SAN FRANCISCO CLEAN WATER PROGRAM

City and County of San Francisco
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(415)558-2131

Mailing Address: P.O. Box 360, San Francisco, California 94101
(415)431-9430

November 25, 1986

7.2.5.11

Peter Douglas, Exec. Director
California Coastal Commission
631 Howard Street
San Francisco, CA. 94105

RE: Revised Beach Nourishment Plan

Dear Mr. Douglas:

Enclosed is the revised Beach Nourishment Plan prepared by the Clean Water Program in close cooperation with your agency and the GGNRA in the past few weeks.

The Board of Supervisors has approved the resolution and ordinance on the Beach Nourishment Plan and Special Fund and the Mayor is expected to sign these documents within the next few days. The Mayor is also transmitting a request to the U.S. Army Corps of Engineers to initate a study of erosion problems at Ocean Beach. Copies of these documents will be forwarded shortly.

We appreciate your support of the revised Beach Nourishment Plan and look forward to its approval at the Commission's December meeting so that we may proceed to reconstruction of the Great Highway without further delay.

Very truly yours,

Robert Cockburn

for Robert T. Cockburn
Executive Director

(5117-1)

cc: Donald J. Birrer, Director DPW & CWP w/attachment
Noah Tilghman, CCC "
Michael Buck, " "
Brian O'Neill, GGNRA "
Doug Nadeau, " "
Mark Dettle, U.S. Army Corps of Engineers, S.F. District w/attachment
George Domurat, U.S. Army Corps of Engineers "
Richard Seymour, Scripps Institute of Oceanography "
Frank Boerger, Chair, GGNRA Advisory Committee "
James J. Walsh, Chair, CWP Citizens Advisory Committee w/attachment

STATE OF CALIFORNIA—THE RESOURCES AGENCY

CALIFORNIA COASTAL COMMISSION
631 HOWARD STREET, 4TH FLOOR
SAN FRANCISCO, CA 94105
(415) 543-8555
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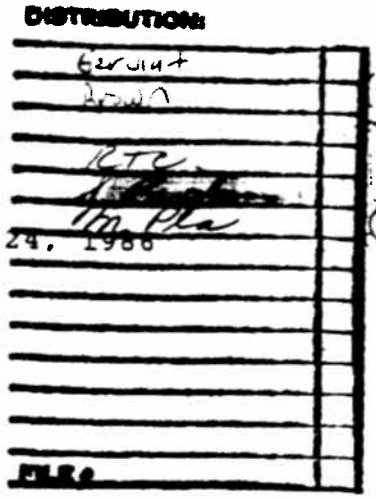
GEORGE DEUKMEJIAN, Governor



December 24, 1986

Todd Cockburn, Executive Director
San Francisco Clean Water Program
770 Golden Gate Avenue
San Francisco, Ca 94101

Dear Mr. Cockburn:

On December 9, 1986, the California Coastal Commission, by a vote of 10 in favor, none opposed, approved the Beach Nourishment Plan submitted by the City and County of San Francisco in compliance with Condition No. 3 of the amended Public Works Plan approval (PW-2-85-8-A). With this approval, the City can now proceed with construction of the seawall and reconstruction of the Great Highway. On behalf of the Commission and its staff I want to thank you and your staff for the cooperation and professional manner in which you worked to resolve this longstanding issue between the City and the Coastal Commission.

If we can be of any additional assistance, please do let me know.

Sincerely,

Peter Douglas

PETER M. DOUGLAS
Executive Director

PD/MB/ma

OCEAN BEACH

BEACH NOURISHMENT PLAN

PREPARED BY
SAN FRANCISCO
CLEAN WATER PROGRAM

NOVEMBER 1986

OCEAN BEACH

BEACH NOURISHMENT PLAN

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November, 1986

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BEACH NOURISHMENT PLAN

Submitted to the California Coastal Commission
by the City and County of San Francisco
November 1986

INTRODUCTION

The City and County of San Francisco (City) is required to submit a Beach Nourishment Plan to the California Coastal Commission (Commission) as a condition of constructing and operating its Westside sewer projects, including restoration of the Great Highway.

The Plan which follows will assure the integrity of Ocean Beach as a recreational resource through the cooperative efforts of the City, Commission and the Golden Gate National Recreation Area (GGNRA), National Park Service, U.S. Department of Interior. Procedures are set up in this Plan for securing implementation of a sand replenishment program by the U.S. Army Corps of Engineers (Corps).

Chapter I provides background information for readers unfamiliar with the history or physical setting of this project. Chapter II sets forth the elements of the Plan and the City's responsibilities in accomplishing each element. Also included is an implementation schedule.

Upon approval of the Plan by the Commission, the City is authorized to proceed with the activities, including physical development, described in Chapter II of this Plan.

CHAPTER I. BACKGROUND

A. HISTORIC SETTING

History of Ocean Beach, San Francisco, California

A description of recreation at Ocean Beach provided by the Olmsteds in their "Ocean Beach Study," cites "movement--the beach walk, the beach ride, the beach drive, the excursion to and along the beach," as a predominating theme since the City's beginnings in Gold Rush days. In the early days, people looked forward to the invigorating buggy ride between Seal Rock and the race track near Lake Merced. (See Figure #1). Unlike the expected image of picnics, bathing, and crowds, summertime visitors to Ocean Beach more often find a foggy, windy place where only the most hardy venture into the cold and dangerous surf.

San Francisco originally was covered by shifting sand dunes west of Twin Peaks. This natural dune system was first altered by William Hammond Hall and John McLaren, who proved with Golden Gate Park that it was possible, with enough water, trees, and patience, to turn what was known as the "Great Desert of San Francisco" into a forested garden. (See Figure 2).

When the Sunday auto drive with the whole family became a dominant theme of outdoor recreation in the early decades of the 20th Century, the City fathers eagerly encouraged it. The Board of Park Commissioners in 1914 (from Olmsted) envisioned an esplanade "three miles in length along the shore of the Pacific as a climax to a trip through our wonderful park". (Olmsted)

The City Engineer, M. M. O'Shaughnessy, shared their enthusiasm for projects that would make way for the automobile age. Viewing the sea as an enemy that "required military strategy to deal with the attacking force...," (Olmsted) O'Shaughnessy designed and built, opposite Golden Gate Park, a seawall/promenade of reinforced concrete now on the National Register of Historic Places. The only force that prevented him from continuing that structure all the way to Lake Merced was the 1929 depression. As a result, the eight-lane Upper Great Highway that O'Shaughnessy built on artificial sand fill between Lincoln Way and Sloat Boulevard was left without adequate shoreline protection.

Fifty years later, visitors find a much changed environment. Homes and pavement replaced the sand dunes in a burst of construction after World War II for returning veterans. Block after block, the homes went up in the Sunset District, until they reached the Great Highway and the Ocean. Wind blown sand replaced four of the eight lanes of the Upper Great Highway. The remaining four lanes were periodically closed due to blowing sand. High dunes blocked views of the Ocean and blowing sand became a chronic problem for the neighborhood, invading homes and yards. The road itself was threatened by wave action where the fill had eroded: the City dumped broken concrete and abandoned gravestones on the bluffs to protect it.

Great Highway/Ocean Beach Improvement Plan

In 1971, the City Planning Department published the "Ocean Beach Improvement Plan: Great Highway Scenic Roadway." The plan called for developing the

Great Highway into a curvilinear recreational drive, and for providing landscaping and recreational amenities within the Ocean Beach corridor. This plan won the approval of the City's Recreation and Park Commission, and the City Planning Commission adopted the proposal under the "Western Shoreline Plan" of the City's Master Plan for Recreation and Open Space.

The Westside Transport Project

During the 1960's, the radical change in outlook about misuse of the nation's resources brought about the environmental movement. Emphasis shifted to conserving and protecting the nation's increasingly polluted air and water. California, and San Francisco in particular, were on the cutting edge of these changes. Many special purpose agencies were established to enact regulations and policies to address environmental problems. For example, the Porter-Cologne Water Quality Act created the State Water Resources Control Board and the Regional Water Quality Control Boards. The San Francisco Bay Conservation and Development Commission was established. Overdevelopment of coastal areas led to Proposition 20 in 1972 which led to the creation of the State and Regional Coastal Commissions. Nationally, Congress enacted legislation creating the first urban parks, protecting coastal resources, regulating air and water resources, and much more.

One result was that San Francisco was required by federal and state regulatory agencies to undertake massive improvements of its sewer system. San Francisco, like most older cities, has a combined sewer system. Both sanitary sewage and storm water runoff are carried in the same pipe to treatment plants. Whenever it rains, the system becomes overloaded and sewage and storm water must be discharged, untreated, onto beaches and into the Bay and Ocean.

In 1969, the City began developing a Wastewater Master Plan for upgrading the level of its sewage treatment from primary to secondary, and for reducing the frequency of wet weather overflows. One key element of this plan is the Westside Transport, a two-and-one-half-mile-long box sewer to reduce Westside combined sewer overflows onto Ocean Beach from an average of 80 times a year to an average of eight times annually. Several locations for this structure were considered during the environmental assessment. The Upper Great Highway location was selected by the City, SWRCB and EPA as the preferred alternative because it was the most cost effective and the least disruptive to the community and the environment.

Because construction of the Westside Transport under the Great Highway would damage or remove much of the road, the Board of Supervisors directed that the Ocean Beach Improvement Plan be implemented concurrently with construction of the Westside Transport.

Golden Gate National Recreation Area

The Golden Gate National Recreation Area (GGNRA) was one of the first urban parks under the jurisdiction of the NPS. The City donated several properties to the new park including portions of Ocean Beach, beginning at the west edge of the Great Highway, and the GGNRA agreed to "maintain the transferred premises in

good and sightly condition... take reasonable measures to prevent the incursion of sand upon roadways...cooperate in the maintenance of existing pedestrian tunnels and construction of additional tunnels beneath the Great Highway...." (1) The agreement also granted the City the right to enter GGNRA property to "maintain lateral support" for the roadway.

In September 1980, the GGNRA's General Management Plan was published. The plan described the goal for Ocean Beach as stabilization and maintenance of planted sand dunes.

Erosion Study

Ten years prior to transferring portions of Ocean Beach to GGNRA, the City had obtained the help of the U.S. Army Corps of Engineers (Corps) to study erosion and blowing sand problems. Considerable data was amassed about tides, winds, waves, currents, tsunamis, beach characteristics, and littoral processes. The Corps completed the study for the GGNRA in 1977, although it was not published officially until 1979.

The Corps examined several alternative measures for "long-range erosion control works," including retardation of blowing sand. The three alternatives described in detail were:

- Beach Fill Plan
- Rubble Seawall
- Dune Toe Protection

These were analyzed for function, effectiveness and cost. Each had advantages and disadvantages. Average annual cost, according to the Corps final draft report was $3.3 million, for the Beach Fill Plan compared with less than a million ($800,000 and $650,000) for each of the other alternatives.

Environmental Review

The environmental review process for the Westside Transport included study of erosion problems at Ocean Beach. The EIR, prepared by an independent consultant, Environmental Impact Planning Corporation, discussed several alternatives, including beach nourishment and structural remedies, such as extending south the existing O'Shaughnessy seawall. The City had the benefit of assistance by Professor J. Johnson, then on the engineering faculty of U.C. Berkeley, and one of the most noted engineers in the field of coastal processes. His conclusion was that the transport itself would have a negligible effect on erosion problems. The City had been in close contact with the GGNRA during this process and had been assured that GGNRA would undertake a sand replenishment program to deal with beach erosion caused by natural forces.

Great Highway Redesign

The City engaged Michael Painter & Associates in 1977 to prepare a conceptual plan for the redesign of the Great Highway/Ocean Beach corridor, in consultation

(1) Agreement between CCSF and NPS, dated April 19, 1975.

with citizens and local agencies, as well as GGNRA and the Commission. The plan published in 1977 called for a curvilinear roadway to slow traffic and enhance views for motorists, more frequent beach access, dune stabilization and a recreation trail for joggers and walkers.

The plan discussed options of a 4-lane road, 2-lane road, and no road. The City's Board of Supervisors adopted the 4-lane alternative based on traffic engineering studies and public testimony.

California Coastal Commission

The City's permit application for the Westside Transport and Great Highway Redesign projects were considered by the Regional Coastal Commission in 1978. At the first hearing concerns were raised by GGNRA staff and others about the effect of the transport box on erosion at Ocean Beach. To discuss this matter more fully, GGNRA convened a conference of experts in August 1978. This group made a number of recommendations which the City agreed to implement. For example, the transport box and the roadway were realigned 50 feet eastward south of Noriega Street where historically wave erosion had been most severe.

The formulation of these plans was coordinated with the staffs of the GGNRA and the Regional Commission, each of which confirmed that the revised plan was an adequate response to the recommendations of the wave erosion conference. The new alignment was also reviewed by Dr. J. W. Johnson, the City's wave erosion expert. He recommended that an additional measure of safety could be realized by installing some sort of "toe of dune slope" protection in the area south of Noriega. This could be accomplished by either retaining the rubble that is currently piled against the bluff or by extending the low concrete seawall that currently exists between Taraval and Santiago Streets. Each of these structures could be covered with sand and would only become exposed in localized areas when storm wave action was severe.

Commission staff recommended approval based on changes made by the City. The Regional Commission denied the City's permit application.

Upon the recommendation of State Commission staff, the City then filed an application with the State Coastal Commission for a Public Works Plan permit for all of its planned Westside projects, rather than appealing the denial of the Westside Transport and Great Highway Redesign project.

Commission staff required that the City:

1. hire another coastal engineer, Dr. Cyril Galvin from the East Coast, to study erosion problems at Ocean Beach, and

2. hold additional public meetings under the aegis of the Coastal Conservancy on the Redesign Plan for the Great Highway.

Galvin Reports

Dr. Galvin studied the site in 1979, reviewed previous studies, and interviewed pertinent people. As requested by Commission staff, he submitted four studies, entitled:

- o Compilation of existing facts and theories, March 1979
- o Coastal processes and sediment budget at Ocean Beach, March 1979
- o Predicted shorelines at Ocean Beach, April 1979
- o Design recommendations, April 1979

Some of Dr. Galvin's recommendations are no longer appropriate because the City has made many changes to its proposed Westside Transport and Great Highway Design projects, including moving the box eastward. However, the following findings and recommendations of Dr. Galvin are still applicable:

- Based on an analysis of the data from the Presidio tide gage, Dr. Galvin concluded that sea level is rising at a rate of 1.5 mm per year. This rate would translate to an apparent loss of beach sand of 5,000 cubic yards per year.

  (Note: Philip Williams and Associates, consultant to the Bay Conservation and Development Commission (BCDC), is forecasting that the rate of sea level rise will increase from the present value of 1.5 mm per year to anywhere from 6 mm per year to 24 mm per year in the future, due to changes in global climate caused by the 'greenhouse effect'. These forecasts are derived from worldwide sea level rise forecasts developed by EPA.)

- The San Francisco Bar is the main source of sand for Ocean Beach.

- The rubble the City had been using for erosion control was effective.

- Ocean Beach is a comparatively stable beach in the long run, though 200 foot movement of the shoreline between summer and winter is possible at some locations. (Emphasis added)

- Based on the assumption that the City would protect the Great Highway, Dr. Galvin concluded that except for "...a series of back-to-back storms which would strip the summer berms from the entire beach" there would always be a beach adequate for walking. (Emphasis added)

In the meantime, GGNRA engaged a coastal engineer, Richard Ecker. Mr.Ecker and Dr. Galvin disagreed on the stability of ocean Beach and the causes of erosion. Where Dr. Galvin asserted that toe of slope protection would be both feasible and cost effective, for example, Mr. Ecker argued that the beach would be lost due to the structure.

1979 Public Works Plan

The Commission in 1979 conditionally approved the Public Works Plan for construction of the City's Westside water pollution control projects. Essentially, the conditions required the City to protect the sewer box by rebuilding dunes whenever storms eroded existing dune. See Appendix A.

In accordance with these permit conditions, the City relocated the transport and roadway eastward and included in the contract specifications for the transport

removal of existing rubble from the beach and placement of excess excavated sand. Trigger monuments and dune maintenance were added to the highway project. However, it was subsequently determined that most of the Ocean Outfall project's spoils would not meet NPS specifications.

Sand Replenishment

With the approval of Coastal Commission staff, the City engaged GGNRA's consulting engineer, Richard Ecker, in order to minimize potential conflicts with GGNRA. His report titled "Ocean Beach Sand Replenishment Program, October 1980", analyzed the accumulated data and outlined a strategy for sand replenishment.

Based on analysis of historical beach survey data and the proposed placements of construction spoils, Ecker estimated that minor replenishments would be needed before the year 2020 but major (greater than 1,000,000 cubic yard) replenishments would be needed around the year 2020 and again around 2055.

Due to on their interpretation of EPA Grant funding regulations (40 CFR 35 Subpart E, Appendix A), the SWRCB concluded they could not allow grant funding for any activity which extended beyond 50 years. Because of this ruling by the SWRCB, the City filed for an amendment to limit its obligations to the allowable funding. Based on the City's cost estimates, Ecker's estimates of sand needs and the Bank of America's interest rate and inflation rate forecasts, it was estimated that a $5.4 million trust fund including accumulated interest, would be sufficient to finance sand replenishment for 50 years.

The Commission approved an amendment on January 7, 1981, but used this opportunity to expand the concept of sand replenishment from protection of the sewer box to include maintenance of portions of Ocean Beach. See Appendix B.

In January, 1981, the City deposited $5.4 million in the escrow account, relying on SWRCB's commitment to share the cost 12 1/2% local, 12 1/2% state and 75% federal (EPA). The City submitted a draft Beach Nourishment Plan in February. The contract for the Westside Transport was immediately awarded to the low bidder and construction began. In April, however, EPA reversed SWRCB's State eligibility determination for the sand replenishment program escrow fund and Federal/State grant funding was cancelled.

Subsequently, the state legislature adopted legislation cancelling the escrow fund agreement and limiting the City's financial commitment to $625,000. The law also required the City to submit a Beach Nourishment Plan to the Commission and the SWRCB for approvals prior to commencement of operation of the new westside sewer system. 1981 California Laws, Ch. 1007, Sec. 5, is quoted in Appendix C.

Ocean Beach Management Advisory Board

In 1982, the City invited representatives of agencies which have jurisdiction or responsibilities in the Ocean Beach corridor to participate in an Advisory Board. The purpose of the Advisory Board was to institutionalize previously fragmented efforts to deal with problems in the Ocean Beach/Great Highway corridor. Membership included persons from the following organizations:

Federal: U.S. Army Corps of Engineers
GGNRA, NPS, U.S. Dept. of Interior

State: Coastal Commission
Scripps Institute of Oceanography, University of California
Department of Boating and Waterways

Local: Clean Water Program, Citizens Advisory Committee
Clean Water Program, Executive Director
SPUR
Chamber of Commerce
City Planning and Rec/Park Departments

At an early stage in its deliberations, the technical members on the Board concluded that the transport box had "nothing to do with erosion" [2]. If the box were ever uncovered, there would be scour but not a permanent loss of sand. Further, the technical members stated that Commission staff were wrong to keep the sewer system from operating because of some suspected damage the box might do, especially since the sewer didn't cause the problem in the first place.

Commission staff acknowledged that erosion and the sewer were unrelated but asked for a proposal outlining several scenarios for insuring a recreational beach. Accordingly, the Advisory Board's first task was preparation of a draft Shoreline Protection Plan which would

- define anticipated problems
- determine mutually acceptable courses of remedial action
- develop the necessary strategies to fund and execute these actions, and
- assign responsibilities for implementation

The draft plan prepared by the City discussed both structural remedies and sand nourishment. Funding would be sought for large scale projects from the Federal government. Subsequently, the Advisory Board adopted a resolution requesting a detailed study by the Corps of shoreline erosion problems at Ocean Beach. This was an essential preliminary step to obtaining Federal assistance.

Res. #481-83 adopted by the Board of Supervisors requested the Mayor to transmit the Advisory Board resolution to the City's congressional representatives and to seek federal authorization and appropriations for the study.

These long range planning efforts were overtaken in the winter of 1983 by the, effects of the storms caused by the "El Nino" phenomenon. In compliance with the Commission permit, the contractor for the Westside Transport had placed over 600,000 cubic yards of excavated dune sand that met GGNRA standards on the bluffs west of the road. These were to be graded and planted under the subsequent Great Highway contract. The City's Coastal Engineer, Richard Ecker,

[2] Minutes of meeting 6/10/83

had estimated "a loss of about 25% during the first year from such a nourishment ..." However, 70% of the sand was lost to the sea by the Spring of 1983. In addition, nearly $400,000 had been spent to remove the riprap on the the bluff in accordance with Ecker's recommendation and the Commission permit. Now, riprap had to be added to keep the detour road from being undermined. Finally, the Great Highway construction contract, which had been advertised for bids just before the storms, had to be pulled back for revisions to reflect the storm losses.

Great Highway Redesign Revised

Neighborhood opposition to this project began to coalesce. In 1979 the Commission had relocated the roadway very close to the homes of residents along the Lower Great Highway--in some locations 60 - 80 feet closer than the original roadway. Advertising for the revised Great Highway contract was cancelled while the Board of Supervisors held public hearings, met with GGNRA and Commission staff, and attempted to form a compromise. Ultimately, the City filed an application to amend the permit, requesting that the road be relocated westward, away from the residents, and proposing that a rock revetment be constructed on the beach to protect the road. The Commission subsequently approved construction of a rock revetment but limited the location to City property. This meant the residents would have a road located, in their view, still too close to their homes to be acceptable.

Seawall Esplanade

Following further hearings, the Board of Supervisors concluded that the existing O'Shaughnessy seawall built north of Lincoln Way over 60 years ago not only had not harmed the beach, but had protected the roadway, enhanced recreational beach area and prevented most windblown sand from reaching the road and residents. The Board, therefore, adopted a policy of phased construction of a seawall, on City property, between Lincoln Way and Sloat Boulevard, with funding to be provided through annual appropriations of $3.5 million. In order to keep the road as far as possible from neighborhood residents, the curvilinear roadway concept had to be abandoned and replaced with a straight roadway, (two 30-foot wide roads separated by a 12-foot median strip). The old road was 125 feet wide, with two 50 foot roadways and 25-foot median. Accordingly, the new road (72 feet wide), a seawall/promenade and buffer zone (55' wide) would be only slightly (2 feet) closer to residents than the original road. In areas where seawall protection is not needed, the 55' wide area would be planted with dune grass.

Subsequently, in 1984, the Commission approved the seawall/promenade and straight roadway projects conditioned to require approval of the Beach Nourishment Plan prior to reconstruction of the Great Highway. (See permit language, Appendix D.)

Construction of the Great Highway is scheduled to begin in early 1987. The seawall project would begin in the spring of 1987, after traffic had been rerouted by the highway contractor.

The Westside Core System includes the Westside Transport/Pump Station and 4 1/2 mile ocean outfall. The Cease and Desist Order of the RWQCB required the system to be in operation in October 1, 1986.

After discussions with Commission staff over several months, the City submitted its Beach Nourishment Plan proposal in August, 1986, to the State Water Resources Control Board (SWRCB) and the State Coastal Commission, as required by State law and the City's permit.

The SWRCB unanimously approved the Plan at is September meeting. (See resolution Appendix E. The Commission rejected the City's plan on September 10, but indicated during the hearing that its action was not intended to delay the start-up of the Westside pollution control system.

In subsequent discussions among representatives of the Coastal Commission, GGNRA, Corps of Engineers and the City, consensus was achieved on the elements of an acceptable Beach Nourishment Plan, embodied in this document. Based on these changes, the City requested approval of the Plan at the December 1986 Commission meeting.

Upon approval of this Plan by the Commission, the City is authorized to proceed with the activities, including physical development, described in Chapter II of this Plan.

B. PHYSICAL SETTING

The Ocean Beach corridor comprises the area from the westerly curb of the lower Great Highway to the Ocean and includes beach and dunes, Great Highway, recreational trail and landscaped, linear park. This corridor was built on fill nearly 60 years ago. The City had planned to construct a seawall the entire length of the corridor, from Cliff House to Sloat Boulevard, at that time, but the Depression intervened.

The shoreline stability of Ocean Beach has been extensively studied compared to most coastal sections. It is subjected to the episodic incursions of the sea which are typical of almost any open ocean sandy shoreline. The shoreline shows generally receding trend south of Lincoln Way. There is a diversity of opinion on the mean rate of recession and on how long the recession will continue. Some feel the Ocean Beach recession is part of continental scale tectonic processes or even global scale processes. Others feel the recession is a natural response to the seaward extension of the shoreline which occurred during the original construction of the Great Highway and that this recession would subside if the shoreline were allowed to recede to its pre-Great Highway position. The material below, discussing the physical characteristics of Ocean Beach, has been compiled from a number of reports (see bibliography).

Gulf of Farrallones

The offshore area, called the Gulf of the Farallones, is part of a broad and shallow continental shelf (see Fig. 3). The shelf varies from 20 to 30 miles wide and slopes westward from the Golden Gate with a inclination of 0.2 to 0.3 percent. The Farallon Islands are located to the west-northwest of Ocean Beach and block some of the wave energy which would normally reach the beach. Sediments on the continental shelf are predominantly fine sand.

Bar

The San Francisco Bar extends in an arc about 5 miles west of the Golden Gate (Figure 4). Depths over the Bar vary from 24 feet on the northern flank known as Potatopatch Shoal to about 36 feet on the southern flank. Waves approaching the beach are refracted as they pass over or in proximity of the San Francisco Bar. The Bar also serves as a source of sand for the Ocean Beach shoreline. Because of the shallow depths, large waves will break as they pass over the Bar.

Coastal Beaches

The coastal segment of the County of San Francisco consist of 4.8 miles of sandy beach from the county line northerly to the Cliff House (see Figure 5). The Fort Funston Beach section, (1.5 miles from the County line to the Zoo) is generally backed by high bluffs with elevations approaching 200 feet. Beach width has varied considerably. The Ocean Beach section extends from Sloat Boulevard to Cliff House, a distance of approximately 3.3 miles. The existing dunes vary from 10 to 220 feet in width along Ocean Beach.

Winds and Waves

Ocean Beach is subjected to direct attack by predominant waves approaching from the West to Northwest and storm waves from the south to southwest. High tides accompanied by large waves have caused erosion of the dune escarpment along the central and southern portion of the beach. Prevailing westerly and northwesterly winds have caused a considerable problem with sand blowing along the frontal dunes and depositing material on the Great Highway and in residential areas.

Longshore transport characteristics along Ocean Beach have been studied by many investigators (Johnson 1977, 1978; Perry et al 1969; Kamel 1962; and, Galvin 1979).

Figure 6 shows the net direction of longshore transport as described by Johnson. This information suggests a divergence area in the center of the beach corresponding to the highest erosion area. The notion of a divergence zone along the beach was also discussed by other investigators. This zone is not stationary but tends to shift. Due to the shifting nature of the divergence zone, the seasonal and yearly change in longshore transport characteristics, the shoreline processes along Ocean Beach are highly complex.

Beach Conditions

The beach configuration varies greatly. The area where the O'Shaughnessy seawall is located north of Lincoln Way is now characterized by a very wide, flat beach up to Kelly Cove near the Cliff House. South of Lincoln Way to Lawton Street, for about 2,900 feet, is a sand accreting area, with large sand dunes and a wide beach. The present shoreline appears to be 200 feet to 500 feet seaward of its late 19th century location in this stretch of beach. South of about Lawton Street, the beach narrows and the dunes become unstable. Between Lawton and Noriega streets (1,150 feet) is a moderate erosion area which may need structural protection within the next 10-15 years.

Noriega to Santiago is a high erosion area, requiring immediate structural protection (3,470 feet). This reach of shoreline has long been a maintenance problem during winter storms. For years, the City dumped broken concrete, bricks, old tombstones to prevent the highway from being undermined. This material was removed in 1981 in compliance with the Commission's permit and replaced with hundreds of thousands of cubic yards of excavated sand from construction of the Westside Transport. This was totally ineffective - 70% of the sand was lost, as well as the westerly lane of the roadway. This zone of about 3,500 feet is often dangerous to the beach visitor at high tide during winter storms because there is no place to retreat for safety.

Santiago to Taraval Street is effectively protected by the existing Taraval Seawall (665 feet). Taraval to Wawona Street is a moderate erosion area (1,175 feet), which is fairly stable at present. Wawona to Sloat Blvd is a low erosion area (400 feet). Total distance between Lincoln and Sloat Boulevard is about 10,000 feet (See Figure 7).

The fronting beach fluctuates throughout the year. The beach builds up during the summer months and then recedes during the winter. The beach width fluctuates both where there are structures and where none exist. For instance, at Pacheco (where emergency rubble exists), the beach fluctuated 104 feet between January and July 1985. Similarly, at Rivera (where rubble also exists), the beach width fluctuated 110 feet and 75 feet, respectively, between January and July 1982, and between January and July 1983. However, no structure exists at Vicente, yet the beach width fluctuated 120 feet and 84 feet, between winter and summer in 1982 and 1983, respectively.

Figures 8-11 show recent summer and winter profiles at Pacheco, Rivera, Taraval and Vicente Streets. Table 1 lists beach widths (horizontal distance between the dune toe and the MHHW line of 94.1 feet project datum). Minimum widths in the project area (Pacheco and Rivera) were about 20-50 feet. Maximum widths ranged between about 150-200 feet. Average widths are indicated on the figures. The figures and the table illustrate the greatly varying width of useable beach between summer and winter and from year to year.

A retired geologist, George Gates, lives along the Lower Great Highway and has developed information on the width of the beach based on analysis of aerial photographs taken since 1946. Again, the beach width fluctuates but returns seasonally. See Tables 2 and 3.

The dunes undergo changes only periodically, and the most noticeable changes occur during storm conditions when waves attack the dune and a large quantity of material is removed. The building process is much slower and unless the dunes are protected from storms for many years, they may show an erosive trend. Tables 4 and 5 show trends in dune erosion along Ocean Beach. The information indicates an average annual dune retreat of 5-10 ft/yr is expected in the high erosion area, although a single storm retreat of 60 feet is possible.

Table 1. BEACH WIDTHS: SUMMER AND WINTER

1977-1976	Pacheco Ft.	Rivera Ft.	Taraval Ft.	Vicente Ft.
Winter				
Range	18-164	53-173	99-247	47-264
Average	90	116	159	174
Summer				
Range	134-196	66-149	95-236	120-237
Average	166	110	158	178
ECKER (1980)				
1915		75	115	205
1918		175	185	205
1938		285	30	220
1942		135	60	150

Notes:
1. Beach width is the distance from the dune toe to MHHW.
2. Pacheco data is 1983-1986.
3. January and July profile data used in analysis, as well as other dates.

Table 2

Estimated Width of Beach Berm[1] Along Ocean Beach
Based on Aerial Photographs
Prepared by George Gates, Resident, Lower Great Highway

Date of Photo	7/29/46	9/25/59	5/17/65	5/1/65	7/22/70	4/22/70	5/3/78
Wawona	180	250	190	190	220	100	120
Vicente	175	210	170	210	140	70	170
Ulloa	130	170	170	180	140	90	22
Taraval	80	230	170	130	180	110	140
Santiago	80	210	150	180	150	70	140
Rivera	120	210	140	190	30	50	90
Quintara	80	140	40	100	40	0	120
Pacheco	180	150	120	20	N/A	30	80
Ortega	120	150	110	50	N/A	110	90
Noriega	230	200	80	80	N/A	90	130
Moraga	210	230	120	90	N/A	100	120
Lawton	210	220	120	60	N/A	130	60
Kirkham	250	190	90	100	N/A	100	60
Judah	240	190	120	50	N/A	100	60
Irving	190	170	160	140	N/A	90	80
Lincoln	340	70	50	190	N/A	90	60
South end of Seawall	340	210	140	250	N/A	140	190
Fulton	190	60	N/A	110	N/A	N/A	140
Cabrillo	190	60	N/A	110	N/A	N/A	140
Balboa	190	30	N/A	40	40	N/A	30

(1) From Base of the bluff to seaward edge of beach above high tide.

Table 3

Comparison of Beach Widths[1]
February 1985 and August 1986
Prepared by George Gates, Resident,
Lower Great Highway

	Feb. 5. 1985[2] FT.	Aug. 7-12 1986[3] FT.	Sept. 30-Oct. 4 1986[3] FT.
1380 ft South of Sloat	53	214	200
700 ft south of Sloat	33	223	220
Sloat	83	233	250
Vicente	54	233	280
Ulloa	13	288	200
Taraval	10	195	180
Santiago	0	158	160
Rivera	0	84	100
46 ft North of Rivera	0	0	110
Quintara	0	0	70
173 ft North of Quintara	0	0	112
Pacheco	0	84	170
Ortega	0	204	230
Noriega	27	158	165
Moraga	20	158	145
Lawton	43	144	160
Kirkham	128	158	170
Judah	106	167	170
Irving	125	158	170
Lincoln	142	195	200
Beach Chalet	149	251	251
Fulton	136	288	288
Cabrillo	78	251	220
Balboa	0	116	100

(1) From base of the bluff to seaward edge of beach above high tide.
(2) February 1985 measurement from aerial photographs.
(3) Measurements by pacing.

Table 4

Average Rate of Bluff Retreat, as Calculated by George Gates

(Minus means erosion; plus means accretion)

Street	1930-42 ft/yr	1965-78 ft/yr	Distance from City/GGNRA Line to Bluff in 1978, ft
Irving	+3.3	0	91
Judah	+1.3	0	162
Kirham	+0.3	-1.2	169
Lawton	-1.6	0	186
Moraga	+1.3	-8.2	122
Noriega	+1.9	-10.3	111
Ortega	+3.3	-10.6	80
Pacheco	-0.6	-8.8	26
Quintara	-3.5	-4.9	60
Rivera	-7.9	-3.5	37
Santiago	-8.3	-2.6	32
Taraval	0	0	61
Ulloa	-6.4	-0.8	55
Vicente	-2.5	-1.9	72
Average	-1.4	-3.4	90

Notes:

1. Source is Galvin, 1979
2. Taraval measured to fixed tunnel entrance
3. Measurements to presumed top of bluff from west edge of upper Great Highway.

Accumulated Storm Induced Bluff Retreat

Location	Accumulated Retreat FT
Kirkham	20*
Rivera	60
Taraval	10
Vicente	30

*Based on aerial photographs

Table 5

Estimated Time for Dune to Retreat to City/GGNRA Property Line

Street	Distance Property Line to Top of Dune, Jan 85 ft	Annual Dune Retreat ft	Accumulated Storm Retreat* ft	Years to Reach Property Line**
Irving	114	1	60-20	54-94
Judah	139	1	60-20	79-119
Kirkahm	95	1	60-20	35-75
Lawton	121	2	60-30	30-45
Moraga	115	5	60	11
Noriega	55	5	60	0
Ortega	7	5	60	0
Pacheco	10	5	60	0
Quintara	17	5	60	0
Rivera	10	4	60	0
Santiago	25	3	60-30	0
Taraval	44	***	***	***
Ulloa	55	2	60-30	0-12
Vicente	67	2	60-30	3-18
Wawona	98	2	60-30	19-34

* Combination of City Surveys & Aerial Topography
** Accumulated storm retreat + annual dune retreat
*** Annual dune retreat and accumulated storm retreat figure from surveys show very little change.

Example on use of Table 5: For Moraga 115' - 60 =55'.55' divided by 5 = 11 years to reach property.

Source: NCHE

Also attached are figures from Ecker (1980 Fig. 12) showing historical profiles between 1915-1942 at Rivera, Taraval and Vicente. The beach widths over this time period are comparable to existing conditions. Some of Ecker's beach widths are also noted in Table 2.

Figure 13 shows the chronological variation of the dune width at Pacheco, Rivera and Vicente Streets at approximately 6 month intervals. The average of the dune width is also indicated. Again, dramatic variation in the dune width is shown.

Sand Size Distribution

The beach sand includes graywacke, sandstone, granite, shell, jasper chert, serpentine and schist. Table 6 shows grain size diameters for samples taken in 1970, 1979, and 1985. Note the great variation over time and location. The ranges of size for beach sand are typical for West Coast beaches with slopes of 1 on 20 to 1 on 8, according to the Corps (1984). Fig. 14 depicts the range of size characteristics of Ocean Beach Sand.

Existing Protection Structure

There are several permanent shoreline protection structures at Ocean Beach:

- The concrete (O'Shaughnessy Seawall) seawall/promenade constructed between Cliff House and Lincoln Way more than 60 years ago. This structure has been successful in resisting high energy wave action . The design includes a stepped revetment, curved parapet and sheet-pile cut-off wall (see Figure 15). The parapet is effective in stopping windblown sand from traveling beyond the beach into the neighborhood.

- A low, metal sheet pile seawall with concrete cap located on the beach between Santiago and Taraval Streets. This structure was built in 1940 to protect the beach access underpass. (See Figure 16). It has worked effectively, without adverse effect on the beach.

- Riprap protection for the Sloat Blvd parking lot.

In addition, temporary riprap has been replaced on the bluffs between approximately Noriega and Santiago Streets to keep the detour road from being undermined. This material will be removed during construction of the proposed concrete seawall/promenade.

Maintenance Procedures

Responsibility for maintenance in the Ocean Beach corridor is divided between GGNRA and the City.

The City has responsibility for maintenance of the roadway and landscaping east of the roadway. In addition, the City, at its own expense and initiative, assisted GGNRA in 1985 by planting dune grass and providing sand fencing on the beach adjacent to the seawall at Lincoln Way where blowing sand has been an acute problem.

TABLE 6

OCEAN BEACH SAND SAMPLES
(TAKEN NEAR MEAN TIDE)
(Grain Size Diameter)

DECEMBER 1970				FEBRUARY 1979				FEBRUARY 1985			
Location	D_{16} mm	D_{50} mm	D_{84} mm	Location	D_{16} mm	D_{50} mm	D_{84} mm	Location	D_{84} mm	D_{50} mm	D_{16} mm
Balboa	0.82	0.38	0.23	Stair #19	0.46	0.33	0.28	Lincoln Way	.59	.40	.26
Fulton	0.50	0.36	0.25	Stair #26	0.41	0.33	0.23	Irving	.49	.30	.19
SF-14	0.50	0.30	0.22	Irving	1.93	0.53	0.28	Judah	.52	.35	.20
Irving	0.70	0.43	0.28	Kirkham	0.36	0.30	0.20	Kirkham	.30	.22	.16
Kirkham	0.98	0.44	0.29	Moraga	2.11	0.94	0.24	Lawton	.50	.35	.21
Moraga	0.51	0.34	0.25	Ortega	0.86	0.46	0.33	Moraga	.45	.25	.16
Ortega	0.38	0.27	0.20	Quintara	2.54	0.79	0.36	Noriega	.40	.25	.16
Quintara	0.46	0.29	0.21	Santiago	0.79	0.41	0.28	Ortega	4.2	.60	.30
Taraval	0.55	0.37	0.29	Ulloa	1.42	0.46	0.28	Pacheco	.50	.38	.21
Vicente	0.64	0.40	0.30	Wawona	3.05	1.57	0.48	Quintara	.50	.33	.20
SF-16	0.70	0.41	0.38	SF-6	2.29	0.64	0.33	Rivera	.48	.32	.20
								Santiago	.90	.40	.20
								Taraval	.42	.25	.16
								Ulloa	.80	.38	.20
								Vicente	.40	.25	.16
								Wawona	.50	.32	.19
								Sloat	.50	.38	.22

D_{16} = 16 percent of sample by weight is coarser
D_{50} = 50 percent of sample by weight is coarser
D_{84} = 84 percent of sample by weight is coarser

South of Lincoln Way, the City in 1985 and 1986 planted dune grass and installed sand fencing on GGNRA property. The City also created access ways at Judah, Lawton and Noriega through the dune grass to the beach and now maintains them. The City will also maintain GGNRA's dune grass for a five year period by annual fertilization and by replacing plants damaged by foot traffic and wave erosion. The project has been successful to date both in controlling blowing sand and in encouraging cooperative efforts between the two entities, GGNRA and the City.

GGNRA has statutory responsibility to maintain the recreational beach and seawall promenade north of Lincoln Way. Its maintenance staff presently removes logs brought by the sea; its machines clean the beach of broken glass and redistribute windblown sand which piles up against the seawall parapet. GGNRA uses the County Sheriff's work release program to remove litter from the beach. Recently, GGNRA repaired the riprap that protects its parking lot at Sloat Blvd. and obtained Federal Department of Transportation funds to repair the viaduct supports above Kelly Cove.

CHAPTER II. BEACH NOURISHMENT PLAN

INTRODUCTION

More than sixty years ago, the Ocean Beach corridor between Lincoln Way and Sloat Boulevard was created by extending fill about 200 feet seaward of the original shoreline. Since that time, various improvements including the Great Highway and Westside Sewer have been built within that corridor, seaward of the original shoreline. Those facilities are subject to damage from erosion due to ocean waves. Two physical processes are involved: erosion of the bluff, and fluctuation in the width of the beach. Erosion of the bluffs is easy to observe as there is no oscillation in bluff retreat. The width of the beach varies seasonally, though, making it much harder to observe the net direction of change. Nevertheless, a gradual process of beach erosion appears to be occurring in some locations, due perhaps to the location of the beach seaward of the historical shoreline and to a gradual rise in sea level.

Both aspects of the shoreline erosion problem need to be addressed in long term planning, although a single solution may not solve both problems. Protection of the Great Highway, recreational facilities, the Westside Transport sewer, and neighborhood residences is essential to the health and welfare of San Francisco. Ocean Beach is a major element of the GGNRA and is a significant federal asset. Protection of the recreational resources of the Ocean Beach corridor is imperative under the Coastal Act, and is important to the community of San Francisco as well as to the residents of the entire Bay Area and nation. The purpose of this plan is to try to protect the resources in the Ocean Beach corridor. Although some combination of structural and non-structural measures may be necessary, beach nourishment is the favored solution to the degree that it is feasible.

1. Sand Replenishment Program

Sand replenishment is a key element for long term management of Ocean Beach. The City, the Coastal Commission, and GGNRA agree that their goal is to maintain the recreational beach through importation of sand. Sand replenishment efforts have been successful in California as well as other parts of the country. Overall goals of the Ocean Beach sand replenishment program are:

- To accomplish sand nourishment in a cost-effective manner that will result in a long-lasting recreational and protective beach.
- To minimize the disruption to beach users from beach nourishment.

To fulfill these goals, the City has concluded that beach nourishment can most feasibly be accomplished through large-scale projects, of the order of two to three million cubic yards. To accomplish a project of this scale, it is essential to involve the U.S. Army Corps of Engineers. Sand nourishment has limited feasibility without participation from the Corps but with active participation of the Corps, beach nourishment will be assured if it is economically feasible.

Beach nourishment projects substantially increase the width of the summer recreational beach. Some experts indicate that large scale nourishment efforts can have an expected life of up to 50 years, while smaller scale nourishment efforts only last about 5 to 10 years. Therefore, both to maximize cost-effectiveness and to minimize recreational impact, large-scale nourishment efforts are proposed.

In order to further increase the longevity of nourishment efforts, sediment used for nourishment should be selected with careful consideration of the relationship between the size of the sediment and the longevity of the material on the beach. The use of significantly finer sand than the native beach sands would require placement of several cubic yards of sand for each effective yard. This would have such undesirable effects as making the cost prohibitively high or resulting in unacceptably high initial sand losses. On the other hand, the use of significantly coarser sand could result in an undesirable steepening of the beach slope.

FUNDING SOURCES

A major sand replenishment program is both costly and technically complex, requiring resources beyond that available to a local community. Such projects are nearly always designed and carried out by the U.S. Army Corps of Engineers at the request of a local government. Therefore, the City is committed to acting as local sponsor for Corps involvement, including seeking funds from Congress for beach nourishment through the Corps projects.

The City is committed also to providing a local share of up to $2.0 million to the study and implementation of beach nourishment at Ocean Beach. This money will be made available through an initial City contribution of $675,000 to a special Beach Nourishment Fund. Interest will accumulate in the account until either:

(a) expenditures from the account reach $2.0 million, or
(b) interest and principal together reach $2.0 million.

At that time, interest earnings would no longer accumulate in the Beach Nourishment Fund but would accrue to the City's regular accounts.

Disbursements of funds in the special Beach Nourishment Account would be limited to the following items:

- Local share of the Corps of Engineers study cost, if required by Congress.

- City share of implementing a major sand replenishment project(s).

The special City Beach Nourishment Fund will be set up within the City's administrative code. A copy of the proposed ordinance to establish the Fund is included as Appendix F.

The City will also seek funding assistance from the State, which typically splits any matching fund requirement with the municipality. A copy of the response to the City's inquiry from State Boating and Waterways will be submitted to the Coastal Commission.

Finally, the City will seek funds from the GGNRA through an agreement between the City/GGNRA regarding long-term maintenance responsibilities in the Ocean Beach Corridor. As part of this agreement, it is hoped that GGNRA will also contribute $675,000 to a Beach Nourishment Fund, with accumulating interest.

The City, Commission and GGNRA have agreed that the foregoing is an efficient way to proceed with beach nourishment. Planning responsibility rests with the Corps of Engineers, which is the organization with the greatest experience in this work, while costs are distributed to the people who benefit.

CORPS OF ENGINEERS STUDY

In 1965, the San Francisco District of the U.S. Corps of Engineers received an authorization from Congress to study shoreline erosion at Ocean Beach. This existing authorization will greatly expedite the Corps study schedule. Therefore, the City will submit a request to the Corps to reactivate the study authorization and will assist the Corps if necessary to obtain congressional funding for the study.

The Corps study procedure has two phases. The first is a Reconnaissance Study which explores the problem and develops a detailed scope of work for the second phase. The commitment of all the groups involved in the Ocean Beach corridor to beach nourishment as the preferred response to shoreline erosion will be underscored in the City's request to the Corps. This will eliminate from serious consideration groins and offshore breakwaters, for example. The City will urge the Corps to begin the Study by February, 1987. According to the Corps, completion of the first phase takes up to 12 months time or about February, 1988. The second phase takes 24 to 36 months and results in a Feasibility Report which describes various alternatives solutions, their environmental impacts and costs. This could be completed as early as February 1990.

If the Corps Study determines that sand replenishment is appropriate, the City will take the initiative in organizing support to obtain federal funds for implementing the beach nourishment project. A schedule for this phase is dependent upon the conclusions of the Corps study.

CONTINGENCY PLAN

The proposal for a beach nourishment program, as outlined in the preceding pages, relies upon the considerable technical expertise of the Army Corps of Engineers to analyze existing conditions at Ocean Beach, predict future beach widths based upon climatological changes, and develop planning strategies for long term maintenance of the recreational amenities of this national resource. Upon completion of the various tasks, implementation of the Corps recommendations will be funded by contributions from the City, GGNRA, and other state and federal sources. Nonetheless, the City recognizes the political realities that often affect the outcome of large scale projects: completed plans are still subject to funding constraints. The City is therefore proposing a contingency plan to be implemented in the event that the Corps study recommends a beach nourishment project but funding from the Federal government is not available. The City's financial contribution to this plan will be limited to the amount of money in the Beach Nourishment Fund discussed earlier. The framework developed in this contingency plan, plus additional data

generated by the Corps study, should provide enough detail to enable the City to approach potential funding sources to implement the plan without the delays normally associated with developing new plans. It is assumed that the two phases of the Corps study, the Reconnaissance and the Feasibility Report, will generate the technical data that would later be incorporated into the City's plan. The sources of a suitable supply of sand, the costs for placing it on the beach, grain sizes, and engineering details would be developed in the Corps Environment Impact Statement (EIS). The Corps would also describe the criteria necessary to trigger large scale beach nourishment.

The intent of this element of the Beach Nourishment Plan is to determine a minimum acceptable beach width, identify a "trigger" stage in beach erosion where large scale beach nourishment is necessary, and at that stage initiate nourishment of the beach in order to restore it to the maximum extent feasible depending upon the amount of money available in the Beach Nourishment Account. The City will also attempt to seek other sources of funding to augment its nourishment efforts. For example, if no federal monies were available for beach nourishment through the Corps, then the City could use whatever funds are available from the City Beach Nourishment Fund and Golden Gate National Recreation Area to approach the California Department of Boating and Waterways for matching funds.

If the need for a beach nourishment project is signalled, in accordance with Section (a) below, and if the Federal government is unable or unwilling to participate in funding, the City shall prepare for and carry out beach nourishment as follows:

a. Until the Corps study establishes a more appropriate criteria for initiating nourishment, the City shall initiate beach nourishment when the beach profile measured over 1,500 feet in length is less than 50 feet in width when measured from the seawall or present City/GGNRA boundary to MHHW during summer beach conditions as of June 1 each year.

b. The grain size of the material placed upon the beach shall match the size and distribution of sand already on the beach.

c. Subject to the availability of funding through the Beach Nourishment Fund, GGNRA, and California Department of Waterways and Boating, the amount of sand to be placed on the beach shall be 125% of the difference between the sand volume of the beach profile measured under Section (a) above and the sand volume of the predicted beach profile at the time of nourishment.

d. Nourishment shall occur between June 1 and August 30 of the following year.

2. Upland Protection

Presently, some areas of the Ocean Beach corridor are actively threatened by erosion. The City recognizes that some hard-edged protection efforts are necessary immediately and perhaps over the long in the event that sand nourishment is not a cost-effective solution for protection of the bluff edge. The City proposes to construct a seawall in the area between Noriega and Santiago as one element of protecting the upland improvements. The structure

will be a concrete seawall/promenade similar to the existing O'Shaughnessy seawall between Cliff House and Lincoln Way. (See Figure 17.) The City selected the O'Shaughnessy type wall over a rock seawall, despite its higher initial cost, for the following reasons:

Reliability: Experience over the past 60 years in the area north of Lincoln has shown that this design will protect the road from erosion in the wave environment at Ocean Beach while at the same time ensuring a beach available for public recreation.

Maintenance: The concrete seawall needs little or no maintenance while a rock revetment may need periodic repairs to function properly.

Safety: The concrete seawall includes steps and therefore is safer than the rock revetment for users such as the very young, the handicapped and elderly.

Environmental: The parapet wall would reduce blowing sand, improving conditions for people who live in the area. A rock seawall may not be effective at stopping sand.

Recreation: A pedestrian promenade next to the ocean will greatly expand opportunities for recreation for a greater range of citizens.

The Board of Supervisors has appropriated $10.0 million for the seawall. An application has been filed with the Department of Boating and Waterways for additional funding to complete the 3,500 foot high erosion area.

Equally important to the protection of threatened uplands is the ability to protect, either on an emergency or short-term basis, other upland areas that may be threatened by continued erosion. The City proposes to use engineered rock revetment to accomplish this purpose. The previous use of rubble for protection will be discontinued, and exposed rubble will be removed. In order to assure that protection with rock rather than rubble will be possible, revetment rock will be stockpiled ahead of time.

If erosion threatens to undermine the roadway in an area unprotected by the seawall by eroding the top of the bluff to within 25 feet of the road, stockpiled rock would be placed on City property on a temporary basis. A generic design and plan for rock placement is provided in Appendix G. Funds for purchase and placement of rock will be provided through the City's annual budget process.

The City will include full information in its periodic Progress Reports to the Commission on the foregoing activity and will use its best efforts to negotiate an agreement with GGNRA which will include procedures for removal of rubble and placement of rock.

3. Sand Disposal on Ocean Beach

Between 1981-1983, about 600,000 cubic yards of sand excavated from the Westside Transport construction projects were added to the beach. Their grain size ranged from 0.10 to 0.30 mm.

During the upcoming construction of the Great Highway and the seawall projects during 1986-1988, an estimated 140,000 cubic yards of dune sand will be placed on the beach. Grain size will be slightly coarser than the transport's spoils (0.15-0.45 mm).

The dune sand from Great Highway construction (about 40,000 cubic yards) will be trucked to the high erosion area south of the seawall contract work area, between Rivera and Santiago Streets.

A portion of the approximately 100,000 cubic yards of dune sand that will be excavated during the first phase of seawall construction will be used as backfill on the newly built revetment, as shown on Figure 18. Surplus sand will be distributed, first, to cover the rip-rap flanks north and south of the new seawall; second, to cover the rock access ways to the beach at Noriega and Rivera Streets; third, to extend the beach westward.

During the next 10-20 years, several additional pollution control projects are planned for construction on the City's Westside. These include the Lake Merced Transport, the Richmond Transport and the Southwest Treatment Plant. The sand in the Lake Merced Transport and Southwest Treatment Plant project areas are dune sands very similar to the sands excavated along the Westside Transport, i.e., grain size generally ranges from 0.1 to 0.3 mm. The bulk of the sands in the Richmond Transport project area are also dune sands, but there are some coarser materials in that project area. Planning for the Richmond Transport is not advanced enough to know which sands, if any, would be excavated. Neither is it known, for any of these projects, the quantities of sand that will be excavated.

A possible source of sand would be excess sand (spoils) from future construction projects within San Francisco, Although a considerable quantity of spoils is generated each year, most major construction occurs on the east side of the City, an area that is largely underlaid with Bay mud or artificial fills--materials not suitable for beach nourishment. Moreover, the quantities, qualities, and availability of suitable construction spoils cannot be foretold. Hence, this should not be considered a firm source, but only as an opportunity to exploit, should it occur.

Use of sand disposal at Ocean Beach should be considered as the cost of construction projects may be reduced and some sand in the ranges most useful for beach nourishment may be provided. However, because the sand is generally finer than the winter beach sand grain sizes, this should be considered primarily a disposal option rather than beach nourishment.

4. Sand Rearrangement

In the event that the beach in a localized area erodes, the GGNRA may request the City to move sand to the problem area from a location on the beach which has a plentiful sand reserve. The City's maintenance crews within the Department of Public Works would perform this work at GGNRA's request.

5. Relocation of the Great Highway

After much controversy, the City, GGNRA and the Commission reached agreement in 1984 to relocate the reconstructed Great Highway fifty-five feet easterly of its present location. This serves the goals of both neighborhood residents and the GGNRA. A substantial dune area will be added which will be vegetated to trap wind blown sands. As these dunes erode, supplying additional sand to the beach, the time when artificial nourishment is needed may be postponed.

By narrowing the roadway and median, the new roadway does not intrude on the park land to the east and will keep traffic noise and dust away from neighborhood residents.

Reconstruction of the roadway and recreational amenities will begin in early 1987. Access to the beach will be vastly improved. Synchronized traffic signals will slow motorists' speeds and enhance pedestrian safety at seven new grade crossings located every other block. Residents' views will be improved by lowering the roadways' elevation and a wide curvilinear recreational trail is designed to accommodate walkers, joggers and cyclists.

6. City/GGNRA Agreement

The City has responsibility for working with the GGNRA to establish joint responsibilities for long-term maintenance of the beach, including a financial contribution by GGNRA similar to the City's toward the cost of beach nourishment activities. In addition to funding, the agreement between the the City and GGNRA would discuss responsibilities regarding:

: temporary rock placement, maintenance and removal
: beach sculpting or rearrangement activities
: dune planting and other measures to control blowing sand
: permitted expenditures from City and GGNRA BNP funds
: prohibited expenditures from City and GGNRA BNP funds
: joint shoreline monitoring program

7. Monitoring Program

The width of the beach at Ocean Beach varies, sometimes dramatically,over the course of a year. It is difficult to identify a clear direction in the changes in the beach, complicating agreement over the appropriateness and timing of beach nourishment efforts. In order to make reasoned decisions about management efforts, it is important to monitor changes in Ocean Beach and in the forces affecting Ocean Beach.

SEAWALL CROSS SECTION

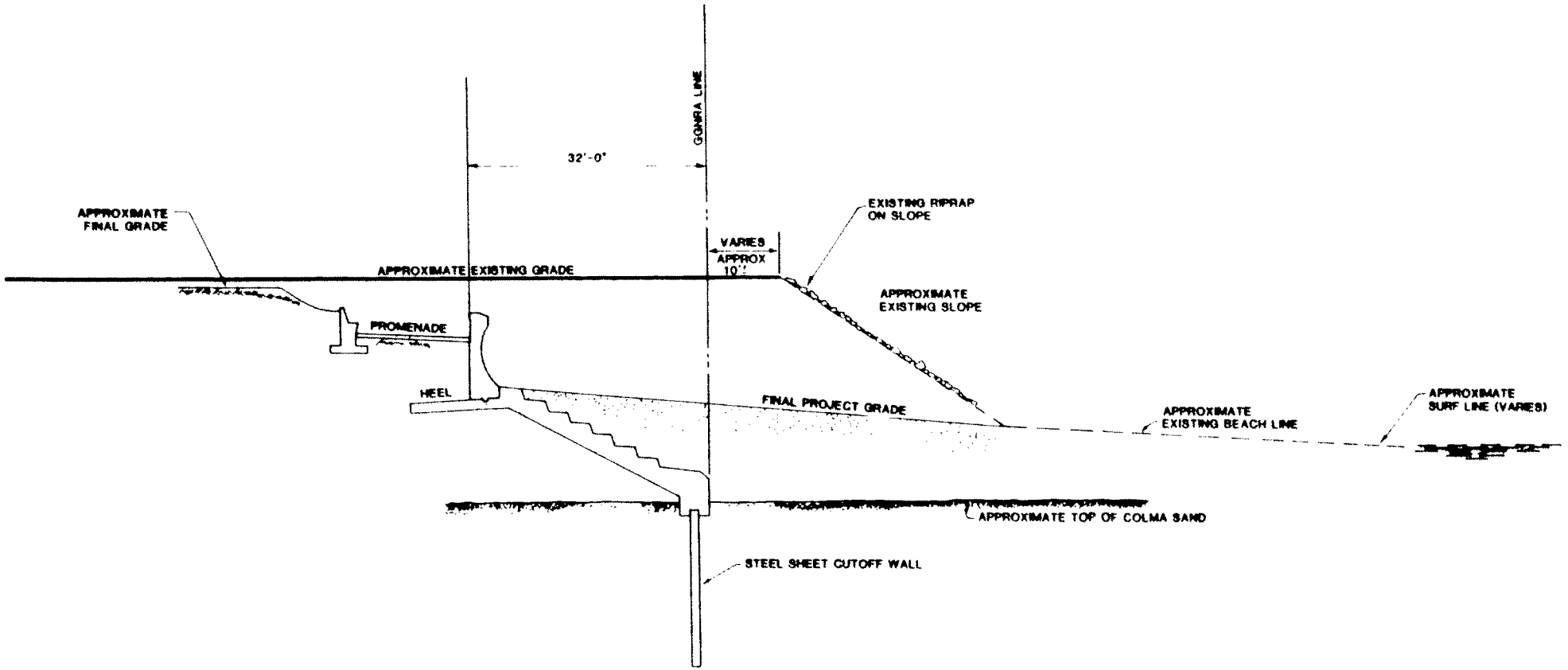

Figure 18

Present monitoring efforts will continue and the City will submit the data from its monitoring program to the Corps of Engineers for use in its Study of Ocean Beach. Further, the City will ask the Corps to evaluate the monitoring program to assure it is reasonably related to the collection of information pertinent to the management of Ocean Beach. Thus, the establishment of a plan of study for the Corps' study represents an important benchmark in evolution of the monitoring program.

8. Schedule

The estimated schedule for implementing the key elements outlined in this plan is provided below. An updated schedule will be included in the Progress Reports the City will submit to the Coastal Commission.

City's Estimated
Milestone Schedule

		Start	Complete
1.	Board of Supervisors establishes Beach Nourishment Plan Trust Fund; approves other elements of Beach Nourishment Plan	10/29/86	12/8/86
2.	City requests Corps of Engineers to reactivate Congressional authorization for the study of shoreline erosion at Ocean Beach	10/29/86	12/8/86
3.	Monitor progress of Corps of Engineers Study,		
	o Phase I	2/87	2/88
	o Phase II	2/88	2/90
4.	Negotiations with GGNRA regarding joint agreement on long term maintenance of the Ocean Beach corridor	11/1/86	5/1/87
5.	Progress reports submitted monthly to Commission until completion of the Great Highway; semiannually thereafter	2/15/87	N/A

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Ocean Beach
1976-1985

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APPENDIX A
Selected
Coastal Commission Permit Conditions
July 1979

"Future Shoreline Protection Measures

All existing rubble shall be removed from the beach between Lincoln Way and the shoreline in front of the proposed pump station. Future placement of riprap or rubble is prohibited. The City shall place at least one row of monuments, markers, or other distinguishable features 50 feet west of the highway-transport alignment at a depth of 20 feet above mean sea level. The markers shall be permanent construction and located every 50 feet. When these features are exposed, the City shall replenish the lost sand, replace and contour the dunes 50 feet seaward of the roadway/transport's west wall. Implementation and enforcement of this condition shall be evidenced by a binding Clean Water Grant condition which requires the City Wastewater Revenue Program to provide an annual fund adequate to provide at least 100,000 cubic yards of sand."

Among the other conditions imposed by the Commission were the following:

"Placement of Suitable Excavated Material on Beach

"Excavated material from any onshore construction site that is not needed for backfill, berm construction, or other on-site work, shall be placed on the beach landward of the surf zone, if it meets National Park Service standards for beach nourishment materials. Materials excavated offshore during outfall construction shall be deposited so as to provide the maximum benefit to the Ocean Beach littoral system. The site of deposition shall be determined by an independent coastal engineer selected by the City and approved the by Executive Director. This sand shall be deposited consistent with a plan approval in advance by the National Park Service.

"No Sand Removal from Beach

As of the effective date of this Commission action, sand removal from the beach shall be prohibited. Any sand that accumulates on streets or any other surface other than the beach or dunes, shall be collected and placed on the beach, landward of the surf zone as directed by the National Park Service.

"Dune Planting

The contractor shall provide an irrigation system and guarantee the success of dune planting for a period of five years. Design of the irrigation system, final contours, planting and fertilization schedules, and plant selection shall be approved by the National Park Service.

"Monitoring of Offshore Processes

The City shall be responsible for a program of collecting data on coastal processes and for making the information available to interested parties.

The program tasks and operating details are described more fully in Exhibit 20 and shall be approved by the Executive Director. At a minimum the program shall include measurement of deep-water and nearshore wave conditions for a period of five years, quarterly measurement of beach profiles at four locations during construction and for five years after the dunes are graded to their final contour, analysis of beach sand sizes, aerial photography, offshore hydrography, and daily visual observations of the littoral environment. A less extensive program shall be continued indefinitely. The National Park Service shall be encouraged to participate in this program to the maximum extent feasible.

"Annual Beach Nourishment

The City shall use its best efforts to implement the Corps of Engineers S.F. Bar Dredge spoil dumping within the littoral system of Ocean Beach. The Commission staff is authorized to assist in this effort in any way possible.

"Relocation of Westside Transport and Restored Great Highway

Consistent with the City's proposed alignment, transport shall be located with the mid point of the structure 108 feet east of the west curb of the existing upper Great Highway. No part of the reconstructed highway shall be west of the transport's west wall. Similarly, the restored recreational corridor shall be shifted to the east in the same manner as the restored Great Highway provided that all features of the restored recreational corridor shall be consistent with plans on file in the application except for the location in relation to the shoreline. The highway itself shall be up to four lanes with two bike lanes and the curvilinear configuration modified to fit within these constraints."

APPENDIX B
Selected
Coastal Commission Permit Conditions
January 1981

"All visible rubble located seaward of the 50 foot markers referred to below shall be removed from the beach as part of the recreational restoration of the Great Highway;

Future placement of riprap or rubble is prohibited;

Prior to the commencement of any construction of the Westside Storage and Transport Structure between Lincoln Way and Sloat Boulevard, the City shall submit for the review and approval of the Executive Director a beach nourishment plan. This plan shall be revised to incorporate additional information and resubmitted to the Commission and the GGNRA every 5 years on January 1 commencing in 1985 for approval or possible revision. The purpose of this plan is to describe in detail how the beach will be managed to protect the line described by the row of monuments required below, to protect the natural appearing qualities and recreational amenities of Ocean Beach and to minimize the amount of sand blown onto the highway and into residential areas. This plan, as approved by the Commission and the GGNRA will serve as the basis for activities financed by the escrow fund described below;

The City shall place at least one row of monuments, markers, or other distinguishable features 50 feet west of the highway transport alignment at a depth of 20 feet above mean sea level. The markers shall be of permanent construction and located every 50 feet. When these features are exposed, the City shall replenish the lost sand, replace and contour the dunes and re-establish appropriate vegetation in accordance with Specific Project Condition 5 to a point at least 50 feet seaward of the roadway/transport's west wall.

To carry out the Beach Nourishment Plan, the City shall deposit $5.4 million dollars into an escrow or trust agreement or execute a bond assuring payment within 120 days of this approval in a form approved on behalf of the Commission by the Executive Director prior to commencement of any construction of the Westside Storage and Transport Structure (Contracts W-1). It is intended that this escrow fund shall be used solely for beach nourishment/restoration efforts and not used to carry out other conditions of the Specific Project approval.

The City shall use its best efforts to obtain additional funding to carry out the Beach Nourishment Plan from the state and federal government in order to insure the perpetual protection of Ocean Beach and its recreational qualities."

APPENDIX C

1981 California Laws, Chapter 1007, Section 5.

"(a) Notwithstanding the provisions of Division 20 (commencing with Section 30000) of Public Resources Code or of any term of condition attached to a coastal development permit issued pursuant thereto, the escrow account established to provide funding for the Beach Sand Replenishment Program required in connection with the San Francisco Westside Transport Phase of the San Francisco Wastewater Management Program is hereby terminated. The money in this account shall revert to the City and County of San Francisco.

(b) Any money received by the City and County of San Francisco from any state or federal agency after January 1, 1982 for purposes of a beach sand replenishment program in connection with that project shall be reserved and expended solely for such purposes.

(c) The City and County of San Francisco shall prepare a beach nourishment plan designed to counter the effect of future erosion which can be anticipated at the site of the San Francisco Westside Transport Phase of the San Francisco Wastewater Management Program. The plan shall ensure protection of the structural integrity of the ocean outfall of the treatment plant and shall also ensure the integrity of the beach area as a recreational resource. The plan shall contain or provide for appropriate funding of beach restoration measures if, or when, such measures become necessary. The City and County of San Francisco shall contribute six hundred twenty-five thousand dollars ($625,000) to the implementation of this plan.

(d) The beach nourishment plan prepared pursuant to subdivision (e) shall be submitted to the State Water Resources Control Board for a determination that it is adequate to ensure the structural integrity of the ocean outfall of the treatment plant. The plan shall also be submitted to the California Coastal Commission for a determination that is adequate to ensure the integrity of the beach area as a recreational resource. The respective determinations required by this subdivision shall be made by a majority vote of the membership of each body.

(e) The Westside Transport Phase of the San Francisco Wastewater Management Program shall not be approved for operation until the determinations required by subdivision (d) have been made.

(f) The Legislature hereby finds and declares that a general statute cannot be made applicable to the circumstances requiring the enactment of this section."

APPENDIX D
Coastal Commission Permit Conditions
1984

"Prior to commencement of construction of the Great Highway or seawall, the City shall submit a Beach Nourishment Plan for the review of the Coastal Commission and a determination by a majority vote of the membership of the Commission that the plan is adequate to ensure the integrity of the beach area as a recreational resource. The Beach Nourishment Plan, as required by Section 5, Chapter 1007, 1981 California Laws, shall be designed to counter the effect of future erosion and shall ensure the integrity of Ocean Beach as a recreational resource. The City shall contribute up to $100,000 toward the preparation of this plan. (This shall be in addition to the existing monitoring requirements pursuant to original Condition 12.) The Beach Nourishment Plan shall contain or provide for appropriate funding of beach restoration measures. The City and County of San Francisco shall contribute a minimum of six hundred twenty-five thousand dollars ($625,000) to the implementation of this plan. The extent of additional contribution by the City beyond $625,000 to the implementation of the plan shall be established in the plan itself. The plan shall be promptly implemented following approval by the Coastal Commission.

"Excess sand produced by excavation for the seawall or the new Great Highway shall be placed seaward of the new highway, if consistent with the Beach Nourishment Plan described above. Placement of sand on GGNRA property shall have the approval of the National Park Service. Beach grass of other plants and sand fences or similar measures to control blowing sand, as approved by the National Park Service, shall be installed on any exposed sand areas.

"Relocation of Westside Transport and Restored Great Highway. The reconstructed Great Highway shall be a straight four-lane road, of which the western edge shall be located approximately 55-60 feet east of the Golden Gate National Recreation Area/City boundary line. The roadway shall be approximately 70 feet in width. The easterly edge of the reconstructed Great Highway shall be approximately the same distance from the Lower Great Highway as the edge of the old Great Highway (approximately 80-100 feet).

"At-grade pedestrian crossings of the reconstructed Great Highway shall be provided at approximately every other block between Lincoln Way and Sloat Boulevard. Pedestrian access from the west side of the reconstructed Great Highway to the beach shall be provided at intervals of every block (approximately 700 feet) where the seawall is constructed or every other block (approximately 1,400 feet) where the seawall is not constructed. A recreational trail approximately 14 feet in width shall be located east of the Great Highway.

"Future Shoreline Protection Measures

A concrete seawall shall be constructed along all or a part of the shoreline identified as high or moderate erosion areas in the report entitled: "Great Highway - Ocean Beach Coastal Engineering Report - Seawall Design" - (Noble Coastal and Harbor Engineering, Ltd., July 9, 1985). The seawall shall be of a stepped design with a cutoff wall on the seaward side with the configuration and approximate dimensions recommended by the above-cited report (see p. 23). The configuration of the wall shall include:

a. Cutoff wall pile cap elevation at 6.0 feet MLLW. Bottom of the cutoff wall at -6.0 feet MLLW or lower.

b. A bench approximately seven feet or more in width between the cutoff wall and the stepped slope.

c. A 1:2 stepped slope.

d. Top of the stepped slope at approximately 17.1 feet MLLW.

e. Berm (or platform) at top of stepped slope.

f. Curved or angled wave screen with a top elevation of approximately 27.2 feet MLLW.

g. The total width of the seawall in cross-section shall not exceed 38 feet, not counting the landside promenade.

Where the concrete seawall is constructed, any visible existing rubble shall be removed from the beach. Future placement of rubble is prohibited. The City shall place markers and perform sand replenishment as previously required unless specifically modified during Commission review and approval of the Beach Nourishment Plan."

SEP 10 [illegible]

APPENDIX e

STATE WATER RESOURCES CONTROL BOARD
RESOLUTION NO. 86-

APPROVAL IN CONCEPT OF THE CITY AND COUNTY OF SAN FRANCISCO'S BEACH NOURISHMENT PLAN FOR OCEAN BEACH

WHEREAS:

1. The City and County of San Francisco received $78 million in state and federal funds to construct the Westside Transport Project along the Great Highway (Clean Water Grant Project No. C-06-[illegible]3-13).

2. 1981 Statutes of California (Uncodified) Chapter 1007, Section 5, requires the Beach Nourishment Plan prepared pursuant to subdivision (e) shall be submitted to the State Water Resources Control Board (SWRCB) for a determination that it is adequate to ensure the structural integrity of the ocean outfall of the treatment plant.

3. 1981 Statues of California (Uncodified) Chapter 1007, Section 5, requires that the Westside Transport Phase of the San Francisco Wastewater Management Program shall not be approved for operation until the Beach Nourishment Plan is approved by the SWRCB and the California Coastal Commission.

4. The City and County of San Francisco has employed recognized experts in the field of coastal engineering to develop the Beach Nourishment Plan for Ocean Beach.

5. The Division of Clean Water Grants staff considers San Francisco's commitment to a phased sea wall construction program to be a prudent course of action that will protect the structural integrity of the onshore grant funded facilities along Ocean Beach.

THEREFORE BE IT RESOLVED:

That the Beach Nourishment Plan for Ocean Beach, prepared by the San Francisco Clean Water Program, be approved as a plan protecting the beneficial uses of the waters of the state.

CERTIFICATION

The undersigned, Administrative Assistant to the Board, does hereby certify that the foregoing is a full, true, and correct copy of a resolution duly and regularly adopted at a meeting of the State Water Resources Control Board held on September 18, 1986.

Maureen Marche'
Administrative Assistant to the Board

DRAFT

APPENDIX F
Proposed Ordinance and Resolution Establishing
Beach Nourishment Plan Fund

Be it ordained by the People of the City and County of San Francisco:

Section 1. Chapter 10 of the San Francisco Administrative Code is hereby amended by adding Section 10.117-62 thereto to read as follows:

SEC. 10.117-62. Beach Nourishment Plan Fund.

(a) Establishment of Fund. There is hereby established a special fund in the Treasury of the City and County of San Francisco for the purpose of funding a beach nourishment plan for Ocean Beach submitted to and approved by the California Coastal Commission. This special fund shall be known and designated as the Beach Nourishment Plan Fund. Monies deposited in this special fund shall consist of $675,000 appropriated by the Board of Supervisors in Ordinance No. 40-81 for the purpose of funding a sand replenishment project at Ocean Beach.

(b) Appropriation of Monies. The monies in the fund, including interest earnings, are hereby appropriated exclusively for the purpose set forth in subsection (e) of this section. The total amount of monies to be expended from this fund shall not exceed $2 million.

(c) Interest. Interest earned from the fund shall become part of the principal thereof, and not be expended for any purpose other than those set forth in subsection (e) of this section. Notwithstanding the above, whenever the total deposits of principal and interest earnings reach $2 million, subsequent interest earnings shall be transferred to the Clean Water Program Operating Fund.

(d) Accrual of Monies in Fund. The balance remaining in the fund at the close of any fiscal year shall be deemed to have been provided for a specific purpose within the meaning of Section 6.306 of the Charter and shall be carried forward and accumulated in the fund for the purposes recited herein.

(e) Authorization to Expend. The Director of Public Works and Clean Water Program may approve expenditures from the fund for the following purposes:

(1) Payment of any local or City share of the cost of a study of shoreline erosion at Ocean Beach to be undertaken by the United States Army Corps of Engineers.

(2) Payment of any local or City share of the cost of the implementation by the United States Army Corps of Engineers of a beach nourishment project.

(3) Payment of the cost of planning, designing, and implementing a beach nourishment project in the event the United States Army Corps of Engineers refuses or is unable to undertake the study mentioned in subsection (1) above.

Section 2. Release of Reservation of Funds. This Board of Supervisors hereby removes the reservation of funds contained in Ordinance No. 40-81 and directs that the funds appropriated by said ordinance for Ocean Beach sand replenishment purposes be deposited in the Beach Nourishment Plan Fund established by Section 2 of this ordinance.

WHEREAS, The California Coastal Commission has required approval of a beach nourishment plan for Ocean Beach prior to the commencement of reconstruction of the Great Highway; and

WHEREAS, the City has received a grant from the U.S. Environmental Protection Agency and the State Water Resources Control Board and this Board of Supervisors has enacted Ordinance No. 266-86 appropriating funds for reconstruction of the Great Highway; and

WHEREAS, the Great Highway reconstruction project has been redesigned in accordance with previous Board of Supervisors resolutions and Coastal Commission permit conditions and has been advertised for receipt of construction bids; and

WHEREAS, This Board of Supervisors enacted Ordinance No. 40-81 appropriating $675,000 for the City's share of a $5.4 million sand replenishment program, the remainder of which the Environmental Protection Agency and the State Water Resources Control Board promised to fund through the award of a grant; and

WHEREAS, Environmental Protection Agency and the State Water Resources Control Board subsequently withdrew their commitment of grant funds for the sand replenishment project; and

WHEREAS, The U.S. Army Corps of Engineers is the appropriate agency with expertise in shoreline erosion problems and beach nourishment projects; and

WHEREAS, The beach areas of the Ocean Beach recreational corridor, which is under the control of the United States of America acting by and through the Golden Gate National Recreation Area, annually serves over 2 million visitors from many parts of the world; and

WHEREAS, Golden Gate National Recreation Area officials have stated that they are committed to the maintenance of this beach as a national recreational resource; and

WHEREAS, It would be advantageous to promptly delineate the respective responsibilities of the City and the Golden Gate National Recreation Area for the long term maintenance of the Ocean Beach recreational corridor following reconstruction of the Great Highway; and

WHEREAS, The State of California has an interest in protecting its ocean shoreline for public use as a recreational asset; and

WHEREAS, the City expects to receive full cooperation, participation and support for its efforts from the Coastal Commission and the Golden Gate National Recreation Area; and

WHEREAS, This Board of Supervisors has been requested to enact an ordinance establishing a special fund to be known as the Beach Nourishment Plan Fund for the purpose of implementing a beach nourishment program; and

WHEREAS, The purposes of the Beach Nourishment Plan Fund and Ordinance No. 40-81 are the same; and

WHEREAS, The Beach Nourishment Plan Fund enabling legislation contemplates that the $675,000 appropriated by Ordinance No. 40-81 be deposited in the fund; now, therefore, be it

RESOLVED, That it shall be the policy of this Board of Supervisors that the City affirmatively pursue all feasible options for development of a beach nourishment project at Ocean Beach to be used in conjunction with a Beach Nourishment Plan Fund established by this Board of Supervisors; and be it

FURTHER RESOLVED, That it is the policy of this Board of Supervisors that the City should request the United States Army Crops of Engineers to undertake a study of shoreline erosion at Ocean Beach and to design and implement a beach nourishment project; and be it

FURTHER RESOLVED, That the Mayor is hereby authorized to urge Congress to provide funding for a comprehensive beach nourishment project for the protection of resources and facilities of regional and national importance and to seek similar funding from appropriate state agencies; and be it

FURTHER RESOLVED, That the Chief Administrative Officer is hereby authorized to enter into negotiations with Golden Gate National Recreation Area for the purposes of delineating mutual long-term maintenance responsibilities for Ocean Beach and securing the financial participation of Golden Gate National Recreational Area in conjunction with the City's use of its Beach Nourishment Plan Fund.

APPENDIX G

Generic Design and Plan for
Temporary Rock Placement

The attached figure shows the basic concept for the placement of material. The concept involves a 2 foot toe trench, a layer of filter fabric, and one layer each of "A" and "B" stone. The height of the protection is 10 feet, or about 18 feet along the slope. Construction guidance includes the following:

1. Place material on slope 1:1.5 or flatter. If the slope is steeper perform minimum shaping to attain 1:1.5 slope, or place additional rock material at the bottom of the slope.

2. Place filter fabric loosely on slope. Do not stretch the material. Material can be rolled out in either direction. Obtain a 3 foot overlap of material at any joint.

3. Place rock with loader from the beach. Drop rock from lowest height to avoid rupturing material.

The above plan assumes there is time to actually place the material. Most of the time during critical erosion, weather and tidal conditions do not allow following the above procedure. Most often material is just dumped over the bluff. Therefore, it is acceptable to dump the "A" Stone over the bluff to meet an immediate need. As soon as conditions permit, the dumped stone should be reclaimed and the above procedure followed:

"A" Stone (3 ton)

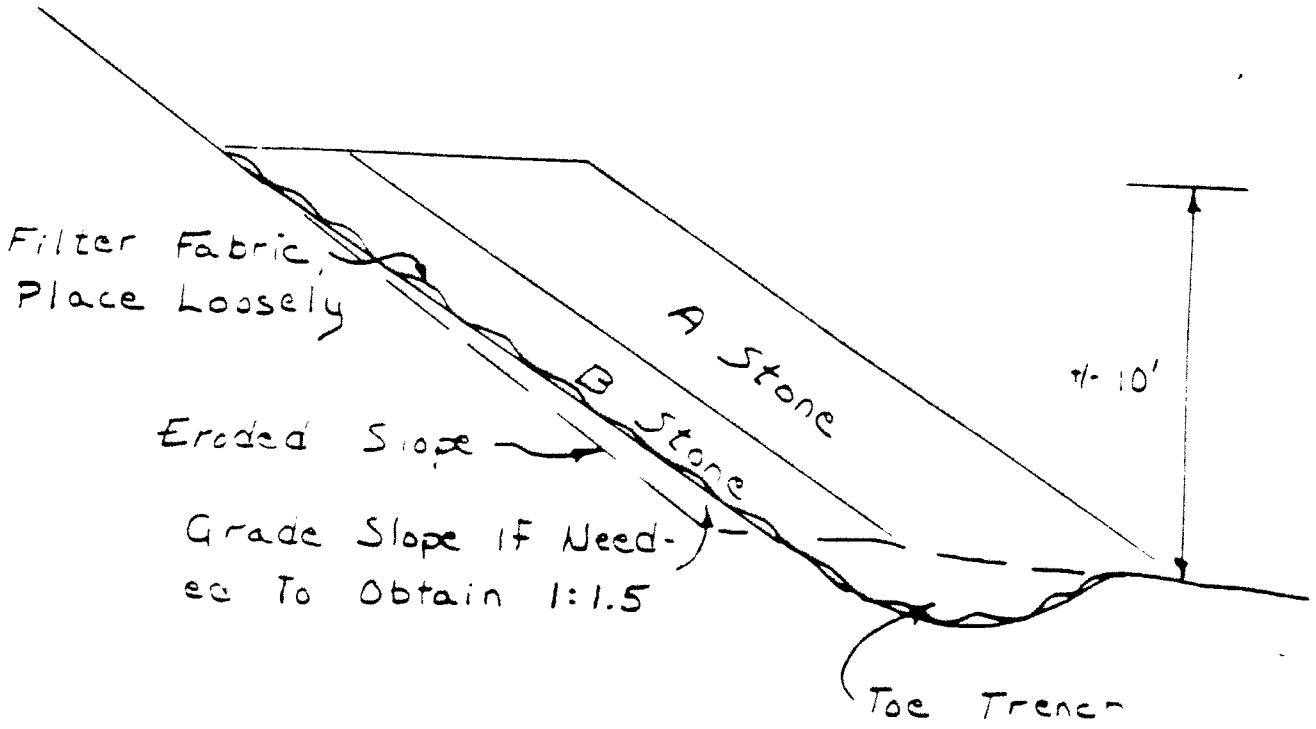
Nominal Size (feet)	Weight (lbs)	Requirement Percent Larger
4.1	10,000	0 - 5
3.7	5,500	50 - 95
3.3	4,000	90 - 100

"B" Stone (400 lb)

Nominal Size (feet)	Weight (lbs)	Requirement Percent Larger
2.2	1,000	5 - 20
1.5	400	50 - 90
1.3	250	90 - 95

Ocean Beach

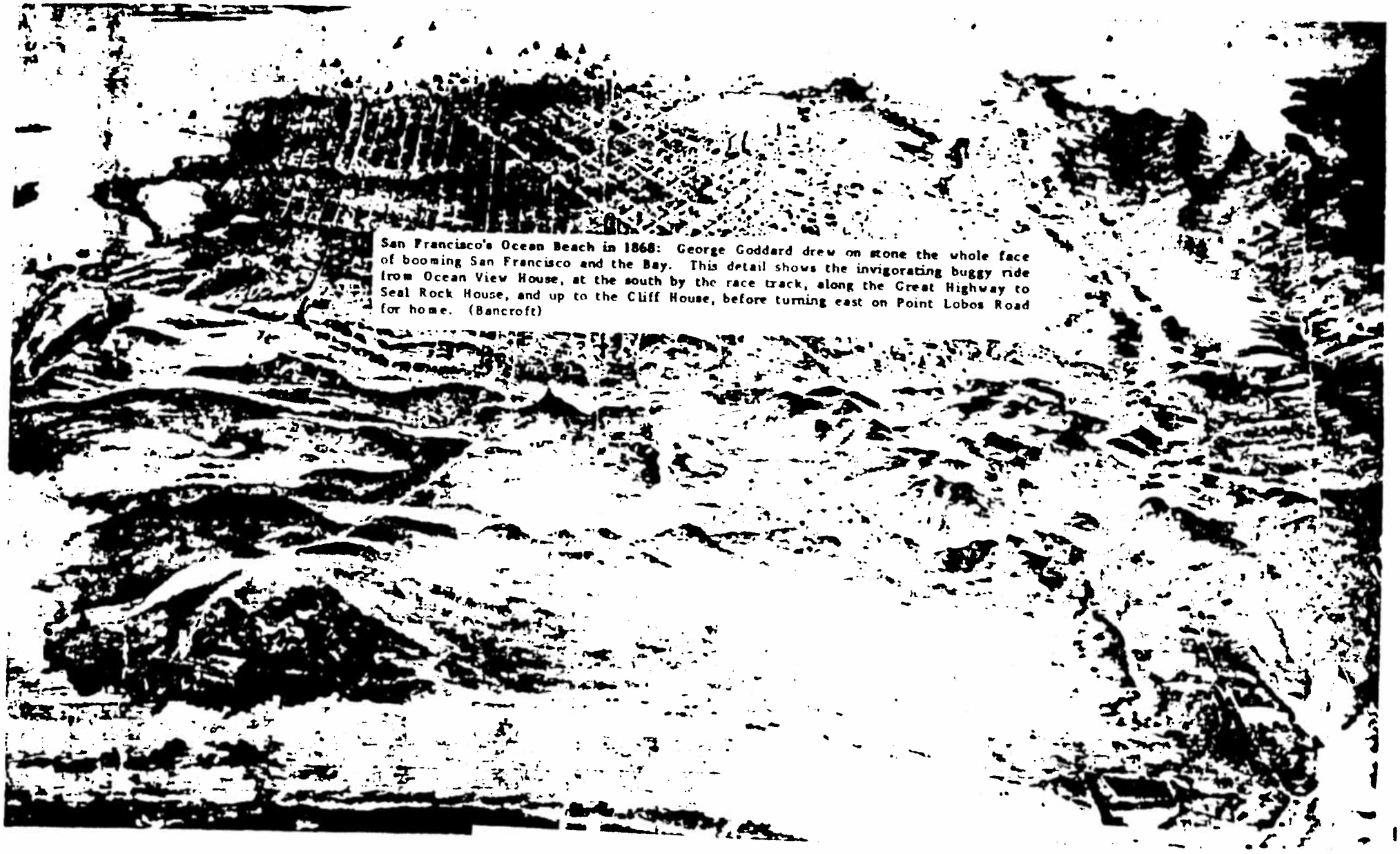
Temporary Shoreline Protection



501-07

10/24/86

NC&HE LIMITED



San Francisco's Ocean Beach in 1868: George Goddard drew on stone the whole face of booming San Francisco and the Bay. This detail shows the invigorating buggy ride from Ocean View House, at the south by the race track, along the Great Highway to Seal Rock House, and up to the Cliff House, before turning east on Point Lobos Road for home. (Bancroft)

Figure 1

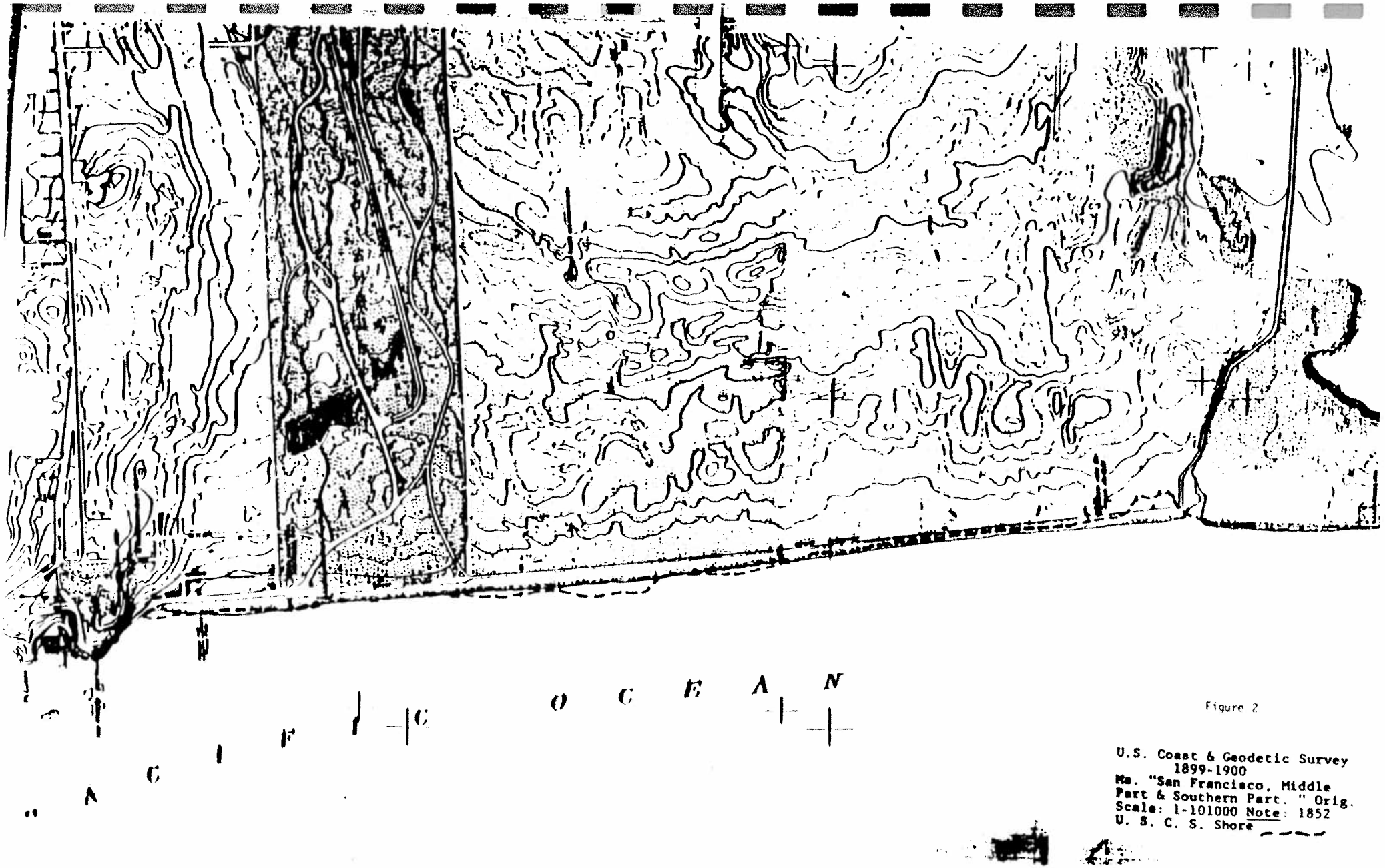


Figure 2

U.S. Coast & Geodetic Survey
1899-1900
Ms. "San Francisco, Middle
Part & Southern Part. " Orig.
Scale: 1-101000 Note: 1852
U. S. C. S. Shore

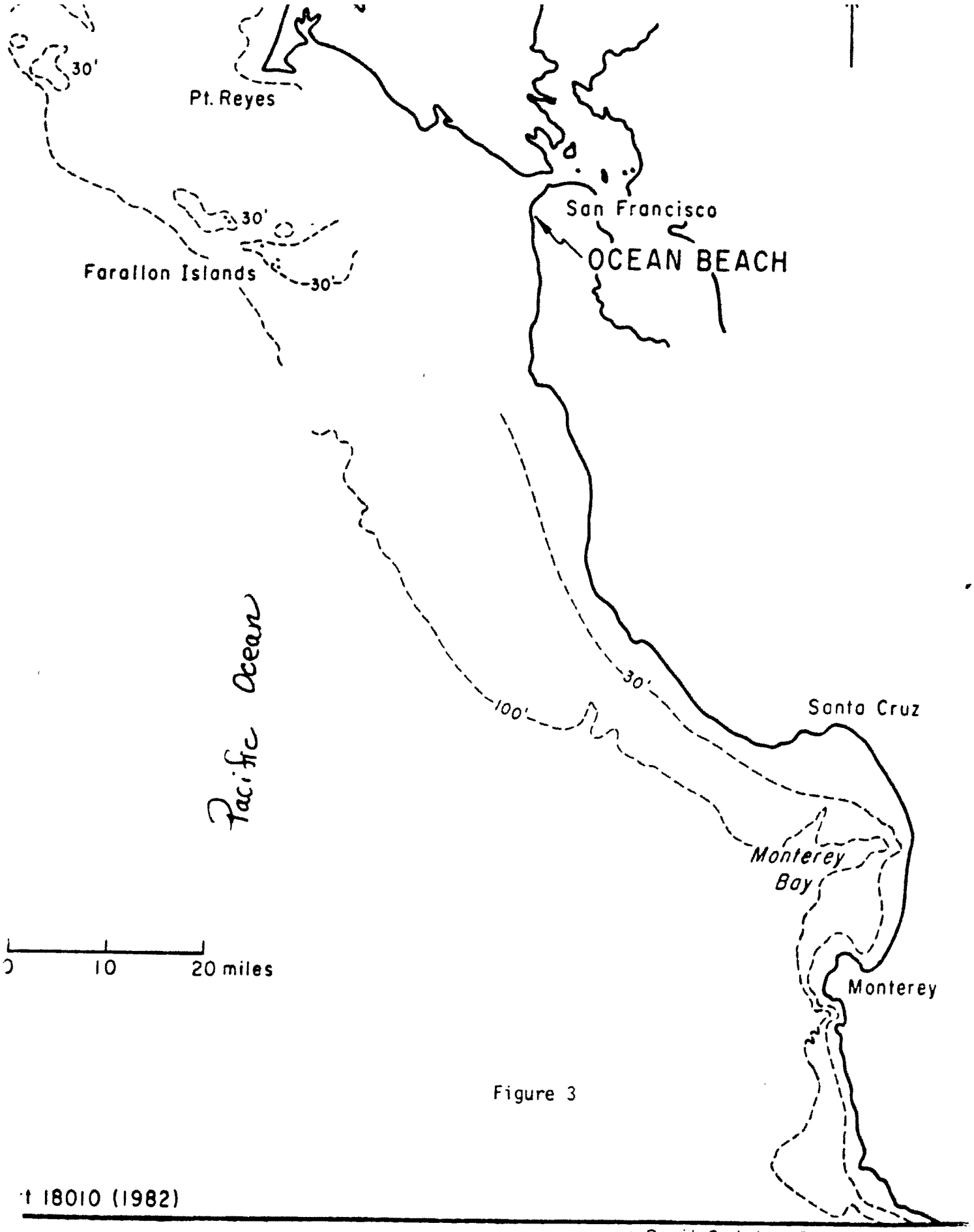


Figure 3

t 18010 (1982)

Cyril Galvin, Coastal Engine

COASTAL EXPOSURE OF OCEAN BEACH

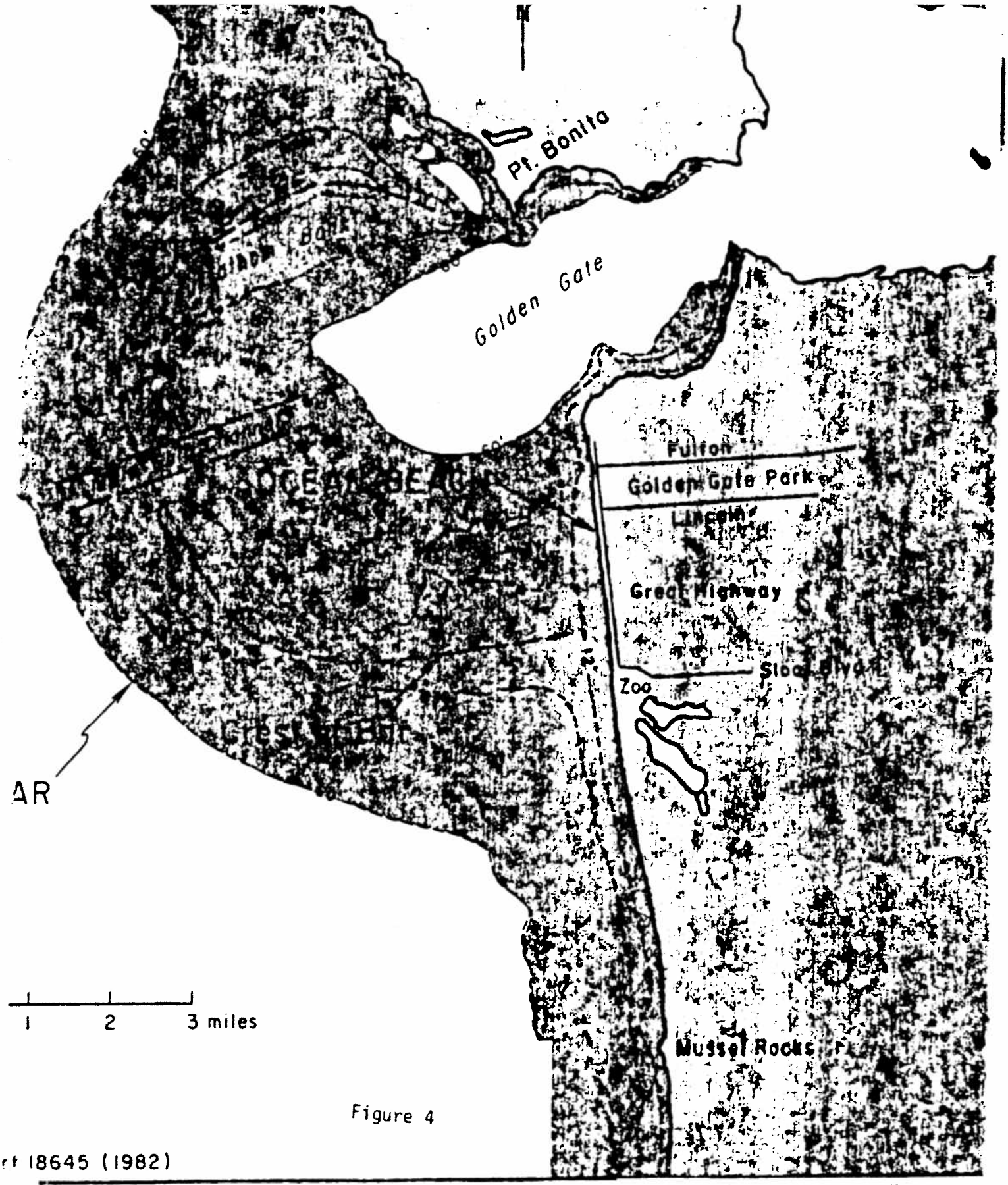


Figure 4

rt 18645 (1982)

Cyril Galvin, Coastal Engineer

SAN FRANCISCO BAR IN RELATION TO OCEAN BEACH

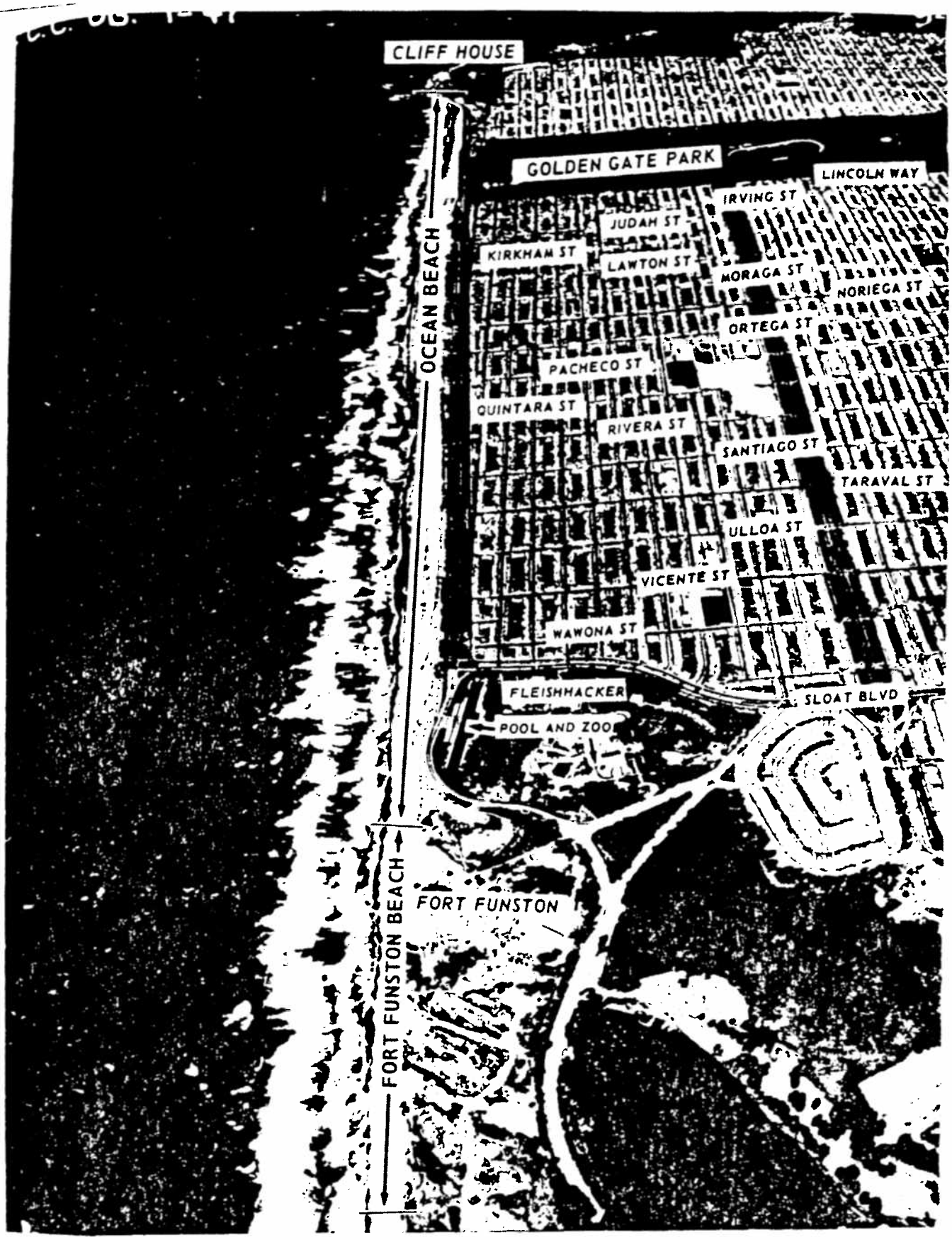


Figure 5 – OCEAN AND FORT FUNSTON BEACHES

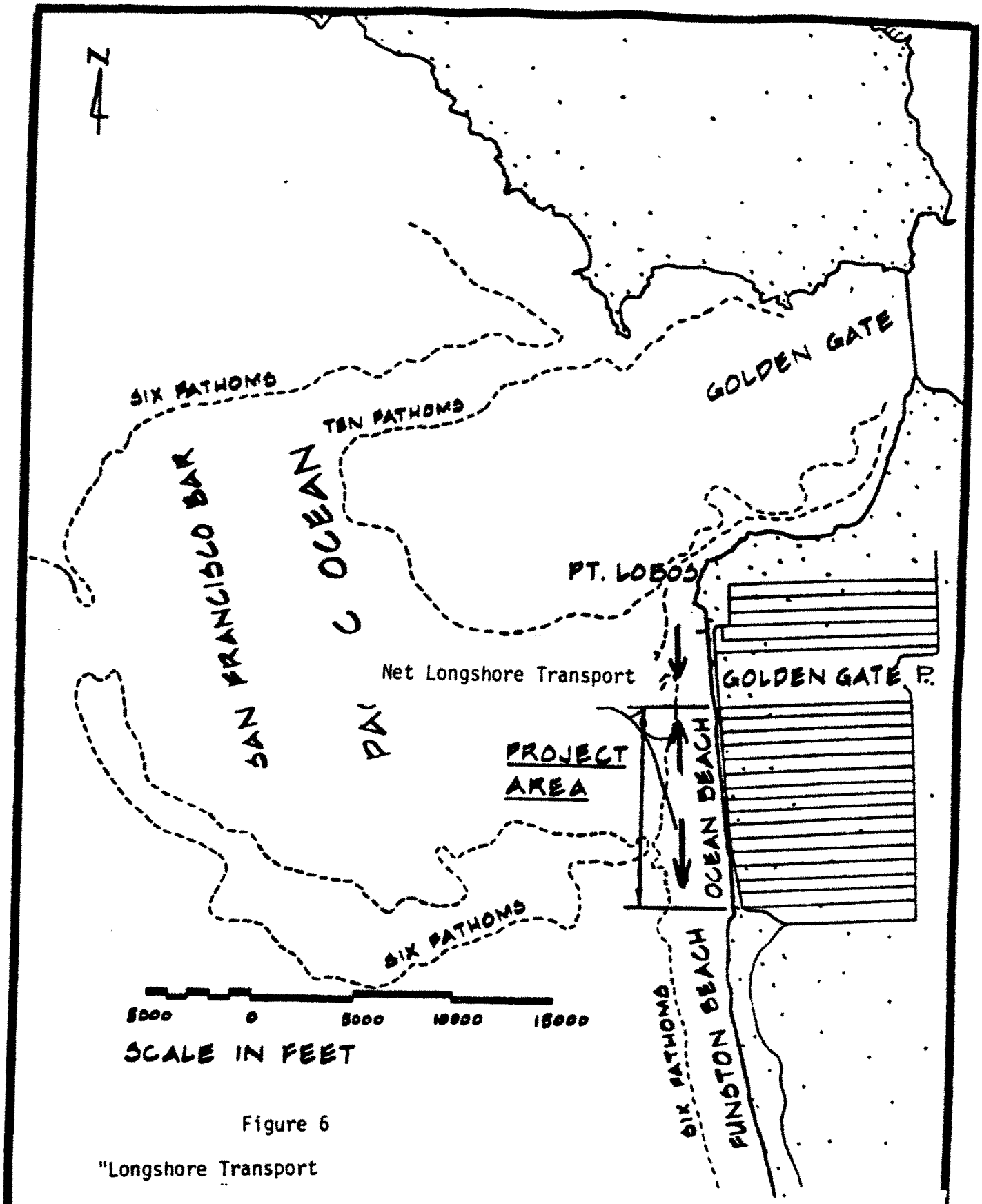


Figure 6

"Longshore Transport

NC&HE LIMITED

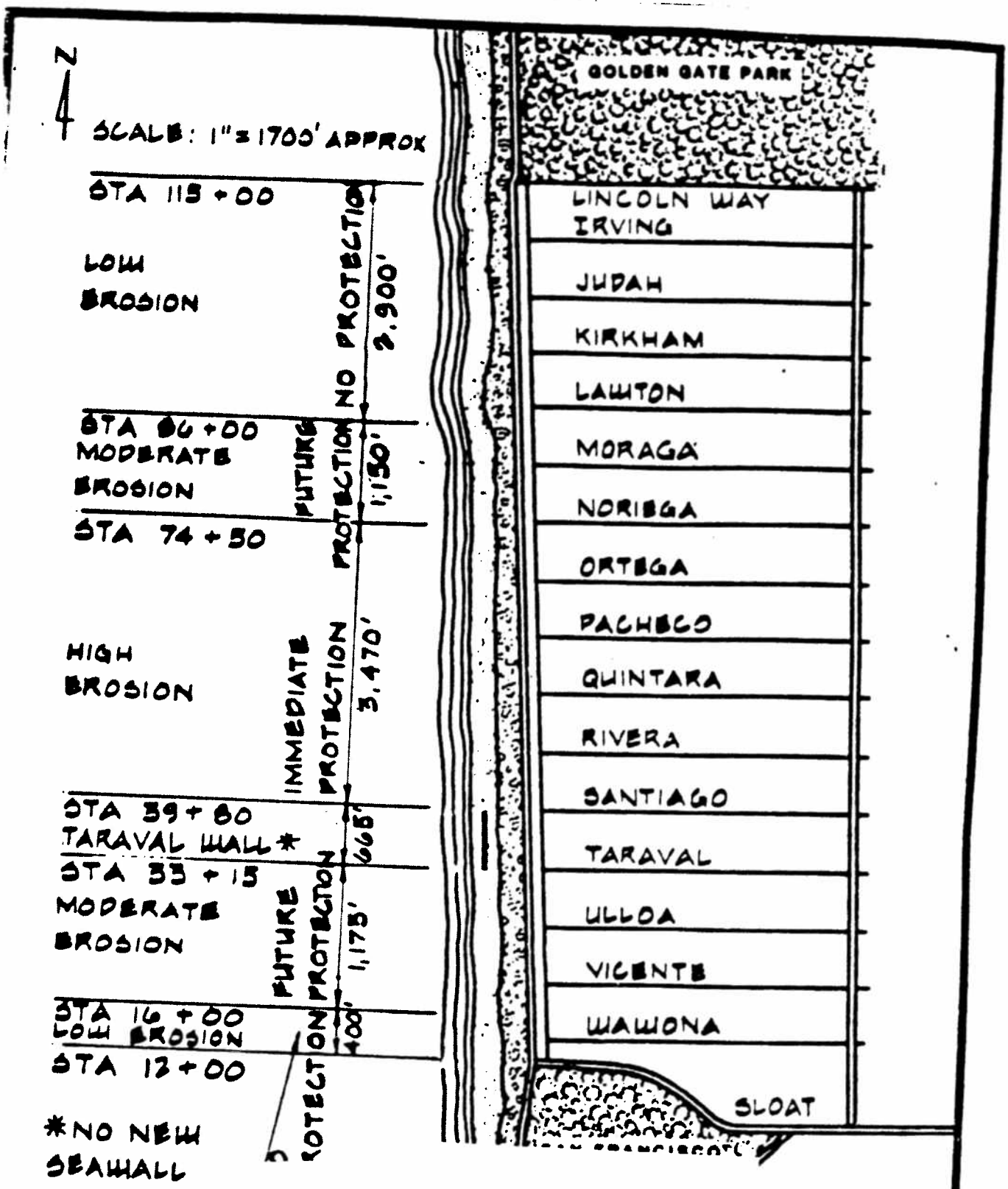
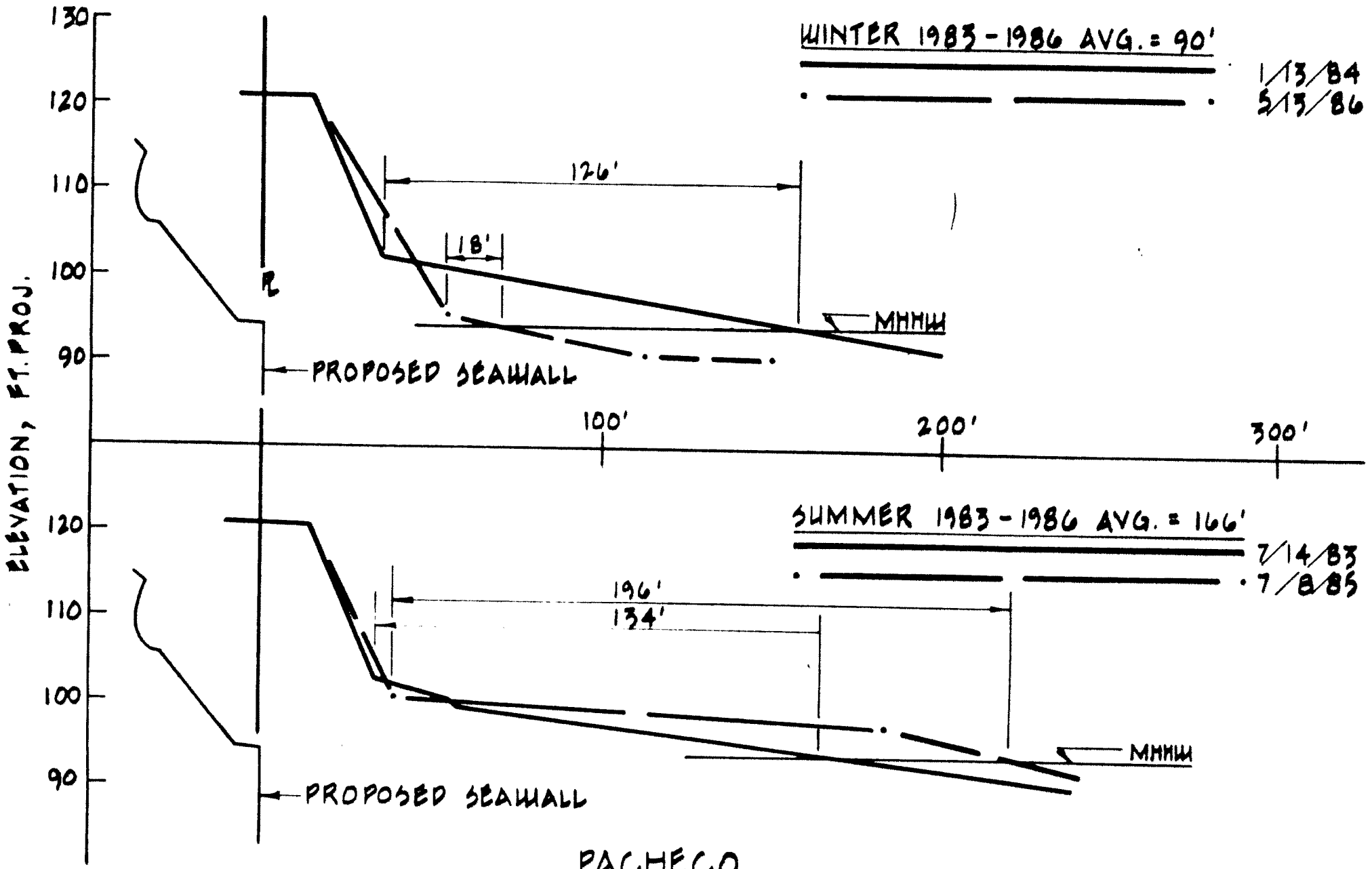


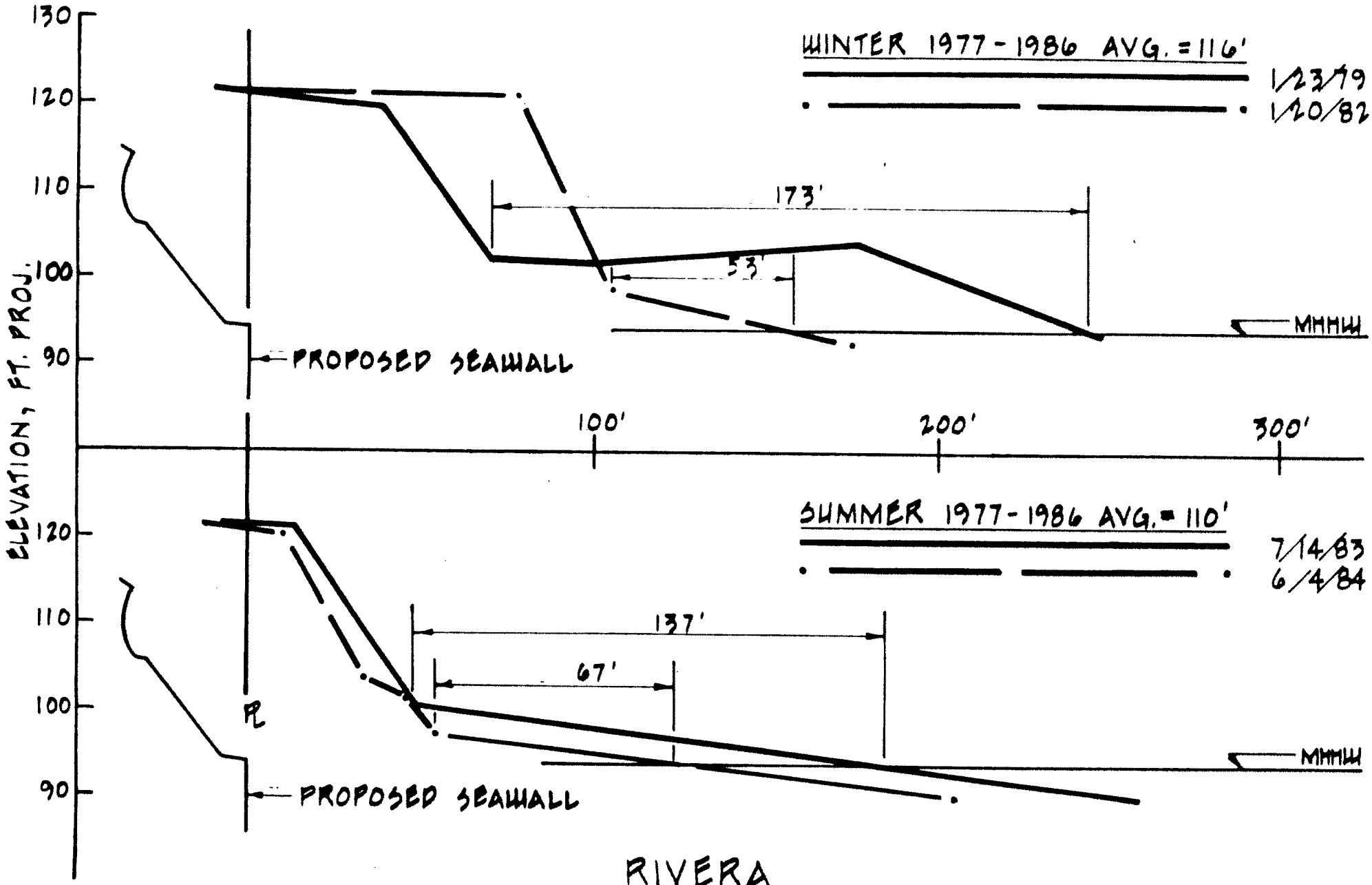
Figure 7

NCHE LIMITED



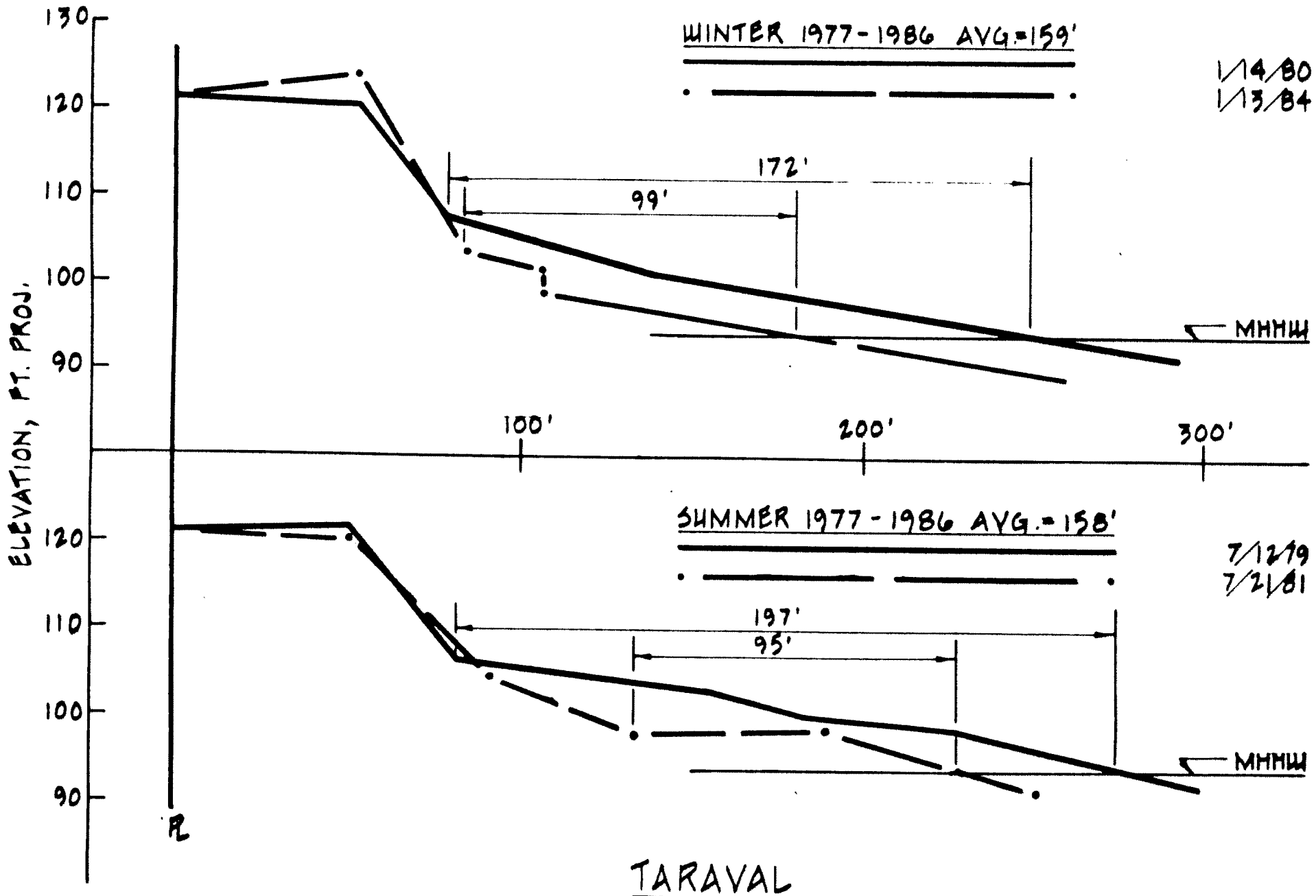
PACHECO

FIGURE 8



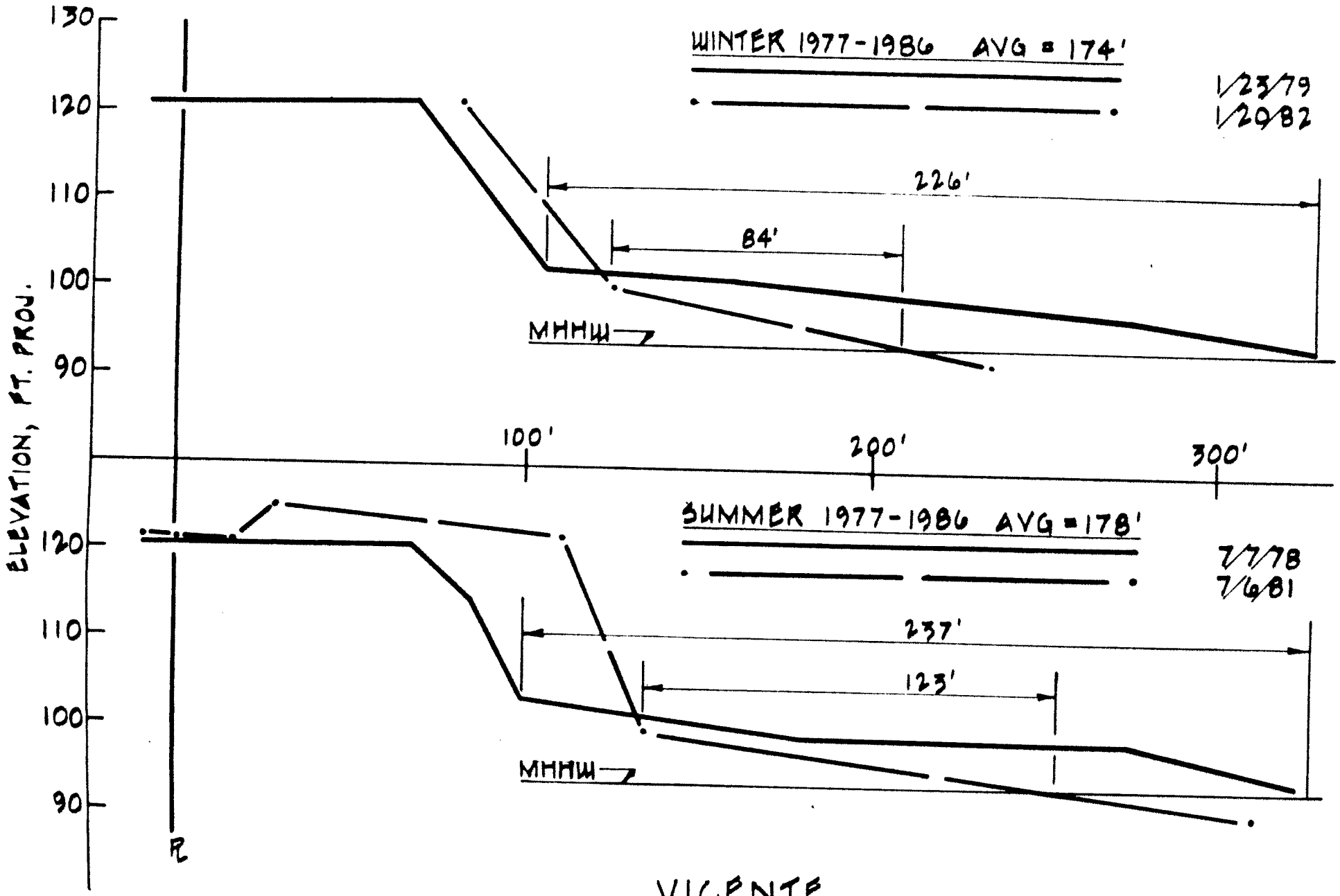
RIVERA

FIGURE 9



TARAVAL

FIGURE 10



VICENTE

FIGURE 11

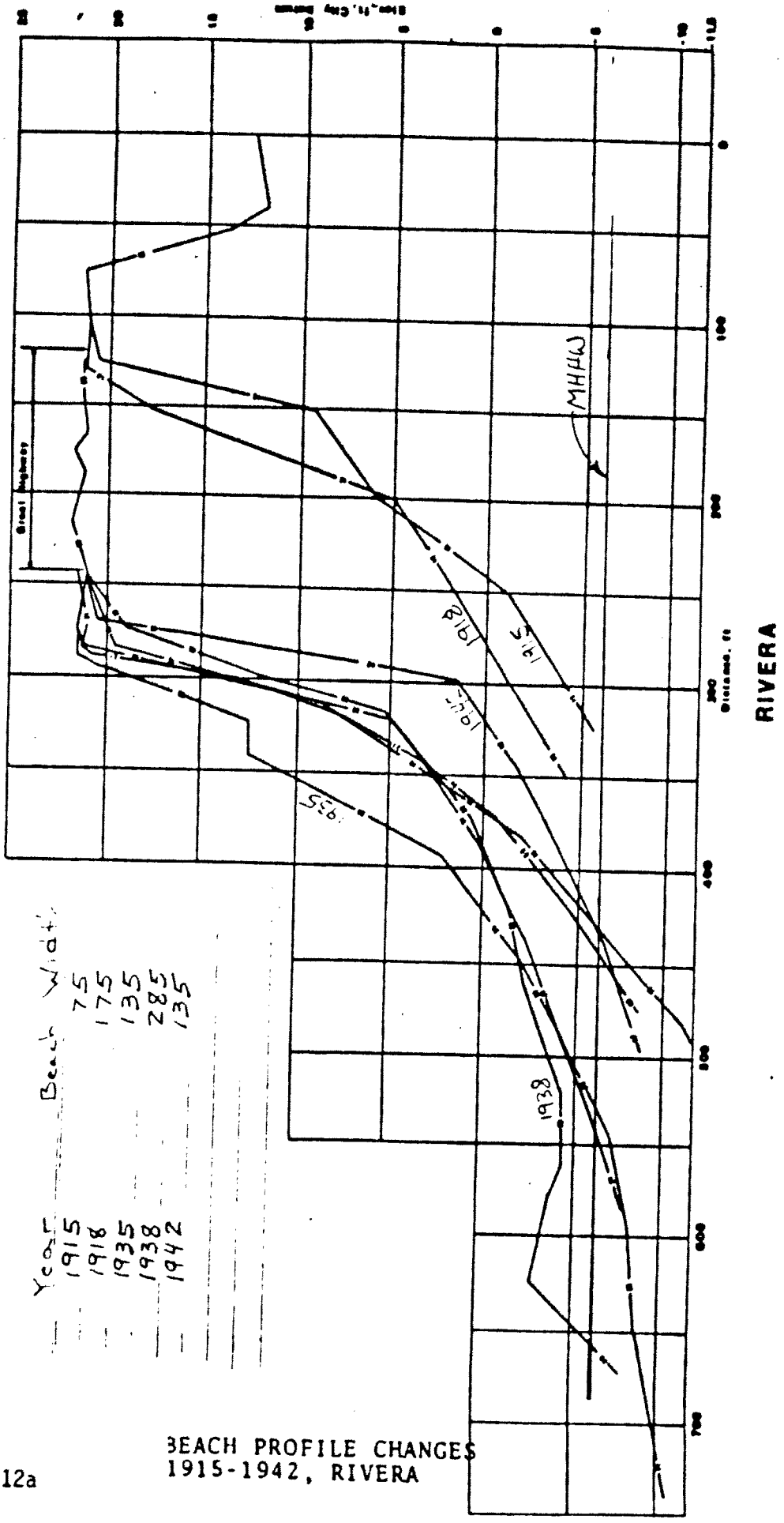
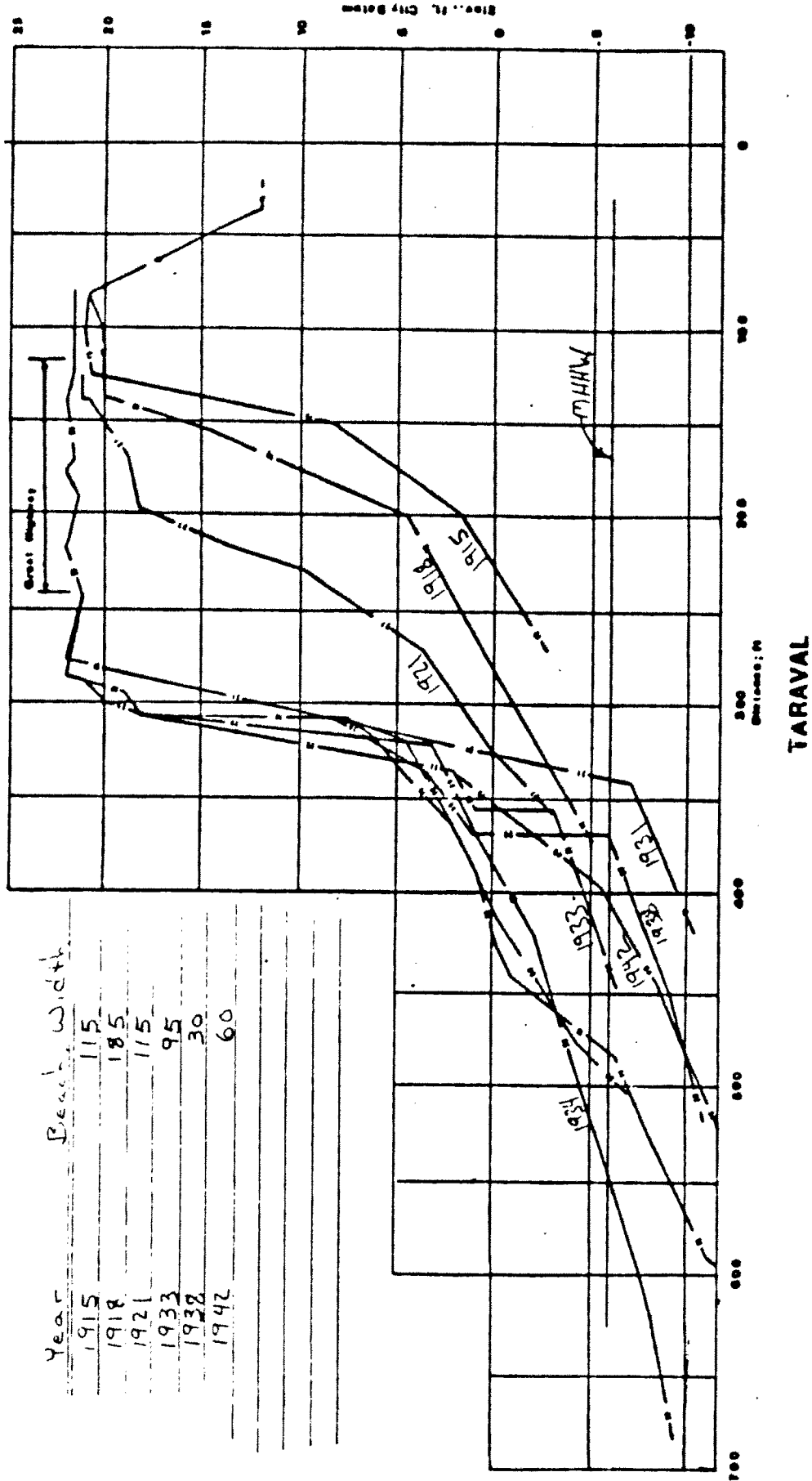


Figure 12a

BEACH PROFILE CHANGES
1915-1942, RIVERA

Ecker (1980)



BEACH PROFILE CHANGES
1915-1942, TARAVAL

Figure 12b

Ecker (1980)

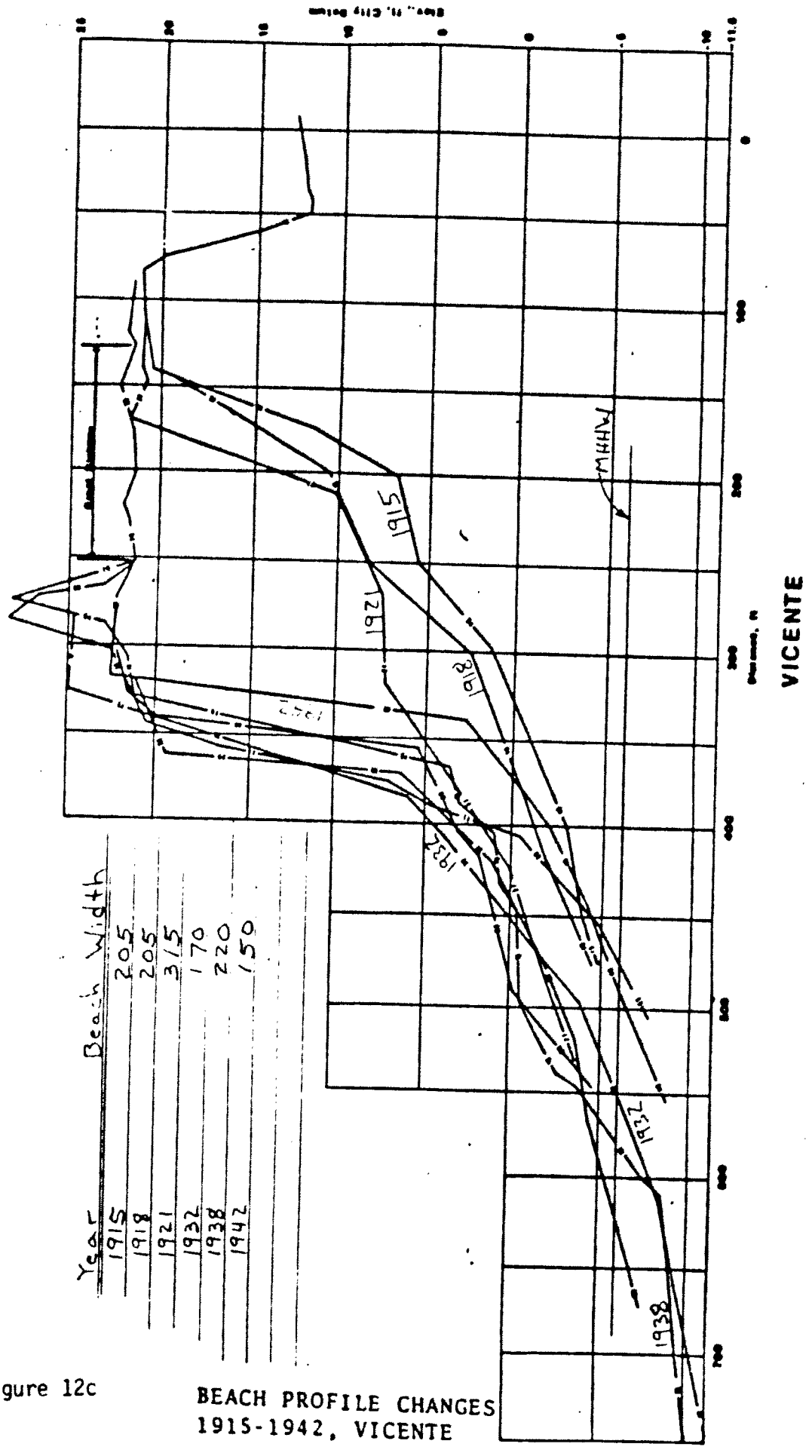


Figure 12c

BEACH PROFILE CHANGES
1915-1942, VICENTE

Ecker (1980)

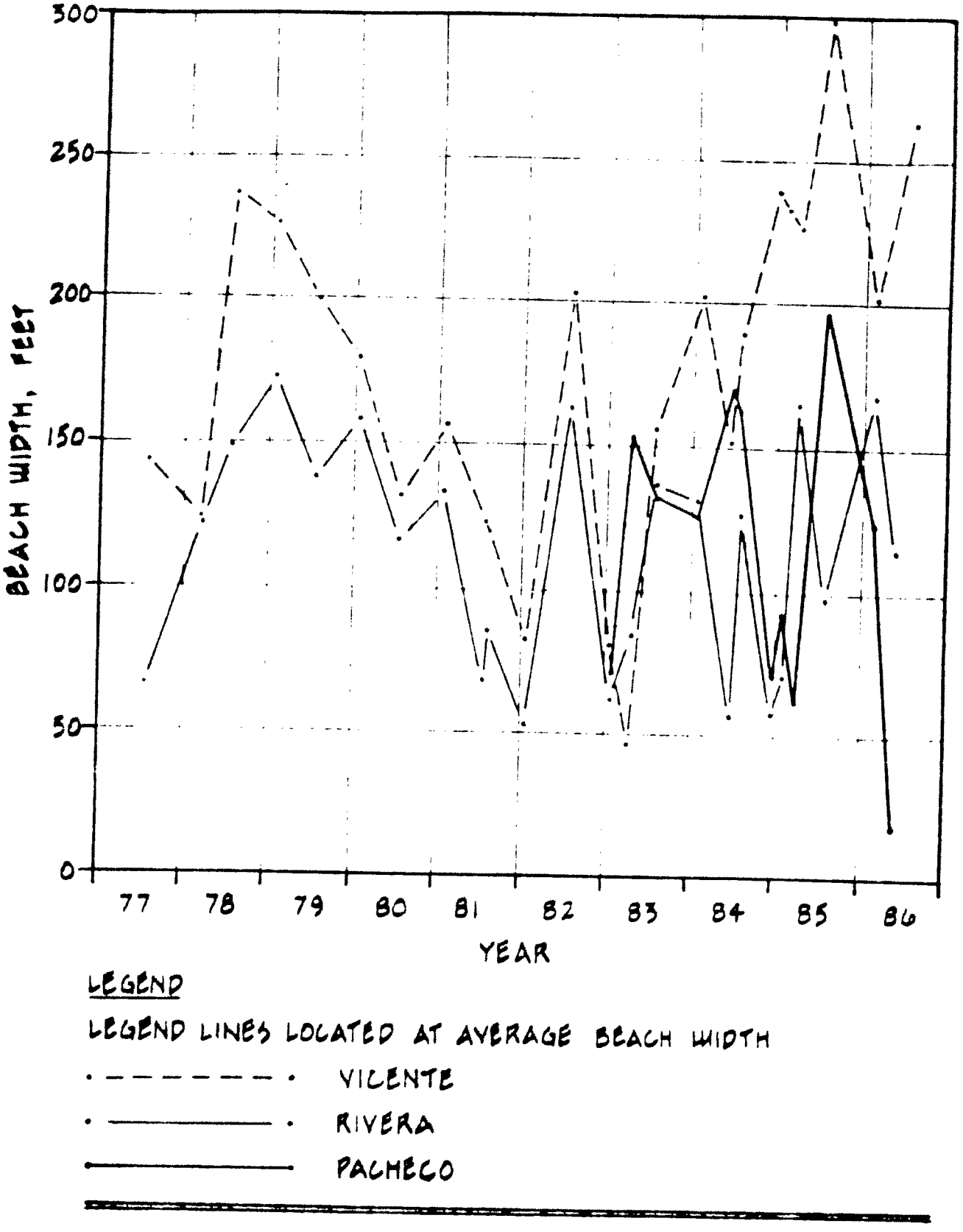


Figure 13. Chronological Variation in Dune Width, 1977 - 1986

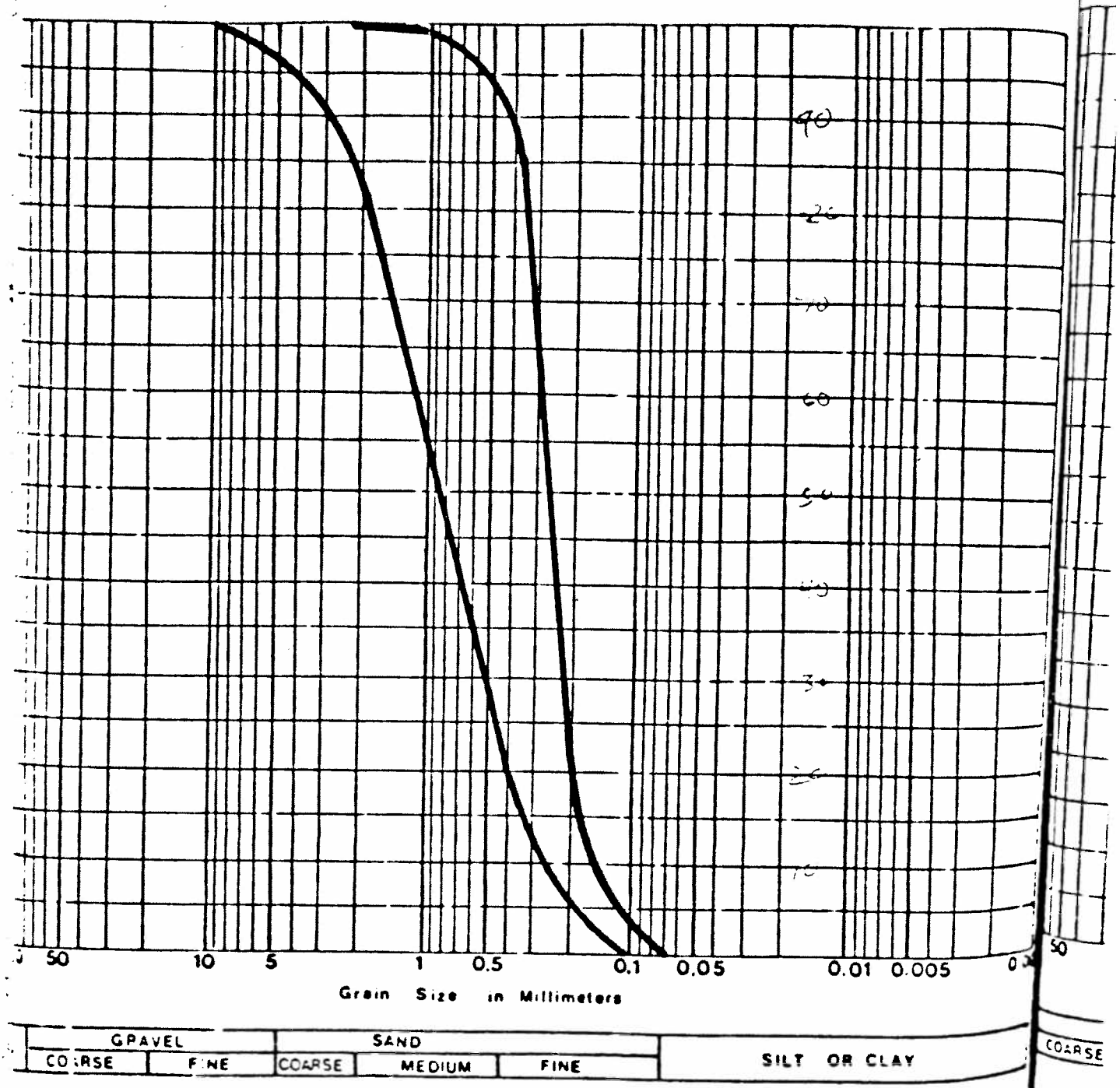
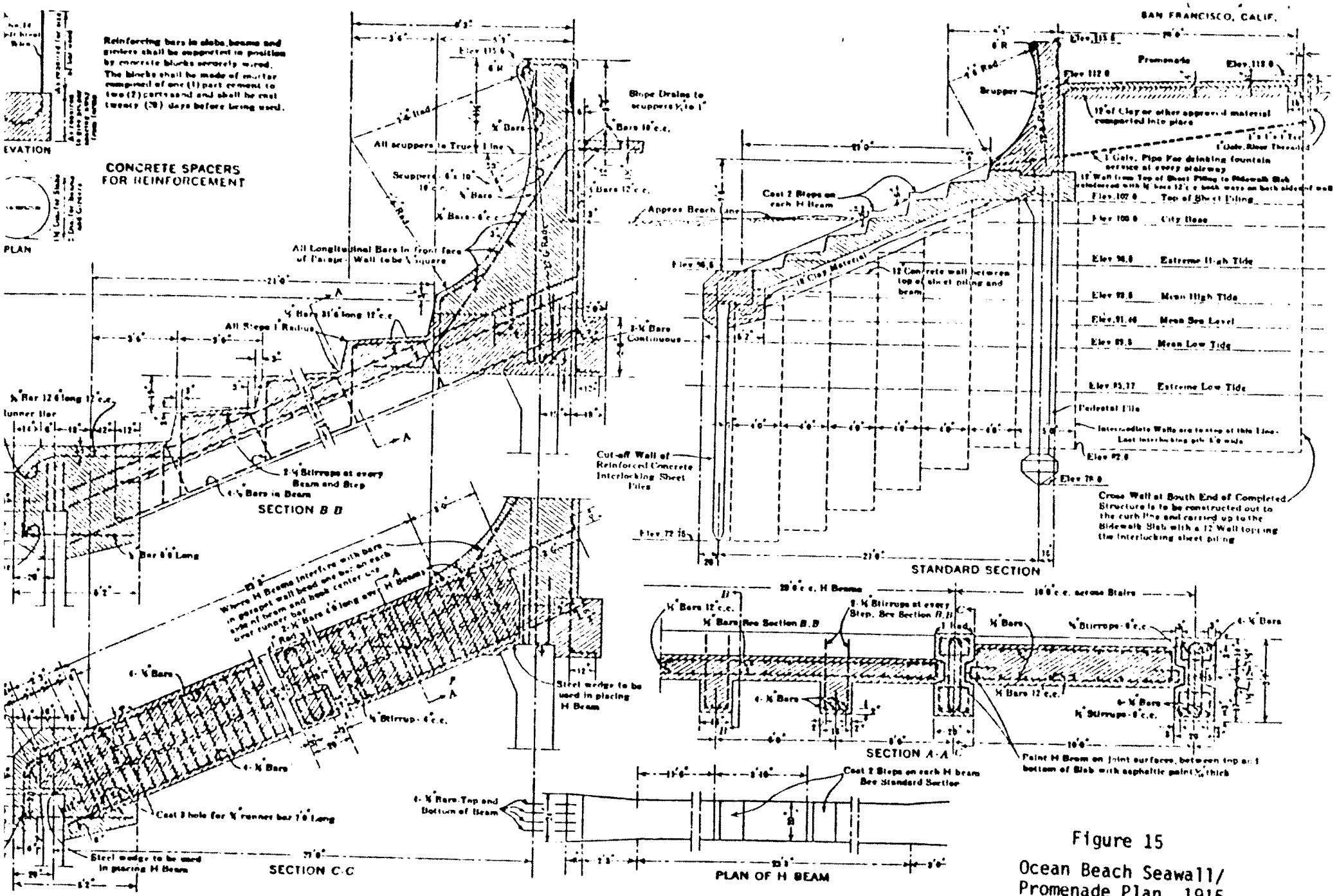


Figure 14

RANGE OF SIZE CHARACTERISTICS
OF OCEAN BEACH SAND

From Ecker (1980)


SAN FRANCISCO, CALIF.
CONCRETE SPACERS FOR REINFORCEMENT
Reinforcing bars in slabs, beams and girders shall be supported in position by concrete blocks securely wired. The blocks shall be made of mortar composed of one (1) part cement to two (2) parts sand and shall be cast twenty (20) days before being used.
ELEVATION
PLAN
SECTION B B
SECTION C C
STANDARD SECTION
SECTION A A
PLAN OF H BEAM
Figure 15
Ocean Beach Seawall/
Promenade Plan, 1915

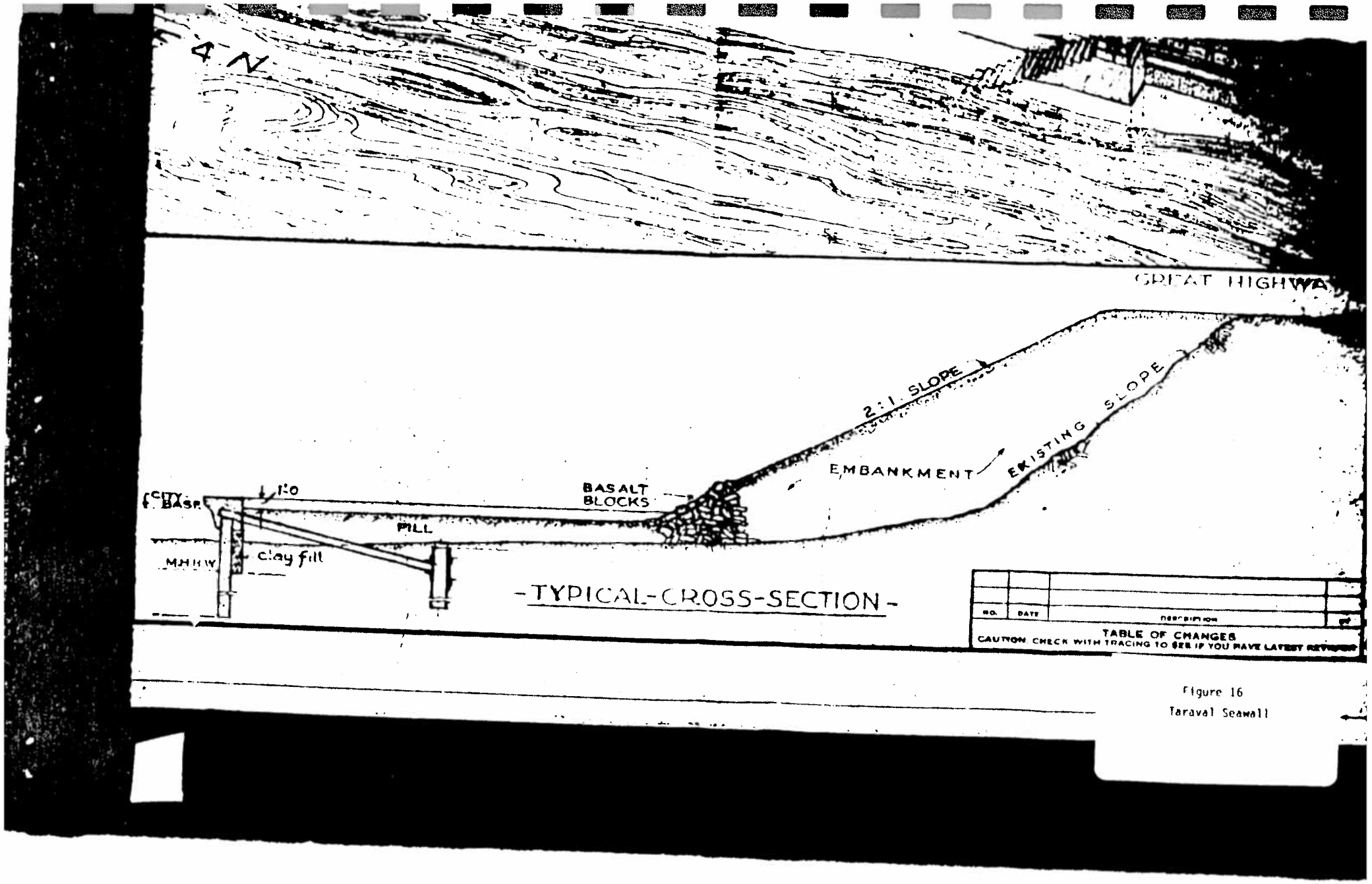


Figure 16
Taraval Seawall

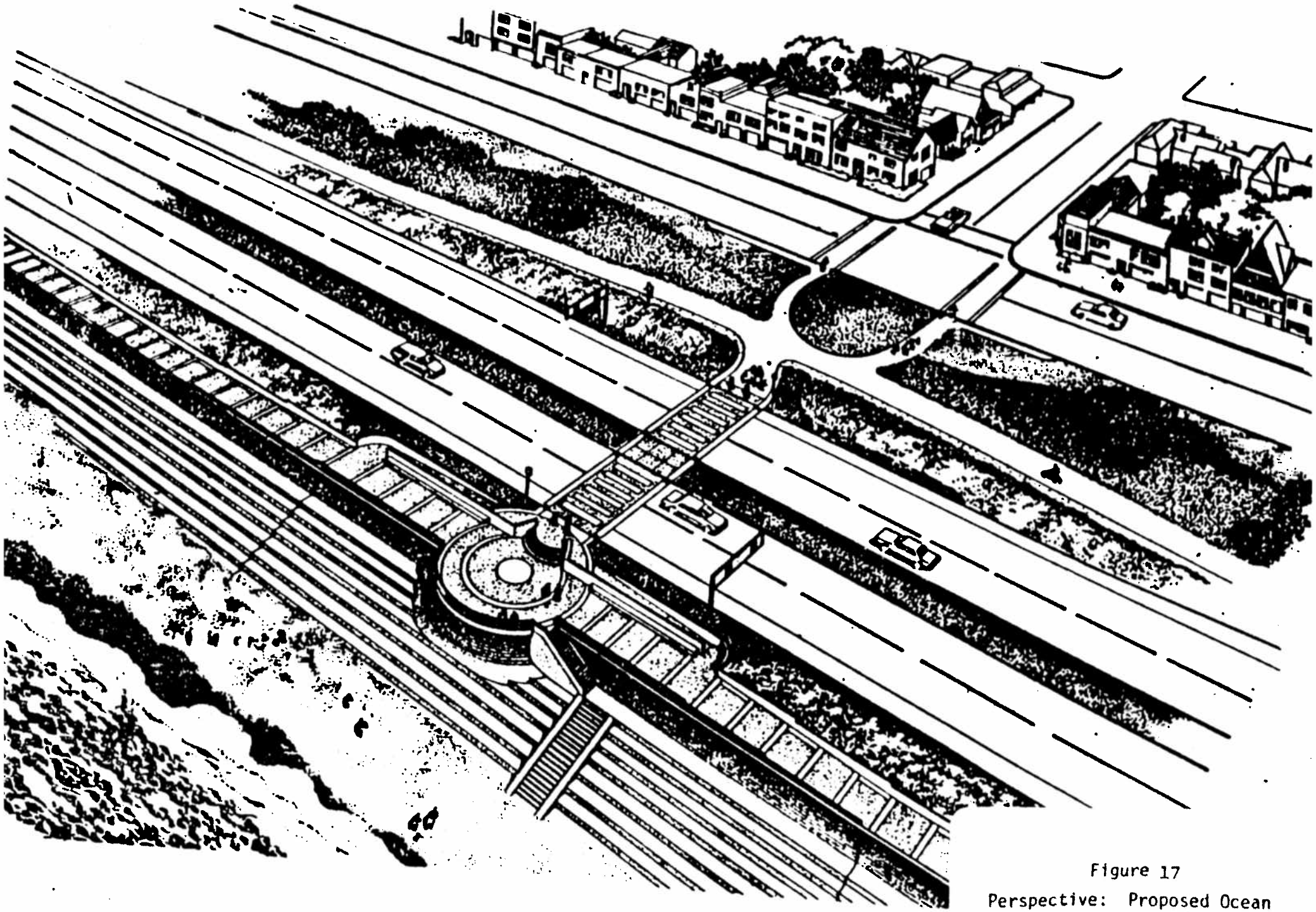


Figure 17

Perspective: Proposed Ocean Beach Cooridor

SEAWALL CROSS SECTION

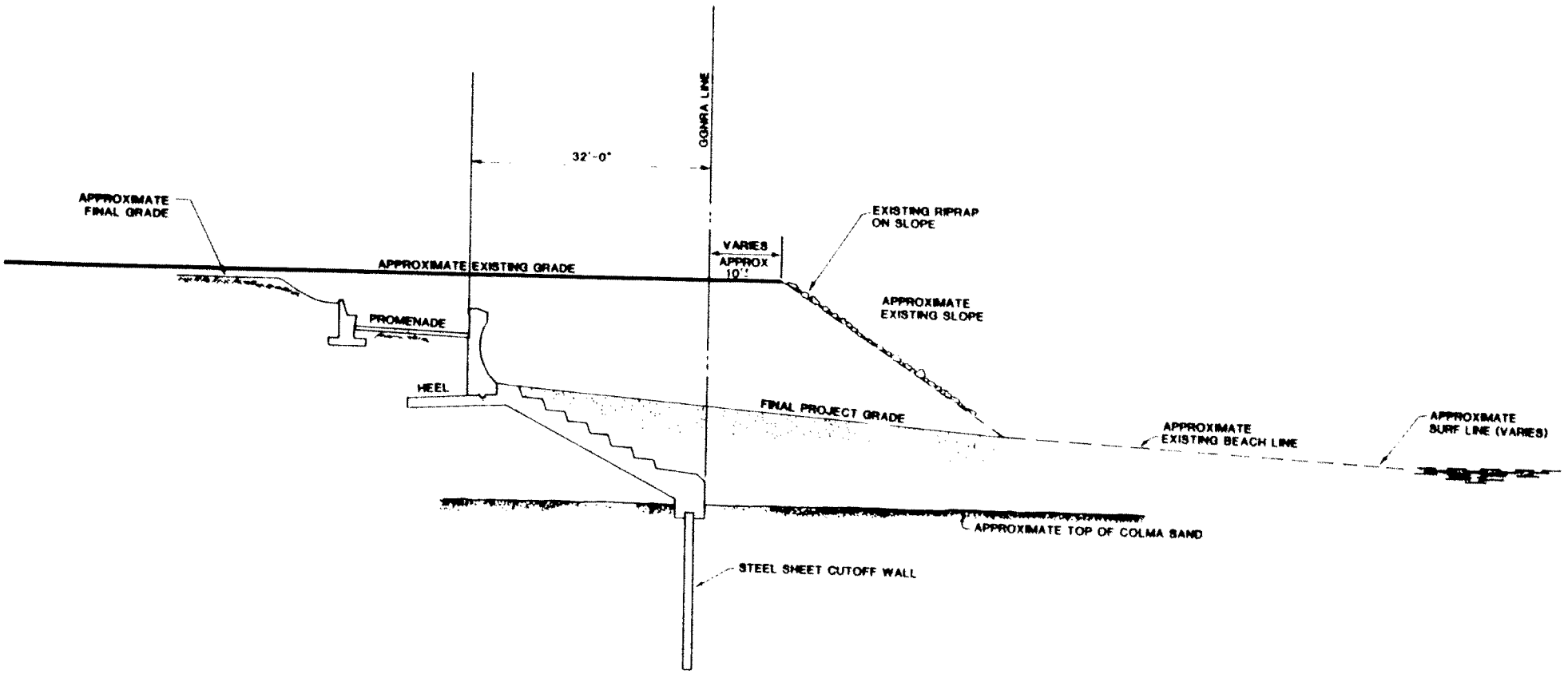


Figure 18