NYSGI-T1-75-004 C. 2

WORKING PAPER

No. 4

TITLE: COASTAL LANDFORMS AND SCENIC ANALYSIS: A REVIEW OF THE LITERATURE, WITH A PRELIMINARY EXAMINATION OF NEW YORK'S SHORELINE

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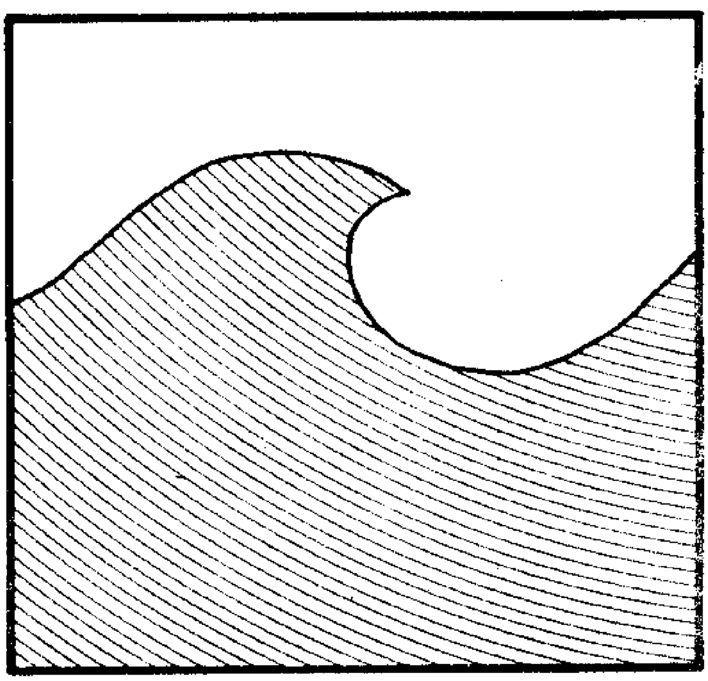
VISUAL QUALITY OF THE COASTAL ZONE



SEA GRANT PROJECT

SCHOOL OF LANDSCAPE ARCHITECTURE
SUNY COLLEGE OF ENVIRONMENTAL SCIENCE AND FORESTRY
SYRACUSE, NEW YORK 13210

SPONSORED BY NOAA OFFICE OF SEA GRANT AND
NEW YORK SEA GRANT INSTITUTE

VISUAL QUALITY OF THE COASTAL ZONE

- WORKING PAPERS -

New York's coastline comprises a wide spectrum of visual environmental character, ranging from the aesthetically pleasing to the physically revolting. Natural processes over time, modified to varying degrees by human activities, have produced unique regional characteristics central to the quality of life of both permanent residents and seasonal visitors. While high aesthetic quality may occur in man-dominated as well as in undisturbed natural environments, thoughtless coastal development often destroys natural scenic values and creates visual horrors.

The vital importance of protecting and enhancing aesthetic values is widely recognized. Public concern has been translated into legislation, such as the National Environmental Policy Act of 1969 (NEPA) and the Coastal Zone Management Act of 1972, requiring that aesthetic values be duly considered along with ecological, cultural, economic and other values in land use decisions. State, regional, and local directives concerned with environmental quality concur. The need for action is clear, but defining, evaluating, and managing the vulnerable visual quality of our coastal zone is highly elusive.

In November 1974, the New York State Sea Grant Institute awarded a grant to the School of Landscape Architecture, SUNY College of Environmental Science and Forestry, Syracuse, N.Y., to investigate the issues of visual quality pertaining to the New York State's coastlines. The long range objective is to provide practical methods by which coastal managers can evaluate visual quality and integrate these findings into land use decisions. The project's initial steps have included the preparation of a series of working documents, intended to provide background information on the subject and to elicit responses from selected readers.

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COASTAL LANDFORMS AND SCENIC ANALYSIS: A REVIEW OF THE LITERATURE WITH A PRELIMINARY EXAMINATION OF NEW YORK'S SHORELINE

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illustrations by Grayson Jones

Part I. Landform Description

A. Introduction

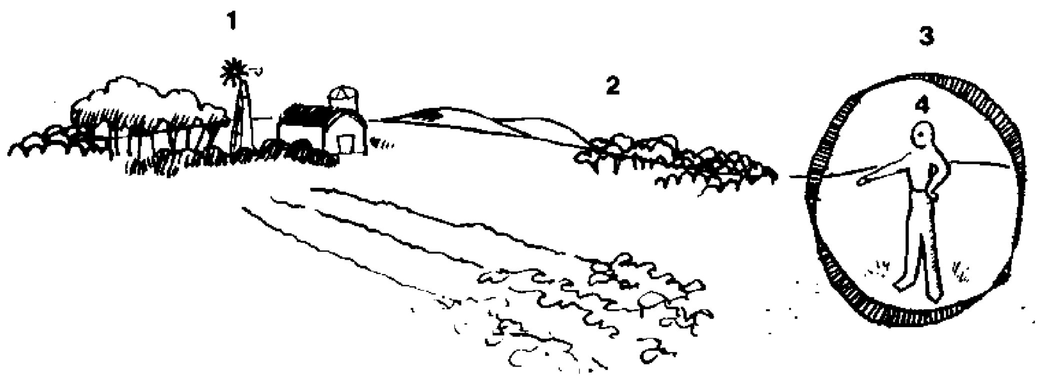
Linton has described scenery as "the form of the ground," and "the mantle of forests and moorlands, farms and factories, natural vegetation and human artifacts by which the hard rock body of the landscape is clothed" (Zube, 1974, p.35).

Scenic perception of a landscape involves the generation, transmission, and interpretation of a visual message. This process is illustrated in Figure 1.

Of these four perception elements, both landscape and visibility are strongly influenced by the form of the earth's surface. Therefore landscape visual quality analyses need a foundation of terrain description. A major difficulty in the field of visual quality assessment arises from the inherently personal character of view interpretations coupled with the absence of a common descriptive vocabulary. Many aesthetic terms may apply to the character of the earth's surface, for example, unity, variety, contrast, uniqueness, grain, and texture. These terms, by themselves, are relative abstractions that do not convey a discrete image. It is therefore highly desirable to develop terminology which conveys images

FIGURE 1

SCENIC PERCEPTION PROCESS



1. LANDSCAPE - a composition of natural and manmade forms
2. VISIBILITY - the physical view zone, and distance relationships between viewer and landscape
3. VIEWER ENVIRONMENT - the local surroundings, viewer mobility, and sequence of views
4. INTERPRETATION - the viewer's psychological analysis of a view's content and meaning

of the various forms that comprise landscape scenes.

B. A Review of Alternative Descriptive Approaches

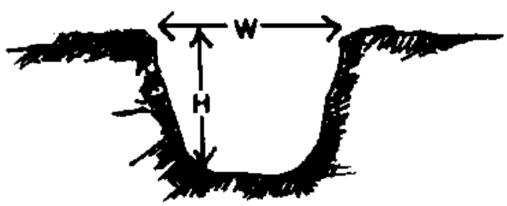
A literature review in the fields of physical geography and landscape assessment reveals a wide variety of analytical approaches to describing surface terrain. One way to categorize these techniques is from the standpoint of abstraction. Three general groupings based on degrees of abstraction can be differentiated: numerical indices, geometrical forms, and geomorphic origins.

1. Numerical. Numerical techniques are the most abstract methods utilized. Use of these techniques to describe terrain characteristics has gained widespread support in recent years because of their relative ease of application to extensive areas, and compatability with computerized data analysis. Military researchers have developed parametric approaches to terrain evaluation for planning large scale troop movements. The QREC (U. S. Army Quartermaster Research and Engineering Center), in a large regional study, utilized simple topographic map measurements such as elevation, slope, and number of divides to quickly group areas into twenty-five distinct terrain regions which contain similar surface characteristics (Mitchell,1973,p.81)

Numerical measures have recently been used in scenic analyses. "Landform has consistently been evaluated on the basis of relative relief--the greater the relative relief, the higher the scenic value" (Zube, 1974, p.39). Leopold, in his aesthetic comparison of river valleys, translated a wide spectrum of descriptions into a composite rating system. One of his prime measures was "landscape scale," which relates the height of adjacent mountains to the width of the valley floor. Numeric measurements thus are used as an indicator of topographic enclosure and contrast (Leopold, 1969, p. 275). Figure 2 illustrates this basic scale relationship.

FIGURE 2

VALLEY PROPORTIONS



Yosemite Valley Section

1:1½ Floor-Wall Proportions

Luray, Va.

15:1 Floor-Wall Proportions

(after Litton, p. 271)

Several researchers have undertaken statistical correlations between scenery dimensions and viewer reactions. Shafer took measurements from ground level photographs which portrayed actual views. Factors measured on the photographs included perimeters and areas of vegetation, nonvegetation, and water. Study results included linear equations relating photographic dimensions to scenic preference. (Schafer, et. al., 1969).

Zube, Pitt, and Anderson have related measurements from topographic maps to viewer reactions, both in the field and to photographs of the field scenes. Of the twenty-three scenic factors studied, seven were directly related to landform: relative relief ratio, absolute-relative relief, mean slope distribution, topographic texture, ruggedness number, spatial definition index, and mean elevation (Zube, Pitt, Anderson, 1974, p. 39).

These and related numerical methods hold great promise for advancing the rigor of scenic evaluation. However, by themselves, they inherently contain several difficulties.

> "The fundamental objection is a belief that landscape cannot be effectively valued by simply measuring and weighing components from a map or aerial photograph...problems arise in deciding on weighting...the landscape contributions of components do not increase in direct proportion to the amount of that component..." (Wallace, 1974, p. 302).

A second problem is the difficulty in conveying a clear mental image of the landscape via mathematical measures. Such an image is critical for communications, planning, and design. The process of numerical abstraction is at least partially irreversible. Geometric-based landscape descriptions help overcome this latter difficulty.

2. Geometric. Geometric descriptions of terrain are widely used by physical geographers. Earthforms include both hill projections and valley depressions. Three-dimensional hill form shapes can be classified as being hemi-spheroid (round), elipsoid (linear), or complex. It is often convenient, analytically and graphically, to project complex three-dimensional forms into two dimensions, plan view and cross

section. In cross section, hills can be classified as being concave, convex, or concave-convex. These generalized forms are shown in Figure 3.

Valleys have also been classified on the basis of geometric cross section and plan view configuration. An evolutionary generalization of valley cross section hypothesizes that initially "young" valleys are steep and "V" shaped. After an equilibrium stream profile is achieved, lateral erosion continues and the section shape is transformed to a rounded, and finally a broad "U". Valley sections can be symmetrical or assymmetrical. (Glaciation can also carve "U" valleys).

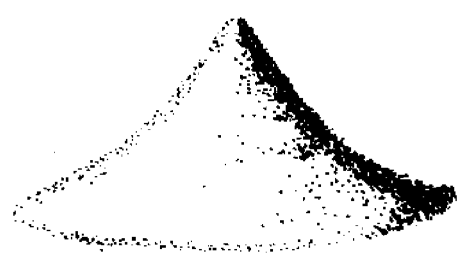
The plan view configuration of drainage patterns is an evolutionary function of geology, climate and stage of development. Way has illustrated sixteen basic patterns such as dendritic, rectangular, parallel, and radial (Way, 1973, p. 8). Horton applied numerical analysis to stream patterns, deriving such parameters as "drainage density" and "stream frequency" (Thornbury, 1969, p.123). An extensive exposition of this subject has been written by Haggett and Chorley (1970).

Cressey's Landform Map of New York State is typical of macro-descriptions based on prevalent topographic relief. A simplified version of this map is shown in Figure 4. Cressey's landform categories include: level plains, rolling plains, hills, rounded mountains, rugged mountains, and lakes (Thompson, 1966, p.49). The geometric terms are clarified by using numerical values for slope and local relief ranges. A similar mapping system has been completed for the entire North Atlantic watershed for the Corps of Engineers at a scale of 1"=40 miles (Research Planning and Design Associates, 1970).

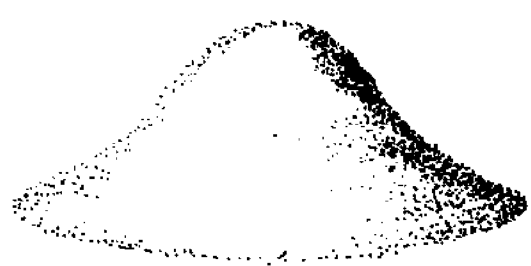
FIGURE 3

Generalized Hill Forms

convex



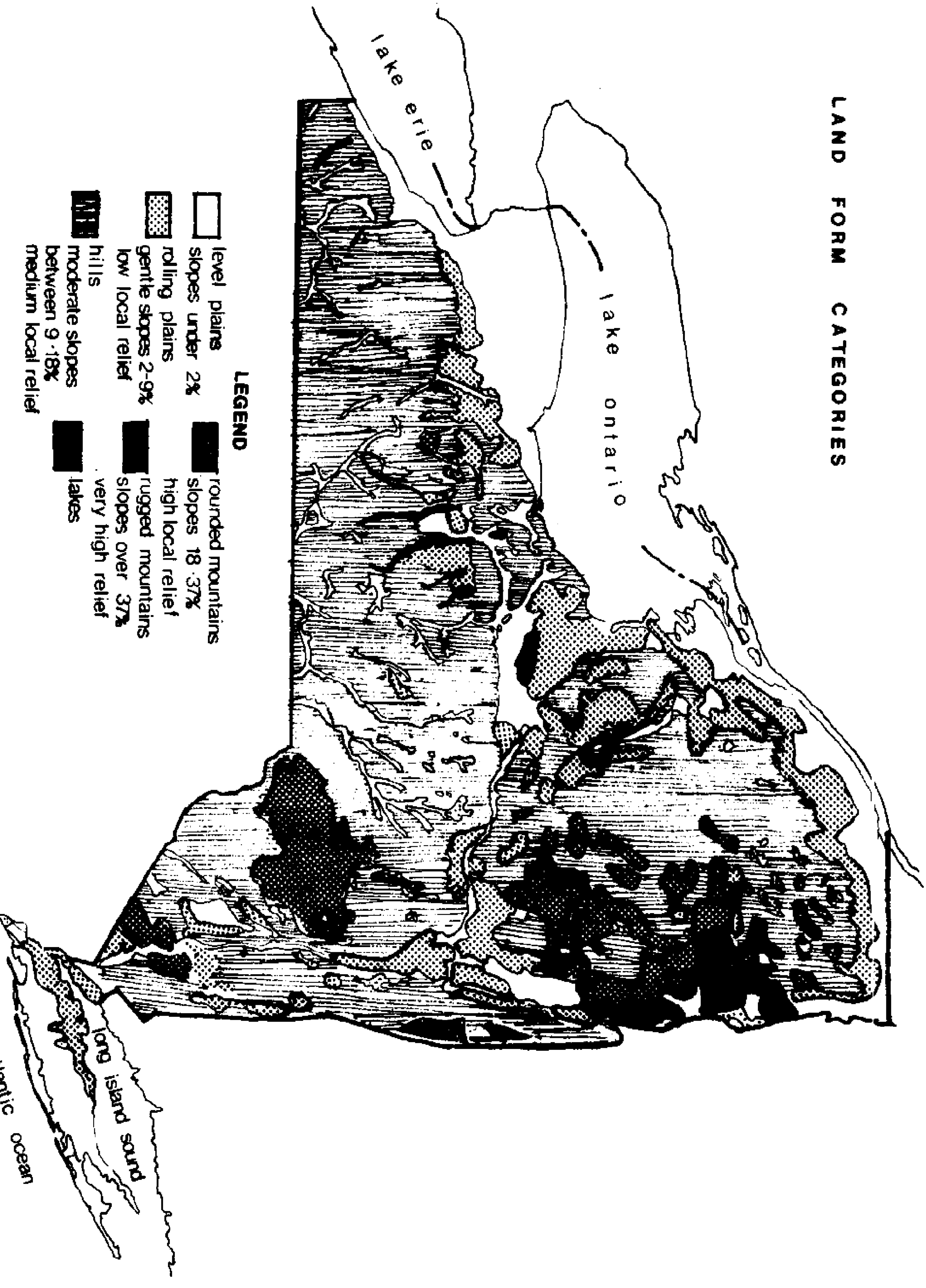
concave



concave-convex

(after Grietzer, 1944, p. 96)

FIGURE 4



(after Thompson, 1966, p. 48)

3. Geomorphic. In contrast to purely geometric descriptions, geomorphic classifications of terrain features combine form, evolution, and physical properties. Geomorphology is the "science of landform" (Thornbury, 1969, p.1). It is a branch of geology dealing with the many processes of erosion and deposition and how they have shaped the earth's surface throughout geologic time.

Belcher and Lueder pioneered in the use of aerial photographs to classify landforms for engineering and land planning decisions. Way has focused these methods on site development. He defines landform as follows:

> "...landforms are terrain features formed by natural processes which have definable composition and range of physical and visual characteristics that occur wherever the landform is found. Thus, specific distinctions can be made among landform units, by which to describe unique topography, composition or structure, or capabilities." (Way, 1973, p.2)

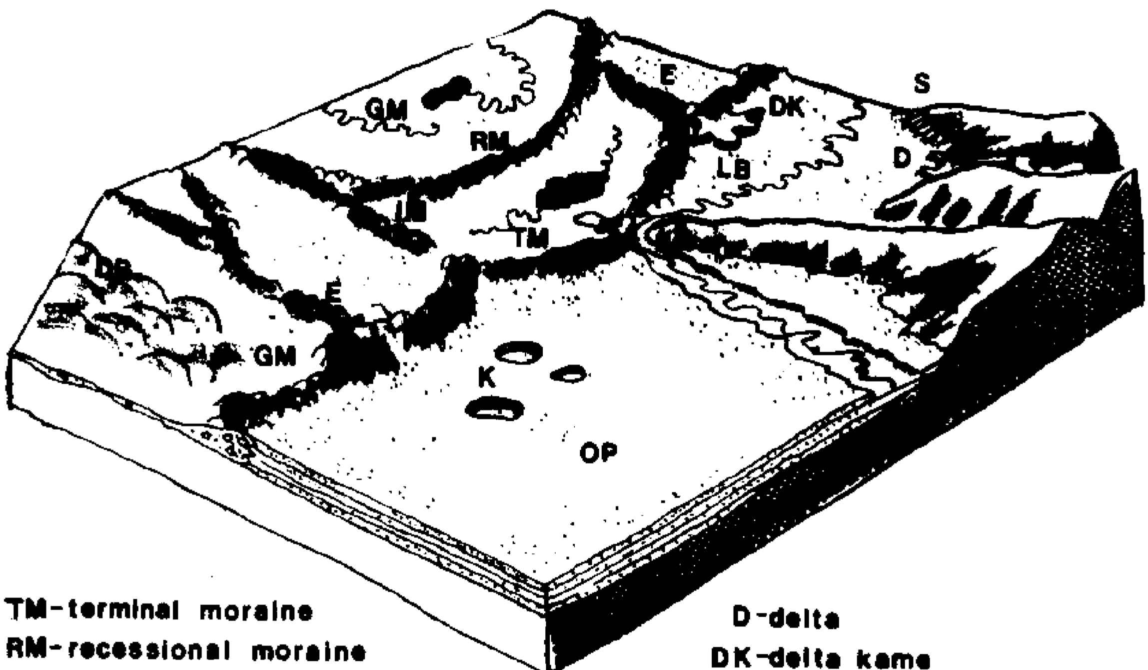
To illustrate geomorphic processes, the block diagram of Figure 5 depicts some of the landforms shaped at the margins of the continental glaciers.

Way identifies geomorphic forms on the basis of bedrock, climate, topography, drainage, vegetation, and land use patterns. For each type of bedrock, such as sedimentary, he reviews the type of soil associated with the various terrain features. General interpretations for development of landforms can then be made, including: sewage disposal, solid wastes, trenching, excavating and grading, construction materials, landslide susceptibility, ground water supply, pond construction, foundations, and highway construction.

Howlett and Felleman have incorporated the mapping of local landforms in the analysis of high voltage transmission line

FIGURE 5

GLACIAL MORAINE LANDFORMS



(after Strahler and Strahler, 1973, p. 444) routing and impact. As shown in Figure 6, the landforms served as a multipurpose basis for ranking local visual quality (contrast, uniqueness), for delineating the proposed facility's potential visiblility (skyline, water crossing...), and for anticipating construction and ecological difficulties (steep slope, marshes...) (Howlett and Felleman, 1973, p.4-2).

The geomorphic approach has the advantage of bridging the gap between description of visual forms and the behavioral characteristics of the terrain which is a necessary basis for land development decisions. Methods utilized in geomorphic classifications are more complex than those needed for numerical or geometric descriptions. Due to the uniqueness of local landform evolution the resultant analyses appear to pose problems for large scale planning generalizations.

C. Scale.

It is apparent that the scale of a visual analysis study area will, in part, influence the selection of a terrain description approach. For example, it would be very costly to delineate Way's detailed geomorphic landforms for an entire statewide study. The issue of scale is important because resource and planning studies often entail decisions, such as facility location and site design requiring varying levels of informational detail.

Researchers in geography and geomorphology have addressed this problem by developing nested hierarchies of terminology. These are analagous to the systems used in botanical taxonomy. One of the most comprehensive of such systems was proposed by Brink, et. al., for Australia. Table 1 summarizes his definition of "land units" (Mitchell, 1973, p.48).

FIGURE 6

ENVIRONMENTAL ROUTE LOCATION

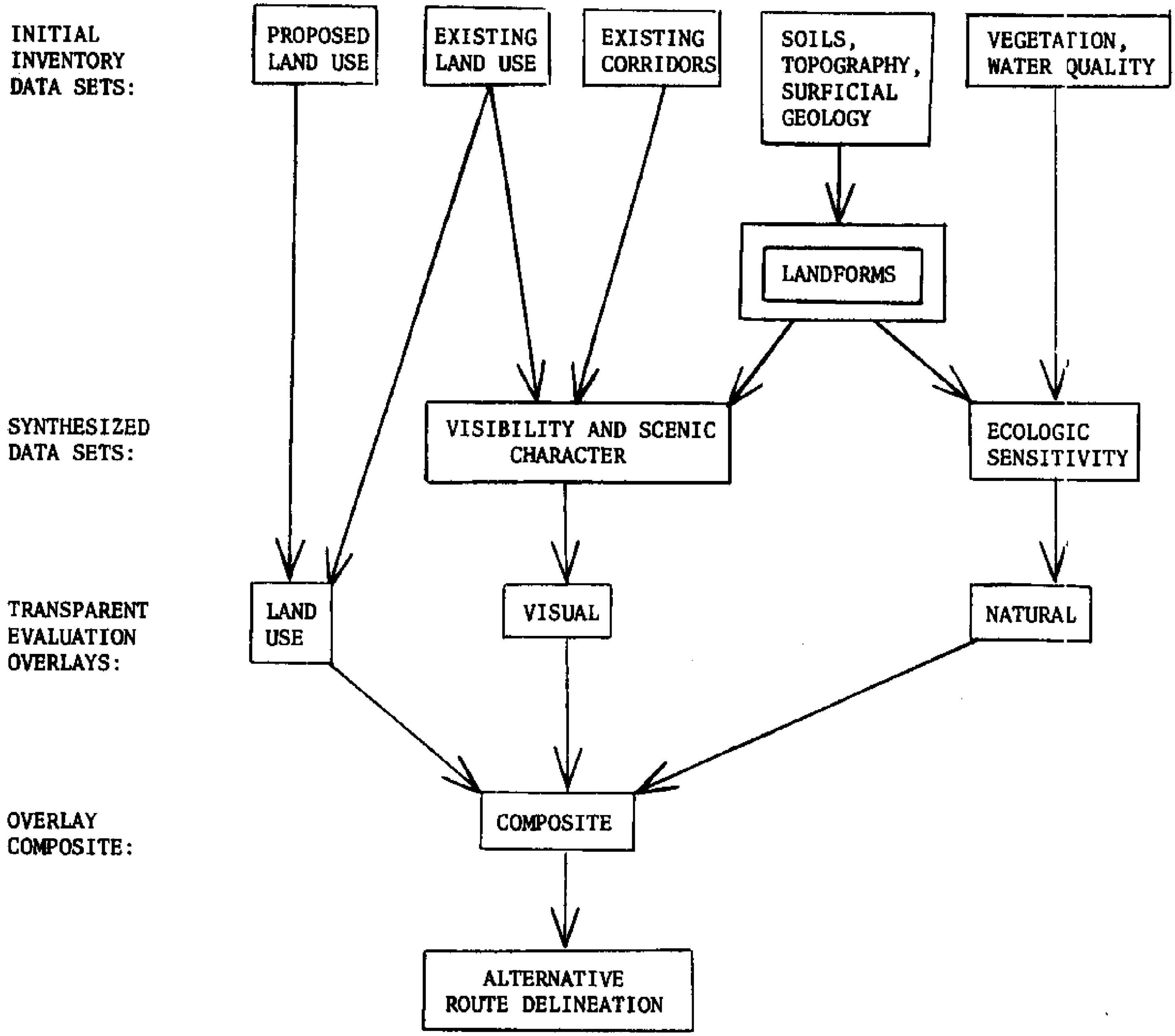


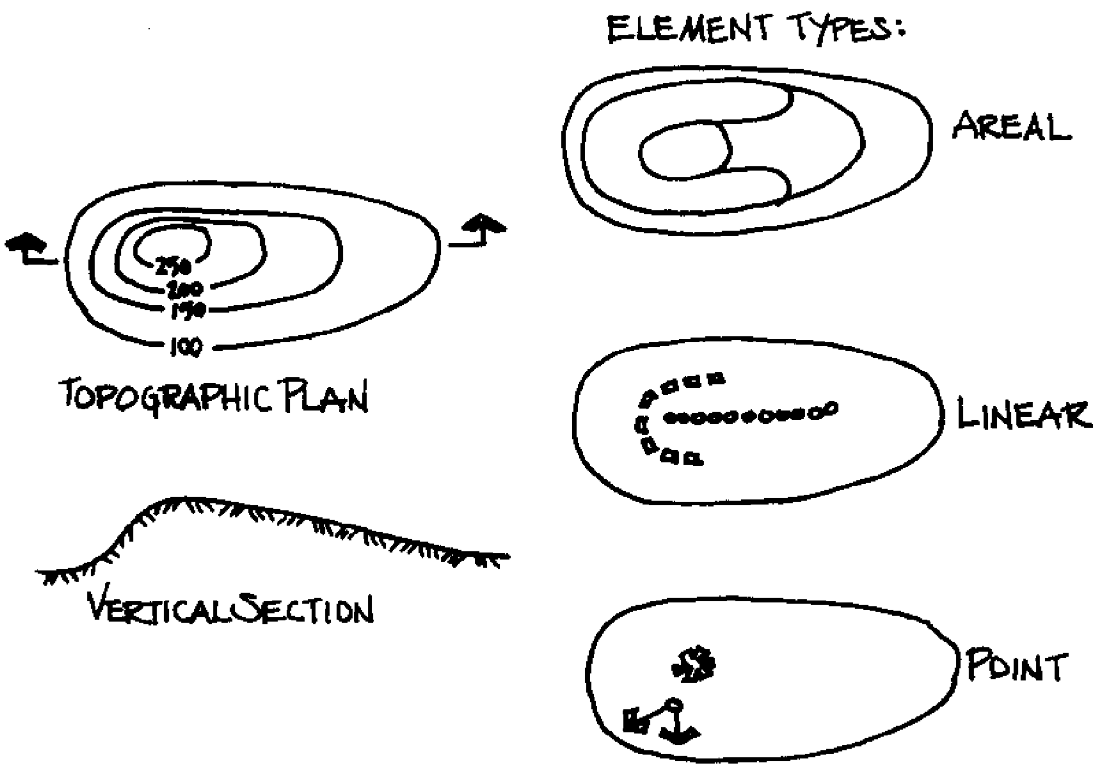
TABLE 1. LAND UNIT HIERARCHY

NAME	DESCRIPTION	SCALE
LAND ZONE	major climatic region	unspecified
LAND DIVISION	continental structure	1:15,000,000 (15m)
LAND PROVINCE	large assembly of forms	1:5m - 1:15m
LAND REGION	small range of surface forms having undergone comparable geomorphic evolution	1:1m - 1:5m
LAND SYSTEMS	recurrent pattern of land facets	1:250,000 - 1:1m
LAND FACET	one or more land element, part of a homogeneous landscape	1:10,000 - 1:80,00
LAND ELEMENT	simplest part of a landscape, uniform soil, form, vegetation	1:10,000

(after Mitchell, 1973, p.48)

By comparison, Cressey's "land form categories" of New York State (1:3,168,000) are roughly equivalent to Brink's "land regions" and the Strahlers' glacial landforms are similar to "land facets". Project design is usually carried out using detailed terrain information. An element can relate to areal, linear, or point features. The concept of "land element" is illustrated in Figure 7 with a longitudinal cross section through a drumlin landform.

FIGURE 7


ELEMENT TYPES:
AREAL
LINEAR
POINT
250
200
150
100
TOPOGRAPHIC PLAN
VERTICAL SECTION

Most aesthetic resource studies appear to utilize one to three scales of landform analysis. The N.A.R. (North Atlantic Region) work, cited above, incorporated two levels:

"landscape series" - large area, general impression;

"landscape systems" - series subdivision, dominant earth forms.

(Research, Planning and Design Associates, 1970)

The N.A.R. earthforms analysis at the "systems" level concentrated on: areal extent, contrast created by vertical relief, water-land interfaces, and character of spatial enclosure. The character of a prototypical coastal "landscape system" consisting of a linear shoreline with moderate sand bluff and coastal plain uplands is shown in Figure 8.

A second example of scale hierarchy is contained in the national Forest Service's Visual Management System. At a gross scale, the study defines 16 major physiographic areas in the Pacific Northwest. These areas are called "character types" with common vegetation and land, rock and water forms. At a finer scale, a further differentiation is made. For example, in the Western Cascades type, four "character subtypes" have been mapped: gorge lands, steep mountain lands, foothill lands, rolling plateau lands. Individual landforms and landform elements are the third scale of analysis. These local forms and elements comprise the actual landscape scenes which are perceived (U.S.D.A. Forest Service, 1972, Ch. 1, p. 5-9).

D. Study Implications

A clear approach to describing terrain features is a valuable step in developing a visual assessment method. There is no consensus on methods for articulating surface characteristics

FIGURE 8

SAND BEACH AND BLUFF

(after Research, Planning and Design Associates, 1970, p. N-74) or terminology for describing them. Tests of all three approaches: numerical, geometric, and geomorphic will be necessary to determine a practical means or combination of methods for defining visual terrain features of New York's coastline.

A visual assessment approach ideally is suitable for both area-wide activity allocation planning and local site design decisions. Therefore, it is necessary to establish a multitiered framework which aggregates characteristic groupings of similar features at the macro scale and utilizes individual landforms or sets of landforms at the local scale. The latter would be applicable to analysis of actual planning and design relating to landscape scenes.

Part II. Coastal Features

A. Coastal Dynamics

Physical geographers and geologists have long studied shore zone processes. This interest is due both to the importance of shores to man and to the complexity of coastal dynamics. Three sets of factors interact to generate natural coastal forms. These determinants include energy (changing sea levels, wind, waves...), shore zone material (stationary and moving), and the geometry of submerged and upland landforms (Pincus, 1959, p.123). In this century, the impact of man (filling, structures, dredging...) has constituted a fourth major shaping force.

The complexity of coastal geomorphology arises, in large part, from the relatively rapid (geological time) response to active forces. For example, Shepard and Wanless (1971, p. 64) have illustrated the dramatic changes in barrier island form and location following major tropical storms.

B. Coastal Landforms

Numerous classification approaches for coastal forms have been developed since Johnson's benchmark efforts in 1919. Some of these systems distinguish between shoreside uplands that are growing and those that are being diminished. Bird has illustrated prototypical coastal landform elements for two diverse sets of geomorphic situations: cliffed erosional, and depositional. These are shown in the cross sections of Figures 9A, B.

FIGURE 9A

EROSIONAL SHORELINE

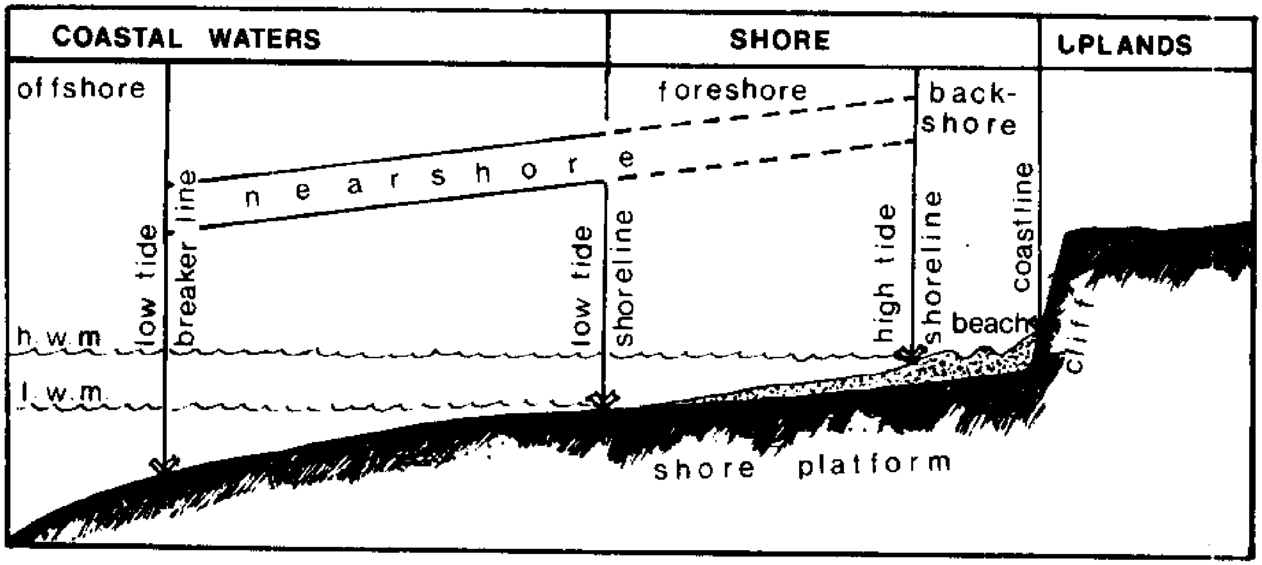
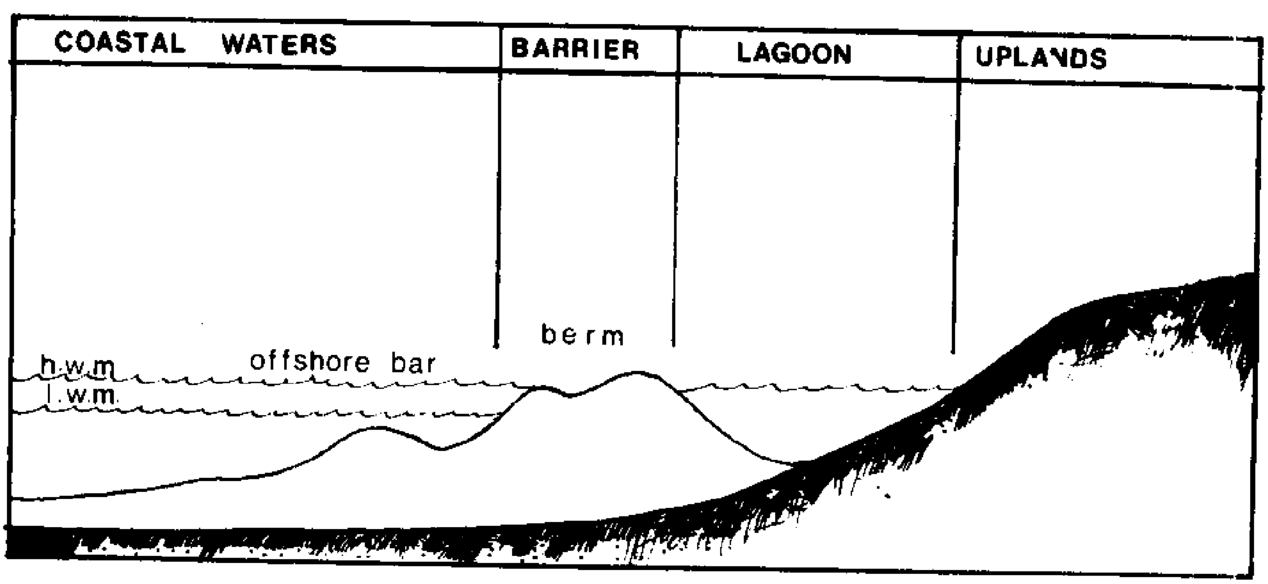


FIGURE 9B

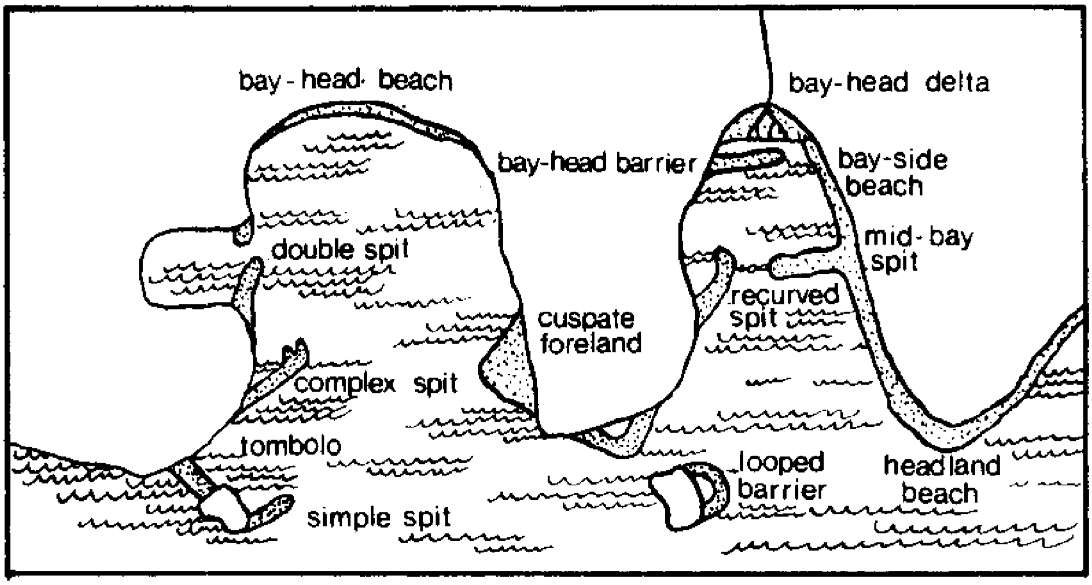
DEPOSITIONAL SHORELINE



(after Bird, 1969, p. 1)

Figure 9 depicts the general relationship of the water-land interface. However, it is in the plan view (aerial or map) that the great variety of coastal forms is revealed. Figure 10 illustrates one approach to the geomorphic classification of depositional features. These features affect our perception of shore areas by providing variety and spatial enclosure.

FIGURE 10



(after King, 1972, p. 503)

Shepard and Wanless (1971, pp. 551-561) have developed an extensive glossary of shoreline terms.*

C. A Review of Selected Studies

The shoretypes of the Great Lakes in Michigan and Wisconsin have been analyzed in small scale cross section to assist local governments and property owners in making efficient, environmentally sound development decisions (Zube and Dega Associates, 1964). Rather than typing landforms, these studies merely identify changes in section configuration and shoreline materials.

* The National Estuarine Pollution Study utilized a plan view "morphological classification" as shown in Appendix "D".

Figure 11 illustrates the Wisconsin Study output.

Pincus has researched the erosional characteristics of the Ohio shore of Lake Erie. His analysis, based on geology, soils, and air photo interpretations begins with classifying dominant shore features. The forms identified are listed in Table II.

TABLE II

Shoreline Types of Ohio's Lake Erie

I. Elongated, shallow, sandy bodies parallel to lake bottom contours

  a. Barrier Beach
  b. Barrier Island
  c. Barrier Spit
  d. Bay Spit
  e. Bay Barrier

II. Lowlands of silts and clays

  a. Lake Shore
  b. Bay Shore

III. Mouths of streams

  a. Drowned mouth
    1. flanked by lowlands
    2. flanked by cliffs
  b. Drowned bay
  c. Cut channel
  d. Manmade structures

IV. Bluffs

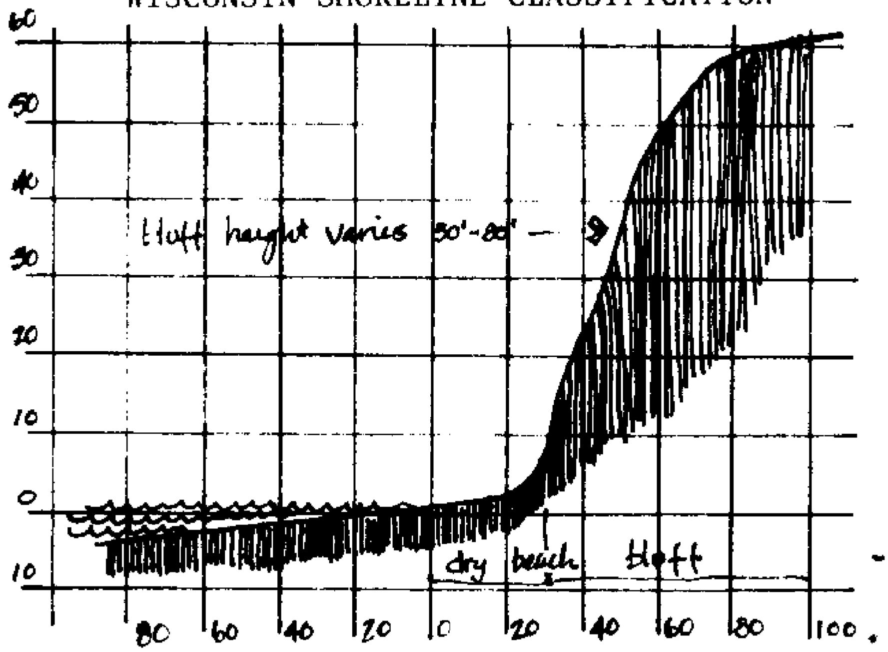
  a. Rock
    1. Dolomite, limestone
    2. Shale
  b. Surficial material
    1. Boulder clay
    2. Laclustrine

V. Artificial

(Pincus, 1962, p. 10-17)

FIGURE 11

WISCONSIN SHORELINE CLASSIFICATION



	WET BEACH	DRY BEACH	BLUFF	UPLAND
MATERIAL	sand to 50' then gravel/boulders to shoreline	sand / gravel with stretches of sand	clay	clay
WIDTH	100 ft out to 6 ft depth	30-60 feet		
SLOPE		4-6%	80-100%	rolling to steep at drainage areas
VEGETATION		none	birch, aspen, hazel white spruce, in erosion free areas	birch, aspen, hazel white spruce maple
WATER	clear			
EROSION			erosion-serious where vegetation and small sand-stone pockets are absent vegetation temporary	
HEIGHT			varies from 30 to 80 ft	
USE				

(after Zube and Dega Associates, 1964)

Although not intended as a visual analysis, the Pincus study demonstrates the multipurpose usefulness of a rigorous geomorphic landform data base.

The U. S. Army Corps of Engineers has comprehensively inventoried and assessed the nation's shorelines (Atlantic, Carribean, Gulf, Lower Mississippi, Pacific, Alaska, and Hawaii.) The congressionally authorized National Shoreline Study, completed in 1973, includes regional inventories, shore protection guidelines and shore management guidelines.

The inventories are designed to classify erosion-related problems; however, much of the information is visually related. Maps at a scale of 1" = 15 miles (approximately $1:1 \times 10^6$) were developed for three data sets: "Shoreland Uses" (9 categories), "Environmental Values, Water Intakes and Waste Outfalls" (8 categories), and "Physical Description, Ownership, and Erosion and Flooding Problem Reaches" (22 categories). An example of the Study maps and their legends are contained in Appendix A.

Each of the map sets contains factors which influence visual quality. The urbanized land uses are aggregated with Corps-related activities such as power plants and public beaches specified. "Environmental Values" include both habitat categories, "Unique" areas, "Outstanding" areas, and potential recreation sites. The Physical Descriptions are mapped by fine grained reaches (see Appendix C for illustration), and include beach and bluff information. The former contains three categories based on material: sand and gravel, large rock, and no beach. Shoretypes (upland edge) are grouped into four classes by vertical scale: bluff over 30 feet high, bluff under 30 feet high, low plain and marsh.

Material subcategories include erodible, non-erodible, and sand dune.

Studies of coastal aesthetics are only recently emerging as important inputs to land use decisions. Litton's "Visual Landscape Units of the Lake Tahoe Region," in Scenic Analysis of the Lake Tahoe Region (South Lake Tahoe, Calif.: Tahoe Regional Planning Agency and U. S. Forest Service, 1971); Looking at the Vineyard: A Visual Study for a Changing Island; and the Environmental Report for the Arizona Station Transmission System are more recent examples of visual inputs to land use planning and decision-making.

The N. A. R. study, referred to previously, included visual contrast as a major determinant of visual quality. Table III contains the study's relative generalizations of the large scale scenic shorefront regions:

TABLE III

N.A.R. Coastal Scenery Evaluations

Location	Character	Internal Contrast	Spatial Variety, Enclosure
Eastern Maine	Embayed, rocky	High	High
Central New England	Linear, rocky	Medium	Medium
Southern New England	Sand Beach-Bluff	Low	Low
Mid-Atlantic	Horizontal Sand Bar - Marsh	Low	Low
Urban	---------------	-----	-----

(Research Planning and Design Associates, 1970)

One of the most comprehensive scenic analyses of a U. S. coast has recently been completed for Long Island Sound by Roy Mann Associates, Inc. (1975). The study was undertaken for the National Park Service and the New England River Basins Commission (N.E.R.B.C.).

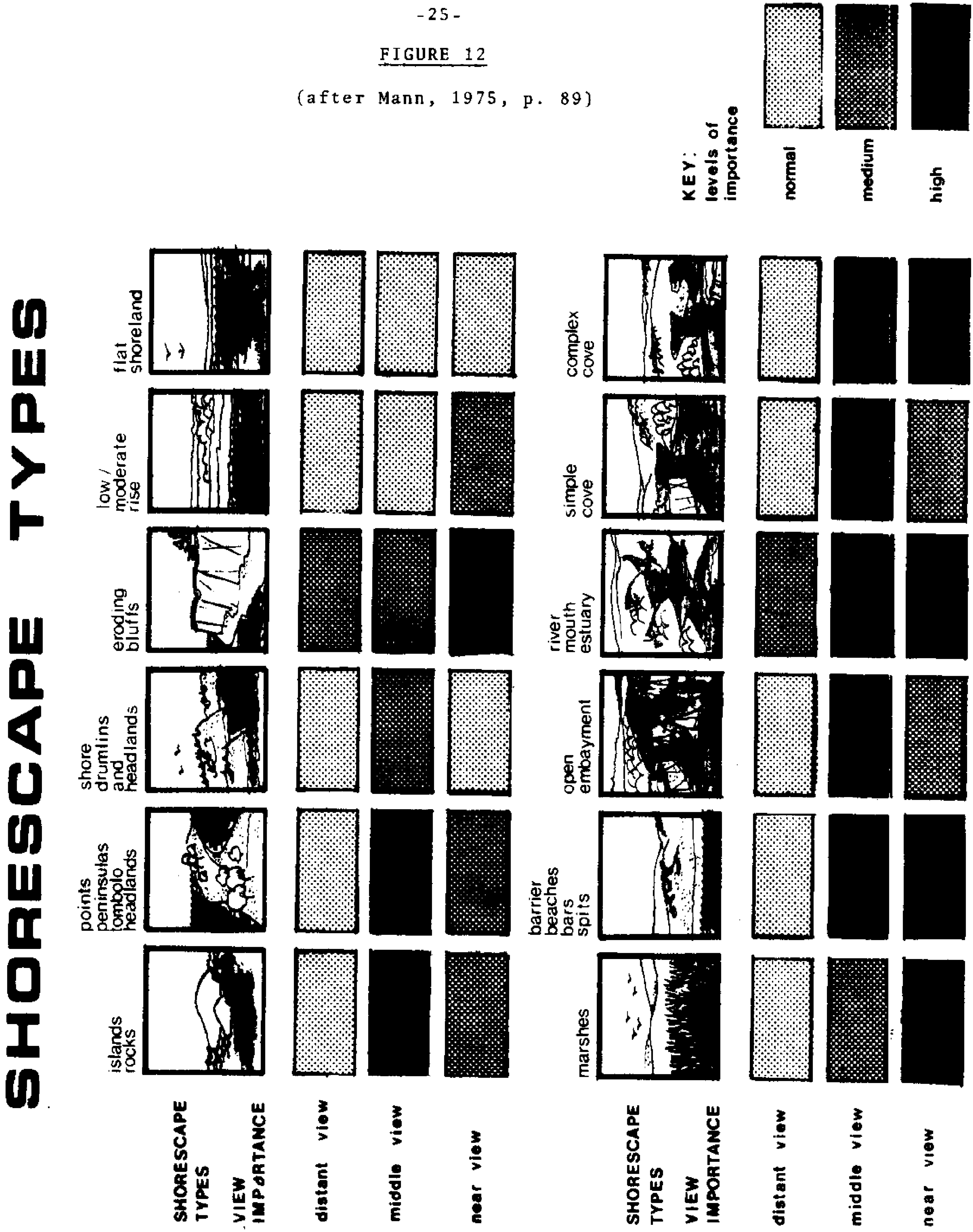
In an interim report, the Commission identified three shore zone cross sectional types: flatland, rise, bluff; and three plan view shore configurations: straight, projecting seaward, and projecting inland. These simple shapes result in nine possible three-dimentional combinations (N.E.R.B.C., 1974, p. 8,9).

The Mann report deals with the subject in much greater depth. Topographic complexity, shoreline complexity, and uniqueness are just three of eighteen natural and manmade criteria that were assessed (methodology unspecified) (Mann, 1975, p. 42). Utilizing the fact that much of the Sound's coast consists of submerged upland hills, the study uses "headlands" (shoreline high points) to delineate "shorescape units" between protruding headlands. The scale of these units, averaging one to two miles, coincides well with an individual's fore- and mid-ground visual perception zone. Adjacent shorescape units of similar character or between major headlands are aggregated into 40 "coastal reaches" (Mann, 1975, p. 45, 46).

The Mann study does not 'identify' individual landforms. The study utilizes twelve prototypical "shorescape types" which consist of adjacent, visually reinforcing landforms and landform elements. These are illustrated in Figure 12. Also depicted are the study's conclusions regarding the visual distance at which each type is aesthetically important. Shore views

FIGURE 12

(after Mann, 1975, p. 89)



were analyzed primarily from a boater's position (methodology unspecified).

D. Study Implications

The complexity of natural shoreline development processes has led to a variety of dynamic coastal land and water features. In developing a visual assessment approach for New York's shorelines, a nested hierarchy of scales will be necessary. Initial large scale groupings can be made on the basis of dominant topographic features and shoreline configurations. Sampling and testing of methods described in Part One will be necessary to ensure that shore zone features are clearly differentiated and communicated. The use of geomorphic terms is desirable where feasible to provide a linkage to related erosional and land development analyses. A comprehensive system must include offshore, beach, bluff and upland components. In addition, embayment-enclosure relationships must be analyzed.

Part III. New York's Sea Grant Shoreline

A. Geologic Development

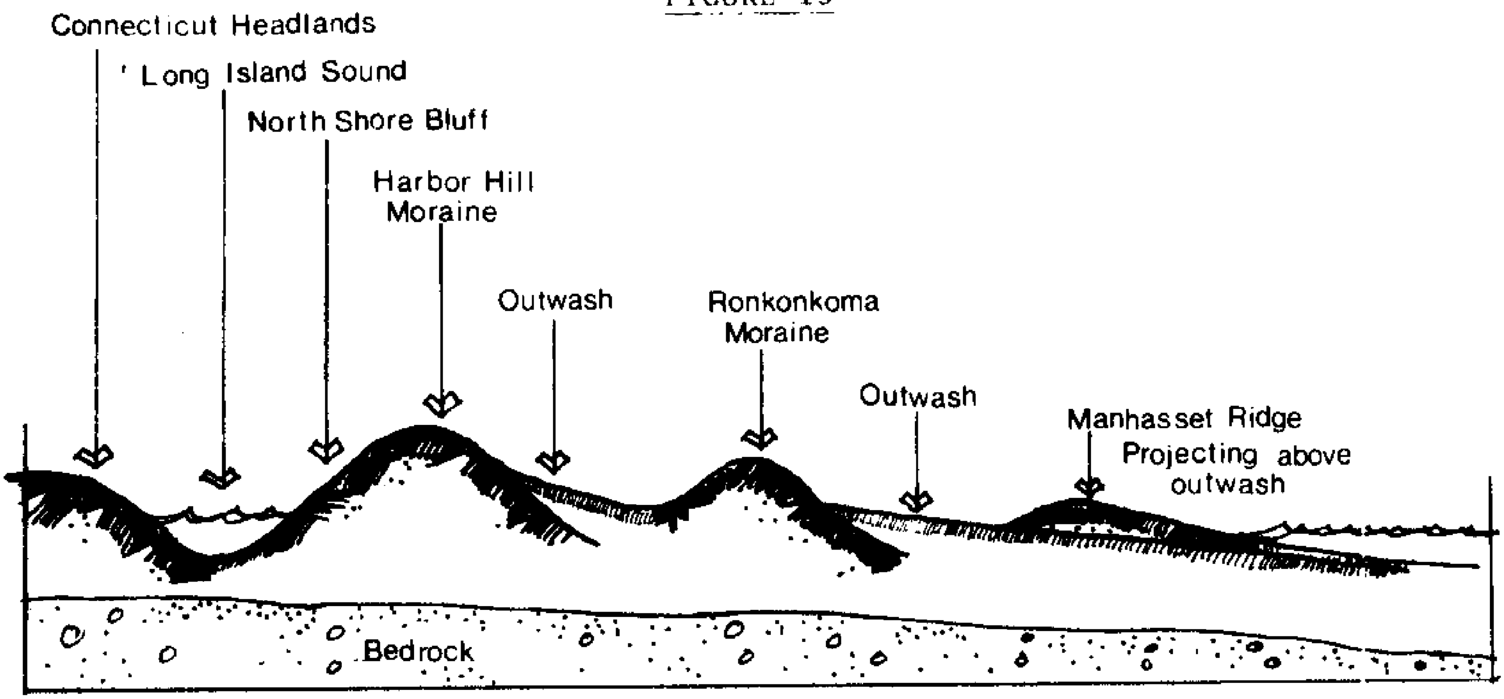
New York is unique among the Sea Grant states in having both Great Lakes and Atlantic Coast shoreline. In addition, Long Island is the largest island adjoining the continental United States. Glaciation was the most recent geologic influence in the evolution of the Lake Erie, Lake Ontario, and Long Island Sound coasts. An excellent history of the evolution of the Great Lakes has been written and illustrated by Hough (1958).

A quick overview of the shoreline utilizing Figure 4 reveals the contrast fo the study area. The Erie-Ontario lowlands bordering the present lakes and stretching from the Pennsylvania border to just west of Sodus Bay were previously featureless glacial lake bottom. Uplift and subsequent erosion have produced local drainage features. The Niagara River and Falls represent one of the outstanding natural features in the world.

Continuing east along the Lake Ontario shore, Cressey has identified three distinct upland landform regions. The Ontario Drumlins area is dominated by elongated glacial hills. The shoreline appearance of these unique features was described in detail by Slater in 1929. The Ontario Ridge and Swamplands area is east of Oswego. It is characterized by ground moraine ridges interspersed with poorly drained marshes. The Eastern Ontario Hills area consists of low glacial drift hills. The shoreline contains extended sand dune areas (Thompson, 1966, p. 26, 34; Long, 1954). The Thousand Island region, lying at the entrance to the St. Lawrence River is an area of unique scenery and recreational opportunity.

New York's marine coast has an equally diverse history. Four successive glaciers covered New York and New England. The third reached as far south as the northern shore of Long Island, while the fourth created the Ronkonkoma terminal moraine ridge. This ridge parallels the east-west axis of Long Island and projects as much as 200 feet above the adjacent plateau (Thompson, 1966, p. 43). Glacial outwash provided the sediments which the Atlantic has shaped along the Island's south shore. A cross-section of Long Island's upland form is shown in Figure 13

FIGURE 13



(Thompson, 1966, p. 43; Mann, 1975, p. 7)

As the glaciers melted, sea waters rose, creating a shoreline of submerged upland features of New England and Westchester County. Offshore islands occur along the Westchester and Eastern Long Island Coasts. Wind and wave forces continue to modify the coast, particularly the bluffs of the Island's north shore and the dune and unique barrier island, such as Fire Island, formations of the south shore. The latter has undergone extensive analysis by the Corps of Engineers. A brief but lucid description of the geologic development of the Westchester, New York City, and Long Island shores is contained in Mann (1975, p. 7-9), and Shepard and Wanless (1971, p. 8-9, 29-66).

B. Shorescape Provinces

The review of previous shoreline and aesthetic studies found that except for the National Shoreline Study noted previously, there has been no statewide physiographic analysis of New York's shoreline. Therefore, the first efforts of the Sea Grant research group were focused on the preliminary delineation of large scale shoreline analysis units containing similar physiographic characteristics. These are called "Shorescape Provinces".

Five statewide data sources were used in establishing the initial boundaries of the shorescape provinces. As discussed above, Cressey has mapped "Landform Regions" and "Landform Categories". It was concluded during the analysis that his gross map units were oriented toward the interpretation of upland rather than coastal characteristics, and that the upland formations did not consistently correspond to readily discernible changes in shore character. The Geologic Map of New York and the Soil Association Map of New York were used to establish broad zones of common parent and surficial materials.

By simultaneous inspection of these initial four sources, the State's coasts were divided into 19 potential shorescape provinces. Each 7½ minute (1" = 2000') U. S. G. S. quadrangle sheet for the entire shore was then examined sequentially to visually establish the similarity of small scale coastal features within provinces, and to ascertain differences in features between provinces. The product of this comparison was the delineation of nineteen shorescape provinces. These are shown in Figure 14. Appendix B contains a listing of which U. S. G. S. quadrangle sheets are included in each province. Table IV contains a brief characterization of each province as identified in selected study sites.

FIGURE 14

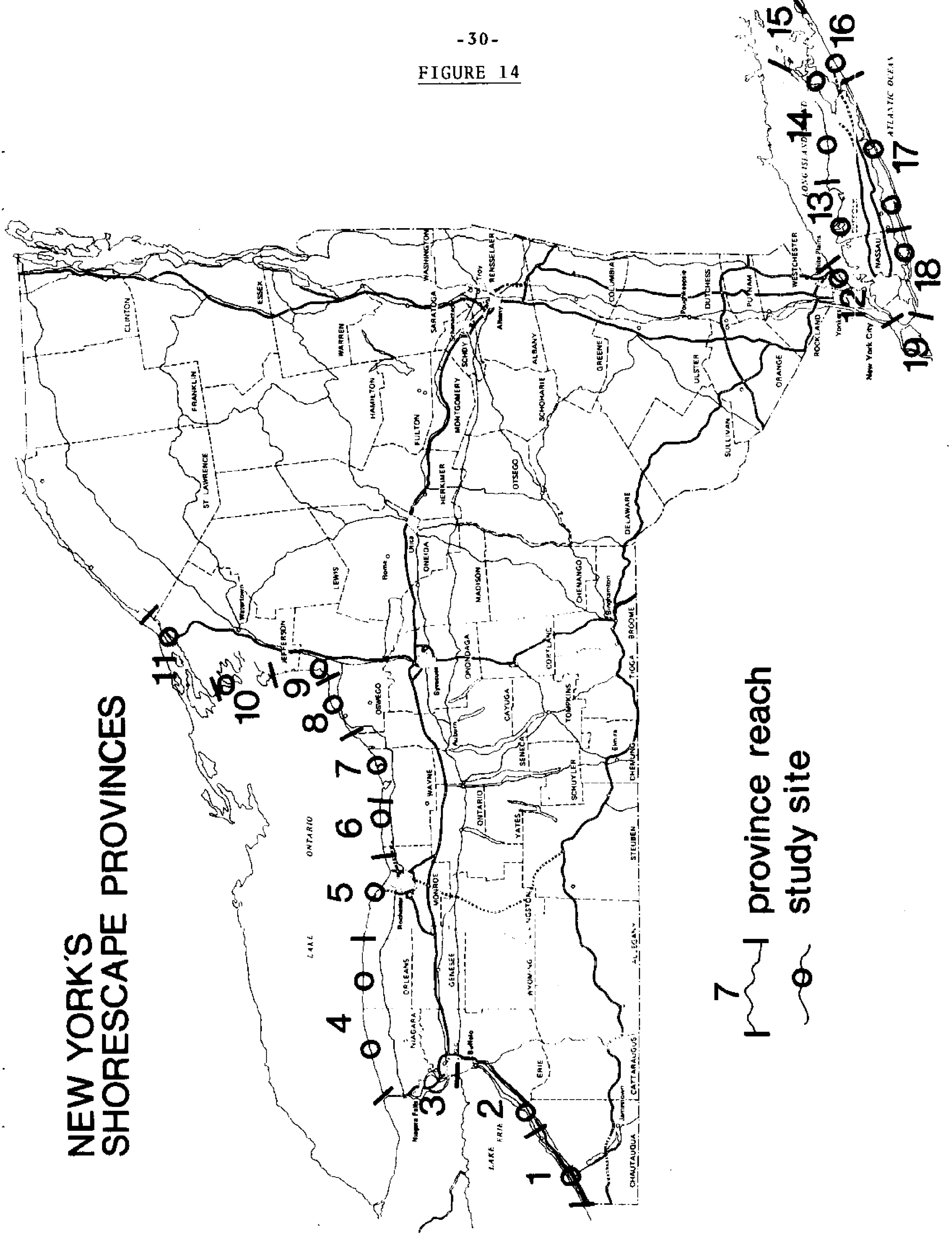

NEW YORK'S
SHORESCAPE PROVINCES
province reach
study site
LAKE ONTARIO
LAKE ERIE
LONG ISLAND
ATLANTIC OCEAN
New York City
Buffalo
Rochester
Syracuse
Albany
Utica
Binghamton
Watertown

TABLE IV

Study Site Characteristics

Shorescape Province		U.S.G.S. Quad(s)	Offshore	Shore Edge	Bluff	Upland
Great Lakes	1.	Westfield	--------	Linear	70' Rock	Lake Plain
	2.	Silver Creek	--------	Slight Embayment	None	Lake Plain
	3.	(not analysed)				
	4.	Wilson; Ashwood	--------	Linear	20' Rock	Lake Plain
	5.	Braddock Hts.	--------	Closed Bays, Marshes	None	Gentle Hills
	6.	Pultneyville	--------	Slight Embayment	20'	Gentle Hills
	7.	North Wolcott	--------	Enclosed Bays, Marsh	100' Drumlin	Drumlin
	8.	West of Texas; Oswego East	--------	Slight Embayments	None	Gentle Hills
	9.	Pulaski	--------	Linear Bar, Enclosed Bays, Marshes	None	Gentle Hills
	10.	Cape Vincent	--------	Embayments	None	Gentle Plain
	11.	Alexandria Bay	Thousand Islands	Small Bays	None	Gentle Hills
Marine	12.	Mamaroneck	Rock Islands	Complex Bays	None	Gentle Hills
	13.	Lloyd Harbor	Islands, Shoals	Large Embayments	some 100'	Gentle Hills
	14.	Wading River	Rocks	Linear Beach	120'	Marine Plain
	15.	Southold	Islands	Bays, Bars	None	Marine Plain
	16.	Sag Harbor	--------	Linear, Closed Bays	None	Marine Plain
	17.	Howells Point Bayshore East	Barrier Is.	Linear	None	Marine Plain
	18.	Jones Inlet Freeport	Barrier Island	Bay Marsh	None	Marine Plain
	19.	(not analysed)				

C. Shoreforms

Because the Sea Grant visual quality research is aimed at developing assessment methods with broad applicability, a sampling approach was needed that would efficiently identify the terrain characteristics of scenes which occur along the shore. Random sampling techniques could potentially provide typical scenes but did not appear directly useful in establishing a spectrum of geomorphic visual features. Therefore, the U.S.G.S. quadrangle sheets were assembled for each shorescape region and, by visual inspection, a subarea within each region was selected as containing a diverse, representative set of local features. This approach is analagous to the Forest Service's establishment of "distinctive" and "common" variety classes (U.S.D.A. Forest Service, 1974, Ch. 1, p. 12). The Forest Service rationale was to provide a comparative base within a region for relative visual quality evaluations. Zube, Pitt, et al. (1974) in their Connecticut Valley Study, also "select (studysites)...from each of the major physiographic provinces..." (p. 19)

For convenience, delineation of the local geometric and geomorphic land and water features was done directly from the topographic quadrangle sheets.* These features are called "shoreforms". For each local study area, a grid of half-mile by one-mile cells was overlaid on the topographic maps. The standard grid was four miles wide paralleling the major axis of the shore and extended two miles inland. (Figure 15A). This size was

*A more comprehensive approach would utilize Soil Conservation Service soil surveys, stereo aerial photographs, the New York State L.U.N.R. interpretations, and field checks.

FIGURE 15A

FIGURE 15B

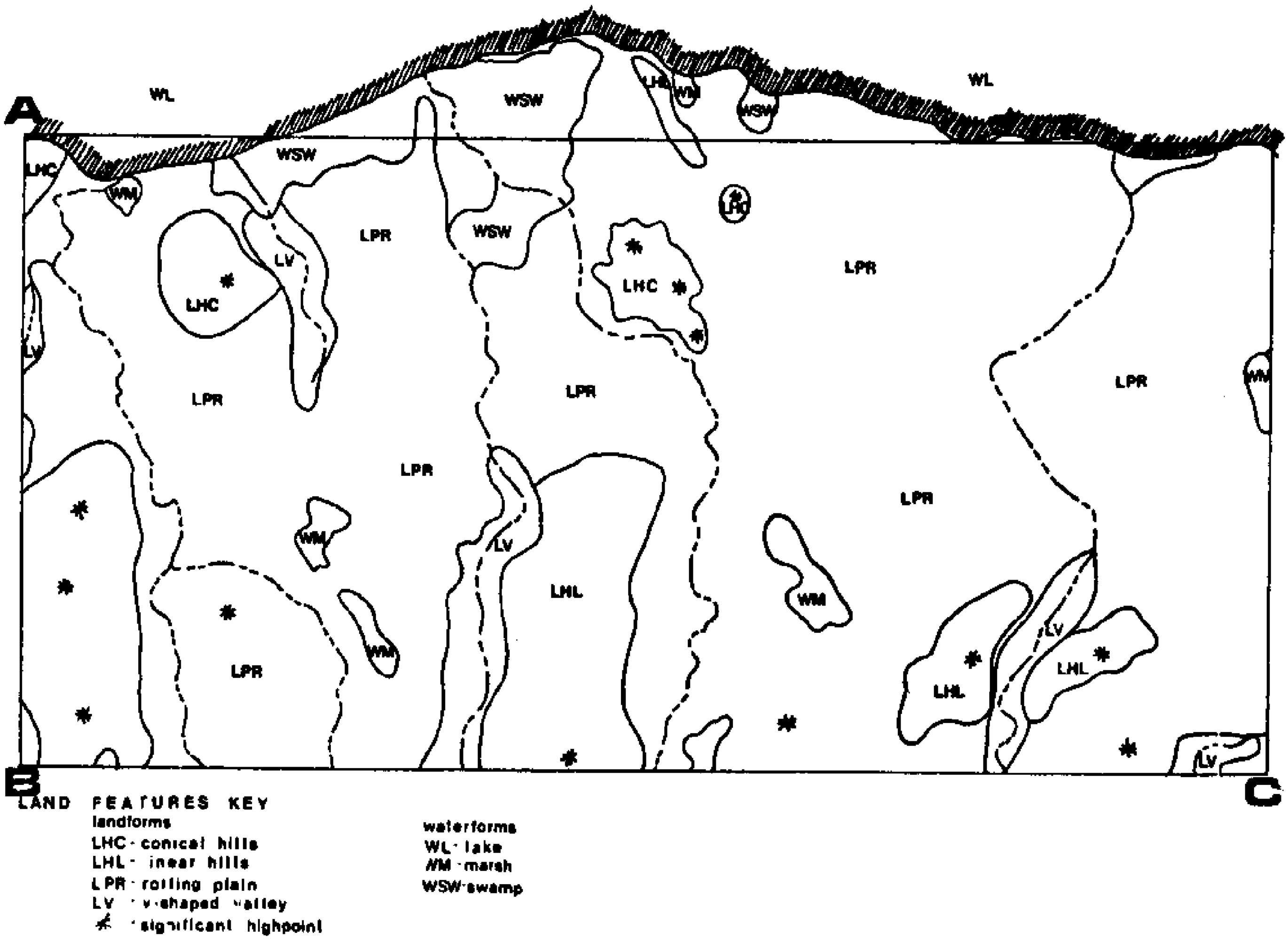
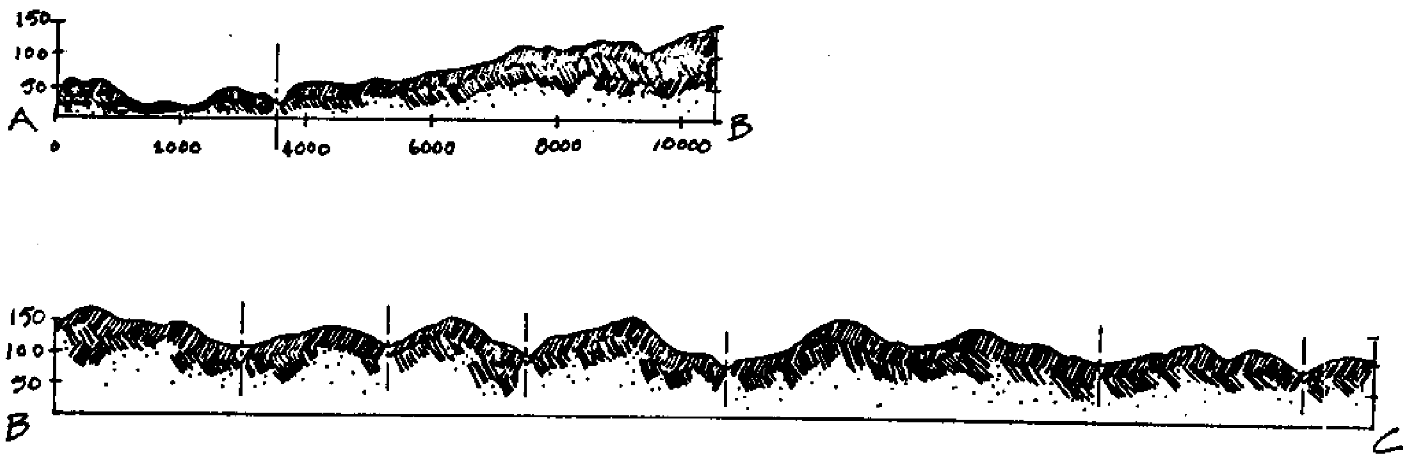


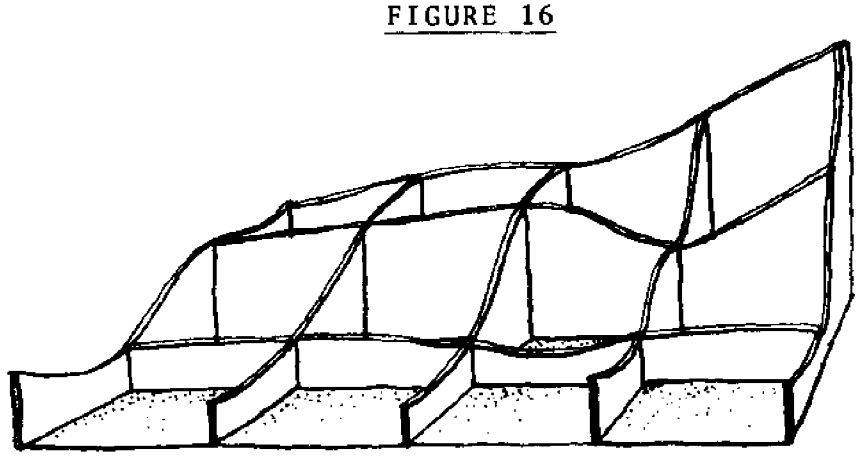
FIGURE 15C



selected to efficiently limit the number of sections developed and to coincide with the general limits of midground visual perception (one-half to three or five miles) in which local forms are readily discernible (Litton, 1968, p. 4). (It is interesting to note the 2x4 mile area is of the same magnitude as Mann Associates' "shorescape units".) In some instances, the grid was extended to encompass an entire shoreform.

Shoreforms were delineated on transparent overlays. Appendix C contains a preliminary list of shoreforms identified in the initial analysis. To assist the analysis of topographic relief and potential visibility, exaggerated cross sections at a scale of 1" = 2,000' horizontal, and 1" = 200' vertical were constructed along each grid line. The exaggeration is needed because of the relatively large map scale and the low upland relief which characterizes New York's shoreline.* An example shoreform map and sections are shown in Figures 15B&C. Collectively, the gridded cross sections comprise an "egg crate" relief model, which illustrates the major spatial relationships between shoreforms. This concept is depicted in Figure 16.

FIGURE 16



*The maximum local relief depicted on U.S.G.S. maps is 200' to 250'.

Recognizing the visual significance of the water's edge, an additional cross-sectional analysis was undertaken for each local study area. A grid section perpendicular to the shore with high relative relief was selected, and an exaggerated section 1" = 80' horizontal, and 1" = 40' vertical was constructed. These shore edge sections illustrate Bird's geomorphic relationships. In addition, they provide the analyst with a comparative framework with shore edge inventories previously completed for Michigan and Wisconsin's Great Lakes.

D. Preliminary Findings

The review of existing landform description and evaluation techniques has led to the establishment of tentative shorescape provinces for New York's coastline. Using topographic map interpretation, a variety of shoreforms have been identified within local study areas that were selected on the basis of terrain diversity. Once identified, shoreforms could subsequently be combined with urban pattern analyses to fully describe the State's shorescapes.

New York State's coast is typified by relatively low, vertical relief. The cross section analysis has established that visibility of the shore from the uplands is frequently quite limited. However, the diversity of local forms coupled with the undulations of the water's edge create a broad spectrum of perceptual experiences. Further analysis will be necessary to clearly establish a comprehensive set of criteria describing shore edge configuration and for delineating a zone of visual influence for the shore.

Part IV. Future Research Needs

A variety of additional research needs can be identified.

1. Development and testing of numerical, geometric, and geomorphic description methods.
2. Acquisition and analysis of low altitude oblique aerial photography to depict shoreforms.
3. Development of an illustrated glossary of shoreform terminology.
4. Combination of shoreforms into representative shorescape scenes based on field studies.
5. Development of urban pattern analysis to be combined with the natural feature descriptions.
6. Analyze visibility delineation techniques.
7. Field check the above.
8. Relate scenery description to perception and evaluation by major user groups.

APPENDIX A

U. S. Army Corps of Engineers' National Shoreline Study Inventory Example (1973, Vol. V, pp. 214, 213)

LEGEND

SHORELAND USES

- Commercial, Industrial, Residential and Public Buildings
- Recreational and Urban Open Space
- Agricultural and Undeveloped
- Forest
- Public Beaches — (B)
- Commercial Deep Draft Harbors — C
- Recreational Harbors — R
- Commercial Deep Draft and Recreational Harbors — C/R
- Electric Power Stations — P

ENVIRONMENTAL VALUES, WATER INTAKES AND WASTE OUTFALLS

- Significant Fish and Wildlife Values
- Unique Ecological or Natural Areas
- Outstanding Shoreland Areas of Possible National Interest
- Potential Recreation Sites

Waste Water Outfalls and Intakes

- Public Outfalls
- Public Intakes
- Private Outfalls
- Private Intakes

PHYSICAL DESCRIPTION, OWNERSHIP, AND EROSION AND FLOODING PROBLEM REACHES

- Federal Lands
- Non-Federal Public Lands
- Private Lands

Shore type

- Artificial Fill Area — A
- Erodible High Bluff, 30 ft. or higher — HB_E
- Non-Erodible High Bluff, 30 ft. or higher — HB_N
- Erodible Low Bluff, less than 30 ft. high — LB_E
- Non-Erodible Low Bluff, less than 30 ft. high — LB_N
- High Sand Dune, 30 ft. or higher — HD
- Low Sand Dune, less than 30 ft. high — LD
- Erodible Low Plain — P_E
- Non-Erodible Low Plain — P_N
- Wetlands — W

Combinations Shown As: — Example

- Lakeward/Landward — W/P_E
- Upper Bluff Material / Lower Bluff Material — $\frac{HB_E}{HB_N}$

Beach Material

- Sand and gravel
- Ledge rock
- No Beach

Problem Identification

- Areas subject to erosion generally protected
- Critical erosion areas not protected
- Non-critical erosion areas not protected
- Shoreline subject to lake flooding
- Shoreline not subject to erosion or flooding
- Bluff seepage problems — S

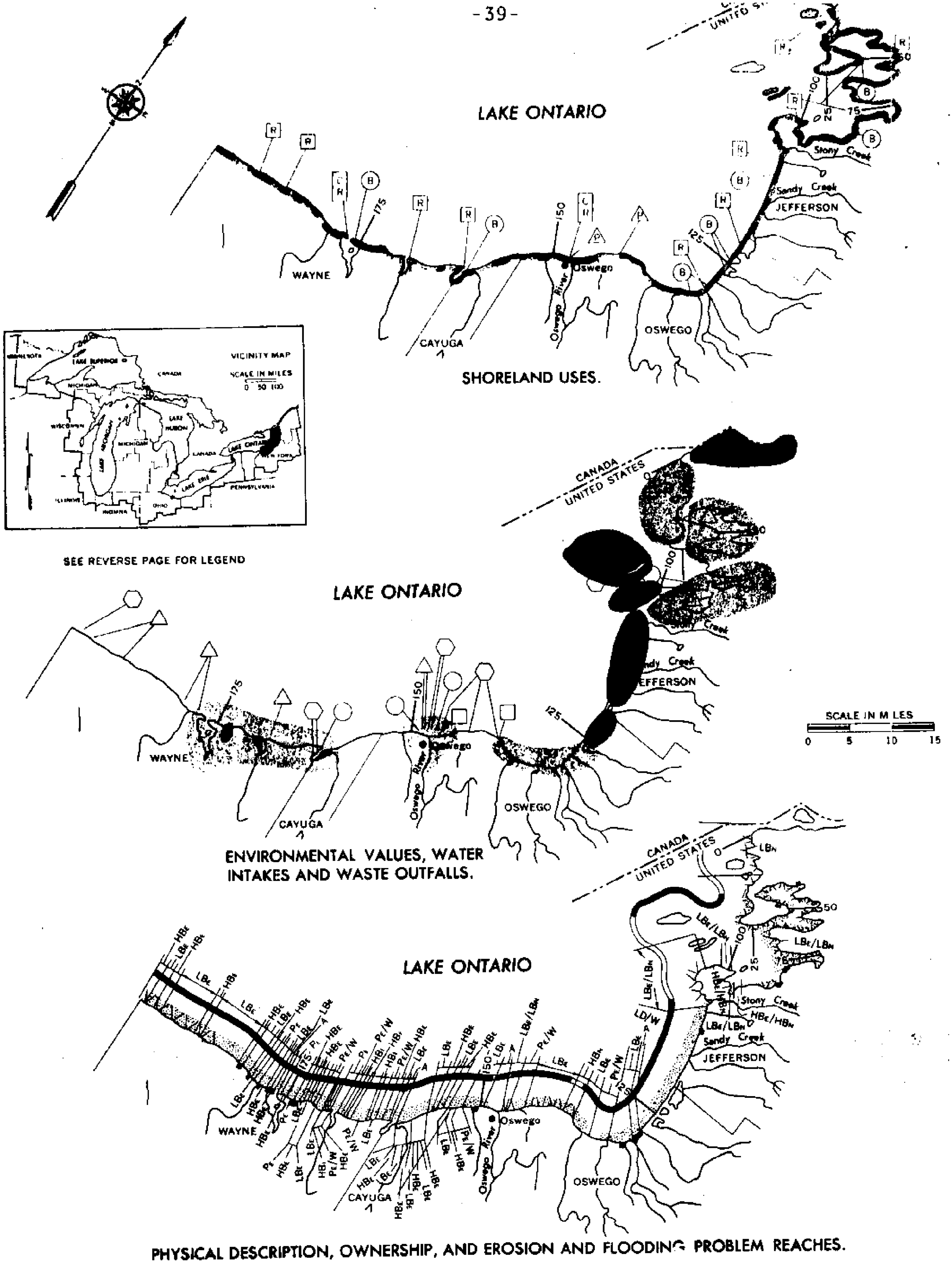


Figure 74 SHORELANDS OF THE GREAT LAKES, CAPE VINCENT, JEFFERSON, OSWEGO, CAYUGA, WAYNE COUNTIES

APPENDIX B

NEW YORK SHORESCAPE PROVINCES

U.S. Geological Survey 7½ minute quadrangles included in each province. For general locations of provinces, refer to Figure 14.

1. Northeast (Pa.)
   Ripley
   Westfield
   Brocton

2. North of Dunkirk
   Silver Creek
   Farnham
   Angola
   Eden
   Buffalo S.E.

3. Buffalo N.E.
   Buffalo N.W.
   Tonawanda East
   Tonawanda West
   Niagara Falls
   Lewiston
   Fort Niagara

4. Fort Niagara
   Six Mile Creek
   Wilson
   Newfane
   Barker
   Lyndonville
   Ashwood
   Kent
   Kendall

5. Hamlin
   Hilton
   Braddock Heights
   Rochester East
   Ninemile Point

6. Furnaceville
   Pultneyville
   Salmon Creek

7. Salmon Creek
   Sodus Point
   North Wolcott
   Fair Haven

8. West Ninemile Point
   Oswego West
   Oswego East
   West of Texas
   Texas

9. Texas
   Pulaski
   Ellisburg
   Henderson
   Stony Point

New York Shorescape Provinces con't.

10. Stony Point
Galloo Island
Point Peninsula
Henderson Bay
Sackets Harbor
Chaumont
Cape Vincent South

11. Cape Vincent North
Saint Lawrence
Gananoque
Thousand Island Park
Alexandria Bay

12. Glenville
Mamaroneck
Mount Vernon
Flushing
Central Park

13. Brooklyn
Central Park
Flushing
Sea Cliff
Mamaroneck
Bayville
Lloyd Harbor
Northport
Saint James

14. Port Jefferson
Middle Island
Wading River
Riverhead
Mattituck
Mattituck Hills
Southold
Orient

15. Orient
Plum Island
Southold
Greenport
Gardner's Island West
Gardner's Island East
Montauk Point
Mattituck
Southampton
Sag Harbor
East Hampton

16. Montauk Point
Napeague Beach
East Hampton
Sag Harbor
Shinnecock Inlet

17. Shinnecock Inlet
Quogue
Eastport
Moriches
Pattersquash Island
Howells Point
Sayville
Bayshore East
Bayshore West
West Giglo Beach

18. West Giglo Beach
Jones Inlet
Lawrence
Far Rockaway
Coney Island

New York Shorescape Provinces con't.

19. Coney Island
    The Narrows
    Arthur Kill
    Elizabeth
    Jersey City

APPENDIX C

Preliminary List of Shoreforms

Landforms

LHC Conical Hill - Circular hill with either rounded or pointed top.

LHL Linear Hill - Elongated or elliptical hill, rounded or pointed top.

LH Compound Hill - Single hill form exhibiting both linear and conical characteristics.

LP Flat Plain - Level, or slightly, but uniformly sloping land.

LPR Rolling Plain - Land with greater relief than plains, but without distinct hills.

LV V-Shaped Valley - A valley with steep sloping sides and no flood plain.

LU U-Shaped Valley - A valley with a distinguishable flood plain.

* High Point - Promontory that is significantly high in relation to its surroundings.

EBL Bluff - A high steep bank or cliff dipping down to the shoreline.

EBE Beach - Sandy deposit along the shoreline, symbolized by a dotted area within land form.

ED Dune - A hill or ridge of sand piled up by wind.

EI Island - A land area completely surrounded by water.

EIB Barrier Island - A linear island running roughly parallel to the shore, e.g. Fire Island.

EPE Peninsula - An area of land almost completely surrounded by water, but with an isthmus connecting it with shoreline.

ER Rocks - As labeled on U.S.G.S. topographic maps, symbolized by * *

Shoreline Forms

EBA Bar - A long, narrow ridge of sand or other deposit, slightly above water level, separating two bodies of water.

ES Spit - A narrow point of sand or other deposit, usually projecting across the mouth of a bay.

EP Point - Outward projection from the mainland, often consisting of resistant bedrock.

Water Forms

WO Ocean - As labeled on U.S.G.S. topographic maps; Atlantic Ocean.

WS Sound - As labeled on U.S.G.S. topographic maps; Long Island Sound.

WL Lake - As labeled on U.S.G.S. topographic maps; Lakes Ontario and Erie.

WP Pond - Fresh-water upland water body.

 Stream - Linear water feature symbolized by single blue line, solid or broken, on U.S.G.S. topographic maps.

WR  River - Linear water feature with two discernable edges, shaded blue area between edges.

WTF Tidal Flat - As labeled on U.S.G.S. topographic maps; non-vegetated tidal area, symbolized by dotted area within water forms.

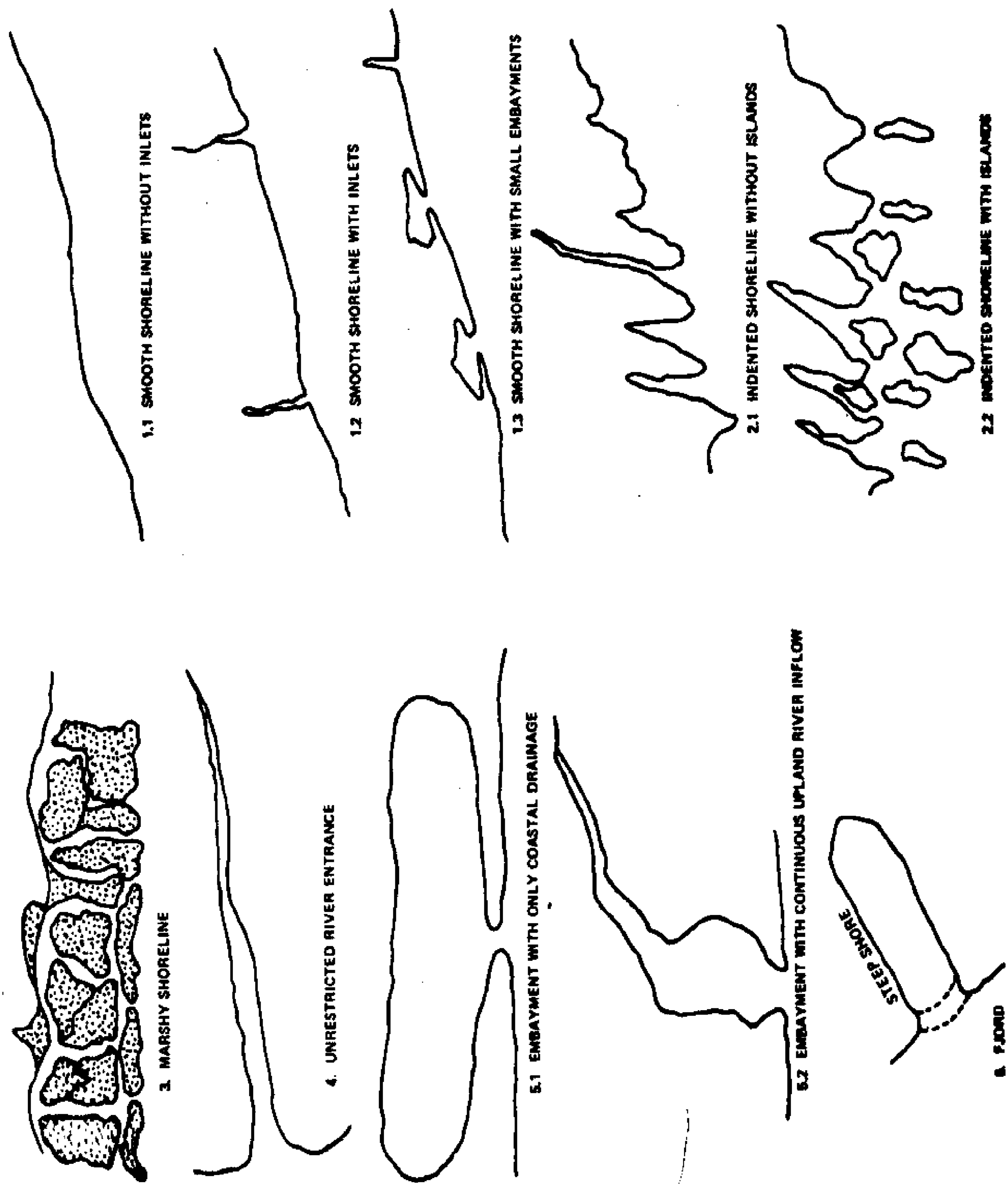
WM Marsh - Wetland in either water forms or land forms, symbolized by 

APPENDIX D

National Estuarine Pollution Study

(U.S. Department of the Interior)

Morphological Classification of Estuaries and Estuarine Zones



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VISUAL QUALITY OF THE COASTAL ZONE

- WORKING PAPERS -

To date this series of working papers includes:

No. 1: M. A. Ross, "Visual Quality in Land Use Control," 1975.

No. 2: S. Haskett, "Evaluating Visual Quality of the Coastline: Some Significant Issues," 1975.

No. 3: R. Viohl, Jr., "Landscape Evaluation: A Review of Current Techniques and Methodologies," 1975.

No. 4: J. Felleman, "Coastal Landforms and Scenic Analysis: A Review of the Literature, with a Preliminary Examination of New York's Shoreline." 1975.

Single copies of these papers may be obtained on request from:

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