Rockaway/Nedonna Beach Dune Management Study

NEDONNA BEACH FOREDUNE GRADING PLAN

Oregon Department of Land Conservation and Development

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NEDONNA BEACH

FOREDUNE GRADING PLAN

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PREFACE

This report provides detailed recommendations for managing the foredune at Nedonna Beach, Oregon to maintain views and to improve protection from flooding. This report is one part of a three-part study. Other parts of the study include a Technical Report, which analyzes beach, dune and nearshore processes in the area and a Management Plan which recommends controls on other uses and activities which can affect dune stability. The plan will be implemented by Tillamook County and the City of Rockaway Beach through their comprehensive plans and zoning ordinances.

The report was prepared by Wilbur Ternyik, an expert on sand dune stabilization, with assistance from Robert Cortright, Coastal Policy Specialist with Oregon's Department of Land Conservation and Development, and other study team members including Roger Redfern, an Engineering Geologist, and Fred Glick of Fred Glick and Associates (FGA), a Landscape Architect of Portland. Ms. Kathy Schutt of FGA prepared the plan's illustrations.

The author and the study team also gratefully acknowledge the input of the following individuals who reviewed and commented on drafts of this plan and other parts of the study:

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TABLE OF CONTENTS

Introduction 1

Objectives and Expected Results 3

Subarea Analysis and Recommendations

Subarea A: South Jetty 8
Subarea B: Jetty Parking Lot 12
Subarea C: Park Street 16
Subarea D: Riley Street 20

Subarea E: Western St. - Sunset St. 24
Subarea F: Lake St. - Beach St. 28

Specifications

Beachgrass Planting 32
Secondary Stablization 34
Crest Grading 35
Foreslope Shaping 38
Mowing 39
Sand Fencing 40
Access Through Sand Fences 42

Applicability to Other Areas 43

Cross-Sections 44

List of Figures, and Tables

Figures

1.	Generalized Cross-Section of Subarea A . . .	9
2.	Shoreline Changes South of Nehalem South Jetty .	9
3.	Generalized Cross-Section of Subarea B . . .	13
4.	Generalized Cross-Section of Subarea C . . .	17
5.	Generalized Cross-Section of Subarea D . . .	21
6.	Shoreline Erosion and Accretion at Riley Street Subarea 1977-1984	22
7.	Dune Accretion at Riley St. 1978-1984 . . .	22
8.	Generalized Cross-Section of Subarea E . . .	25
9.	Generalized Cross-Section of Subarea F . . .	29
10.	Placement of Graded Sand	36
11.	Recommendations for Beachgrass Mowing . . .	39
12.	Placement and Spacing of Sand Fencing . . .	40
13.	Accessways Through Sand Fencing	42

Tables

1.	Transplants Needed With Varied Spacing Requirements	33
2.	Recommended Native Plants for Dune Stabilization .	34

INTRODUCTION

This plan provides detailed recommendations for grading and stabilizing the foredune at Nedonna Beach, Oregon. This plan was prepared to demonstrate how state planning requirements for grading of developed foredune areas should be applied. The Nedonna-Rockaway Beach area was selected because of the extent of problems there and the interest of the property owners and elected officials in doing a plan. The plan and its recommendations are intended as a model for other areas with similar problems.

The foredune at Nedonna Beach is presently high enough in front of most houses to qualify for grading under Statewide Planning Goal 18 (Beaches and Dunes) (i.e., the dune is more than four feet above the 100-year flood elevation). Grading is being done to restore ocean and beach views from oceanfront homes whose views have been blocked by dune accretion. Proper placement and stabilization of the graded sand will also repair and strengthen the foredune, improving its function as a buffer to ocean flooding for the entire area.

The protective capability of the foredune should only be considered as a temporary feature. The foredune's protective ability for wave erosion lies in its width, height, and slope, and to a very limited extent, the vegetative cover. Although the vegetative cover is an integral part of the ability of the dune to grow in height and width by sand accumulation, once the foredune is attacked by waves, the foreslope vegetative cover will sluff off. The main protective ability lies in the foredune's width and height. It will take tides and storm waves some uncertain amount of time to remove the bulk of the foredune. This would allow landowners behind the new foredune some time to install riprap or other structural measures if erosion is very serious. Historical data shows that past storms have caused as much as 100-150 feet of erosion retreat on foredunes without structural protection, particularly where rip currents develop. Therefore, the width question at present can only be answered as the wider the better, because there is more sand bulk to be eroded. The sand bulk question is also relevant to increased sand supply to the sand budget along any given reach of the ocean. In other words, if enough sand is present then the foreshore and nearshore areas can be flattened, bars formed and wave energy dissipated. The other aspect of dune width of importance is that a wider foredune would increase the likelihood of percolation of wave uprush, thus diminishing the power and volume of water which would overtop the dune.

While the recommendations in this report are specific to Nedonna Beach, the recommended grading and stabilization techniques may be applicable to other developed foredunes. Readers should also consider the following:

- This plan is based on a careful evaluation of the sand system for the entire Rockaway-Nedonna shoreline;

- A variety of other human activities can affect stability of the foredune and stabilizing vegetation. An accompanying foredune management plan recommends controls on these activities which should need to be followed if these measures are to be effective as possible.

- Foredunes are inherently unstable areas. The grading and vegetative stabilization measures recommended here should improve protection the foredune provides from ocean flooding, but these actions cannot guarantee damage from ocean flooding will be prevented.

OBJECTIVES AND EXPECTED RESULTS

The overall purpose of this grading plan is to allow crest grading as part of a total program that will strengthen the foredune. The plan will be carried out by:

- Creating a uniform crest at no lower than 26' (NGVD). This will involve building up low spots (through a combination of filling and/or planting or fertilizing) and limited grading of crest areas.

- Widening the foredune in most areas by:

  (1) Placing excess graded sand from the foredune crest onto the foreslope.

  (2) Smoothing the foreslope and fertilizing and planting european beachgrass in poorly vegetated areas to enhance even accretion of sand on the foreslope.

- promoting a new foredune from approximately Western Street to the Nehalem River south jetty to provide a more continuous foredune throughout this stretch of shoreline.

Specific problems for individual areas are described in the subarea descriptions which follow. The specifications section describes how corrective actions should be undertaken. These recommendations should be followed unless the subarea recommendations indicate otherwise.

The timing of each management measure is important because of the potential for grading to reactivate sand movement which would destabilize the foredune. Management measures generally should be done during the dormant season for beachgrass (between October and March). They should be done in the following order:

Year 1:

Foredune crest grading should be done in qualified areas (i.e., where foredune crest is more than 4 feet above the 100-year flood elevation).

As indicated in the specifications, graded sand should be used to fill low spots on adjacent lots. Portions of the crest that are currently below the base flood elevation should, at a minimum, be filled to the base flood elevation. Crests that are between the base flood elevation and the 4 feet level, should also be filled. However, these areas may instead be replanted with european beachgrass or fertilized if there is an adequate stand of grass.

Any sand not used in filling the crest should be pushed forward onto the foreslope. Further alteration of the foreslope should not occur at this time. (Grading of both areas in the same year will result in sand inundation in the back area.)

The graded area should be immediately fertilized or, if the area is poorly vegetated, replanted with european beachgrass.

For the area north of Western Street, a "new" foredune should be started. Placement of sand fences followed by vegetation planting in year 2 is the preferred method of accomplishing this since fences will rapidly establish a new foredune. The alternative is to plant grass without sand fencing. This will work but will take four-to-six years because of beachgrasses more limited ability to build up windblown sand. In the interim sand that would be captured by the sand fence will instead be captured on the existing foredune or blow inland.

Because of their different abilities to capture windblown sand, sand fences and beachgrass plantings cannot be interspersed alongshore. The result would be an uneven foredune which would be less effective in blocking ocean wave erosion. A whole stretch should be treated by one technique or the other. These steps are not a prerequisite for grading but should be done as part of the overall program to strengthen the foredune.

Year 2:

Grade hummocky foreslope areas to create a more even foreslope to enhance sand accretion. This should only be done where crest vegetation is adequately established (or recovered) to capture most windblown sand or where temporary stabilization measures such as sand fences are installed. Also no mowing should be done until the foreslope vegetation has recovered from grading.

Areas with more than 50% vegetative cover should be fertilized.

Expected Results:

Year 1:

Grading will temporarily result in more open sand in crest areas since beachgrass will be bladed off or buried by placed sand. These areas should recover in one growing season.

The crest will be of a more uniform height throughout. However, the total amount of sand in the foredune should not change since sand will simply be redistributed within the foredune system.

Areas with sand fences will begin to accumulate sand, and depending on wind and weather conditions, should fill entirely within the first year.

The result will be a low (4-5 foot) open sand ridge up to 45-50 feet wide immediately in front of the present foredune. The sand fence may fill at different rates and high winter storm waves might erode a portion of the dune. (This should not seriously affect the foredune, especially if promptly repaired.)

Sand captured by the sand fences would otherwise have accumulated on the foredune or blown behind the foredune or beyond the jetties. Consequently, there may be a slight reduction in the rate of sand accretion on the existing foredune. However, sand will accrete at normal rates once the fences have filled until stabilizing vegetation becomes well established. If beachgrass is planted in place of sand fences, the grass should be spreading and begin to accrete sand.

End of Year 2:

Vegetation on graded areas should be substantially recovered or established. Overall the crest should have more and thicker vegetation coverage than prior to grading. Depending on the strength of winter winds the crest may begin to receive some new sand accretion although most new material should be trapped in sand fences or on the foreslope (in ungraded areas).

After grading, reshaped foreslope areas will temporarily have a reduced ability to trap windblown sand. This will increase sand accumulation slightly on ungraded crests. (Prompt replanting or fertilizing of european beachgrass will reduce this effect.)

Sand fenced areas will have been planted with european beachgrass. In its first six months the new beachgrass will capture only a little sand. Six to twelve months after planting the grass should be well established enough to capture sand at a rate equal to other areas.

End of Year 3:

Vegetation on graded crests should be fully recovered, and the entire crest should be well vegetated. Mowing may temporarily reduce height of the grass, but when done during the summer season and properly fertilized, it should grow back thicker. Crest areas should be receiving only small amounts of sand accretion.

Foreslopes reshaped during the previous year should have well-established vegetation that is trapping most of the sand.

Vegetation in sand fenced areas should also be well established except in isolated pockets of erosion (which should be in various states of repair depending on how recently they occurred). The "new" foredune should be trapping most of the windblown sand. The sand-fenced dune should grow at a rate of 18 inches to 24 inches per year.

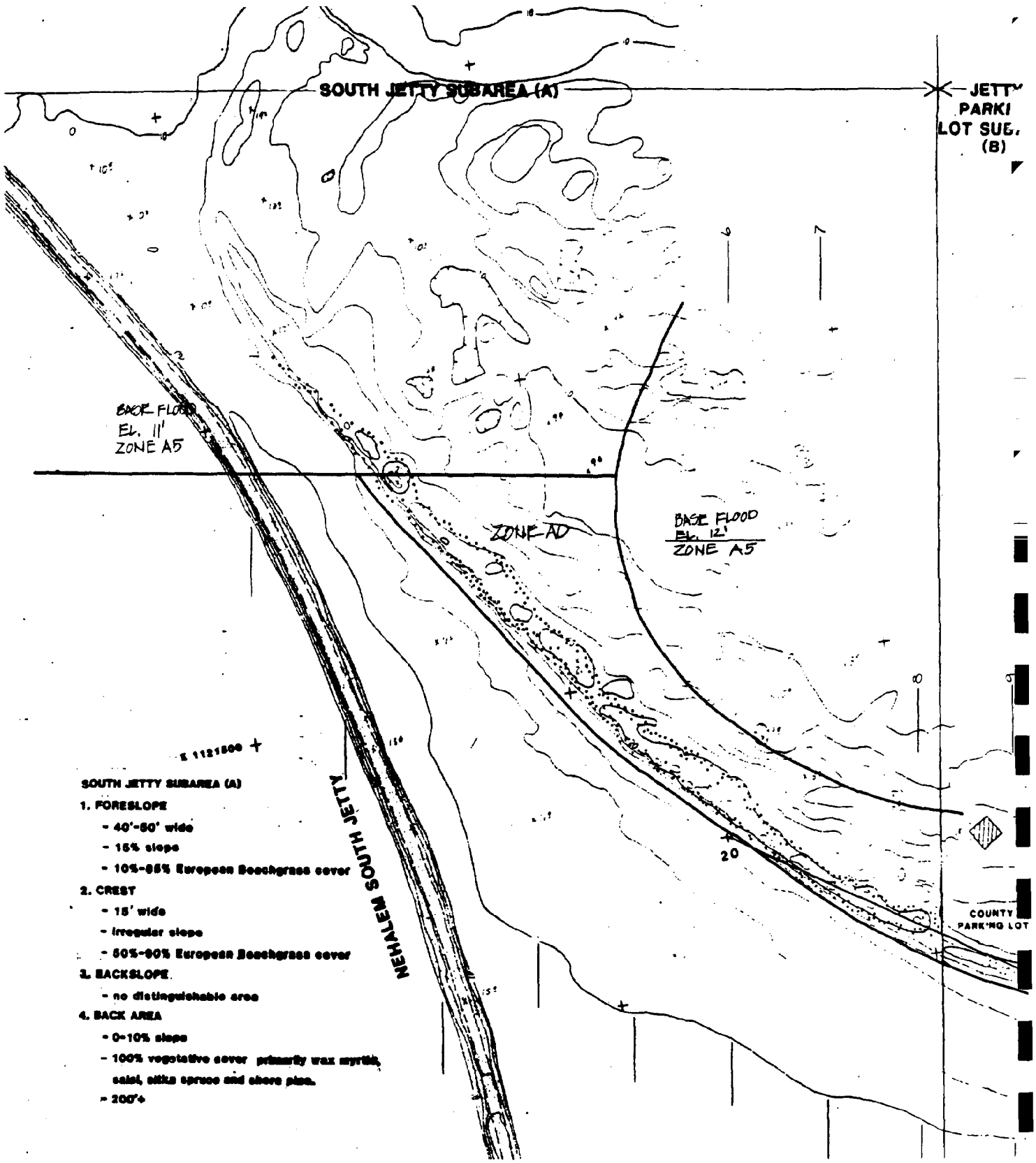
Years 5-10:

Notwithstanding major flood events the foredune should continue to grow oceanward. If foreslope vegetation is properly established and maintained throughout the Nedonna area, sand accretion at the crest should be very slight or could be stopped altogether. Instead windblown sand will be entirely trapped by the widening foreslope. The foreslope should grow slowly as accretion occurs.

In areas where the foredune is widened through placement of a sand fence the existing foreslope and crest will receive less and less windblown sand as the "new" foredune grows in height. The result will probably be a slight trough between the "old" foreslope and the "new" crest (actually an elongated foreslope). The new foredune should continue to grow in height and may eventually (after 10 years or more) be as high as the existing crest. (It would be appropriate to allow some sand to fill in the "trough" area through periodic mowing after the "new" foredune is well established.)

Some foreslope areas will likely be eroded by ocean storm waves. It is assumed that where more than 50% of the foreslope is eroded that the eroded slope will fill naturally or be shaped and replanted. These areas will recover, albeit inconsistently with adjacent areas. While these areas are recovering, hummocks may develop on adjacent foreslope areas as a result of the eroded area's reduced ability to capture windblown sand.

SUBAREA ANALYSES



EXISTING CONDITIONS

SCALE IN FEET

0 50 100 200 300 500

NORTH

LEGEND

- NEWLY FORMING SEAWARD EDGE OF DUNE VEGETATION
- TOE OF BACKSLOPE
- BEACH ZONE LINE
- AVERAGE CREST OF EXISTING FOREDUNE
- MAN-MADE DEPRESSIONS
- ESTIMATED BUILDING SETBACK LINE
- 100 YEAR FLOOD ZONE AREAS

SUBAREA ANALYSIS AND RECOMMENDATIONS

Subarea A: South Jetty Subarea

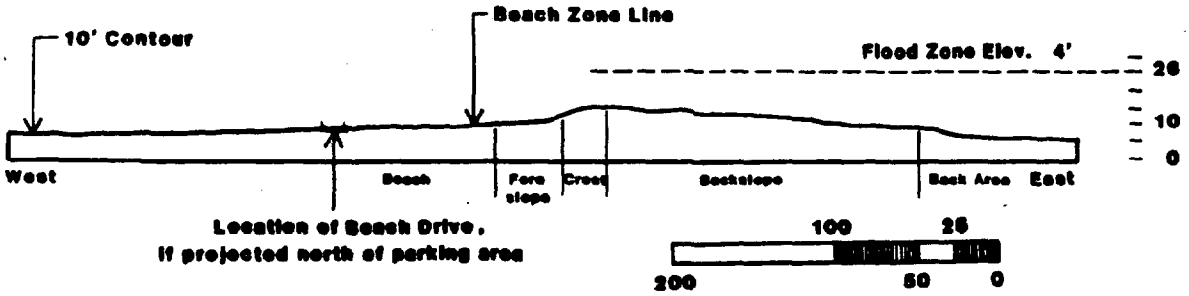


Figure 1: Generalized Cross Section of Subarea A

Setting

The foredune in this subarea is noticeably different in form and location from the foredune in other subareas. The foredune is quite narrow and curves back at a northeasterly direction from the jetty parking lot to the jetty. The orientation of the foredune is probably the result of wave action and a rip current in this area prior to jetty reconstruction. The beach in the triangular embayment between the jetty and the foredune is largely unvegetated but appears to be accumulating sand since jetty rehabilitation in 1981 (see figure 2). Aerial photographs show that the beach is wider and flatter than in earlier years and that several hummocks have developed. Because of the orientation of the foredune and the absence of stabilizing vegetation on the beach it appears that sand is being blown across the beach to the jetty and into the Nehalem River.

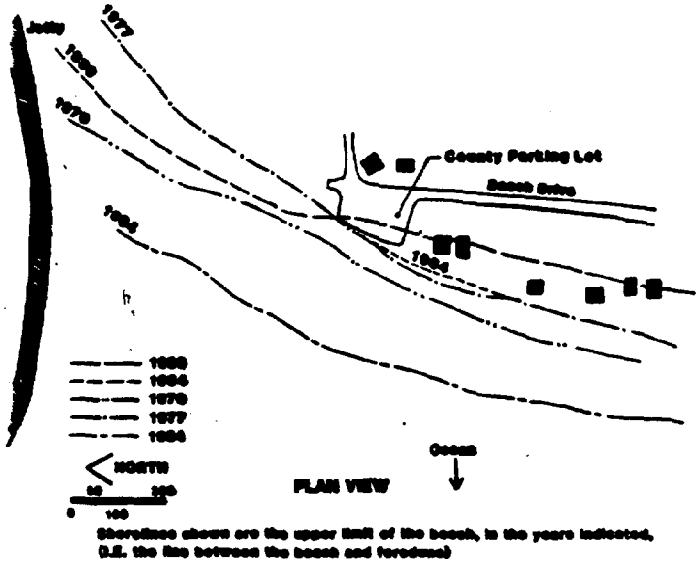


Figure 2: Shoreline Changes South of Nehalem South Jetty

The foredune, such as it is, is a low, narrow band (25-50 feet) fronting a wide well-vegetated back area. The foredune crest averages 18-20 feet in elevation, five to seven feet higher than the well-vegetated back area. The back area is thickly vegetated with mature shrubs and trees averaging 4-8 feet in height. Dominant species are wax myrtle, sitka spruce, salal and shore pine.

As noted elsewhere, maintenance of the jetties is critical to the stability of the beach at this location. If the jetties are not maintained, their effect on ocean waves will steadily lessen and the area will likely erode back to its earlier configuration.

The accreted sand in this entire subarea (i.e., sand accumulated since jetty rehabilitation) should be considered a natural 'bank account' for the shoreline south to Tillamook Bay. Much of the current accumulation is the result of net northerly movement of sand from El Nino. This sand may be eroded away as the beach system adjusts back to the normal pattern of zero net drift. This entire open sand area is very unstable because it is subject to ocean and river flooding or erosion. It should not be developed.

Absence of a foredune in this subarea means sand is being blown over the jetty and to inland areas and lost to the sand system. The absence of a foredune also creates a low opening for flooding into back areas.

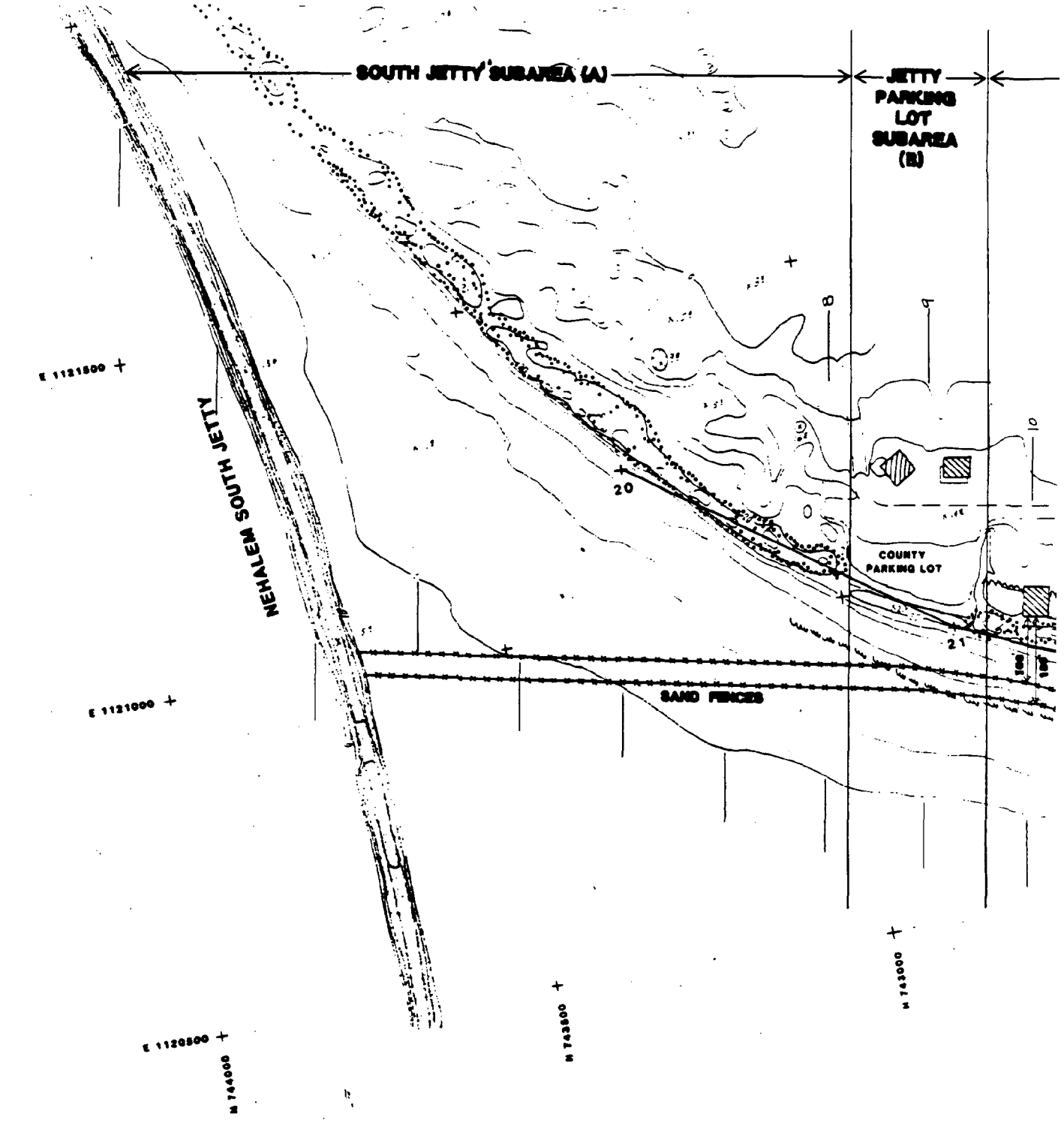
Recommendations

1. Steps should be taken to establish a new foredune in this area to capture accreting sand and to provide improved flood protection to back areas. The foredune should be extended due north to the jetty from the existing foredune south of the jetty parking lot. The foredune could be encouraged through plantings of european beachgrass alone or by placement of sand fences followed by beachgrass plantings once fences have filled.

2. This area does not qualify for crest grading because of its elevation and the fact that there are no homes here. No other grading appears to be appropriate here for the forseeable future.

3. Pedestrian and emergency access across this area to the beach along the south jetty should be provided for. Emergency vehicle access should occur via a due east-west crossing wide enough for a single vehicle (10-12 feet). This should be located close to the jetty. The existing access across the foredune at the jetty parking lot should be fenced to prevent vehicles from crossing there.

4. The undeveloped area behind the vegetation line is subject to ocean and riverine flooding. Residential or commercial development should not occur in this area unless there is a guarantee that the jetties will be maintained for the life of the proposed structures. Development in this area should be limited to low intensity recreational uses and structures allowed by the county's recreation-management zone for the property.



GRADING PLAN

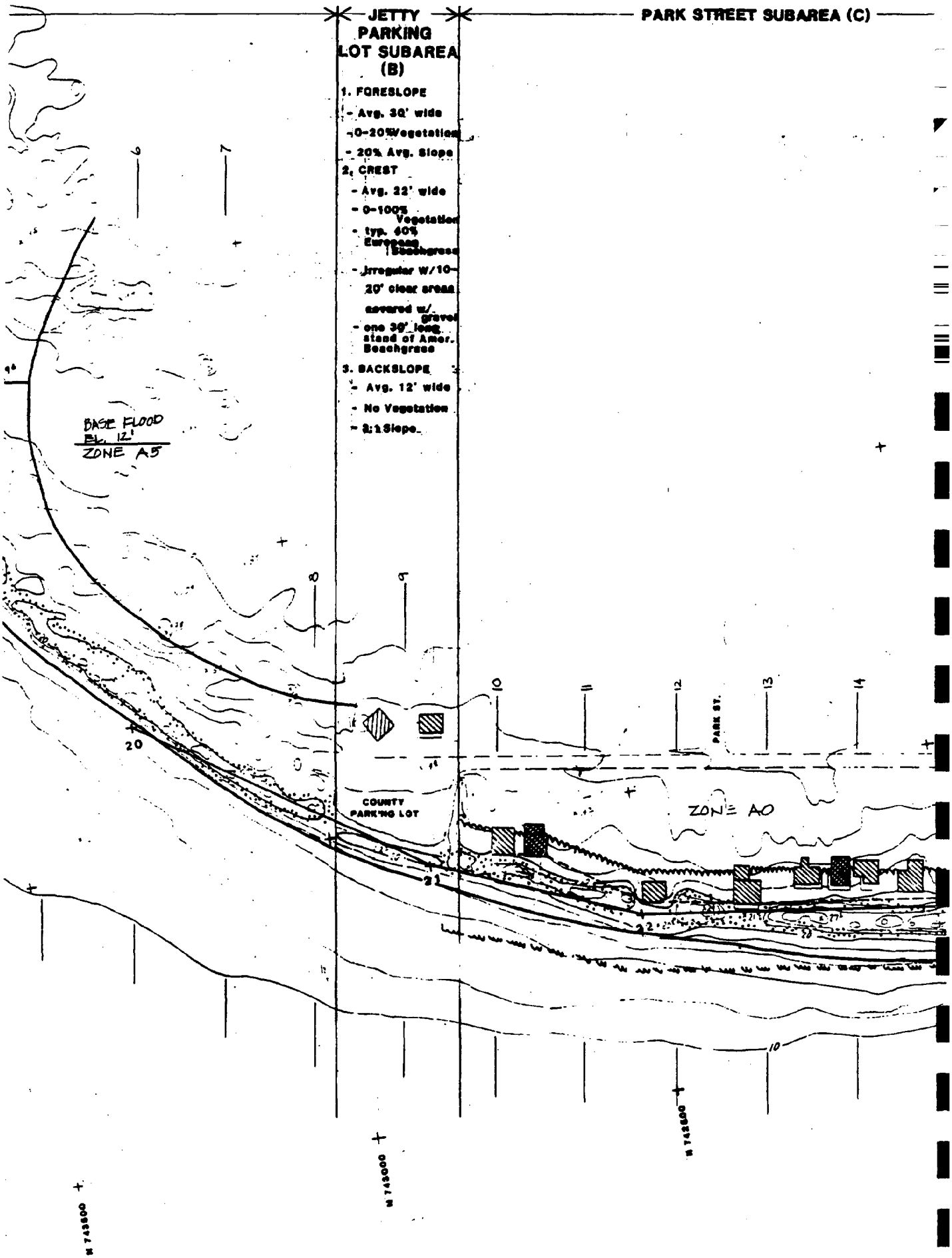
SCALE IN FEET

0 50 100 200 300 500

NORTH

LEGEND

- NEWLY FORMING SEAWARD EDGE OF DUNE VEGETATION
- TOE OF BACKSLOPE
- BEACH ZONE LINE
- SAND FENCE
- ESTIMATED BUILDING SETBACK LINE
- AVERAGE CREST OF EXISTING FOREDUNE
- NATURAL & SAND-MADE LOW POINTS (TO BE FILLED)
- AVAILABLE ADJACENT FILL AREAS & DIRECTION OF GRADING


JETTY
PARKING
LOT SUBAREA
(B)
1. FORESLOPE
- Avg. 30' wide
- 0-20% Vegetation
- 20% Avg. Slope
2. CREST
- Avg. 22' wide
- 0-100% Vegetation
- typ. 40% European Beachgrass
- Irregular W/10-20' clear areas covered w/ gravel
- one 30' long stand of Amer. Beachgrass
3. BACKSLOPE
- Avg. 12' wide
- No Vegetation
- 2:1 Slope
PARK STREET SUBAREA (C)
BASE FLOOD EL. 12'
ZONE A5
ZONE AO
PARK ST.
COUNTY PARKING LOT
N 743500
N 743000
N 742500

Subarea B: Jetty Parking Lot Subarea

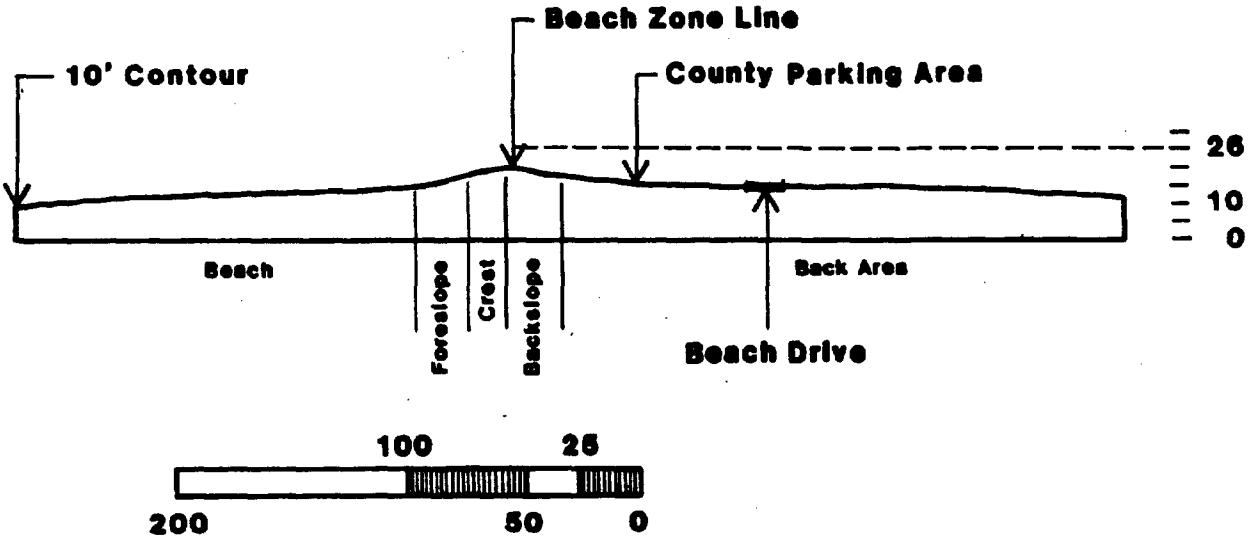
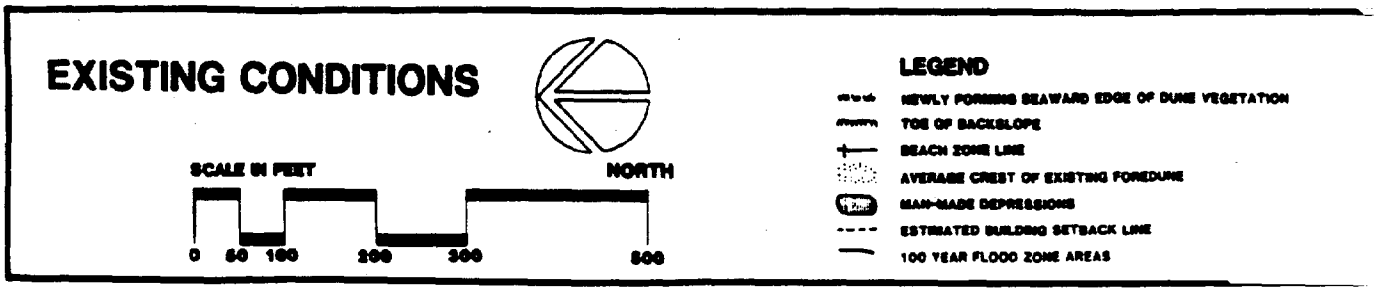


Figure 3: Generalized Cross-Section of Subarea B

Setting

The foredune at the jetty parking lot has been seriously damaged by the vehicle traffic and foot traffic across the dune. As a result, the foredune is noticeably lower and narrower than the adjacent Park Street subarea. (The foredune at the jetty parking lot averages 20 feet in elevation and 60 feet in width vs. 25 feet and 115 feet respectively for Park Street.) Traffic across the foredune has also destroyed and prevented spread of beachgrass. Cover is non-existent on the backslope, while the crest has 40% cover and the foreslope has 0-20% cover. The lack of vegetation has resulted in sand accumulations in the parking lot which have been periodically bulldozed back over the foredune.

Access at this location is needed for emergency vehicles to conduct search and rescue at the south jetty. The parking lot is also the only public access north of the Manhattan Beach Wayside with off-street parking.



Recommendations

1. The foredune should be stablized to prevent sand deposition into parking lot and to inland areas. Access for emergency vehicles and pedestrians should be provided and designed to avoid harming the foredune.

2. The foredune should be restored with a combination of sand fences and beachgrass plantings. Fences should be placed to widen the dune seaward to provide increased erosion protection.

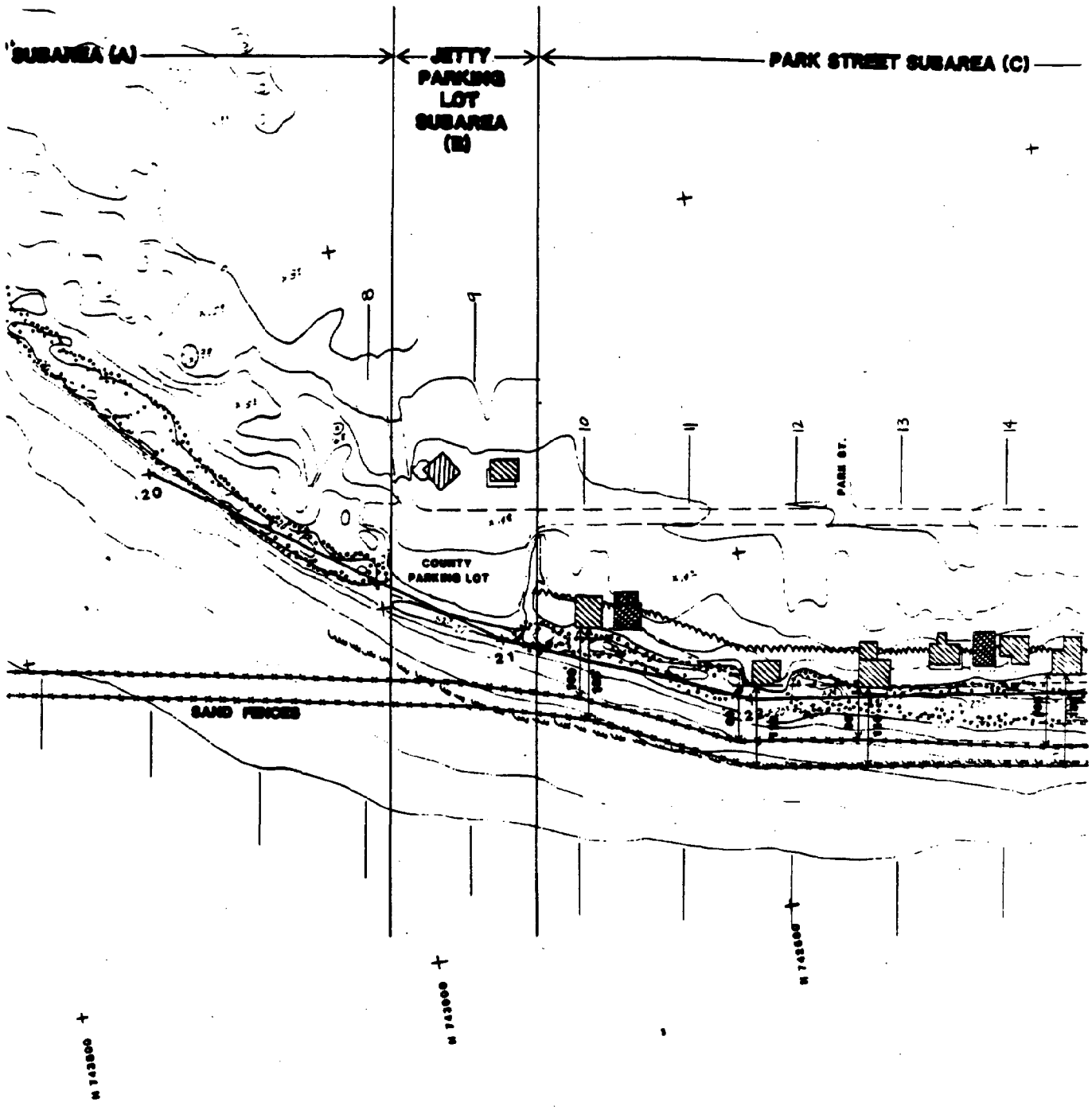
3. Sand fences should be constructed with openings to allow pedestrian access across the foredune while sand is accreting. These accesses should be oriented east-west to avoid wind and erosion.

4. Once vegetation is well-established on the dune the accessways should be fenced and revegetated, and permanent accessways across the rehabilitated foredune should be opened.

5. The foredune crest is much too low to allow crest grading and there are no oceanfront homes in this subarea. Grading in this subarea should be limited to foreslope shaping necessary to prepare the site for beachgrass plantings.

6. Vehicles should not cross the foredune at this location. Instead they should travel due north of the end of Beach Drive and cross the low beach or new foredune farther north closer to the jetty. The access should be signed "for emergency vehicles only," to limit access to emergency, salvage and similar operations. Where emergency access across the foredune is necessary, it can occur at the pedestrian accesses described above.

   Vehicle access at this location should be limited to search and rescue at the jetty or on the beach. Vehicle access to the beach for other purposes should occur at the south end of the Manhattan Beach Wayside. The access there is much better oriented, and the dune is better developed to withstand vehicle impacts.



GRADING PLAN

SCALE IN FEET

0 50 100 200 300 500

NORTH

LEGEND

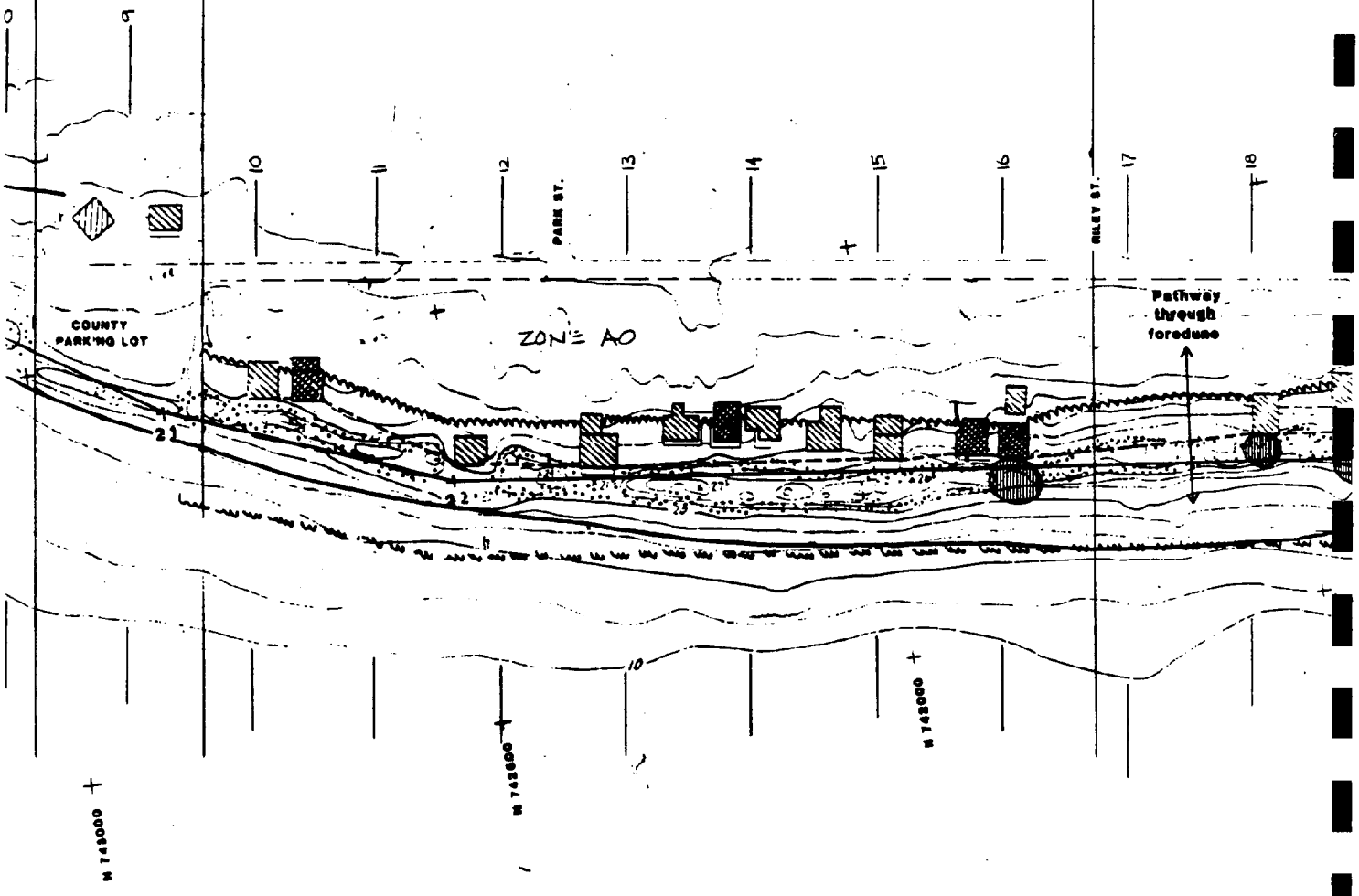
- NEARLY PERENNIAL SEAWARD EDGE OF DUNE VEGETATION
- TOE OF BACKSLOPE
- BEACH ZONE LINE
- SAND FENCE
- ESTIMATED BUILDING SETBACK LINE
- AVERAGE CREST OF EXISTING FOREDUNE
- NATURAL & MAN-MADE LOW POINTS (TO BE FILLED)
- AVAILABLE ADJACENT FILL AREAS & DIRECTION OF GRADING

JETTY PARKING LOT SUBAREA (B)

PARK STREET SUBAREA (C)

RILEY STREET SUB.

1. FORESLOPE
   - -Averages 40' wide
   - -15% grade with some variation
     - · Some areas include hummocks in unevenly sloped sand (Elev. 3-6' higher & 20-25% slope)
   - -Vegetation
     - · 15-25% coverage
     - · Healthy European Beachgrass
     - · Substantial sand accumulation around beachgrass hummocks
2. CREST
   - -Averages 35' wide
   - -5 to 25% grade (Slope very irregular)
   - -Vegetation
     - · 60-70% coverage (Seaward half more open, 40% coverage with isolated tufts of vegetation)
     - · Pathways evident
   - -Axis north/south varies 0-4'
3. BACKSLOPE
   - -Averages 40' wide
   - -10 to 20% grade
   - -Vegetation
     - 100% coverage
     - Incidental shorepine, strawberry & salal
   - -Occasional depressions
     - · Pathways & cuts near houses



Subarea C: Park Street Subarea

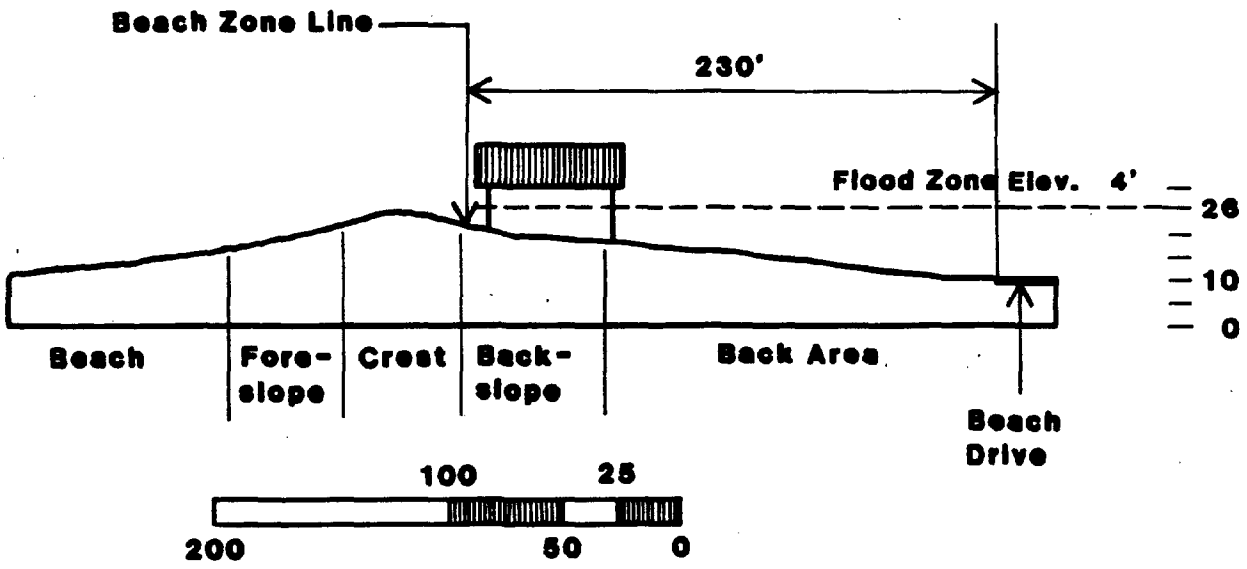
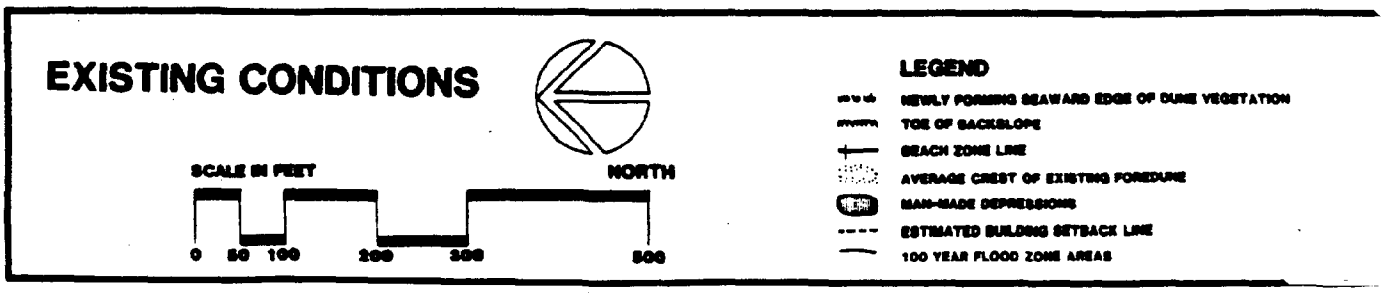


Figure 4: Generalized Cross-Section of Subarea C

Setting

This portion of the foredune has been developed with homes. The foredune itself is low (24-26 feet) and narrow (averaging 115-120 feet in width). The foredune is poorly to moderately vegetated. Cover in backslope areas is 100% but crest areas are about 40-60%, and some graded lots have no cover. The foredune is narrowest and least well vegetated on the north and gradually widens and is better vegetated towards the south.

The condition of the foredune is a result of previous erosion, grading and house construction. The four existing homes north of Park Street are all located on the forward portion of the crest. This has required grading to keep the houses from being inundated with sand. The house immediately north of the end of Park Street is lower than the crest of the foredune on adjacent lands.



A rip-current centered near Park Street caused substantial erosion of this subarea in the winter of 1977 and 1978. The foredune eroded back at this time. Virtually the entire shoreline was rip-rapped at that time to prevent further erosion. (Rip-rap was placed in an even line parallel to the shore 20-40 feet in front of the homes.) Since rip-rapping in 1978, the foredune has begun to recover and re-establish itself. Except in two locations where view grading has occurred the foredune now completely covers the 1978 erosion. Rip-rap apparently added after the 1978 episode is also apparent in these low spots.

The pattern of hummocks and the sparse vegetation indicate the area has filled without man-made assistance. (Property owners confirm this observation.) Presently, the foredune expands 80 feet in front of the homes (varying from 60 feet to 90 feet).

Recommendations

The foredune in this area needs to be stabilized through increased vegetative cover and strengthened in both width and height. Several specific steps are appropriate to accomplish this.

1. Plant open sand areas and areas with less than 60% cover with european beachgrass per beachgrass planting instructions. Plantings should be blended into the existing line of vegetation or adjacent unplanted lots.

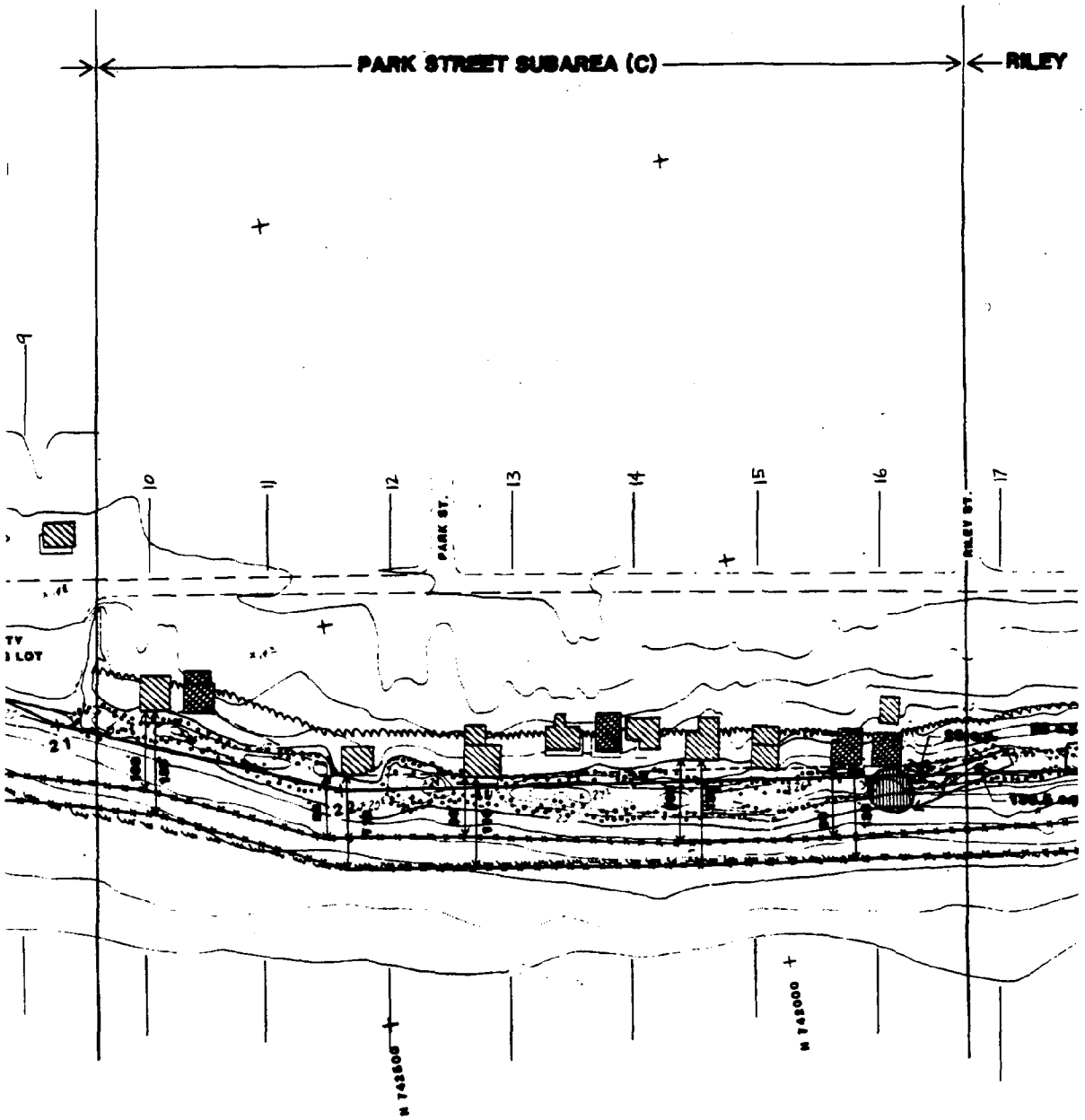
2. The foredune from Park Street north is too low to qualify for grading of the foredune crest. Grading here should be limited to smoothing the foreslope for planting of beachgrass.

3. Three of the eight houses south of Park Street qualify for some grading of the foredune crest. The priority locations for placement of graded material are low spots in adjacent crest areas first and low or narrow portions of the foreslope second. (See grading plan map.)

   (a) Areas with less than 60% vegetative cover should be replanted with european beachgrass per the specifications to provide more uniform vegetative cover.

   (b) Low spots (i.e., below 26 feet), particularly graded areas or breaches in the crest of the foredune, should be stabilized with parallel sand fences to promote even sand filling followed by beachgrass plantings. Planting vegetation alone is an acceptable alternative.

4. The new foredune to be created by sand fencing extends throughout this area as shown on the maps.



GRADING PLAN

SCALE IN FEET

0 50 100 200 300 500

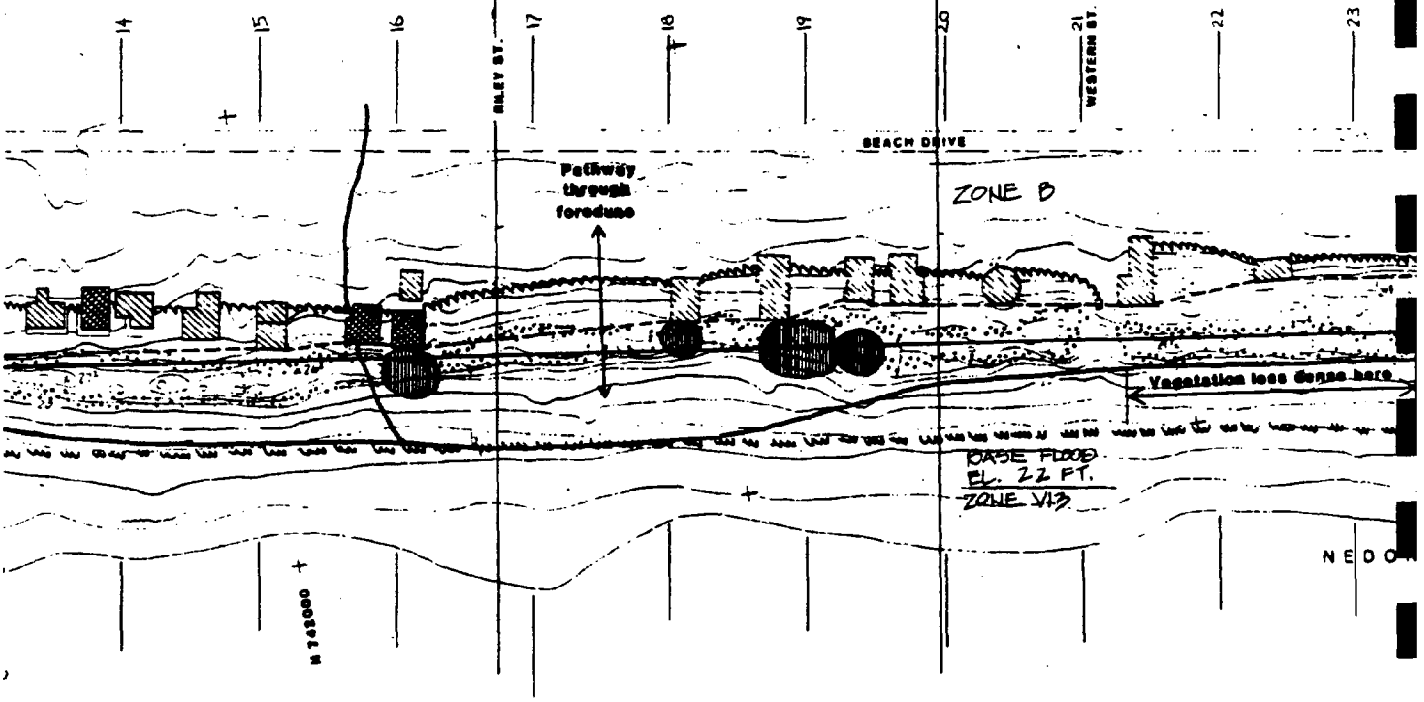
NORTH

LEGEND

- NEWLY FORMING SEAWARD EDGE OF DUNE VEGETATION
- TOE OF BACKSLOPE
- BEACH ZONE LINE
- SAND FENCE
- ESTIMATED BUILDING SETBACK LINE
- AVERAGE CREST OF EXISTING FOREDUNE
- NATURAL & MAN-MADE LOW POINTS (TO BE FILLED)
- AVAILABLE ADJACENT FILL AREAS & DIRECTION OF GRADING

:T SUBAREA (C) → ← RILEY STREET SUBAREA (D) → ← WESTERN STREET/SUNSET STRE

1. FORESLOPE
   - -Averages 75-80' wide
   - -5 to 45% grade, mostly 5 to 10% grade except near crest where it becomes 20 to 45% grade
   - -Vegetation
     - 10 to 15% coverage, hummocks
2. CREST
   - -Average width & grade similar to Subarea C
   - -Vegetation
     - 80 to 90% coverage
   - -Two severe cuts
3. BACKSLOPE
   - -Width, slope & vegetation similar to Subarea C



Subarea D: Riley Street Subarea

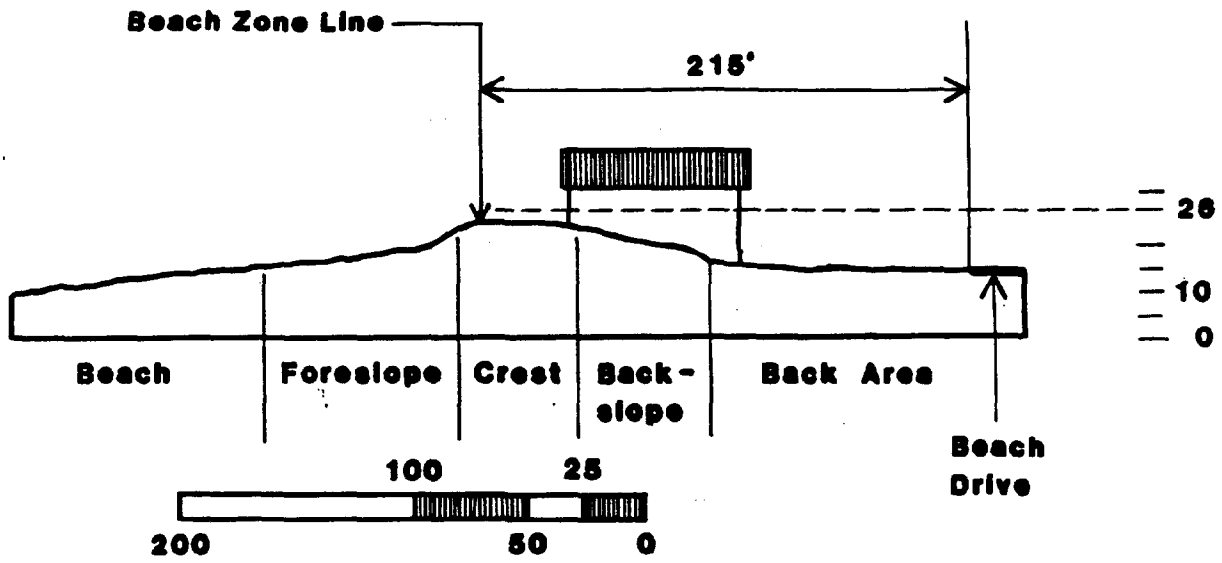


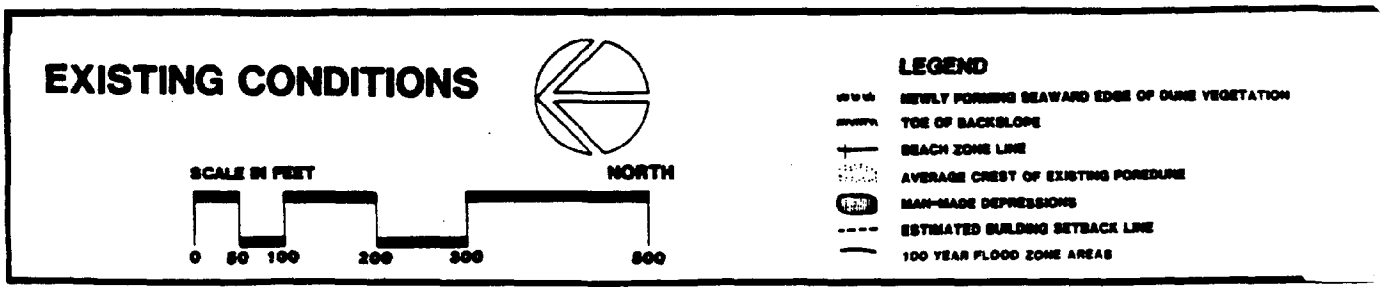
Figure 5: Generalized Cross-Section of Subarea D

Setting

The foredune in this subarea is very similar to the Park Street subarea (Subarea C) with the following differences:

- The foreslope is noticeably wider (75-80 feet vs. 50-60 feet) and has slightly less beachgrass cover.
- The crest has been recently graded (i.e., within the last two years) in front of several houses in this area. The crest is at approximately 24.5 feet, or 1.5 feet below the approved grading elevation.
- The portion of the foreslope immediately forward of the crest is steeper than the subarea to the north, though both areas are characterized by hummocky foreslopes.

Like the Park Street subarea, Riley Street experienced substantial erosion during winter storms in 1977-78. Figures 6 and 7 illustrate the extent of erosion that occurred. Rip-Rap is now covered by the foredune which has grown seaward of its 1977 location. This seven-year episode of retreat and advance illustrates the dynamic forces at work in foredune areas.



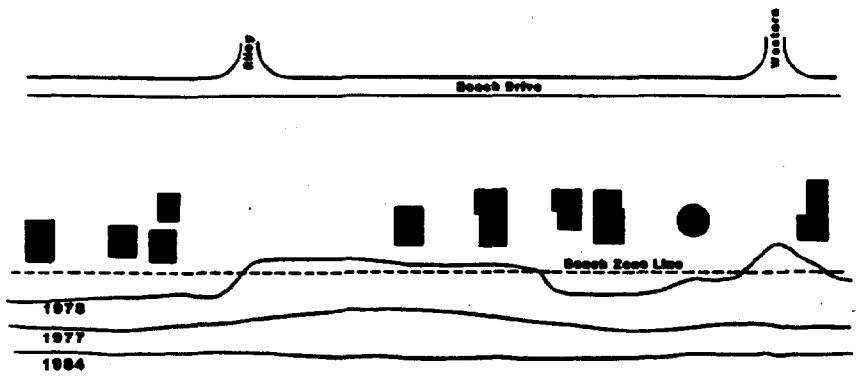


Figure 6: Shoreline Erosion and Accretion at Riley Street Subarea 1977-1984

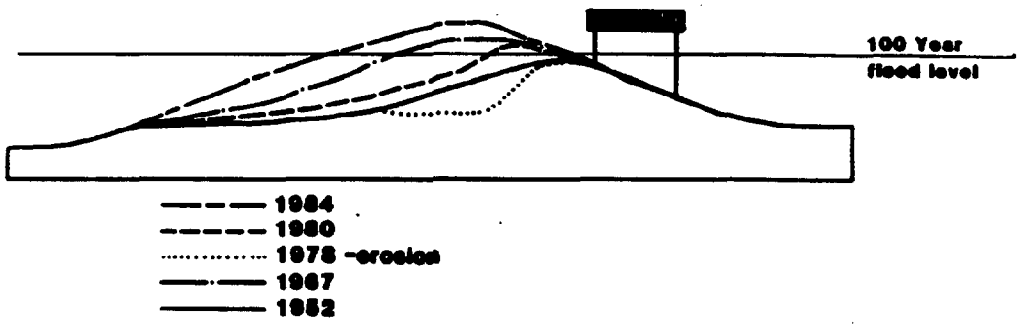


Figure 7: Dune Accretion at Riley Street 1978-1984

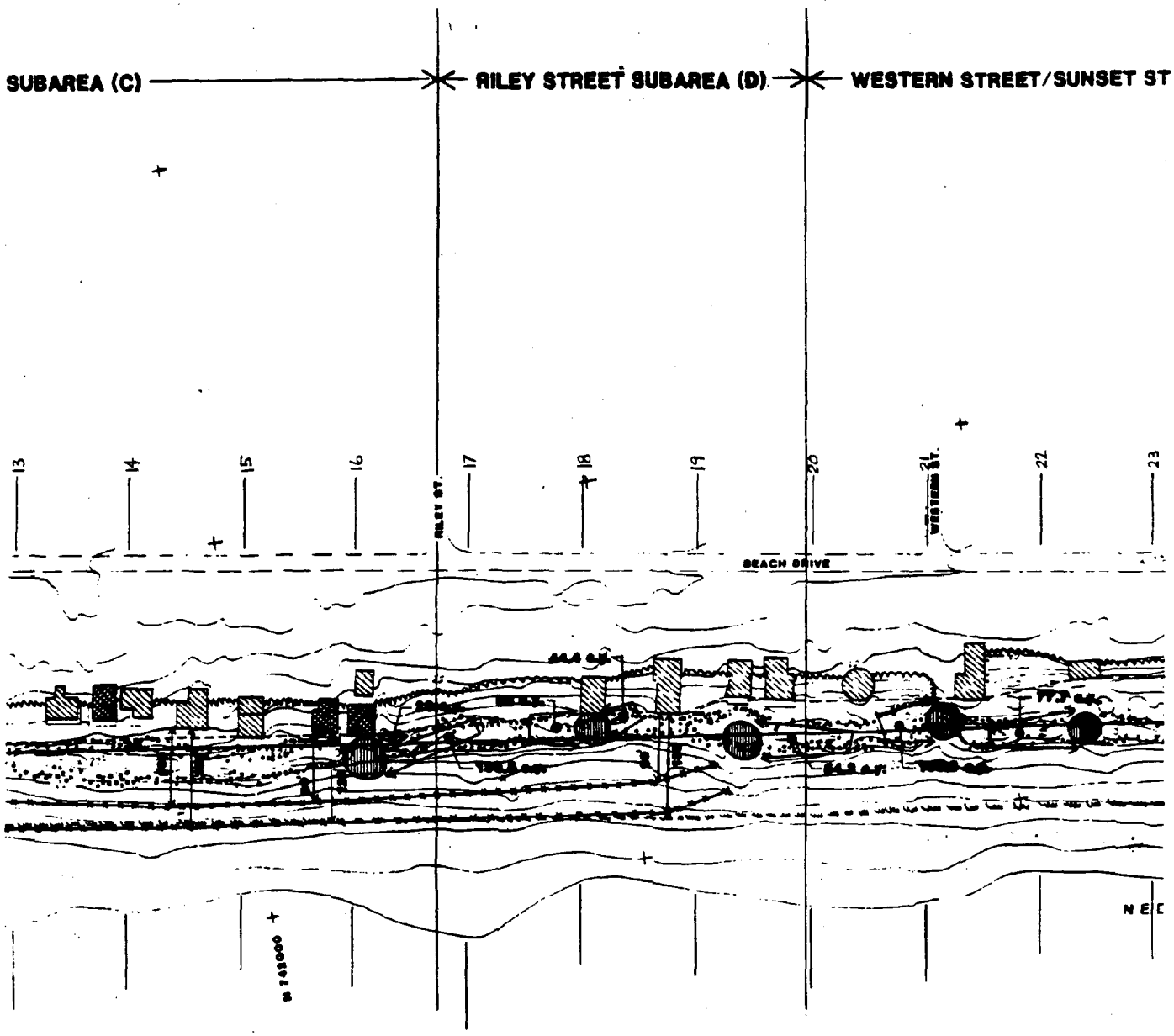
There is also a depression in the foredune north of the northern house in this subarea apparently caused by vehicle access. The depression may be the result of use of the site as a staging area for placement of rip-rap in 1978.

Recommendations

1. Crest grading is only appropriate for the southernmost house in this subarea. Graded material from this lot should be used to fill the crest on the adjacent lot to 26 feet. Alternatively, excess sand may be graded onto the foreslope if the adjacent area is stabilized through beachgrass plantings and fertilization.

2. Foreslope grading is appropriate in this area and is needed to create a more even slope. Foreslope grading will provide a better slope for planting of beachgrass to enhance sand accretion.

3. A new foredune should be constructed with sand fences in this subarea in the locations shown on the map. The new foredune should be tapered into the existing wider foredune to the north.



GRADING PLAN

SCALE IN FEET

0 50 100 200 300 500

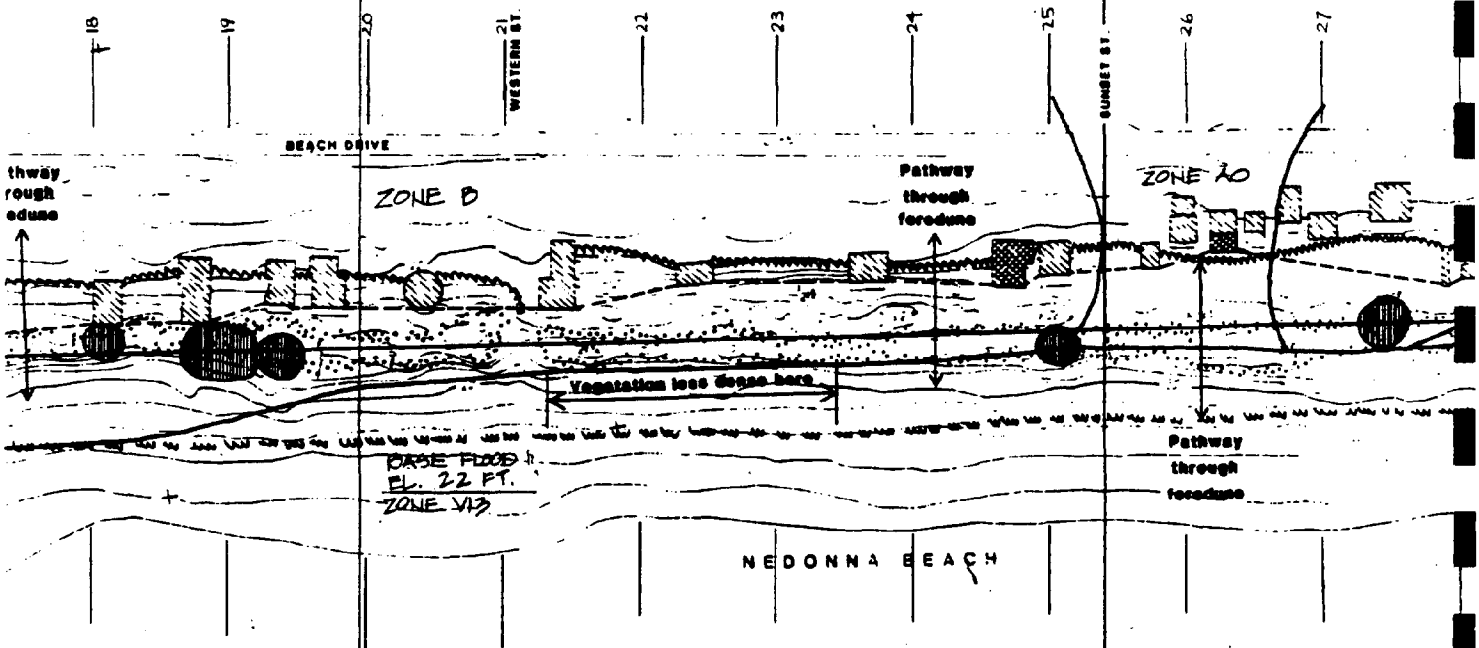
NORTH

LEGEND

- NEWLY FORMING SEAWARD EDGE OF DUNE VEGETATION
- TOE OF BACKSLOPE
- BEACH ZONE LINE
- LAND FENCE
- ESTIMATED BUILDING SETBACK LINE
- AVERAGE CREST OF EXISTING FOREDUNE
- NATURAL & MAN-MADE LOW POINTS (TO BE FILLED)
- AVAILABLE ADJACENT FILL AREAS & DIRECTION OF GRADING

SUBAREA (D) ← **WESTERN STREET/SUNSET STREET SUBAREA (E)** →

1. FORESLOPE
   - -Averages 90' wide
   - -5 to 30% slope
   - -Vegetation
     - · 50% coverage, beachgrass hummocks
   - -Long depression fronted by emergent foredune, hummocky vegetation
2. CREST
   - -Averages 50' wide, except for few 15' wide spots
   - -5 to 40% slope
   - -Vegetation similar to Subarea D
   - -Includes an older foredune crest (Averages 3-4' lower than newer crest)
3. BACKSLOPE
   - - Averages 75' wide
   - -20 to 30% slope
   - - Vegetation
     - · 100% coverage, American Beachgrass



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Subarea E: Western Street - Sunset Street

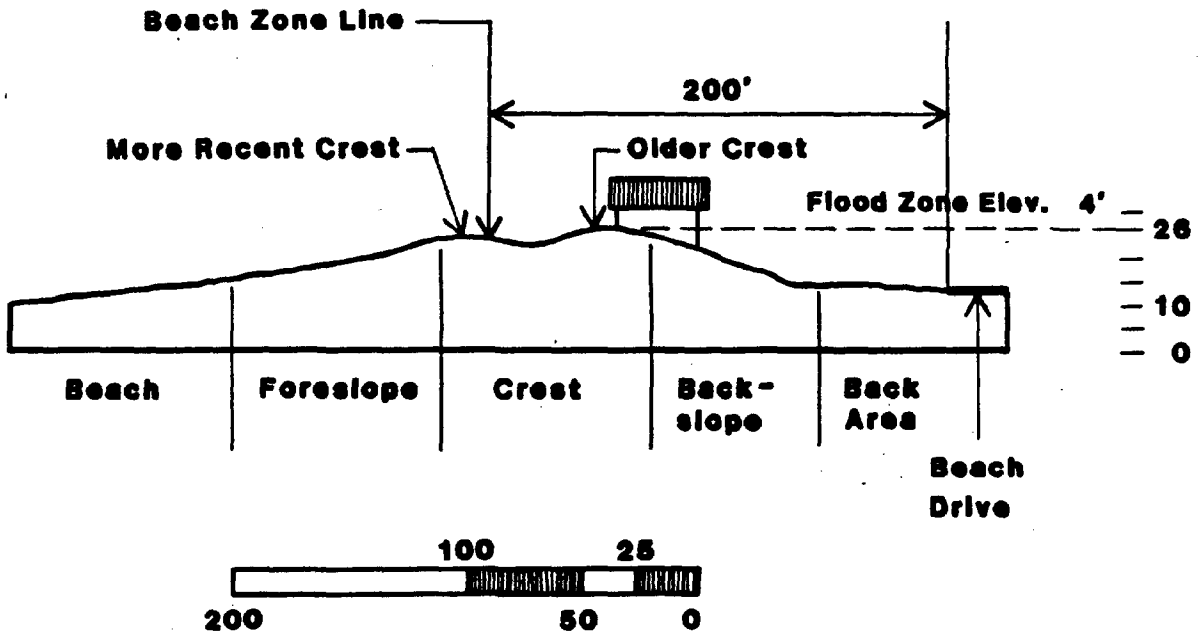
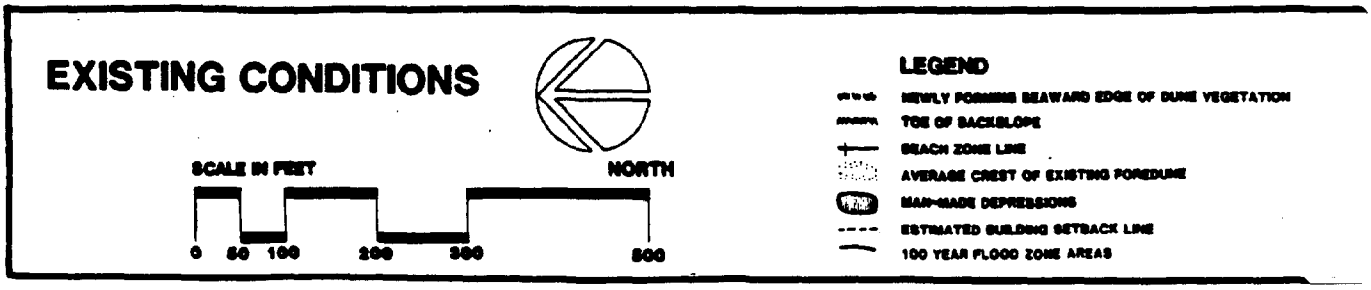


Figure 8: Generalized Cross-Section of Subarea E

Setting

The foredune in this subarea is wider, taller and better vegetated than those to the north. The crest averages 50 feet in width and height varies from 25 to 30 feet. In this subarea, the foredune is progressively wider and better vegetated to the south.

The foredune in this subarea is in better condition than the Riley Street subarea because homes are set back slightly further, there has been less alteration of the foredune, and no ocean erosion has occurred recently. Actually the homes are located on the crest of an older foredune. There is a slight trough in front of this older foredune and an apparent, though poorly formed, crest and foreslope in front of the trough. (See generalized cross section -- Figure 8.)



The 1977-78 erosion appears to have tapered off at the edge of this subarea; only the four houses north of Western Street were rip-rapped at that time. The northernmost rip-rap is located some 20-30 feet further west than rip-rap on lots to the south. According to property owners, the additional erosion occurred overnight after the northern houses were rip-rapped since the southern houses were riprapped the following day.

Much of the variation in height of the crest (from 25 to 30 feet), is the result of unevenness of a naturally formed foredune. It is also the result of grading. (Two of the six built lots in this subarea have been graded.) The crest of the foredune in the middle of this subarea (between cross sections 23 and 24) occurs about 50 feet landward of the crest in the remainder of this area. This sinuous crest creates an opportunity for both wind-blown sand and severe ocean storm waves to overtop the foredune at this location.

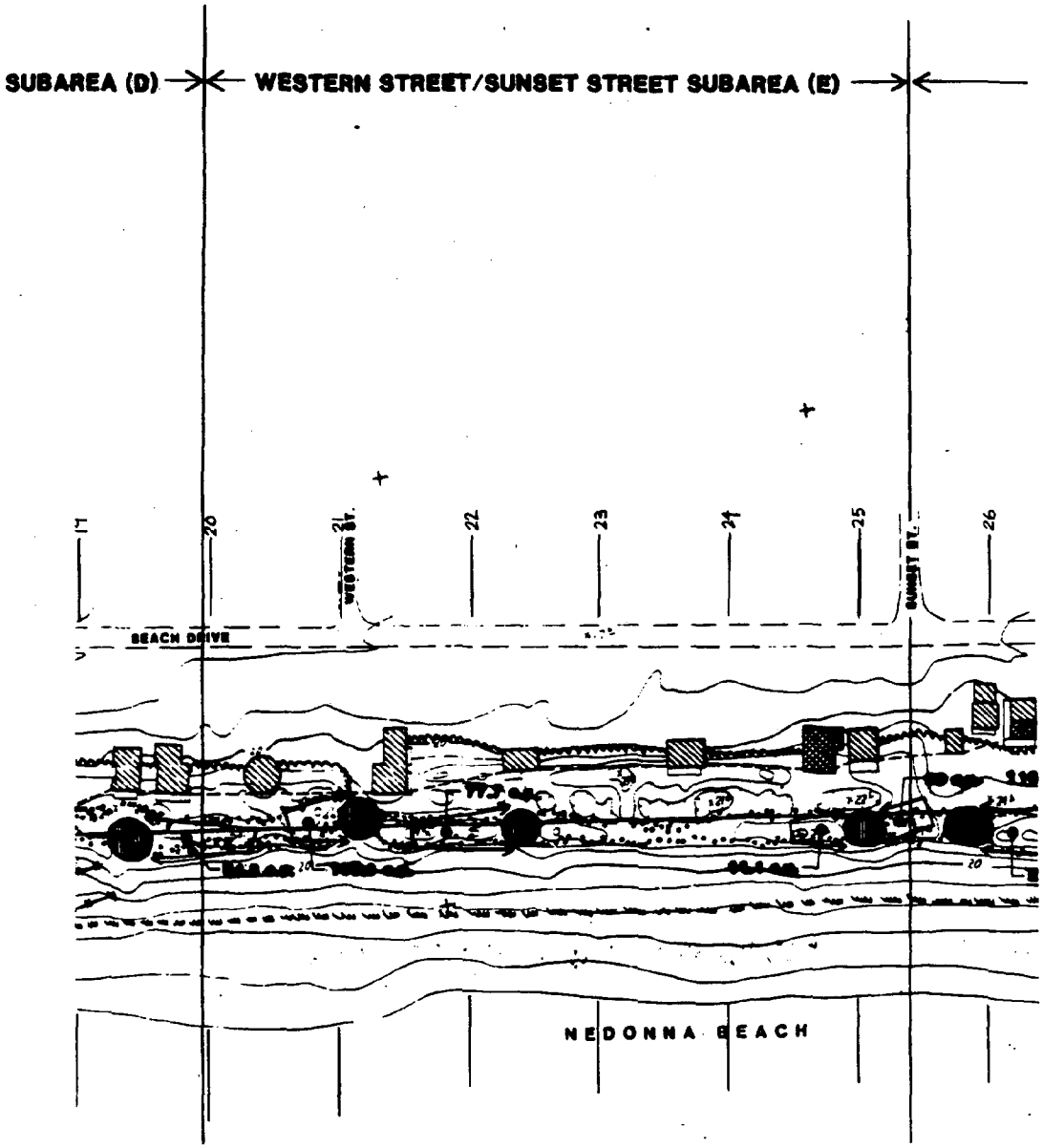
The foredune west of Western Street has not fully recovered from breaching that appears to have occurred in 1977-78 when it was used as an access way for placing rip-rap. While the site has covered with sand, it is not vegetated and the crest is 6 to 8 feet lower than on adjacent lots north and south.

Public pedestrian access appears to have occurred west of the end of Western Street. While the access point is lower than surrounding areas, lowering may have been caused by access for placement of rip-rap in 1978 and subsequent grading of the lot immediately to the south rather than pedestrian use. Nonetheless, the crest is bare for 25-40 feet in this area.

Recommendations

1. Low spots in the foredune should, at a minimum, be planted with european beachgrass to encourage growth in the height of the foredune in this area. In particular, the breach at the end of Western Street should be planted, preferably after use of sand fences to raise the elevation of the crest at that location.

2. Many of the lots in this area presently qualify for some crest grading. The amount of sand to be graded will not be adequate to fill low spots up to the recommended crest elevation (26 feet). Consequently, lower crest lots that do not receive graded sand should encourage crest growth by applicaton of fertilizer and planting bare areas with european beachgrass.



GRADING PLAN

SCALE IN FEET

0 50 100 200 300 500

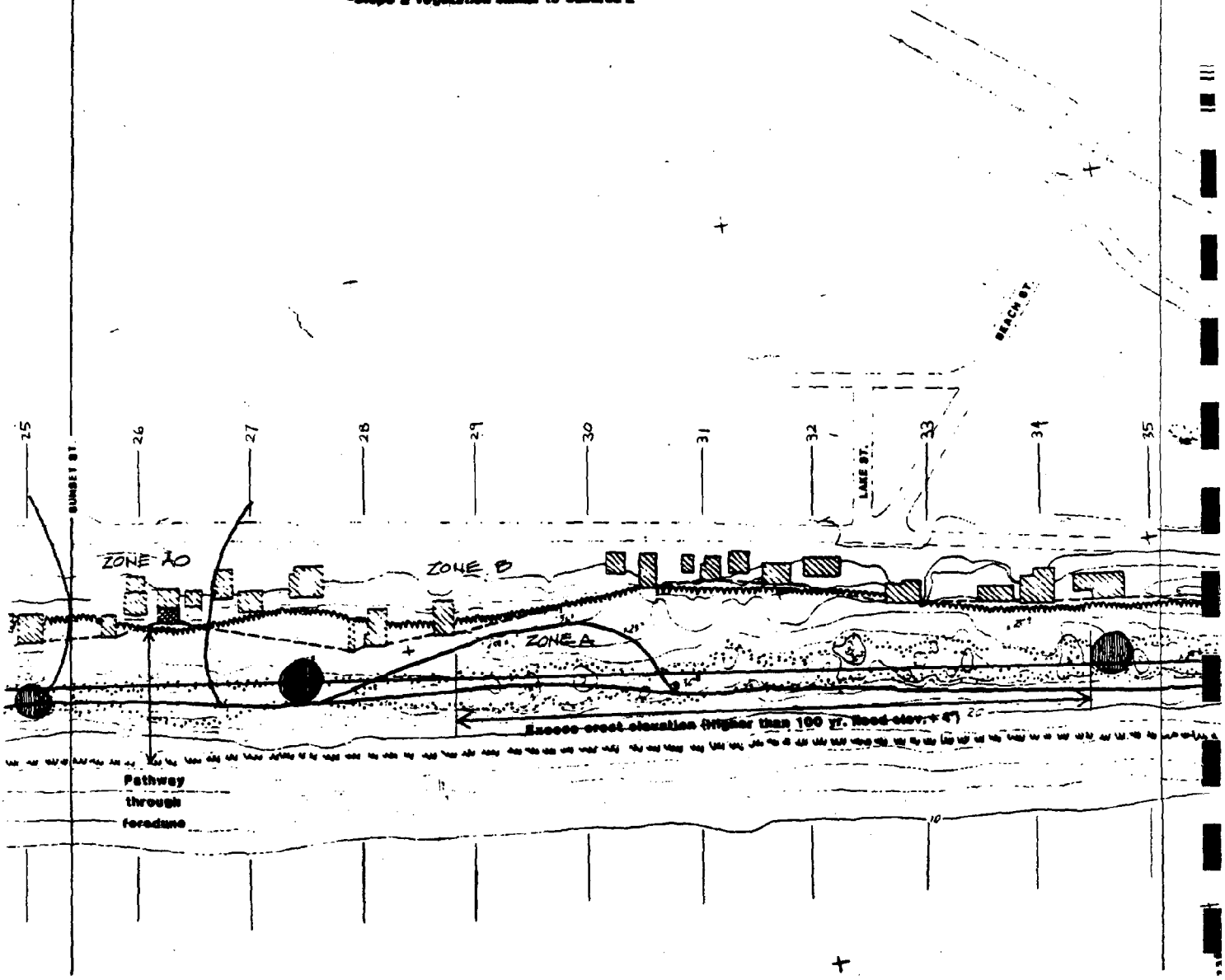
NORTH

LEGEND

- NEWLY FORMING SEAWARD EDGE OF DUNE VEGETATION
- TOE OF BACKSLOPE
- BEACH ZONE LINE
- SAND FENCE
- ESTIMATED BUILDING SETBACK LINE
- AVERAGE CREST OF EXISTING FOREDUNE
- NATURAL & MAN-MADE LOW POINTS (TO BE FILLED)
- AVAILABLE ADJACENT FILL AREAS & DIRECTION OF GRADING

LAKE STREET/BEACH DRIVE SUBAREA (F)

1. FORESLOPE
   - -Averages 75' wide
   - -Long, gentle slopes with 1-2' high hummocks [Steeper slopes in southern part of subarea]
   - -Vegetation
     - Coverage varies from 25% to 50%. Heavier coverage in southern part of Subarea F
   - -Two man-made cuts & three, long natural depressions
2. CREST
   - -Averages 100 - 125' wide
   - -Low, gentle grade with some hummocks
   - -Vegetation
     - 95% coverage except for few small, open areas
3. BACKSLOPE
   - -Averages 40 - 100' wide
     (Includes remains of very old foredune)
   - -Slope & vegetation similar to Subarea E



Subarea F: Lake St.- Beach St. Subarea

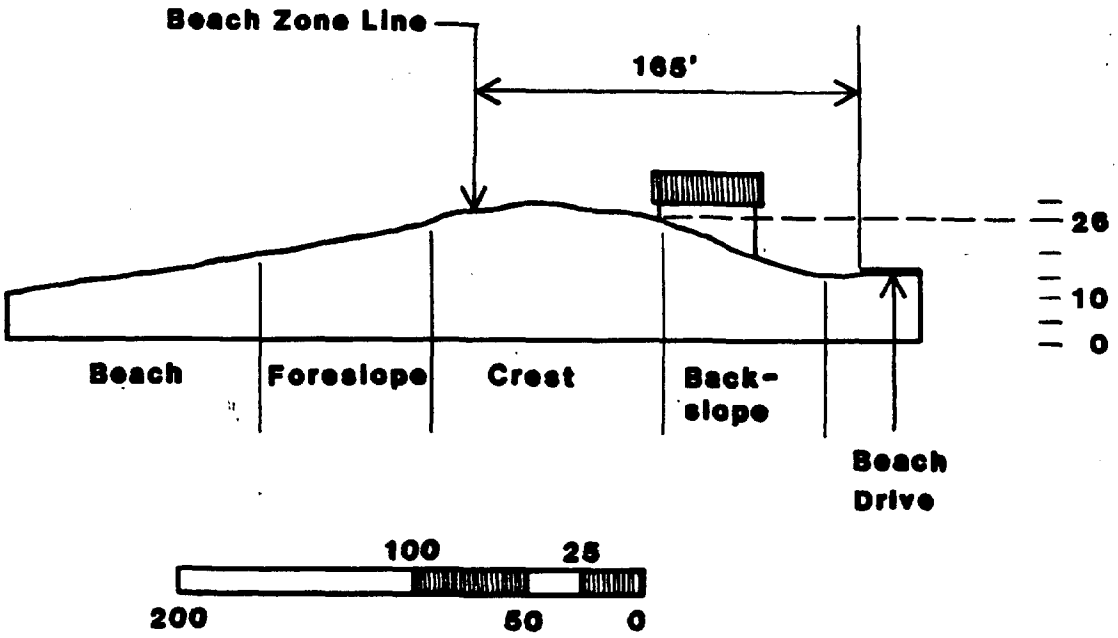


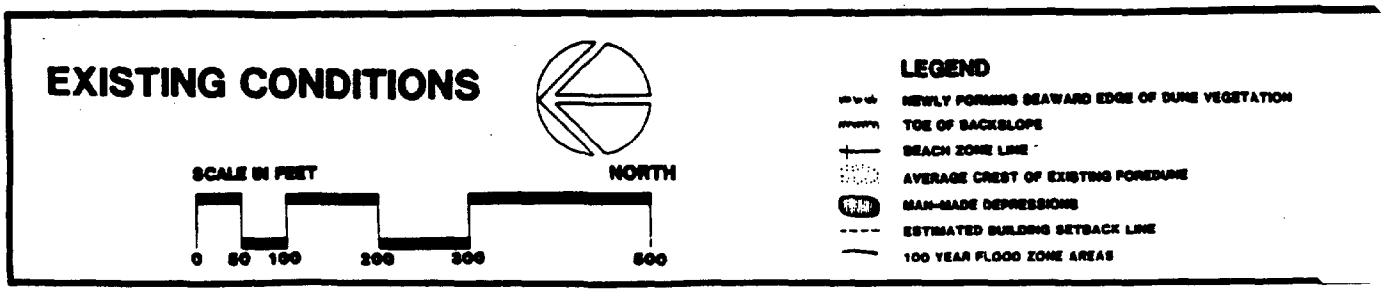
Figure 9: Generalized Cross-Section of Subarea F

Setting

This stretch of the foredune is consistently higher, wider and better vegetated than the areas to the south. All of the homes in this area are located 25-100 feet landward of the crest. Most are located on an older foredune just west of Beach Drive. These are generally the older oceanfront homes in this subarea. They were apparently built before the present foredune accreted to its current height.

The backslope in this subarea is well vegetated. There is a complete cover of european beachgrass, with a mix of secondary vegetation including some small shorepine. There are also several noticeable depressions in the foreslope.

The crest in this area is wide (100-125 feet), well-vegetated, with an even low-relief characterized by flat areas and numerous low hummocks. The crest on many of the lots has been graded or mowed but the entire area appears to be at or above the recommended crest elevation and the vegetation is in very good condition.

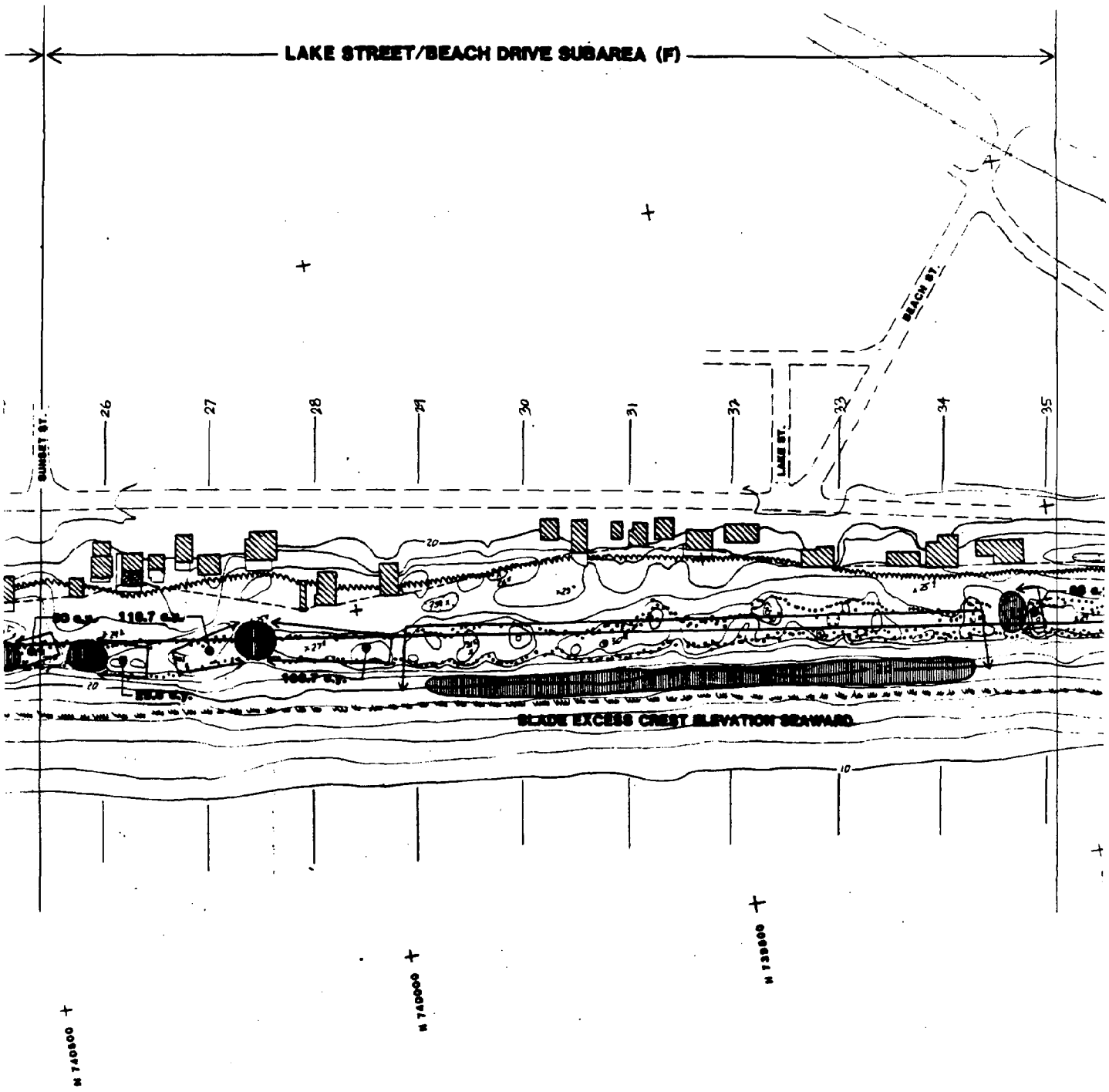


The foreslope, like that immediately to the north, is 50-75 feet wide, with a gentle slope punctuated by a series of small hummocks (1 to 2 feet in height). Vegetation cover varies from 25-50% with the southernmost area being better vegetated than the area to the north.

The southern boundary of this subarea is the Manhattan Beach Wayside. That is the limit of private ownership in this stretch of beach. Property owners just north of the wayside would like the foredune immediately south of them graded to maintain their view. Such grading would be consistent with the recommendations of this plan but would require permission from State Parks Division. Grading done in the state park should consider public use and access needs and should be limited to the area within 100-150 feet south of the park's northern property line.

Recommendation

Crest grading in this area may involve substantial movements of sand since the crest is two to five feet above the allowed grading elevation. Also, there are few low spots in the crest that need additional material. Consequently, most of the graded material should be pushed toward the foreslope, further widening the crest.



GRADING PLAN

SCALE IN FEET

0 50 100 200 300 500

NORTH

LEGEND

- NEWLY FORMING SEAWARD EDGE OF DUNE VEGETATION
- TOE OF BACKSLOPE
- BEACH ZONE LINE
- SAND FENCE
- ESTIMATED BUILDING SETBACK LINE
- AVERAGE CREST OF EXISTING FOREDUNE
- NATURAL & MAN-MADE LOW POINTS (TO BE FILLED)
- AVAILABLE ADJACENT FILL AREAS & DIRECTION OF GRADING

SPECIFICATIONS

Planting European Beachgrass 1/

Planting Stock:

The stock to be planted is European Beachgrass (Ammophilia arenaria). The source and quality of the planting stock should be approved by the contracting officer or the authorized representative.

Digging, Stripping and Trimming:

The plants should be thoroughly cleaned by shaking sand and silt from the roots. Dead stalks and trash should be removed from the culms by stripping. The underground stems should be broken back so that one or two nodes remain. The grass culms should be sorted and tied into bundles weighing approximately 10 pounds; tops should be cut back so that the overall length of the planting stock measures about 20 inches.

Storage:

The planting stock should be planted within eight hours of removal from the nursery areas or heeling-in beds. The heeling-inbeds should be a well-drained damp trench with the roots (nodes) covered to a depth of at least 8 inches. Stock should not be held in heeling-in beds for a period exceeding two weeks. The supply of stock at the planting site must be kept in a cool shady place or otherwise protected against damage from excessive drying. Cold storage at 34-38 degrees farenheit for periods of up to 2 months is also acceptable.

The planting stock should be handled and transported by any method that does not damage the planting stock or area.

Planting:

1. The grass is planted in hills with an average of three live culms per hill but no fewer than two in up to 10% of the hills.

2. The spacing between hills should average 12 inches on the foreslope and 18 inches on the crest. (See Table 1)

3. The grass should be planted to a depth of 12 inches, with sand or silt for cover compacted to exclude air from the roots (nodes). The top of the plant should be upright and extend approximately eight inches above the ground.

4. No planting should be done on any area until the moisture is within three inches of the ground surface. Nor should any planting be done when the temperature exceeds 60 degrees F. or when freezing conditions prevail.

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1. Adapted from Ternyik, 1979. Specifications are also applicable to American beachgrass (Ammophila breviligulata) and Sea Lyme-grass (Elymus mollis).

5. All areas planted should be fertilized with coarse particle ammonium sulfate commercial fertilizer (21-0-0), applied at a rate of 42 pounds of available nitrogen per acre (one pound per 1000 square feet). (Elephant Brand or its equivalent is recommended because grains are large enough to avoid being blown by wind.) Fertilizer should be applied when the wind is calm and the rain is steady; irrigation may be substituted for rain. The fertilizer should be applied at the time directed by the contracting officer or the authorized representative.

TABLE 1: Transplants Needed With Varied Spacing Requirements

Transplant Type	Spacing	1,000 sq. ft.	one acre
Beachgrass - 3 culms per hill	12"x12"	3,004	130,680
Beachgrass - 3 culms per hill	18"x18"	1,335	58,080
Beachgrass - 3 culms per hill	24"x24"	751	32,670
Beachgrass - 3 culms per hill	30"x30"	480	20,880
Beachgrass - 5 culms per hill	12"x12"	5,006	217,800
Woody species - 1 transparent per hill	3'x3'	111	5,840
Woody species - 1 transparent per hill	6'x6'	28	1,210
Woody species - 1 transparent per hill	8'x8'	16	680
Woody species - 1 transparent per hill	12"x12"	7	302

Note - A word of caution: Always order 3% more to offset heavy planting.

Inspection:

1. Inspections should be made by the contracting officer or his authorized representative. A representative cross section of not less than 5% of the planted areas should be inspected to ensure compliance with the contract requirements.

2. Nonconformance with any specifications classifies a plant hill as unsatisfactorily planted. A tolerance of 5% or 5 unsatisfactory plant hills per 100 is satisfactory. However, any amount over 5% should be applied as an equal percentage reduction of the acreage planted (payments being made on the basis of net acreage). When the deficiencies are 10% or over, the contractor should be expected to take steps to correct them.

Timing:

Planting is recommended between November 15 and April 10. Plantings occurring this time of the year will be most successful because of the abundant rainfall and natural growth pattern of european beachgrass. Beachgrass can be planted at other times of the year, however, additional measures are necessary to assure planting success such as irrigation and fertilization. Usually, it is preferable to delay planting to the November to April season noted above and temporarily stabilize the area by placing rye grass straw (1 inches-2 inches) covered loosely with sand to prevent blow-outs.

Storage:

Plants should be kept in water immediately prior to planting to maintain moisture and proper temperature.

Planting:

Should be done at night or when temperature is below 60 degrees farenheit. Plants should be watered after planting and fertilizing.

Secondary Stabilization:

Plantings of secondary stabilizing vegetation are appropriate in well-vegetated backslope and back areas but not in the crest or foreslope.

Species:

The following plants are appropriate for secondary stabilization:

Salal (Gaultheria shallon)
Evergreen Huckleberry (Vaccinium ovatum)
Shore Pine (Pinus contorta)
Purple Beach Pea (Lathyrus japonicus)
Seashore Lupine (Lupinus littoralis)
Tree Lupine (Lupinus arboreas)

Planting Requirements:

Secondary stabilization should be done in conformance with the recommendations provided in Table 2.

Conditions:

1. Secondary stabilization should only be done when initial stabilizing vegetation (i.e., european beachgrass) is well established.

2. Secondary plantings should occur directly in existing stands of beachgrass. Beachgrass should not be destroyed or removed prior to planting, so that it can continue to stabilize the area as secondary plants are establishing themselves. Succession should occur without destruction since beachgrass tends to thin out and die where it is cut off from sand accretion.

TABLE 2: SECONDARY STABILIZATION

Recommended Native Plants for Dune Stablization

Species	C	S	BR	B&B	Seed	1-0	2-0	Size	CA	FC	SP	Season
European Beachgrass	X		X				X	20"	X		18"x18"	11/15 - 3/15
American Beachgrass	X		X				X	20"		X	18"x18"	11/15 - 4/15
Sea Lyme grass	X		X				X	20"		X	18"x18"	11/15 - 2/15
Seashore Bluegrass		X			X			15 lb.		X	cc	9 or 4 - 6
Seashore Lupine		X			X			7 lb.		X	cc	9 or 4 - 6
Purple Beach Pea		X			X			15 lb.		X	cc	4 - 6
Tree Lupine		X			X			30 lb.		X	cc	4 - 6
Salal		X		X			X	1 gal.	X		3'x3'	12 - 2
Evergreen Huckleberry		X		X			X	1 gal.	X		3'x3'	12 - 2
Scotch Broom		X	X			X		14"		X	8'x8'	12 - 3
Shore Pine		X	X	X			X	12"-20"	X		8'x8'	12 - 2

C - Colonizer-initial stabilizer
S - Secondary-permanent S
BR - bare root stock
B&B - balled and burlapped
1-0 - one year old
2-0 - two year old
Size - height or pounds per acre
A-1 - foredune or frontal areas
A-2 - deflation plain or wet interdune
A-3 - open sand areas
A-4 - older stabilized dunes
CA - commercially available
FC - ffield collection
SP - spacing inches, feet, cc-complete cover
Season - planting dates (optimum)

Adapted from: Ternyik, Dune Stabilization Methods and Criteria, 1979.

Crest Grading:

Limited grading of sand from crest areas above the 26 foot elevation is allowed by this plan. These specifications should be followed carefully to minimize damage to dune vegetation and to stability of the foredune. *If done improperly, grading can destroy stabilizing vegetation, cause* unwanted sand accretion on adjacent lots and homes, and substantially increase potential for ocean flood damage.

Timing:

1. Grading should generally be done between November 1 and March 15. Beachgrass planted or fertilized subsequent to grading will grow best at this time of the year.

2. Grading may be done at other times of the year but is not encouraged. If grading is done between March 15 and November the foredune should be temporarily stabilized by discing of rye grass straw into the graded crest immediately after grading to prevent wind movement of sand.

3. Planting and fertilization of european beachgrass should be done in the following November-March season. Planting should be done directly into the ryegrass and spacing may be increased to 24 inch centers.

Conditions:

The crest area to be graded must be more than 4 feet above the 100-year flood elevation; in most of the Nedonna area this is the 26-foot elevation (MSL).

Equipment:

A bulldozer with size depending upon the extent of the area to be graded.

Method:

1. The area to be graded should be staked by a qualified individual in advance of grading, so that the operator knows the limits on the area and the depth of grading to occur (setting elevations is simplified by the fact that elevations were marked on most homes in a December 1985 survey by Handforth & Larson Engineers of Manzanita).

2. The management authority should be notified so that a representative can view the staked area, the grading operation, and the completed grading.

3. The bulldozer should get to the lots through the jetty parking lot and along the beach. The bulldozer should minimize crossing the foreslope.

Placement of Graded Sand:

1. The first priority for placement of graded sand is filling of low

spots in the crest to the 26-foot elevation. This need not be done if low spots are planted with beachgrass and fertilized consistent with the specifications in this plan. (This approach is feasible at Nedonna Beach because the foredune is at or above the 100-year flood level. Consequently, only relatively minor amounts of accretion are necessary to repair the foredune. In other areas where low spots are really major breaches, filling of the breach to at least the 100-year flood level should be a prerequisite to any grading.)

2. Low spots in the crest on the lot or adjacent lots (i.e., below the 26 foot elevation) are the priority location for graded material (see Figure 10). The management authority should identify spots on adjacent lots appropriate for filling which need additional sand. These low spots should be filled to to the 26 foot elevation. (This will result in a crest roughly 50-75 feet wide at a uniform 26 feet height, except in Subarea E, where the crest is 100-125 feet wide.)

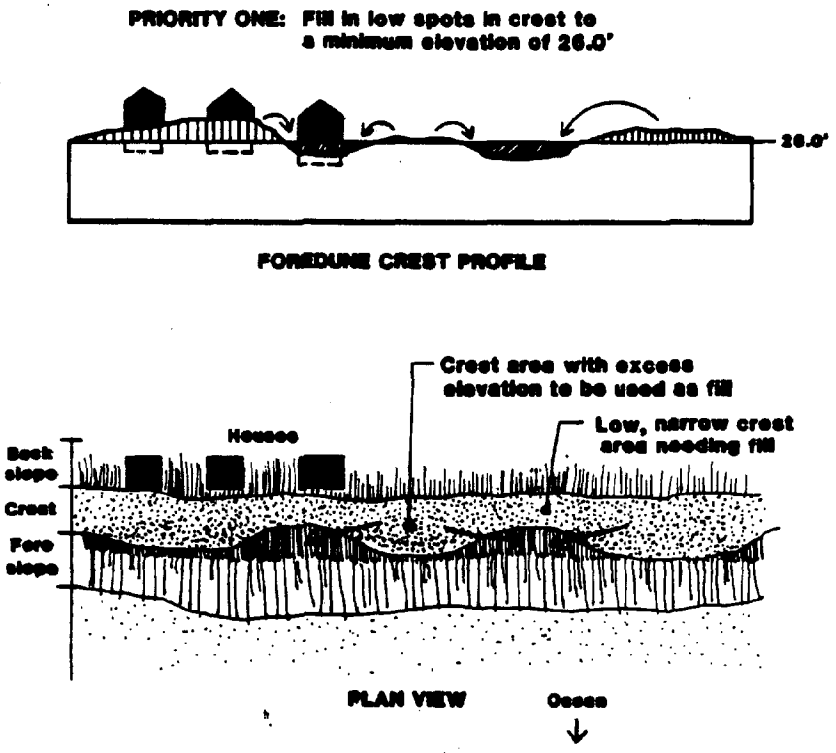


Figure 10: Placement of Graded Sand

3. Where the adjacent lots are at the minimum elevation, crest grading can be done in two ways:

   (a) A series of short passes pushing sand directly oceanward from the crest to the foreslope.

   (b) One or several passes along the crest of the foredune with the blade angled so that sand is deposited on the foreslope.

In either case sand should simply be pushed onto the foreslope. Where a substantial amount of sand is placed on the foreslope it should be smoothed out to create an even slope. If only a small amount of sand is graded forward, the bulldozer should not attempt to smooth the sand forward on the foreslope.

Tapering:

If the crest of adjacent ungraded lots is more than 4-feet higher or lower than graded lots, the grading should taper the crest into these areas rather than leave a right angle cut at the lot line.

Minimum Area:

Grading should be done over several lots at a time to achieve a uniform crest height throughout. However, grading may be done on a lot-by-lot basis provided all other specifications are met.

Fertilizing:

Areas graded less than 3 feet should be promptly fertilized per the fertilization recommendations for beachgrass plantings. Fertilizer should be applied to graded sand placed on the crest and foreslope as well.

Planting Beachgrass:

Areas graded more than 3 feet in height should be replanted with european beachgrass at 18 inch spacing. Any graded crest area with less than 30% vegetative cover should also be replanted with european beachgrass.

Monitoring:

1. The management authority should inspect the site before and after grading to confirm that grading and other measures have been done in compliance with specifications here.

2. Permits for grading should be conditioned to require reestablishment of vegetation on all areas affected by grading or filling. The management authority should inspect the graded area periodically after grading and recommend remedial measures at those times. Failure to comply should provide for management authority authorization to reestablish vegetation at the permittee's expense.

Foreslope Shaping:

Foreslope shaping is appropriate in limited situations to establish an even slope for maximum accretion of sand and foredune slope growth. Shaping should only be done when the present foreslope is so uneven and hummocky that it significantly impedes growth of the foredune.

Equipment:

Lightest possible bulldozers should be used since less sand will be moved than for crest grading.

Slope:

Grading should attempt to establish an even slope at an angle between 25% to 33% slope (between 1 to 3 and 1 to 4) depending on the amount of sand available.

Distribution:

Unless sand is placed as a result of approved grading elsewhere, shaping should only re-distribute sand presently on the foreslope. Only sand from the foreslope should be moved. Grading of sand from the crest or the beach onto the foreslope is regulated separately as grading or beach bulldozing and may be appropriate to provide sand for grading if there is a surplus of sand in these areas.

Minimum Area:

Shaping should occur over several lots at a time as shown on the grading plan map.

Tapering:

Shaped areas should be tapered into adjacent unshaped areas to avoid creating wind erosion or accretion problems.

Method:

Shaping should move as little sand as possible to establish an even slope (i.e., top off hummocks). The operator should make as few passes as possible and should avoid damaging vegetation on the crest of the foredune.

Fertilization:

Vegetated areas that are not seriously damaged or buried more than 3 feet of sand should be immediately fertilized.

Plantings:

Unvegetated areas and areas covered by more than 3 feet of sand should be immediately replanted with european beachgrass according to planting specifications.

Mowing Beachgrass:

Mowing of beachgrass is generally discouraged because, once cut, grass temporarily loses most of its ability to trap windblown sand. However, mowing can be an approrpiate management tool to maintain views across the crest or to promote even sand deposition on the foreslope.

General Requirements:

1. Mowing should be done between March and October.

2. Mowing should be done with a "weed-eater" type machine. Grass should be cut as evenly as possible levaing six to eight inches of grass remaining above ground.

3. Mowed areas should be fertilized immediately with 21-0-0 ammonium sulfate at a rate 2 1/2 pounds per 1000 square feet and watered.

Mowing for View Maintenance:

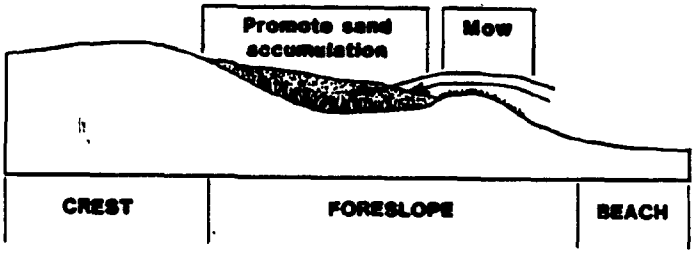
The foreslope should have at least 60% mature unmowed beachgrass cover to assure capture of accreting sand.

Mowing to Promote an Even Foreslope:

Mowing of foreslope vegetation is appropriate where the foreslope is accreting unevenly. Uneven accretion is usually indicated by a trough or a series of hummocks forward of the crest area. The high spots in the foreslope captured some accreting sand with the balance passing through to the crest. Mowing is recommended to allow sand to be captured in low spots to provide a smooth even angle to the foreslope. This technique should promote capture of sand on the foreslope reducing the need for future grading of the crest.

1. Foreslope mowing should only be done when low spots in the foreslope (which will remain unmowed) have at least 60% mature unmowed vegetation. Areas with less than 60% cover should be planted with european beachgrass at 18 inch spacing.

2. Mowed grass should be scattered in unmowed low-spots to promote capture of windblown sand.



Plant grasses on a 24" spacing, mow high area to allow sand to pass through and into low, unmowed area.

Figure 11: Recommendations for Beachgrass Mowing

Sand Fencing:

Type of Fence: Four foot high, wooden lath snow fencing or plastic fencing (such as Mirafi). (Green or tan is preferred color for plastic fencing.)

Posts: Six foot heavy-duty steel posts.

Wire: 14-gauge galvanized steel wire.

Placement: Fencing should be located as shown on the plan maps for placement. Fencing should be placed in two parallel rows 30-35 feet apart. Posts should be driven 2 feet into the ground at 10 foot intervals. Fencing should be firmly attached to each post at the top, middle and bottom. The fences should be anchored with guy wires at 50 foot intervals. End posts should be anchored in three directions. Cover the base of the fence with a mat of rye-grass straw (not wheat straw) 18 inches wide and 2 inches deep and cover the straw with sand.

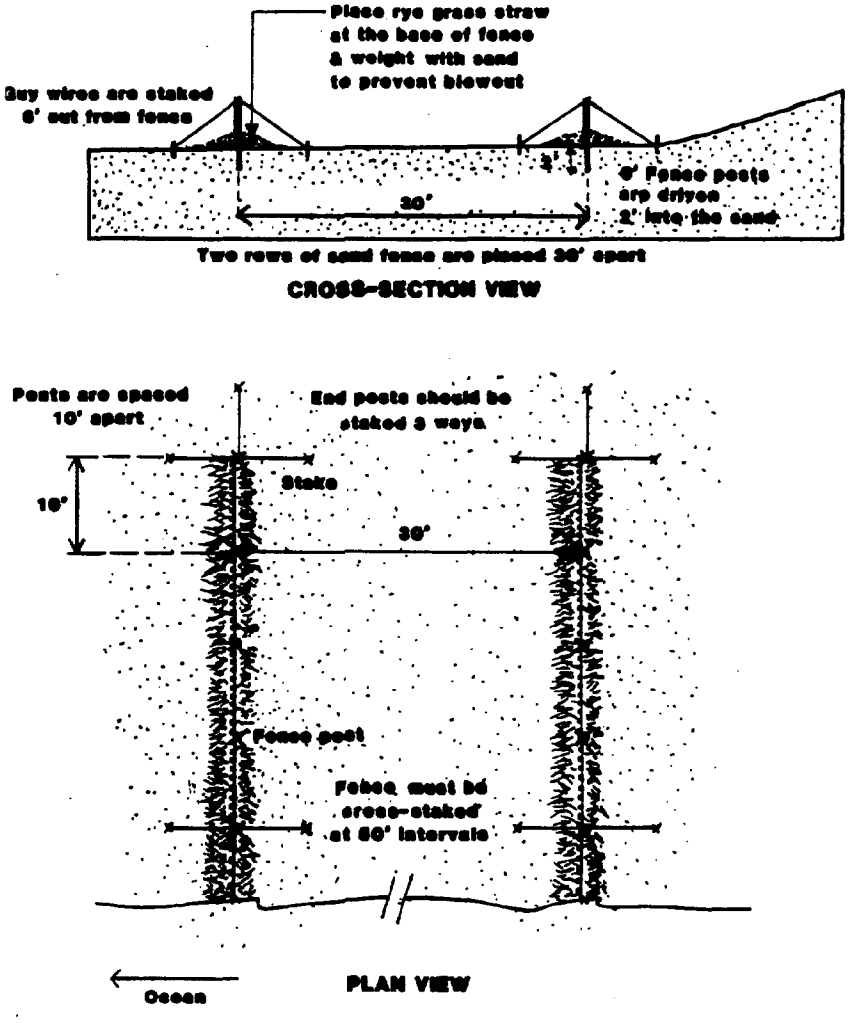


Figure 12: Placing and Spacing of Sand Fencing

Timing:

Fencing should be placed from November 15 to January 1 to maximize capture of wind blown sand. Fences may be placed at other times of the year but will fill more slowly.

Beachgrass Planting:

Once the sand fences have filled or substantially filled (i.e., within 6 inches of the top of the fence), beachgrass should be planted according to specifications for beachgrass planting following surface grading to provide an even surface for planting.

- The foreslope (i.e., in front of the seaward sand fence) to a width of approximately 35 feet should be planted at 18-inch centers.
- The crest (between the parallel sand fences) should be planted at 18-inch centers.
- The back portion from the shoreward sand fence approximately 24-feet should be planted on 18-inch centers.

Other:

1. Fences must be repaired if damaged by erosion or vandalism.
2. Signs should be placed at public access points to explain the purpose of sand fencing projects to encourage public cooperation.

Access Through Sand Fences

The specifications provided here should be applied to both pedestrian and vehicle access through sand-fenced areas should be provided according to the following specifications:

Cross-Fencing:

The parallel rows of sand fencing should be cross-fenced at the access to keep pedestrians and vehicles in the access and to capture sand.

Width:

Pedestrian accesses should be four to five feet wide. Vehicle accesses should be 10-12 feet wide.

Forward Fence:

A third sand fence should be placed 10-12 feet seaward of and parallel to the main sand fences in front of the access opening. The fence should overlap the opening by at least 5 feet on each end.

Orientation: Accesses should be oriented directly east-west.

Signing:

Public accesses should be signed both on the beach and landward to encourage use and discourage crossing the sand fence.

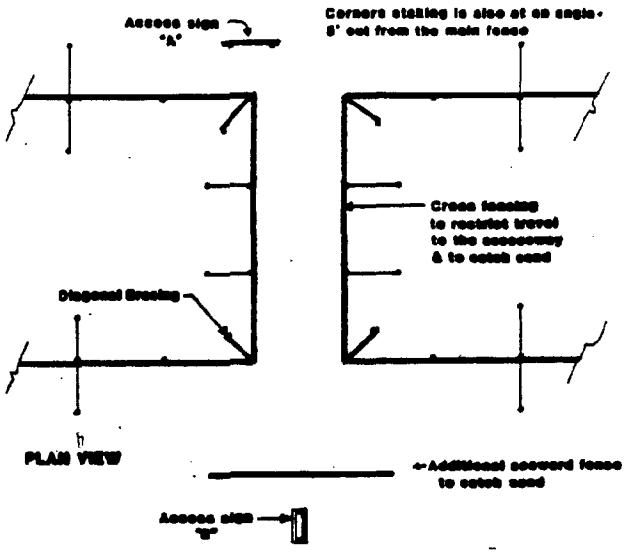


Figure 13: Accessways Through Sand Fencing

Revegetation:

Once vegetation is well established on the stabilized dune, the access way should be fenced and stabilized and a new access established through a vegetated portion of the foredune. European beachgrass should be used and all other recommendations for planting should be followed.

Applicability to Other Areas:

The specifications recommended here were drawn up based on a detailed examination of the circumstances at Nedonna Beach. Nonetheless, many of the specifications in the plan can be applied to other developed foredune areas on the Oregon Coast.

Specifications for foreslope shaping, beachgrass planting, secondary stabilization and accesses through sand fences are applicable to other areas where these measures are determined to be appropriate. Specifications for crest grading and sand fencing are transferable to other developed foredunes with the limitations noted below.

Crest Grading:

Statewide Planning Goal 18 (Beaches and Dunes) requires a complete foredune management plan when crest grading to maintain views is proposed under the Goal. Such grading can only be permitted in presently developed areas where the crest is more than 4 feet above the 100-year flood level. The crest grading recommendations in this plan can be applied to other areas using the specifications in this plan with one exception. This plan allows low spots in the crest to be filled in over-time by planting and fertilization of european beachgrass and allows, natural accretion to filling the gaps. However, the preferred technique is to fill in low spots with graded sand, immediately followed by planting and fertilization of beachgrass. Using beachgrass and natural accretion is appropriate in Nedonna Beach only because the foredune crest is presently at or above the 100-year flood elevation. In other foredune areas where portions of the crest are below the 100-year flood elevation, filling of low spots should be a condition of approval for crest grading.

Sand Fencing:

The specifications for sand fencing are generally applicable to other areas where a plan determines that a new or widened foredune is appropriate. The location of fencing in relation to the shoreline and the foredune should be based on a site-specific investigation. Closer spacing between parallel fences may be appropriate in some areas.

CROSS-SECTIONS:

The following cross-sections illustrate the shape of the foredune at regular 150 foot intervals throughout the Nedonna Beach area. The locations of the cross-sections are shown on the maps included with the study.

The cross-sections (and maps) were prepared from October 1984 Oregon Department of Transportation Aerial Photography by George Gross and Company of Portland. The scale of the photography (1:12,000) limits the accuracy of sections; elevations should be accurate plus or minus one foot. This level of accuracy was considered appropriate for the study since the foredune's shape is constantly being changed by accretion and erosion. On the ground observation during the study shows that most of the area has experienced some accretion since October 1984. (Note that the vertical scale of the cross-sections is exaggerated to enhance dune relief.)

Cross-sections also show the location of a "proposed foredune." The grading plan recommends establishment of a new foredune at this location over time through a combination of measures outlined in the plan, including sandfencing, placing of graded sand, planting of vegetation, and fertilization. Grading will not immediately result in the proposed foredune in most areas, especially to the north, because only a small amount of sand will be graded. The proposed foredune cross-section is provided to show where future windblown sand should be captured and stabilized.

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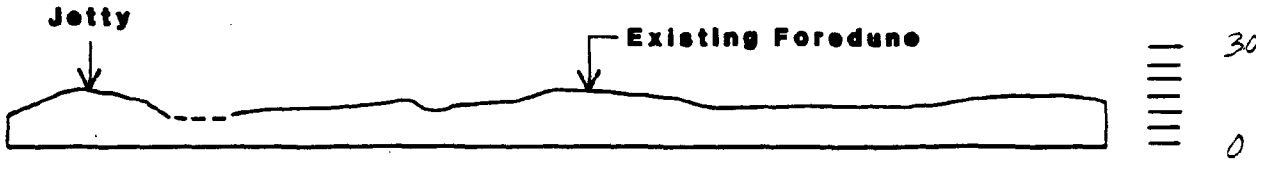

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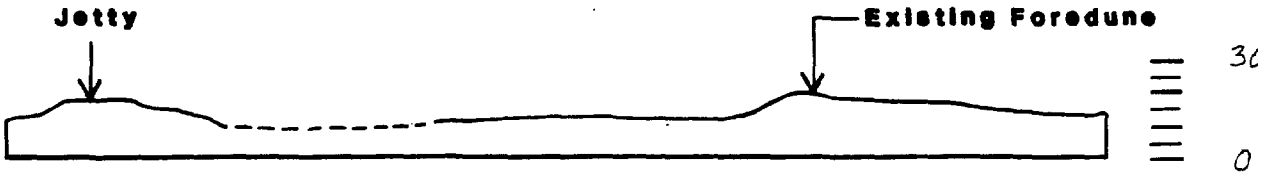

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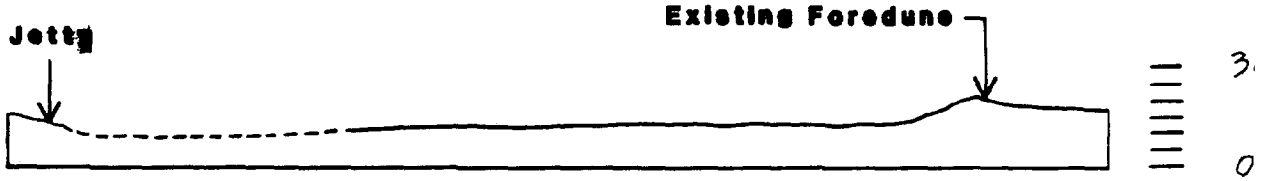

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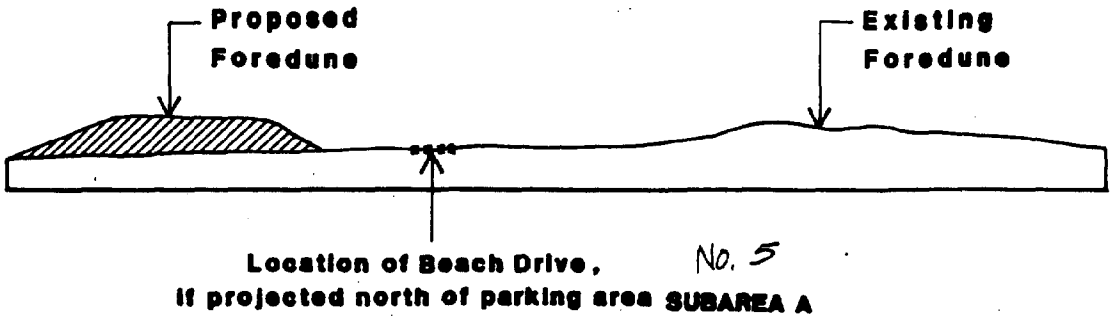
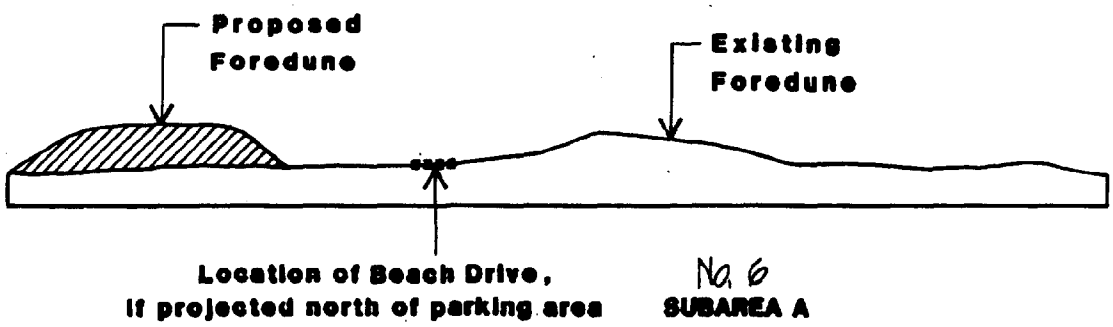
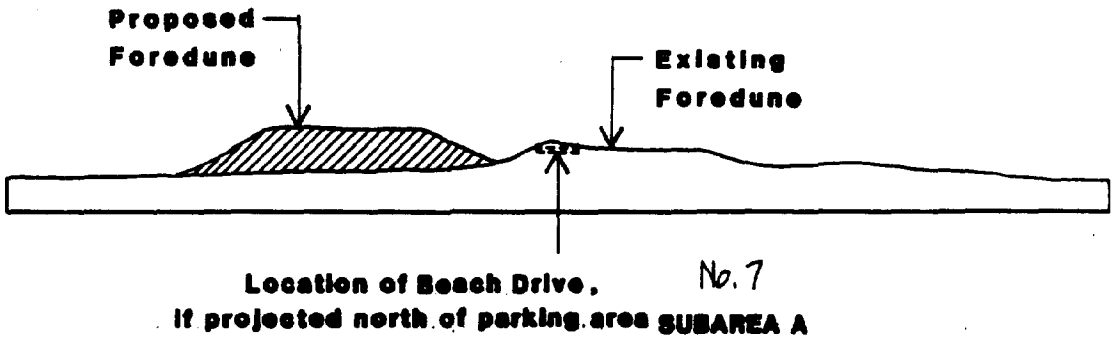
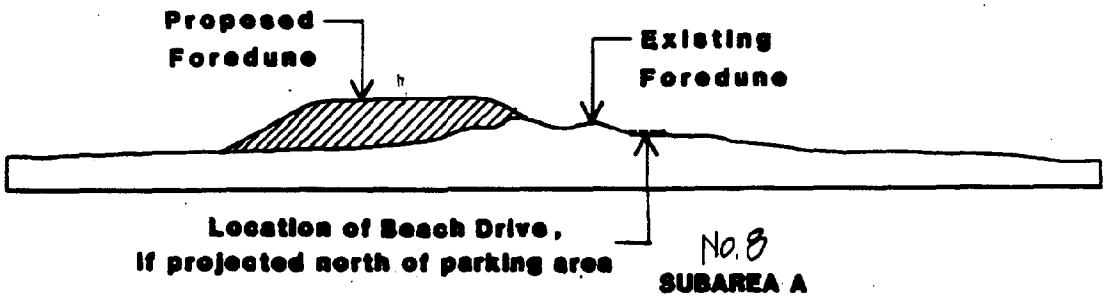
NEDONNA BEACH GRADING PLAN CROSS-SECTIONS









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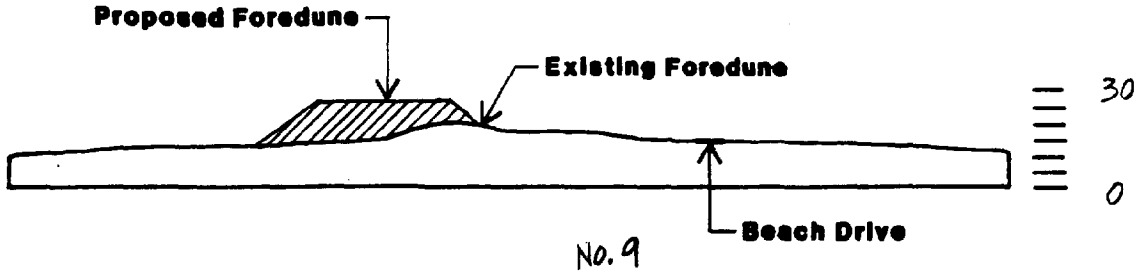

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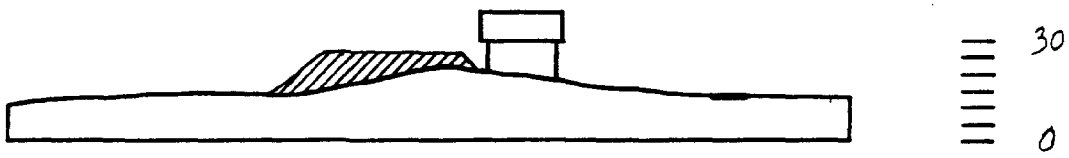

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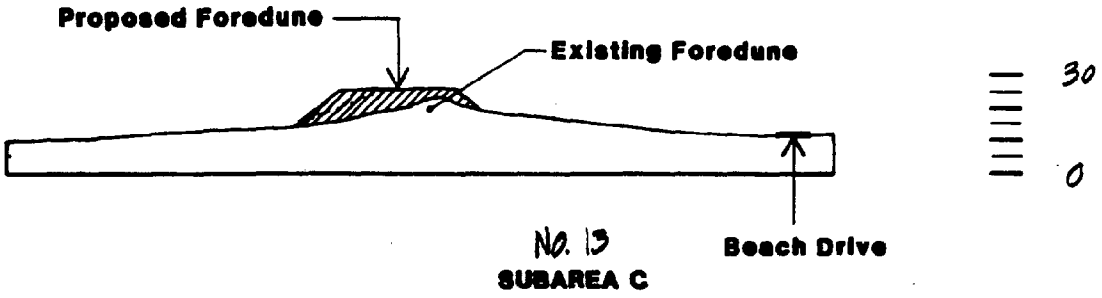

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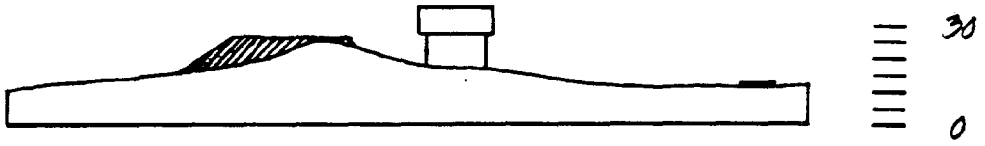

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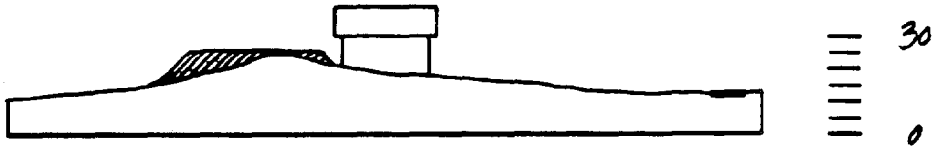

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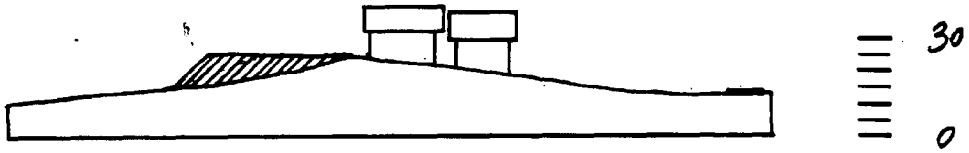

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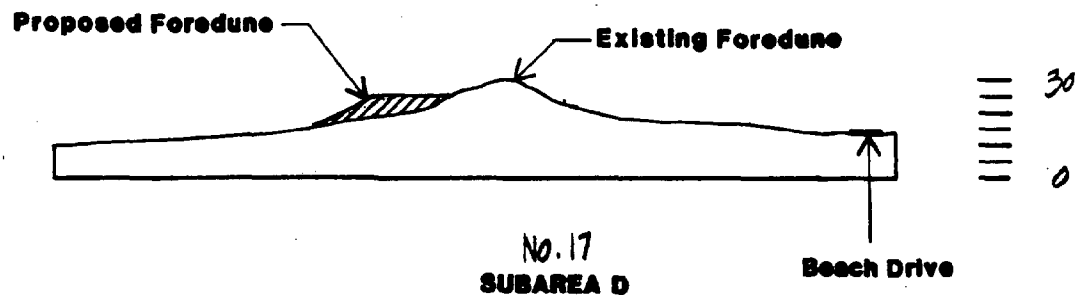

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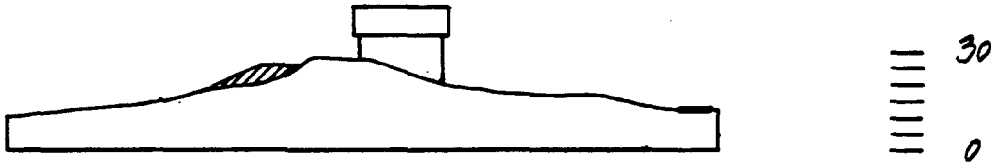

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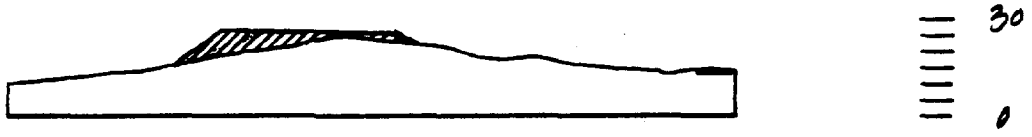

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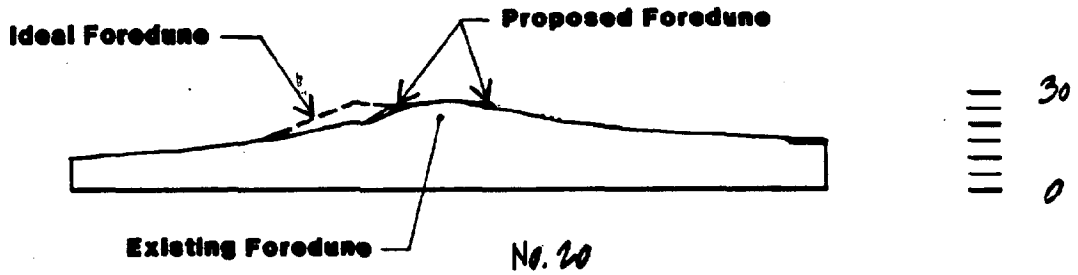

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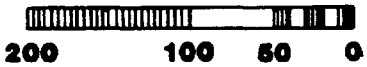

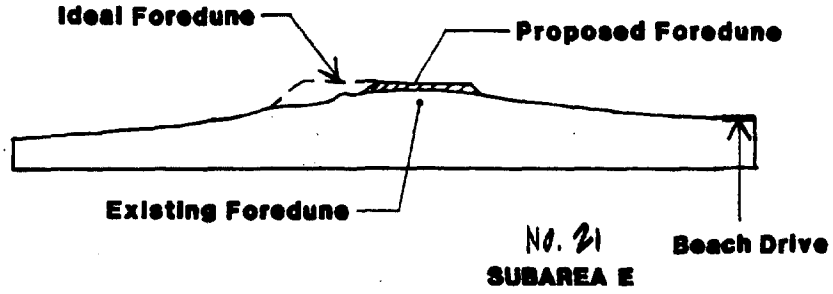

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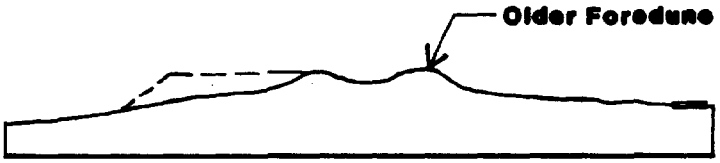

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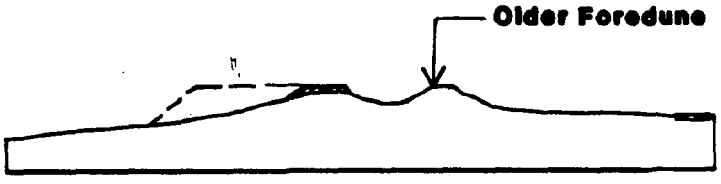

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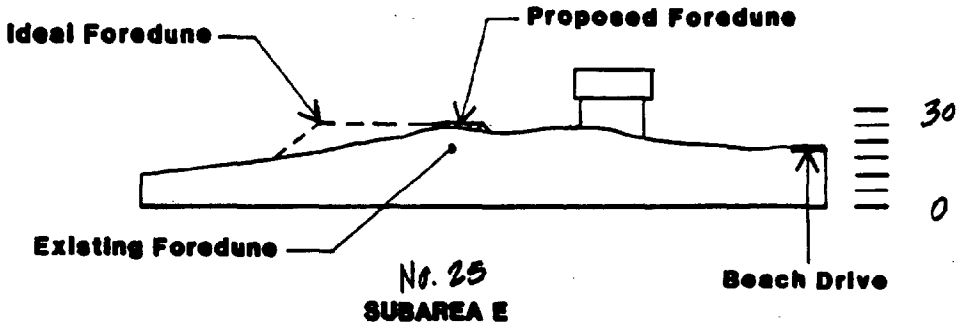

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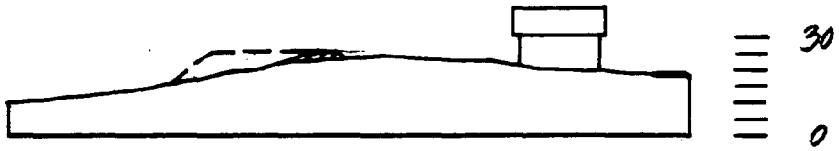

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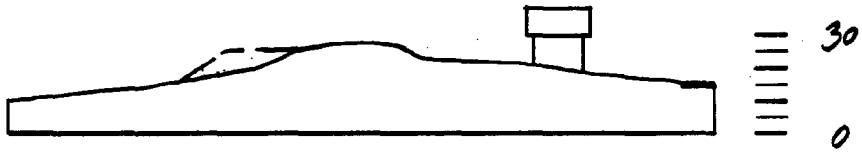

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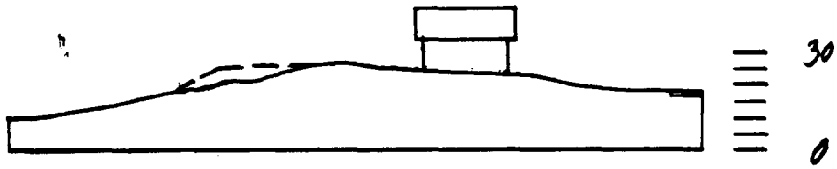

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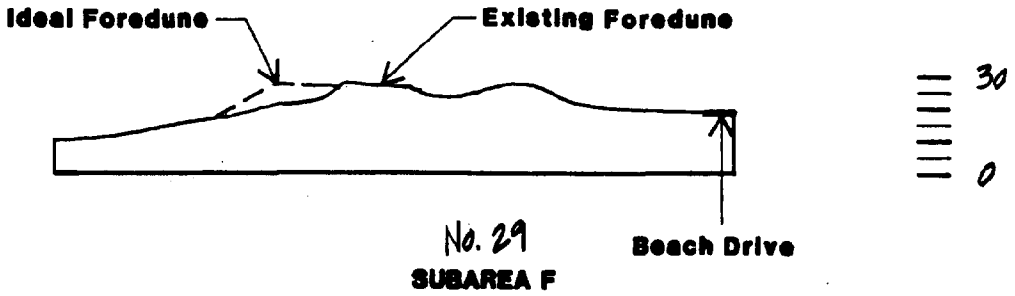

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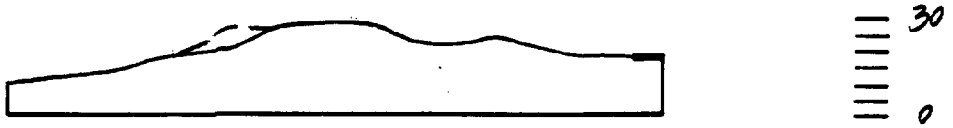

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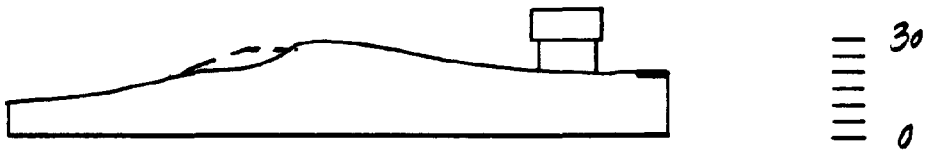

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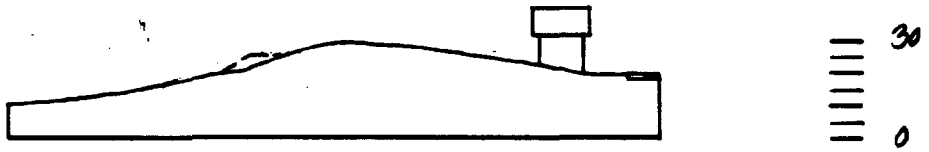

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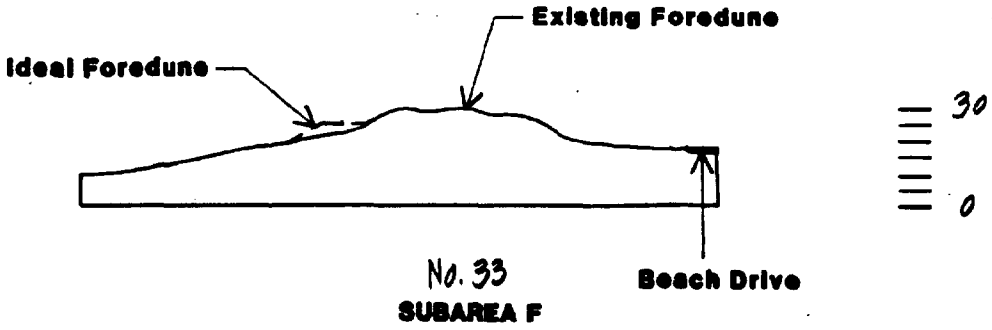

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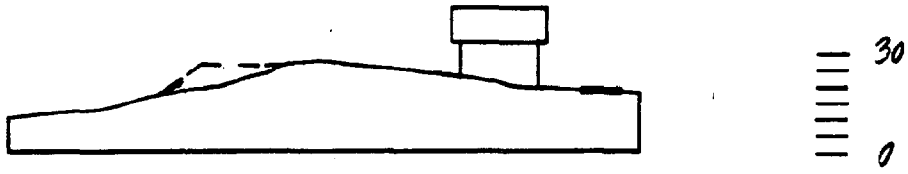

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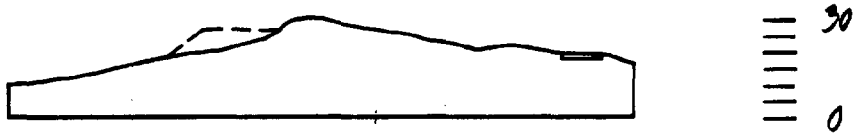

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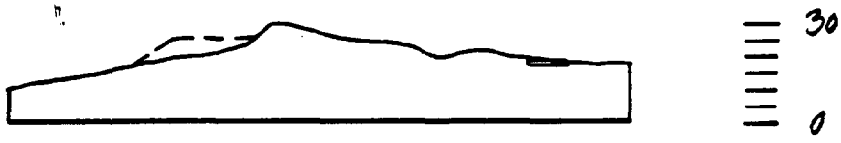

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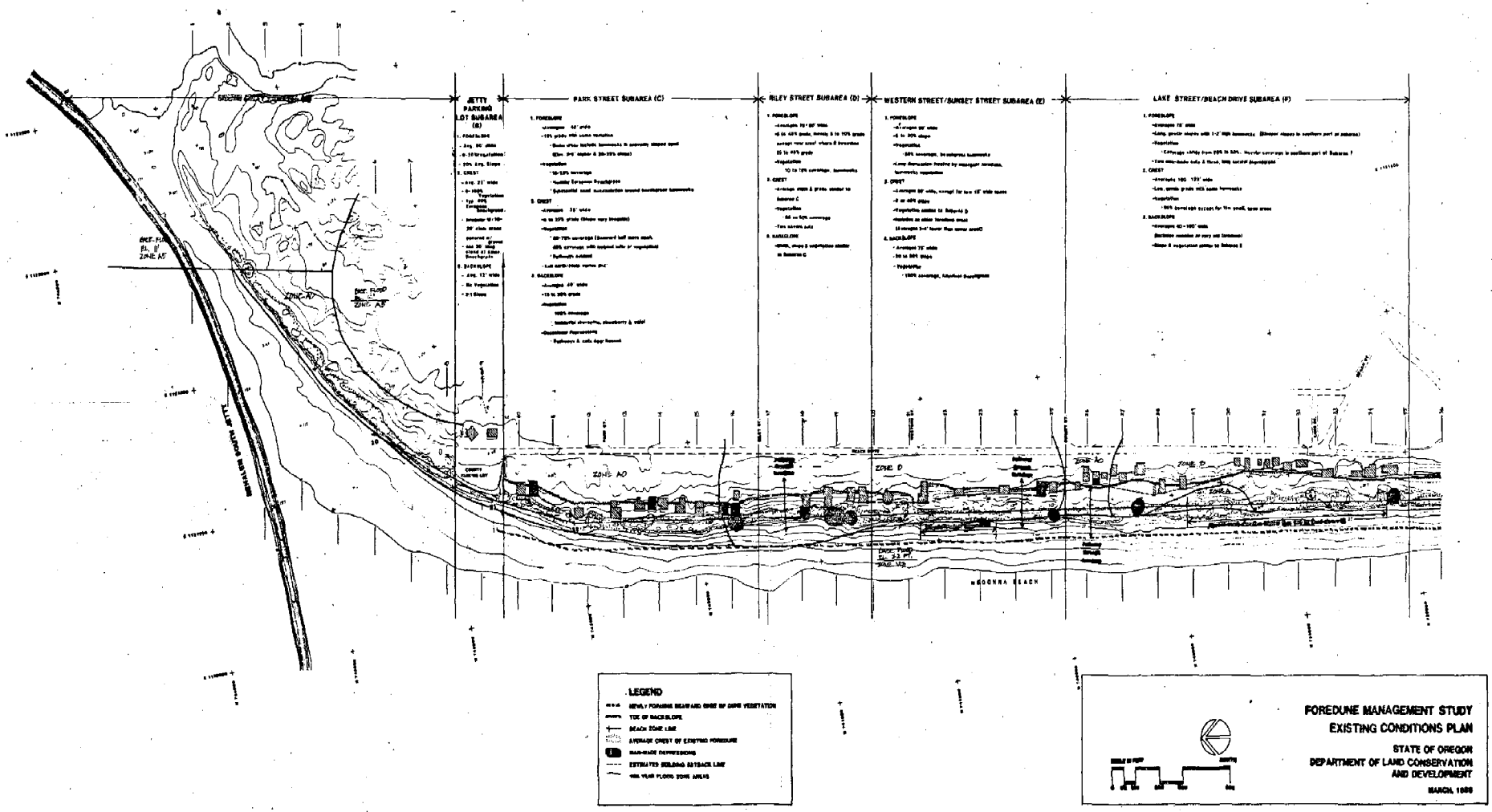
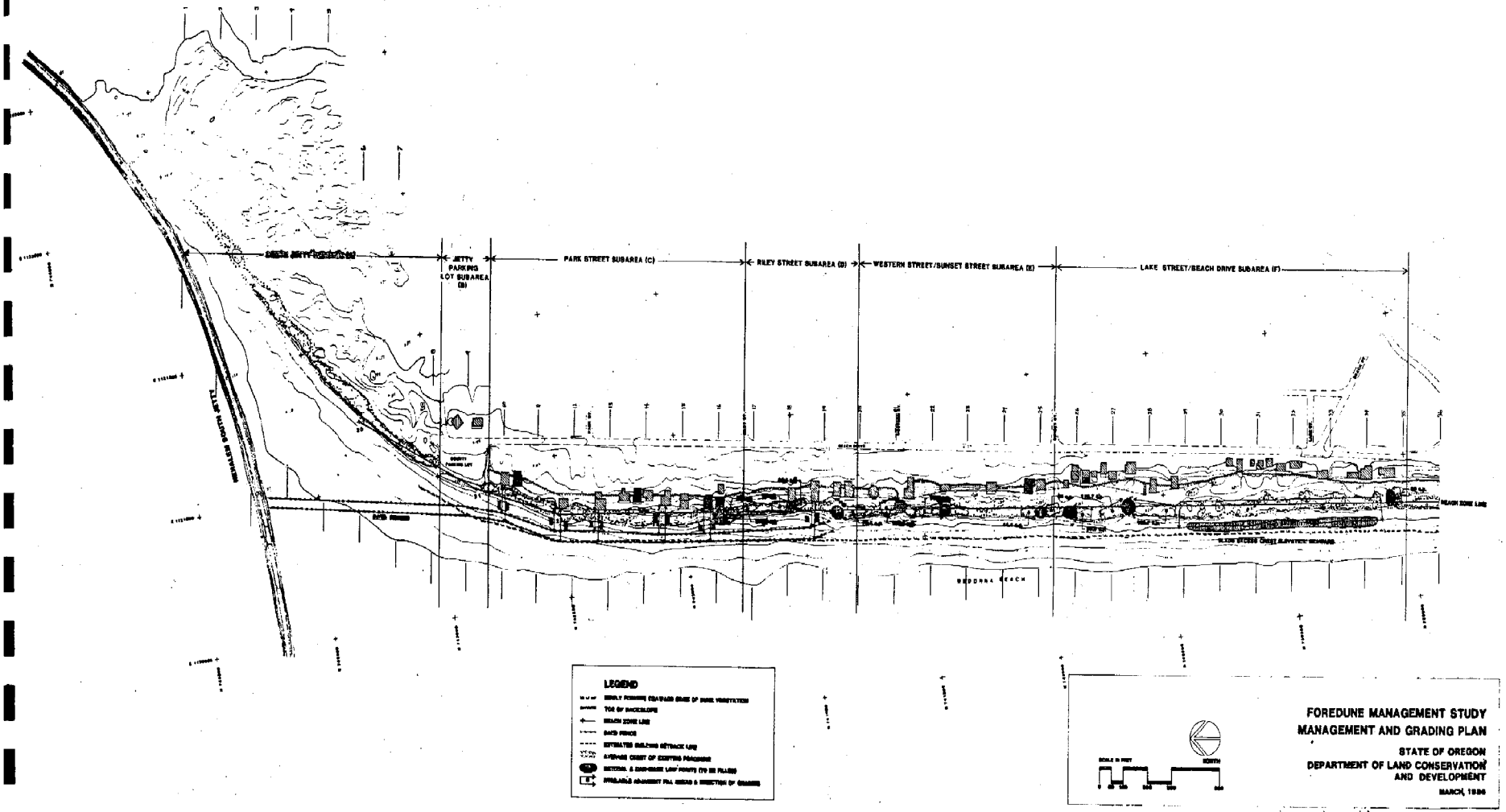


FOREDUNE MANAGEMENT STUDY
EXISTING CONDITIONS PLAN

STATE OF OREGON
DEPARTMENT OF LAND CONSERVATION
AND DEVELOPMENT

MARCH, 1988


JETTY PARKING LOT SUBAREA (B)
PARK STREET SUBAREA (C)
RILEY STREET SUBAREA (D)
WESTERN STREET/SUNSET STREET SUBAREA (E)
LAKE STREET/BEACH DRIVE SUBAREA (F)
REDONDA BEACH
LEGEND
FOREDUNE MANAGEMENT STUDY
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