D R A F T C O P Y

SARASOTA COUNTY

ENVIRONMENTAL ELEMENT

PHASE III

December, 1975

This Element is prepared by the Long-Range Planning Division of the Sarasota County Planning Department as part of the Sarasota County Comprehensive Plan

SECTION 1

Introduction and Purpose

As described in Sarasota County Environmental Element, Phase 1, this document, Phase 3, represents the "projection" and "needs" portions of the Environmental Element. In so doing, there are three major sections of this Phase 3: 1) Factor Interrelationships; 2) Critical Factors; and 3) Critical Areas.

It is the intent of Phase 3 to synthesize the information presented in Phase 2 and to identify, as applicable, the functional and geographic patterns of the six Environmental Factors. Since the interrelationships of such natural systems follow a most complex pattern, only general interactions among these Factors are developed in Phase 3.

The remaining Phase 4 will set out specific plans, priorities, and alternatives to best utilize the natural systems described in Phases 1, 2, and 3.

SECTION 2

Factor Interrelationships

> The earth operates as a series of inter-related systems within which all of the components, living and non-living, are linked with one another in complex ways so that a change in one component will bring about some corresponding change in the operation of the whole system.
>
> Promoting Environmental Quality Through Planning and Controls, Environmental Protection Agency, 1974

The interactions among the six Environmental Factors (Climate, Geomorphology, Hydrology, Soils, Vegetation, Wildlife) identified in Environmental Element, Phase 1 are so complex and interdependent that attempts to devise a simple matrix table to graphically depict them are futile. Each Factor influences, directly and indirectly, each other Factor so greatly that values cannot be established without extremely complicated and intricate interaction models and flow charts.

The following brief descriptions attempt to identify at the first level of specificity some of those interrelationships. As such, these descriptions are by no means inclusive.

Geomorphology - Climate

The linkage between geomorphology and climate is perhaps best illustrated by changing sea levels. As worldwide temperatures change, creating fluctuations in the ice caps, corresponding fluctuations in sea level produce marine terraces, barrier islands, and, eventually, geologic substrata.

The distribution of land and water is partially responsible for prevailing winds which create the littoral currents responsible for sand transport along the barrier islands. Hurricanes have created inlets along these barrier islands, changing their shape and the direction of tidal flow in the bays.

Convectional storms depend upon the uneven heating of land and water coupled with adequate supplies of moist air from the Gulf of Mexico. These storms assist in recharging surface

and ground water systems. Excessive precipitation from either convectional or cyclonic storms combined with low elevation create a potential threat along flood plains and coastal areas.

Geomorphology - Hydrology

The interactions of geomorphology and hydrology form the surface and ground water systems of Sarasota County. The slow moving streams and shallow lakes are an expression of low elevations and minimal relief. Aquifer systems providing potable water for Sarasota's residents are a result of the "layercake" of clays and permeable limestones existing beneath the surface. The same clays in the Upper Hawthorne Formation block local recharge and cause the ground water systems of Sarasota County to be dependent on precipitation falling outside of its political boundaries.

Geomorphology - Soils

Thick formations of sands deposited by ocean waters during the Pleistocene epoch are the parent material for Sarasota County's surface soils. The marine origins of acid sands (which overlay rock, marl, or shell strata) have determined the characteristically poor drainage, acidity, infertility, and light color of these soils. These soils in turn, influence the shape of the land; loose sand, not anchored by vegetation, is easily eroded by winds creating a varied relief, particularly along coastal beaches (Re: Phase 2, Figure 6).

Poorly drained soils have formed shallow depressions or sloughs, a familiar feature of inland Sarasota County, whereas the higher elevations are remnants of marine terraces and are characterized by excessively drained deep sands.

Climate - Hydrology

One aspect of climate is precipitation, which provides the fresh-water input necessary to recharge surface and groundwater systems. In Sarasota County, seasonal climatic fluctuations are expressed during the dry winter months by dropping water levels in lakes and streams. During the rainy season these same systems may overflow due to thunderstorms and hurricanes.

The amount of retained precipitation is partially determined by atmospheric temperature and the permeability of the soil and substrata. Subtropical temperatures and plant transpiration create an evapotranspiration rate which returns three quarters of Sarasota's rainfall to the atmosphere.

Long-term climatic changes have influenced fluctuations in sea level and resultant marine sediments deposited in the past form the geologic structure of Florida. This geologic structure is composed of limestones and clays responsible for Sarasota's aquifer systems.

Climate - Soils

Weathering of bedrock is an important step in the formation of soils. The action of rain which dissolves minerals, transports soil particles, erodes topsoil which exposes substrata, etc., are evidence of climatic influence upon soils. Soils, however, do not exert significant control over climate; this, rather, is accomplished by vegetation, which is greatly influenced by soils.

Climate - Vegetation

The subtropical climate, year-round growing season, summer rains and dry winter season are greatly responsible for Sarasota County's native vegetation and is extremely important in permitting the rapid growth of some exotics. The County is situated between tropical South Florida and the freeze-prone North Florida. This condition produces an edge-effect resulting in higher diversity of plant species. Unfortunately, under these conditions, exotic, undesirable flora can establish itself and rapidly preclude native vegetation. (Re: Phase 2, p. 47)

Vegetation has a moderating effect upon temperatures " . . in contrast to the fluctuation between hot days and chilly nights in open areas such as fields, suburbs, and cities." (ASPO p. 51). Woodlands also ameliorate the flooding resulting from storms, as well as high winds. Coastal vegetation effectively shields less salt-tolerant plants from salt spray during storms.

Climate - Wildlife

The effect of climate upon wildlife is quite notable, although climate is relatively unaffected by wildlife. The dry winters and rainy summers require animals inhabiting Sarasota County to adapt to flood/drought situations. In addition, the warm climate combined with coastal location has nurtured a varied wildlife of shore birds, terrestrial, estuarine and marine

organisms. Rainfall, prevailing winds, and temperature have great effects upon estuarine life, affecting tides, waves, salinity, eutrophication rates.

Numerous migratory birds winter in this area, finding abundant food sources in undisturbed areas of inland Sarasota County.

Hydrology - Soils

The hydrologic cycle and soils are strongly interrelated. As water returns to earth via precipitation, soils are eroded, carried into streams and deposited in distant places, while moisture plays a leading role in the decay of organic matter into humic soil. Water availability combined with warm temperatures assure high leeching rates. The soil's erodability, permeability, depth, etc., determine aquifer recharge potential, water table, river and stream bed location.

Hydrology - Vegetation

The interaction of hydrology and natural vegetation patterns are extremely important. Precipitation, water table, and surface water features greatly determine vegetation associations while vegetation controls the amount of water transpired into the atmosphere, retention of precipitation and gradual percolation into the water table or aquifer, and slowing of runoff and erosion along water courses. These two Environmental Factors, particularly, are very closely related and the disturbance of one will have immediate and severe repercussions in the functioning of the other.

Hydrology-- Wildlife

The uninterrupted flow of the hydrologic cycle is most important to wildlife - terrestrial, avian, and aquatic; however, wildlife does not figure critically in the County's hydrology. The water storage areas, i. e., marshes, swamps, sloughs, draw large populations of animals, while water courses harbor fishes, insects, zooplankton, etc. If a drought affects the area, water storage decreases and water tables drop, causing wildlife to be stressed and perhaps decline in number. The hydrologic cycle, on the other hand, will not be significantly affected by the extinction of a species, introduction of an exotic animal, or other wildlife population fluctuations.

Soils - Vegetation (See Appendix A)

The parallels between soils and vegetation are numerous and extremely important. The soils' characteristics (drainage, composition, depth, fertility, etc.) determine the types of plant life found in an area. Vegetation reciprocates, adding organic matter to the soil, anchoring it in place, transporting nutrients down through the soil layers via roots, and aerating soil, enabling gases to be exchanged through roots.

Soils - Wildlife (See Appendix A)

The two factors of soils and wildlife are affected one by the other. The detritus from vegetation is ingested and excreted by earthworms and other burrowing organisms, while animal carcasses contribute to soil composition, etc. Different types of soils attract different wildlife species, i. e., burrowing animals are found in deep draughty soils. The strongest influence upon wildlife, however, remains vegetation.

Vegetation - Wildlife (See Appendix A)

Of all six Environmental Factors, vegetation and wildlife are among the two most interdependent. The varied levels of vegetation (canopy, understory, forest floor) act as microhabitats for wildlife, serve as a food source, provide shelter from predators and harsh climate, etc. The animals influence vegetation associations to some extent. Birds and furry animals distribute seeds and fruits from one area to another. Feeding habits often help to control particular plants, and some animals act as a biological check on harmful insects which could adversely effect vegetation.

SECTION 3

Critical Factors

> A single drop of water in the uplands of a watershed may appear and reappear as cloud, precipitation, surface water in creek and river, lake and pond or groundwater; it can participate in plant and animal metabolism, transpiration, decomposition, combustion, respiration and evaporation. This same drop of water may appear in water supply, flood, drought, and erosion control, industry, commerce, agriculture, forestry, recreation, scenic beauty, in cloud, snow, stream, river and sea. We conclude that nature is a single interacting system and that changes to any part will affect the operation of the whole. (p. 56)
>
> Design with Nature
> Ian McHarg, 1969

Ecosystems are often classified as to their degree of organization. The term "succession" is used to describe the evolving process of an ecosystem as it reaches maximum maturity or "climax". The more stable the physical surroundings, the more probable that the ecosystem will become organized into a climax state.

The inhabitants of a mature ecosystem would typically possess lower metabolic rates, more selective feeding, elaborate interrelationships, slower reproduction, and greater species diversity than in systems of less maturity.

Sarasota County possesses many of the requirements necessary to produce a mature ecosystem. The mild, subtropical climate and normally adequate rainfall provide an environment which has encouraged an intricate and fragile ecosystem to develop.

The six Environmental Factors described in Phase 2 interact to form the major systems responsible for Sarasota County's natural environment. These natural systems are, in turn, modified by the Human Community. This interrelatedness is both a strength and a nemesis, for changes occurring in one system will normally affect the other systems.

Figure I illustrates the interactions occurring between the Environmental Factors and the Human Community. Figure I depicts the physical (non-living) system and the biological (living) system, and the interaction of the Environmental Factors and the Human Community. Arrows indicate the direction of influence of one factor upon another, many of which are reciprocal.

Ecosystems are very real things. They can be touched, seen, measured, mapped, identified on the ground, and photographed. Nonetheless, these systems do not have impermeable boundaries, for there is a constant flow of energy and materials among the component ecosystems.

Many potentially critical variables exist within these Factors and their linkages. Because it is virtually impossible to monitor all these variables, it becomes essential to monitor those which possess qualities most easily measurable and which reflect the overall condition of the natural environment. On the basis of available information, Hydrology and Vegetation appear to be the factors most valuable as environmental indicators.

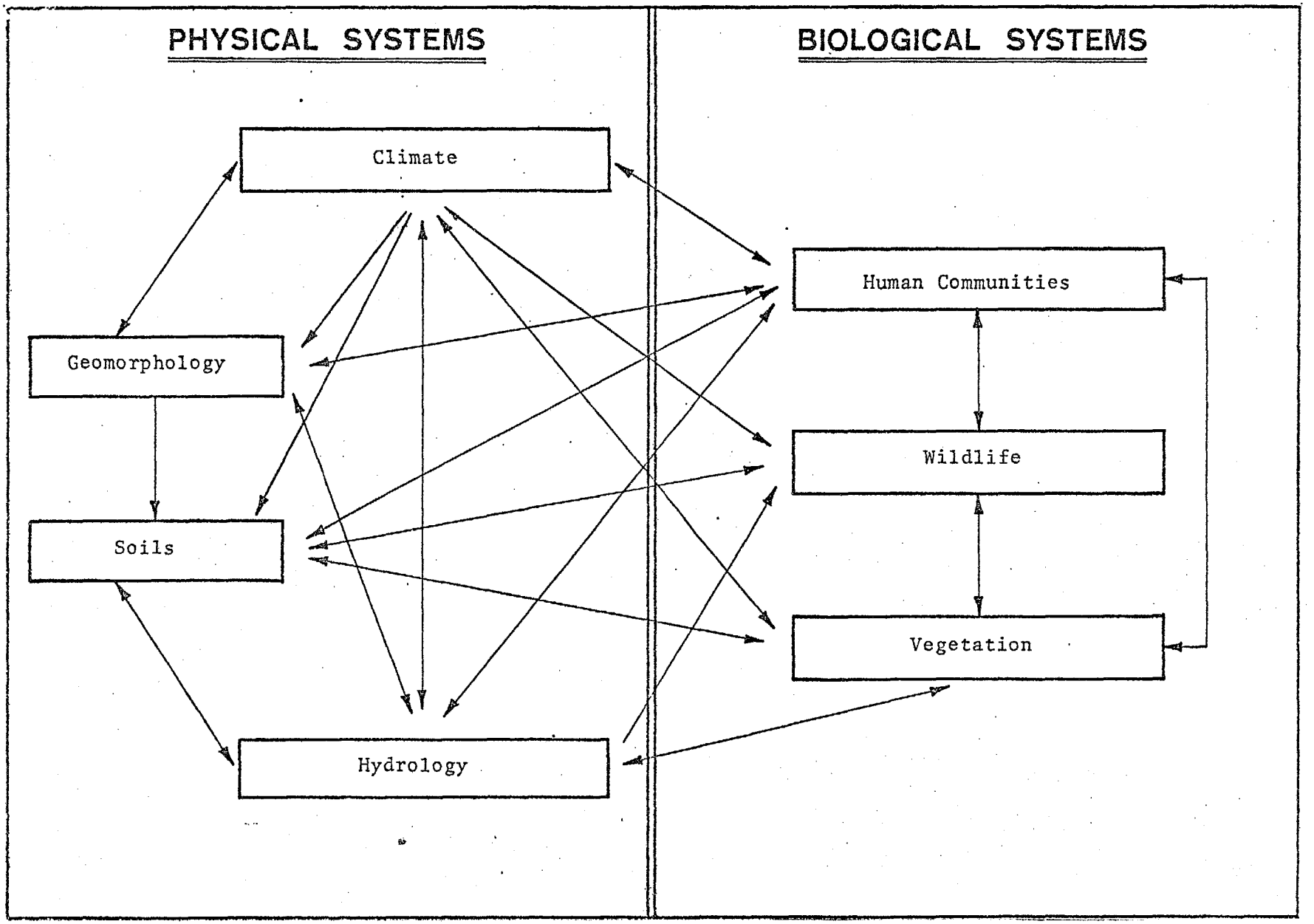
The hydrologic cycle is in many ways analogous to an organism's circulatory system. It acts as the lifeblood of the ecosystem providing needed moisture, distributing nutrients and removing waste. Once contaminated, however, it may spread toxins throughout the entire system. Techniques to monitor the quality and quantity of water are well established. The function of water as a link between the various Environmental Factors adds to its validity as an indicator of overall environmental quality.

Vegetation is a result of interaction among climate, soil, and hydrology while wildlife is greatly dependent upon vegetation patterns. By utilizing macro-sensing techniques, such as aerial photography, it is possible to accurately determine the quality and quantity of an area's vegetation.

Vegetation also serves as a fairly accurate indicator of the total condition of environmental systems. A floral inventory of a specific area (e.g., drainage basin, large development site, or coastal beach) allows interpretation of soils, subsurface geology, microclimate, hydrology, and wildlife communities. Vegetation reflects the operation of other ecosystem components, and it is just these natural operational processes that are the major targets of protection. Free services are provided by natural systems for the Human Community. Water and air purification, run-off control, soil formation and stabilization, climate moderation, and pest control are

Figure 1

THE INTEGRATION OF NATURAL PROCESSES INTO AN ECOSYSTEM



Adapted from Promoting Environmental Quality Through Planning and Controls, EPA.

accomplished by normally functioning ecosystems. Furthermore, vegetation analysis can aid in determining what major changes would take place in biotic and physical systems as a result of landscape alteration through land development activities. Impact on these processes can be foreseen and, if necessary, land use alternatives proposed.

The primary standard of the Sarasota County Environmental Element is to maintain all environmental factors at the current level or better and to permit no further environmental degradation until the relationship of each Environmental Factor is comprehended and can be planned for. It is believed that this standard can best be achieved by monitoring, protecting and improving the hydrologic and vegetative systems of Sarasota County.

Phenomena, such as pollution, are adverse to ecosystem functions and are stress producing. Energy must be diverted from other activities to accommodate these added stresses. Changes in the basic life support systems will often be transmitted to the more complex dependent systems with amplified intensity. An example of this concentration of impact is the buildup of toxins in the bodies of predators as they consume contaminated prey. This pyramiding effect is of exceptional importance to the Human Community due to man's position at the top of the food chain.

A decline in the diversity of species within an ecosystem is often an indication of stress.

> . . . the diversity of species can be related to a number of such variables as the structure of the habitat, the diversity of microhabitats, the nature of the physical environment, climate and protection from its adverse effects, the availability of food, nutrient supply and time.
>
> Ecology and Field Biology
> Robert L. Smith

> One guiding principle should be maintenance of as many diverse species and habitats as is possible. Ecologists have found that the diversity of species and environments usually found in natural ecosystems has great value in maintaining system stability.
>
> Promoting Environmental Quality Through Urban Planning and Controls, Environmental Protection Agency, 1974.

SECTION 4

Critical Areas

In order to best designate environmentally critical areas in Sarasota County, it is desirable to map those Environmental Factors most important to or indicative of the overall ecosystem. Section 2 of this Phase 3 determined that the two most critical Factors are Vegetation and Hydrology.

Vegetation patterns are mapped in Phase 2 and those types deemed appropriate may be utilized intact. Hydrology, however, does not map well because water volumes and quality vary over short periods of time and subsurface features and patterns are not always known.

Soils are quite stable over relatively long periods of time, are well mapped in Sarasota County, and most importantly, are the direct result of long term hydrologic action. For these reasons soil patterns may be mapped in lieu of actual hydrologic activities, with quite valid results.

A standard technique to combine these various Factors graphically is the construction of an overlay map (Design With Nature, Ian McHarg, 1969). Such a map results in a composite picture with those areas affected by multiple Factors becoming darker with each subsequent overlay.

To construct such a Composite Critical Factors map it is necessary to define exactly those variables chosen for mapping. The following Figure 2, Composite Critical Factors map is the result of overlaying the following variables:

1. Sensitive Soils
   a. riverine and coastal soils
   b. very poorly drained organic soils
   c. poorly to very poorly drained soils, shallow over alkaline materials.

2. Very Sensitive Soils
   a. riverine and coastal soils
   b. very poorly drained organic soils.

3. Sensitive Vegetation
   a. tidal marsh
   b. slough and freshwater marsh
   c. forested areas.

4. Very Sensitive Vegetation
   a. tidal marsh
   b. slough and freshwater marsh.

5. Flood Prone Areas
   a. U. S. Army Corps of Engineers, Intermediate Regional Flood
   b. areas inundated by flood of September 1962.

There results, therefore, a theoretical potential for any area to be affected by up to twelve environmental variables. In the case of vegetation and soils, however, those areas designated as falling within a "very sensitive" category will automatically fall in a "sensitive" category. These "very sensitive" soils and vegetation associations are double counted due to their inherent sensitivity and because they represent wildlife habitats or potential habitats.

Figure 2, Composite Critical Factors Map, then, represents the result of the described approach. As more variables affect a given area, the overlays darken that area. The darker the area on the map, the more critical it is, based upon the stated criteria.

The Composite Critical Factors Map is a useable tool in guiding land development in Sarasota County. Phase 4 will utilize this tool, among others, to establish priorities, specific plans, and implementation alternatives.

APPENDIX A

Soils/Vegetation Correlation

It is possible to correlate natural vegetation patterns with soils found in Sarasota County. Because soils exhibit various drainage characteristics, degrees of fertility, and relief, certain native flora have become established and associated with the soils. Following is a description of the natural vegetation associations (re: Phase 1, Environmental Element, pp. 14 & 15) and the soils upon which the associations usually occur.

The pine flatwoods/prairie association establishes itself upon a variety of soils, these being:

Alkaline	Acid
Ona fine sand;	Scranton fine sand;
Sunniland fine sand;	Imokalee fine sand;
Adamsville fine sand; and,	Leon fine sand; and,
Keri fine sand	Pomello fine sand

Of these soils, some are very acid, whereas others vary from less acid to neutral, resulting in 1) alkaline flatwoods and 2) acid flatwoods. Both types of soils are somewhat poorly drained, low in organic matter, fertility, and moisture retention.

Scattered throughout the flatwoods are open, treeless sloughs, lower in elevation than the surrounding land. The poorly to very poorly drained, strongly acid to neutral soils which characterize these sites are:

Arzell fine sand;
Charlotte fine sand;
Delray fine sand;
Felda fine sand; and
Pompano fine sand

Due to poor drainage, the slough is wet most of the year and during rainy months forms a slow-moving waterway, several inches deep.

Sand pine scrub is found on Lakewood fine sand and St. Lucie fine sand, both excessively drained deep soils. These sites are typically higher in elevation than the surrounding, usually acid flatwoods. Lakewood and St. Lucie fine sands are white, deep sand soils, low in moisture, organic matter, and fertility.

Another vegetation associated with deep, somewhat excessively to moderately well drained soils such as Lakeland fine sand and Blanton fine sand, is the pine/oak sandhill. These nearly level to sloped locations are characterized by low moisture, low organic matter, and low fertility.

Considering vegetation and soil associations adjacent to lakes and rivers, there is the freshwater marsh and the low hammock. Looking first at the freshwater marsh, it is known that the site is nearly level and a little lower in elevation than adjacent flatwoods. The marsh soils are separated into 1) mineral and 2) organic.

The mineral soils are:

Felda fine sand;

Manatee loamy fine sand and fine sandy loam; and,

Rutledge fine sand and mucky fine sand.

These soils are low in moisture, low to medium in organic matter content and low in fertility. The organic soils are:

Terra Ceia muck; and

Pamlico peaty muck

They have very poor drainage, and are deep deposits of organic soils derived from aquatic plants.

Low hammocks occupy areas on river floodplains and lake margins, in association with somewhat poorly drained soils over calcareous materials. In association with the same soils, but on higher ground than the usual surrounding marsh, swamp, or slough is found the high hammock. The hammock soils are:

Bradenton fine sand;

Parkwood fine sand; and,

Keri fine sand

which are favorable to dense growth of trees, shrubs, and vines because of intermediate moisture conditions.

The remaining vegetation associations: freshwater swamp; coastal strand vegetation; mangroves; and, saltwater marshes are found upon miscellaneous soils which are not classified into soil associations. They are a mixture of soils varying in color, texture and composition. Freshwater swamps grow on alluvial sands along streams, often flooded throughout the rainy season. The

coastal strand vegetation is supported by the extremely drained coastal beach ridge which is mostly deep sand and fragments of shells. Mangroves and tidal marshes are inundated by salt water, and have developed a tolerance to salty soils.

Because of the relationship between soils and vegetation, it is possible to compile a table correlating the two factors and listing habitat descriptions and ecosystem functions. Following is the table.

NATURAL VEGETATION/SOILS CORRELATION
Habitat Description
and
Ecosystem Function

VEGETATION	SOILS
Forested Areas Hammock shelter for wildlife food source for wildlife soil retention, prevents erosion acts as transition zone along river banks, absorbing polluted run-off moderates temperature changes of day & night	Bradenton fs Parkwood fs Keri fs important to recharge of water table acts as transition zone along river banks, absorbing polluted run-off flood control as stores excess rain water
Swamp Forest food and refuge for varied wildlife storage of excess flood waters anchoring soil, prevent erosion vast, varied plant selection water reservior during drought unique resource Sarasota County moderates temperature changes of day & night	Alluvial Sands
Sand Pine Scrub Pine/Oak Sandhill supports a xerophyic scrub (a relatively rare vegetative type in Sarasota) shelters different wildlife; ie. Fla. Scrub Jay	Lakewood fs St. Lucie fs Lakeland fs Blanton fs vestiges of relic sand dunes (sand pine scrub) could be important for aquifer recharge due to deep, well-drained sands
Pineflatwoods source of food for wildlife natural habitats for wildfowl & game proper management could preserve wildlife	Keri fs Sunniland fs Imokalee fs Leon fs

Tidal Marsh + Swamp	
Mangroves transitional buffer zone from bay to uplands (effective during hurricanse, against wave action, high water, & wind) active land builders, by trapping debris & accumulation of root structure intercepts and filters upland run-off rookeries for coastal avifauna (ie. endangered brown pelican) adjacent to estaurine feeding areas food source for host of marine organisms (leaf detritus, algal growth)	Miscellaneous Soils acts as filter for upland run-off, absorbs metals & pollutants acts as transition zone from low-energy bays to low-lying uplands, protecting against saltwater intrusion, coastal erosion, & salt spray trapped sediment, debris, etc. builds up soil
Grasses nursery & breeding ground for small fishes & marine invertebrates (foundation of marine food web) filter for upland run-off, absorbs metals & pollutants acts as transition zone from low-energy bays to low-lying uplands, protecting against saltwater intrusion, coastal erosion, & salt spray	Miscellaneous Soils habitat for burrowing molluscs filter for upland run-off, absorbs metals & pollutants acts as transition zone from bay to uplands
Slough and Freshwater Marsh serves a flood control and storage for excess rainwater wintering sites for migratory birds rookery, watering, and feeding sites for wildlife absorbs and recycles pollutants and excess nutrients reduces run-off of freshwater into estuarine waters high aesthetic value	Arzell fs Felda fs Charlotte fs Pompano fs Rutledge fs Manatee loamy fs + fine sandy loam Terra Ceia muck Pamlico muck water source in time of drought reduces downstream flooding by absorbing's storing excess water absorption of pollutants & excess nutrients

Coastal Strand

- protection of keys from wave action
- environment for shorebirds, crabs, loggerhead turtles,etc.
- anchoring roots protect dunes against wind erosion

Submerged Grassbeds

- sediment trap & stabilizer of bottom
- basic areas of productivity (ie. breeding grounds)
- direct food source for marine animals (ie. endangered manatee from leaves to detritus)
- refuge & food source for juveniles of many species of seafood organisms (ie. scallops, crabs, shrimp)
- attachment for benthic algea

Miscellaneous Sandy Soils

- protection of low-lying mainland from waves, winds, & salt spray
- habitat for many supra-littoral, & sub-littoral burrowing animals

Miscellaneous Soils

- anaerobic soil - Thalassia
- aerobic soil - Diplanthera
- reduced or oxidized - Syringodium sediment

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