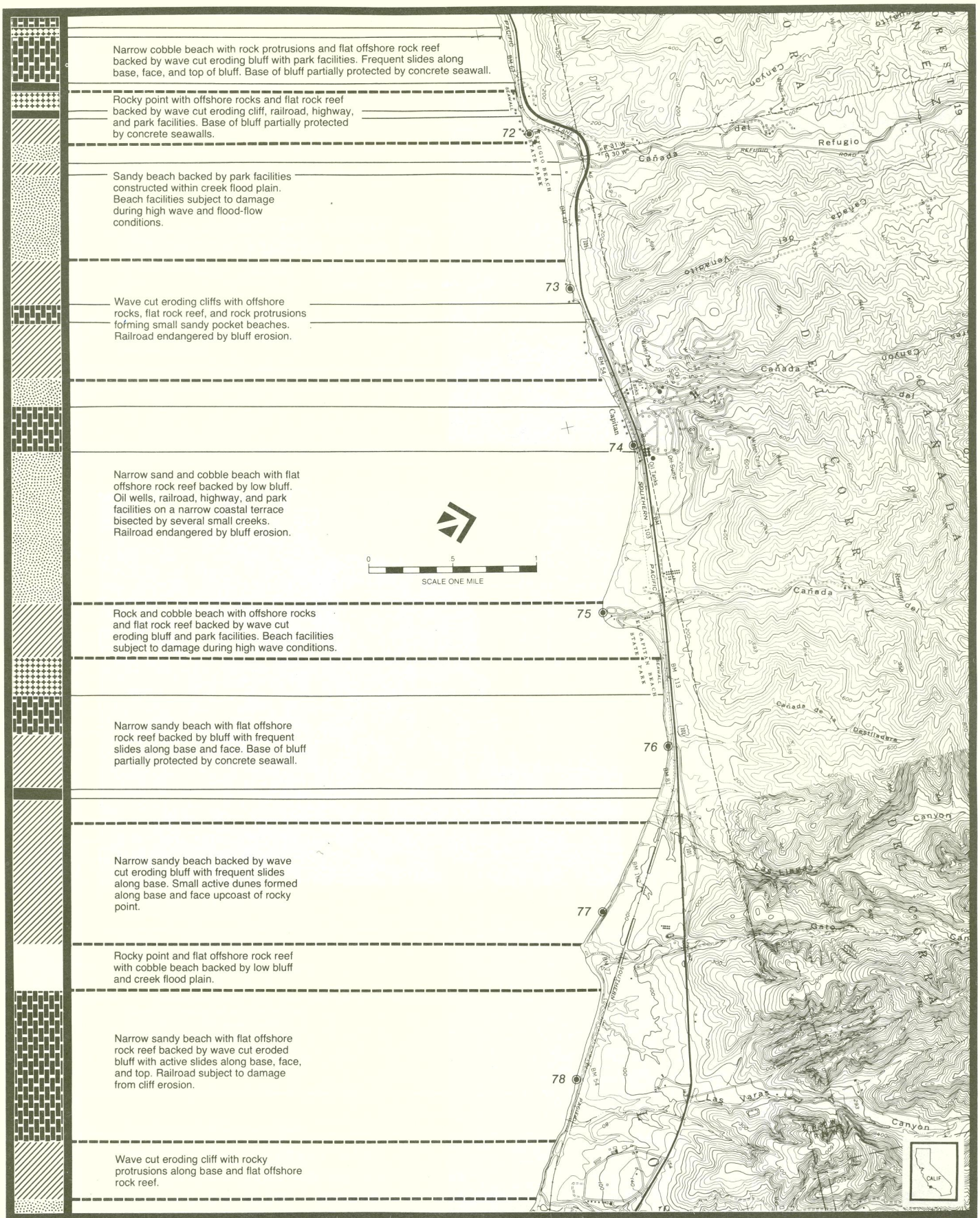
DNOD

1977

Refugio State Beach
Santa Barbara Mi. 72.1
3/9/76 Tide +1.2

Refugio State Beach
Santa Barbara Mi. 72.4
3/9/76 Tide +0.95

El Capitan State Beach
Santa Barbara Mi. 75.0
3/9/76 Tide +0.8



▪ SHORELINE CONDITION ▪

- PRESENT DEVELOPMENT CRITICAL
- PRESENT DEVELOPMENT NON-CRITICAL
- FUTURE DEVELOPMENT CRITICAL
- ARTIFICIAL PROTECTION
- PROTECTIVE BEACH
- STABLE ROCK

SANTA BARBARA CO. — MI. 72 - 78

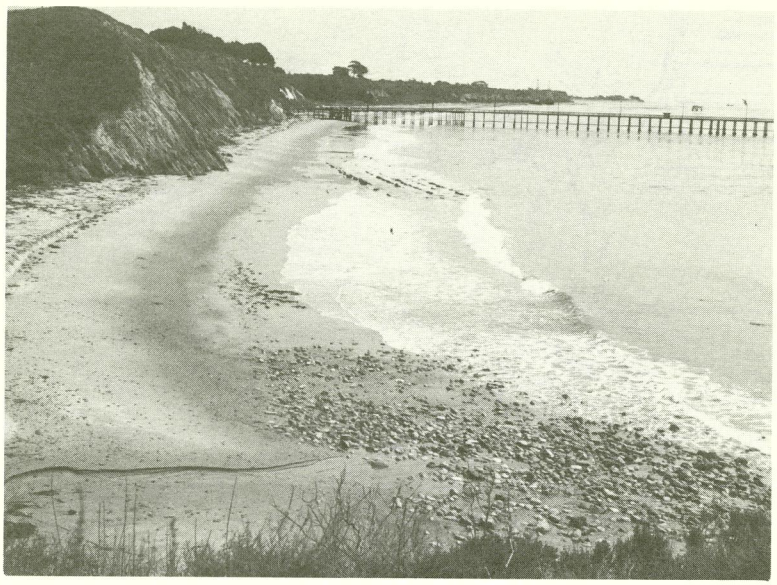
MAP NUMBER 94

STATE OF CALIFORNIA — THE RESOURCES AGENCY

DEPARTMENT OF NAVIGATION & OCEAN DEVELOPMENT

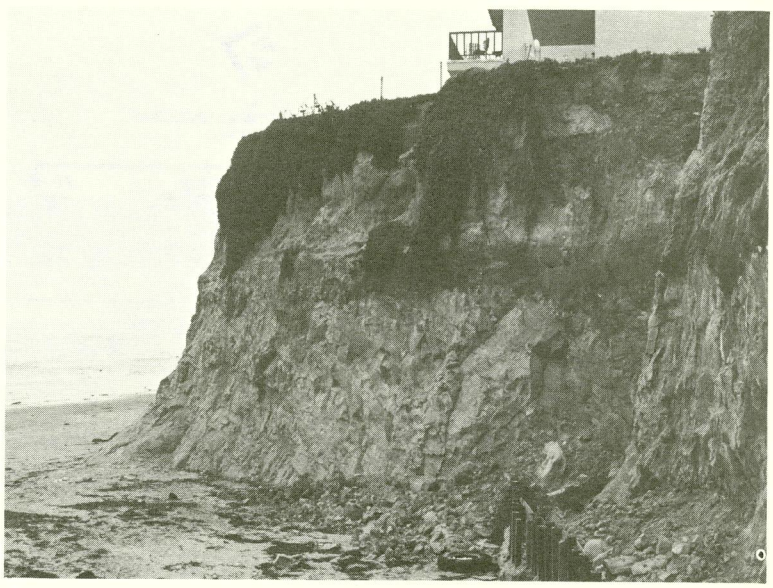
DNOD

1977

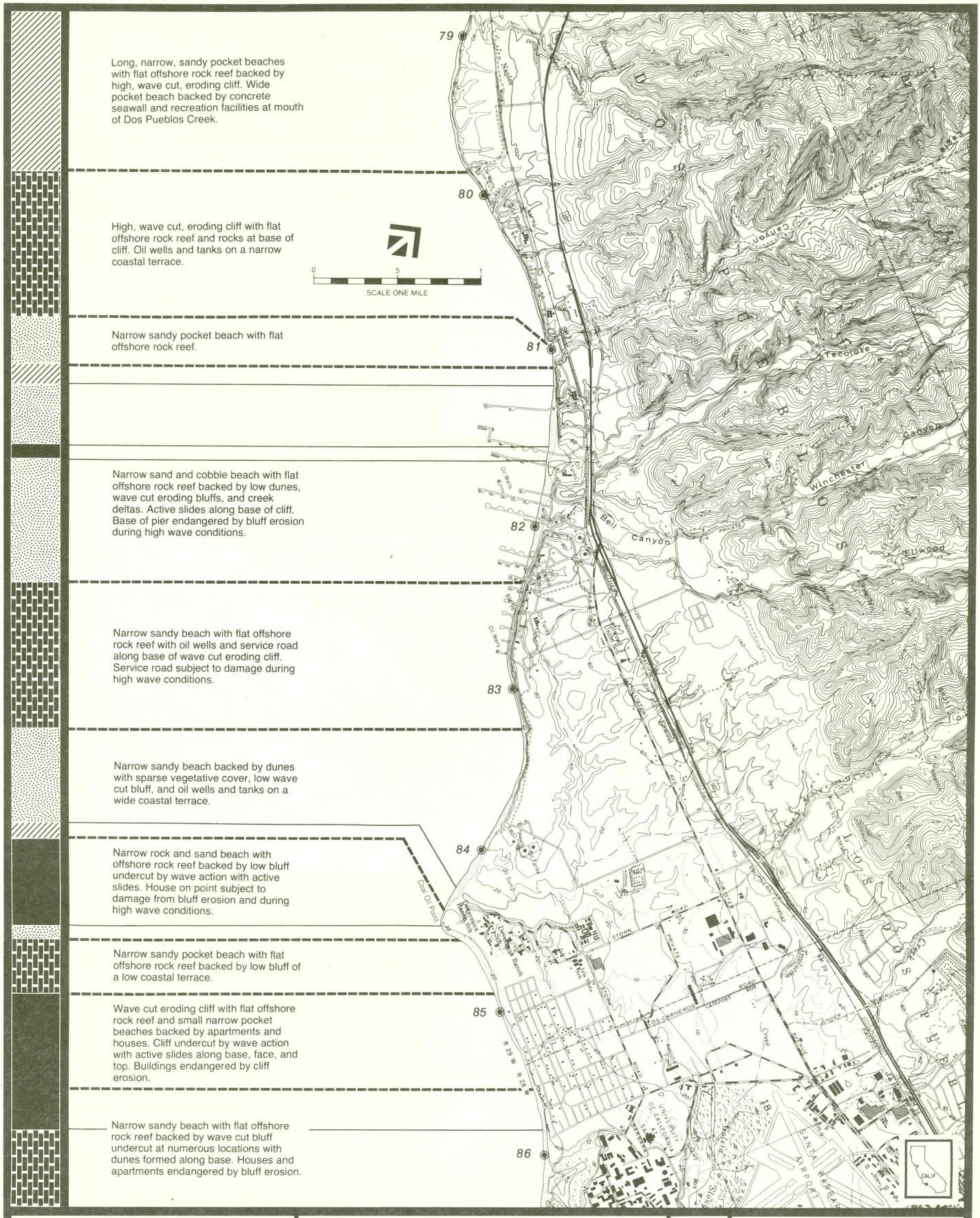


Signal Oil Pier
Santa Barbara Mi. 80.9
3/9/76 Tide +0.8

Isla Vista
Santa Barbara Mi. 85.4
3/9/76 Tide +1.15



Isla Vista
Santa Barbara Mi. 85.4
3/9/76 Tide +1.15



▪ SHORELINE CONDITION ▪

- PRESENT DEVELOPMENT CRITICAL
- PRESENT DEVELOPMENT NON-CRITICAL
- FUTURE DEVELOPMENT CRITICAL
- ARTIFICIAL PROTECTION
- PROTECTIVE BEACH
- STABLE ROCK

SANTA BARBARA CO. — MI. 79-86

MAP NUMBER 95

STATE OF CALIFORNIA — THE RESOURCES AGENCY

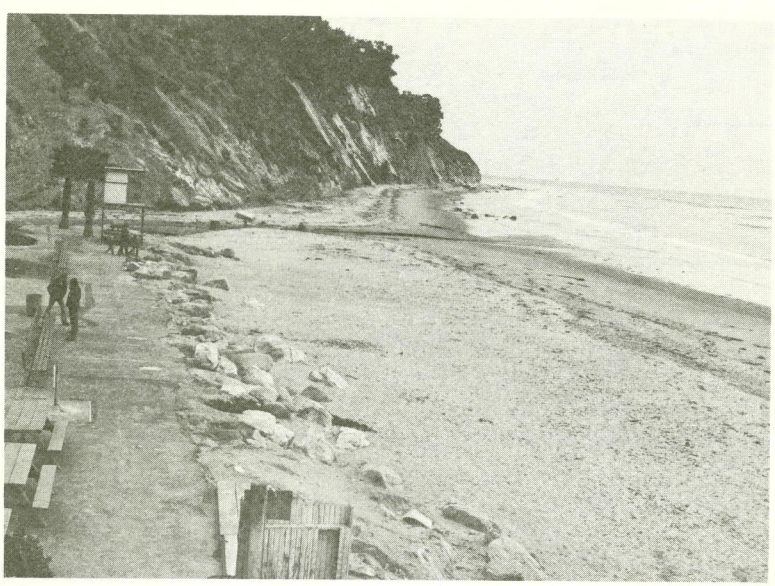
DEPARTMENT OF NAVIGATION & OCEAN DEVELOPMENT

DNOD

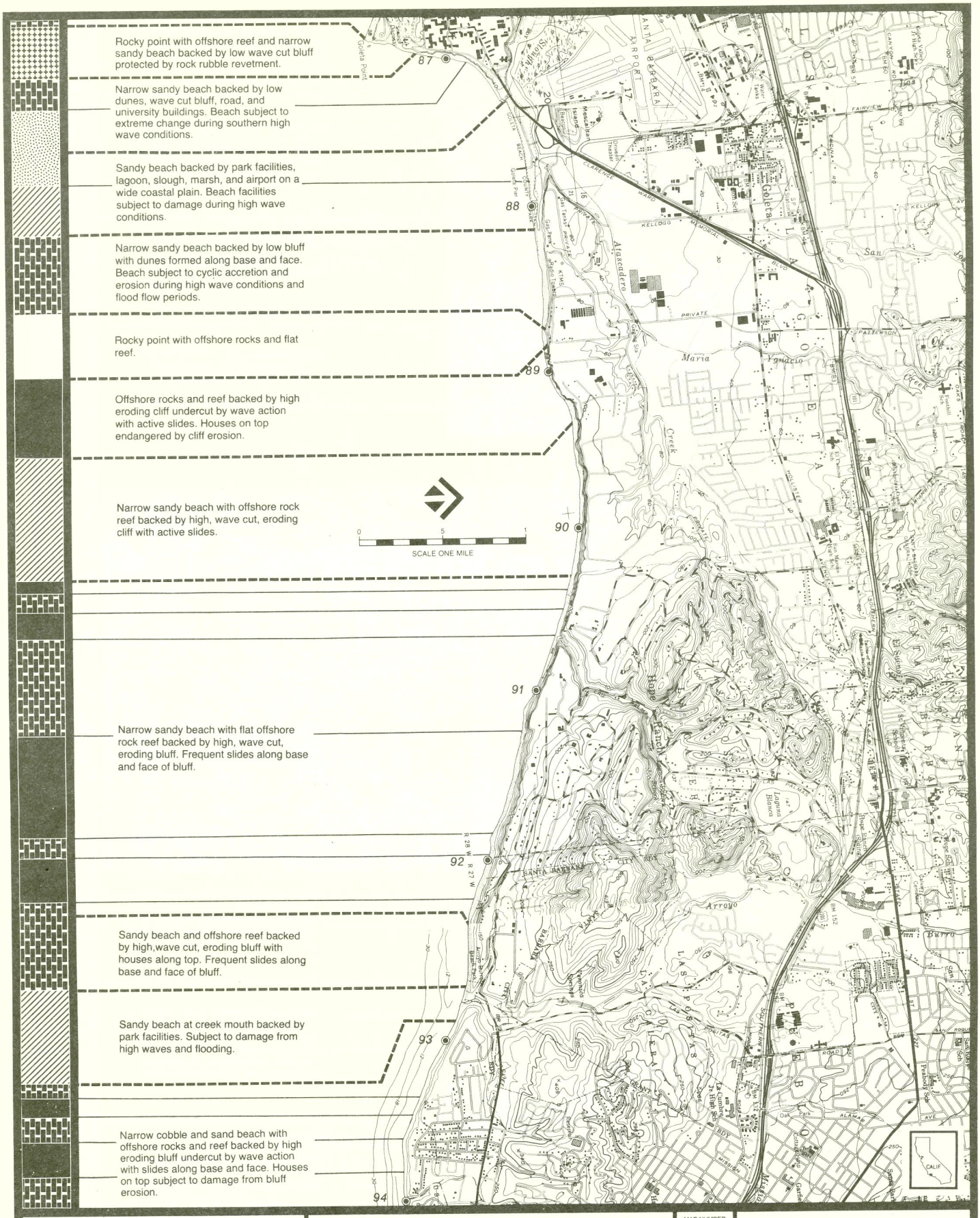
1977

Goleta County Beach
Santa Barbara Mi. 87.8
3/9/76 Tide +1.8

Arroyo Burro County Beach
Santa Barbara Mi. 92.7
3/9/76 Tide +1.9



Arroyo Burro County Beach
Santa Barbara Mi. 92.7
3/9/76 Tide +1.9



▪ SHORELINE CONDITION ▪

- PRESENT DEVELOPMENT CRITICAL
- PRESENT DEVELOPMENT NON-CRITICAL
- FUTURE DEVELOPMENT CRITICAL
- ARTIFICIAL PROTECTION
- PROTECTIVE BEACH
- STABLE ROCK

SANTA BARBARA CO. — MI. 87 - 94

MAP NUMBER **96**

STATE OF CALIFORNIA — THE RESOURCES AGENCY

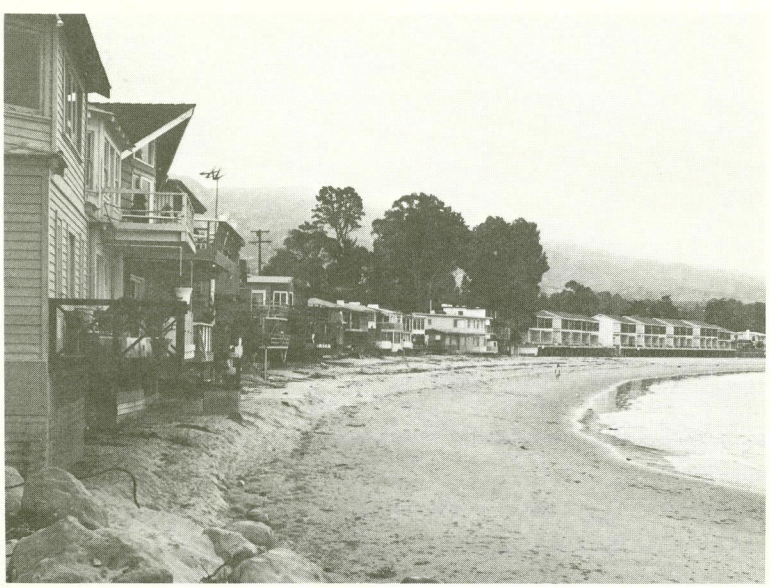
DEPARTMENT OF NAVIGATION & OCEAN DEVELOPMENT

DNOD

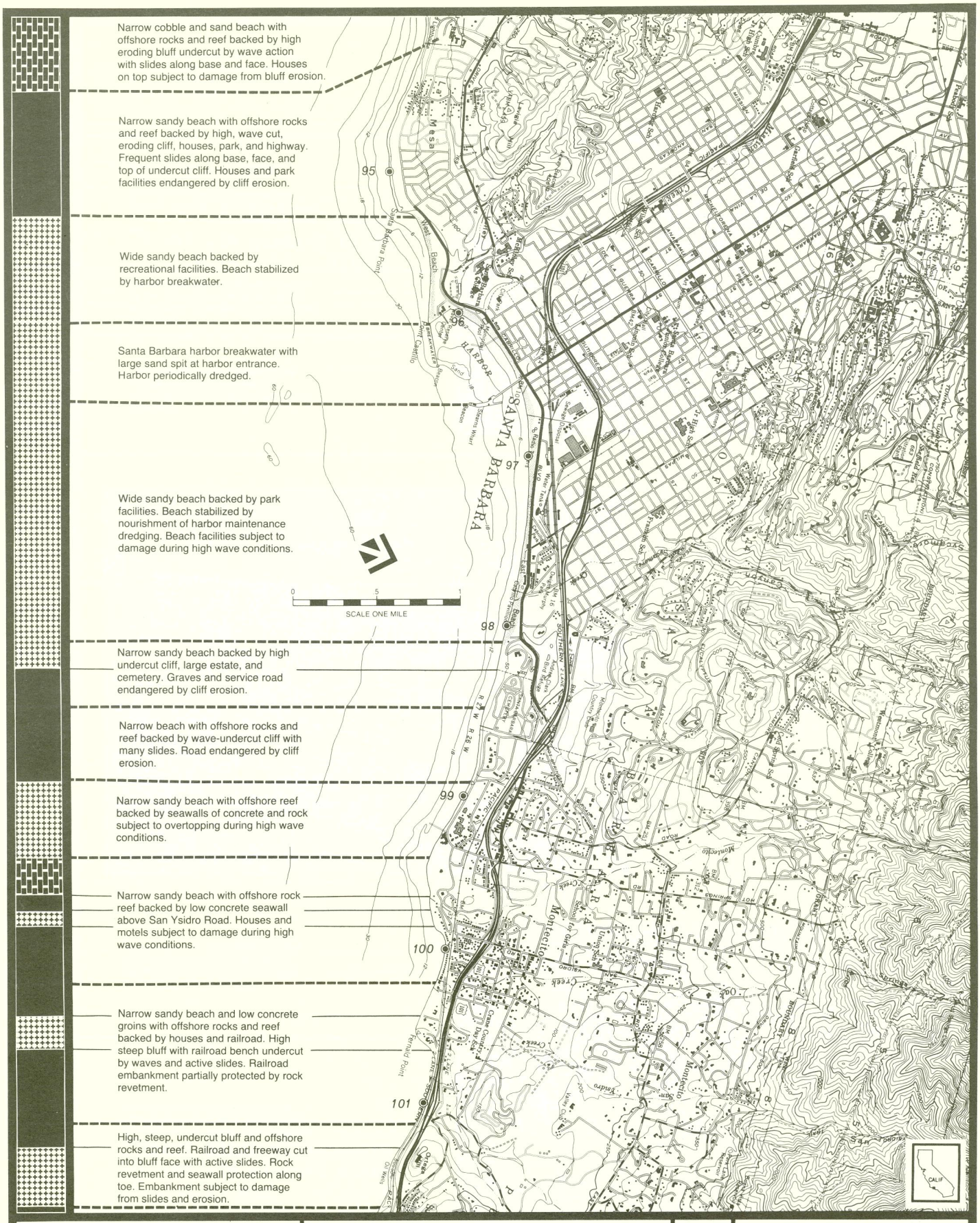
1977

Shoreline Park
Santa Barbara Mi. 95.4
3/9/76 Tide +2.2

Santa Barbara City Beach
Santa Barbara Mi. 97.7
3/9/76 Tide +2.4



Eucalyptus Lane,
City of Santa Barbara
Santa Barbara Mi. 99.8
3/9/76 Tide +2.6



▪ SHORELINE CONDITION ▪

- PRESENT DEVELOPMENT CRITICAL
- PRESENT DEVELOPMENT NON-CRITICAL
- FUTURE DEVELOPMENT CRITICAL
- ARTIFICIAL PROTECTION
- PROTECTIVE BEACH
- STABLE ROCK

SANTA BARBARA CO. — MI. 95 - 101

MAP NUMBER **97**

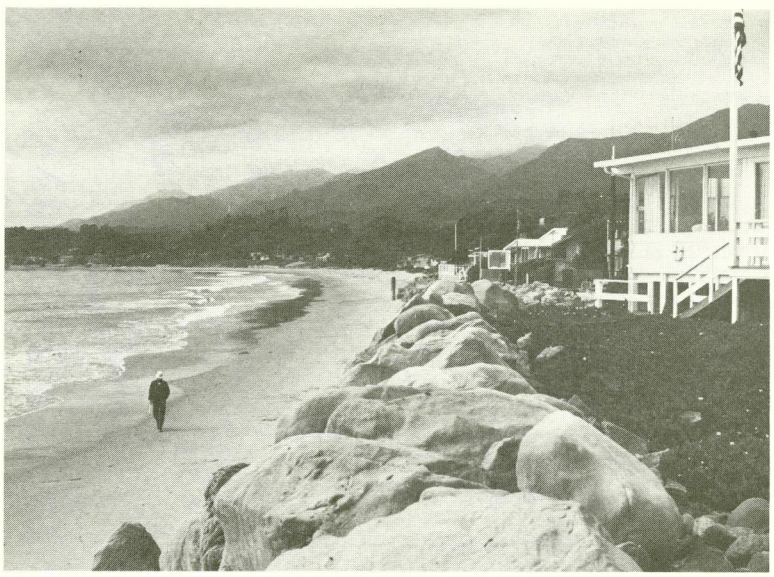
STATE OF CALIFORNIA — THE RESOURCES AGENCY

DEPARTMENT OF NAVIGATION & OCEAN DEVELOPMENT

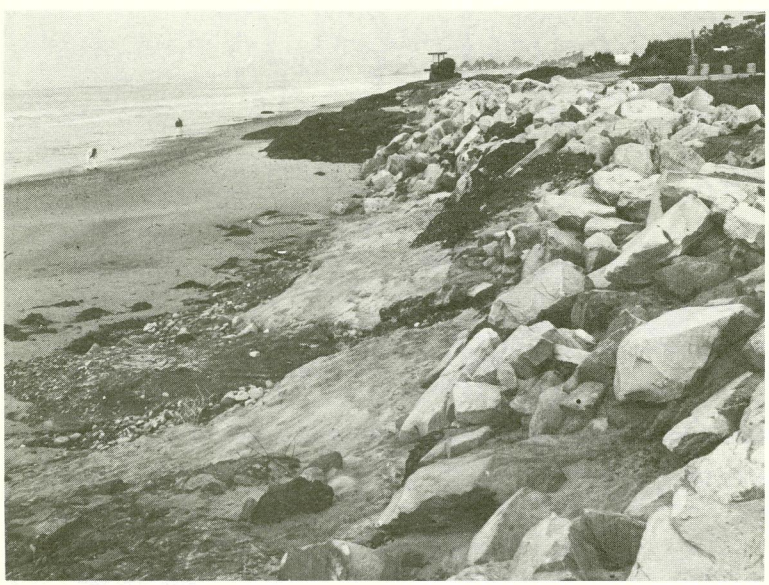
DNOD

1977

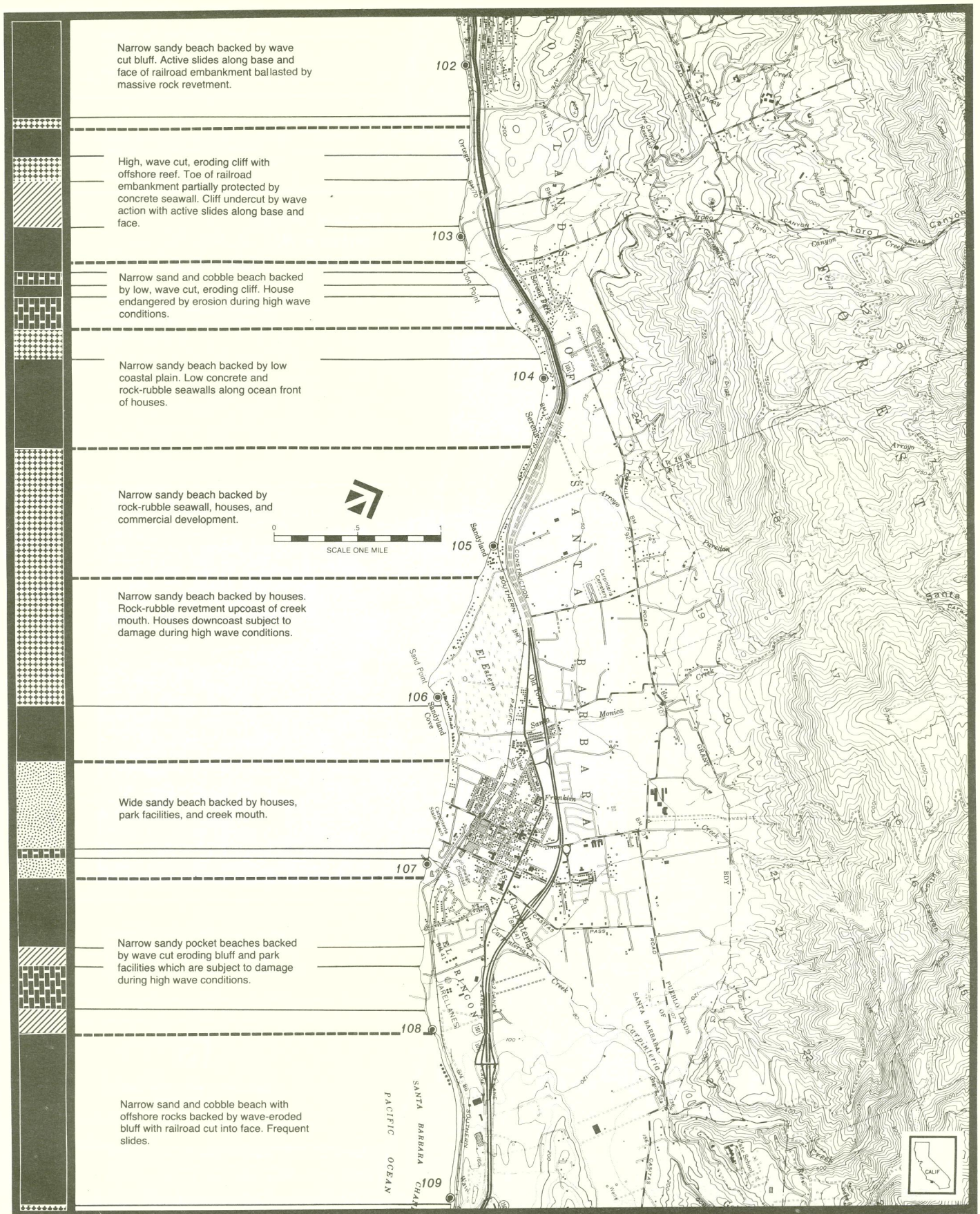
Summerland Beach
Santa Barbara Mi. 101.5
3/8/76 Tide +1.9



Serena
Santa Barbara Mi. 104.3
3/8/76 Tide +2.1



Carpinteria State Beach
Santa Barbara Mi. 107.5
3/10/76 Tide +1.9



▪ SHORELINE CONDITION ▪

- PRESENT DEVELOPMENT CRITICAL
- PRESENT DEVELOPMENT NON-CRITICAL
- FUTURE DEVELOPMENT CRITICAL
- ARTIFICIAL PROTECTION
- PROTECTIVE BEACH
- STABLE ROCK

SANTA BARBARA CO. — MI. 102 - 109

MAP NUMBER 98

STATE OF CALIFORNIA — THE RESOURCES AGENCY

DEPARTMENT OF NAVIGATION & OCEAN DEVELOPMENT

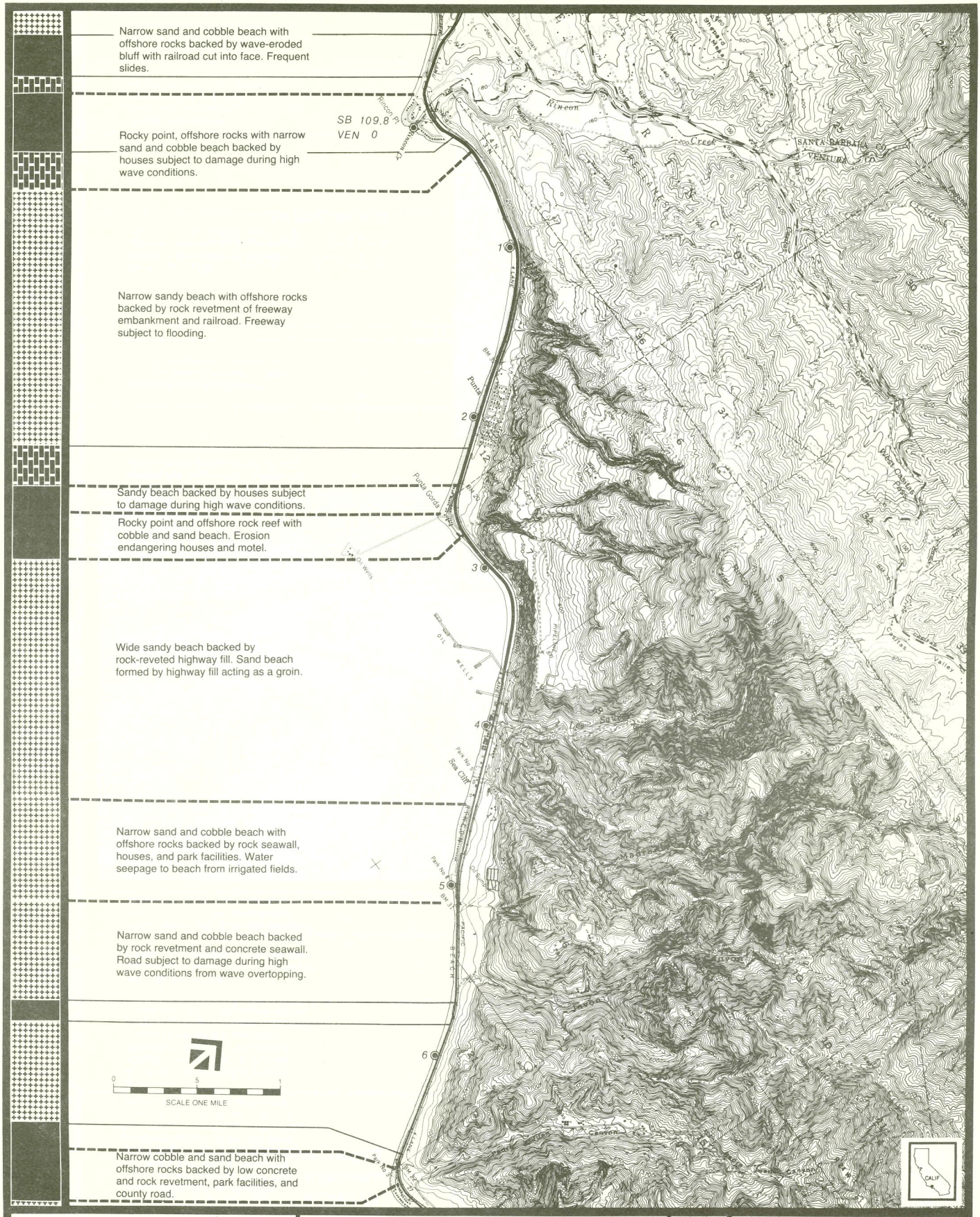
DNOD

1977

Rincon Point
Ventura Mi. 0.5
3/10/76 Tide +0.8

Punta Gorda
Ventura Mi. 2.6
3/10/76 Tide +0.65

Sea Cliff Colony
Ventura Mi. 4.5
3/10/76 Tide +0.5



• SHORELINE CONDITION •

- PRESENT DEVELOPMENT CRITICAL
- PRESENT DEVELOPMENT NON-CRITICAL
- FUTURE DEVELOPMENT CRITICAL
- ARTIFICIAL PROTECTION
- PROTECTIVE BEACH
- STABLE ROCK

SANTA BARBARA CO. — MI. 109 - 109.8
VENTURA CO. — MI. 0 - 6

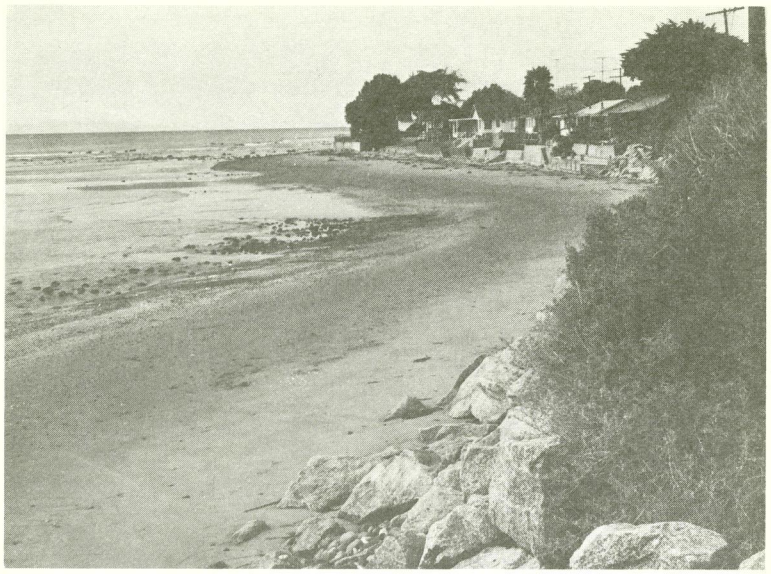
MAP NUMBER
99

STATE OF CALIFORNIA — THE RESOURCES AGENCY

DEPARTMENT OF NAVIGATION & OCEAN DEVELOPMENT

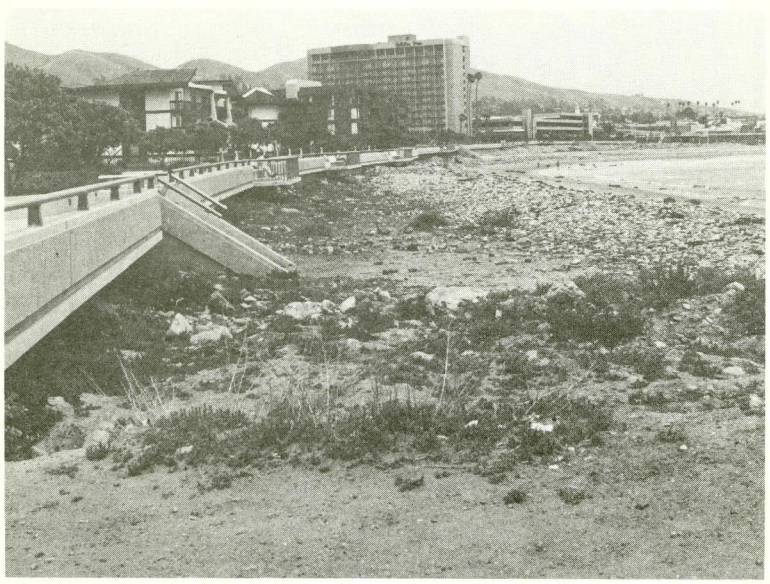
DNOD

1977

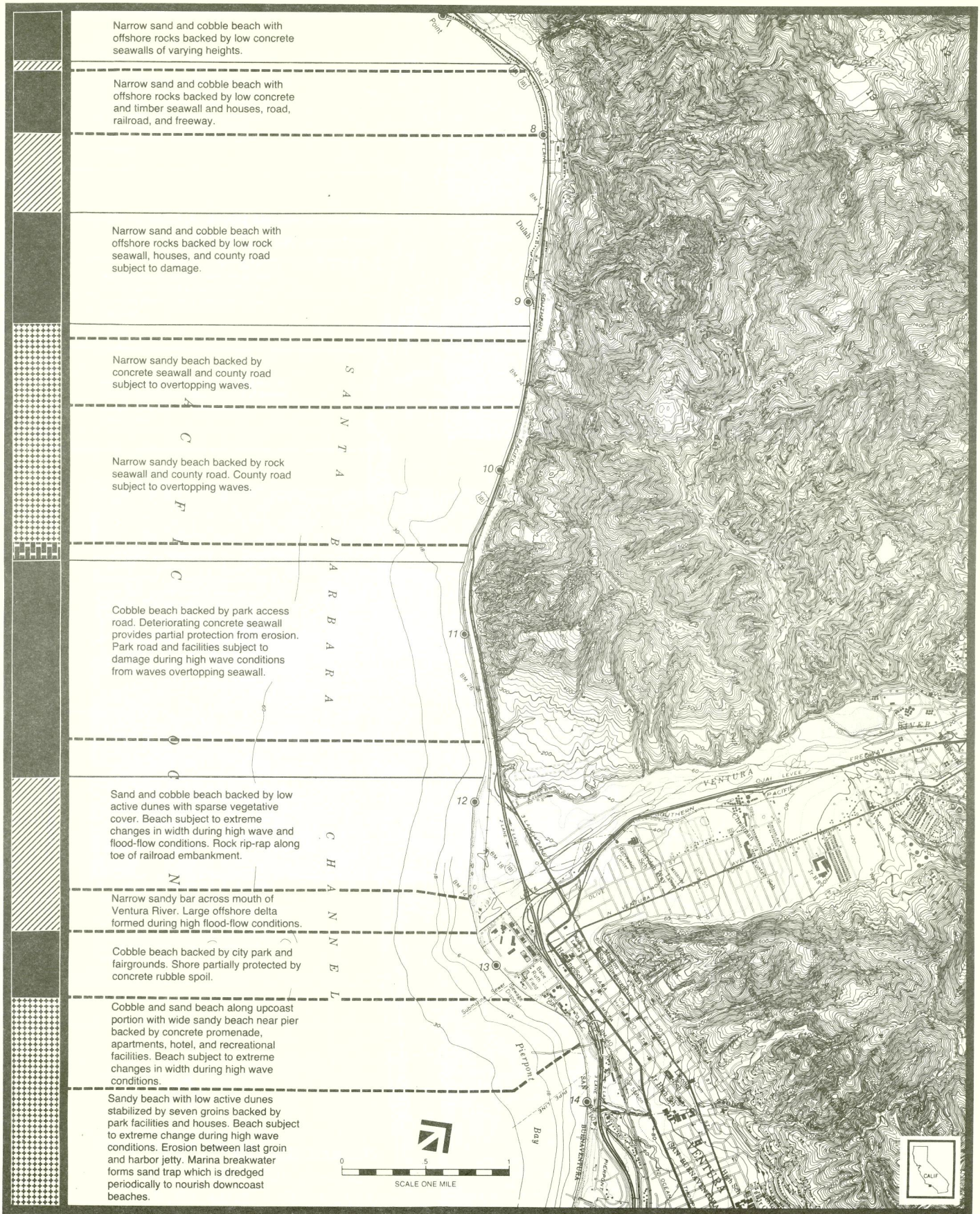


Pitas Point
Ventura Mi. 7.6
3/11/76 Tide +1.35

Emma Wood State Beach
Ventura Mi. 10.85
3/11/76 Tide +0.5



Prominade-Ventura Beach
Ventura Mi. 13.6
4/28/76 Tide +1.5



▪ SHORELINE CONDITION ▪

- PRESENT DEVELOPMENT CRITICAL
- PRESENT DEVELOPMENT NON-CRITICAL
- FUTURE DEVELOPMENT CRITICAL
- ARTIFICIAL PROTECTION
- PROTECTIVE BEACH
- STABLE ROCK

VENTURA CO. — MI. 7-14

MAP NUMBER 100

STATE OF CALIFORNIA — THE RESOURCES AGENCY

DEPARTMENT OF NAVIGATION & OCEAN DEVELOPMENT

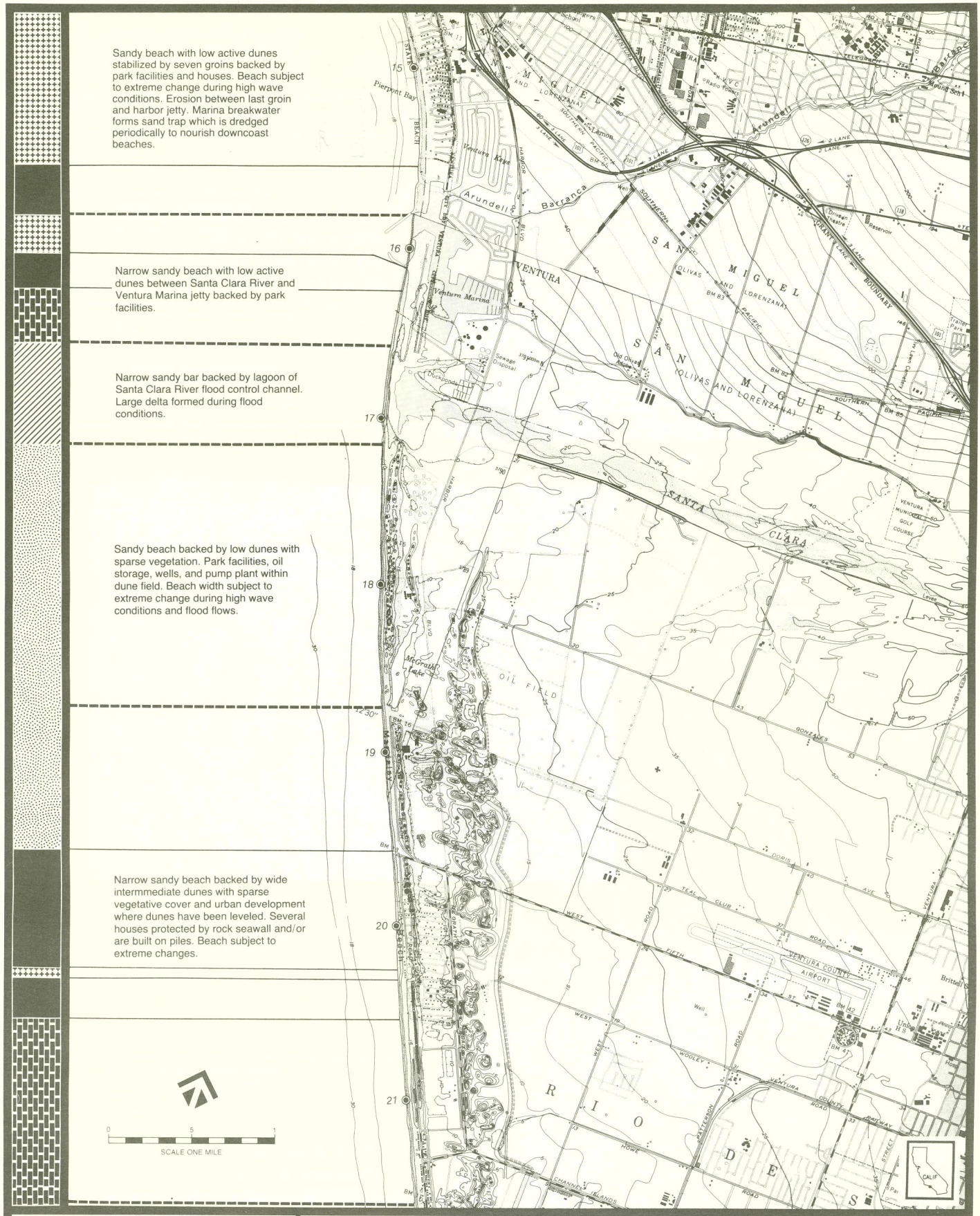
DNOD

1977

Ventura-Pierpont Groin #4
Ventura Mi. 15.05
5/1/75 Tide +1.70

Oxnard Shores
Ventura Mi. 19.7
11/10/76 Tide +0.4

Oxnard Shores
Ventura Mi. 20.0
11/10/76 Tide +0.4



▪ SHORELINE CONDITION ▪

- PRESENT DEVELOPMENT CRITICAL
- PRESENT DEVELOPMENT NON-CRITICAL
- FUTURE DEVELOPMENT CRITICAL
- ARTIFICIAL PROTECTION
- PROTECTIVE BEACH
- STABLE ROCK

VENTURA CO. — MI. 15-22

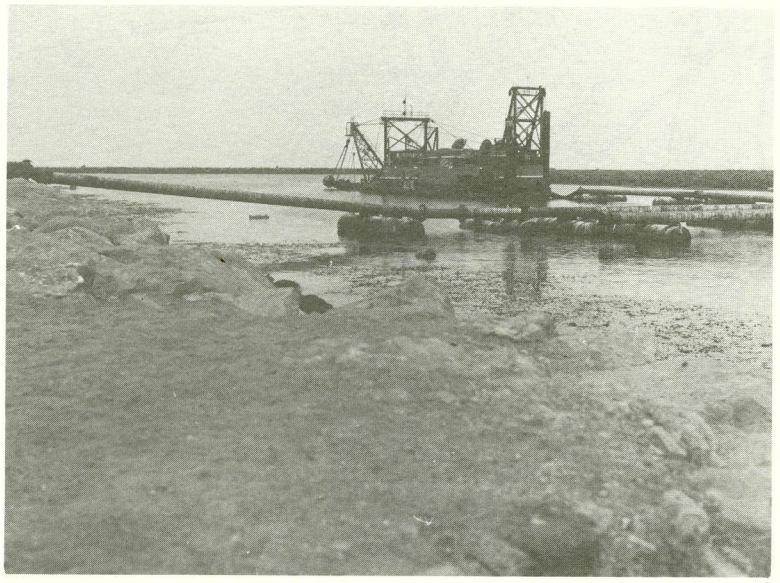
MAP NUMBER 101

STATE OF CALIFORNIA — THE RESOURCES AGENCY

DEPARTMENT OF NAVIGATION & OCEAN DEVELOPMENT

DNOD

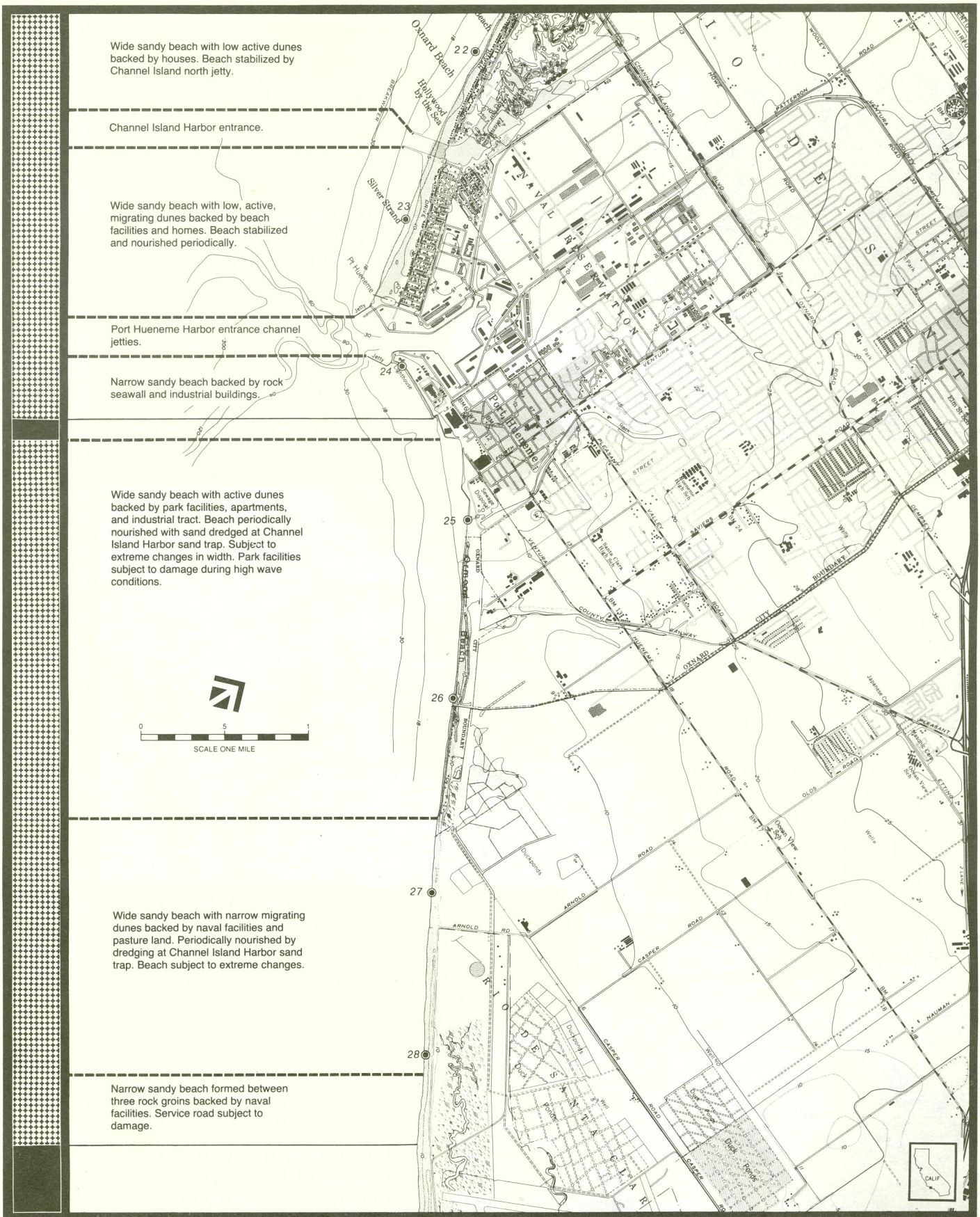
1977



Channel Islands Harbor
Entrance Channel
Ventura Mi. 22.7
9/11/75 Tide +3.0

Hueneme Beach Park
Ventura Mi. 24.6
5/1/75 Tide +2.2

Port Hueneme
Ventura Mi. 25.0
9/11/75 Tide +4.62



▪ SHORELINE CONDITION ▪

- PRESENT DEVELOPMENT CRITICAL
- PRESENT DEVELOPMENT NON-CRITICAL
- FUTURE DEVELOPMENT CRITICAL
- ARTIFICIAL PROTECTION
- PROTECTIVE BEACH
- STABLE ROCK

VENTURA CO. — MI. 22 - 28

MAP NUMBER **102**

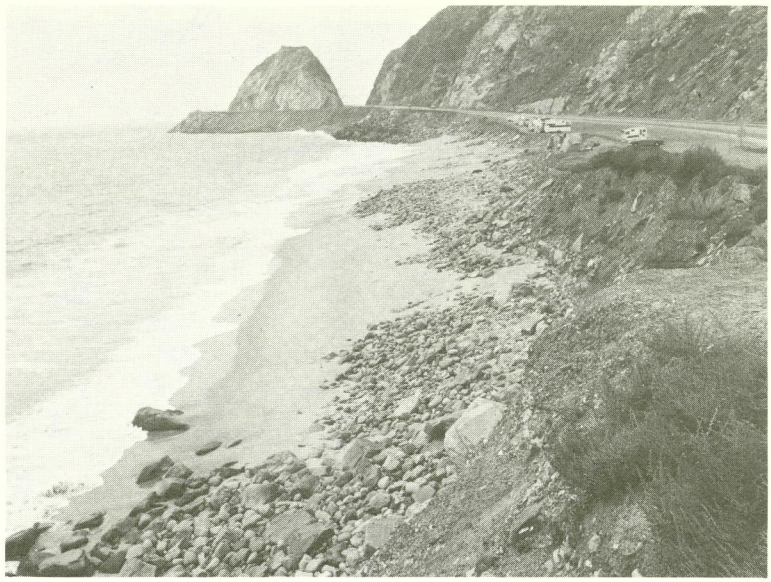
STATE OF CALIFORNIA — THE RESOURCES AGENCY

DEPARTMENT OF NAVIGATION & OCEAN DEVELOPMENT

DNOD

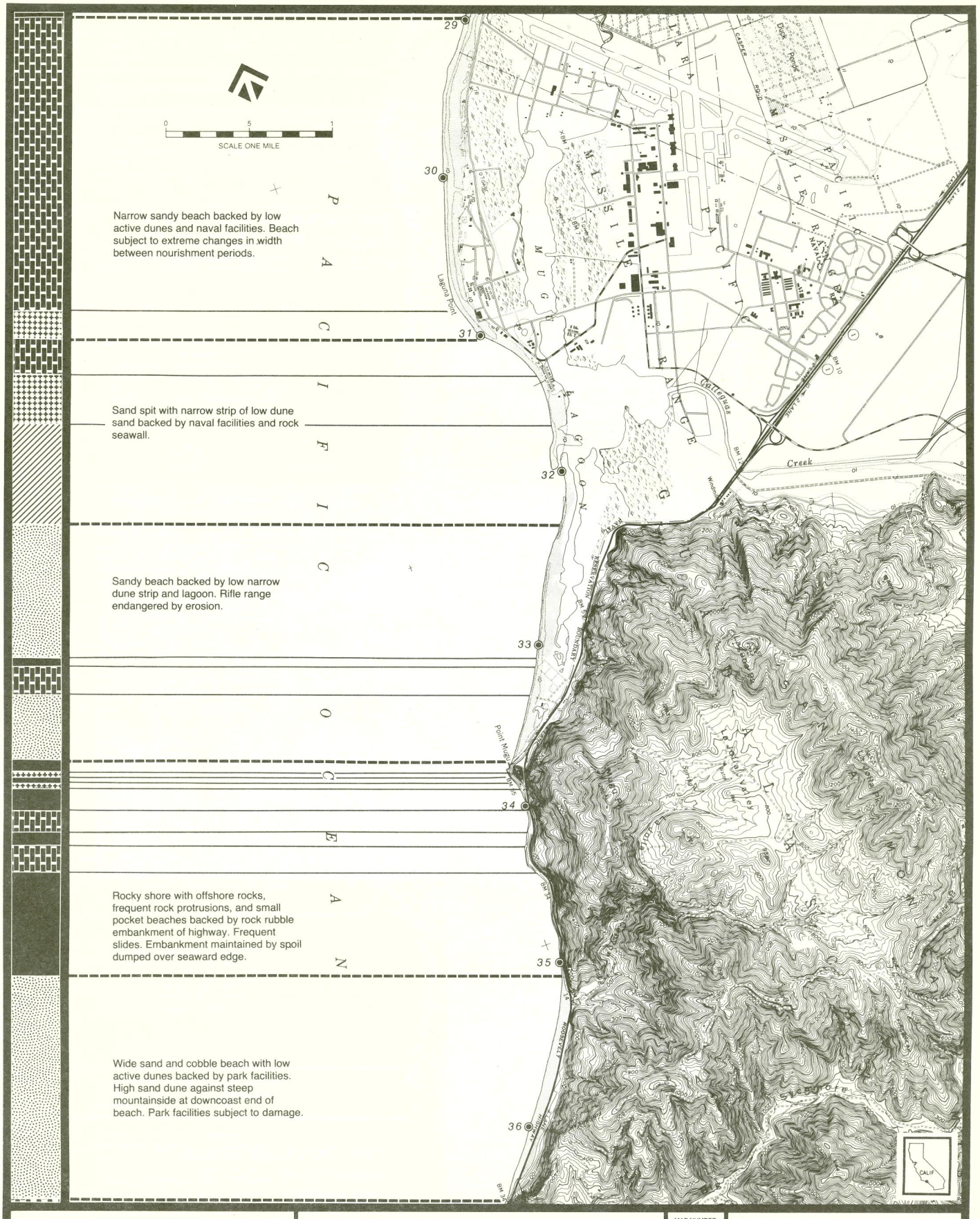
1977

Point Mugu
Ventura Mi. 33.7
4/23/75 Tide +2.5



Point Mugu
Ventura Mi. 34.1
10/19/76 Tide +1.7

Point Mugu State Beach
Ventura Mi. 35.0
9/11/75 Tide +3.35



▪ SHORELINE CONDITION ▪

- PRESENT DEVELOPMENT CRITICAL
- ARTIFICIAL PROTECTION
- PRESENT DEVELOPMENT NON-CRITICAL
- PROTECTIVE BEACH
- FUTURE DEVELOPMENT CRITICAL
- STABLE ROCK

VENTURA CO. — MI. 29-36

MAP NUMBER 103

STATE OF CALIFORNIA — THE RESOURCES AGENCY

DEPARTMENT OF NAVIGATION & OCEAN DEVELOPMENT

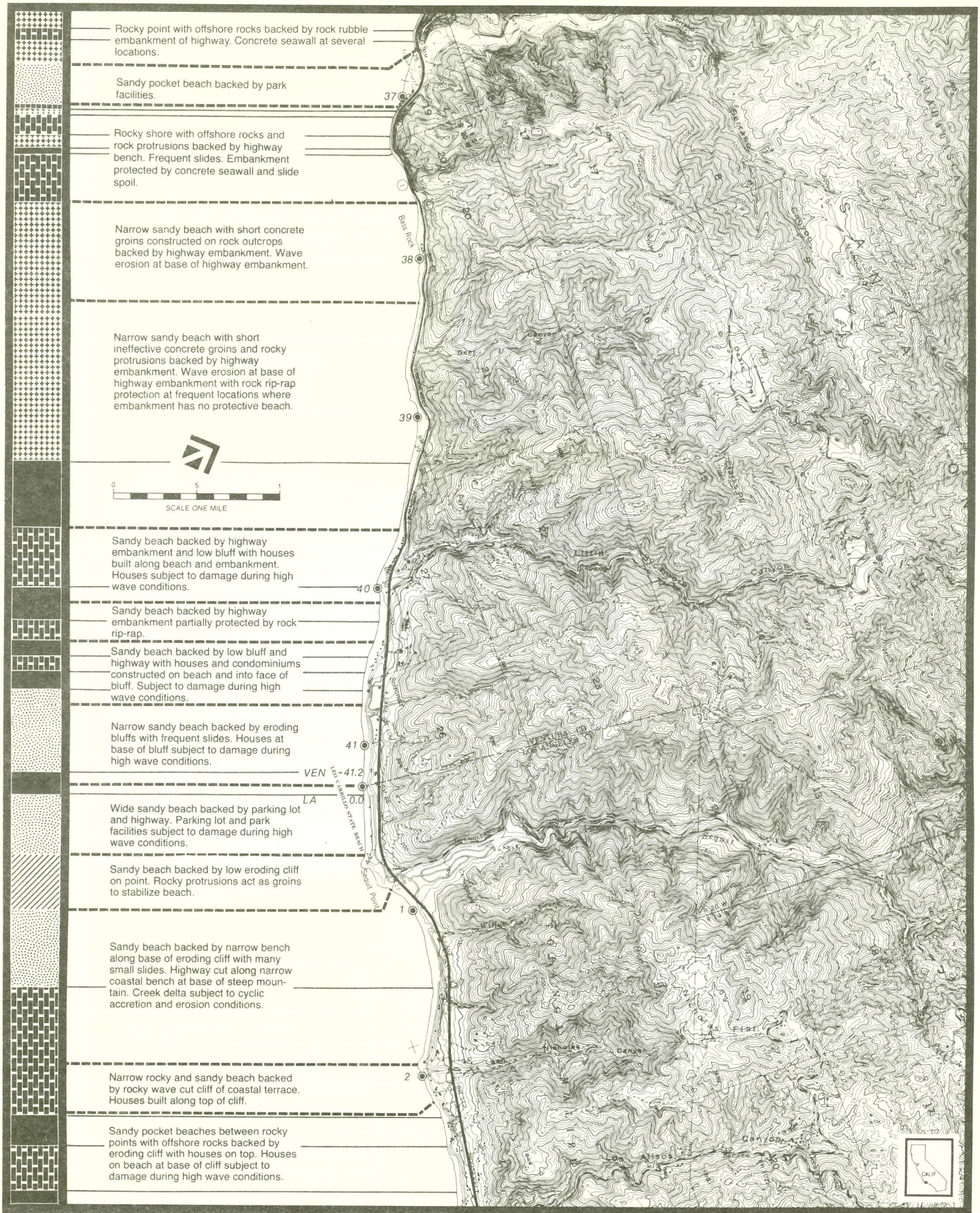
DNOD

1977

Big Sycamore Creek Beach
Ventura Mi. 37.1
4/23/75 Tide +0.80

Little Sycamore Creek Beach
Ventura Mi. 37.6
4/23/75 Tide +0.50

Leo Carrillo State Beach
Ventura Mi. 41.3
10/20/76 Tide +5.0



SHORELINE CONDITION

- PRESENT DEVELOPMENT CRITICAL
- PRESENT DEVELOPMENT NON-CRITICAL
- FUTURE DEVELOPMENT CRITICAL
- ARTIFICIAL PROTECTION
- PROTECTIVE BEACH
- STABLE ROCK

VENTURA CO. — MI. 37 - 41.2
LOS ANGELES CO. — MI. 0 - 2

MAP NUMBER **104**

STATE OF CALIFORNIA — THE RESOURCES AGENCY

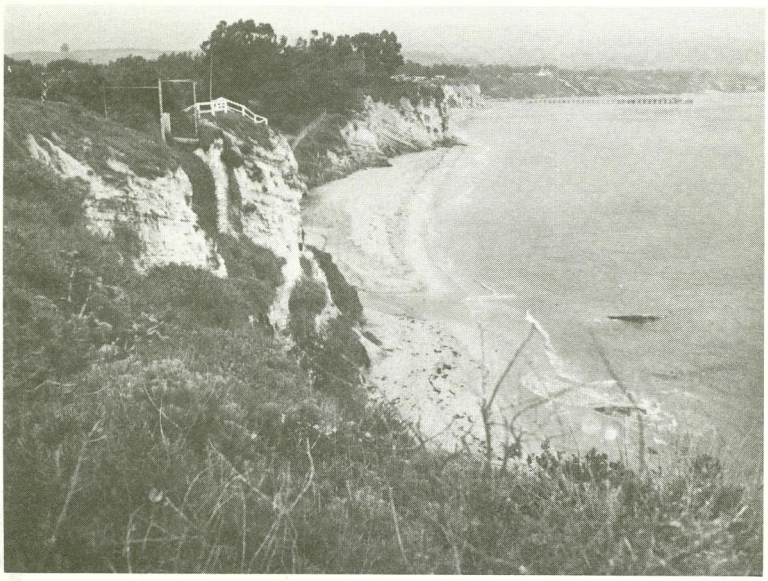
DEPARTMENT OF NAVIGATION & OCEAN DEVELOPMENT

DNOD

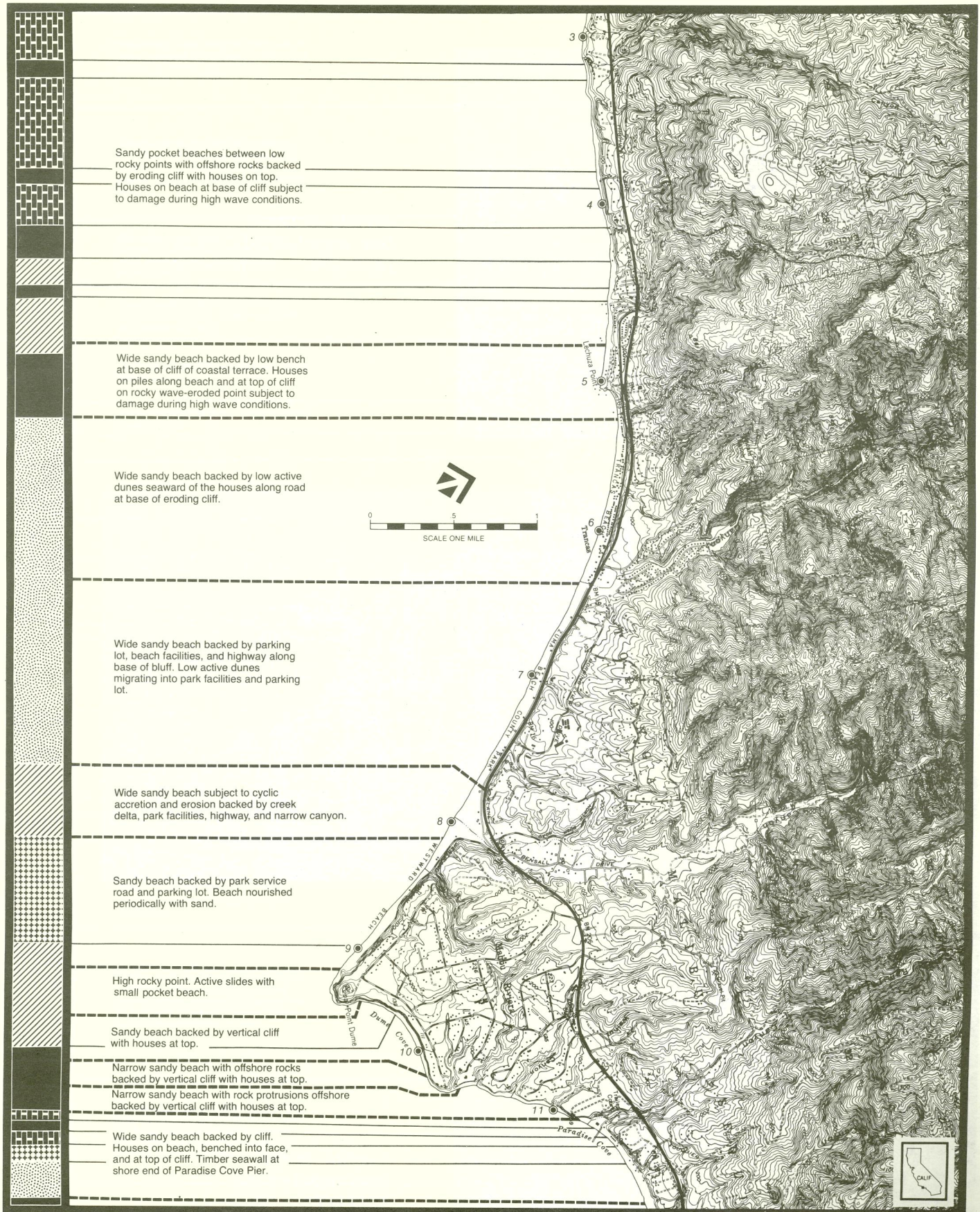
1977

Nicolaus Canyon Beach
Los Angeles Mi. 2.6
10/20/76 Tide +4.0

Westward Beach County Park
Los Angeles Mi. 8.3
10/20/76 Tide +0.8



Paradise Cove
Los Angeles Mi. 10.6
10/21/76 Tide +5.6



• SHORELINE CONDITION •

- PRESENT DEVELOPMENT CRITICAL
- PRESENT DEVELOPMENT NON-CRITICAL
- FUTURE DEVELOPMENT CRITICAL
- ARTIFICIAL PROTECTION
- PROTECTIVE BEACH
- STABLE ROCK

LOS ANGELES CO. — MI. 3-11

MAP NUMBER 105

STATE OF CALIFORNIA — THE RESOURCES AGENCY

DEPARTMENT OF NAVIGATION & OCEAN DEVELOPMENT

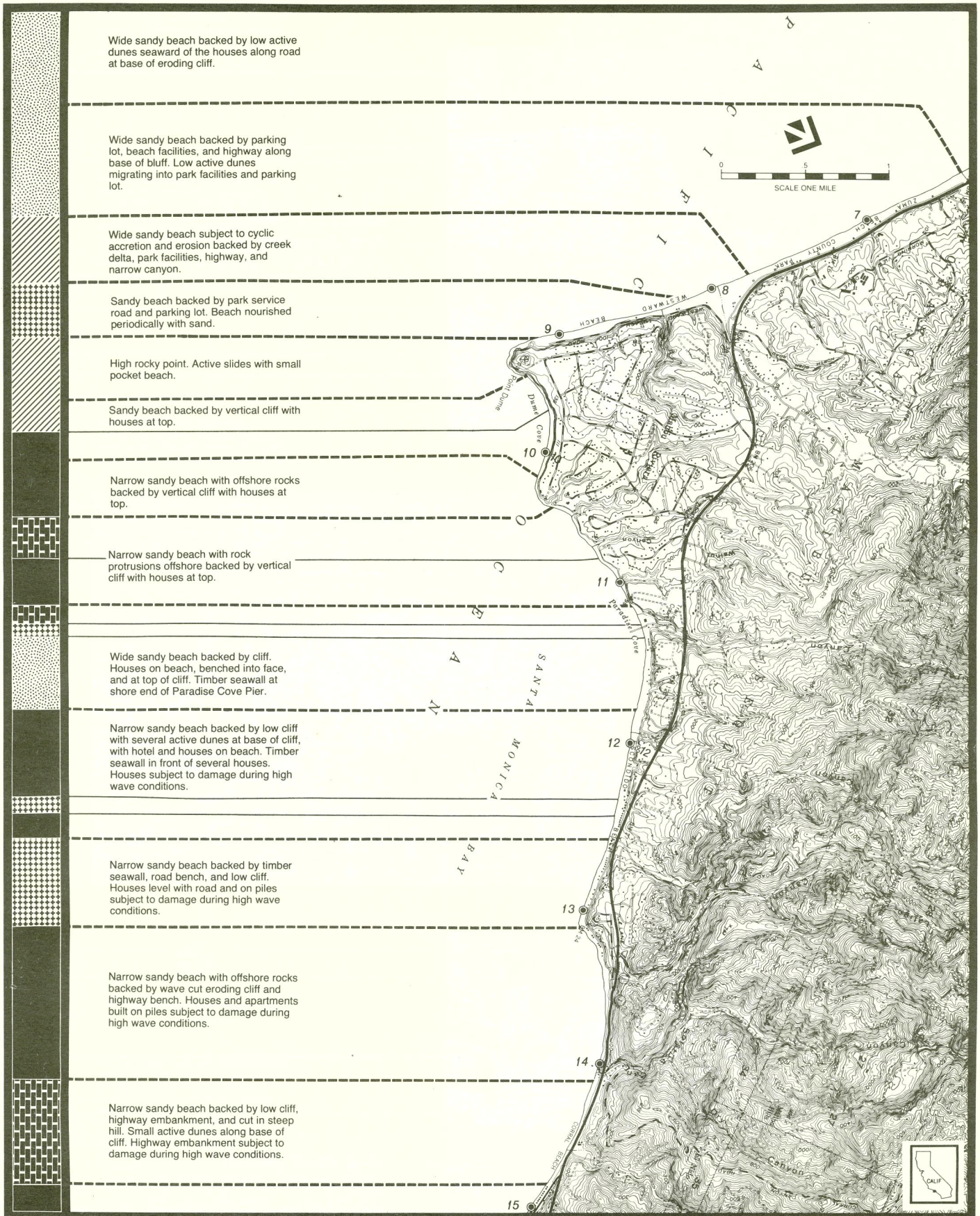
DNOD

1977

Paradise Cove
Los Angeles Mi. 11.4
10/20/76 Tide +1.4

Solstice Canyon Beach
Los Angeles Mi. 13.9
10/21/76 Tide +4.7

Corral Beach
Los Angeles Mi. 14.8
10/21/76 Tide +3.7



• SHORELINE CONDITION •

- PRESENT DEVELOPMENT CRITICAL
- PRESENT DEVELOPMENT NON-CRITICAL
- FUTURE DEVELOPMENT CRITICAL
- ARTIFICIAL PROTECTION
- PROTECTIVE BEACH
- STABLE ROCK

LOS ANGELES CO. — MI. 7-15

MAP NUMBER 106

STATE OF CALIFORNIA — THE RESOURCES AGENCY

DEPARTMENT OF NAVIGATION & OCEAN DEVELOPMENT

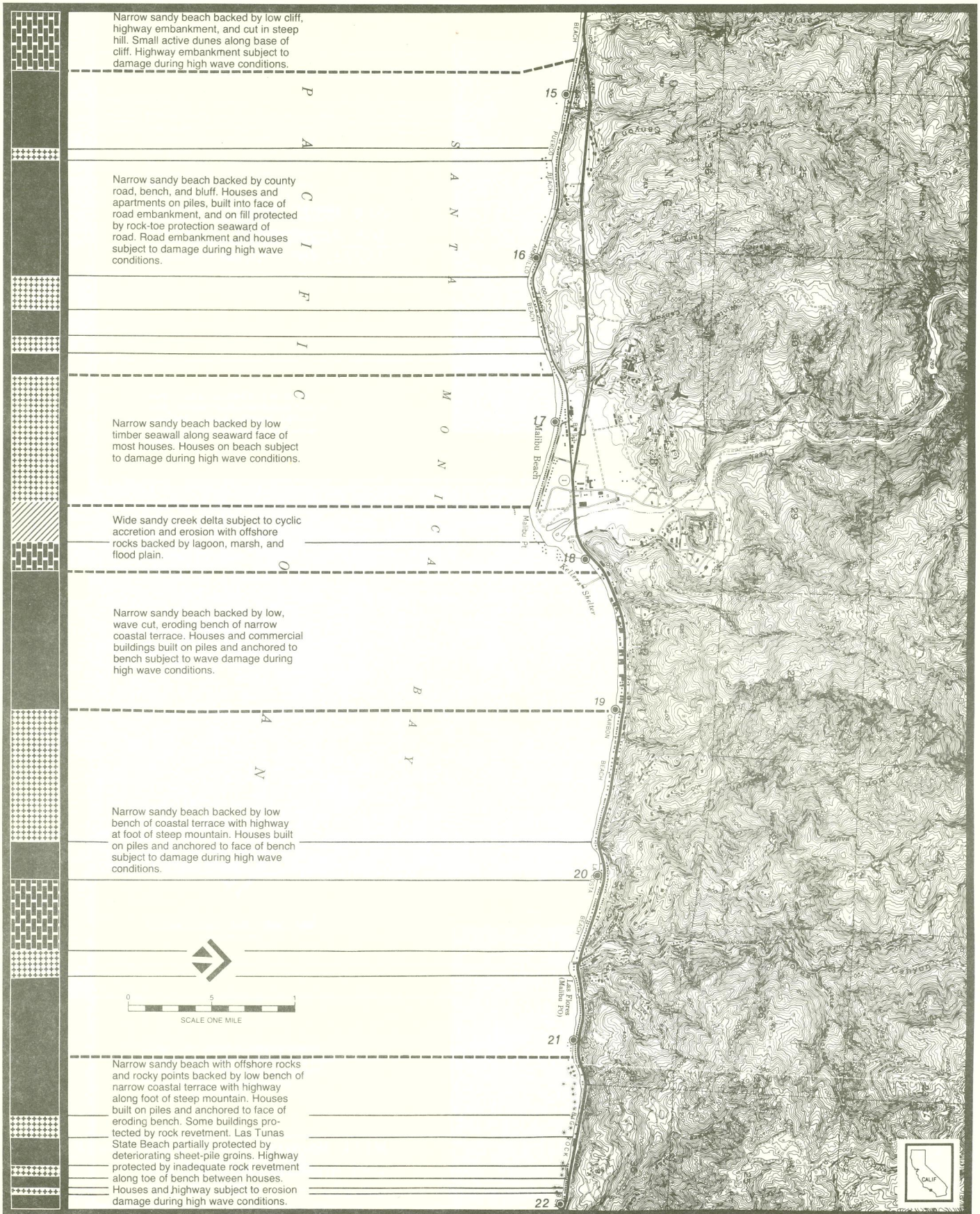
DNOD

1977

Amarillo Beach
Los Angeles Mi. 16.1
10/21/76 Tide +3.0

Malibu Pier
Los Angeles Mi. 18.2
10/21/76 Tide +2.1

Big Rock Beach
Los Angeles Mi. 21.9
10/21/76 Tide +0.5



▪ SHORELINE CONDITION ▪

- PRESENT DEVELOPMENT CRITICAL
- PRESENT DEVELOPMENT NON-CRITICAL
- FUTURE DEVELOPMENT CRITICAL
- ARTIFICIAL PROTECTION
- PROTECTIVE BEACH
- STABLE ROCK

LOS ANGELES CO. — MI. 15 - 22

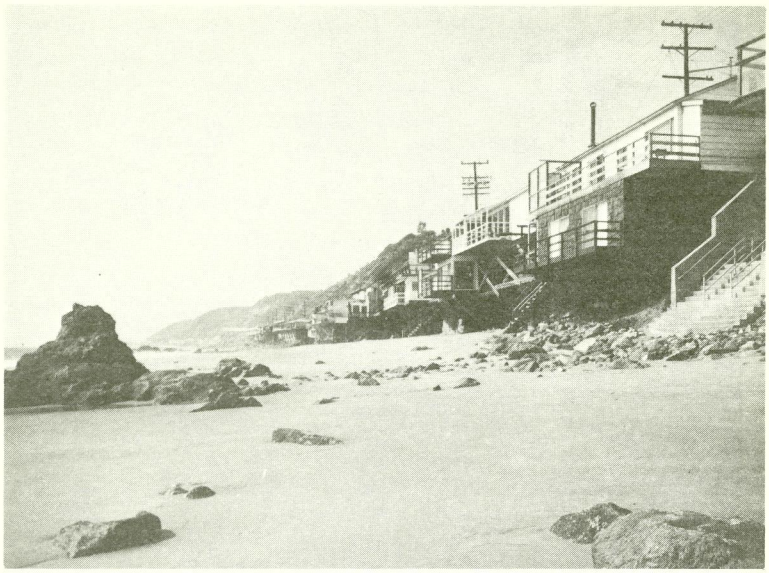
MAP NUMBER 107

STATE OF CALIFORNIA — THE RESOURCES AGENCY

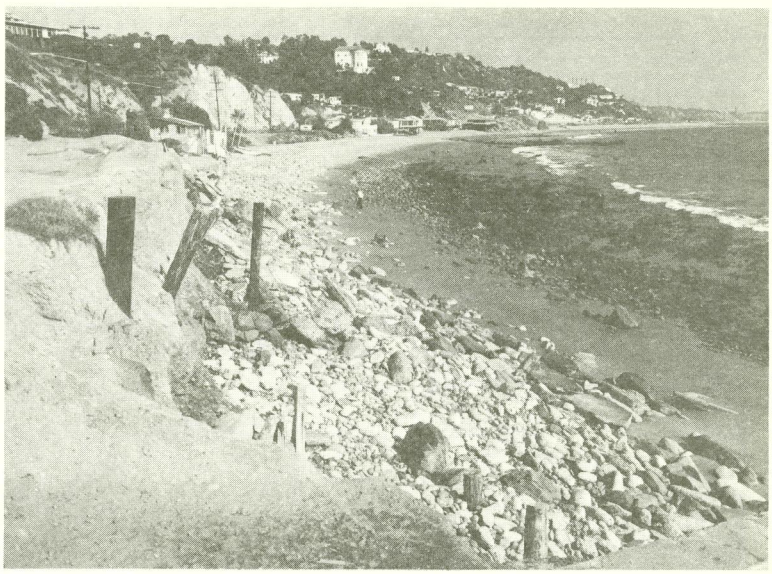
DEPARTMENT OF NAVIGATION & OCEAN DEVELOPMENT

DNOD

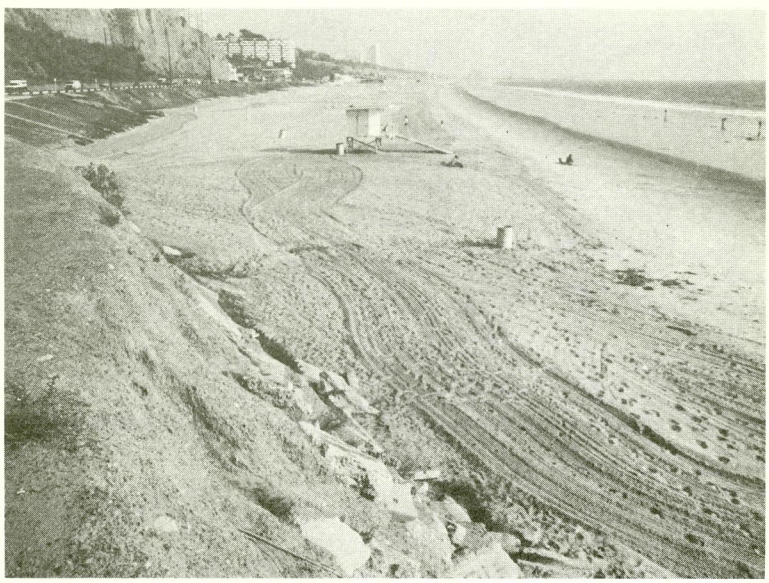
1977



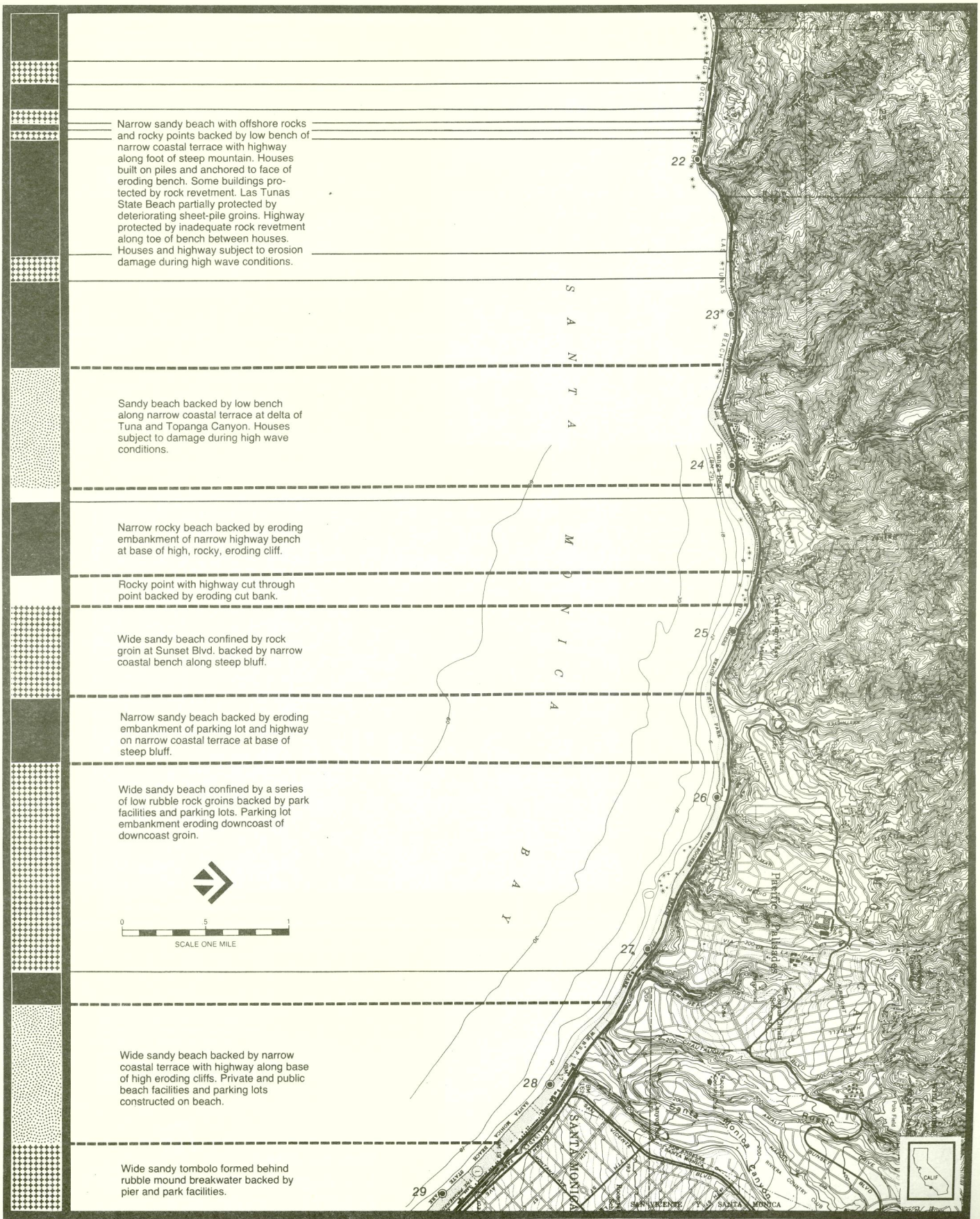
Big Rock Beach
Los Angeles Mi. 22.1
10/21/76 Tide +0.3



Topanga Beach
Los Angeles Mi. 24.5
10/21/76 Tide -0.2



Will Rogers Beach State Park
Los Angeles Mi. 27.4
10/21/76 Tide +0.15



• SHORELINE CONDITION •

- PRESENT DEVELOPMENT CRITICAL
- ARTIFICIAL PROTECTION
- PRESENT DEVELOPMENT NON-CRITICAL
- PROTECTIVE BEACH
- FUTURE DEVELOPMENT CRITICAL
- STABLE ROCK

LOS ANGELES CO. — MI. 22 - 29

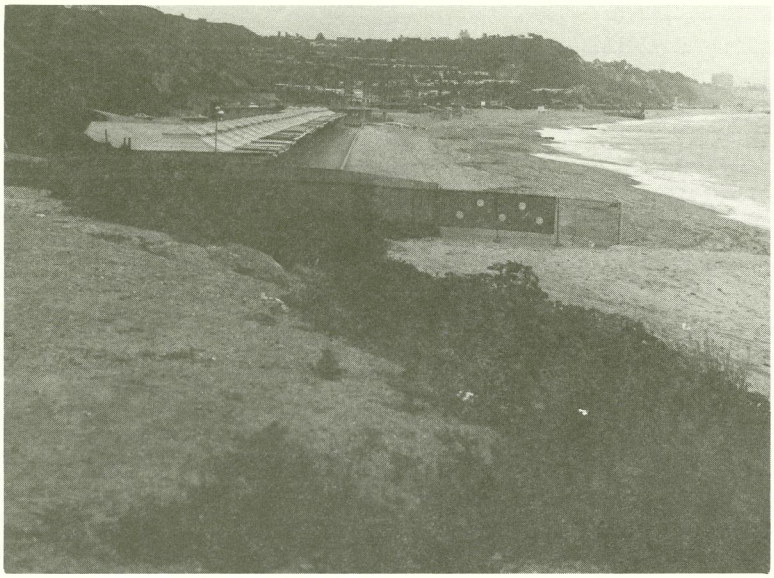
MAP NUMBER **108**

STATE OF CALIFORNIA — THE RESOURCES AGENCY

DEPARTMENT OF NAVIGATION & OCEAN DEVELOPMENT

DNOD

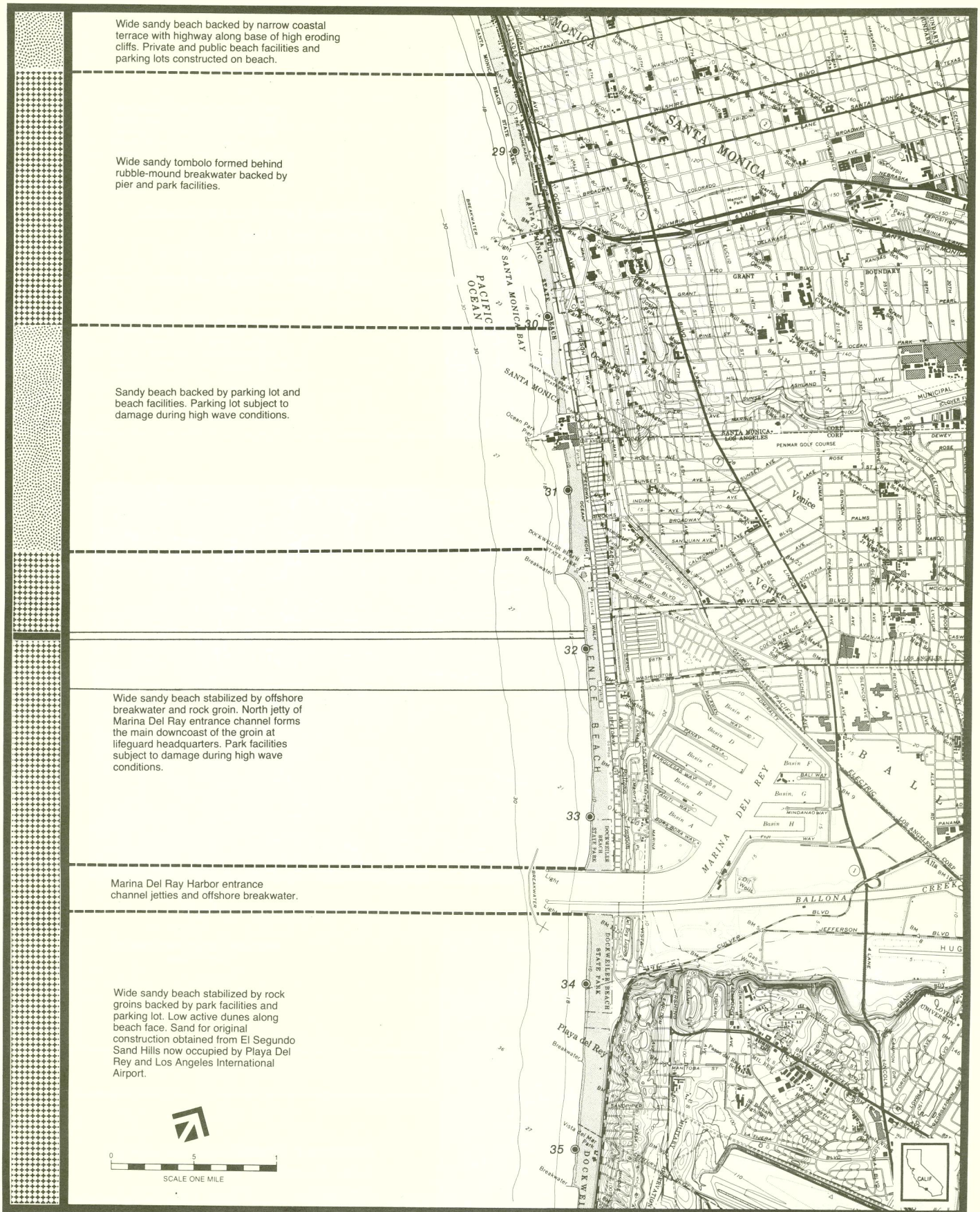
1977



Bel Aire Beach Club
Los Angeles Mi. 25.8
4/22/75 Tide +4.1

Venice Beach
Los Angeles Mi. 32.2
4/22/75 Tide +2.6

Venice Beach
Los Angeles Mi. 32.2
4/22/75 Tide +2.6



▪ SHORELINE CONDITION ▪

- PRESENT DEVELOPMENT CRITICAL
- PRESENT DEVELOPMENT NON-CRITICAL
- FUTURE DEVELOPMENT CRITICAL
- ARTIFICIAL PROTECTION
- PROTECTIVE BEACH
- STABLE ROCK

LOS ANGELES CO. — MI. 29 - 35

MAP NUMBER 109

STATE OF CALIFORNIA — THE RESOURCES AGENCY

DEPARTMENT OF NAVIGATION & OCEAN DEVELOPMENT

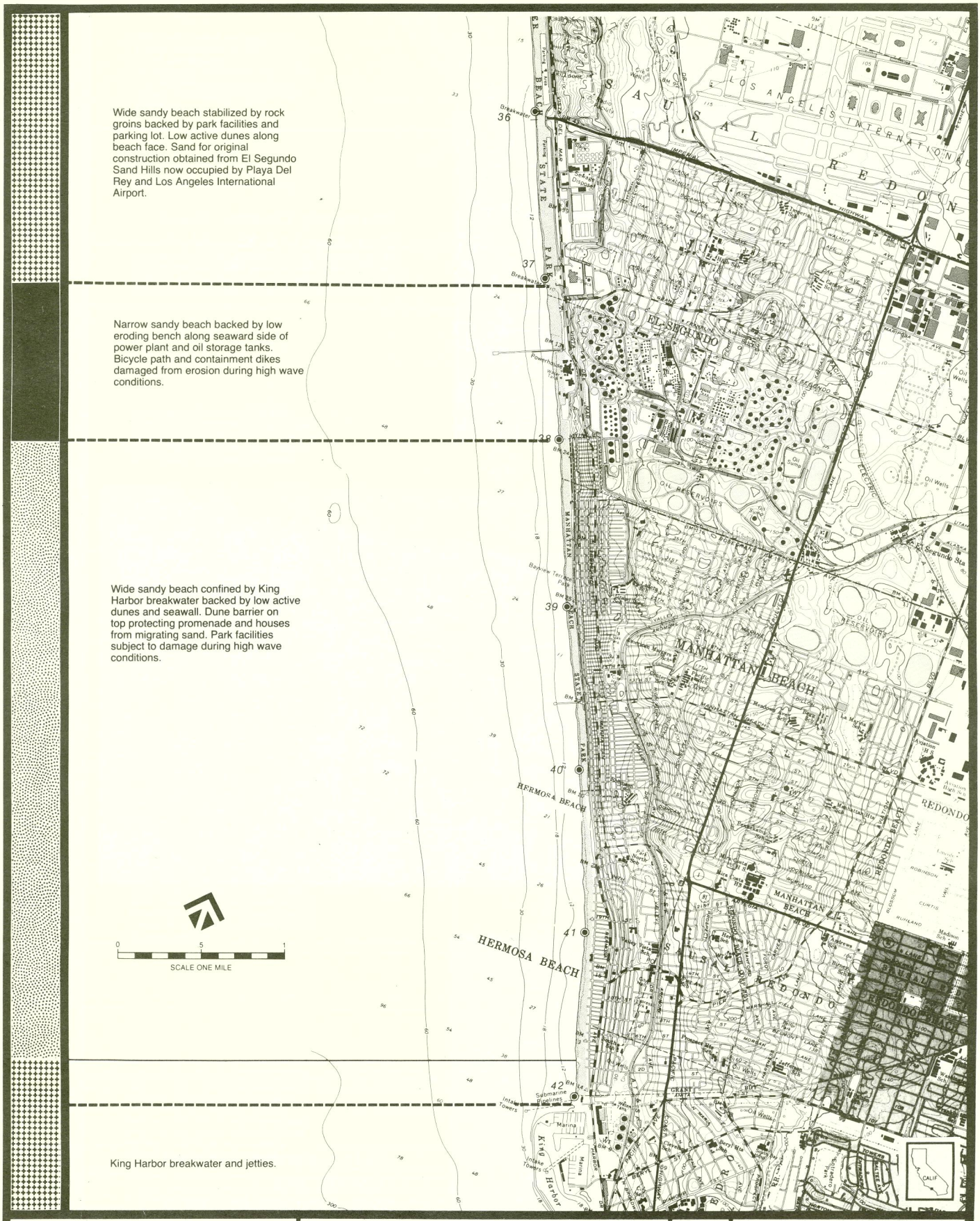
DNOD

1977

Dockweiler State Beach,
Playa Del Rey
Los Angeles Mi. 35.3
10/22/76 Tide +3.6

Manhattan Beach
Los Angeles Mi. 38.0
10/22/76 Tide +1.2

Hermosa Beach
Los Angeles Mi. 41.2
10/22/76 Tide +0.15



▪ SHORELINE CONDITION ▪

- PRESENT DEVELOPMENT CRITICAL
- PRESENT DEVELOPMENT NON-CRITICAL
- FUTURE DEVELOPMENT CRITICAL
- ARTIFICIAL PROTECTION
- PROTECTIVE BEACH
- STABLE ROCK

LOS ANGELES CO. — MI. 36 - 42

MAP NUMBER 110

STATE OF CALIFORNIA — THE RESOURCES AGENCY

DEPARTMENT OF NAVIGATION & OCEAN DEVELOPMENT

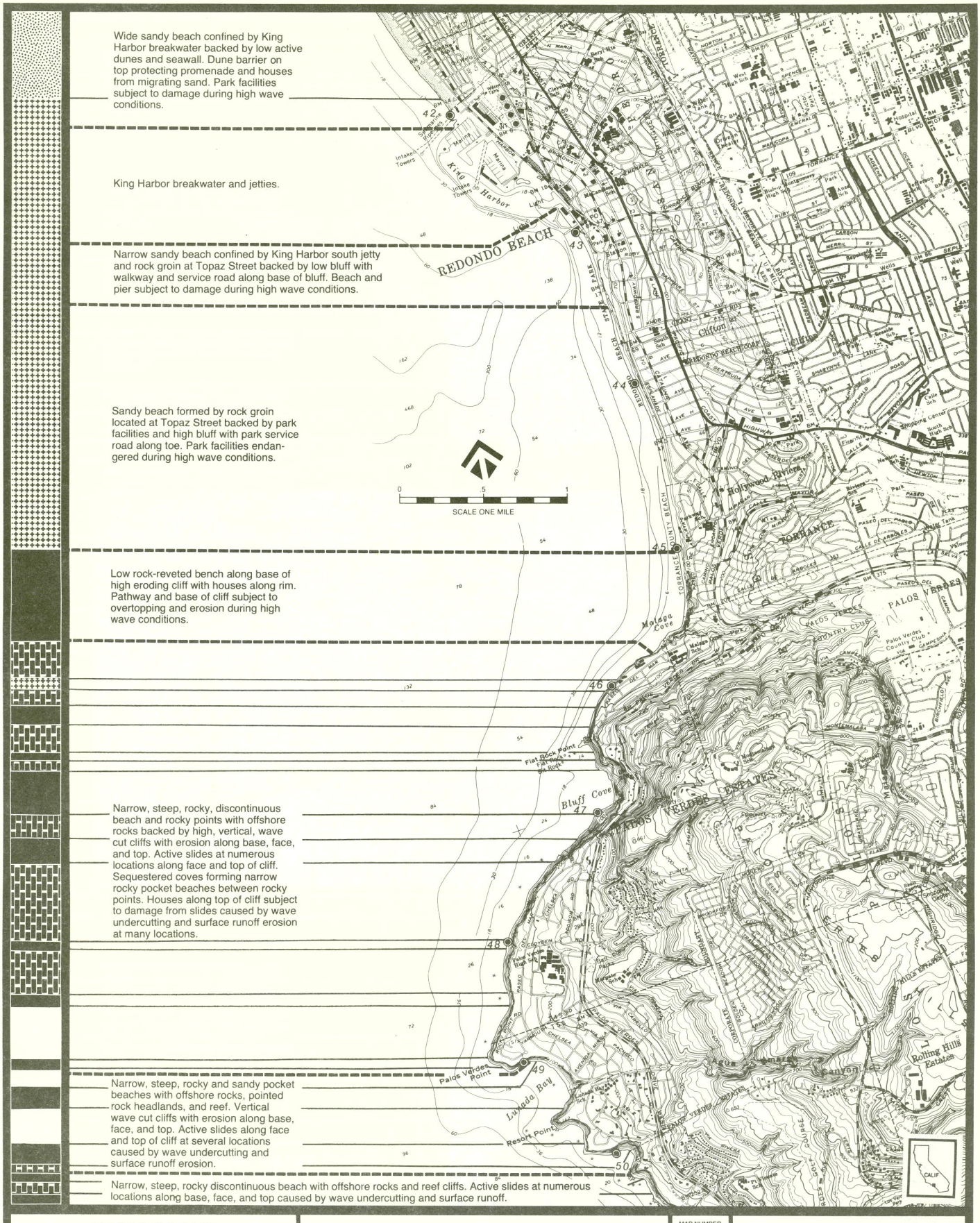
DNOD

1977

Torrance County Beach
Los Angeles Mi. 44.7
10/22/76 Tide -0.7

Malaga Cove, Torrance County Beach
Los Angeles Mi. 45.7
10/23/76 Tide +6.5

Palos Verdes Estates, Lunada Bay
Los Angeles Mi. 49.3
10/23/76 Tide +3.6



▪ SHORELINE CONDITION ▪

- PRESENT DEVELOPMENT CRITICAL
- PRESENT DEVELOPMENT NON-CRITICAL
- FUTURE DEVELOPMENT CRITICAL
- ARTIFICIAL PROTECTION
- PROTECTIVE BEACH
- STABLE ROCK

LOS ANGELES CO. — MI. 42 - 50

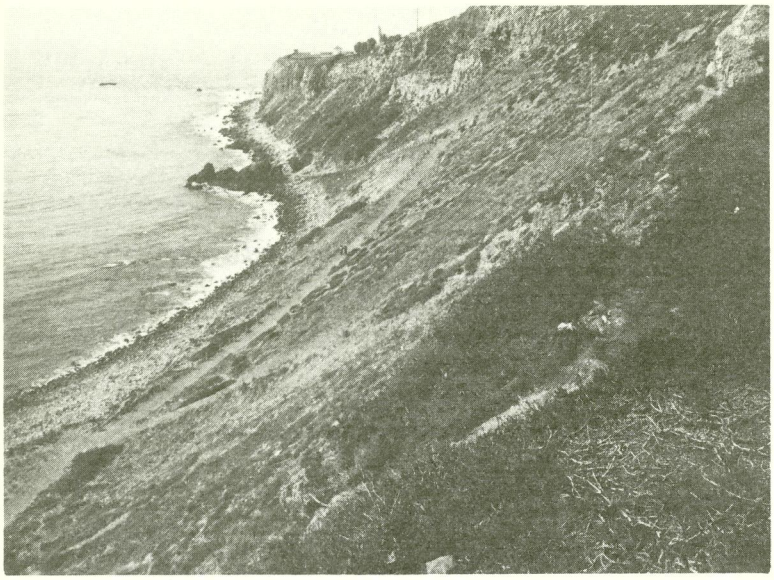
MAP NUMBER 111

STATE OF CALIFORNIA — THE RESOURCES AGENCY

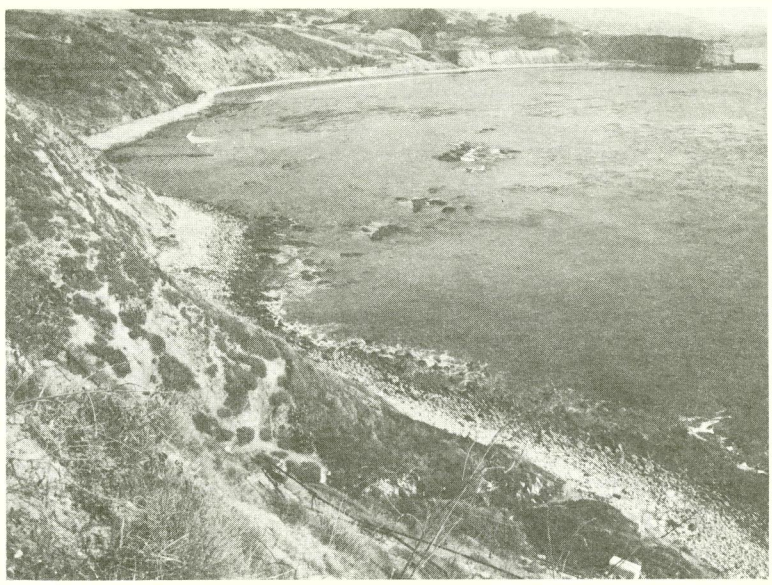
DEPARTMENT OF NAVIGATION & OCEAN DEVELOPMENT

DNOD

1977

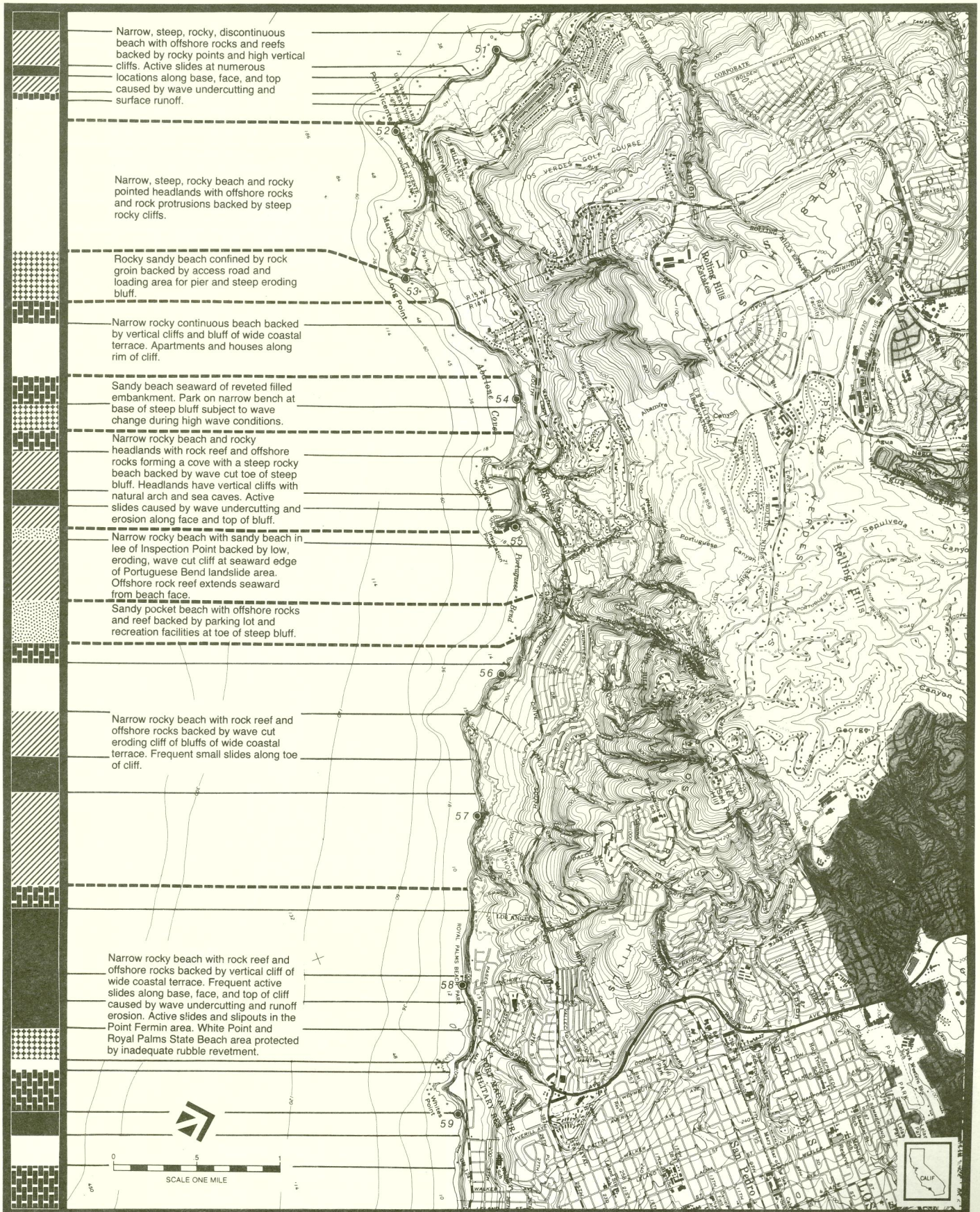


Point Vicente
Los Angeles Mi. 52.4
10/23/76 Tide +2.2



Abalone Cove
Los Angeles Mi. 53.6
10/23/76 Tide +2.2

Royal Palms Beach, White Rock County Park
Los Angeles Mi. 58.2
10/23/76 Tide -0.25



SHORELINE CONDITION

- PRESENT DEVELOPMENT CRITICAL
- PRESENT DEVELOPMENT NON-CRITICAL
- FUTURE DEVELOPMENT CRITICAL
- ARTIFICIAL PROTECTION
- PROTECTIVE BEACH
- STABLE ROCK

LOS ANGELES CO. — MI. 51 - 59

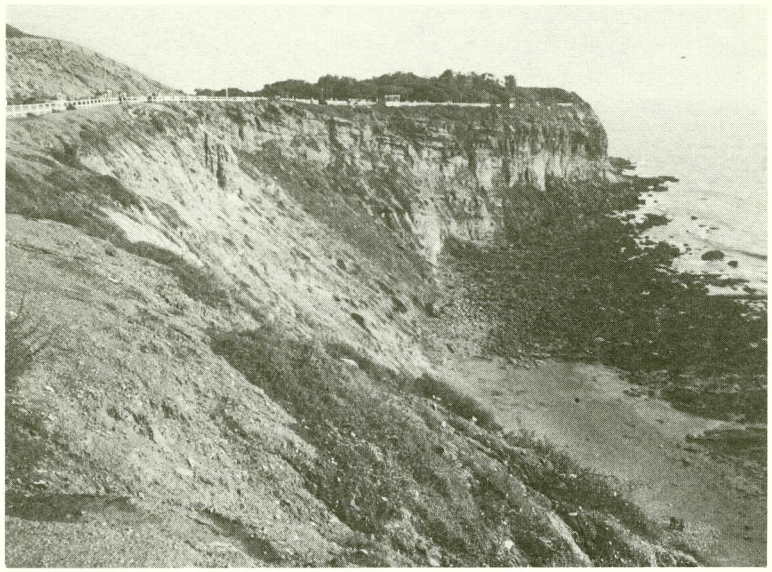
MAP NUMBER **112**

STATE OF CALIFORNIA — THE RESOURCES AGENCY

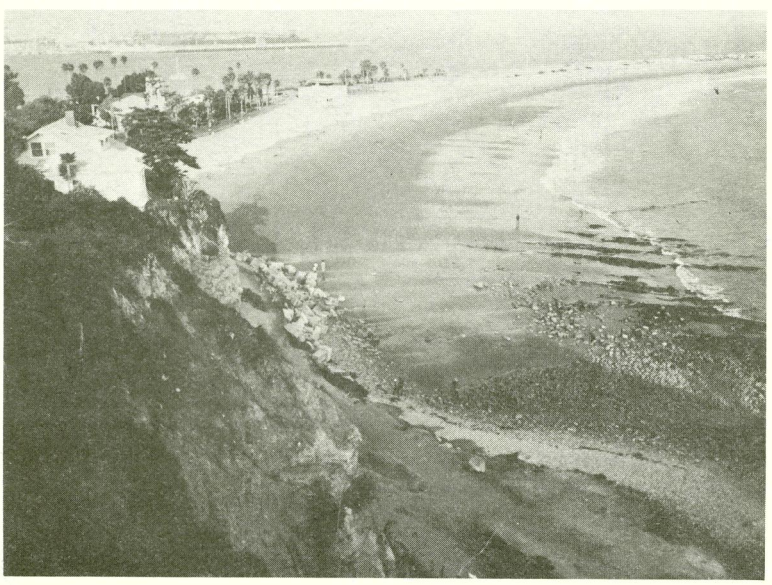
DEPARTMENT OF NAVIGATION & OCEAN DEVELOPMENT

DNOD

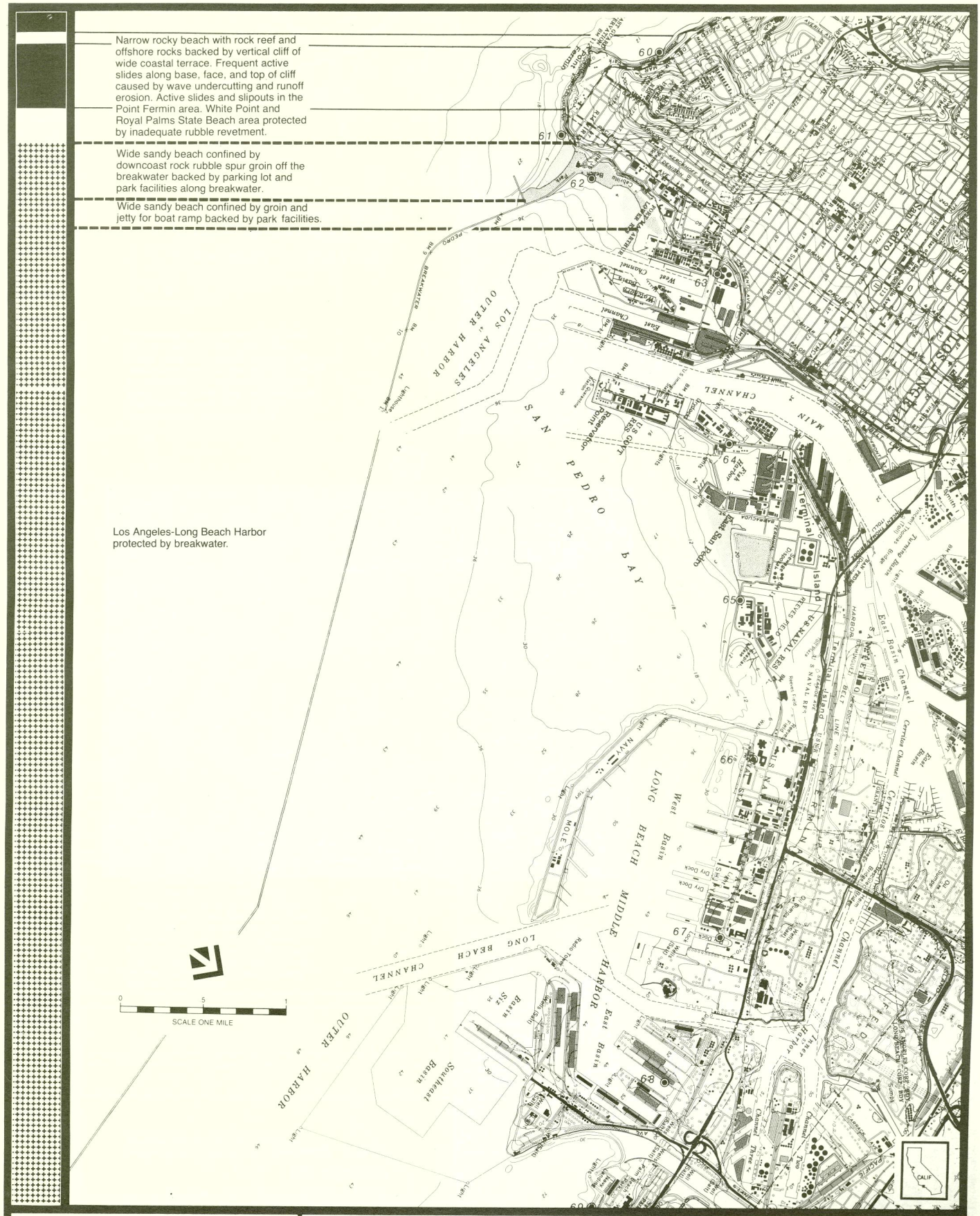
1977



Point Fermin
Los Angeles Mi. 60.2
10/23/76 Tide -1.0



Cabrillo Beach
Los Angeles Mi. 61.1
10/23/76 Tide -1.0



• SHORELINE CONDITION •

- PRESENT DEVELOPMENT CRITICAL
- PRESENT DEVELOPMENT NON-CRITICAL
- FUTURE DEVELOPMENT CRITICAL
- ARTIFICIAL PROTECTION
- PROTECTIVE BEACH
- STABLE ROCK

LOS ANGELES CO. — MI. 60 - 69

MAP NUMBER **113**

STATE OF CALIFORNIA — THE RESOURCES AGENCY

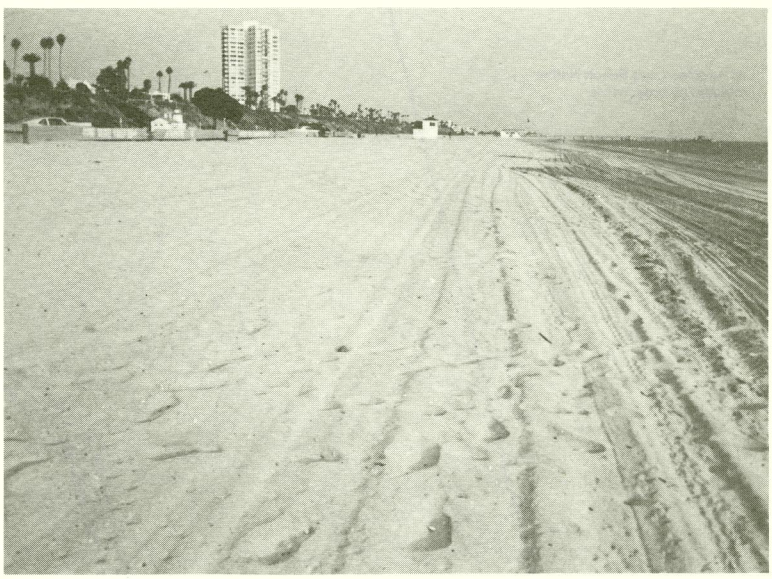
DEPARTMENT OF NAVIGATION & OCEAN DEVELOPMENT

DNOD

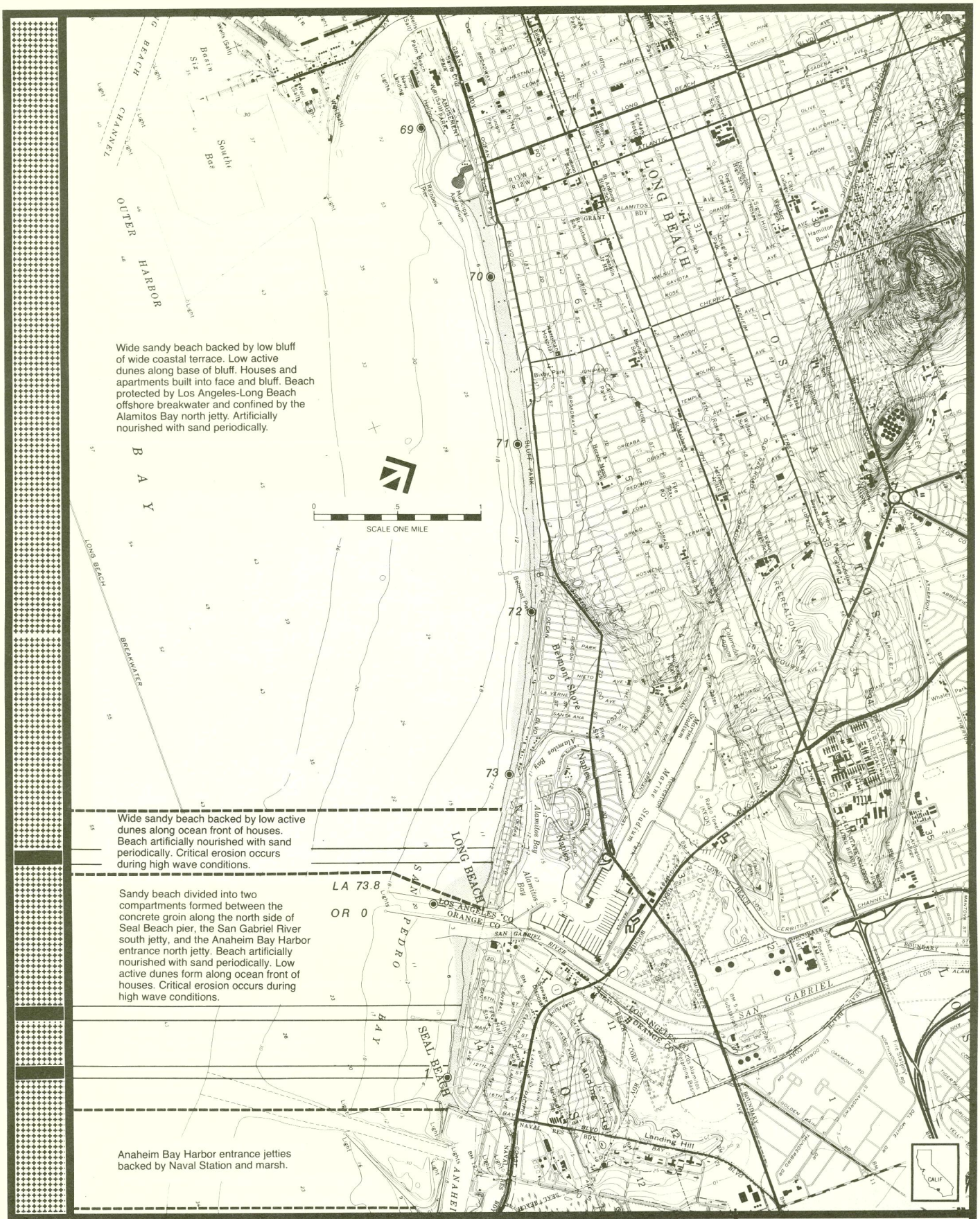
1977

Long Beach
Los Angeles Mi. 70.7
10/22/76 Tide -0.1

Long Beach
Los Angeles Mi. 70.7
10/22/76 Tide -0.1



Seal Beach
Orange Mi. 0.7
10/24/76 Tide +5.2



▪ SHORELINE CONDITION ▪

- PRESENT DEVELOPMENT CRITICAL
- PRESENT DEVELOPMENT NON-CRITICAL
- FUTURE DEVELOPMENT CRITICAL
- ARTIFICIAL PROTECTION
- PROTECTIVE BEACH
- STABLE ROCK

LOS ANGELES CO. — MI. 69 - 73.8
ORANGE CO. — MI. 0 - 1

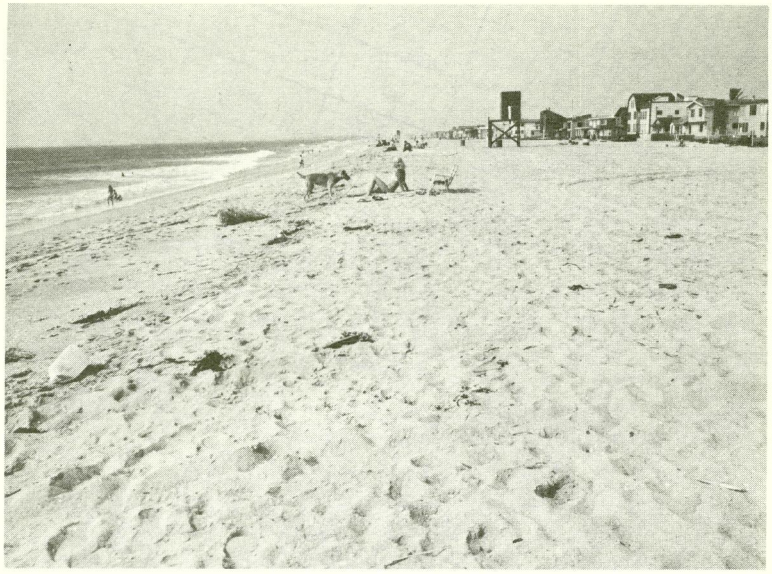
MAP NUMBER **114**

STATE OF CALIFORNIA — THE RESOURCES AGENCY

DEPARTMENT OF NAVIGATION & OCEAN DEVELOPMENT

DNOD

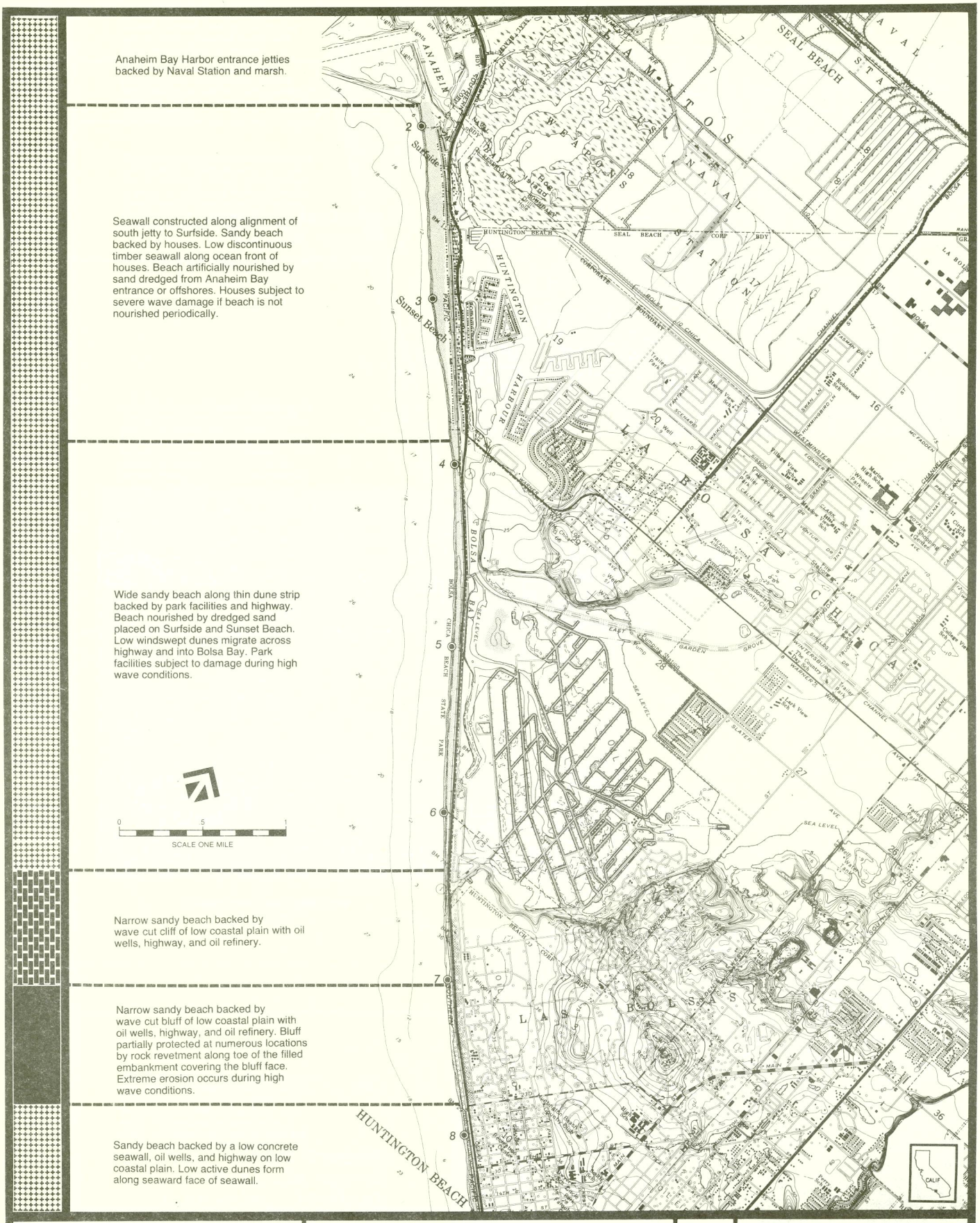
1977



Sunset Beach, Bolsa Chica State Beach
Orange Mi. 3.75
10/24/76 Tide +2.9

Bolsa Chica State Beach
Huntington Beach
Orange Mi. 6.4
10/24/76 Tide +2.1

Huntington Beach
Orange Mi. 8.5
10/24/76 Tide +0.9



▪ SHORELINE CONDITION ▪

- PRESENT DEVELOPMENT CRITICAL
- PRESENT DEVELOPMENT NON-CRITICAL
- FUTURE DEVELOPMENT CRITICAL
- ARTIFICIAL PROTECTION
- PROTECTIVE BEACH
- STABLE ROCK

ORANGE CO. — MI. 2-8

MAP NUMBER 115

STATE OF CALIFORNIA — THE RESOURCES AGENCY

DEPARTMENT OF NAVIGATION & OCEAN DEVELOPMENT

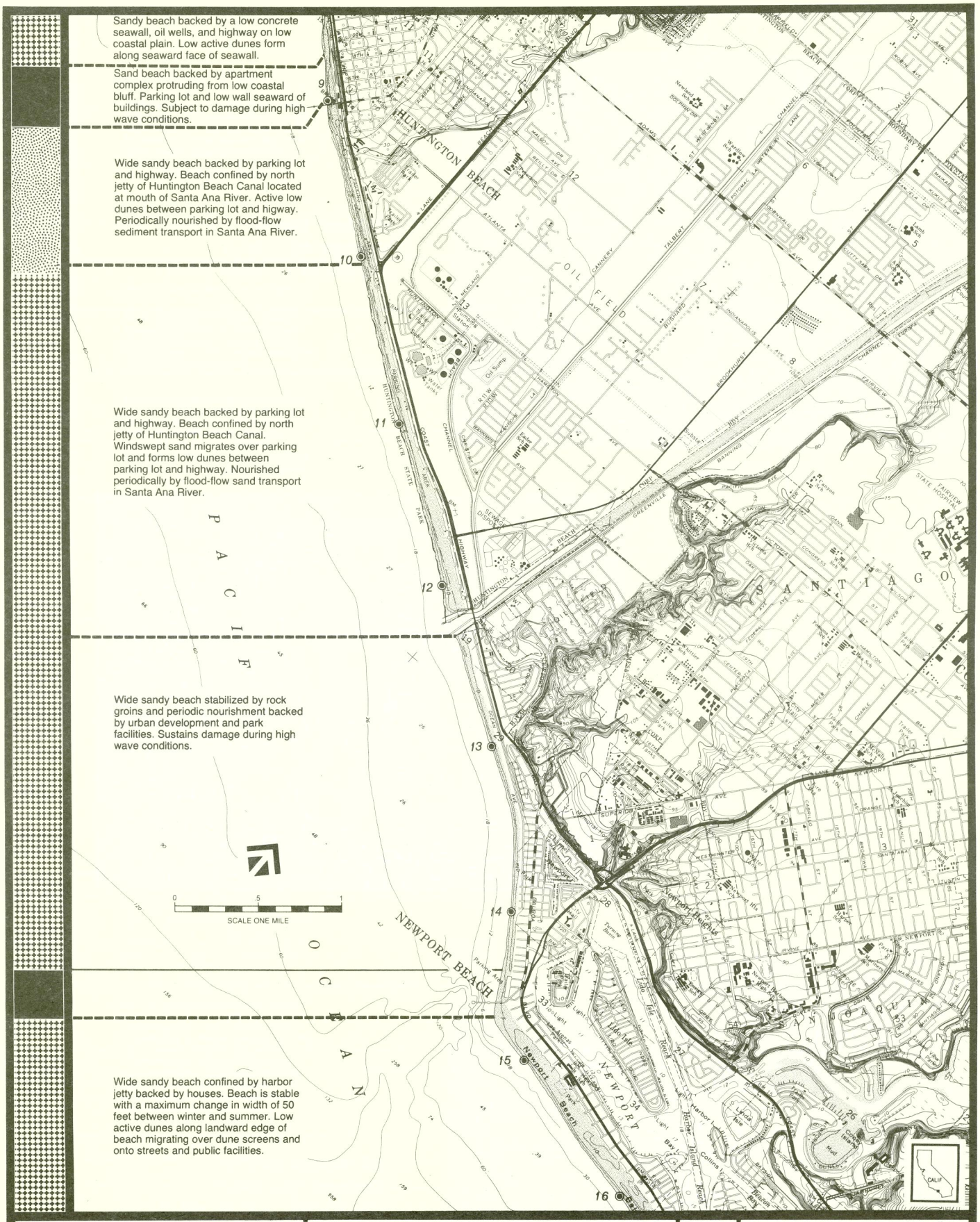
DNOD

1977

Huntington Beach
Orange Mi. 9.0
10/24/76 Tide +0.5

Newport Beach
Orange Mi. 13.5
10/25/76 Tide +6.4

Newport Beach
Orange Mi. 14.55
10/25/76 Tide +6.3



▪ SHORELINE CONDITION ▪

- PRESENT DEVELOPMENT CRITICAL
- PRESENT DEVELOPMENT NON-CRITICAL
- FUTURE DEVELOPMENT CRITICAL
- ARTIFICIAL PROTECTION
- PROTECTIVE BEACH
- STABLE ROCK

ORANGE CO. — MI. 9-16

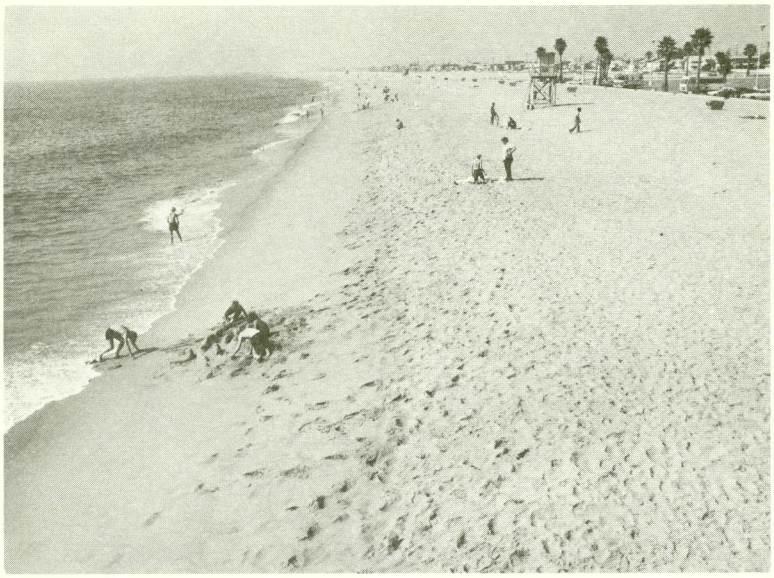
MAP NUMBER **116**

STATE OF CALIFORNIA — THE RESOURCES AGENCY

DEPARTMENT OF NAVIGATION & OCEAN DEVELOPMENT

DNOD

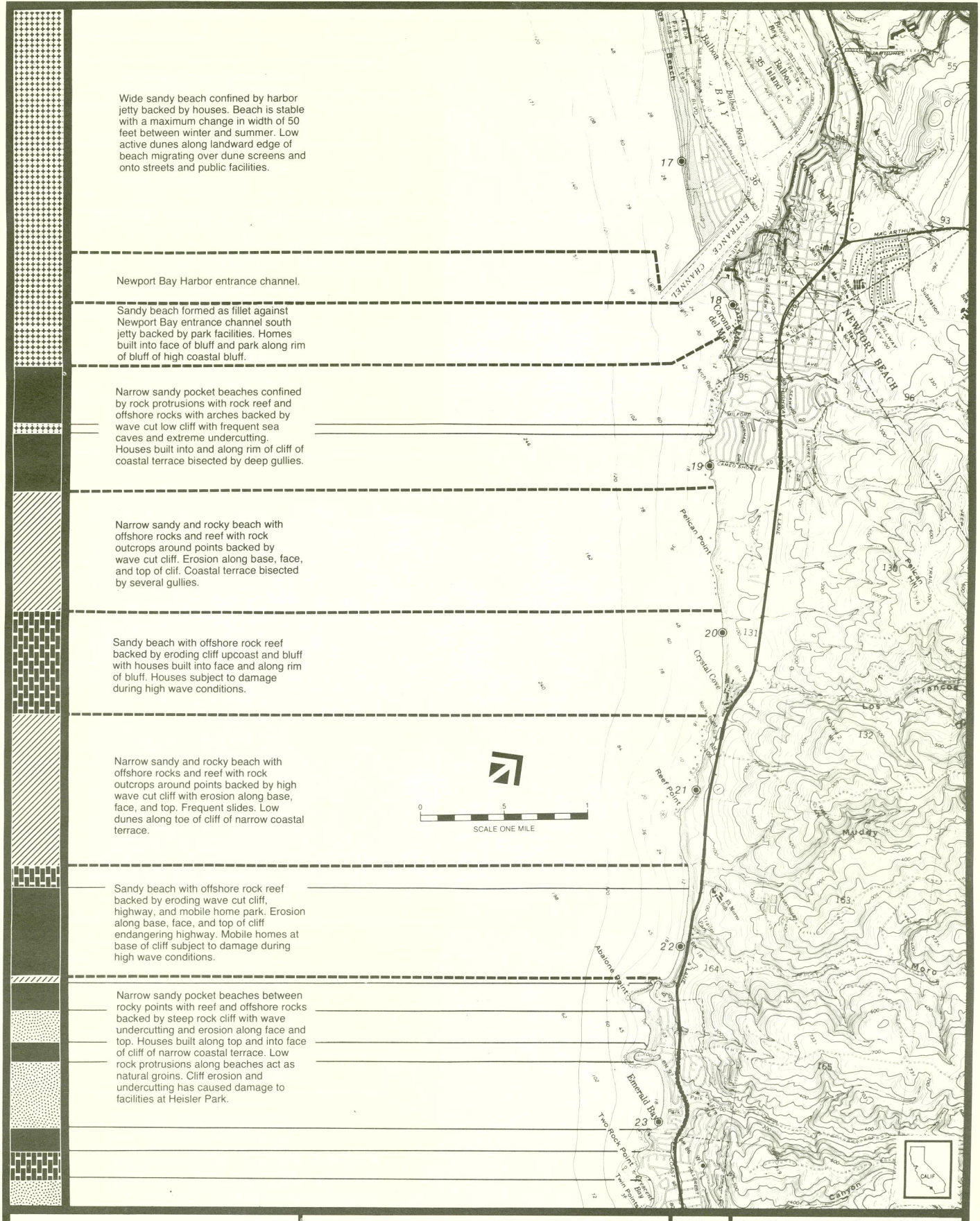
1977



Balboa Beach
Orange Mi. 16.4
10/25/76 Tide +5.3

Corona Del Mar
State Beach
Orange Mi. 18.2
10/25/76 Tide +3.4

El Morro Beach
Orange Mi. 21.9
10/25/76 Tide +0.3



▪ SHORELINE CONDITION ▪

- PRESENT DEVELOPMENT CRITICAL
- PRESENT DEVELOPMENT NON-CRITICAL
- FUTURE DEVELOPMENT CRITICAL
- ARTIFICIAL PROTECTION
- PROTECTIVE BEACH
- STABLE ROCK

ORANGE CO. — MI. 17 - 23

MAP NUMBER 117

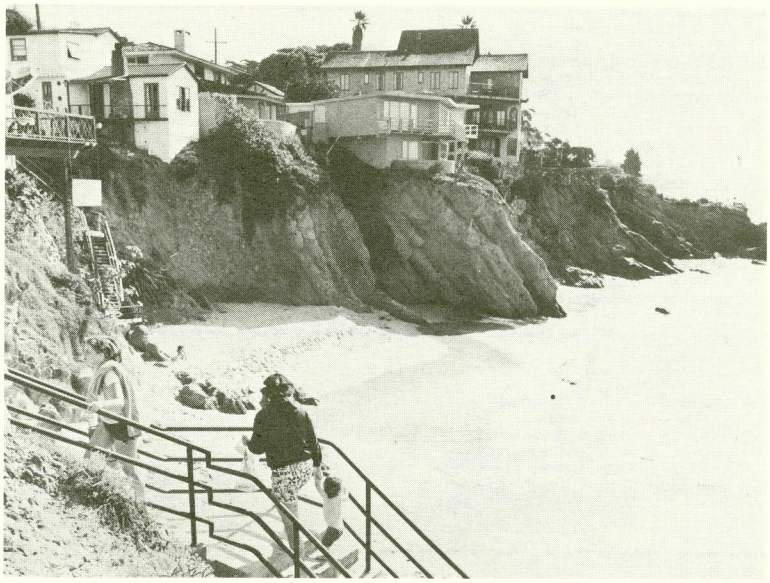
STATE OF CALIFORNIA — THE RESOURCES AGENCY

DEPARTMENT OF NAVIGATION & OCEAN DEVELOPMENT

DNOD

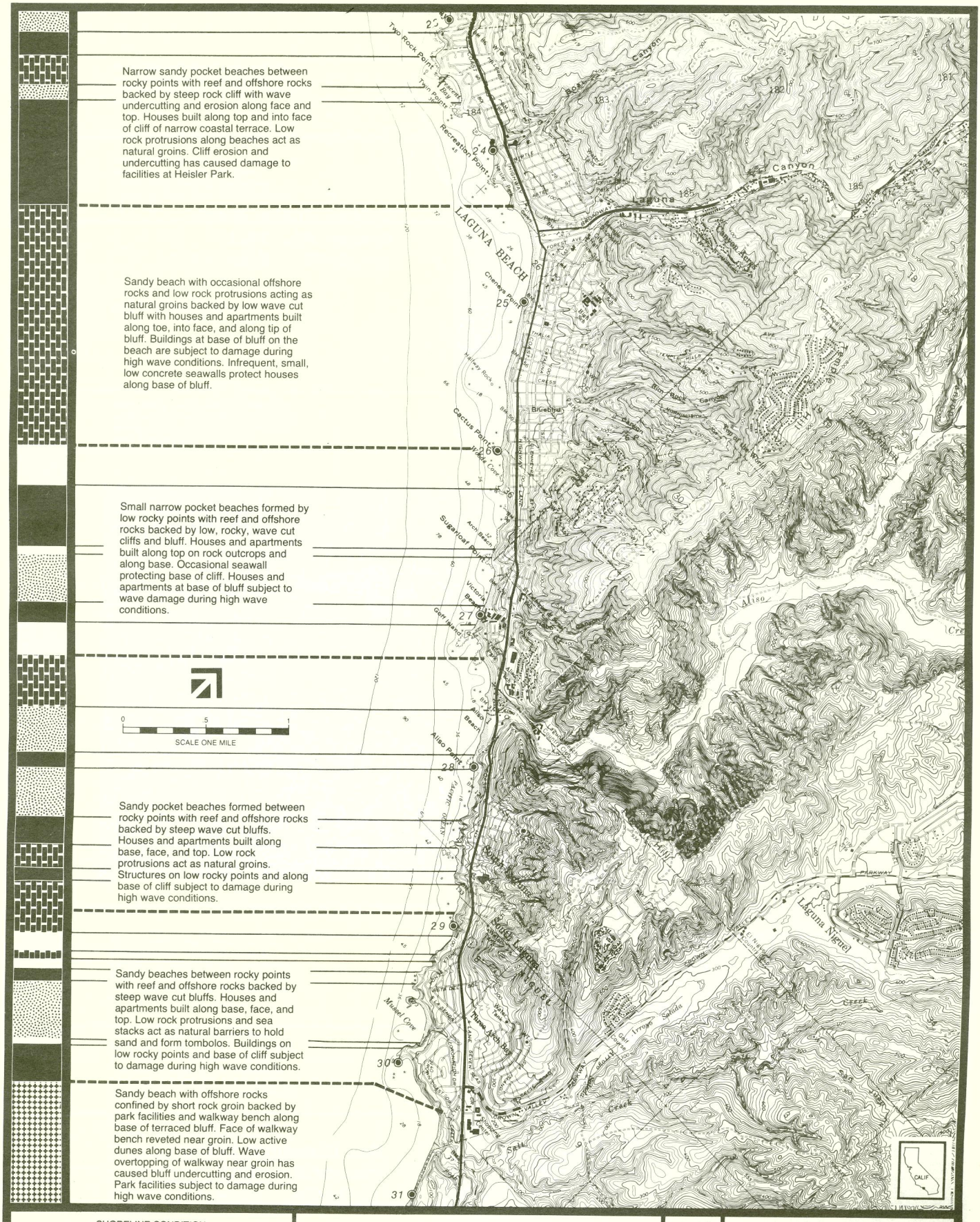
1977

Heisler Park, Laguna Beach
Orange Mi. 24.3
10/26/76 Tide +4.65



Woods Cove Beach,
Laguna Beach
Orange Mi. 26.0
10/26/76 Tide +6.15

Niguel Beach Park
Orange Mi. 31.3
10/26/76 Tide +5.4



• SHORELINE CONDITION •

- PRESENT DEVELOPMENT CRITICAL
- PRESENT DEVELOPMENT NON-CRITICAL
- FUTURE DEVELOPMENT CRITICAL
- ARTIFICIAL PROTECTION
- PROTECTIVE BEACH
- STABLE ROCK

ORANGE CO. — MI. 24 - 31

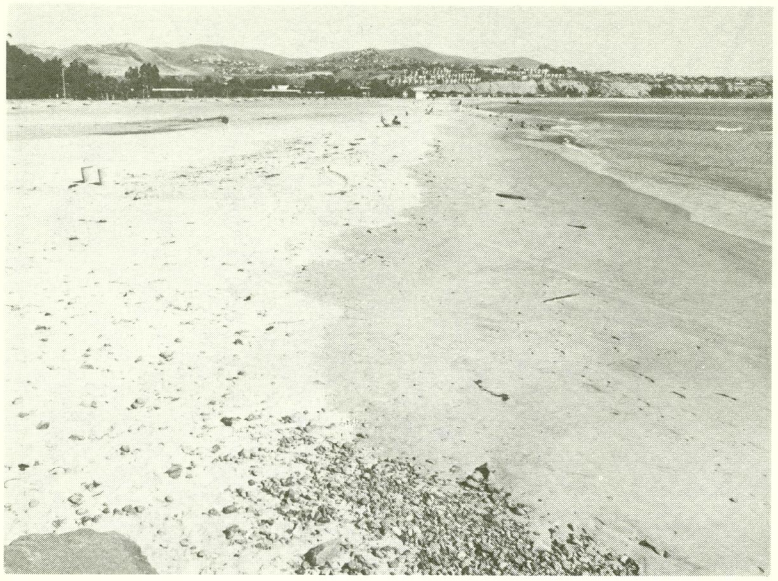
MAP NUMBER 118

STATE OF CALIFORNIA — THE RESOURCES AGENCY

DEPARTMENT OF NAVIGATION & OCEAN DEVELOPMENT

DNOD

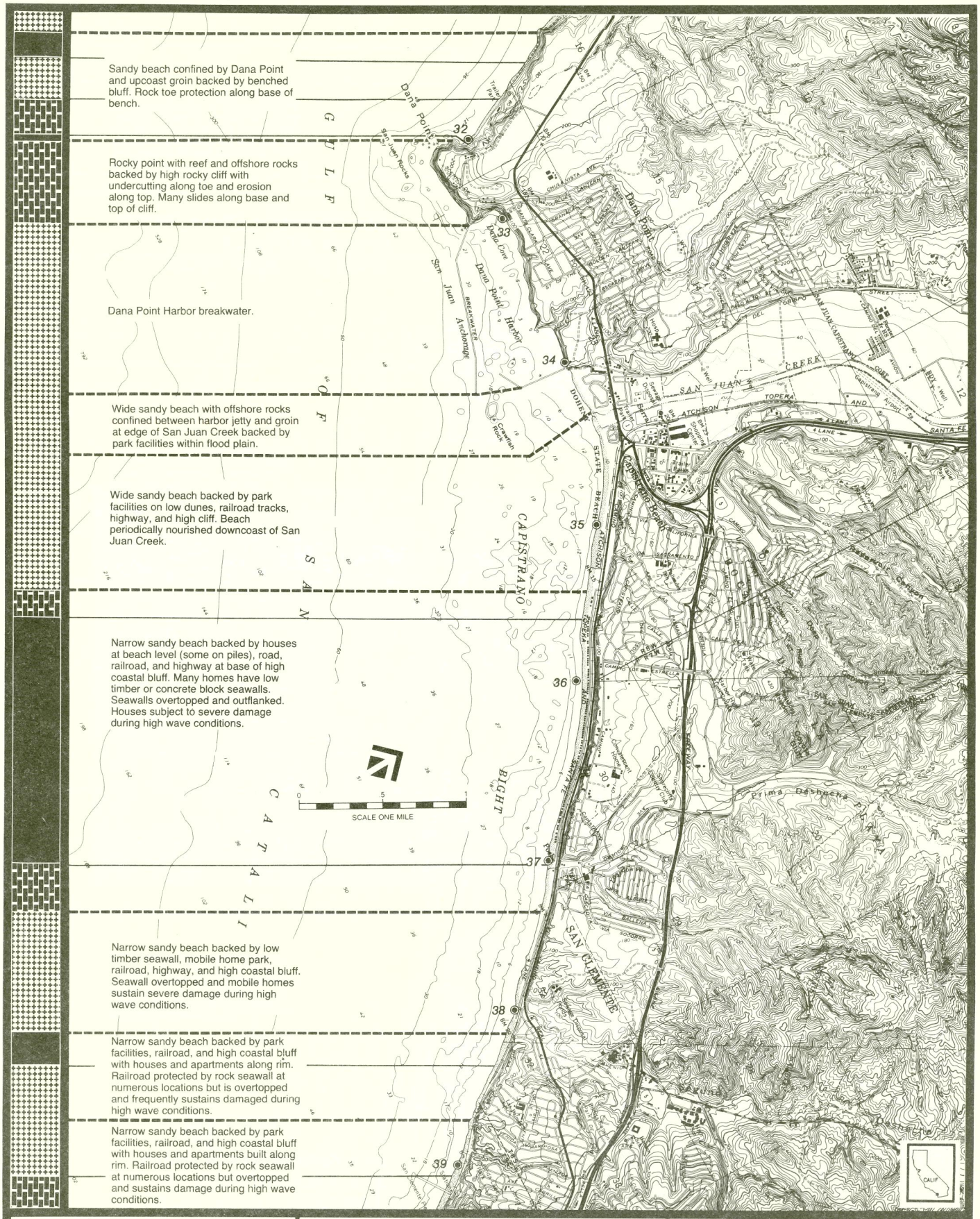
1977



Doheny State Beach
Orange Mi. 34.1
10/26/76 Tide +3.7

Capistrano Bay Colony
Orange Mi. 35.9
10/26/76 Tide +2.6

San Clemente Beach
Orange Mi. 39.2
10/26/76 Tide +0.8



▪ SHORELINE CONDITION ▪

- PRESENT DEVELOPMENT CRITICAL
- PRESENT DEVELOPMENT NON-CRITICAL
- FUTURE DEVELOPMENT CRITICAL
- ARTIFICIAL PROTECTION
- PROTECTIVE BEACH
- STABLE ROCK

ORANGE CO. — MI. 32-39

MAP NUMBER 119

STATE OF CALIFORNIA — THE RESOURCES AGENCY

DEPARTMENT OF NAVIGATION & OCEAN DEVELOPMENT

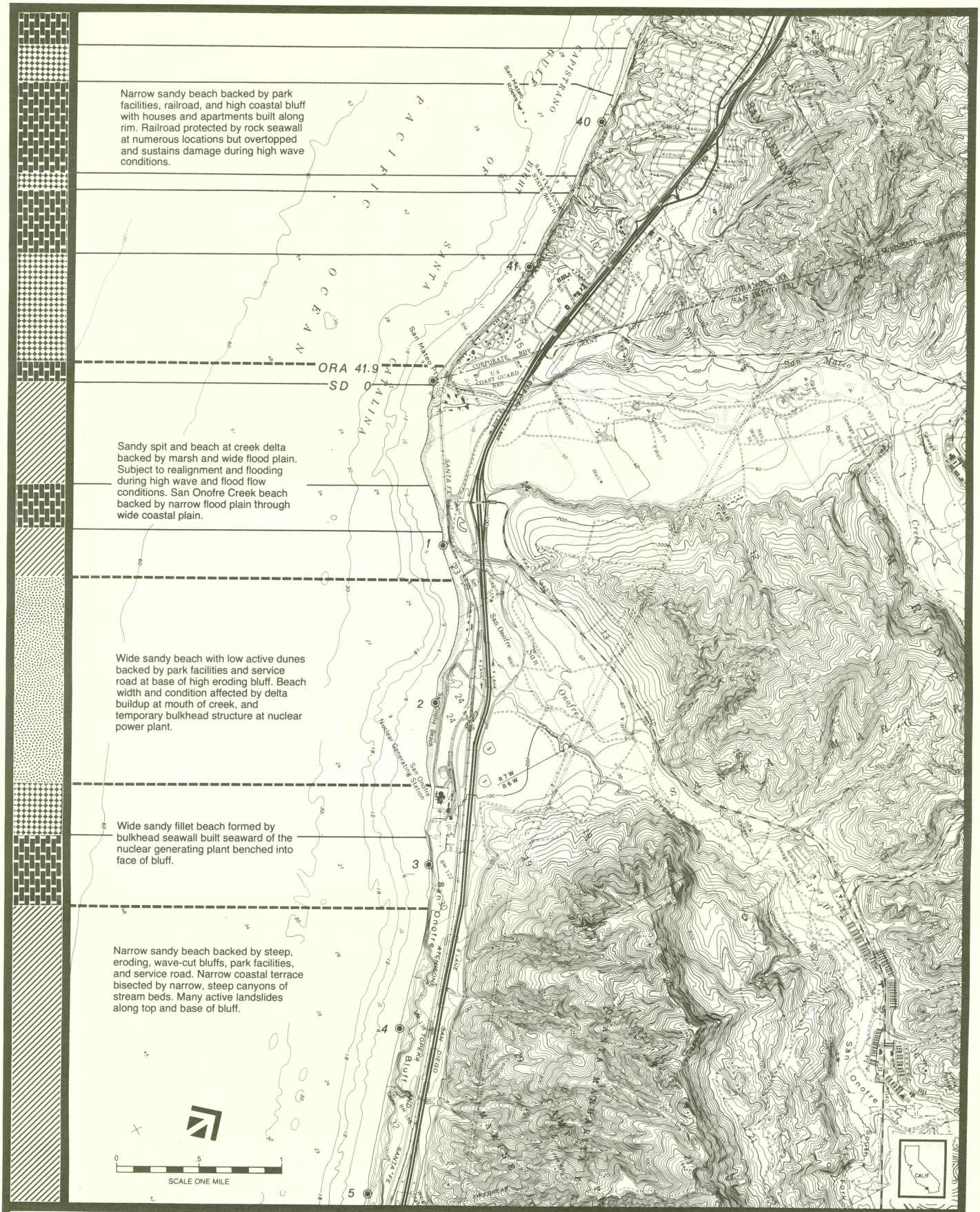
DNOD

1977

San Clemente State Beach
Orange Mi. 40.8
5/20/75 Tide +0.85

San Onofre State Beach
San Diego Mi. 1.9
10/27/76 Tide +5.1

San Onofre State Beach
San Diego Mi. 3.7
10/27/76 Tide +5.3



▪ SHORELINE CONDITION ▪

- PRESENT DEVELOPMENT CRITICAL
- PRESENT DEVELOPMENT NON-CRITICAL
- FUTURE DEVELOPMENT CRITICAL
- ARTIFICIAL PROTECTION
- PROTECTIVE BEACH
- STABLE ROCK

ORANGE CO. — MI. 40 - 41.9
SAN DIEGO CO. — MI. 0 - 5

MAP NUMBER **120**

STATE OF CALIFORNIA — THE RESOURCES AGENCY

DEPARTMENT OF NAVIGATION & OCEAN DEVELOPMENT

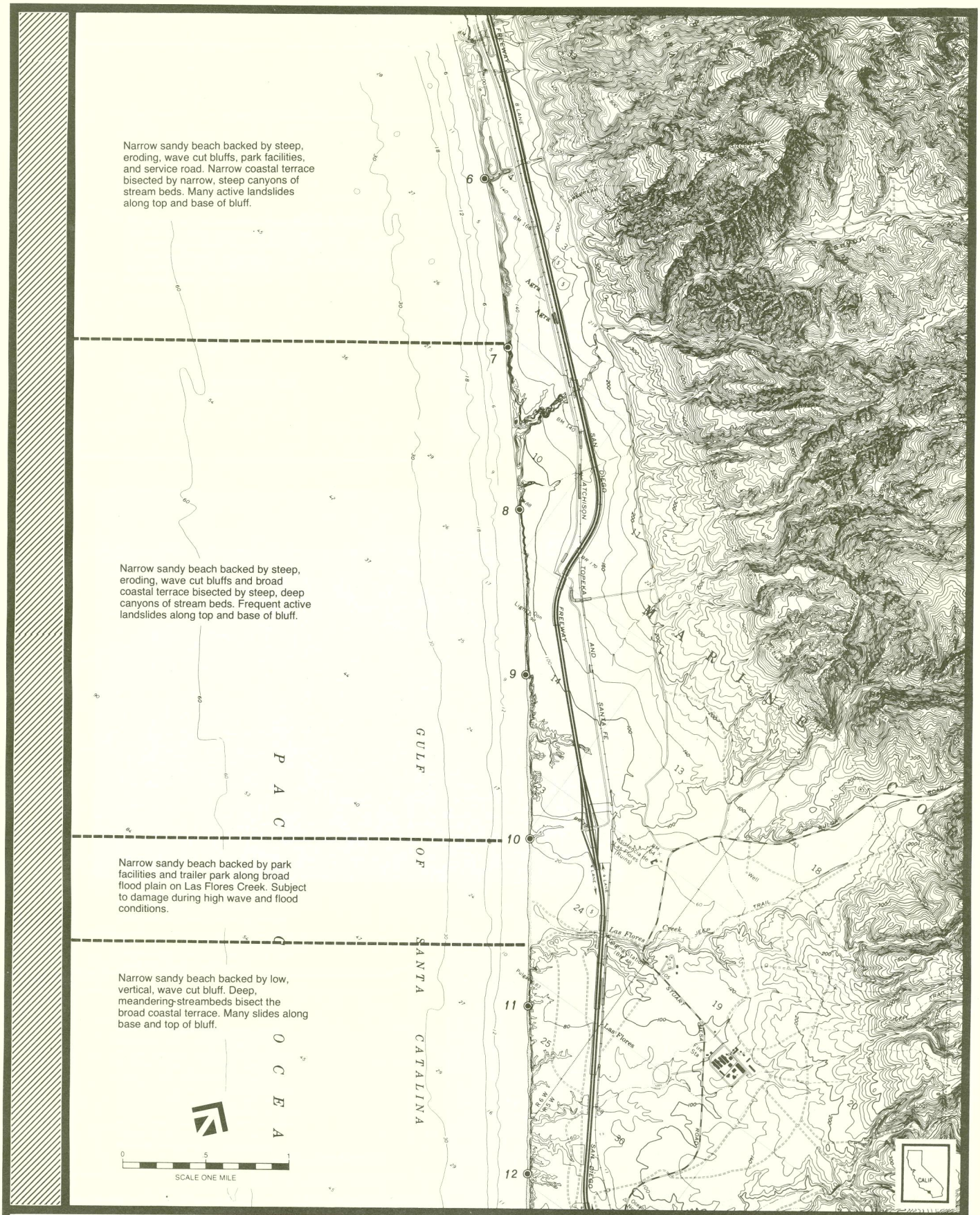
DNOD

1977

Las Flores Creek,
Camp Pendelton
San Diego Mi. 10.4
10/27/76 Tide +5.6

Las Flores Creek,
Camp Pendelton
San Diego Mi. 10.6
10/27/76 Tide +5.6

Las Flores Creek,
Camp Pendelton
San Deigo Mi. 10.6
10/27/76 Tide +5.6



▪ SHORELINE CONDITION ▪

- PRESENT DEVELOPMENT CRITICAL
- PRESENT DEVELOPMENT NON-CRITICAL
- FUTURE DEVELOPMENT CRITICAL
- ARTIFICIAL PROTECTION
- PROTECTIVE BEACH
- STABLE ROCK

SAN DIEGO CO. — MI. 6-12

MAP NUMBER 121

STATE OF CALIFORNIA — THE RESOURCES AGENCY

DEPARTMENT OF NAVIGATION & OCEAN DEVELOPMENT

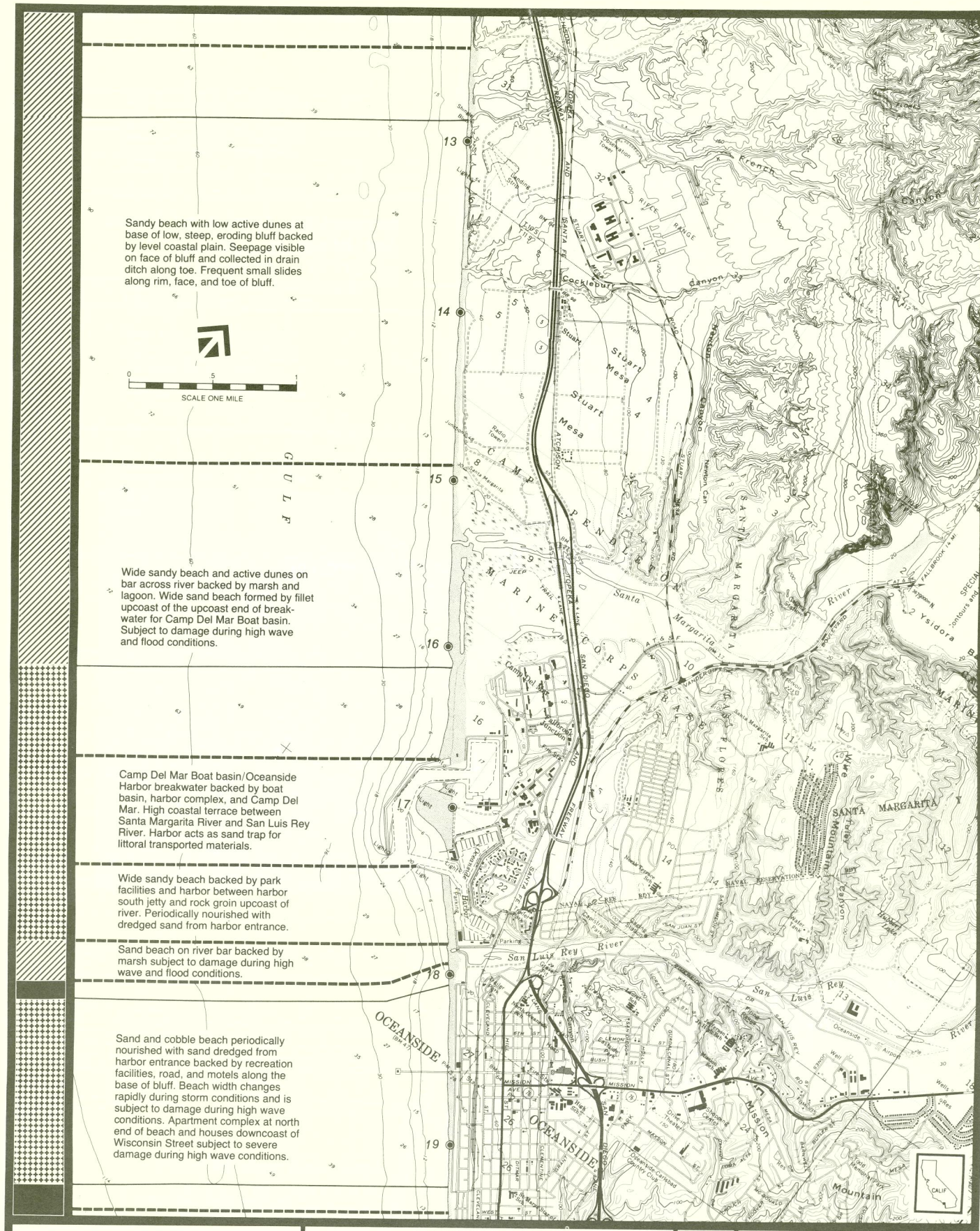
DNOD

1977

Oceanside
San Diego Mi. 18.1
10/27/76 Tide +5.3

Oceanside
San Diego Mi. 18.1
10/27/76 Tide +5.3

Oceanside
San Diego Mi. 18.6
10/27/76 Tide +5.15



▪ SHORELINE CONDITION ▪

- PRESENT DEVELOPMENT CRITICAL
- PRESENT DEVELOPMENT NON-CRITICAL
- FUTURE DEVELOPMENT CRITICAL
- ARTIFICIAL PROTECTION
- PROTECTIVE BEACH
- STABLE ROCK

SAN DIEGO CO. — MI. 13-19

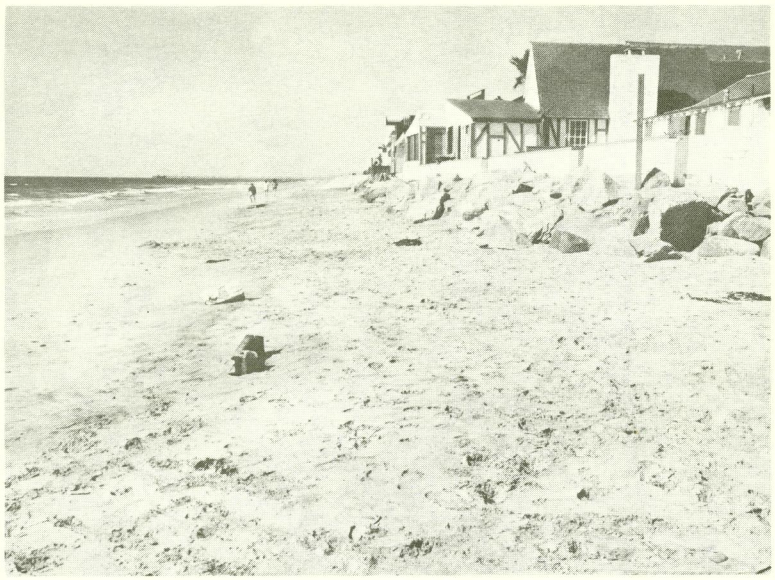
MAP NUMBER 122

STATE OF CALIFORNIA — THE RESOURCES AGENCY

DEPARTMENT OF NAVIGATION & OCEAN DEVELOPMENT

DNOD

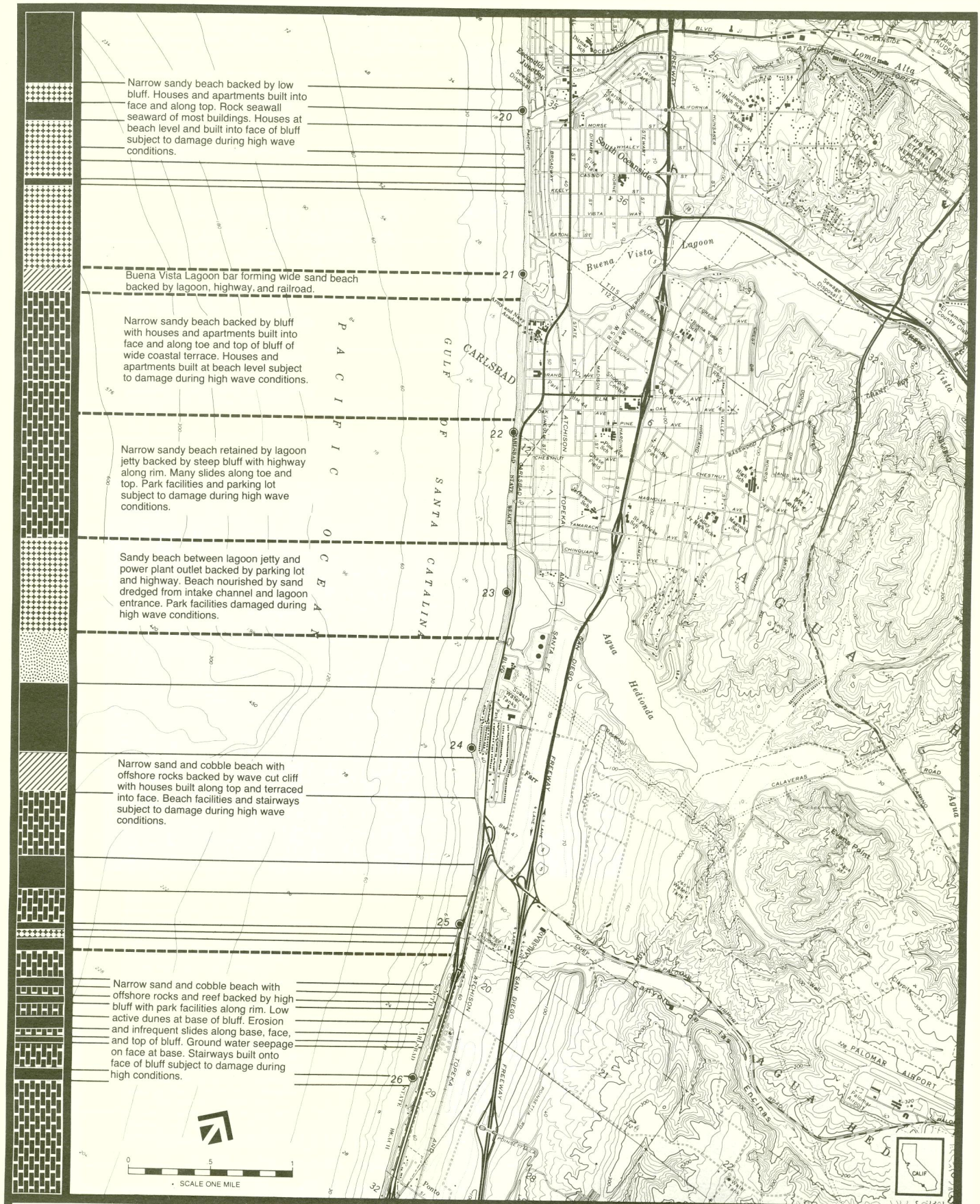
1977



Oceanside, Loma Alta Creek
San Diego Mi. 20.1
10/27/76 Tide +4.6

Agua Hedionda Beach
San Diego Mi. 23.0
10/27/76 Tide +4.0

Agua Hedionda Beach
San Diego Mi. 24.4
10/27/76 Tide +3.3



▪ SHORELINE CONDITION ▪

- PRESENT DEVELOPMENT CRITICAL
- PRESENT DEVELOPMENT NON-CRITICAL
- FUTURE DEVELOPMENT CRITICAL
- ARTIFICIAL PROTECTION
- PROTECTIVE BEACH
- STABLE ROCK

SAN DIEGO CO. — MI. 20-26

MAP NUMBER **123**

STATE OF CALIFORNIA — THE RESOURCES AGENCY

DEPARTMENT OF NAVIGATION & OCEAN DEVELOPMENT

DNOD

1977

Leucadia State Beach
San Diego Mi. 28.9
10/27/76 Tide +2.8

Moonlight State Beach
San Diego Mi. 30.2
10/27/76 Tide +2.2

San Elijo State Beach
San Diego Mi. 31.7
10/28/76 Tide +3.2

Narrow sand and cobble beach with offshore rocks and reef backed by high bluff with park facilities along rim. Low active dunes at base of bluff. Erosion and infrequent slides along base, face, and top of bluff. Ground water seepage on face at base. Stairways built onto face of bluff subject to damage during high wave conditions.

Wide sand and cobble beach with low active dunes along seaward edge of highway. Highway fill and bridges across Batiquitos Lagoon mouth. Bridge abutments reveted with rock. Park facilities subject to damage during high wave conditions.

Narrow sandy beach with offshore rock reef backed by high, nearly vertical, wave cut bluff. Condominiums, apartments, and houses built along rim. Bluffs are undercut by wave action with erosion and some slides along base, face, and top. Stairways built onto face of bluff and park facilities along base subject to damage during high wave conditions. Ground water seepage along base and face of bluff at numerous locations.

SCALE ONE MILE

Wide sandy beach backed by park facilities and highway built within flood plain of creek.

Narrow sandy beach with frequent rock outcrops and offshore reef backed by steep wave cut bluff. Erosion and frequent slides along base, face, and top. Ground water seepage along base and face at numerous locations. Houses, condominiums, and apartments built along top and into face of bluff. Stairways built into face of bluff subject to damage during high wave conditions.

Sandy beach backed by low active dunes and steep bluff with highway and railroad along rim. Erosion along face and base of bluff and embankment of highway. Park trail at downcoast end of area endangered by erosion along face of bluff. Park facilities subject to damage during high wave conditions.

Narrow sandy beach backed by steep wave cut bluff with erosion and some slides along base, face, and top. Ground water seepage along base and face. Park facilities along rim. Stairways built into face of bluff subject to damage during high wave conditions.

Narrow sand and cobble beach on bar backed by park facilities, commercial establishments, and highway at mouth of San Elijo Lagoon. Low concrete and rock revetment protection of commercial buildings. Rock revetment protection along edge of park facilities and highway. Commercial buildings, park facilities, and highway subject to damage during high wave conditions.

Leucadia

Encinitas

Cardiff-by-the-Sea (Cardiff)

Solana Beach

BATIQUITOS

SAN ELIJO LAGOON

• SHORELINE CONDITION •

- PRESENT DEVELOPMENT CRITICAL
- PRESENT DEVELOPMENT NON-CRITICAL
- FUTURE DEVELOPMENT CRITICAL
- ARTIFICIAL PROTECTION
- PROTECTIVE BEACH
- STABLE ROCK

SAN DIEGO CO. — MI. 27-33

MAP NUMBER 124

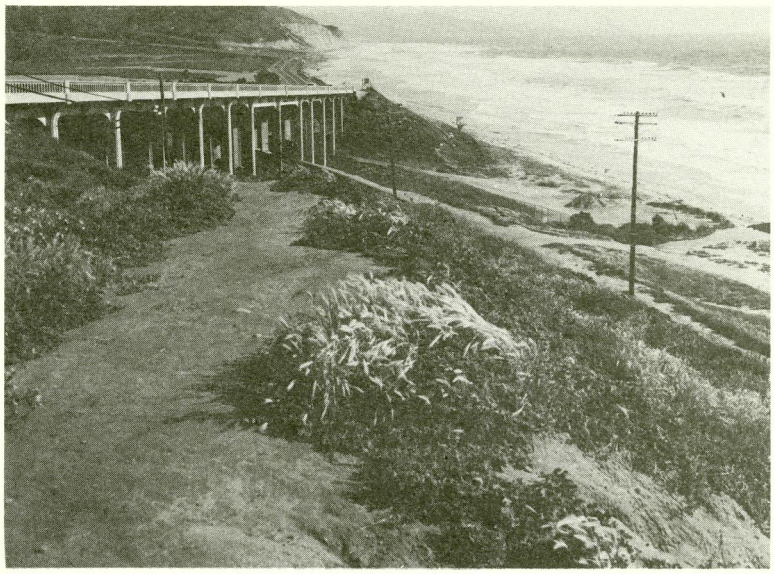
STATE OF CALIFORNIA — THE RESOURCES AGENCY

DEPARTMENT OF NAVIGATION & OCEAN DEVELOPMENT

DNOD

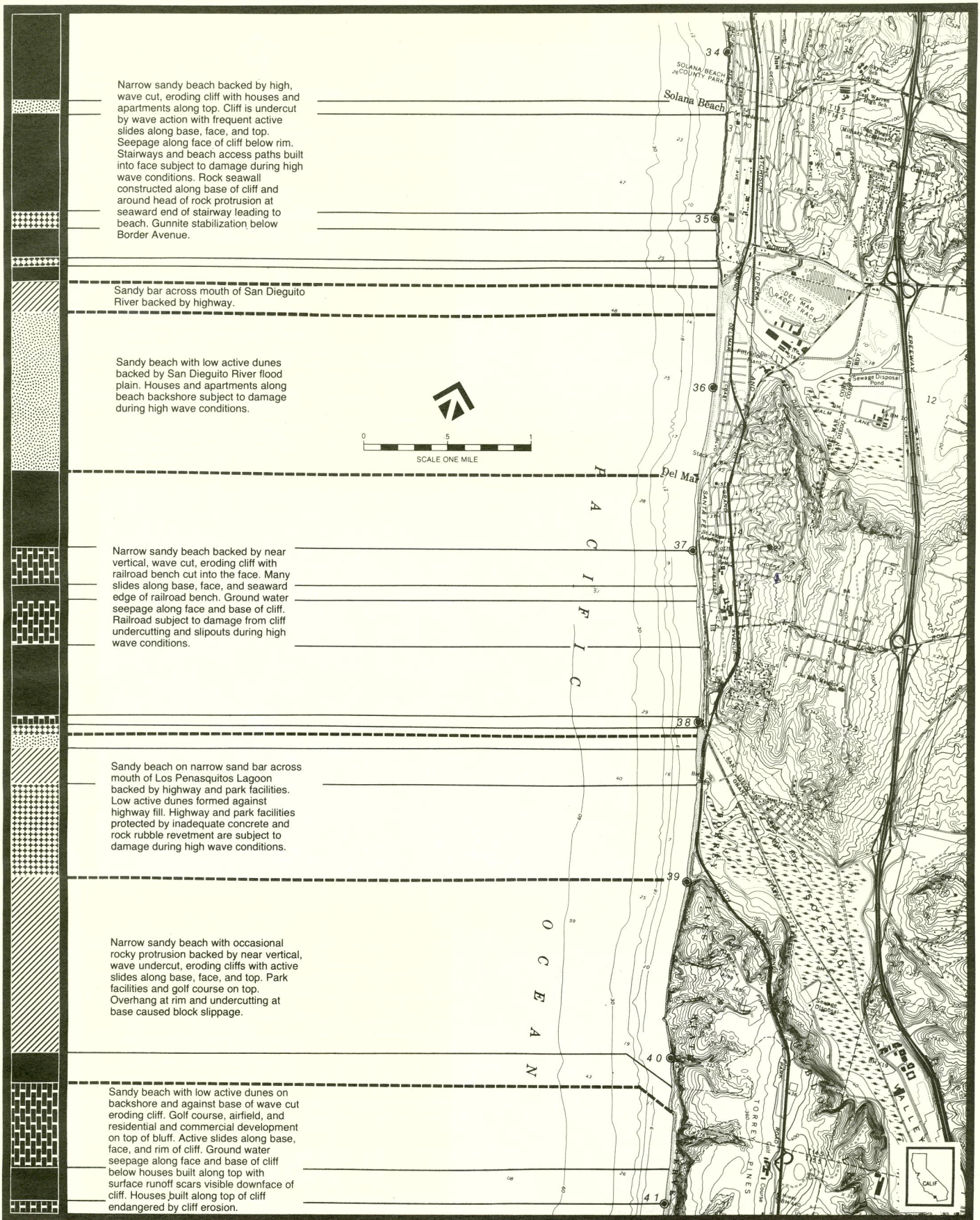
1977

Solana County Beach
San Diego Mi. 34.4
10/28/76 Tide +3.9



Soledad Valley
San Diego Mi. 37.0
5/20/75 Tide +4.30

Torrey Pines State Beach
San Diego Mi. 41.3
7/20/77 Tide +2.8



▪ SHORELINE CONDITION ▪

- PRESENT DEVELOPMENT CRITICAL
- PRESENT DEVELOPMENT NON-CRITICAL
- FUTURE DEVELOPMENT CRITICAL
- ARTIFICIAL PROTECTION
- PROTECTIVE BEACH
- STABLE ROCK

SAN DIEGO CO. — MI. 34 - 41

MAP NUMBER **125**

STATE OF CALIFORNIA — THE RESOURCES AGENCY

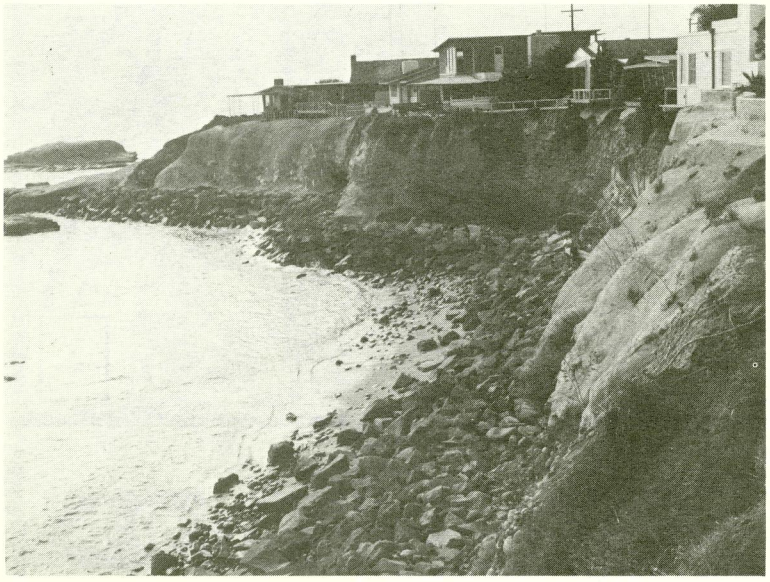
DEPARTMENT OF NAVIGATION & OCEAN DEVELOPMENT

DNOD

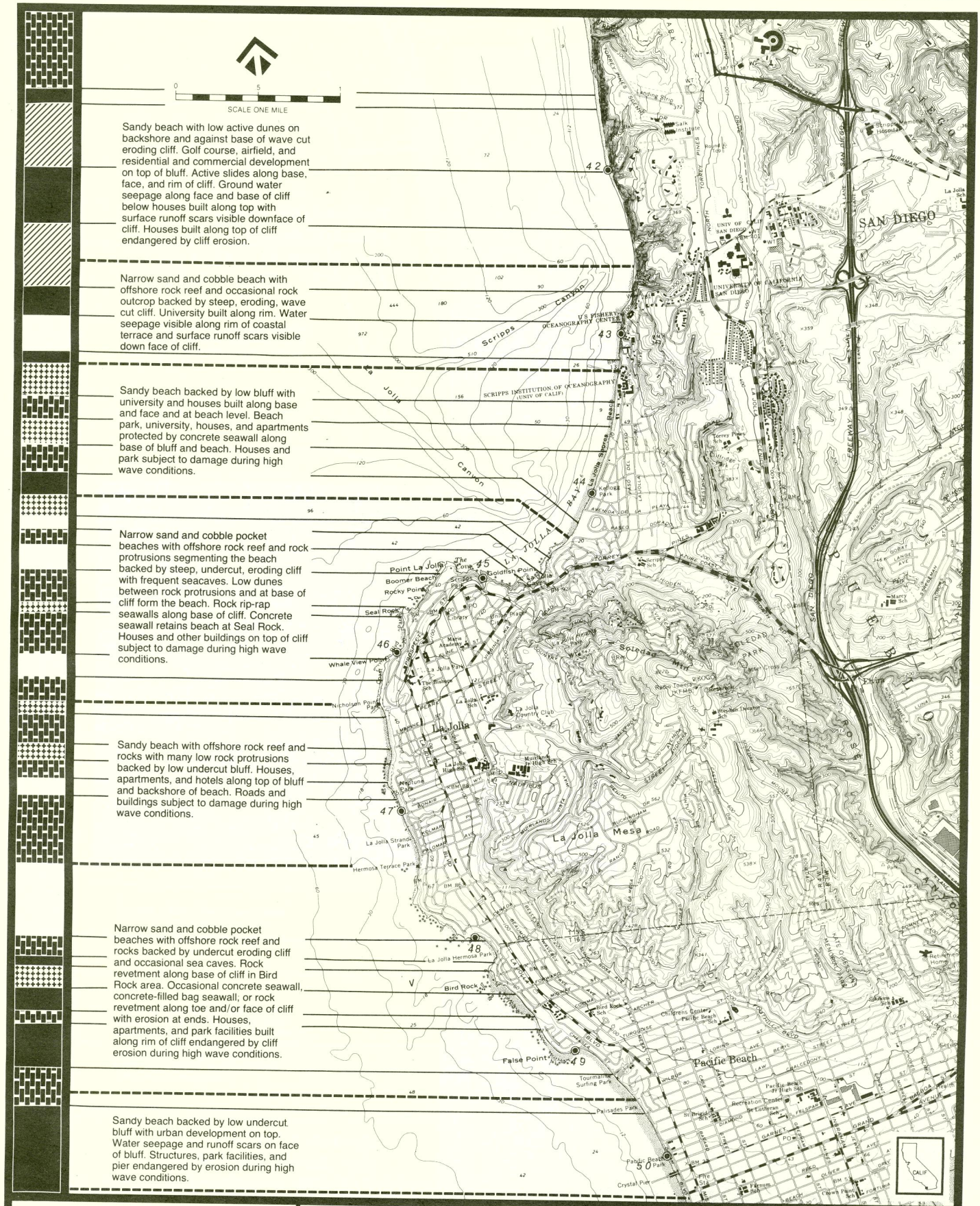
1977

Torrey Pines State Beach
San Diego Mi. 41.8
7/20/77 Tide +4.3

Point La Jolla
San Diego Mi. 46.0
7/21/77 Tide +4.0



La Jolla
San Diego Mi. 48.5
7/21/77 Tide +2.8



▪ SHORELINE CONDITION ▪

- PRESENT DEVELOPMENT CRITICAL
- PRESENT DEVELOPMENT NON-CRITICAL
- FUTURE DEVELOPMENT CRITICAL
- ARTIFICIAL PROTECTION
- PROTECTIVE BEACH
- STABLE ROCK

SAN DIEGO CO. — MI. 42 - 50

MAP NUMBER 126

STATE OF CALIFORNIA — THE RESOURCES AGENCY

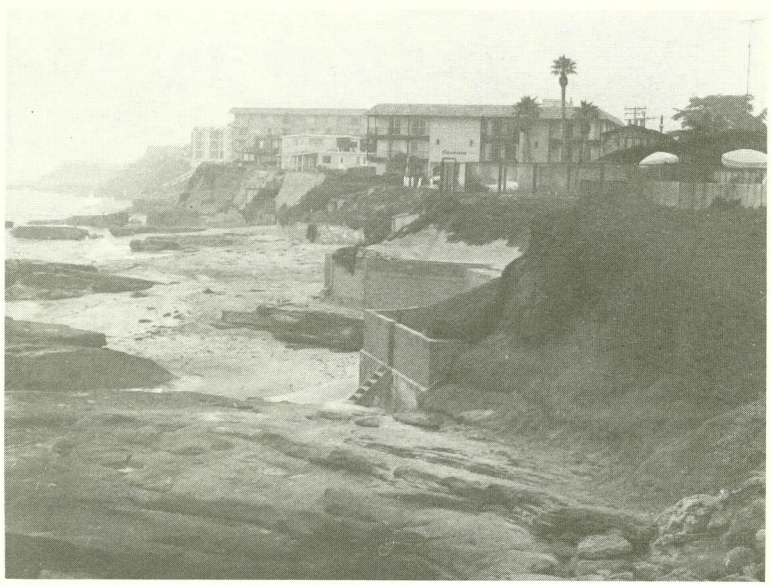
DEPARTMENT OF NAVIGATION & OCEAN DEVELOPMENT

DNOD

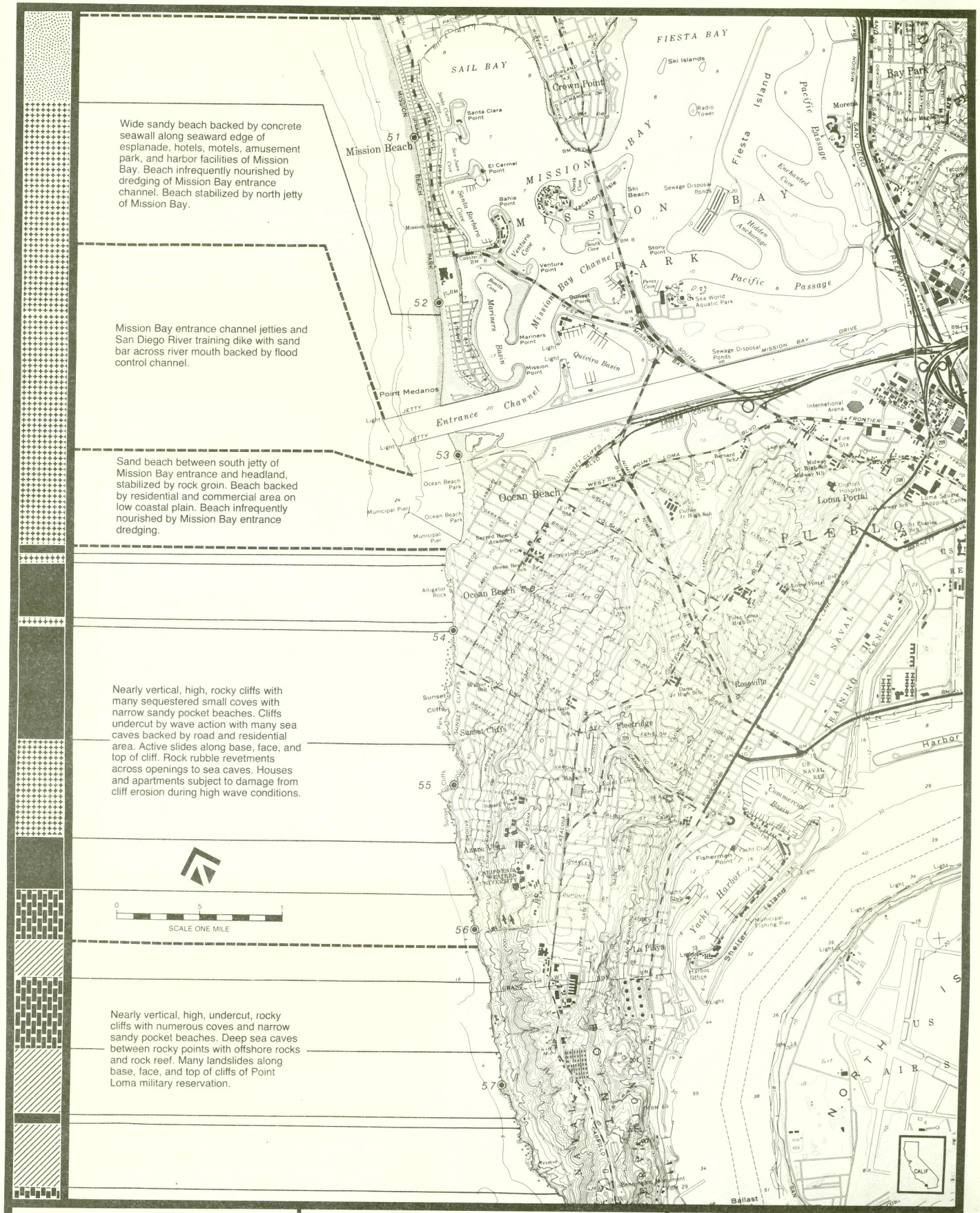
1977

Tourmaline Park,
Pacific Beach
San Diego Mi. 49.3
7/21/77 Tide +3.7

Ocean Beach
San Diego Mi. 53.3
5/21/75 Tide +0.93



Sunset Cliffs
San Diego Mi. 54.3
7/22/77 Tide +2.1



▪ SHORELINE CONDITION ▪

- PRESENT DEVELOPMENT CRITICAL
- PRESENT DEVELOPMENT NON-CRITICAL
- FUTURE DEVELOPMENT CRITICAL
- ARTIFICIAL PROTECTION
- PROTECTIVE BEACH
- STABLE ROCK

SAN DIEGO CO. — MI. 51 - 57

MAP NUMBER 127

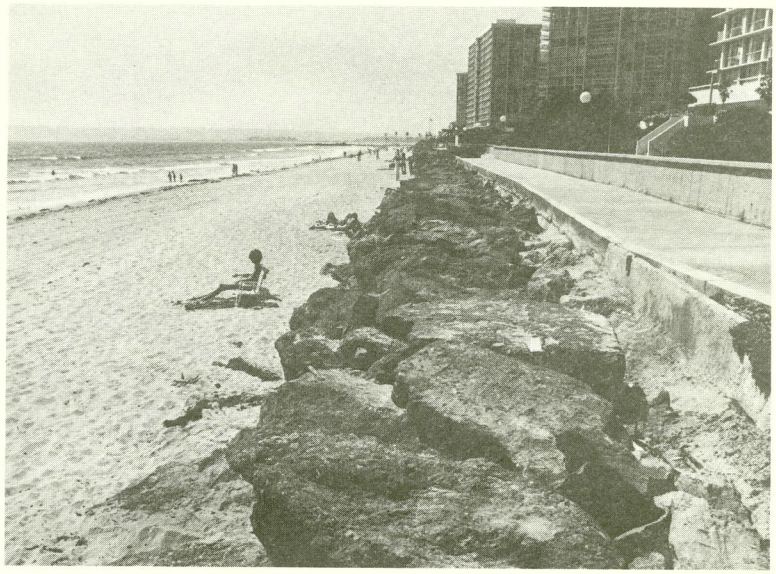
STATE OF CALIFORNIA — THE RESOURCES AGENCY

DEPARTMENT OF NAVIGATION & OCEAN DEVELOPMENT

DNOD

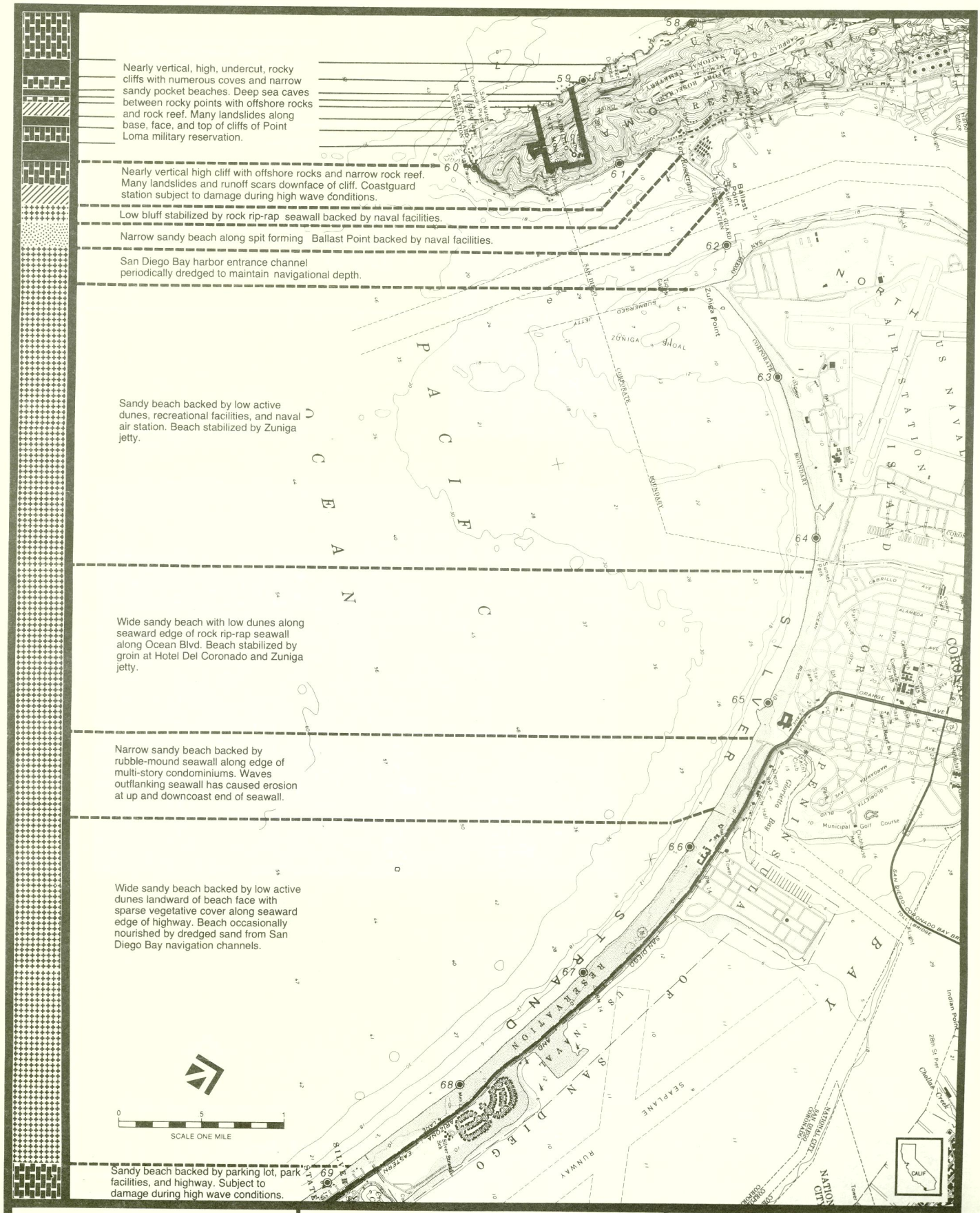
1977

Coronado City Beach
San Diego Mi. 64.7
7/7/77 Tide +4.7



Coronado Shores
San Diego Mi. 65.7
7/7/77 Tide +4.6

Silver Strand State Beach
San Diego Mi. 69.6
7/7/77 Tide +4.5



▪ SHORELINE CONDITION ▪

- PRESENT DEVELOPMENT CRITICAL
- PRESENT DEVELOPMENT NON-CRITICAL
- FUTURE DEVELOPMENT CRITICAL
- ARTIFICIAL PROTECTION
- PROTECTIVE BEACH
- STABLE ROCK

SAN DIEGO CO. — MI. 58 - 69

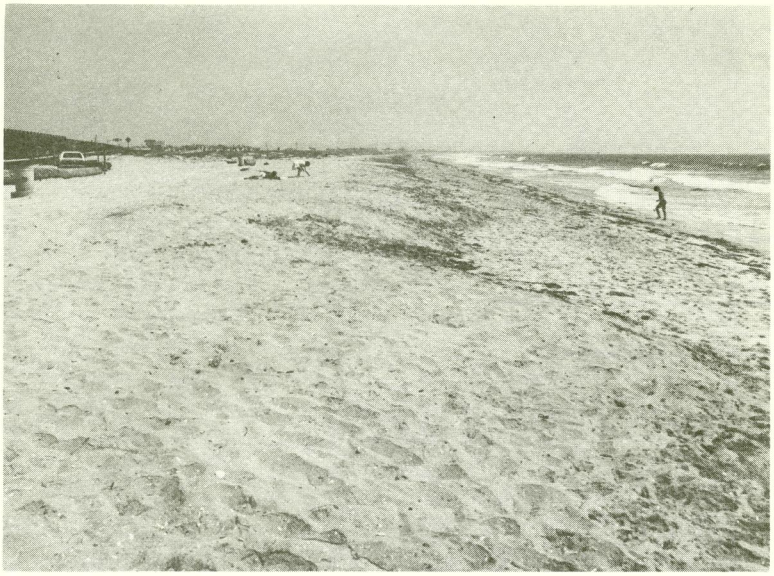
MAP NUMBER **128**

STATE OF CALIFORNIA — THE RESOURCES AGENCY

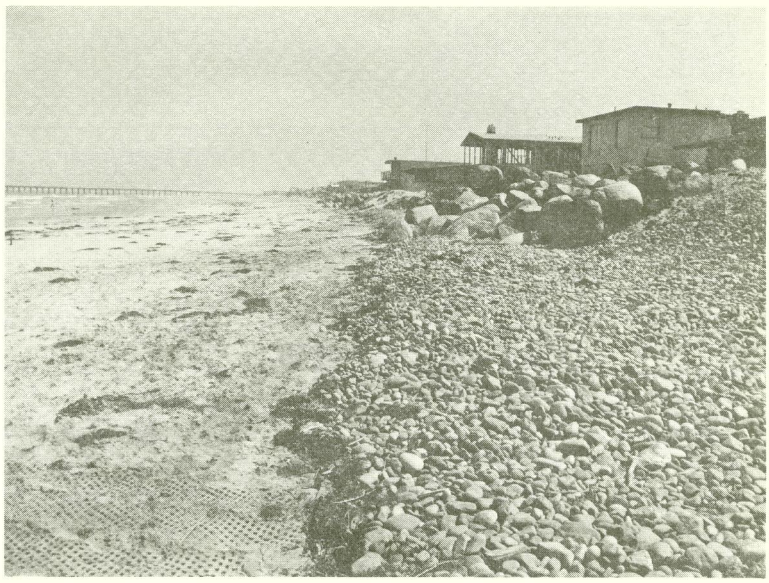
DEPARTMENT OF NAVIGATION & OCEAN DEVELOPMENT

DNOD

1977

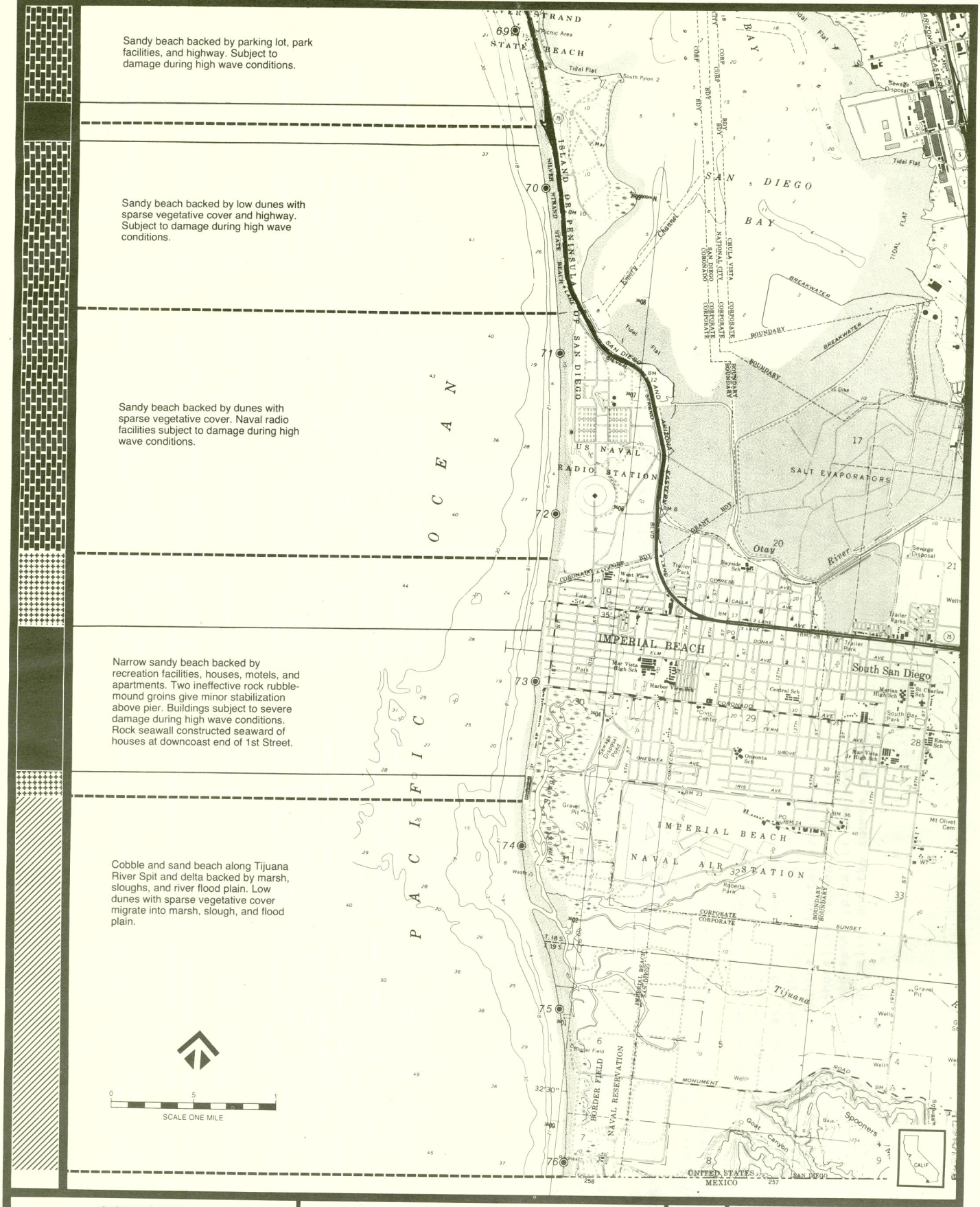


Silver Strand State Beach
San Diego Mi. 69.6
7/7/77 Tide +4.5



Imperial Beach
San Diego Mi. 73.4
7/7/77 Tide +1.4

Imperial Beach
San Diego Mi. 73.7
7/7/77 Tide +1.1



▪ SHORELINE CONDITION ▪

PRESENT DEVELOPMENT CRITICAL	ARTIFICIAL PROTECTION
PRESENT DEVELOPMENT NON-CRITICAL	PROTECTIVE BEACH
FUTURE DEVELOPMENT CRITICAL	STABLE ROCK

SAN DIEGO CO. — MI. 69-76.1

MAP NUMBER 129

STATE OF CALIFORNIA — THE RESOURCES AGENCY

DEPARTMENT OF NAVIGATION & OCEAN DEVELOPMENT

DNOD

1977

78617 – 461 1M 1–79 OSP

State of California, Department of Navigation and Ocean Development, Sacramento, California 95814

ASSESSMENT AND ATLAS OF SHORELINE EROSION ALONG THE CALIFORNIA COAST, by John S. Habel and George A. Armstrong. 277 pages. July 1978.

KEY WORDS: California, Shoreline Erosion, Littoral Cells, Maps, Photographs, Problem Areas

ABSTRACT: A study of the shoreline erosion problems along the ocean shoreline of California with a description of the general coastal processes. The more critical areas, both existing and potential, are noted as well as the areas where shoreline protection has been installed. An atlas of 129 maps graphically locates erosion conditions. The physical characteristics of the shoreline segments are briefly described on each map along with photographs typical of the area. The coastline is divided into littoral cells, and the source, movement, and losses of beach sands are noted.

State of California, Department of Navigation and Ocean Development, Sacramento, California 95814

ASSESSMENT AND ATLAS OF SHORELINE EROSION ALONG THE CALIFORNIA COAST, by John S. Habel and George A. Armstrong. 277 pages. July 1978.

KEY WORDS: California, Shoreline Erosion, Littoral Cells, Maps, Photographs, Problem Areas

ABSTRACT: A study of the shoreline erosion problems along the ocean shoreline of California with a description of the general coastal processes. The more critical areas, both existing and potential, are noted as well as the areas where shoreline protection has been installed. An atlas of 129 maps graphically locates erosion conditions. The physical characteristics of the shoreline segments are briefly described on each map along with photographs typical of the area. The coastline is divided into littoral cells, and the source, movement, and losses of beach sands are noted.

State of California, Department of Navigation and Ocean Development, Sacramento, California 95814

ASSESSMENT AND ATLAS OF SHORELINE EROSION ALONG THE CALIFORNIA COAST, by John S. Habel and George A. Armstrong. 277 pages. July 1978.

KEY WORDS: California, Shoreline Erosion, Littoral Cells, Maps, Photographs, Problem Areas

ABSTRACT: A study of the shoreline erosion problems along the ocean shoreline of California with a description of the general coastal processes. The more critical areas, both existing and potential, are noted as well as the areas where shoreline protection has been installed. An atlas of 129 maps graphically locates erosion conditions. The physical characteristics of the shoreline segments are briefly described on each map along with photographs typical of the area. The coastline is divided into littoral cells, and the source, movement, and losses of beach sands are noted.

State of California, Department of Navigation and Ocean Development, Sacramento, California 95814

ASSESSMENT AND ATLAS OF SHORELINE EROSION ALONG THE CALIFORNIA COAST, by John S. Habel and George A. Armstrong. 277 pages. July 1978.

KEY WORDS: California, Shoreline Erosion, Littoral Cells, Maps, Photographs, Problem Areas

ABSTRACT: A study of the shoreline erosion problems along the ocean shoreline of California with a description of the general coastal processes. The more critical areas, both existing and potential, are noted as well as the areas where shoreline protection has been installed. An atlas of 129 maps graphically locates erosion conditions. The physical characteristics of the shoreline segments are briefly described on each map along with photographs typical of the area. The coastline is divided into littoral cells, and the source, movement, and losses of beach sands are noted.