LAND DESIGN FOR STORMWATER RUNOFF CONTROL IN MYRTLE BEACH

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Waccamaw Regional Planning and Development Council

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contents

introduction

The City of Myrtle Beach, located in Horry County, South Carolina, is one of the most popular resort cities of the Atlantic coast. Its wide quartz sand beaches, sunny climate, family-oriented amusements, golf courses, moderate hotel room rates, and ease of access by automobile from eastern and midwestern states have sustained the city's attractiveness over the years.

Together with these positive qualities and the continuing growth of the greater Myrtle Beach region today, however, stand several problems that threaten to undermine the appeal of the city's central, older beaches: **erosion by the sea, overbuilding within the dune zone, the aesthetic impairment brought on by the construction of seawalls and bulkheads to protect beachside buildings from sea erosion, and erosion and pollution from urban stormwater runoff,** which typically cascades onto the beach from the ends of storm drains, gullying the beach and degrading its quality.

The purpose of this report is to suggest measures that may be easily undertaken by both public and private owners in Myrtle Beach to deal with the last-mentioned issue: erosion of the beach by urban stormwater runoff. The report also describes measures that can be applied to the problems of beach erosion by the sea and of dune zone overbuilding and seawall construction, although these latter issues lie outside the main area of the guidebook and are more fully addressed elsewhere. A list of titles for recommended reading and contacts for further assistance on all three areas of concern are given on the end papers of this guidebook.

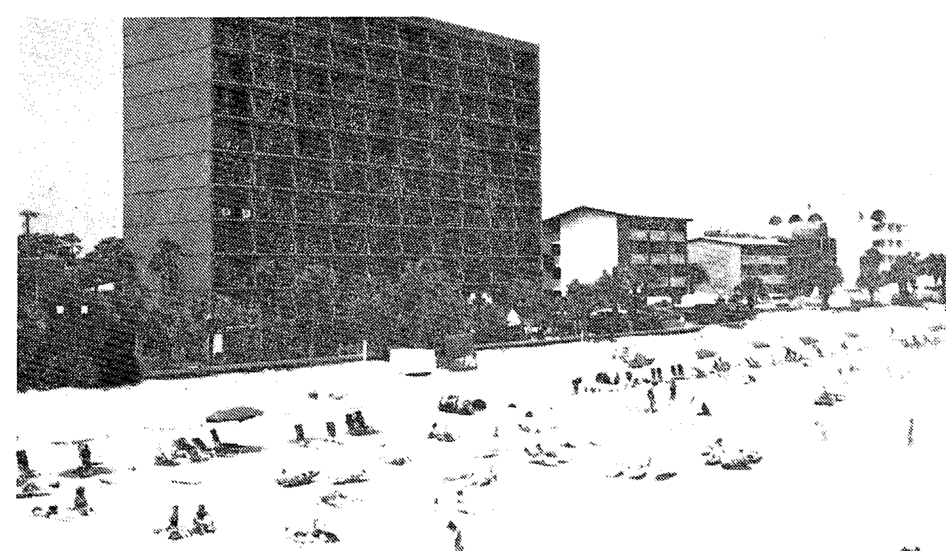
The reader is encouraged to review and consider the measures presented on the following pages. Before actual construction of any recommended technique, the owner should obtain the assistance of a registered landscape architect or site engineer and apply for any required permits.

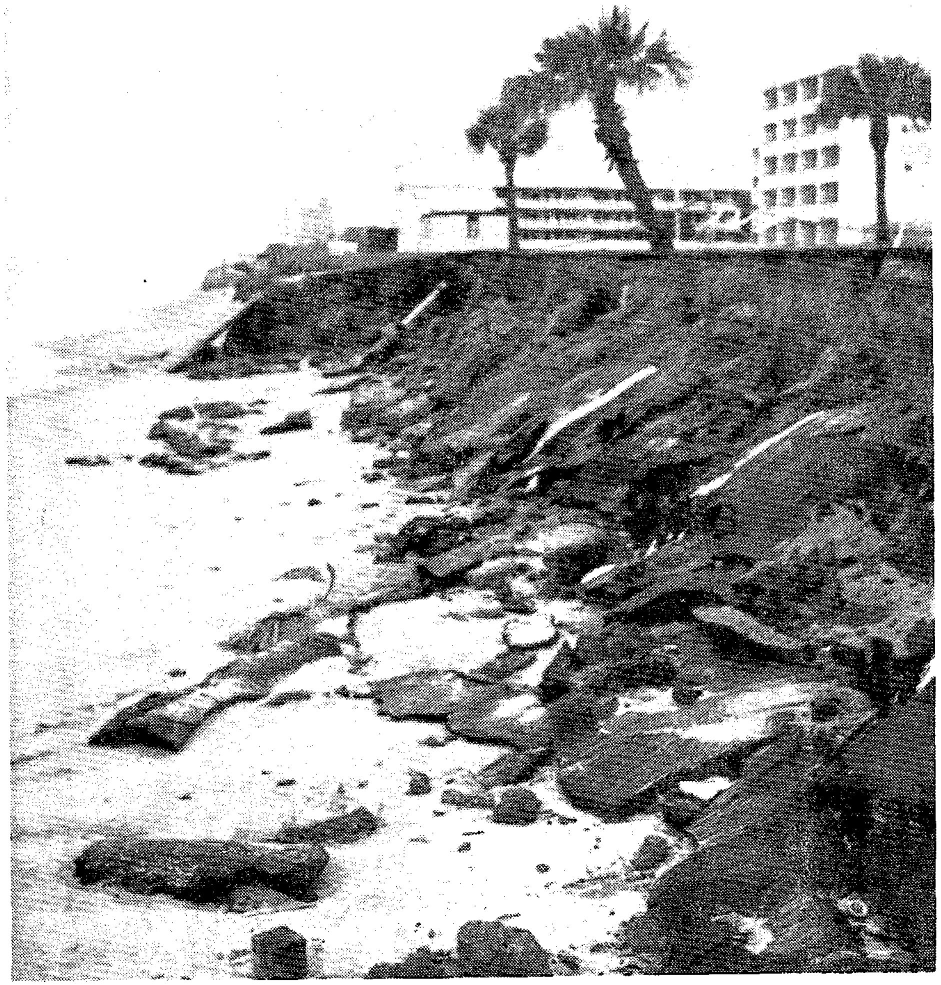
the growth of myrtle beach as a resort city

Myrtle Beach, situated on the "Grand Strand" of northern South Carolina, has been popular as a resort city ever since guest houses and hotels were erected to accommodate summering vacationers in the early part of the twentieth century. At that time, most of the land on which the city stands was in the ownership of Myrtle Beach Farms and the first visitor accommodations enjoyed a distinctly rural flavor. Houses and inns were of one or two stories, widely spaced along the beach, and set respectfully back of the low dunes that stretched up and down the coast. Walks to the wide beach passed fragrant back-dune thickets of the wax myrtle for which the city is named. Many homes and inns had wood plank walks and dune cross-overs to allow access to the beach without disturbing the dunes, important as protectors of the backshore properties as well as attractive features in their own right. Many walks had gazebos or other kinds of seating structures astride them at the dune crest. Some of these structures persist today in the older areas of Myrtle Beach and several modern day motels have built sun shelters in this old style.

During the 1950's Myrtle Beach grew rapidly, accommodating the post-war desire for vacationing and offering a medley of amusements and entertainment that complemented the beach as attractions for families with children of all ages. In the 1960s and 1970s, the city grew yet further as the development of the nation's interstate highway system, economic air travel, Myrtle Beach golf courses and winter golfing, and other factors created good conditions for hotel construction and expansion.

In the surge of growth, the old beneficial relationships between buildings and the beach-dune vegetation system were ignored. Dunes and their mantles of stabilizing vegetation, including the back-dune myrtle, were leveled to make way for patios, swimming pools, parking lots. Some buildings were built on the dune line itself. To protect the new hotels and their outdoor features, seawalls and bulkheads began to spring up, since the old dune system that had performed the same role previously was now gone where new construction encroached on the beach. To drain rainfall from the pavements and other hard surfaces of the motels, drainpipes were installed, leading to the beach itself.





With the series of assaults from the sea that have occurred over the last decade, including Hurricanes David and Frederick, and winter storms, some beach has been lost and several seaside structures, including seawalls, bulkheads, and parking lots, have been damaged as the result of increased exposure to storm waves. The urban storm runoff, too, has done its part to erode the beach and leave pools of polluted water beneath the drain outlets.

Recently, however, the city of Myrtle Beach has taken steps to ensure better protection of the beach and more effective measures to deal with erosion through the adoption of zoning and ordinances to control development.

Will the private owners, though, do their share to remedy the damage to water quality and the physical condition of the beach and dunes?

Fortunately, many beachfront owners have expressed a willingness to take action, in pursuit of the finer quality beach landscape on which the city's tourism industry is dependent to a large degree. This report has been prepared to help them be of help.

the myrtle beach urban storwater runoff control study

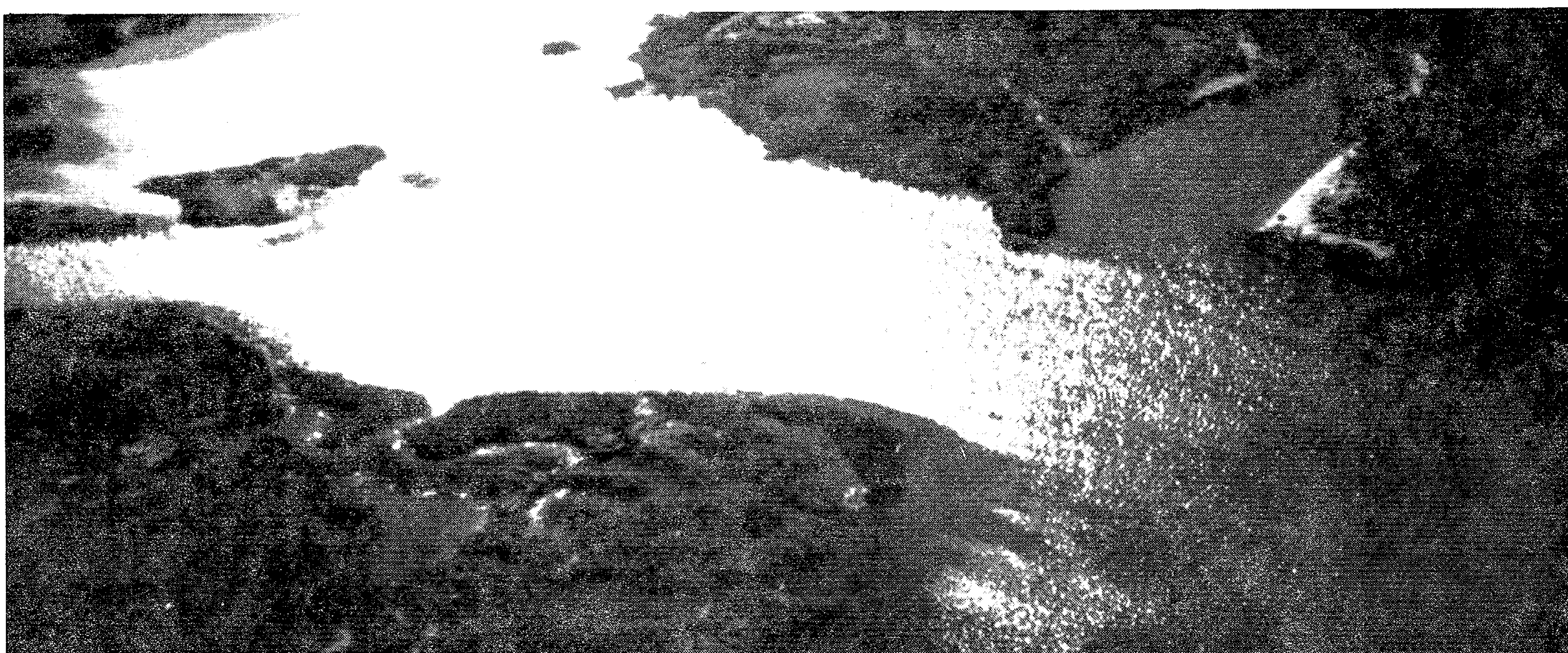
The first comprehensive studies of the stormwater runoff problem in Myrtle Beach were the 1978 Waccamaw Regional 208 Areawide Water Quality Management Plan* that was conducted under a grant by the Environmental Protection Agency. This area was later designated as one of the "Nationwide Urban Runoff Program Demonstration Areas." These studies identified surf water quality impairment resulting from stormwater runoff, and the 1980 Final Evaluation of Stormwater Runoff Control Alternatives.* The latter study examined both "structural" and "non-structural" control alternative solutions to the problem. Among the structural alternatives, that is, approaches that would employ the construction of conduits to contain and carry runoff to outlet points other than the beach and foreshore, were stormwater discharge to the Intra-

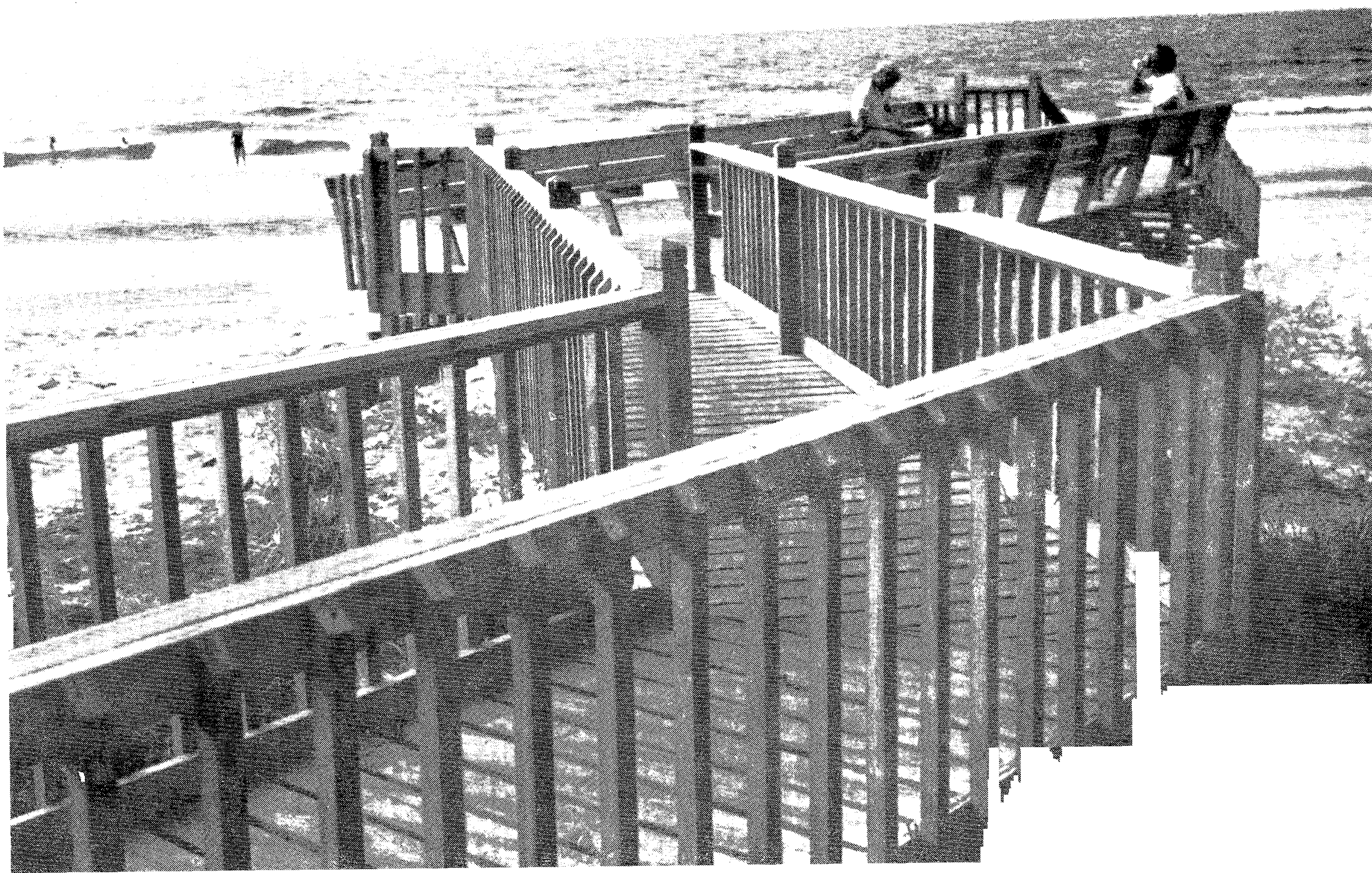
* See Suggested Reading List

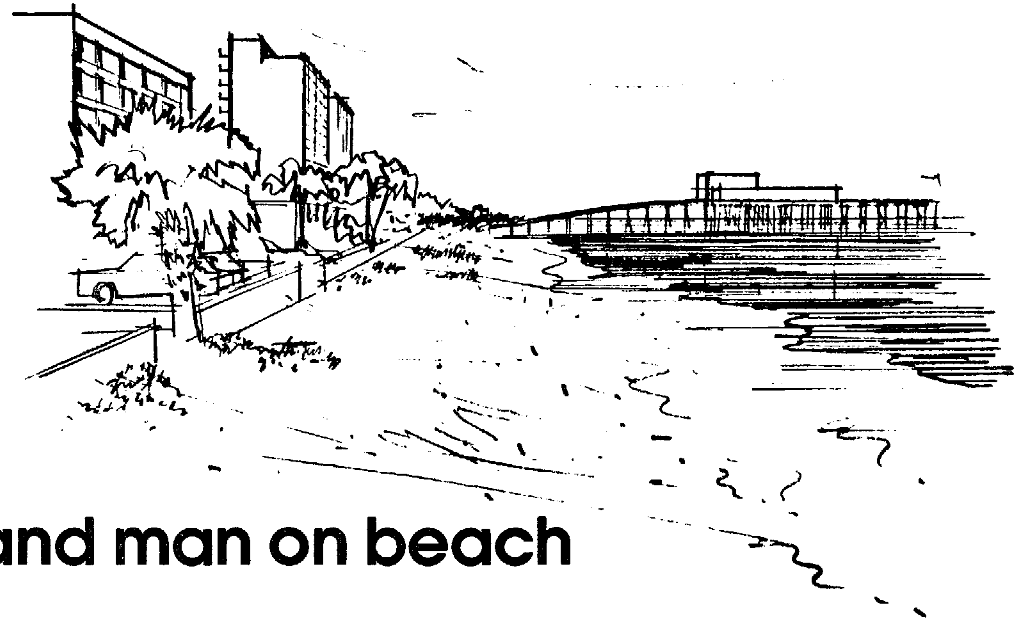
coastal Waterway, control of flow in Withers Swash, and ocean discharge.

Because of the cost of such construction, $30 to $50 million, any progress in controlling runoff through non-structural alternatives would constitute savings in capital expenditures to the City of Myrtle Beach. Among the non-structural alternatives studied were source controls, such as the use of porous pavement, which permits infiltration of rainfall into the soil to reduce runoff, and elimination of curbs and gutters, which permits street runoff to be shed into grassed and other earth or sand areas. In addition, on-site detention techniques were studied. These included such alternatives as detention ponds, landscape design, infiltration trenches, and dry wells, all having the potential to detain runoff.

This report is a follow-up to the final Evaluation report's examination of non-structural alternatives. The extent that property owners can undertake the measures recommended here will determine whether some or all of the costly expenditures of the structural alternatives can be avoided. But there are other advantages as well. The greater use of landscaped features, the avoidance of bulkheads along the beach and their possible replacement one day with man-made dunes, and the removal of the myriad drainpipes that clutter and blight the beach today can produce a great aesthetic improvement in the beach and backshore landscape, an improvement that would have great potential value to Myrtle Beach's tourism and vacation industry.







the influence of nature and man on beach and water quality

1

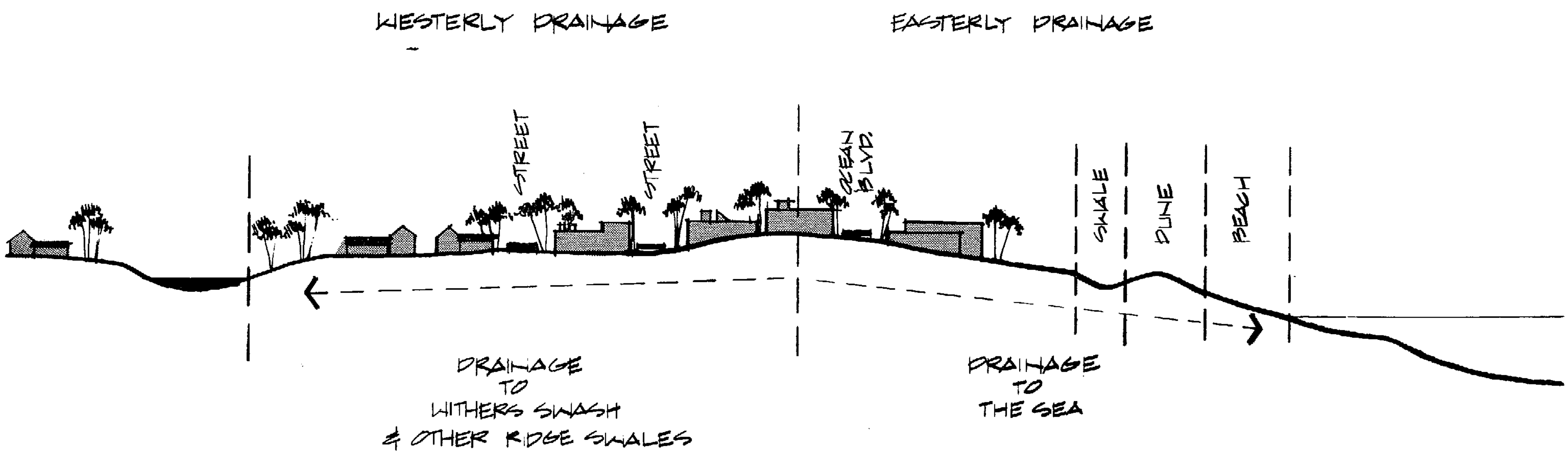
the influence of coastal topography on storm runoff

Because of low topography and frequently occurring waterways that break through the beach ridges at right angles to the sea, municipal storm drains and other man-made systems in much of Myrtle Beach carry runoff inland to Withers Swash, the Atlantic Intracoastal Waterway (AIW), or other backshore waterways, while street and private storm drains on the narrow ocean-fronting slope of the strand carry runoff directly seaward through the mouths of numerous culverts and drainpipes onto the beach itself.

It is the latter pattern that creates the ugly and damaging gullying of the beach face of Myrtle Beach during storms. In three and a half miles of central Myrtle Beach, 151 drains disgorge runoff openly onto the beach today. The spouting runoff not only creates the gullies that last until the tides remove their traces, but leaves pools of polluted water, collections of the litter, automotive leakages, and other matter that are carried from streets and parking areas. The sand flushed from the beach through gully erosion ends up, in part, lost to the longshore currents that carry the drifting materials to other portions of the coast.

Draining storm runoff inland to Withers Swash and the AIW is not without its own problems. Since natural gradients, or the slope of the land, are so shallow, it is difficult to move large quantities of rain water quickly and effectively to waterways through storm drains, swales, and ditches.

The extensiveness of paved and other impervious surfaces — streets, parking lots, rooftops — forces large quantities of water that would otherwise fall on the porous sands of the Strand to shed into storm drain systems. Rainfall is thus carried swiftly to the beach, or to the backshore drainageways, with an intensity that is proportional to the intensity of the storm.

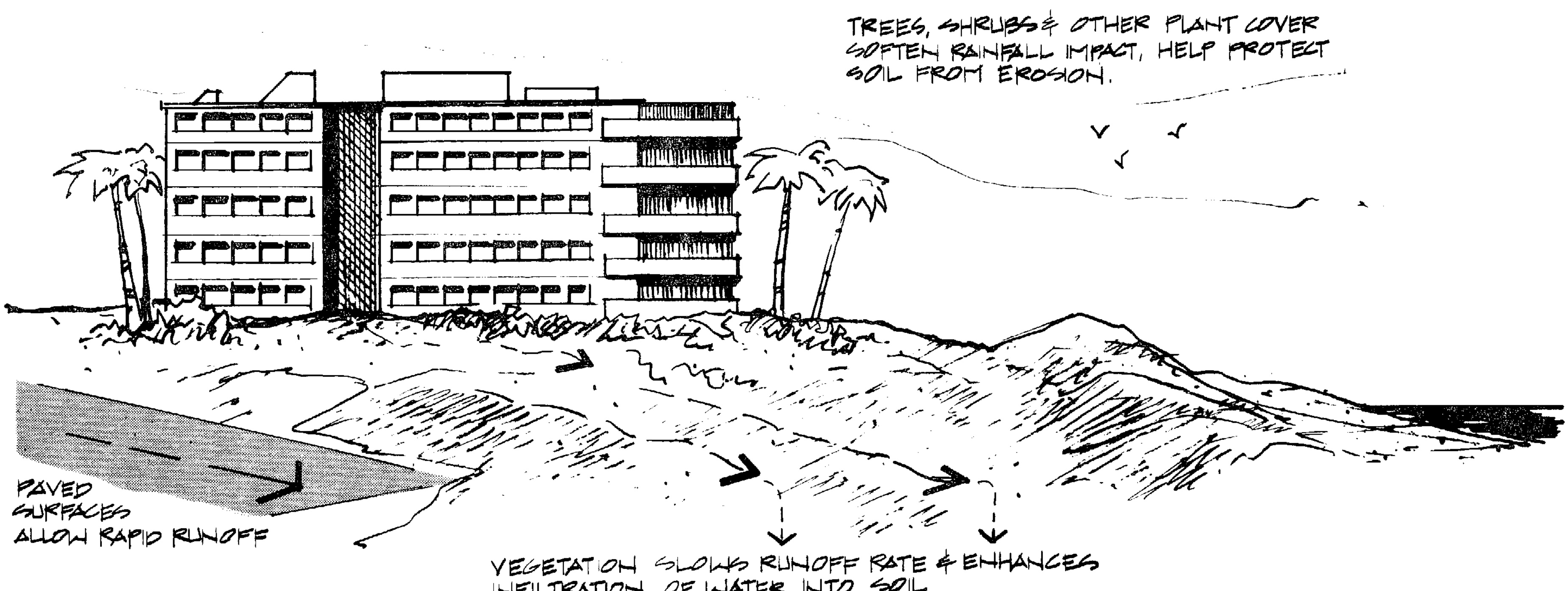


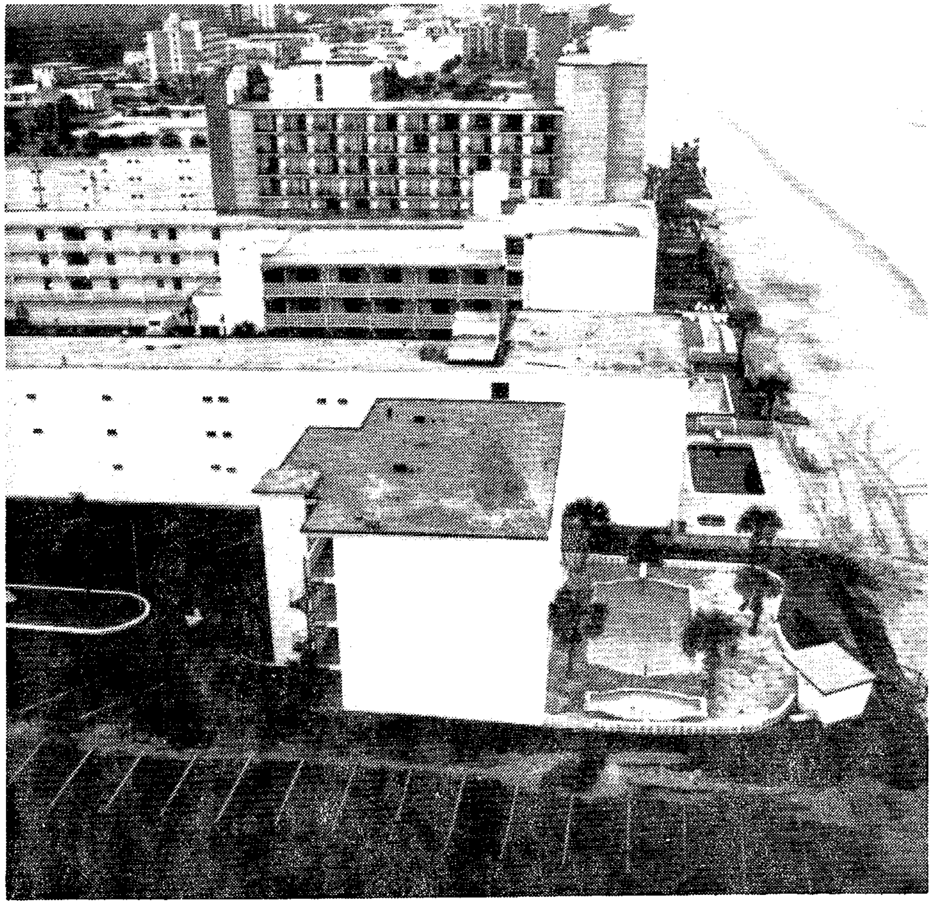
With continuing urban development in Myrtle Beach, the extent of paved surfaces will grow, and with this growth the area of sands and soils left open and capable of absorbing rainfall will decrease.

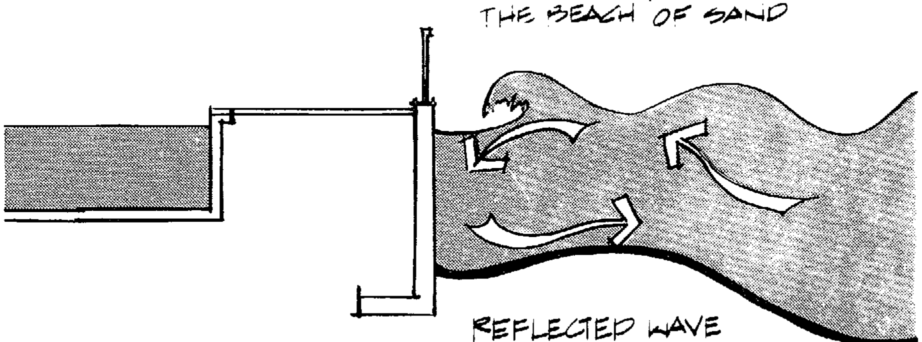
Unless counter-measures are taken to promote infiltration, yet more runoff will occur and will tend to increase the intensity of flow at beachface and backshore outlet points.

If ways could be found to increase infiltration of rainfall into the sands and soil and thereby reduce the amount of runoff collected and moved across paved surfaces and through conduits, the problems of beach disfiguring, pollution, and erosion on the ocean side and the exceeding of drainageway capacities on the inland side could be alleviated.

There **are** ways to achieve greater infiltration and reduce piped runoff. This report explains what they are and how private owners and public agencies can take steps to implement them. The techniques recommended will not solve flooding and erosion problems associated with major storms but can be effective in dealing with the frequently occurring rainfalls of light and moderate inensity, and this improvement alone could achieve a vastly improved image for Myrtle Beach.







dune encroachment, surface runoff, and beach damage

problems

Beach erosion at Myrtle Beach is the result of a complex of factors: long-term geological processes (the high-water mark has been moving inland generally on this section of the coast), the nearshore bottom patterns that refract (divert and concentrate the energies of) incoming waves, the direction, intensity, and duration of on-shore storms, and other causes. Not the least of these other causes is the erosion caused by urban storm runoff and the actual displacement of sand dunes by urban construction.

dune encroachment

- **building, patio, pool, and parking construction**

When hotels or other urban development encroach on the dune ridge that lies at the back of the beach, not only is the natural protection afforded by the dunes removed, but a portion of the sand supply needed for natural renourishment of the beach is lost. Without the sand supply of the dunes, which provide sand to the beach when damaged by storms, the beach must rely alone on sand transported in from nearshore berms and terraces during the spring and summer "beach build-up" season. (The storm-damaged dunes are themselves rebuilt effectively only if a sufficiently broad beach can offer sand driven by winds from the beach to the dune scarp, or front edge.)

- **seawalls and bulkheads**

These protective structures themselves encroach on the dunes as well as on the beach face itself. Although sand may be backfilled directly behind them, it is really cut off from the "sand budget" on which the dynamics of beach and dune rebuilding relies.

Seawalls and bulkheads are also aesthetically a problem. Many beach visitors consider them a detriment rather than a contribution to the beach experience. This poor image is worsened when seawalls and bulkheads are damaged by storms or crack because of undercutting and settlement problems.

beach damage

As a result of the drainage and impervious surface problems described above, significant amounts of runoff are stopped from infiltrating into the ground and are forced to shed off through street storm drains and private property drainpipes onto the beach itself. Gullying and stagnant pools result. In addition, where runoff sheets over uncurbed surfaces to the beach line, the flow of water leads to erosion of the top edge of the built surface or the lawn edge. Where seawalls and bulkheads are built, not only is sand lost from the sand budget during construction, but the hard vertical surfaces of the walls and bulkheads create an effect that is known as "wave reflection," a process that drives even more sand outward to sea. To provide a clearer picture of these destructive processes, the diagrams to the right are given.

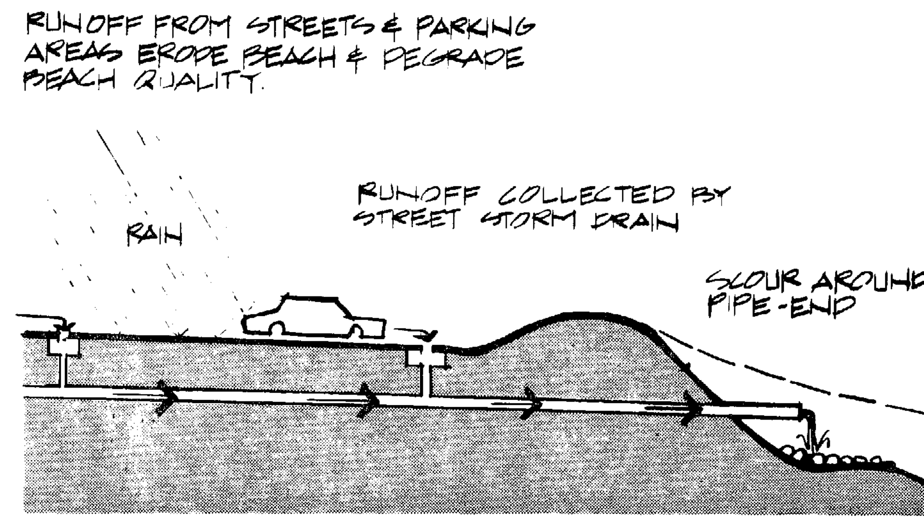
surface runoff

- **street and walkway runoff**

Ocean Boulevard, the street ends between the Boulevard and the beach, and in some areas, street sections to the west of the Boulevard, all shed water towards the sea. Together with the rainfall running off of walkways and sidewalks, a considerable amount of runoff is collected in the public right-of-way during rainfalls of even moderate intensity and duration. Much of this runoff is discharged to the beach through street overflow drains. Since the water quality of this effluent is generally poor (litter, automotive leakages, etc.), the quality of swimming conditions is also degraded. Pools of discharged runoff that remain beneath the outlets of drainpipes also scar the beach's appearance and environmental quality.

- **parking area runoff**

Parking areas of the hotels and motels fronting the ocean discharge runoff directly to the beach. Many parking areas on the second row and on some of the west-east avenues discharge runoff to Ocean Boulevard, which of course ends up on the beach as well. In a few instances, large parking areas



on Kings Highway also shed water towards the beach. The same pollutants are found in parking areas as are found on street surfaces — parking area discharge can adversely affect beach quality.

- **roof runoff**

Although the roof of any one building along the beach collects only a relatively modest amount of rainfall, compared to the total rainfall of a given property, the total runoff from the roofs of the several buildings adjoining the common parking area or street end to which they discharge may be a significant contributor to the intensity and impact of runoff discharge. If the rate at which roof runoff is discharged to the roof drain, and the speed at which water emerging from the bottom of the drainpipe reaches the beach could both be reduced, the intensity of runoff during the first critical moments of a storm might be also reduced as a result. Ways to manage roof discharge (delay ring, dry wells, infiltration trenches) are discussed in the "What the Property Owner Can Do" section of this report.

- **lawn runoff**

Although lawns and other planted areas are the principal surfaces within the developed lands of the city into which rainfall may infiltrate and thereby migrate more slowly to the sea, some lawns have been planted on imported soils high in clay content and are much less permeable to rainfall than are the natural sands of the area. In many instances, gumbo, a thick clayey soil, has been brought in to replace or cover the sand of the dune ridge fronting the hotels, in part to attempt to stabilize the altered sand surface and in part to provide a planting medium retentive of more moisture, to minimize lawn irrigation. Unfortunately, rainfall sheds off the surface of a gumbo lawn almost as readily as it does from a street. Also, since dune grasses, such as Sea Oats or Switch Grass, avoid gumbo or other clayey soils, gumbo lawn edges exposed to storm waves at the dune scarp line have no thick fabric of the dune grass roots that effectively stabilize dunes elsewhere. With the onslaught of storm waves, exposed gumbo edges are easily disintegrated.

taking stock of the beachfront: classification and analysis

How significant to the environment and welfare of the beach and dune edge of Myrtle Beach is the double mischief of erosion by stormwater runoff and erosion by the sea?

Would it be possible to undertake remedies to either or both of these problems?

To determine the answer to these questions, surveys of beach, nearshore, and backshore conditions were undertaken in 1980. Conditions affecting sea erosion and the potential measures that might be adopted to affect it were studied by Research Planning Institute in 1981. Conditions resulting from stormwater runoff, encroachment of urban development on the dunes and beach, and the potential measures that might be adopted to improve runoff control and the beachfront landscape in general were studied in 1980 and 1981 by Roy Mann Associates. Data on storm drains, water quality, and runoff control were provided by Moore, Gardner & Associates, Inc. The results of these surveys are presented on the following fold-out map and include a number of key observations.

beachfront classes

Six types, or classes, of beachfront can be defined at Myrtle Beach, reflecting the impacts of land use on the historic dune ridge.

- **Class 1:** stable dune and back swale; insignificant disturbance.
- **Class 2:** dune remnants; back swale filled with soft landscape
- **Class 3:** dune remnants; back swale filled with hard surfaces
- **Class 4:** dune and swale non-existent; minor seawall or bulkhead; substantial made berms
- **Class 5:** dune and swale non-existent; major seawall or bulkhead; minor made berms
- **Class 6:** dune and swale non-existent; major seawall or bulkhead; no berms; large pipes exposed.

● **Analysis:** Given the location and extent of the beachfront classes, it is possible to begin to estimate the practicability of restoring remnant dunes, protecting existing stable dunes, and constructing new dunes as measures for restraining and absorbing storm runoff. But other factors described here shed further light on whether this approach may be practicable and where on the beach it may be effective.

edge condition

Three conditions are typical, although others exist, on the edge of developed beachfront property, exclusive of dunes.

- Seawall or bulkhead
- Gumbo embankment (ordinarily planted with lawn grasses)
- Sand berms (man-made and not stabilized with dune grasses)

In addition, some rip-rap or rubble stone revetments have been installed in lieu of bulkheads by beach property owners. Dune fencing is another edge condition feature, installed between private lawns and public dunes.

● **Analysis:** Gumbo and other earth embankments are the edges most amenable to change. If these could be altered to provide a reconstructed dune to intercept and absorb surface stormwater runoff and a low swale behind the dune to allow excess intercepted runoff to settle and be absorbed by the sands over a wider area, most or all of pipe discharge to the beach might be eliminated. See the "What the Property Owner Can Do" section for installation of Dutch drains as overflow devices. Where sand berms adjoin lawn-surfaced property edges, conditions may be even riper for application of this measure, if the berms are suitable for development into dunes. (Note that the "dunes" referred to in this report as reconstructions cannot be considered equal to the historic dunes of the beach ridge, which were part of a natural system that is now missing, for the most part, in Myrtle Beach. However, even though artificially created, they would resemble true dunes — and so the use of the term is justified.)

Where seawalls or bulkheads exist, there is little likelihood that dunes can be restored, although if allowed by altered conditions such as an increase in beach width or the failure of the walls under storm attack, some restoration may be possible.

land use behind the edge

Of the conditions identified, lawn or other landscaped areas and natural areas constitute a minor portion and parking and other hard, impervious surfaces cover the major portion of the property of the backshore.

● **Analysis:** The land and impervious surfaces of streets and private properties behind the beach contribute large amounts of storm runoff to the beach. Unless these areas are resurfaced with porous paving and other surfacing systems that allow substantial infiltration of runoff, pipe discharges to the beach will continue. Unless, in new hotel construction or reconstruction, hard patios, pools, and parking are not located at a sufficient setback from the historic dune line, creation of dune and swale runoff absorption systems will not be possible at these locations.

stormwater outfall

The locations of exposed pipe ends, length of exposure, the severity of erosion at the pipe's point of emergence, and the location of standing water were judged as having heavy bacteria counts in 1980 and are indicated on the map.

● **Analysis:** The reliance on piped discharge of runoff is so extensive in Myrtle Beach that a shift to reliance on greater infiltration and absorption of runoff in the zones behind the beach would be possible only with concerted public and private effort and cooperation. Careful evaluation must also be given to such possible measures as a municipal marginal conduit collection and pumping system and controlled overflow outlets as supplements to a system that relies on infiltration and absorption.

beach face conditions

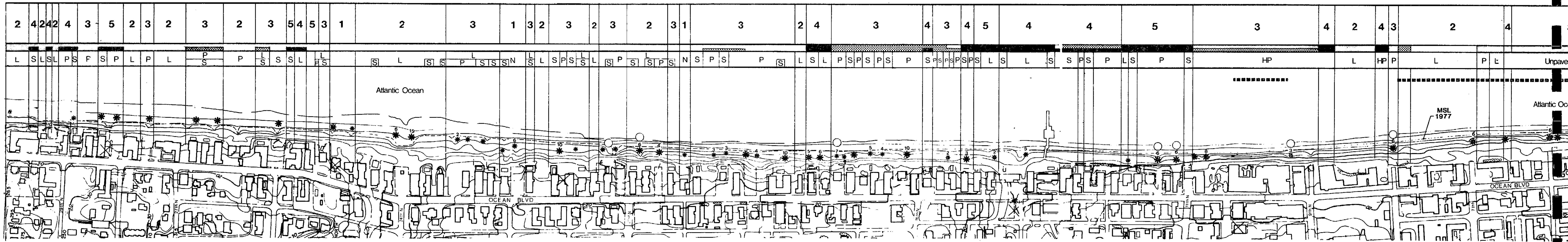
The beach face is variable in width, slope, erosion rate, nearshore sand supply, and other factors that determine probable future erosion (or accretion) of the beach section and also help determine the relative feasibility of dune and swale reconstruction, on a site by site basis.

● **Analysis:** With modest beach renourishment in selected areas, accomplished by inexpensive means such as mechanized scraping or small-scale hydraulic pumping of sands from suitable nearshore deposits, the profile of the beach face may be raised, beach width expanded, and dunes/swales reconstructed.

For an in-depth identification and analysis of beachface conditions and recommended beach treatment measures, see selected references identified at the end of this guidebook.

Recommended measures, with defined locations, are given in the fold-out map: Unified Concept Plan.

On the fold-out map that appears on the following double spread, a classification and analysis of conditions that existed on the development edge of Myrtle Beach in 1980, the year of the survey, are presented. The map illustrates the severity of displacement of dunes by parking lots, pools and patios, as well as the frequency of exposed pipe ends and the water quality impairment features evident on the beach. In addition, the potential of individual beach segments for dune restoration are noted. Beach conditions were surveyed in 1981.



BEACHFRONT CLASSES

1	stable dune swale behind dune controlled pedestrian access (walk-over structures and dune fences) native vegetation
2	dune remnants, but dune protection required swale nonexistent landscaped (soft) treatment of swale zone limited pedestrian control
3	dune remnants evident, but dune restoration/protection required swale non-existent hard surfaces/edges in swale zone limited planting (soft) areas no pedestrian control over dune.
4	dune nonexistent minor sea wall apparent substantial man-made sand berms limited planting (soft) areas minor aesthetic problems
5	dune/swale nonexistent major sea walls or swimpool walls minor man-made sand berming moderate beachfront erosion moderate aesthetic problems
6	dune/swale nonexistent major sea walls & swimpool walls man-made sand berms nonexistent severe beachfront erosion major aesthetic problems: rubble, garbage, broken pipe ends, etc.

EDGE CONDITION

- Sea Wall or Bulkhead
- Gumbo Embankment
- Sand Berms
- Existing Dune Fencing

BEACH FACE CONDITION Source: RPI 1981

- 1 Excellent
- 2 Good, some problems
- 3 Fair, numerous problems
- 4 Poor feasibility without some renourishment
- 5 Infeasible without major renourishment

LAND USE BEHIND EDGE

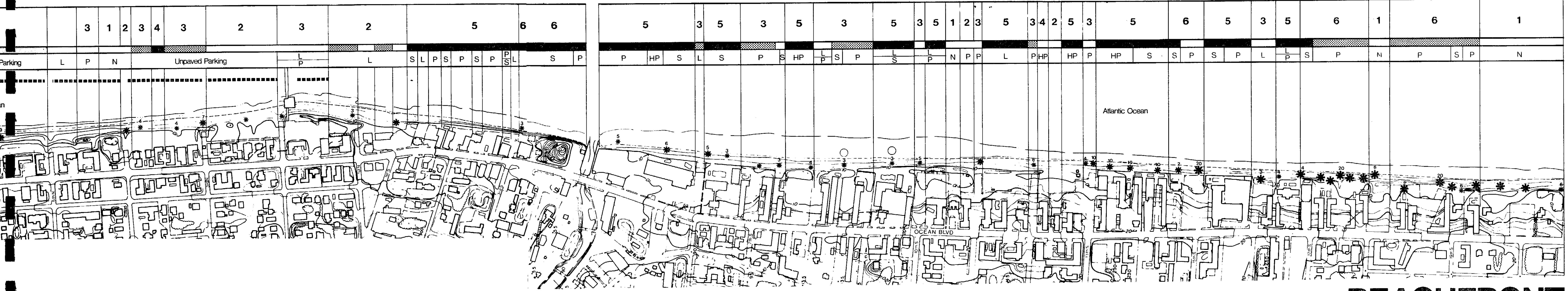
- P Parking
- HP Other Hard Paved Surfaces
- S Swimming Pool
- L Lawn or Landscaped Area
- N Natural

STORMWATER OUTFALL

- * Pipe End: Moderate Beachfront Erosion
- * Pipe End: Severe Beachfront Erosion
- * Pipe End: Extremely Severe Beachfront Erosion
- ○ Toxic Standing Water
- 15 Linear Feet of Exposed Pipe

Beach Line

The 1977 Mean Sea Level (MSL) beach line is the contour indicated on this map. See the Unified Concept Plan fold-out map in the conclusions section of this guide-book for the plotted 1981 MSL beachline and a comparison of the two.



BEACHFRONT ANALYSIS

Section 5/Stormwater Runoff Control Study Area

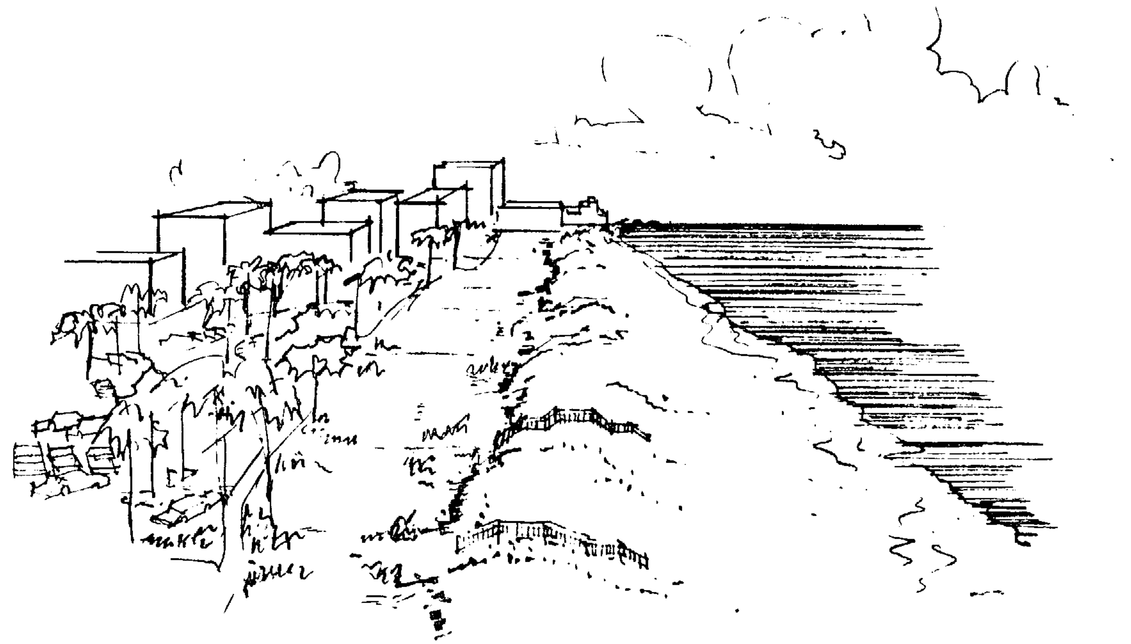
Myrtle Beach, South Carolina

Waccamaw Regional Planning and Development Council

Roy Mann Associates, Inc., consultant

Museum Wharf, Boston, Massachusetts

0 100 200 600



a strategy for oceanfront revitalization

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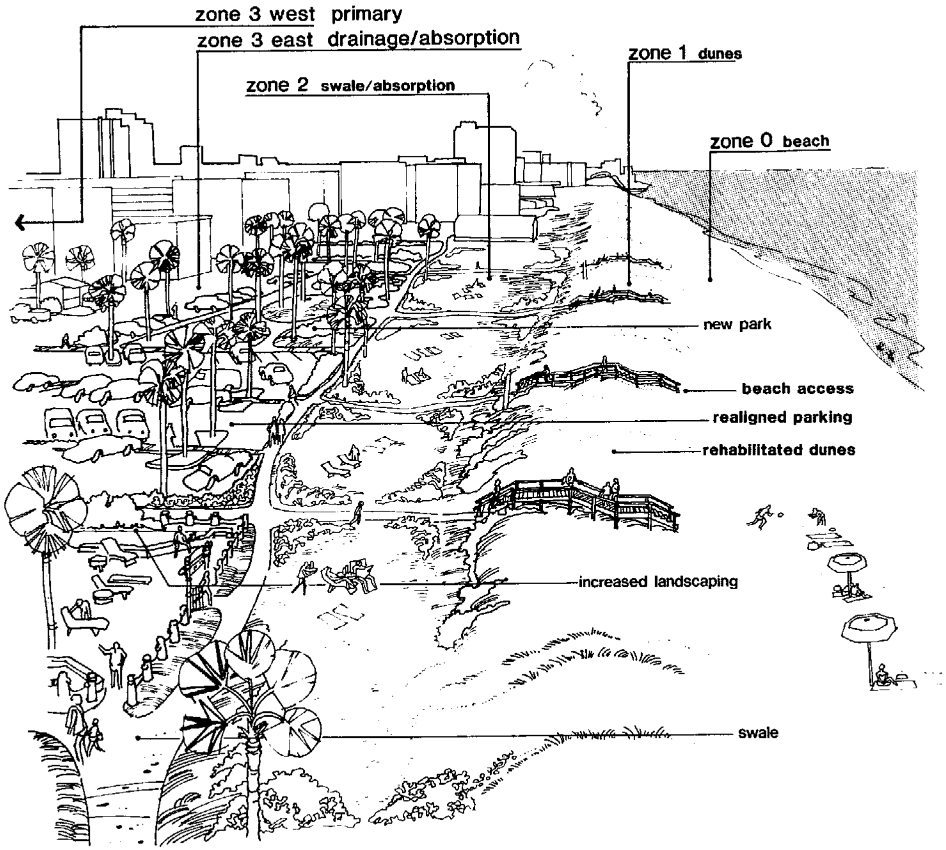


The beach (Zone 0 of the coastal edge) is vulnerable to erosion from both the sea and stormwater runoff. The dune line (Zone 1) can hold back and absorb surface runoff unabsorbed by the swale. The swale (Zone 2) provides for infiltration of runoff not absorbed by Zone 3 surfaces. Public and private parking areas, motels, street ends, and public walkways form the primary absorption zone (Zone 3). Existing surfaces in this zone should be redesigned to incorporate porous materials for parking, drives, and walks, along with extensive landscaping to provide for positive absorption of stormwater.

the four zones of the city's beach: how they can be used in defending against runoff erosion

As we have seen, there are two major causes of erosion of the beach: **storm-driven waves of the sea** and **storm runoff from the land.** We also know that although the sea can cause serious erosion, urban storm runoff also degrades water quality and the aesthetic qualities of the beach. If we can control urban storm runoff, a good deal would be accomplished to restore the recreational, water quality, and visual character of the beach.

At the same time, if the beach can be helped to withstand further narrowing by erosion from the sea, a good deal more could be accomplished from the recreational standpoint, not to speak of the added protection that could be afforded to property along the beach.

With these objectives in mind, we can see the broad belt along the sea as divided into **four parallel zones,** in each of which lie opportunities for private as well as public action to remedy erosion and water quality impairment.

These zones are called:

- **Zone 0 — the beach**
- **Zone 1 — the dune**
- **Zone 2 — the swale**
- **Zone 3 — managed absorption zone**

Let's examine each in turn, starting from the landmost side:

zone 3 — the managed absorption zone

This zone can really be further subdivided into the area that slopes directly downwara to the beach, much of which lies to the east of Ocean Boulevard (which we can call Zone 3/East) and the other areas of Myrtle Beach, some of which drain indirectly to the beach over street surfaces while others drain indirectly or directly to Withers Swash and elsewhere (which we can call Zone 3/West).

In Zone 3/West the opportunities for improvement lie in managing lands to absorb as much rainfall as possible on-site, by substituting porous or other permeable paving for hard surfaces, setting aside as much of a portion of the property as possible as landscaping, and by other means that encourage infiltration of water into the subsoil and prevent excess waters from reaching Zone 3/East, or reaching the Intracoastal Waterway.

In Zone 3/East the opportunities for improvement include all those that are applicable to Zone 3/West and, in addition, a number of measures designed to make sure that water shedding down the slope to the beach is slowed as much as possible, so that infiltration into the subsoil is given the best chance for success before runoff reaches the swale zone.

These measures include parking surface grading designed with shallow "landings," or breaks in the downward pitch of the pavement, so that water can be slowed at these intervals and given a greater chance to infiltrate through open pores of the porous paving or other permeable paving used. Such techniques — explained in greater detail under "What the Property Owner Can Do" — will help slow and reduce the amount of runoff reaching Zone 2/the Swale.

zone 2 — the swale

This line of defense is an important key in the battle to control urban stormwater runoff. In most areas of Myrtle Beach, there is no buffer between the lower end of parking and other paved areas (Zone 3) and the beach (Zone 0) that can absorb or at least retard runoff flow. In locations where dunes still exist, the land in the lee of the dunes is raised lawn or patios (designed high to afford lounging hotel patrons a better view of the ocean). The high profile allows no runoff to collect, so that all overflow parking drainage must, under these conditions, be piped to the beach.

Where a high profile fails, a low swale — scooped out to an elevation somewhat lower than the parking area and lower than the dune as well — can succeed in receiving overflow runoff, before it reaches either a dune or an emergency overflow drain to the beach. Given a good, permeable surface — standard lawn on a sandy soil is ideal — the swale can act to absorb and transmit to the subsoils and the underportions of the dune considerable amounts of runoff, the excess portions of which will migrate beneath the dunes to the beach "invisibly," without the gullying, scarring effects that the existing pipe systems cause.

zone 1 — the dune line

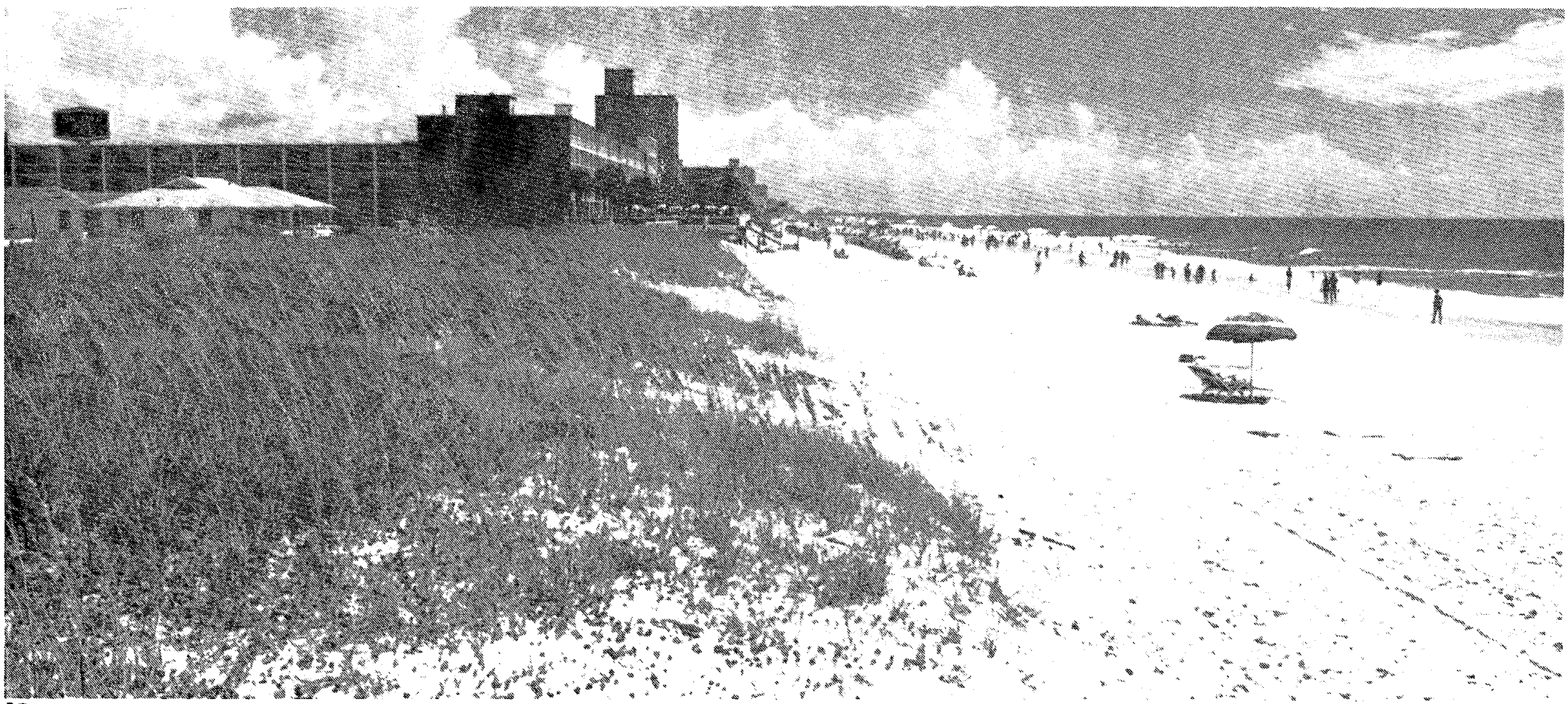
Here, with a more complete dune system (whether artificially reconstructed or natural), a number of things happen to strengthen the ways in which stormwater runoff is prevented from reaching the beach:

- **Runoff impoundment.** Excess water not absorbed by the back-slope swale will accumulate above the surface of the swale, moving relatively slowly through the dune and spreading out through the sand structure. If existing drainpipes are removed, the movement of runoff to the beach will therefore be relatively slow and non-erosive. With emergency overflow trenches buried within the dune, some washing away of sand on the beachside of the dune can be expected, but on the whole, runoff may be effectively controlled through dune impoundment.

zone 0 — the beach

Here, with limited but effective beach scraping and a higher, wider beach, several things will happen that can aid in sustaining existing and restored dunes and berms and reduce erosion to the beach resulting from stormwater runoff.

- **Better protection of dunes from wave attack.** The higher, wider beach will tend to keep storm-generated waves and high tides further away from the dunes, allowing them to persist and be of value during the more infrequent storms of greater severity. Dunes that are relatively safe from the frequent nibbling away by the sea that is typical of the Myrtle Beach dune line today provide a more hospitable environment for dune grass growth, and with this growth, greater stabilization and strengthening of the dune.
- **Greater sand supply.** With a wider beach, more sand will be picked up and carried by winds to the dunes. There, dune grasses and, where they are placed, grass and sand build-up compensate sand losses in-dune fences will trap the sand particles and help curred during storms and trampling by beach visitors.
- **The net result.** The effect of the stronger dune-nourishing brought about by beach scraping will be better protection of the beach from stormwater run-off, which can be barred from pouring onto the beach by the dunes. In addition, better protection of backshore property from wave attack from the sea can be accomplished.



design objectives for a low-cost beach improvement program

the objectives

- **increasing infiltration**

  To allow greater entry of rainfall into the ground, thereby reducing the flow across surfaces to the beach, diminishing the intensity of flow impact, and reducing pollution.

- **impounding and decreasing runoff**

  To hold surface runoff in swales, ponds, and other containments to reduce surface flow during peak rainfall periods.

- **establishing a construction setback from the dune line**

  To protect existing dunes and the high beach from encroachment and destruction.

  To allow eventual construction of dunes and backdune swales as beach conditions allow.

- **restoring and maintaining dunes**

  To allow both reconstructed and existing dunes, together with backdune swales, to act as an urban detention and absorption system and as a barrier to storm-driven waves.

  To improve the aesthetic quality of the beachscape by reinforcing the natural appearance of the backshore, while at the same time allowing possible removal, where conditions allow, of seawalls and bulkheads for which the dunes and swales may serve as a substitute, as well as removal of drainpipes.

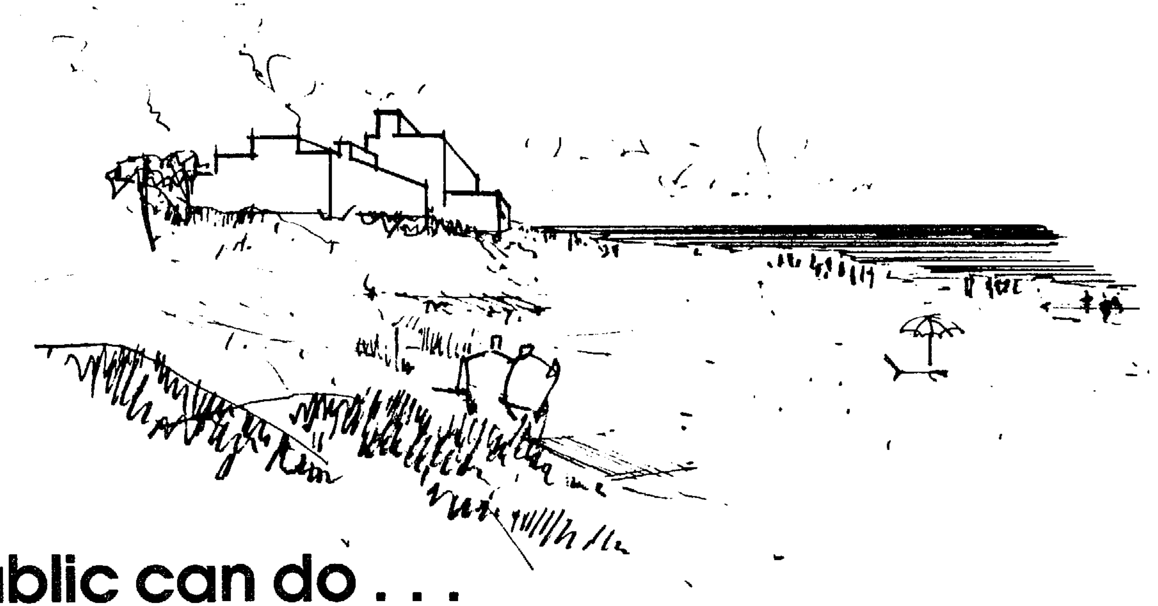
- **limited renourishment and maintenance of the beach**

  To restore a higher and wider beach profile in areas of the beach that have been subjected to excessive erosion.

  To provide a greater degree of protection for beachfront property and for the dunes from storm-driven waves.

  To provide a greater supply of beach sand from which winds can nourish the dunes.

  To decrease or eliminate installation of seawalls and other structures that weaken the resistance of the beach to erosion.



what the public can do . . .

3

Street ends and public walks between Ocean Boulevard and the beach, the beach itself, most of the sand dune system (Zone 1), public parks, and the streets and public parking facilities that serve the beach area are all important factors in the beach recovery story.

Fortunately, they are all public property, and the City of Myrtle Beach is embarking on a vigorous program to control urban storm runoff and restore a quality beach to its ocean frontage.

The following techniques illustrate those steps that either are being currently taken by the City, such as are described in a number of the dune reconstruction and walkover design examples, or are recommended as additional measures to help achieve greater rainfall infiltration and runoff control on public property.

Additional measures, such as the development of adequate public parking capacities along Ocean Boulevard, are recommended to help private owners pull back parking from existing sites at the dune line — an indirect step towards allowing swale and dune reconstruction and the achievement of a quality beach landscape.

street end resurfacing and redevelopment

Stormwater control measures that, as detailed in the "What the Property Owner Can Do" section of the handbook, should be used to upgrade existing and proposed street end parking areas where feasible and on all proposed public and private on-grade parking facilities adjacent to the beach. Also, where runoff is in excess, drainage methods should tie into an improved street storm drainage system. The following proposed measures should be used.

- **permeable paving**
- **improved grading**
- **infiltration structures**
- **uncurbed median strips and landscaping**

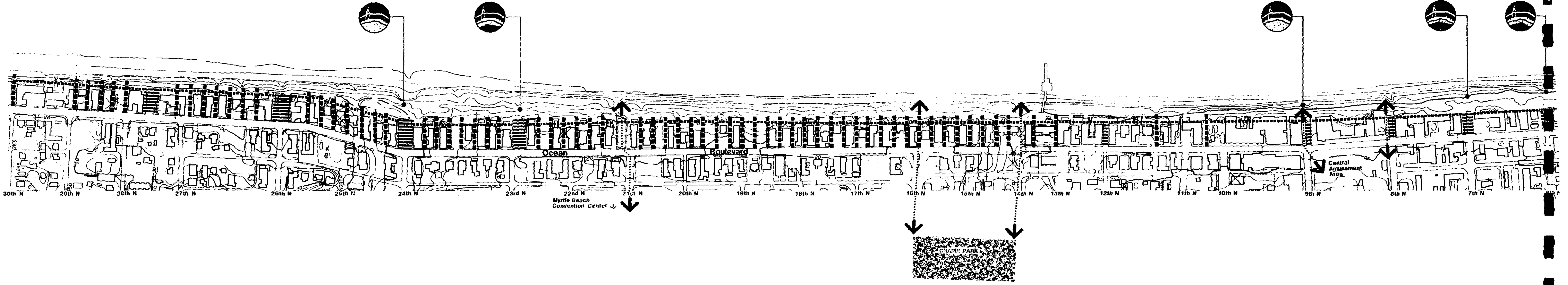
All redeveloped street end parking should be designed and developed together with private and/or public redevelopment in Zone 3.

parking facility relocation

Parking facilities should be located or relocated sufficiently away from the beach to avoid direct destruction, stormwater runoff, and other impacts on dunes and the beach. A setback of 100 feet landward of Mean High Water should be voluntarily adopted by builders, unless local ordinances require other conditions. New or relocated parking could be:

- **developed into open space associated with beachfront hotels (Zone 3).**
- **built as multi- or bi-level structures on the west side of Ocean Boulevard, which can help free the dune zone and beach edge from parking.**
- **developed on existing undeveloped parcels on Ocean Boulevard.**

On the fold-out map that opens at the right, public parks, including proposed street-end parks and other park areas, and an improved public access system are presented. All such improvements can be designed for high infiltration, serving important roles in stormwater runoff management.



PUBLICLY OWNED LAND

- State of South Carolina Title
- Mean High Water (City base, 1977)
- Beach in City Title
- Property Line (City base, 1977)
- Street Ends
- Public Walks

SPECIAL ACCESS FEATURES

- Major Beach Access Points
- Linkages/ Beach and Key Recreation Facilities

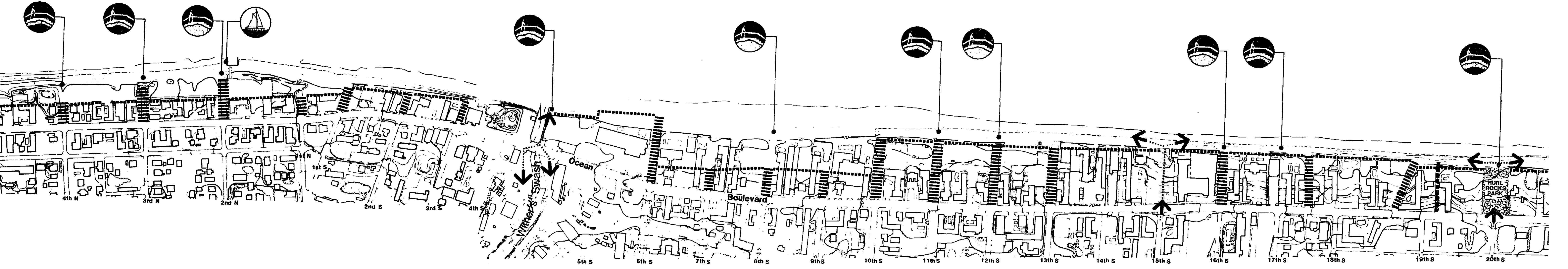
RECREATION AND OPEN SPACE FACILITIES

EXISTING

- Parks
- Fish Pier
- Dune Walkover

PROPOSED

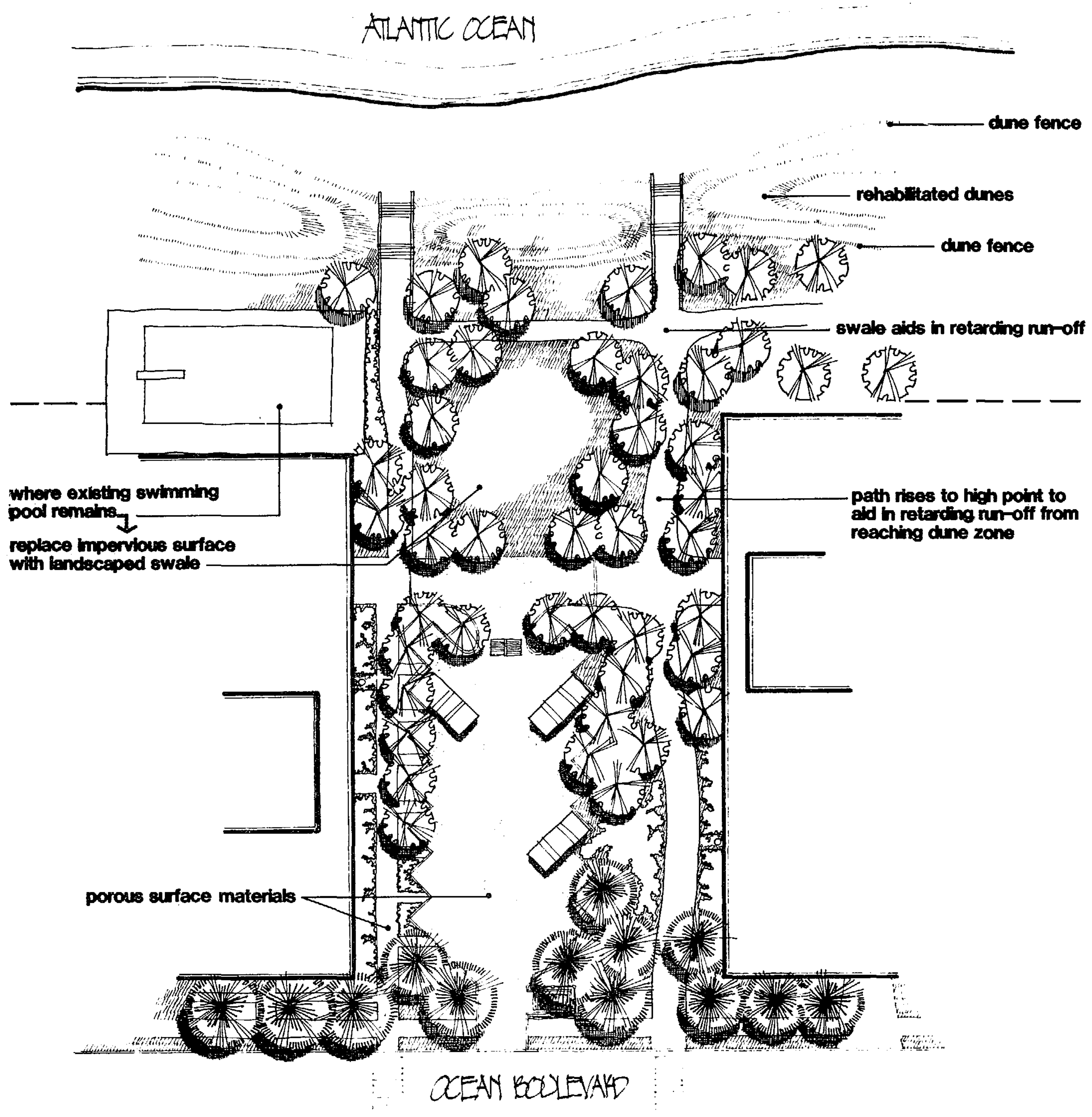
- Parks (sources: "Myrtle Beach Plan" "RMA street-end plans")
- Boat Ramp(source: "Myrtle Beach Plan")
- Dune Walkover (source:"City of Myrtle Beach")



PUBLIC ACCESS

Section 5/Stormwater Runoff Control Study Area
Myrtle Beach, South Carolina
Waccamaw Regional Planning and Development Council
Roy Mann Associates, Inc., consultant
Museum Wharf, Boston, Massachusetts

0 100 200 600



street end redesign concept for increased runoff control

street storm drain system improvements

The contributions to controlling stormwater runoff that both public and private property owners make through increased on-site infiltration, dune and swale reconstruction, and other measures, can have a beneficial effect on street storm drain systems. With more runoff percolating downward at each site, less water escapes parking lots, drives, and other hard surfaces into the street system.

If enough effective on-site management is achieved, future expansion or enlargement of the municipal system may be less extensive than would be the case if parking and other hard surfaces continue to be constructed of impermeable materials alone.

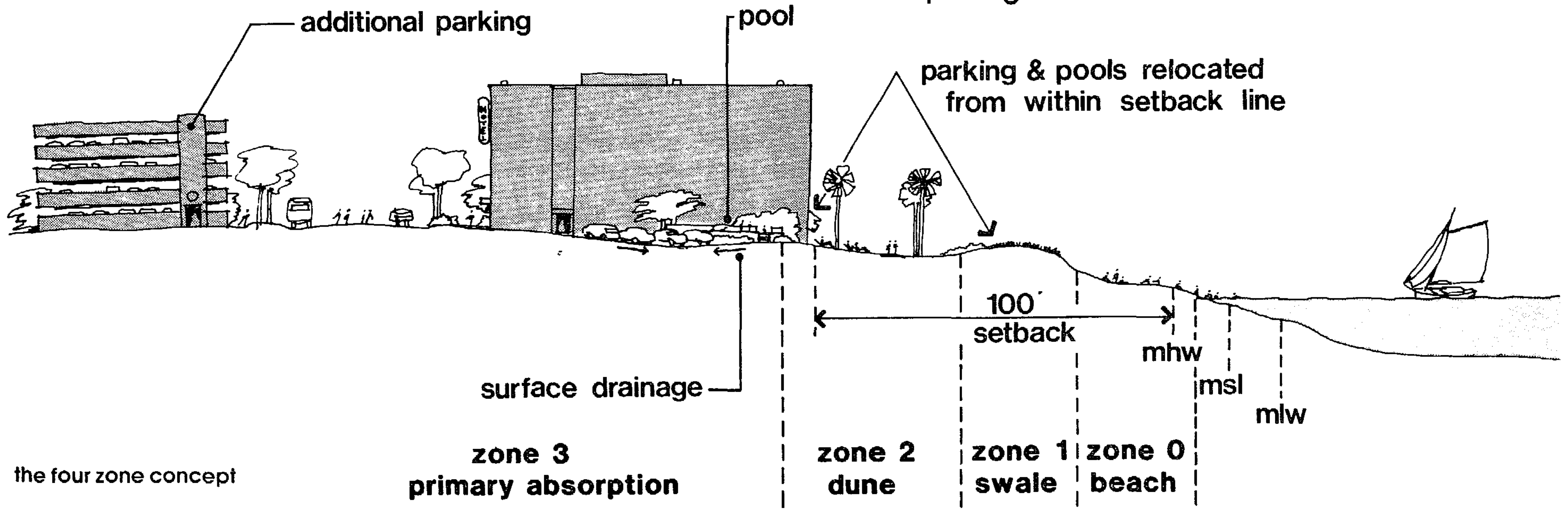
If the problem of beach pipe runoff can be alleviated through adoption of the design tools explained in this handbook, there is also a possibility that the need for costly interceptors designed to divert stormwater runoff from reaching the beach may be reduced.

Obviously, it is in the best interests of the citizens of Myrtle Beach to work to achieve stormwater runoff management through greater reliance on the simpler, less costly measures discussed here. If they cannot be achieved, the reliance on more expensive solutions may be necessary.

park development and public access

Parks are public leisure grounds which are predominantly free of structures and typically include lawns, gardens, and other extensively planted areas. Having few impervious surfaces, parks allow infiltration of rainfall with relative ease, depending on soils, slope, and rainfall conditions. Parks and other natural areas serve important functions, therefore, in helping to absorb runoff with:

- **lawn areas**
- **shrub beds**
- **play surfaces employing ungrouted aggregate**
- **walkways and other hard surfaces using permeable paving**



the four zone concept

Hurl Rocks Park and Chapin Park are two public parks in Myrtle Beach that work in this manner.

The street ends and public walks of Myrtle Beach are also potentially helpful in providing surfaces between developing parcels that can serve as infiltration zones. They can do so with:

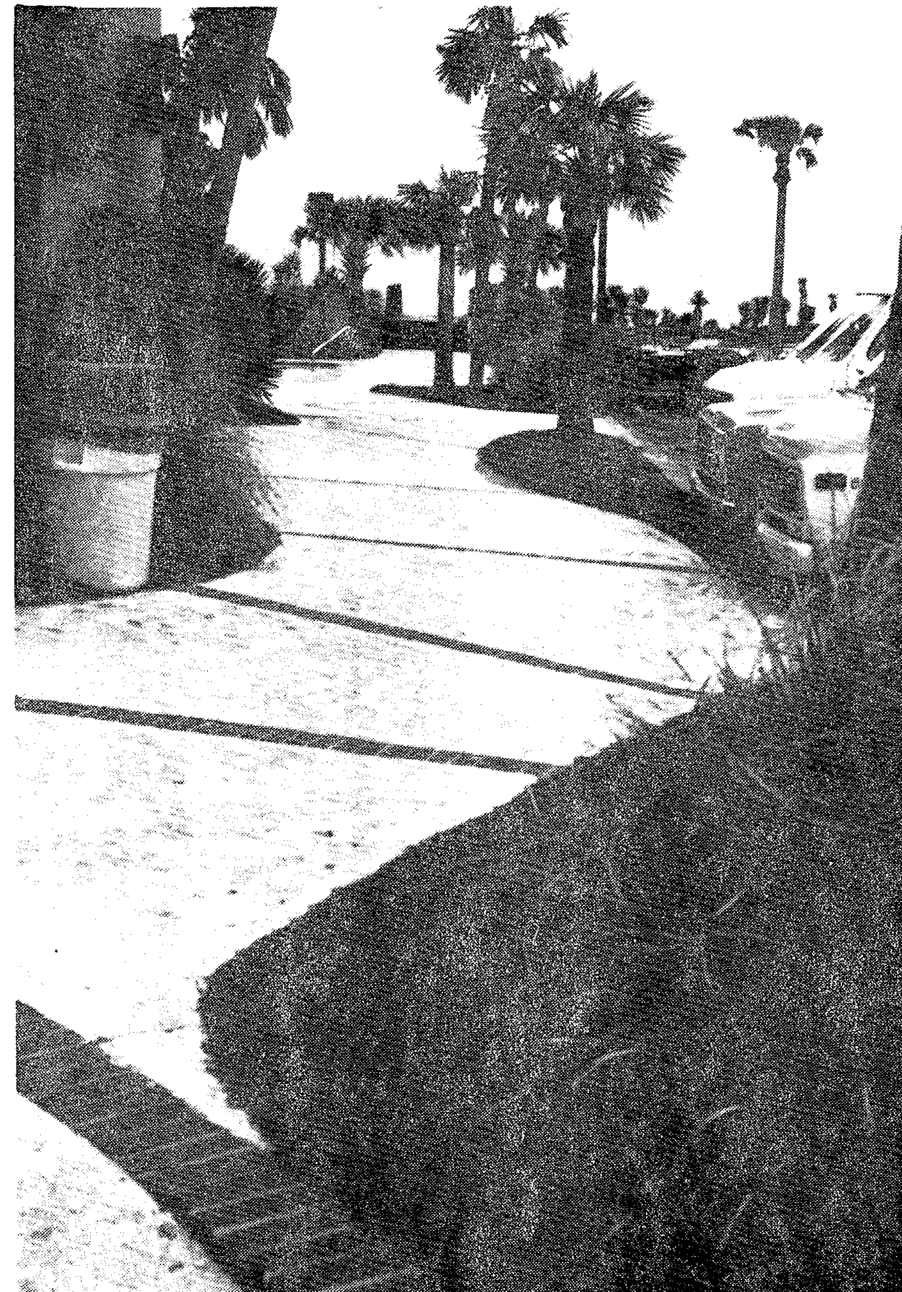
- **permeable paving**
- **landscaped borders**
- **grading that controls the velocity and direction of runoff so that infiltration is maximized.**

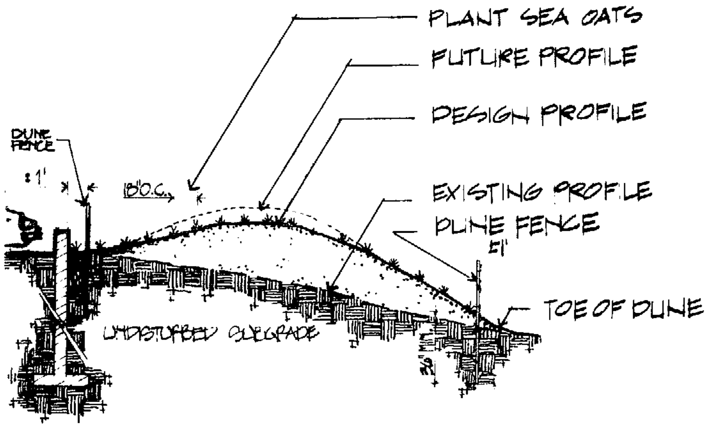
Any public access improvement program should consider the utilization of the above techniques so that runoff control is enhanced at the same time that public access is improved.

beach scraping and maintenance

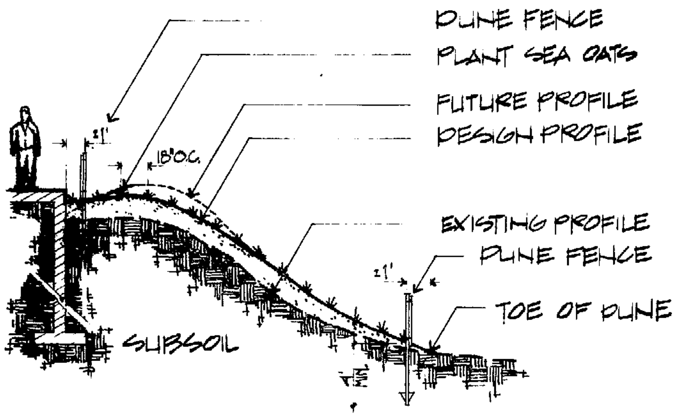
Beach scraping (bulldozing of sand from areas of the beach at or below the low tide mark) is a technique that can be employed to restore modest amounts of sand to the beach face or to the dune zone. Where used, this technique can help improve the recreational quality of the beach and secure a sand supply on the upper part of the beach that, with the aid of on-shore winds, can help keep dunes well shaped.

Beach scraping and maintenance principles and recommendations can be found in consultants' reports on the subject listed in the References section of this handbook.

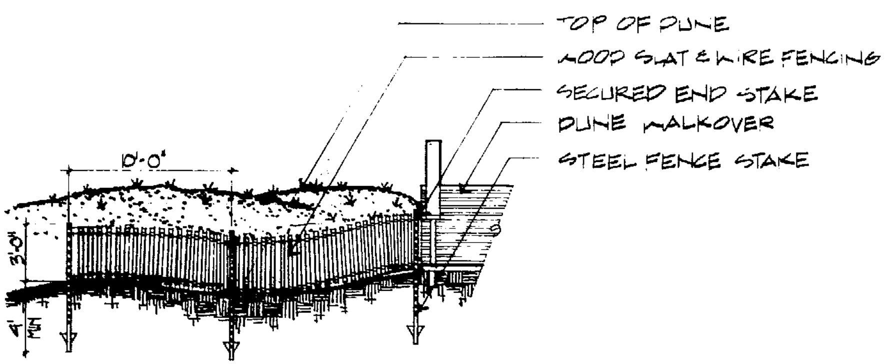




dune reconstruction fronting seawall



berm construction fronting seawall



dune fence section/elevation

dune and swale reconstruction and maintenance

Sand dunes can be reconstructed where beach width and profile and other factors allow.

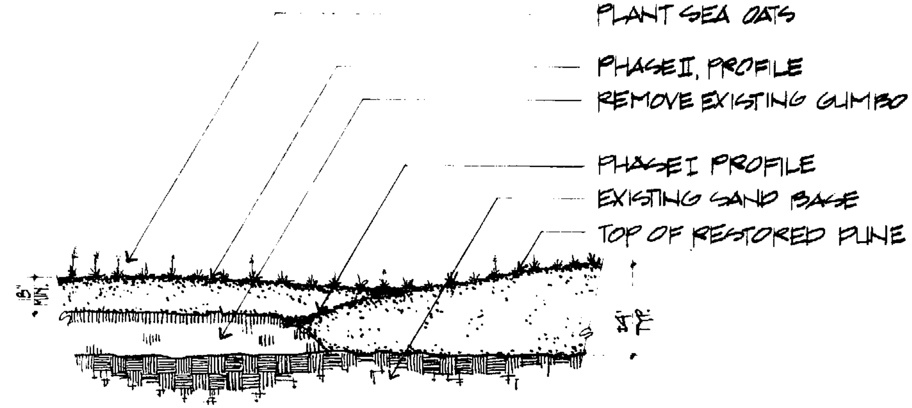
- **Dune reconstruction** can be accomplished by importing or bulldozing borrowed sand from the beach against the dune scarp or up to and over the existing free standing seawall or bulkhead. After sand placement, stabilization should be attained through dune grass establishment and dune fence construction.
- **Free standing seawalls and bulkheads** can be incorporated into dune reconstruction and can serve as fortifying cores to improve this line of defense against the sea.
- **Sand berms** can be constructed in front of seawalls and bulkheads and should follow the guidelines for dune reconstruction. Dune fencing, however, should be placed directly behind the berm crest within one foot of the seawall or bulkhead, as well as at the berm toe.
- **Vegetation** suited to the beach environment should be used to stabilize dunes and collect windblown sand for dune construction and restoration. Sea Oats *(Uniola paniculatum),* Hatteras Beach Grass *(Ammophilas breviligulata "Hatteras"),* and other suitable species can be used; however, professionals should be consulted before planting to determine site specific suitability for particular species.
- **Dune fencing** that is typically constructed of wire-tied vertical wood slats and secured every ten feet by seven-foot steel stakes that are driven into the beach sand approximately four feet should be installed behind the scarp toe and along the landward side of the dune or sand berm. The fencing directly behind the scarp toe will encourage sand deposition that leads to dune formation and provides protection from beach access together with the fencing along the back side of the newly-formed or established dunes.

- **Back dune swales** should be constructed in conjunction with sand dunes at elevations calculated to allow urban runoff to collect and be absorbed. In areas where permeable sandy soil exists, swales need only be properly graded and planted with lawn grasses. Where less permeable soils exist, such as gumbo and others, removal or scarificatoin of these soils and placement of an eighteen-inch minimum layer of sand is recommended in conjunction with vegetation establishment.
- **Maintenance of sand dunes, berms, and swales,** whether existing or newly formed, should be performed by installing dune fencing to prevent foot access over dunes and by planting dune vegetation so that positive stormwater control is assured.
- **Existing drain pipes** that extend onto the beach should be cut and capped in conjunction with dune swale reconstruction and maintenance at their inlet side, and cut from the beach side and backfilled with beach sand so as not to become a physical and visual nuisance on the beach.

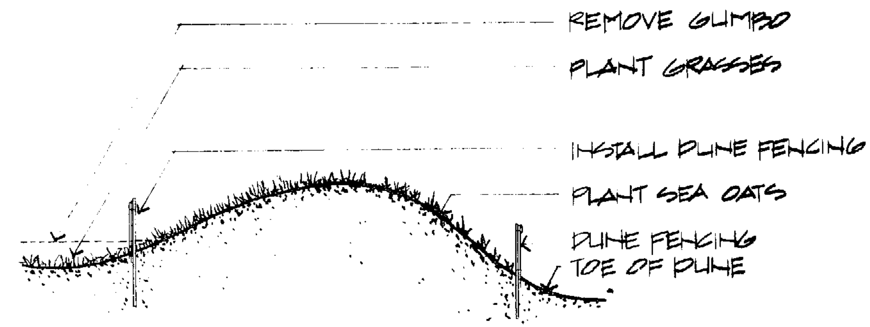
dune walk-over structures

Beach access and dune walk-over structures should be used to facilitate beach entry from street ends and shorefront parks and other public access points. Such structures will protect dunes from trampling and sand loss.

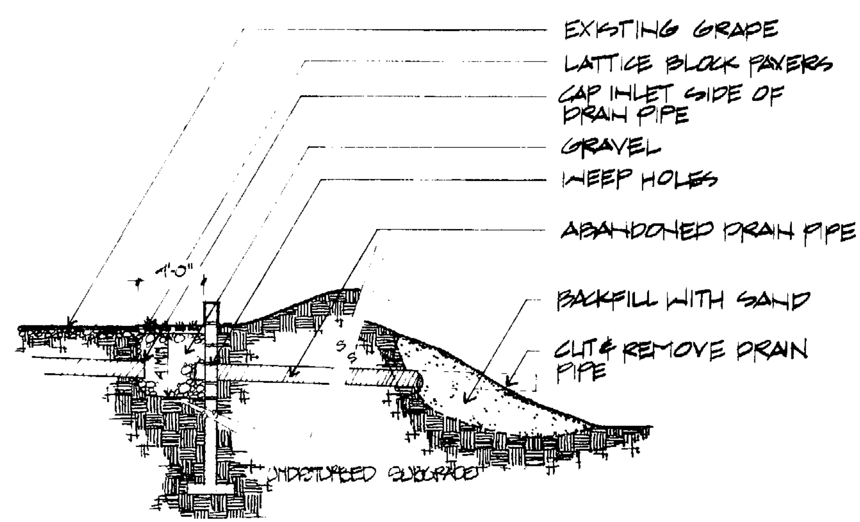
- The **design and placement** of beach access structures should follow the requirements of locally accepted engineering practices.
- **Pressure-treated lumber** and **hot-dipped galvanized bolts, nuts, washers, nails, and other hardware** should be used for all planking, platforms, and stair construction.
- **Secured wood planking** constructed of two-by-six-inch lumber, separated by one-inch galvanized pipe spears, and held together by galvanized steel cable



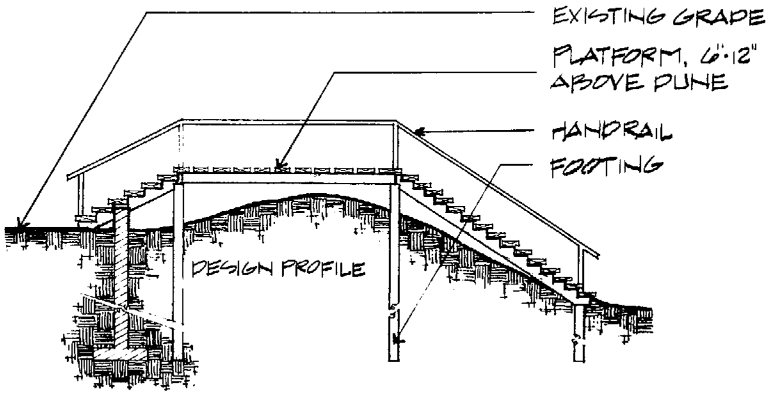
swale and duge edge reconstruction



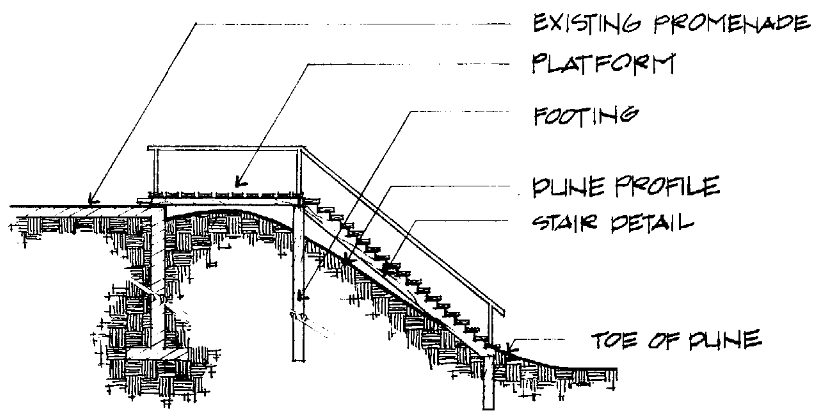
dune maintenance



drain pipe abandonment



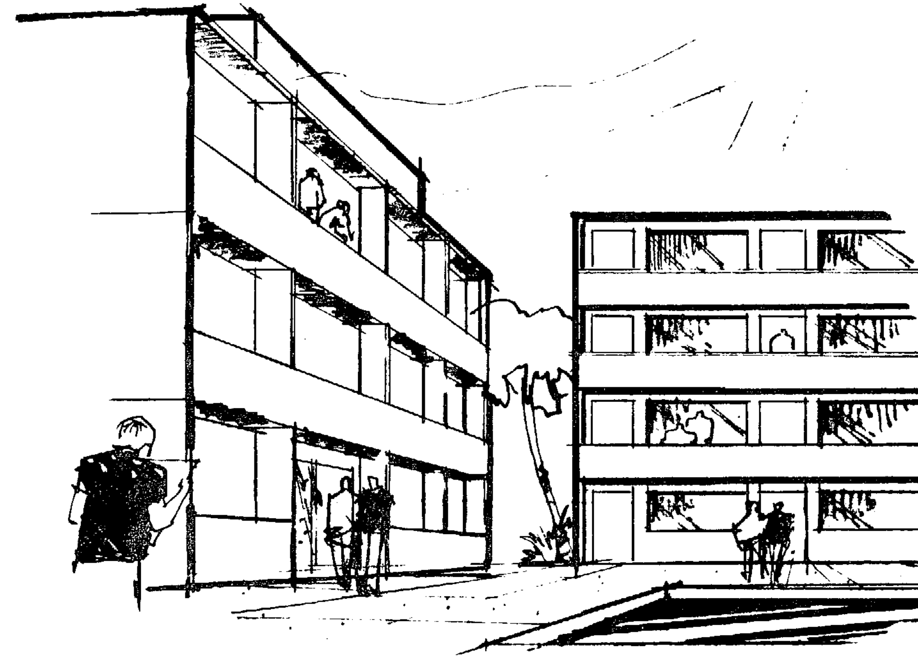
typical dune walkover



extended stairs over dune

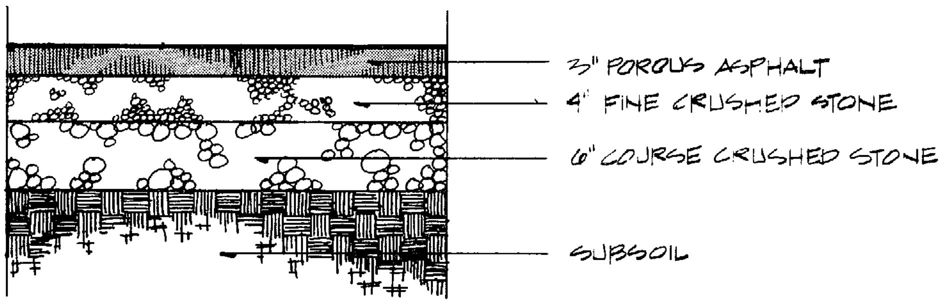
should be used where feasible to provide confined beach access within back-dune zones.

- **Elevated walk-overs** should be used to provide beach access over sand dunes and berms. Either boardwalks or wood plank paths can be used to provide access to the walk-overs. Wood plank paths are less expensive and more aesthetically compatible than raised boardwalks where clear visibility along the backs of the dunes is critical.
- **Dutch drains** dug directly into the ground and filled with shell hulls, gravel, or other highly permeable material that is separated from the soil by a filter mat, can underlay porous walkways and thus accept and absorb runoff. The filter mat will prevent soil from clogging the pores of the coarser material. These Dutch drains can also provide an emergency route for excess runoff that has collected within back-dune swales. Overflow would move into the trench and out through the dune base when water in swales reaches a certain level. These ditches can extend behind the dune scarp and be covered by dune grass or other appropriate cover if they are not used as beach access paths.

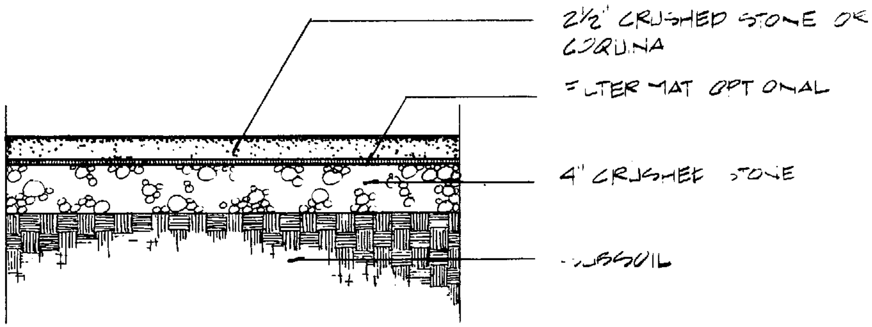


what the property owner can do

4



popcorn paving



aggregate paving surface

The individual property owner can improve protection of beach area dwellings and other valuable structures on sites vulnerable to standing water and runoff impact through a number of simple techniques, depending on the location, soils, slopes, and water table of the site.

The property owner, at the same time the site is being improved to enhance protection of valuable structures, can help neighbors and the public at large by improving on-site runoff management control, so that rainfall is not simply shed off the property onto streets and, as is sometimes the case, down to the beach.

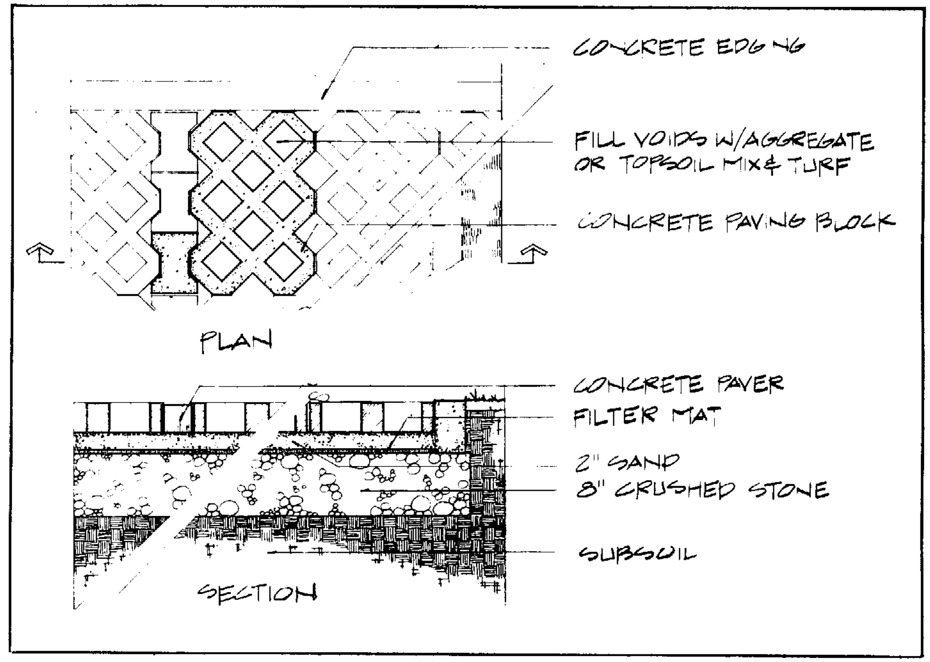
The following techniques demonstrate how stormwater runoff management on private property can be effectively accomplished, for both the individual and common good.

permeable paving

Permeable paving should be considered on sites where sandy, absorptive soils exist, since they allow infiltration of runoff into the soil and slow down the rapid flow of water to swales and ditches from hard surfaces. Water moves through permeable paving into a layer of gravel and then filters naturally into the underlying soil. The Waccamaw Regional Planning and Development Council can provide advice on local sources, costs of permeable paving, and conditions of use.

- **Porous asphalt paving,** commonly known as popcorn paving, should be used on driveways, parking areas, and road surfaces where highly porous soils exist. Where less permeable soils exist, borrowed proous fill from on- or off-site can be graded into areas that are to be paved. Clogging of the paving pores by silt and sand may occur over time, but hosing or regular vacuuming and sweeping can prevent this from happening. Its strength and stability make it acceptable for a great range of access and parking conditions.

- **Aggregate paving, such as gravel and crushed stone,** can also be used in areas of pedestrian and low-speed vehicular use. They provide better infiltration than the popcorn paving and pavers set in sand, although they do not possess their stability and require greater maintenance. They also require adequate subgrade base depth where vehicular use is intended.
- **Precast interlocking and brick pavers,** set on sand for increased absorption, can provide a hard support surface for pedestrian use on patios and sidewalks and for vehicular parking. Precast pavers are somewhat more expensive than porous asphalt paving but are visually pleasing.
- **Lattice block pavers** contain hollow voids that can be filled with sand, crushed stone, grass over porous soil, or other porous material. Their use can be best applied to special parking areas where low speeds are suited to their masonry quality.

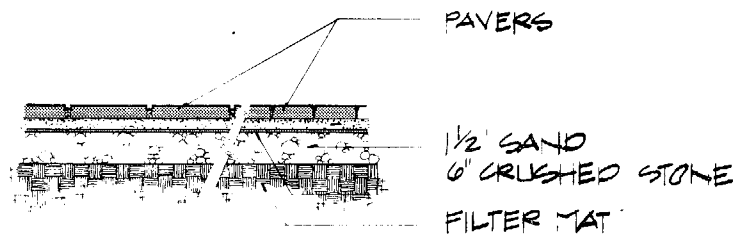


lattice block paving

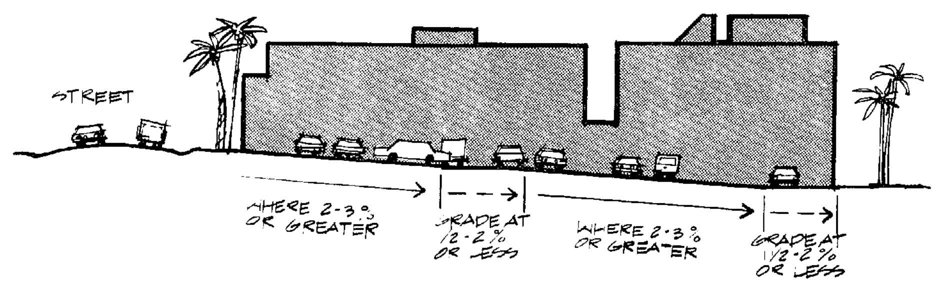
improved quality

Improved grading in residential, commercial, and other large developments should direct runoff from parking lots, roadways, and grassed surfaces toward on-site areas that can detain and either absorb or discharge rainwater slowly to other outlet points.

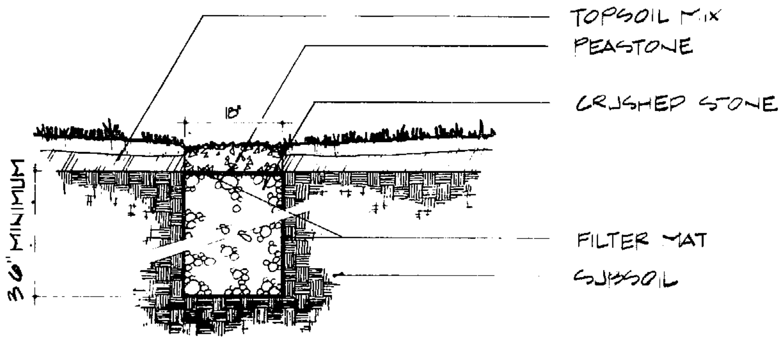
- The **gradient** of parking surfaces should not exceed 2% where feasible, to slow runoff and increase infiltration through pavement pores. Where parking surfaces are forced into steeper slopes, flatter bands or landings should be graded at no more than 1 1/2-2%, at suitable intervals, to intercept flow from the steeper areas and increase infiltration through the porous paving or other permeable material used.
- **Runoff** should be shed toward swales, perimeter ditches, medians, and other detention areas by proper grading design.



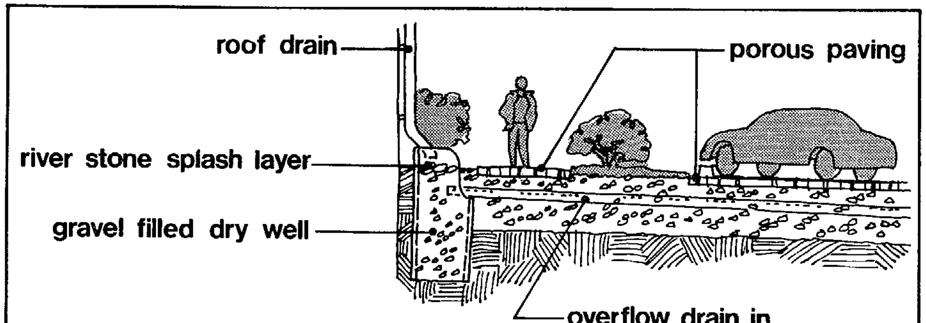
unit pavers



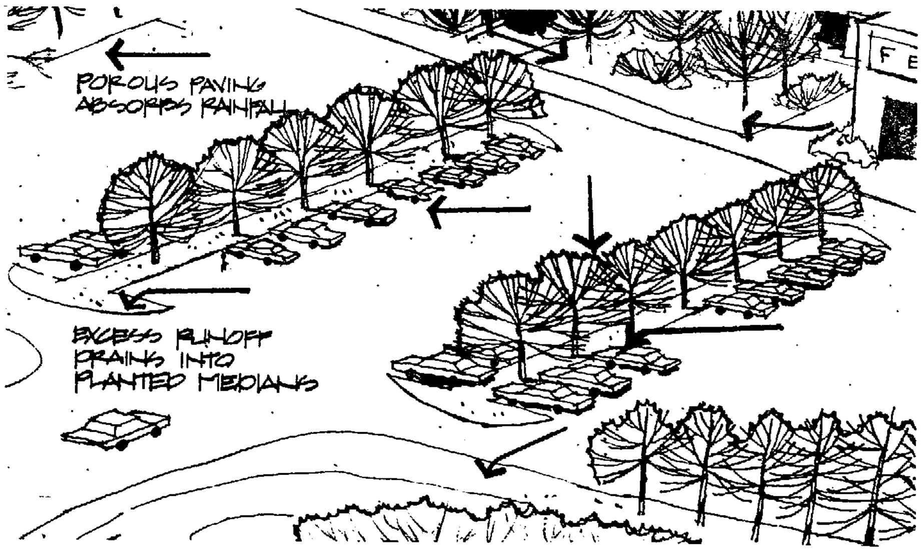
improved grading for vehicular parking



typical infiltration pit



roof downspout drainage



infiltration structures

Infiltration structures should be used to receive runoff from driveways, parking surfaces, and lawn areas and to allow the runoff to be absorbed directly into the lower layers of soil. Since soil will accept less infiltration with continuing rainfall, pits, dry wells, and other stone-filled drains are most effective at the beginning of storms.

- **Infiltration pits** can be dug directly into the ground and filled with gravel, shell hulls, or porous rubble that is separated from the soil by a filter mat, and used to intercept and absorb runoff. The filter mat will prevent soil from clogging the porous gravel and decreasing infiltration.
- **Dutch drains** are linear infiltration pits or trenches filled with gravel or other coarse material.
- **Dry wells,** pits filled with gravel or stone rubble and surrounded by a mesh soil separator or by a vertically set perforated fiberglass, concrete, or metal cylinder, can be used to collect stormwater from roof gutter downspouts. The water will be absorbed into the ground provided the soil is sufficiently permeable and unsaturated.
- **French drains,** perforated pipes surrounded by gravel, can be used to collect excess stormwater from the base of dry wells in areas where less permeable soils exist and lead it into areas of greater soil permeability or to drainage outlets.

median strips

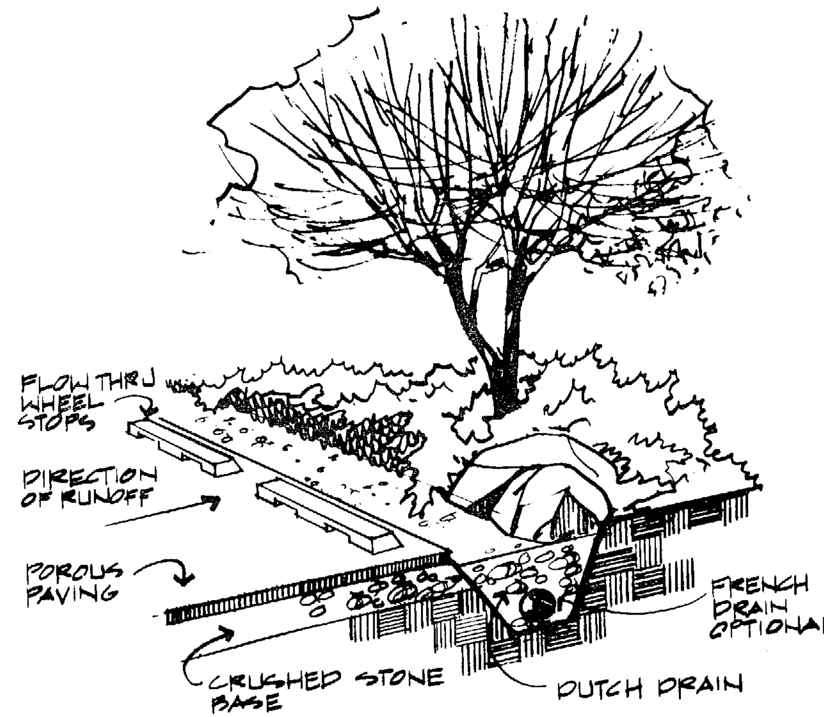
Median strips can be designed without curbing to accept safe amounts of runoff from adjacent roadways and parking lots. Depending on their size, they can incorporate plantings of species tolerant of temporary wet conditions and urban stormwater runoff, along with linear infiltration pits. Not only can median strips absorb stormwater runoff — passing excessive amounts on to other on-site outlet points — but they may also filter out pollutant collected by runoff.

- The **size** of median strips should vary depending on planning requirements and the overall dimensions and requirements of each site.
- **Dutch drains** may be used along the perimeter of medians to help intercept runoff, store it, and allow it to percolate into subsurface soils. Filter fabric should be used to separate gravel from the bordering soil to prevent clogging.
- **Perforated wheel stops** should be used to allow runoff to flow through their base and into medians. They are typically precast in concrete and have horizontal voids in their base.
- **French drains** should be used to carry excessive stormwater from Dutch drains to permeable soils or outlet points.
- **Sweeping and vacuuming** on roadways and parking lots should be performed on a regular basis to reduce clogging of pores caused by fine particles of soil and other debris.

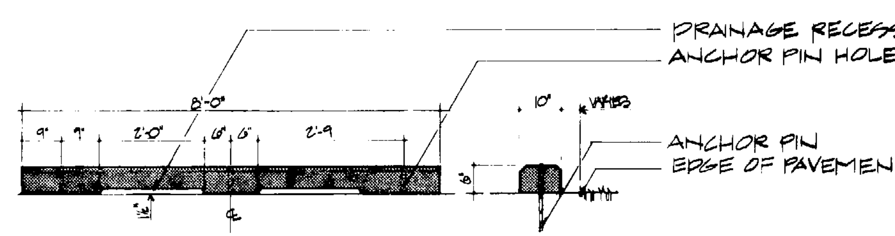
roadside drainageways

Roadside drainageways should be designed to ensure efficient roadside flow by properly locating ditches, culverts, and pipe inverts. Elevations should be specified by a qualified professional to avoid local blockages and overflow.

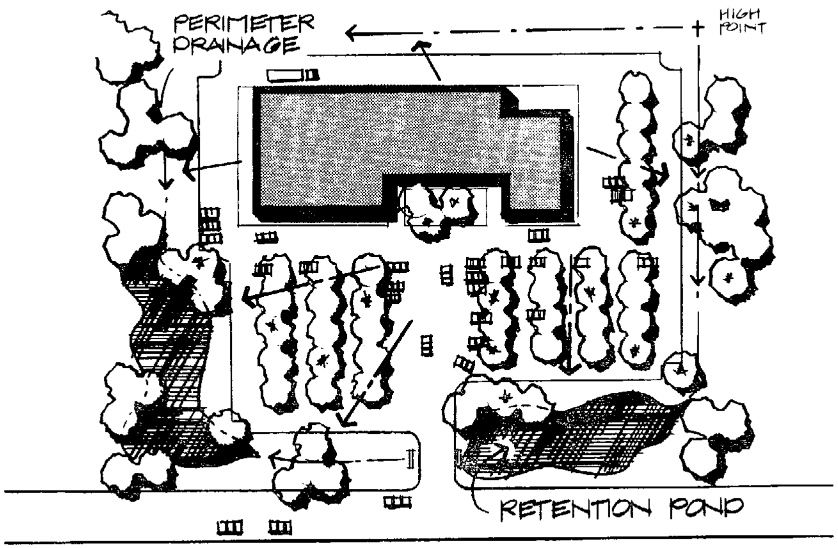
- The **design** of street storm drains and catch basins in built-up areas of Myrtle Beach should be designed to accept that runoff which cannot be accommodated by roadside absorption.
- **Low, dense grasses** should be planted on swale bottoms, slopes, and adjacent areas to stabilize soil and restrict weed growth in low density areas of the city.
- **Side slopes** of sandy, unstable soil should be cut at 45%. In areas where clayey soil exists, 60% is acceptable.



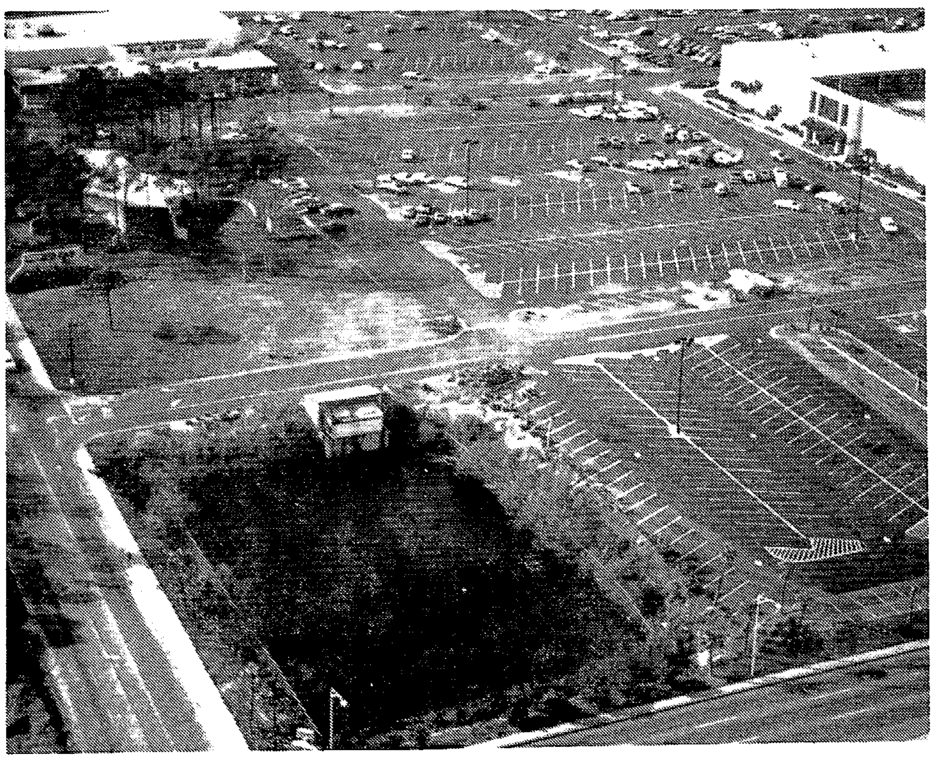
median strips intercept and absorb runoff



precast concrete wheel stops with runoff cuts



onsite stormwater detention design



perimeter ditches

Perimter ditches, or a principal drainage channel, should be located around shopping centers and other large developments to accept a portion of parking lot and roadway runoff while providing an opportunity for natural absorption and evaporation, and to carry runoff into an onsite detention pond where feasible.

- **Construction principles** for perimeter ditches should follow those for roadside drainageways.

detention ponds

Detention ponds should be designed to store on-stie runoff collected from storm drains, Dutch drains, French drains, swales, perimeter ditches, and paved and unpaved surfaces. During periods of moderate and high rainfall, detention ponds release excess amounts of stormwater into natural water courses or mand-made systems. At other periods in time, they allow for vegetative absorption, evaporation, and natural infiltration of detained water.

- The **size** of detention ponds should not be determined by their function of controlling stormwater alone, but with consideration given to their potential as recreation areas, groundwater resuppliers, aesthetic resources, or other uses. A larger than mimally sized pond can yield various benefits to the owner.
- **Weirs** provides outlet of excess stormwater at pond edges and should be designed and set at a proper elevation by an engineer or other professional. Weirs may also be arranged to hold back a higher head of water during storms than during fair weather and thus aid in flood control.

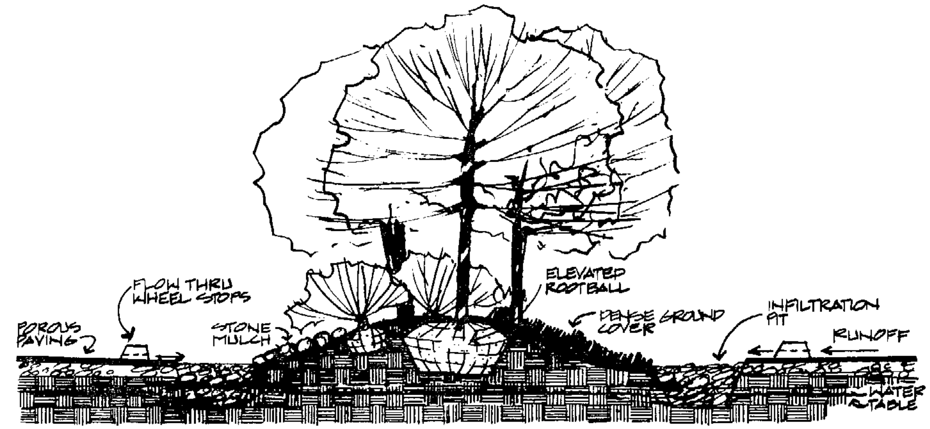
landscaping

The use of native or exotic (imported) trees, shrubs, and ground cover should be incorporated into residential homesites, shopping centers, and other large developments.

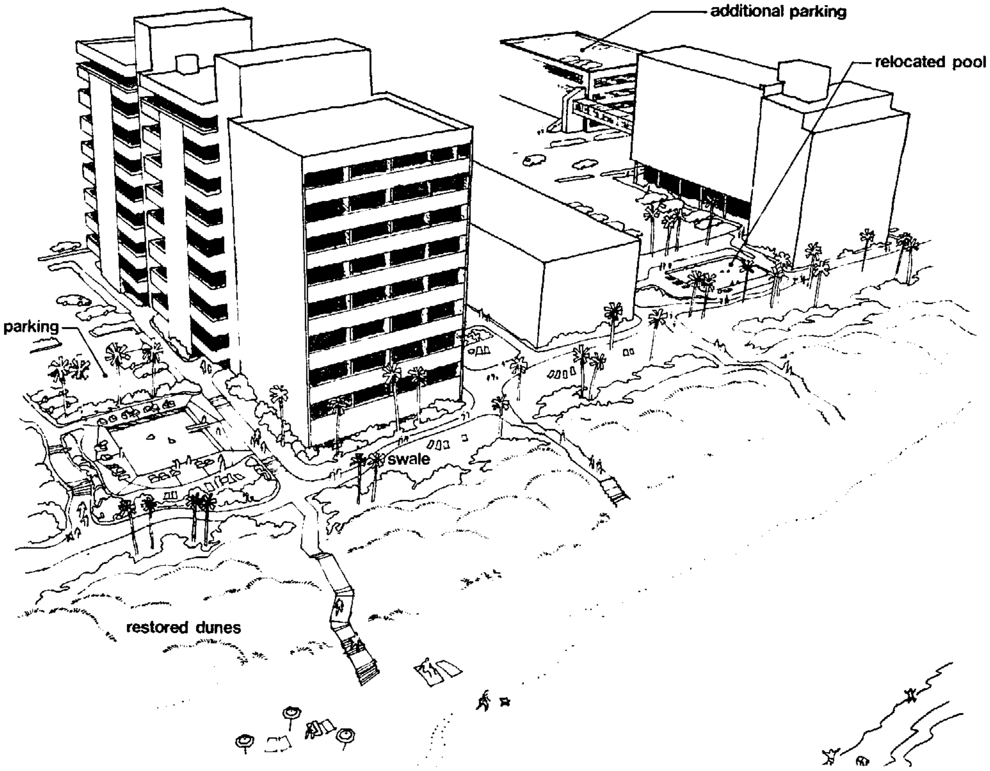
- **Existing vegetation** should be protected from construction practices and retained as extensively as possible.
- **Low, dense grasses,** such as tight-growing Bahia, Bermuda, or Common Lespedeza, should be planted on swale and drainageway bottoms, sloping sides, crests and perimeters, and on other unvegetated bare soil surfaces. Grassing will soften initial rain impact on soil, slow runoff, and help moderate fluctuations in ditch flow.
- **Dense vegetative ground covers** and **heavy mulches,** such as gravel, rocks, and shell hulls, may be used in plant beds, median strips, and areas where the soil is void of cover to prevent erosion and retain moisture necessary for plant establishment and survival.
- **Root zones** of plantings should be slightly elevated by berming where standing water is likely to occur, especially in median strips.
- **Invasive vegetation,** including types with intrusive root systems, should not be used in areas where they may cut down absorptive capabilities of French drains, infiltration pits, and other runoff conduits.
- A local landscape architect can best provide information on plant types, their availability, design, and other pertinent landscape information.

locating pools, patios, and parking at a safe setback

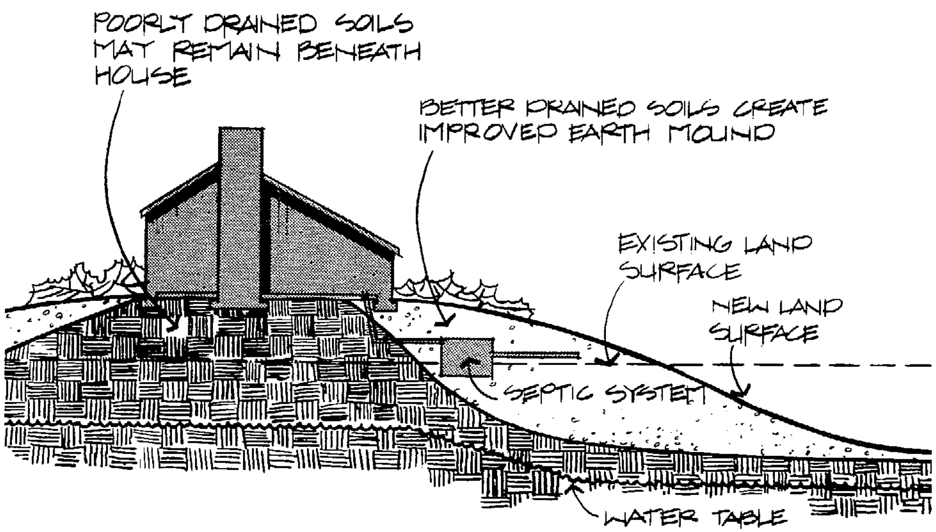
Swimming pools and impervious patios, along with parking facilities, should be moved from within the proposed swale absorption zone (Zone 2) to the positive drainage and absorption zone (Zone 3) wherever feasible. This would allow for the redevelopment of a protective dune ridge and an absorptive swale.



landscaping controls stormwater and improves aesthetic appearance



concept for pool, patio, and parking setback



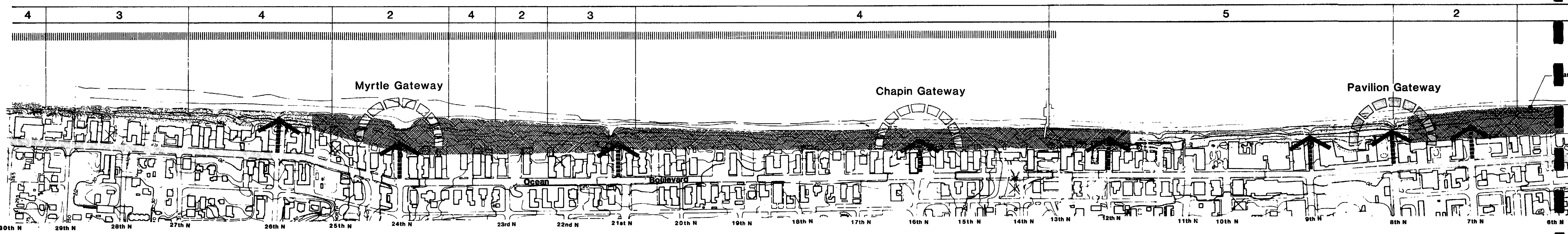
both flood protection and groundwater protection are improved

- The **location** of relocated pools should be designed to take advantage of southern exposures where possible.
- **Large swimming pools** could be designed for joint use by neighboring motels rather than relocating small, separate versions, where owners can agree.
- **Porous pavings** should be used on all proposed and remaining pool perimeter surfaces, on all parking surfaces, and on all public and private pathways.
- **Landscaping** should be incorporated within parking medians on path borders, and around pool patios. Vegetation, mounding, and swales will assist in stormwater runoff control.
- **Public and private infiltration structures** should be used, where necessary, to further facilitate runoff control.

mounding

Mounding can be accomplished on individual house lots and on large parcels of developed land by grading existing on-site soils and borrowed fill. The benefits of mounding are the improvement of protection of houses, motels, and other valuable structures from stormwater flooding, the shaping of the remainder of the site for better infiltration, and achievement of a more attractive landscape.

- **Slopes** should permit runoff to flow at an even, nonerosive rate into adjacent swales.
- **Landscaped mounds** may increase the rate of runoff away from the valuable structures, but the adjacent swales will tend to slow down and absorb the runoff flow.
- **On-site sewage disposal units** within mounded homesites should be placed in porous soil away from less permeable soil and away from shallow water tables.



LEGEND

Mean High Water (City base, 1977)

Mean High Water (RPI, 1981)

Backlands and beach with high public open space enhancement potential

Backlands with limited enhancement potential

Beach gateway (access of special aesthetic importance)

Parks and streets of special public access importance

Areas in which consolidation of public walks would be beneficial

Ocean Boulevard frontage: improvements of (1) parking capacity, (2) pools and patios (3) streetscape image

2 Dune/Swale Reconstruction Potential

Dune/Swale Reconstruction Potential (1)	Typical Measures (2)
1 Excellent	D/S/A
2 Good, some problems	D/B/S/A
3 Fair, numerous problems	D/B/S/A
4 Poor feasibility without some renourishment	B/D/A
5 Infeasible without major renourishment	B/A

(1) Source: Research Planning Institute, Inc., November 1981

(2) Typical Measures:

- D Dune reconstruction (zone 1)
- B Berm construction (zone 1)
- S Swale development (zone 2)
- A Absorptive repaving (zone 3)

* 3/4 Reconstruction Potential

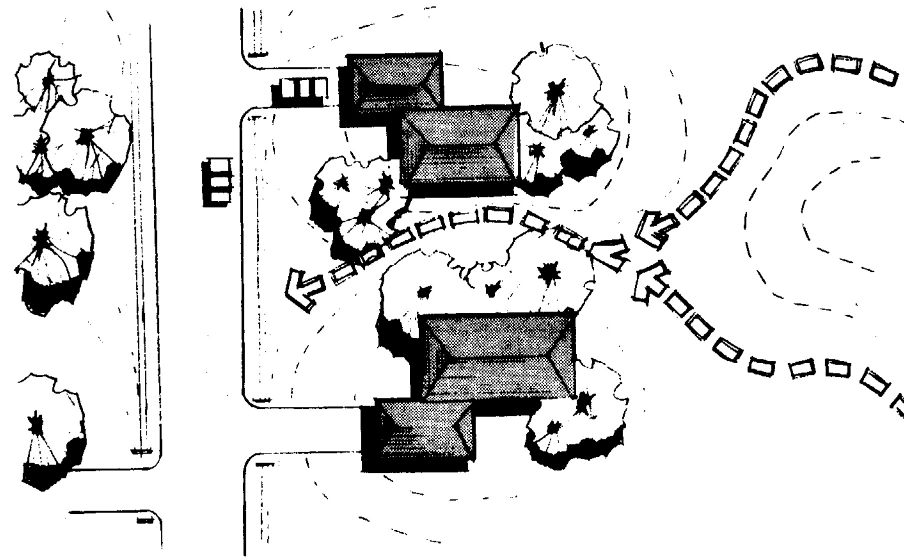
3 where no parking lot exists

4 where parking lot exists

swales

Swales should be graded in conjunction with mounds to slow the rate and amount of runoff entering roadside and other drainageways.

- The **location** of swales should be along natural drainage paths in the lower and border areas of the site.
- The **grading** of swales should be designed to assure the flow of runoff into roadside drainageways so that standing water does not occur.
- **Side slopes** should be designed to allow for a slow, even flow of runoff, enabling the swales to absorb water and reduce downstream flooding.
- **Grasses,** such as tight-growing Bahia and Common Lespedeza, should be planted in swales to help slow runoff, stabilize soil, and restrict weed growth.

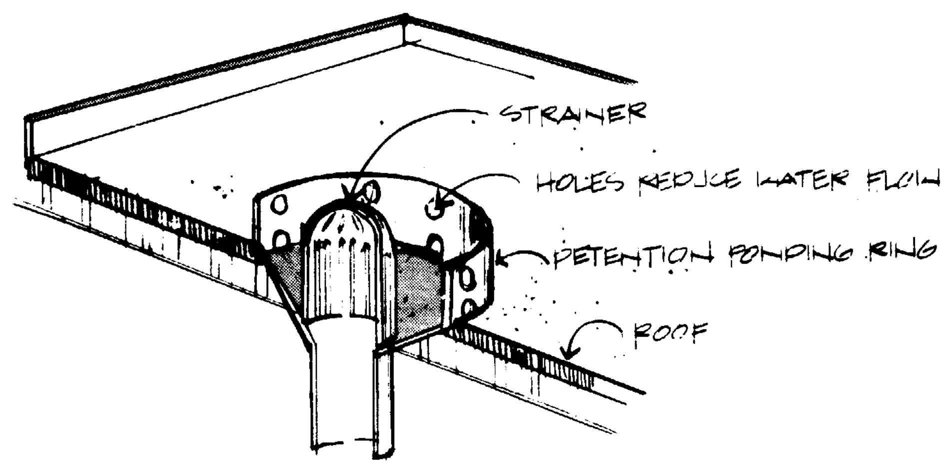


swales slow runoff entering roadside drainageways and natural watersheds

controlled roof drainage

Controlled roof drainage should be achieved by using infiltration structures in residential and commercial developments.

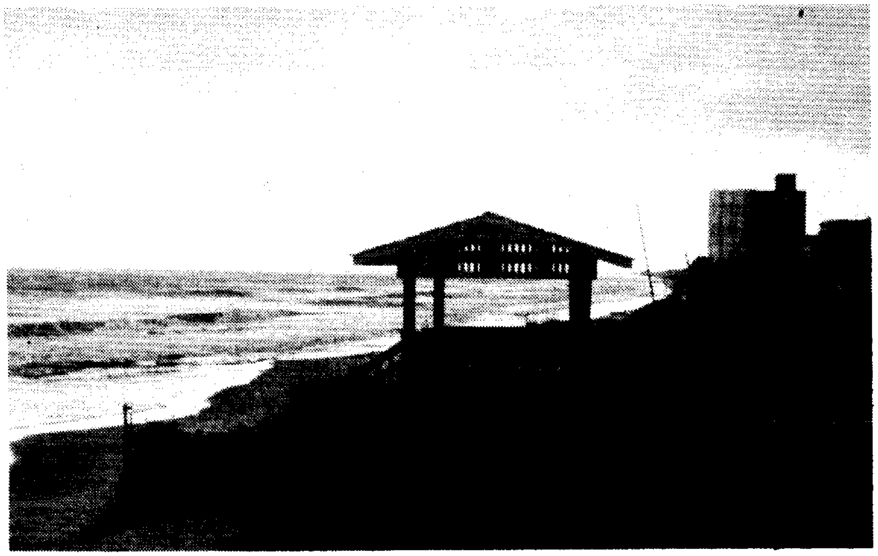
- **Rooftop drains** that utilize a strainer and detention ring to ensure a safe, moderated release of water into a drain pipe should be used on large, flat roofs in shopping centers and other commercial developments.

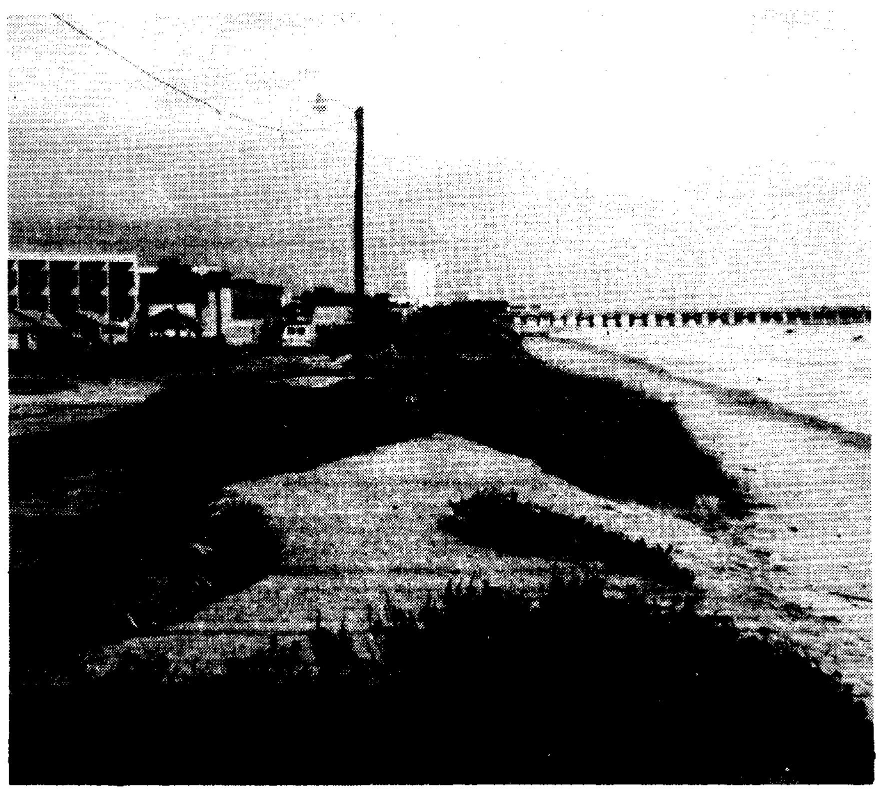


rooftop drain

dune and swale reconstruction and maintenance

Dune and swale reconstruction and maintenance on residential, commercial, and other properties bordering the beach should follow the techniques proposed within the "What the Public Can Do" section of this report.





dune walkover structures

Beach access and dune walkover structures should be used by all private and public property owners to provide beach access. The proposed structures and techniques for construction can be found within the "What the Public Can Do" section of this report.

revetments, seawalls, bulkheads, and acceptable alternatives

Wherever possible sand dunes backed by a swale should be used instead of revetments, seawalls, or bulkheads.

Where structural erosion controls are decided on, a sloped revetment that utilizes adequately-sized stone layed on a sloped bank of crushed stone and that is backed by a filter mat should be used instead of a seawall or bulkhead. Wherever possible, sloped revetments should be sited in accordance with an adequate setback from the beach. Seawalls and bulkheads are undesirable because problems of wave reflection and beach scouring and beach erosion that occur with their use intensify beach erosion.

The fold-out map opening on the right summarizes recommendations for a four-zone stormwater runoff management approach, unified with improved public street ends, public parks, and other beach landscape features. Together, these can potentially enhance the water quality, beach quality, and landscape quality of Myrtle Beach's ocean frontage.

The proposed plan is based on recommendations, ideas, and commentary developed at a series of public meetings held in Myrtle Beach in 1980 and 1981, sponsored by the City of Myrtle Beach and the Waccamaw Regional Planning and Development Council, at which Roy Mann Associates, Inc., and Moore, Gardner & Associates, Inc., provided technical support.

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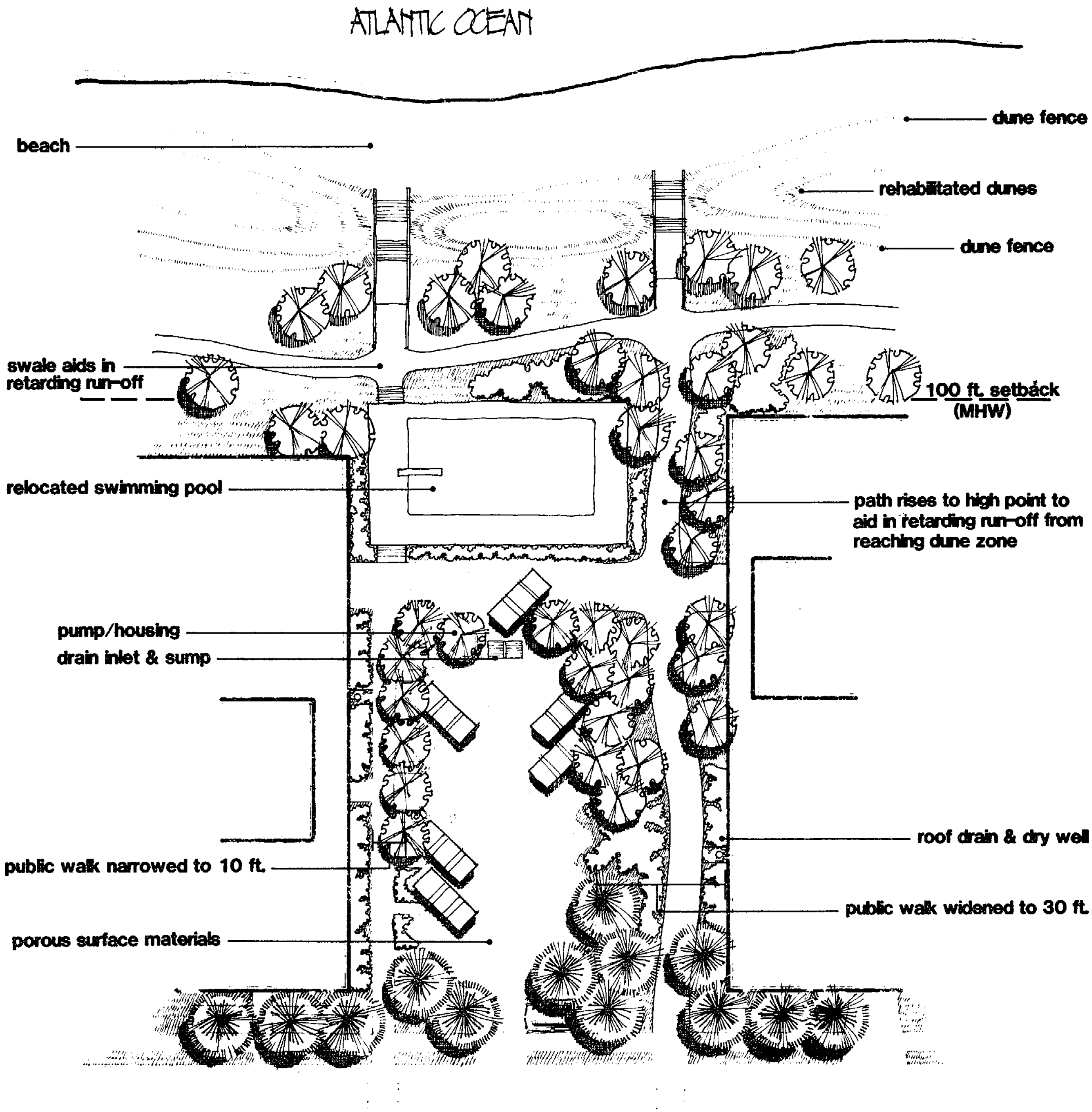
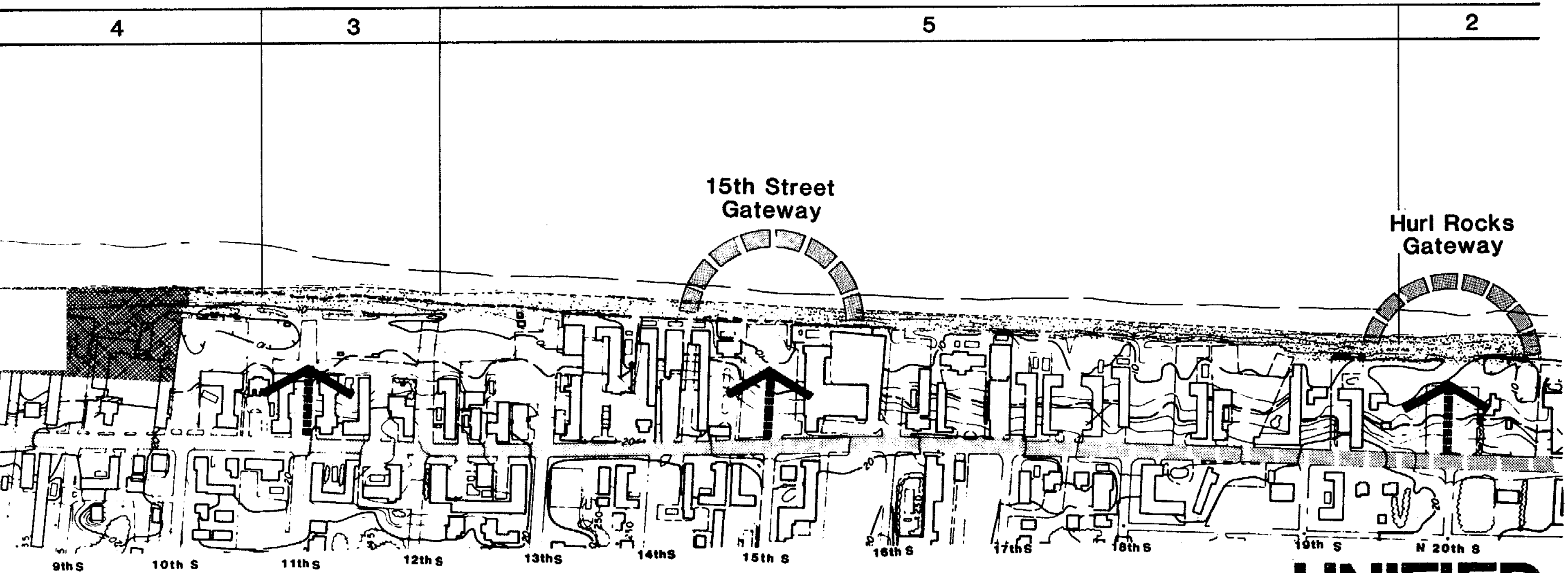


street end redesign concept for increased runoff control



UNIFIED CONCEPT PLAN

Section 5/Stormwater Runoff Control Study Area

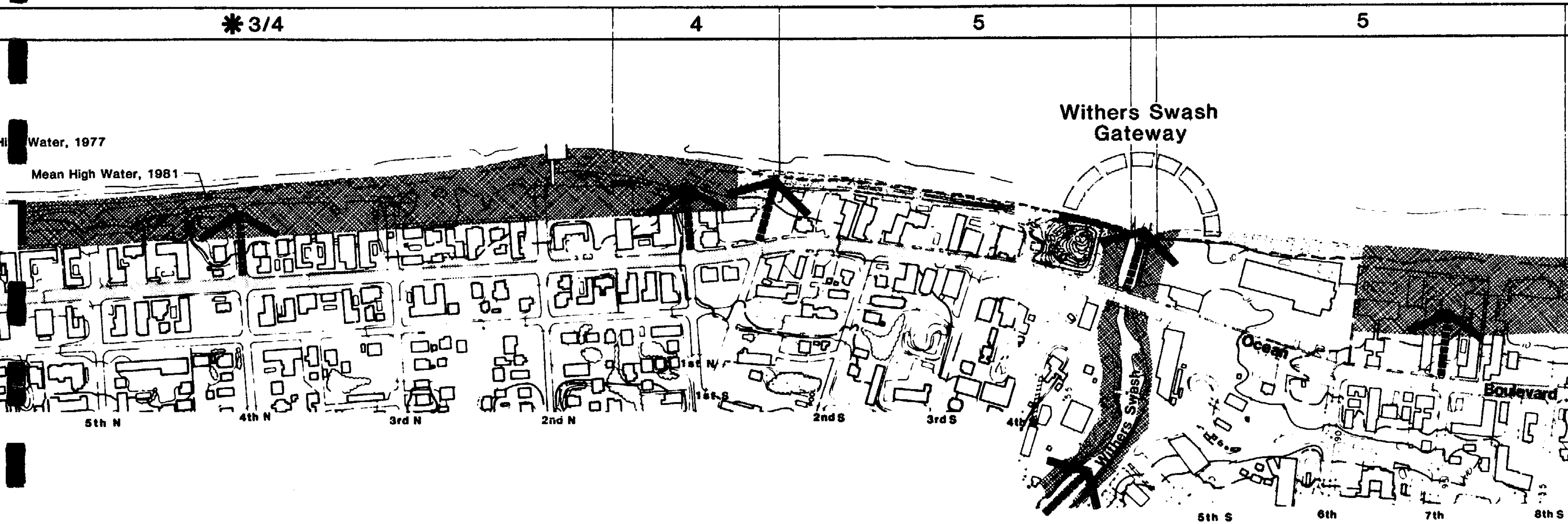
Myrtle Beach, South Carolina

Waccamaw Regional Planning and Development Council

Roy Mann Associates, Inc., consultant

Museum Wharf, Boston, Massachusetts

0 100 200 600



✱3/4
4
5
5
Withers Swash
Gateway
Water, 1977
Mean High Water, 1981
Ocean
Boulevard
Withers Swash
5th N
4th N
3rd N
2nd N
1st N
1st S
2nd S
3rd S
5th S
6th
7th
8th S

conclusions

Through use of the techniques and action steps outlined in this handbook, improvements in stormwater runoff management, public access, and the beach and dune landscape of Myrtle Beach can be achieved.

With progress in these areas, less beach erosion and water quality impairment will be caused by stormwater runoff. The beach will offer a better and safer recreational experience. Many properties will enjoy better protection from ocean storms, through improved setback of pools and other built elements from the dune zone. The landscape of the ocean frontage of the hotels and motels of the city — so vital to Myrtle Beach's tourism and vacation economy — will be enhanced. Public access from Ocean Boulevard will be improved and made more enjoyable. And improved parking capacities along Ocean Boulevard will provide better parking than can be found in parking encroachments upon the dune zone, where parking surfaces are vulnerable in any event to storm damage.

Benefits to the owners of private sites away from the beach can include improved protection from on-site flooding and the added landscape quality that properties will enjoy where sites are designed, graded, and planted to encourage infiltration of rainfall into soil and porous surfaces and the location of buildings on higher, contoured ground.

In summary, the public of Myrtle Beach has at its disposal effective tools for stormwater control and environmental quality improvement. Both the public at large and individual owners of property have a golden opportunity to take advantage of these tools — now — before beach erosion, water quality impairment, and other storm-related problems grow to levels of higher and higher economic, health, safety, and environmental costs.

for further assistance

For further information on ways in which you can help minimize drainage problems, please contact:

- Waccamaw Regional Planning and Development Council
  1001 Front Street
  Georgetown, South Carolina 29440
  (803) 546-8502
- The City of Myrtle Beach
  Post Office Drawer 2468
  Tenth Avenue North
  Myrtle Beach, South Carolina 29577

  City Manager (803) 448-2430
  Planning Department
  Landscape Architect (803) 448-2347
  Public Works Department
- Myrtle Beach Hotel and Motel Association
  Post Office Box 1303
  Myrtle Beach, South Carolina 29577
  (803) 626-9668

suggested reading

Dames and Moore, **Design and Construction Manual for Residential Buildings in Coastal High Hazard Areas.** U.S. Department of Housing and Urban Development, 1981.

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Untermann, Richard K., **Grade Easy.** American Society of Landscape Architects Foundation, 1717 N Street, NW, Washington, DC.

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acknowledgements

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