Tenoroc State Recreation Area:
A Conceptual Master Plan Study

By

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TENOROC STATE RECREATION AREA RECLAMATION STUDY

Michelle Walker
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Virginia Polytechnic Institute and State University
Department of Landscape Architecture

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ABSTRACT

Reclamation has been required since the mid-1970's in Florida and many other states that mine land for phosphate. While often controversial, land reclamation has involved a variety of technologies and regulations which often reflect the complexity of economical, ecological and political forces involved in the decision-making process. Most often, reclamation procedures are dictated by economic constraints and less often by environmental concerns.

In 1982, Borden, Inc. donated a 6,040.7 acre abandoned phosphate mine, located within Polk County in Central Florida, to the State of Florida. In 1989, the site was designated by the State of Florida as a state recreation area known today as Tenoroc State Recreation Area. The Area currently provides facilities for hiking, picnicking, and horseback riding with particular emphasis on quality fishing within its manmade lakes. It is the intent of the state to integrate land reclamation functions with the recreational potentials of the site, thus providing a public use area that will generate support revenue. (Scruggs, 1992).

The primary difference between the reclamation activities at Tenoroc and those reclamation activities of today is the lack of a conceptual plan. For the most part, reclamation at Tenoroc has been planned as stand-alone projects with minimal foresight of the needs for future recreational uses, drainage patterns or continuing reclamation activities. At this point, a conceptual master plan is needed to integrate hydrological and land reclamation functions with the recreational potentials of the site into a framework for future management and development of Tenoroc.

The goals and objectives of this study are as follows:

1. To produce a plan for the restoration of Tenoroc State Recreation Area which will address the reclamation of natural systems with emphasis on wildlife habitat and landscape diversity;

2. To provide for safety and recreation of visitors and staff, and

3. To develop a plan for a unique, educational and recreational experience that will fulfill the objectives of the Florida Department of Natural Resources.

The process of reclamation starts the moment man begins to explore the earth for its minerals. Since mining is here to stay, reclamation should be looked upon as a continuation of succession of the landscape, rather than repair of a damaged landscape. By approaching reclamation holistically, as just another step in the mining process; through proper planning, management and program, the strife for achieving a balance between our quality of life and our sustainability becomes that much more of a reality.

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GOALS AND OBJECTIVES

The goals and objectives of this study are as follows:

1. To produce a plan for the restoration of Tenoroc State Recreation Area which will address:

   - the reclamation of natural systems and\or improvement upon existing systems that currently provide for wildlife with emphasis on wildlife habitat and landscape diversity;

   - the improved hydrological aspects of the site - visually, functionally and ecologically through stream restoration and connection of existing water systems, with consideration taken for downstream effects;

   - the construction of a littoral shelf in lakes to provide an aquatic nursery and area for wading birds, and

   - the development of design guidelines for increasing endangered species habitat ;

2. To provide for safety and recreation of visitors and staff through an evaluation of:

   - the slopes left by mining;

   - the construction of a littoral shelf in lakes, and

   - design guidelines for buffer zones between recreational areas and environmentally sensitive areas;

3. To develop a plan for a unique, educational and recreational experience that will fulfill the following objectives of the Florida Department of Natural Resources:

   - the creation of a recreation area that will meet user needs in an area extending from Tampa, east to Orlando;

- the generation of revenue through concessioned activities and user fees so that Tenoroc becomes a self-supporting recreation area;

- the education of the public in the topics of mined - land rehabilitation, natural systems and the role of the Florida State Government in these areas of concern.

INTRODUCTION

Reclamation has been required since the mid-1970's in Florida and many other states that mine land for phosphate. While often controversial, land reclamation has involved a variety of technologies and regulations which often reflect the complexity of economical, ecological and political forces involved in the decision-making process. Most often, reclamation procedures are dictated by economic constraints and less often by environmental concerns.

In addressing the definition of reclamation, it is important to clarify the difference between the term "reclamation" and the term "restoration". Many view the difference between these two terms as just a matter of semantics and often use them interchangeably. However, in dealing with drastically disturbed lands (such as phosphate mined lands), restoration is believed to be a much more complex and comprehensive process than reclamation. Reclamation is defined as "the process of recontouring and revegetating land and water bodies disturbed by mining processes" (Marion, 1986a). Restoration is a processs which "includes reshaping the surface, recreating moisture conditions, revegetating and re-establishing the ecological functions of a landscape unit that existed prior to mining" (Marion, 1986). Ecological functions would include considerations such as regional drainage, soil profile characterisitics and native vegetative communities.

Conservationists and environmentalists have not supported the term "reclamation," because recontouring and revegetating do not fulfill the philosophies of these groups.Their objective is to get the mining industry to "put it back the way it was" (Marion, 1986a). The mining industry has stayed away from the term "restoration" because of the costs involved in restoring the land as well as the implied long-term commitment to the land (Marion, 1986a). Reclamation has been performed for many years throughout the country, but for the most part, these projects have been for experimental or demonstration purposes. Serious consideration of restoration has only occurred recently and therefore information is difficult to obtain. While the future promises advances in both reclamation and restoration, presently, the concepts associated with these two terms remain

contoversial. This paper will deal primarily with reclamation while including aspects of restoration.

In 1975, two forms of legislation came into effect that greatly impacted the Central Florida phosphate region. First was the state regulation that required all land mined after July 1,1975 be reclaimed, and second, recognizing the ever-increasing population growth of Florida, the state legislated the "Local Government Comprehensive Planning Act of 1975," which required counties and incorporated cities to develop comprehensive plans for their areas. Elements within the plan that concerned phosphate mining were items such as water quality, future land use, air quality and groundwater recharge (Florida Dept. of Administration, 1976).

Each mine is required to have a general conceptual reclamation plan from which individualized, more detailed plans for each section of the mine are developed. The latter are submitted to both the state and local agencies for review, and it is the responsibility of the local agencies to see that the reclamation plans are in agreement with their own comprehensive plans. Therefore, the comprehensive plans of local agencies play a major role in the future land use of all mined lands.

In 1982, Borden, Inc. donated a 6,040.7 acre abandoned phosphate mine, located within Polk County in Central Florida, to the State of Florida. In 1989, the site was designated by the State of Florida as a state recreation area known today as Tenoroc State Recreation Area. The Area currently provides facilities for hiking, picnicking, and horseback riding with particular emphasis on quality fishing within its manmade lakes. It is the intent of the state to integrate land reclamation functions with the recreational potentials of the site, thus providing a public use area that will generate support revenue. (Scruggs, 1992).

The definition of a state recreation area is "sites which are provided to meet the more active recreation needs of the public in at least a multi-county service area. It is preferably located convenient to its primary using public and is selected so as to assure the availability of the types of recreational resources most needed in its locality. Major emphasis is given to providing opportunity for active recreational pursuits, and resource consideration is generally subordinate. Additionally, program emphasis is devoted toward promoting beneficial use of the area's recreational opportunities. Thus, much more intensive use of a recreation area is permitted than in a state park (State of Florida Unit Classification System)."

Tenoroc State Recreation Area was mined for phosphate between 1940 and 1978, with the majority of the site being mined prior to 1960. Although most of the site was mined prior to the regulations of 1975, approximately 4,300 acres of

Tenoroc have been reclaimed. The primary difference between the reclamation activities at Tenoroc and those reclamation activities of today is the lack of a conceptual plan. For the most part, reclamation at Tenoroc has been planned as stand-alone projects with minimal foresight of the needs for future recreational uses, drainage patterns or continuing reclamation activities. At this point, a conceptual master plan is needed to integrate hydrological and land reclamation functions with the recreational potentials of the site into a framework for future management and development of Tenoroc.

In developing a conceptual master plan for Tenoroc State Recreation Area, there are several ecological principles that have been considered: 1) that diverse natural plant communities provide important habitats for similarly diverse animal communities; 2) these natural communities serve as indicators of the "health" of ecosystems which greatly enrich our quality of life, and 3) human development activities, such as mining, have had long-term detrimental impacts on natural plant and animal communities and that reclamation and/or restoration back to natural systems on at least a portion of a mined site is a necessary and worthwhile objective for present and future generations.

The process of reclamation starts the moment we begin exploring the earth for its minerals. This process continues well beyond the end of the extraction process as the land continues to change thorugh natural succession. This continuum of change back to a natural system takes hundreds of years on its own, but with the intervention of man, this time period can be greatly reduced. The mining process virtually turns the earth upside down causing the natural vegetative communities to lose their foothold, allowing the invasion of exotic species which further promote the loss of natural systems. It is important to understand that each type of vegetative community, while different from each other, are important as a whole in ensuring the survival of much of our flora and fauna. Therefore, a holistic approach to reclamation, one that begins in the initial stages of the mining process and includes long-term restoration, land use and design plans, can ensure that mined land continues its successional process with a complete set of ecosystems both within itself and within its region.

LITERATURE REVIEW

Reclamation

Prior to the mid 1970's, the despoliation of land through the mining process was generally accepted as the consequence of the industry (Downing, 1972). Land

ownership entitled the owner to do with the land what he wished, which, in the mining industry often meant leaving behind useless land for future generations.

Owing to widespread dereliction of mined-out and excavated landscape, there came about a decided alteration in public policy. In 1977, the federal Surface Mining Act was initiated which required reclamation of mined-out lands in order to address such issues as air quality, water quality and safety standards.Today, this regulation has been further extended to take the form of local and county ordinances, regional impact studies and state reclamation standards which are designed to protect more specific regional issues such as vital wildlife habitats and tranquility of residential neighborhoods.

Phosphate Mining

It is understood that phosphate mining results in the extraction of chemicals and other materials that are useful to man and his survival in today's modern world. It should also be recognized that the primary incentive for mining is the profit motive of our free enterprise system, with reclamation and environmental concerns considered important, but secondary.

Since the federal Surface Mining Act of 1977 has never been extended to include phosphate mining, there is little involvement at the federal level in phosphate mine reclamation. Phosphate reclamation regulations are primarily developed and enforced by state agencies in the eastern United States, with federal stipulations being more important in the western United States where much of the mining occurs on federal lands, thus providing federal agencies with a vested interest in their outcome (Marion, 1986a). As mentioned earlier, the 1975 legislation of the "Local Government Comprehensive Planning Act" required counties and incorporated cities to become more involved in the long-term planning of their communities. One of the problems associated with this role of local agencies that concerns the reclamation of mined lands, is that county requirements vary tremendously in that they are generally written under the strong influence of local industry and are consequently not too difficult to meet. Counties with an existing industry tax base tend to write liberal mining laws, while counties with little mining are more restrictive (McFarlin, 1990).

A second problem is misinterpretation of reclamation rules. While reclamation rules are often revised, the misunderstanding is more often sited as variations of interpretations of reclamation rules by the officials who enforce them (Marion, 1986a).

Additionally, mining companies express a concern that the reclamation rules are too restrictive or inflexible. This complaint could be due to the misinterpretation of the rules, rather than the rules themselves. As one phosphate mining official summarized: "The current reclamation rules try to regulate the method of reclamation as well as the final results. In addition, mining permits are filed six months before mining and are difficult to amend to accomodate actual conditions after mining" (May, 1970). It is important to keep in mind that mining provides profit for the company, which is partially achieved by being responsive to changing economic conditions. If reclamation is to play a strong role in mining operations, reclamation rules must be flexible enough to allow for unforeseen economic conditions associated with phosphate mining.

At one time regulatory agencies were mostly concerned with aesthetics and a timetable for completing reclamation. But with the increase in environmental awareness due to loss of habitat and the increasing extent of mining operations, governments have had to change their philosophy to more of a "put it back the way it was" approach (Marion, 1986a). However, the concept of replacing landforms just as they were prior to excavation has become controversial in that this "all or none" approach may stifle innovation in reclamation rather than stimulate new ideas. Additionally, returning to a pre-existing landform may be totally inappropriate for long-term land use considerations. There is a need for further research into short- and long-term landform and land use tradeoffs and criteria for properly assessing the impacts of those decisions.

Emphasis on the necessity for and final results of reclamation have changed considerably in the past two decades. Generally, phosphate reclamation has included recontouring the surface and revegetating with a cover of grass, often having an end product of pasture or agricultural land. More recently, reclamation back to natural systems (habitat) rather than agro-economic systems has been considered (Marion, 1986b). This is partly due to the recent increase in public concern over reclamation to natural systems.

Phosphate Mining in Florida

The removal of phosphate rock by mining has occurred within a five-county region (Hillsborough, Manatee, Desoto and Hardee and Polk Counties) for over 100 years and will continue well into the next century. Present day mining techniques are capable of mining over 6,000 acres per year and produce about 40 million metric tons of phosphate rock (Central Florida Regional Planning Council, 1990).

Of the nineteen operational mines in these counties, eleven will have mined out their current permitted reserve land ownership by the year 2000.

Out of these five counties, Polk County will feel the greatest effect of the land use changes on phosphate industry owned lands. By the year 2010, only two mines and a portion of a third are expected to be in operation (Central Florida Regional Planning Council, 1990). Most of the lands mined in Polk County will have been reclaimed, and the full impact of phosphate mining in Polk County, long proclaimed by the industry as a temporary land disturbance, may then be evaluated.

Although reclamation plans for the mines are separate, some generalizations can be made on the impact of reclamation on the county as a whole (this information provided by the Central Florida Regional Planning Council, 1990). The Department of Natural Resources regulation requiring "type for type", "acre for acre" reclamation of mined and disturbed wetlands ensures the quantity of marsh and swamp. This is assuming that techniques currently used for rebuilding or recreating these wetlands are successful - a highly controversial issue (Kusler, Kentula, 1990).

Much of the mined land will be reclaimed to upland pasture. While most of this land will initially be put to agricultural use (grazing or citrus production), the soils should be stable enough to support many types of urban development.

Habitat Restoration

One of the restrictions in creating natural systems on phosphate mined lands is that sixty to seventy percent of the landscape becomes clay settling areas which are not available for reclamation for close to twenty years after mining has been completed. As these settling ponds begin to dry up through evapotranspiration and re-use of their clarifed surface waters in the mining process, an upper crust begins to form allowing the edges to be put to agricultural uses. The uneven settling of these clays prohibits these areas from supporting urban land uses, thus limiting their reclamation to grasses for pastureland or re-creation of wetlands. Their greatest potential lies in agriculture, with research showing promising results of using these areas for growing row crops, such as alfalfa.

Due to innovative mechanical dewatering techniques, the settling time of these ponds has been reduced to possibly three to five years. A second innovation, which has potential in reducing the time needed to complete reclamation, is the mixing of sand and clay which increases the rate of percolation of these clay settling areas (McFarlin, 1990). Currently, however, this mixture tends to separate, with the sand sinking to the bottom, leaving the unstable clays at the surface. Additional research is needed to develop techniques that allow a mixing of these materials without separation.

There are, however, possible negative effects to the reclamation of clay settling ponds. While in their active state, these areas provide temporary habitat for migratory waterfowl. With the increased spoilage of natural lakes and wetlands due to urban growth, these birds have been forced to rely heavily on clay ponds as feeding areas. While many small lakes and wetlands will be created on phosphate lands through reclamation, it is not known whether they will provide enough habitat to support these birds when the clay ponds are reclaimed.

Additionally, active clay settling ponds are important for flood control. As the clays consolidate, clear water is removed through the use of spillways. When a storm or hurricane is approaching, the spillway levels could be raised, thereby holding the rainwater that falls into the settling area, and then slowly releasing the water after the storm has passed. Once these settling areas are reclaimed, flood control is dependent upon the reclaimed marshes and swamps that adjoin natural water systems. These areas may not be as effective in controlling flooding after several rainfall events.

According to the Florida Department of Natural Resources (1980) Mine Reclamation Rules, revegetation involves "either a diverse vegetation, native to the area, capable of regeneration at least equal in permanence to the natural vegetation or an agricultural or silvicultural crop suitable to the reclamation program and the surrounding area" (Marion, 1986). Revegetation is usually associated with a time period of one to five years. Ideally, the long-term revegetation of a site is what should be considered because there will be a series of vegetative communities resulting from natural succession. For example, a wetland may be initially planted with marsh plants, but through succession may be replaced by shrubs and trees, thus the marsh becomes a swamp .

There are three main reasons for the lack of concern over long-term revegetation: 1) many landowners want to retain maximum flexibility in both long and short-term land use decisions, 2) the unpredictable nature of future cultural changes (including land values and urbanization), and 3) the lack of understanding thus far of long-term post-mining landscapes (Marion, 1986). All three topics are worthy of further research.

Successful reclamation requires the use of good quality planting stock and site-specific site preparation. One of the newer approaches in facilitating revegetation, particularly in wetland areas, is supplying an organic surface layer (muck). This technique quickly increases the organic matter in the soil as well a providing a ready seed source for re-establishing native species of plants. Also, maintaining an adjacent natural plant community may serve as a valuable seed source.

Transplanting or mulching with native, pre-stripped vegetation has proven successful; even where stumps from recently cut hardwood trees were transferred to a reclamation site, resulting in the sprouting of young trees from the stumps (Ruesch, 1983).

Currently, most upland areas of phosphate mined lands are being replanted with slash pine. Ideally, these areas should be planted with indigenous hardwood species because it is believed that the hardwoods provide better food and cover for wildlife. The lack of interest in planting hardwoods in upland areas is attributed to: 1) lack of plant material or seed sources, 2) difficulty in establishing species and their character of slow growth, and 3) the lack of incentives for growing hardwoods (Marion, 1986). Perhaps a future incentive may include companies being permitted to mine an area only if it can be shown that it is possible to successfully revegetate hardwoods in the area.

Another amendment to reclaimed landscapes that shows promise for wildlife habitat is the transplanting of dead trees to recently reclaimed sites, providing perches, feeding and nesting areas for birds and other animals. The seeds defecated by perched birds aid in the revegetation process. Additionally, brush piles provide shelter for various wildlife species and log piles in streams provide shelter for aquatic species (King, 1985).

The effects of mining on drainage systems is considerable. Watershed boundaries are increased and drainage patterns are altered. Additionally, percolation rates change due to the separation of the component parts of the soil, and there is a loss of vegetative communitites that aid in flood control. The water requirements of a mining operation result in a system of ditches, pipes and structures that draw from the surface water supply. These ditches and pumping facilities are used to convey large volumes of water to various areas of the site as needed. This use of water in the mining process results in a decrease of surface runoff, since most of the water is retained on site to be used in the mining process. Since regulations require that the surface hydrology of a mined site be returned to pre-mining conditions (meaning a smaller watershed boundary), proper function of drainage structures would be vital in avoiding downstream disaster during a heavy storm (Kelly, 1992).

Recreation

With the increasing levels of urbanization and demand for leisure time, there is an ever-growing need for recreational space that can accomodate highly populated areas. With increased use levels coinciding with decreased public budgets, serious consideration should be given to user fees, access, design and

management, as well as opportunities for the private sector. With appropriate planning and careful study of future land uses, reclaimed phosphate mine land allows for both the public and private sector to provide recreational opportunities through revenue-generating programs.

Some of the opportunities of phosphate mined lands have already been put to use. A California aggregate operation that began as a borrow pit, providing road base material for interstate highway construction, has evolved into a recreational center for northern San Joaquin Valley residents. The centerpiece of this recreational complex is a 70-acre lake that is continually enlarged by sand mining during the resort's off-season. The complex offers activities such as waterslides, camping, swimming, boating and outdoor concerts. In Dayton Ohio, a 177-acre limestone quarry has been reclaimed as Madison Lakes Park. This park is centered around abandoned quarry pits; both of which have been reclaimed to lakes that provide fishing, picniking and boating. The park includes an interpretive center which overlooks the lakes, playgrounds and hiking trails (Constantino, 1989). And finally, in Colorado, near the city of Fort Collins, Flatiron Sand and Gravel Company has plans of reclaiming a mined site into a wildlife habitat/natural recreation center. Their plans involve using vegetated, fertile topsoil to maintain soil productivity and to reduce visual impacts. Reclamation plans for the center include an observation blind, a visitor center, nature trails, a panfish habitat, a meadowland/grassland, a bike trail and a deep-water pond (Wassenaar, 1989).

These projects deal with issues similar to those in Florida phosphate mine reclamation. Due to the high water table, there is a body of water left to be addressed after the mining extraction occurs. Because of the cost of reclamation, developing a program for the site that generates revenue helps to offset these expenses. These projects better acquaint people with the realities of the environment around them. Rather than try to hide the scar of the mining process, these parks incorporate the scar as an educational experience. And finally, with the increased public pressures concerning loss of habitat and the preconception that mined land is wasted land, through comprehensive planning and design, these developments express the concept of nature integrated with man, providing a harmonious, unified whole (see table T-1).

Recreation in Florida

In Florida, there is a recreational need for freshwater fishing areas. While the mining process produces deep, fresh water lakes that are not natural to the Florida landscape, after reducing the slopes of the shoreline for safety purposes, these lakes provide excellent fishing opportunities. The private sector can utilize these reclaimed lands for revenue-generating fish camps. The public sector can do the

Comparative Matrix:
Phosphate Mining vs. Other Areas and Other Types of Mining

Table T-1

	Phos./ Florida	Phos./ Tenn.	Phos./ Idaho	Phos./ North Carolina	Coal Mining	Gravel Mining
Most common recla. activity	Agricul-ture, wetlands, uplands	pasture returned to pasture	grasses	grasses, salt marsh habitat	re-vegetate, agricul-ture	agricul-ture, urban land use
Land-form pro-duced	finger lakes (fine texture), clay ponds	shallow pits, often backfilled	large, unstable overburd-en mounds	deep pit, clay ponds	large pit with sides with ledges	large pit, vertical sides, below water table
Major issues	Clay ponds, no organic matter, gypsum	lime-stone outcrops near surface	erosion, instability	clay ponds, no organic matter, gypsum	returning to original landform	little spoil -- left for reclama-tion
Laws that are most influen-tial	state/ local	state/ local	state/ local	state/ local	federal	federal
Water source effected	surface flow	surface flow	surface flow	surface flow	surface flow and ground-water	ground-water

same while providing more readily accessible property for research and monitoring of the quality of such fishing. Currently, Tenoroc is considered as one of the best places in Florida for freshwater fishing. This may be due to the strict fishing regulations being applied and studied on Tenoroc's lake system, which have proven beneficial in providing revenue. While the restrictions are very limiting in the types and amount of fishing that can occur, the fishermen do not oppose the fees required to access the lakes because of the high quality of fishing that they can actively particpate in (Perry, 1992).

Methodology

In developing the methodology used in this study, several recreation planning models were examined so that appropriate condsideration of both user and resource would provide a balanced recreational plan for Tenoroc State Recreation Area.

The first model examined is the Systems Planning Model (Jubenville, 1976) which looks at recreational experiences as a series of relationships which, when viewed together can indicate possible results of a given action (cause and effect). The major subsystems are the visitor, the resource and the planning. This model involves establishing criteria for an activity, defining its constraints and then looking at the potential outcome. Interrelationships are needed between the criteria of an activity and its constraints in order to optimize the recreational experience. It is not a closed system; many external variables affect internal variables and relationships. For example, a large tree fallen across the curve of a multi-use trail would effect the experience of a bicyclist differently than that of a backpacker. The backpacker might look at the tree as part of the ruggedness of the hike, while a bicyclist may perceive it as a danger to those cyclists coming quickly around a bend. This model involves examination of behavioral studies, public opinion and the overall potential of the area (Jubenville).

A second model examined is the User-Resource Relationship Model (Jubenville, 1976). This model requires assessment of user needs and resource capability in order to provide satisfactory recreational experiences (Jubenville, 1976). The essential steps in this model are to identify the recreation users and the resources available, estimate the demand and supply and develop a recreational plan based on the latter. Emphasis is placed on the relationships of use areas (including structures) to the site, the surroundings and to each other (Gold, 1980).

And finally, a third model examined is the Carrying Capacity Approach (Gold, 1980). This model is based on the concept that space (facilities) have minimum,

desirable and optimum levels of human and natural carrying capacity, and these capacities can be translated into space with standards (Gold, 1980).

According to Seymour Gold's: Recreation Planning and Design, it is possible to use a combination of positive aspects from several planning models so as to achieve a balance between requirements of the user and a resource. Relationships in this approach are linked in the planning process by evaluating potential recreation resources, identifying user groups, estimating supply and demand of resource types and user group requirements and then translating these requirements with guidelines, design studies and landscape interpretation. It is this Combined Approach (Gold, 1980) that has been used as the basis for developing a recreational plan for Tenoroc.

Gold's Recreation Planning and Design describes the concepts behind the Combined Approach as the following:

- all potential recreation participants can be combined into user groups based on the recreational experience that each user desires;

- user groups can be described by social and economic characteristics from census data and surveys which could be used to estimate their impact on present and future recreation requirements

- the amount of space needed for each type of recreational experience can be determined by physical and psychological requirements;

- the environmental characteristics of each landscape type have a potential for recreation use;

- each recreation resource has a maximum carrying capacity which, if exceeded, will reduce the quality of the resource and the recreational experience;

- natural resource capability and design studies can determine the most suitable type, amount and arrangement of recreational development on a given site, and

- recreation experiences have tangible and intangible values which include direct dollar expenditures, user satisfaction and social benefits.

The methodology for developing Tenoroc State Recreation Area is based on program needs already identified by the State of Florida using an approach similar

to the User-Resource Relationship Model. These programs needs were determined by the State through user surveys and general requests of the public for specific recreational activities within this region of Florida.

A combination of both the Systems Model and the Carrying Capacity Approach have been used in this study to assess whether the program elements provided by the State can be accomodated on the Tenoroc site. At this time, information dealing with recreation planning specifically for reclaimed sites is not available. Therefore, the research and methodology to be developed for this study is based upon gaining an understanding of the damage created by the phosphate mining process, assessing the possible reclamation techniques and procedures and estimating the amount of time required by each phase of the reclamation process so that the land can be brought to a sustainable state. This study will focus on achieving the following:

- developing appropriate relationships amonst user areas, structures and the park surroundings,
- making the park user friendly,
- satisfying both function and aesthetic requirements,
- establishing an appropriate user experience,
- satisfying technical requirements such as size, quantities, orientation to natural forces and operating needs, and
- providing ease of supervision.

With these understandings, the site will be analyzed in terms of its suitability for the recreational activities that have been identified.

Tenoroc provides an ideal opportunity for testing many of the new techniques in phosphate land reclamation. In a sense, it is like starting with a clean slate. The land is state-owned, providing opportunity for research and monitoring of ongoing processes and programs. In particular, it allows for the study of the use of reclaimed phosphate land for recreation as well as determining the viability of mixing natural system restoration with recreation.

LOCATION

Tenoroc State Recreation Area is located within Polk County, Florida, approximately two miles northeast of Lakeland and four miles west of the Aburndale/Winter Haven area in northwestern Polk County. Interstate 4 is two miles north of Tenoroc, putting the Area within an hours drive from Tampa to the west and Orlando to the northeast. The southwest section of the site adjoins Lake Parker. The Tenoroc site extends about two miles in a north-south direction, and about five and a half miles in an east-west direction (see figure F-1).

AREA POPULATION

The estimated 1990 population for Polk County is 431,900. Projected population for the year 2000 is 509,572. The current population within a 60-mile radius of Tenoroc (which includes portions of Hillsborough, Polk, Sumter and Orange Counties) is estimated by the Central Florida Regional Planning Council as 1,094,353. The projected estimate of this radius for the year 2000 is 1,703,468.

SITE ACCESS

The park entrance is from Tenoroc Mine Road, which served as a rail bed during the mining days. It extends east from its intersection with County Road 33A. The site is accessible from several directions; from Interstate 4, south along State Road 33 to County Road 33A; from Lakeland, north along Combee Road; from State Road 33, east on Old Combee Road to County Road 33A and from Saddle Creek Road (S.R.546), then north along Combee Road (see figure F-2).

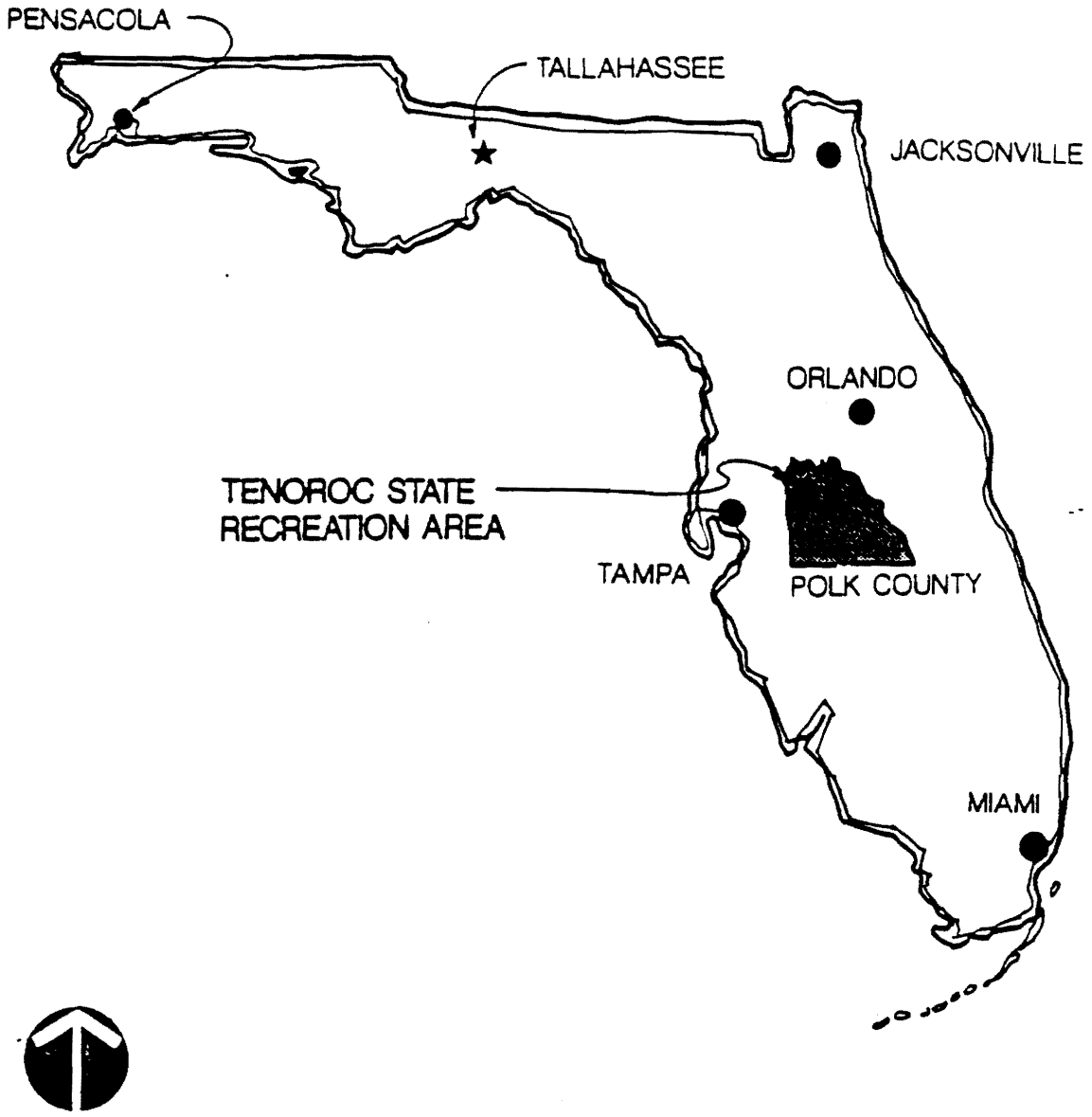
There is an additional entrance to the western portion of the site from Old Combee Road and Lake Parker Drive.

The most significant potential roadway planned for the area is the proposed Polk County Parkway. This roadway is planned as a north - south corridor just east of Tenoroc. Although the corridor has not been established as yet, it is proposed to run very near to or abutting the Tenoroc eastern property line.

Due to budget constraints, the final planning and construction of the parkway have been delayed, but its probable construction is an important consideration for future access into Tenoroc and should be considered in current planning.

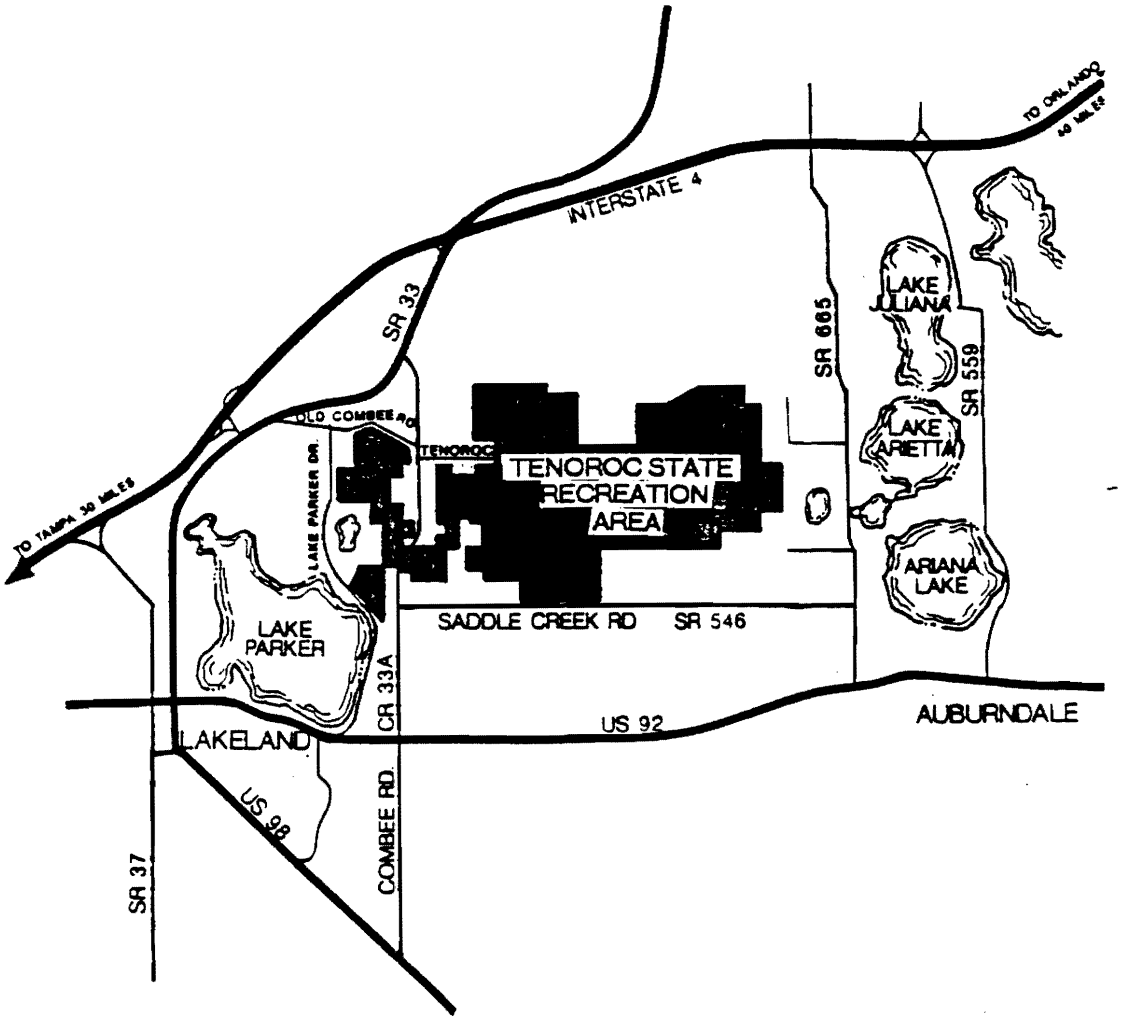
F-1

LOCATION MAP



F-2

SITE ACCESS



DESCRIPTION

For management purposes, the Florida Department of Natural Resources has assigned different zone headings to all areas of the park. Additionally, Tenoroc is divided into two main tracts for identification: the site area west of Combee Road (C.R. 33A) is known as the Lake Parker Tract, and that portion east of Combee Road is known as the East Tract (see figures F-3,4 & Appendix A-1-3).A description and approximate acreage of each zone is located in the appendix.

Existing Facilities

Approximately 4,350 acres of the Tenoroc site have been reclaimed. For the most part, these reclamation activities have been planned separately with minimal foresight for future recreational uses, ecosystem restoration or continuing reclamation activities. The majority of the reclaimed acreage has become pastureland.

Tenoroc's existing recreational facilities include minimal picnic areas, equestrian trails and hiking trails, but the main activity provided is fishing.

There are approximately 1,000 acres of lakes and channels that were created by the mining process and which provide both recreational and research opportunities.

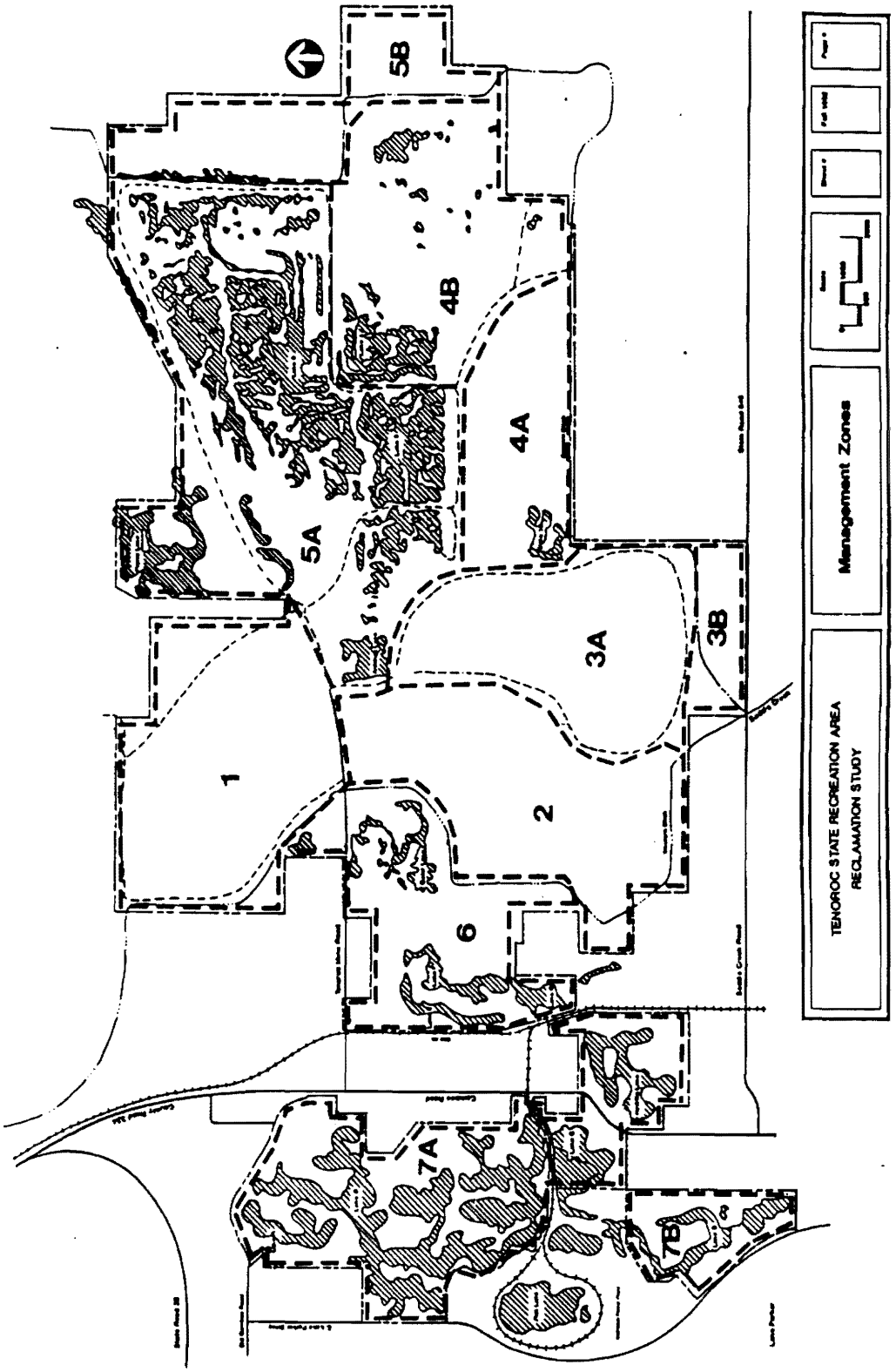
In 1983, many of the lakes were included in the Tenoroc Reserve Fish Management Area. Through regulation and observation, this program is designed to help protect the state's fisheries and enhance the fishing experience. The program allows biologists to study the effects that regulations have on fish populations and examine the attitudes of fishermen and their acceptance of tighter regulations in exchange for quality bass fishing. The idea is to compare effects different rules have on the number and size of bass caught by fishermen. Catch and release, restricted bag limits, slot limits, gear restrictions and quotas on boats and fishermen are examples of the experimental regulations at Tenoroc (Tenoroc State Recreation Area Brochure)(see management guidelines in Appendix A-4,5).

Adjacent Land Uses

Lakeland's urban sprawl has just begun to reach the areas adjacent to Tenoroc. According to the Lakeland Comprehensive Plan, projected growth is expected to expand northward to I-4 and along the highway corridor.

F-3

F-4


5B
4B
4A
5A
3A
3B
1
2
6
7A
7B
TENOROC STATE RECREATION AREA
RECLAMATION STUDY
Management Zones

The two land uses that occupy most of the adjacent land around Tenoroc are agriculture and abandoned phosphate mines. The agricultural lands are primarily citrus groves and occupy most of the adjacent land east of Tenoroc. North of the site are large tracts of mined and reclaimed phosphate lands. Near the southeast property corner is an abandoned county landfill which occupies about ninety acres. South of the site is a mix of residential neighborhoods and open spaces, many of them wooded.

Southwest of the Tenoroc property are Lake Parker and the City of Lakeland's McIntosh Electric Plant. The electric plant is massive and highly visible from a great distance (2-3 miles). This visual intrusion can be screened through planting. Additionally, there are runoff and groundwater seepage from the nearby power plant's slag heaps. These issues are being monitored by the City of Lakeland's Department of Public Works (Cennon, 1992) (see figure F-5).

The existing light industry areas along State Road 546 are another source of visual conflict. These too can be ameliorated through reclamation processes.

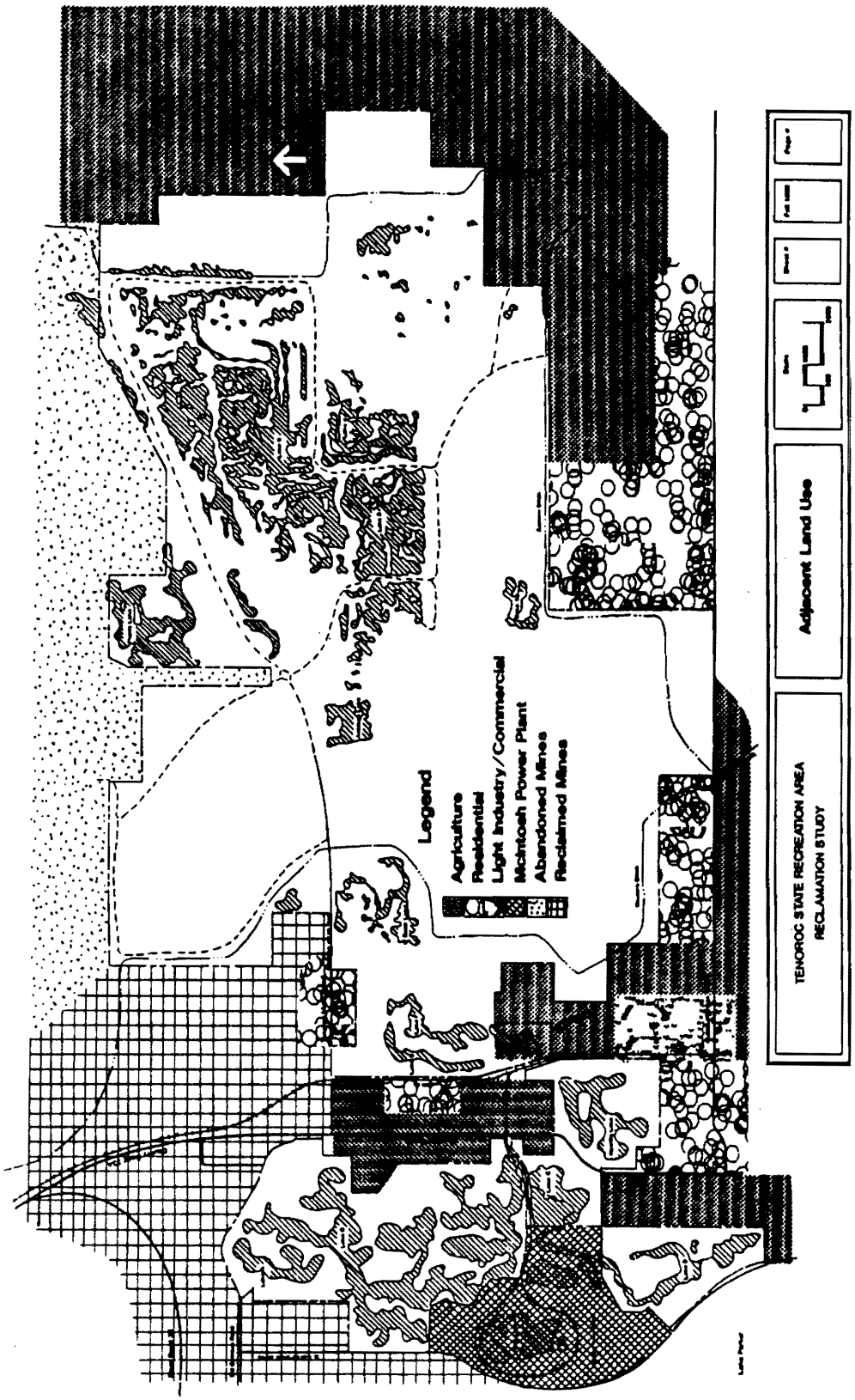
Parallel to County Road 33A is a CSX Railroad line which terminates a few miles north of Tenoroc. The rail is slated for abandonment, and there is interest by the State of Florida to possibly acquire it for conversion to the Rails-To-Trails Program.

The increasing threat of development has raised concerns for future availability of open space and the preservation and protection of natural resources. Polk County and the City of Lakeland have recently updated their Comprehensive Plans (1990) and have proposed to ring the edge of the Lakeland area with a conservation and preservation corridor (see figures F-6,7). The benefits derived from a continuous greenbelt include water conveyance, recharge and purification, vegetation and wildlife habitats (particularly , as an extension of the Green Swamp), recreational opportunities and increased values of adjacent lands. There are several tracts of publicly owned land already within the proposed greenbelt, and Tenoroc is one of these tracts (City of Lakeland Comprehensive Planning Program,1990).

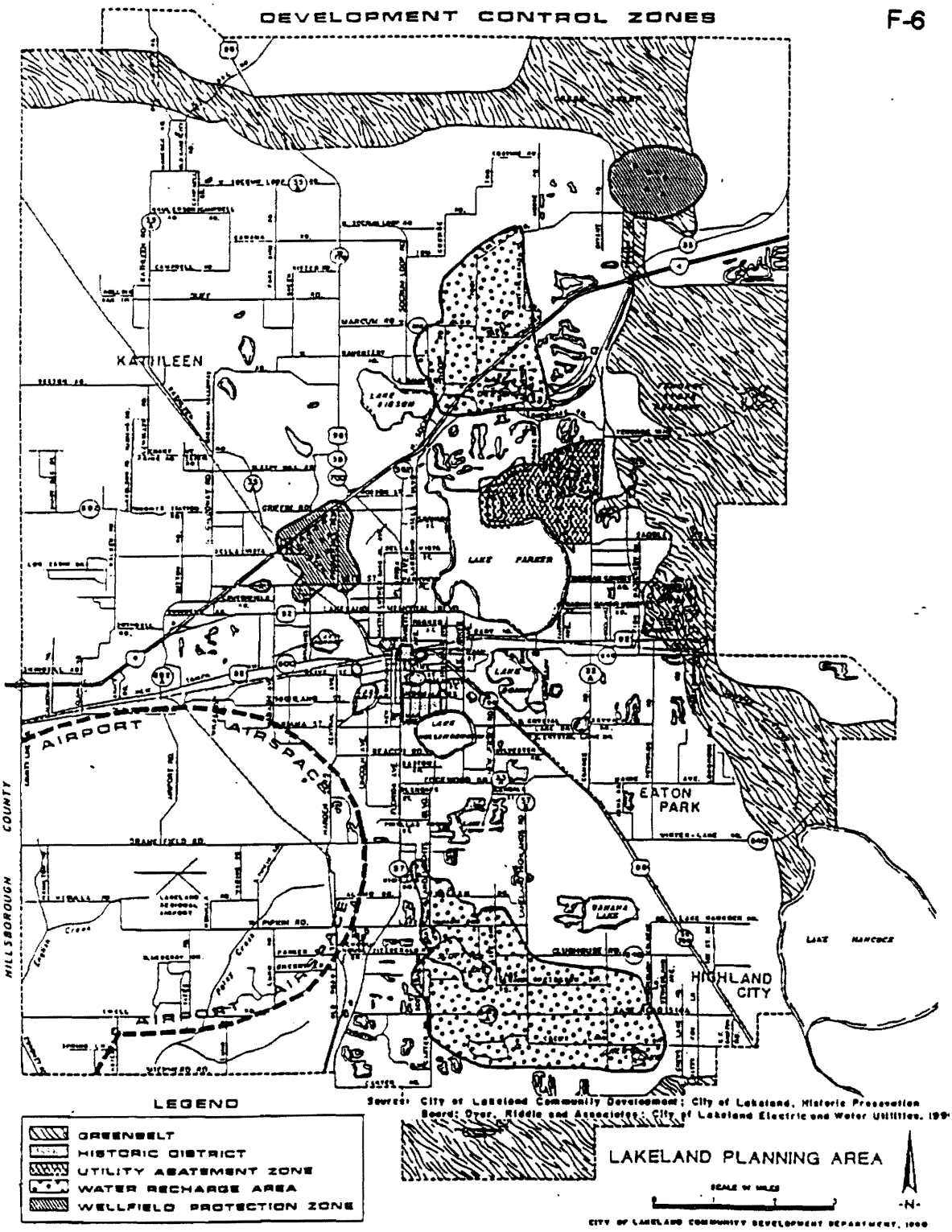
The Mining Process

Phosphorous is found in phosphate rock, and is a mineral required by every form of life on earth. Plants get their phosphorous from the soil, and we get ours from the foods we eat that grow in the soil. In order for crops to repeatedly grow in the same soil and provide the nutrients we need, phosphate must be replenished by applying phosphate fertilizers.

F-5

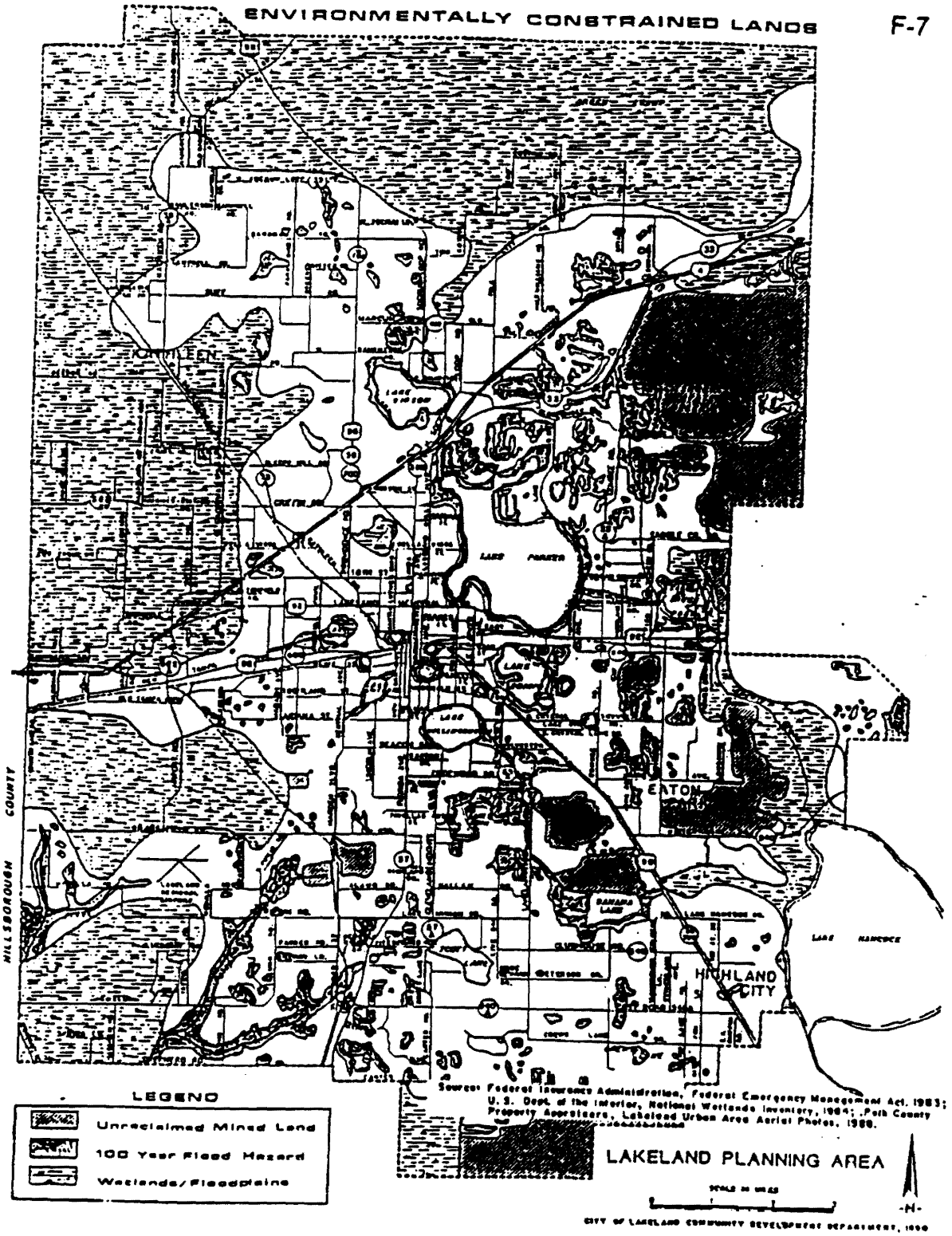

Legend
Agriculture
Residential
Light Industry/Commercial
McIntosh Power Plant
Abandoned Mines
Reclaimed Mines
TENOROC STATE RECREATION AREA
RECLAMATION STUDY
Adjacent Land Use

F-6



GREENBELT CORRIDOR

ENVIRONMENTALLY CONSTRAINED LANDS F-7



GREENBELT CORRIDOR

Florida provides 80% of the nation's and one- fourth of the world's supply of phosphate. Of the phosphate produced in Florida, 95% is used in agriculture: 90% goes into fertilizer and 5 % goes into livestock feed supplements. The balance is used in soft drinks, cloth dyes, vitamins, steel hardeners, gas and oil additives, toothpaste, shaving cream, soaps, bone china, plastics, optical glass, film, light bulbs, water softeners, insecticides, flame resistent products, aluminum polish, dental cements and in oil and gas drilling fluids (Florida Phosphate Council Brochure). Thus, phosphate has become a necessity in modern day living and phosphate mining an integral part of Florida's economy.

Due to the necessity of this mineral, Tenoroc has gone from a natural landscape to a man-made one from both the mining process and reclamation. Despite the advances in reclamation technology, it is impossible to erase these changes.

In order for Tenoroc to remain stable and progress toward a more natural system, intervention by man is needed to protect and/or monitor the site from further man-made influences that might alter or retard the recovery process. Pollution runoff and exotic species invasion are examples of such influences. This intervention by man must begin with an understanding of the mining process and its after-effects on the landscape.

Florida phosphate ore is found under scrub land and is comprised of one-third sand, one-third clay and one-third phosphate.The soil above this matrix, known as overburden, is thirty to fifty feet thick and is composed of sands, clays and organic matter such as peat or humus. The overburden is removed by draglines and piled in trenches. The matrix is then removed and placed in a pit and mixed with water. This watery mixture, known as slurry, is then pumped through a pipe to a washer plant. At the washer plant, the rock is crushed and shaken on vibrating screens. The pebbles are sent to rock storage piles and the tiny bits of phosphate mixed with sand (called feed) pass through the screens and into a flotation machine. At this point, the clay stays in the water and is pumped to clay settling areas. In the flotation machine, substances are mixed with the feed to help separate the phosphate rock from the sand. The separated rock is then sent to storage piles and the sand (known as sand tailings) is pumped back to the mining area for storage or use in reclamation projects such as fill for recontouring uplands. (Florida Phosphate Council) (see figure F-8).

The clay settling ponds, due to the colloidial properties of clay, take twenty to thirty years to become stable enough to support any type of load. At Tenoroc, the clay settling ponds cover approximately 2,500 acres, with an average clay depth of 20 feet. Typically, two-thirds of the land mined in this area is needed for clay settling ponds. Although this makes the ponds unsuitable for development for many

years, when they are full of water in their early years, these ponds support wetland vegetation and wading bird habitat.

Overburden fill, including topsoil, is typically used as a surface-layer cap over sand tailings. More recently, it has been used in wetland reclamation and to enhance upland habitat in Florida. Only about 20 perecent of the overburden is saved and re-used. Its high content of sand and low organic content makes it unworthy of selling or stockpiling. (Richardson, 1992)

An unwelcome by-product of processing phosphate rock for use as fertilizer is phosphogypsum - more commonly known as gypsum. This by-product is stored in areas similar to clay settling ponds and are known as gypsum stacks due to the mounds of this material that is currently being stockpiled. The phosphogypsum contains a disconcerting amount of radioactive material, resulting in a federal moratorium on its current or future use, including research applications. There are additional concerns over the leaching from these stacks that may be contaminating groundwater. This has become an urgent issue within the phosphate industry bacause storage of this by-product is currently using approximately 25 percent of the acreage of a fertilizer plant. It is estimated that there are over 600 million tons of gypsum being stored in Florida with about 30 million tons of production being added each year. This issue is beyond the scope of this paper, but provides opportunity for extensive research (McFarlin, 1990).

As a result of mining operations, numerous lakes are formed within the disturbed landscape. Tenoroc is characterized by two types of lakes: unreclaimed mine cuts known as "finger lakes," and reclaimed lakes which are known as "land and lakes" (see figures F-9,10).

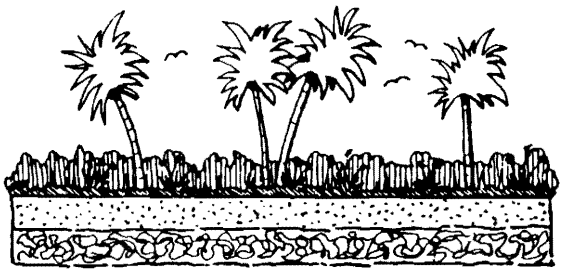
The finger lakes usually have narrow channels and are divided by steep spoil ridges. These lakes have bank slopes of 20 to 50 percent and can be up to 100 feet in depth.

"Land and lakes" is a term used to describe a resulting landform in which former mine cuts have been re-shaped to a more natural appearance with flatter slopes. These lakes were finger lakes prior to reclamation (Marion, 1986a).

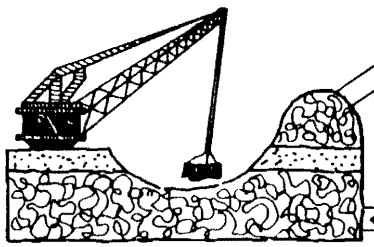
Reclamation

In 1975, chapter 578 of the Florida statutes was passed, which deals with the mined-land reclamation. This statute had a four-fold impact in the mining/development process:

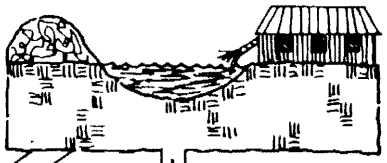
THE MINING PROCESS



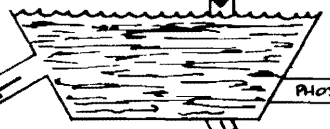
1. FLORIDA PHOSPHATE ORE IS FOUND UNDER SCRUB LAND. THE TOP LAYER OF SOIL (OVERBURDEN) IS 30 TO 50 FEET THICK. THE OVERBURDEN COVERS THE PHOSPHATE MATRIX - A LAYER OF PHOSPHATE ROCK MIXED WITH SAND AND CLAY.



2. A DRAGLINE MACHINE SCOOPS OUT THE OVERBURDEN AND PUTS IT TO ONE SIDE. THEN, THE DRAGLINE DIGS OUT THE PHOSPHATE MATRIX.

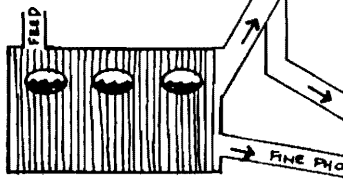


3. THE DRAGLINE PUTS THE MATRIX IN A PIT CLOSE BY. HOSES ON A PORTABLE PIT CAR MIX WATER WITH THE MATRIX (CALLED SLURRY). THE SLURRY IS THEN PUMPED TO A WASHER PLANT.



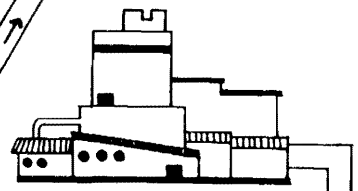
4. AT THE WASHER PLANT, THE PHOSPHATE ROCK IS CRUSHED AND SHAKEN ON VIBRATING MACHINES. THE PEBBLES ARE SENT TO ROCK STORAGE PILES, AND THE TINY BITS OF PHOSPHATE MIXED WITH SAND (CALLED FEED) PASS THROUGH THE SCREENS AND INTO THE FLOTATION MACHINE.

5. THE WATERY CLAY ARRIVES AT A SETTLING POND. HERE, IT IS STORED WHILE THE CLAY SLOWLY SETTLES TO THE BOTTOM. CLEAR WATER IS DRAWN OFF AND PUMPED BACK TO THE MINES AND USED AGAIN.



6. THE FEED IS MIXED WITH SUBSTANCES THAT HELP SEPARATE THE TINY PIECES OF PHOSPHATE ROCK FROM THE SAND. THE SAND (CALLED SAND TAILINGS), IS PUMPED BACK TO THE MINING AREA.

7. PROCESSED PHOSPHATE.



8. THE PHOSPHATE IS THEN SENT TO A PROCESSING PLANT WHERE IT IS USED MOSTLY IN FERTILIZER AND ANIMAL FEED.

9. RECLAMATION - THE SAND TAILINGS PUMPED BACK TO THE MINE ARE USED TO FILL THE MINE HOLE. THE OVERBURDEN SAVED IS USED TO COVER THE SAND.

1. It established a Land Use Advisory Committee, who evaluate land disturbed by phosphate mining prior to July 1, 1975; land not subject to mandatory reclamation.

2. It allows the Department of Natural Resources to develop master plans that would provide guidelines for reclamation on lands mined prior to July 1, 1975, and to preview reclamation plans for present and future mining operations.

3. It created the mandatory Land ReclamationTrust Fund which provides monies for reclamation of lands based on master plan guidelines. It also allows the Department of Natural Resources to use fund money to purchase land determined to be in the public interest.

4. It established the Florida Institute of Phosphate Research which studies reclamation practices and mining operations and funds research projects concerning the phosphate industry and reclamation.

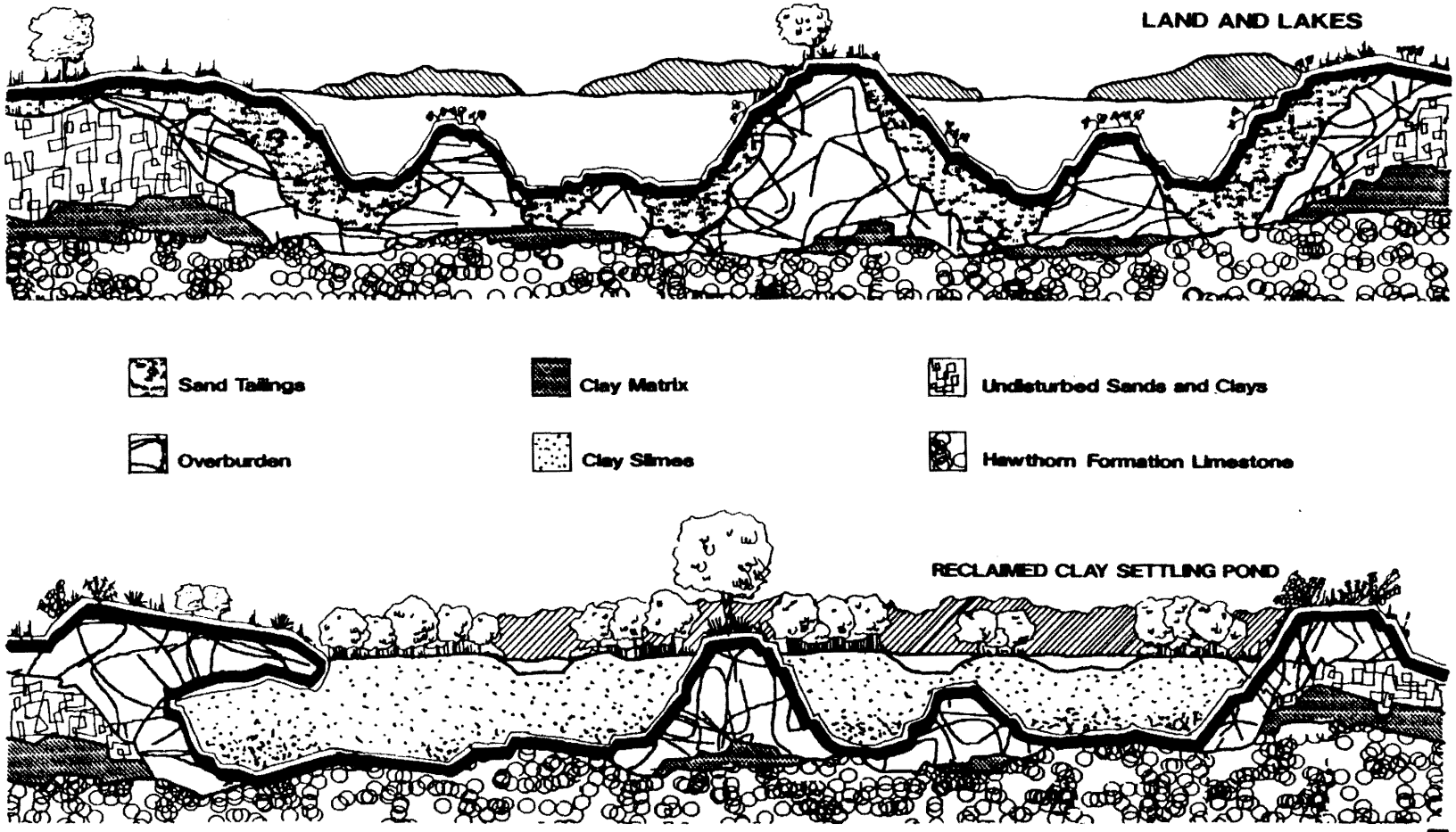
One of the benefits for Tenoroc that came out of the 1975 regulations is the "Old Lands" Reclamation Program, which establishes regulations and funding for lands altered by phosphate mining operations prior to July 1, 1975. Tenoroc has approximately 1,275 acres that are eligible for these funds (Scruggs, 1992).

Geology

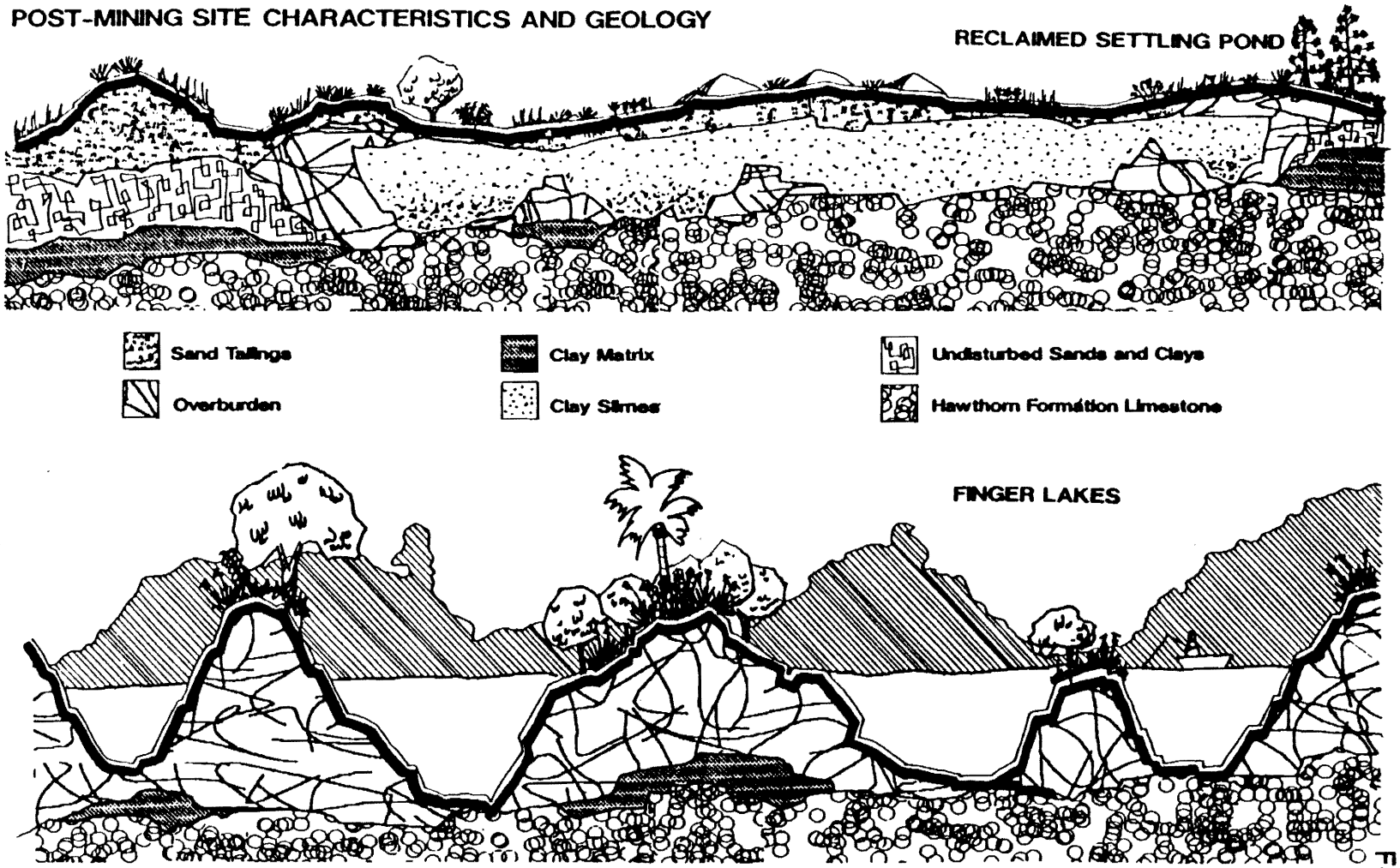
Tenoroc lies within the Polk Upland physiographic province. The rock layers of this area include deposits which date back to the Paleocene and Holocene Ages. This includes rock layers from the Pliocene and Miocene Ages where phosphate deposits are typically found. More specifically, the phosphate deposits are found within the Hawthorn and Bone Valley Formations, with most of the phosphate ore mined in Florida being located in the Bone Valley Formation (Scott, 1988).

It is important to note that this geologic description of Tenoroc no longer exists (see figure F-11). It has been drastically changed by the mining process. Everything above the bedrock of the Hawthorn Formation has been removed, separated by the benefication process (phosphate removal and separation) into sand tailings and clay slimes, and placed back on top of the bedrock in piles or beds as segregated materials (see figures F-9,10).

POST-MINING SITE CHARACTERISTICS AND GEOLOGY



POST-MINING SITE CHARACTERISTICS AND GEOLOGY



Soils

Soil characteristics are an integral part of a project analysis, particularly where reclaimed lands are concerned. Basically, the mining process reverts soil development back to its earliest evolutionary stages, resulting in a growing medium that lacks organic and nutrient value needed to support vegetation (Clewell,1981).

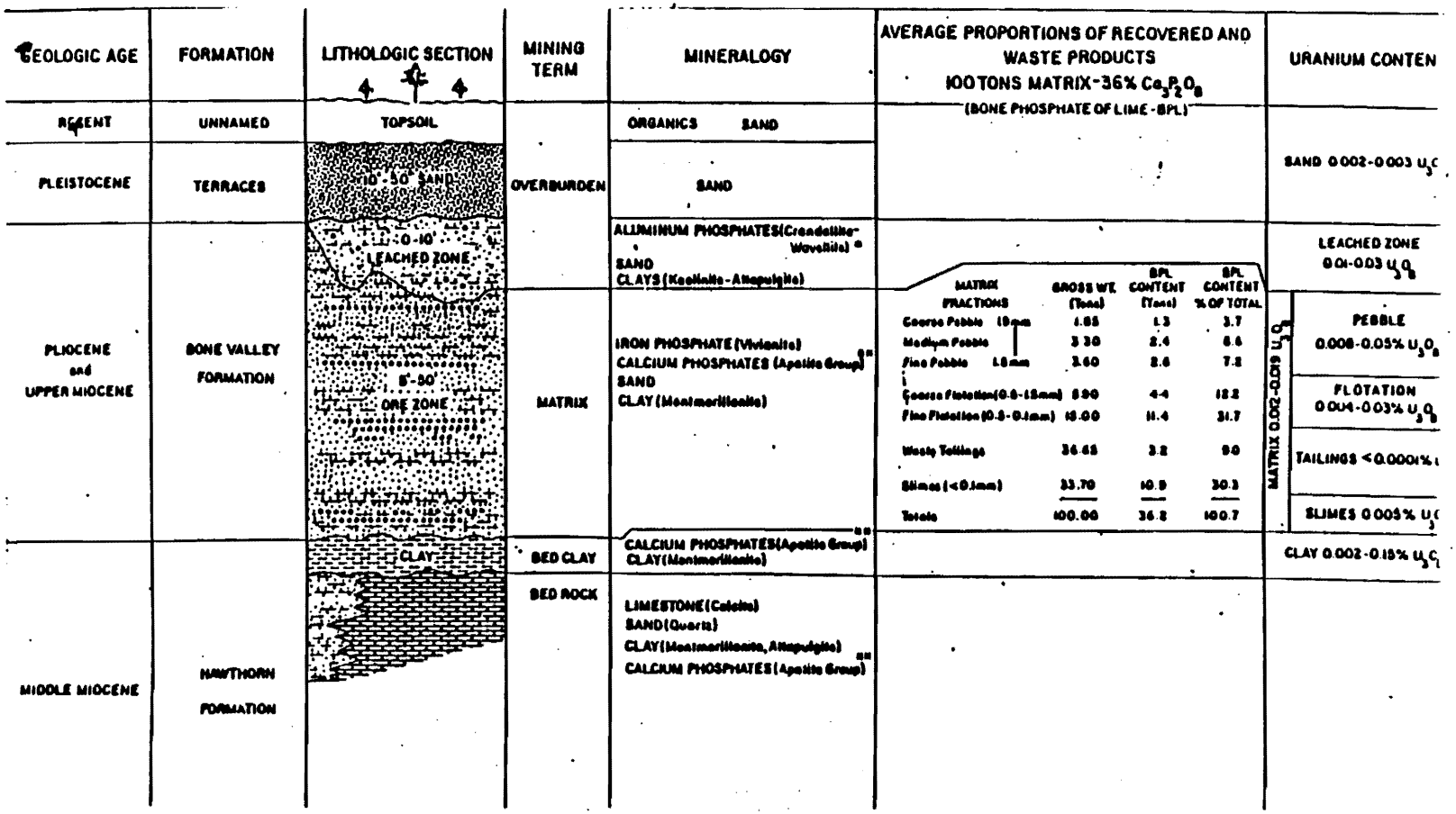
According to the 1927 Soils-Vegetation Map, the original soils of Tenoroc were almost half underwater; in swamps, peat bogs and cypress domes. (see figures F-12-14). A majority of the remaining lands were flatwoods that detain water for long periods of time. While prime ecosystems have been destroyed, the alterations produced by the mining process have in fact increased the development potential of Tenoroc. The removal of clay and organic materials has increased the percolation rates, and the consolidation of surface waters into deep pits has created dry land in the place of swamps (see Soils Description, Appendix A-6-10).

However, this is not true for all of Tenoroc. Many areas are just as limited for development if not more so. The majority of the land at Tenoroc is now comprised of clay settling ponds which may not be capable of supporting flora and fauna for many years.

The 'finger lakes' area which has not been reclaimed are unstable and still have slopes that are too steep and unstable for development. The high content of sands in these spoil piles currently contribute to the problem of washouts along the primitive roads and boat ramps within Tenoroc.

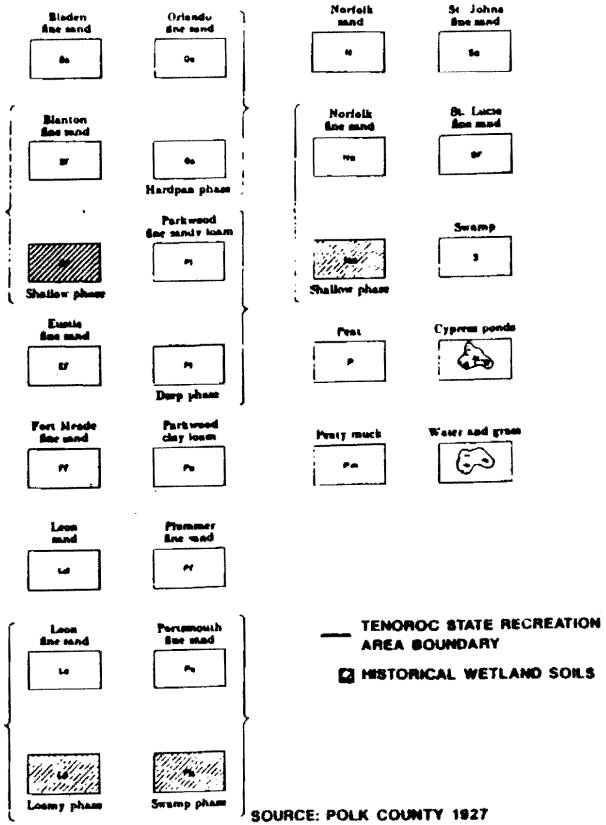
Additionally, there is concern at this point that any attempt to restructure some of these areas would result in the destruction of wildlife habitat that, after twenty years, has established itself naturally (Scruggs, 1992).

In order to support vegetative communities at Tenoroc, the soil development process must begin again. Left alone, this process could take centuries. But with reclamation programs and management, the time frame can be greatly reduced. While the existing soils can never be returned to their characteristics prior to the mining process, the vegetative communities that they can best support can be determined through analysis. For example, sand areas may be best for xeric pinelands due to the lack of nutrients and fast percolation rates; clay settling areas may be more suitable as hydric habitats because of their water retention, and areas of overburden may be suitable for upland habitat because of the existing nutrient and organic matter.With the addition of nutrients and organic matter, the

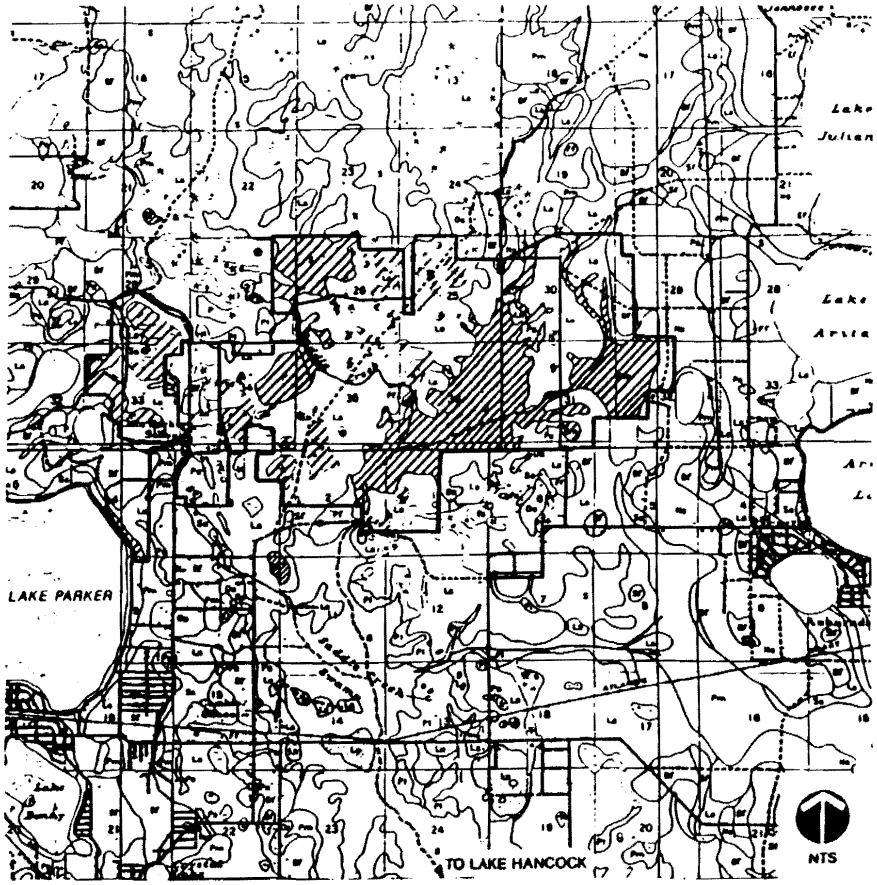


SOURCE: WAKELAND THESIS, 1981

LEGEND



SOURCE: POLK COUNTY 1927 SOIL SURVEY



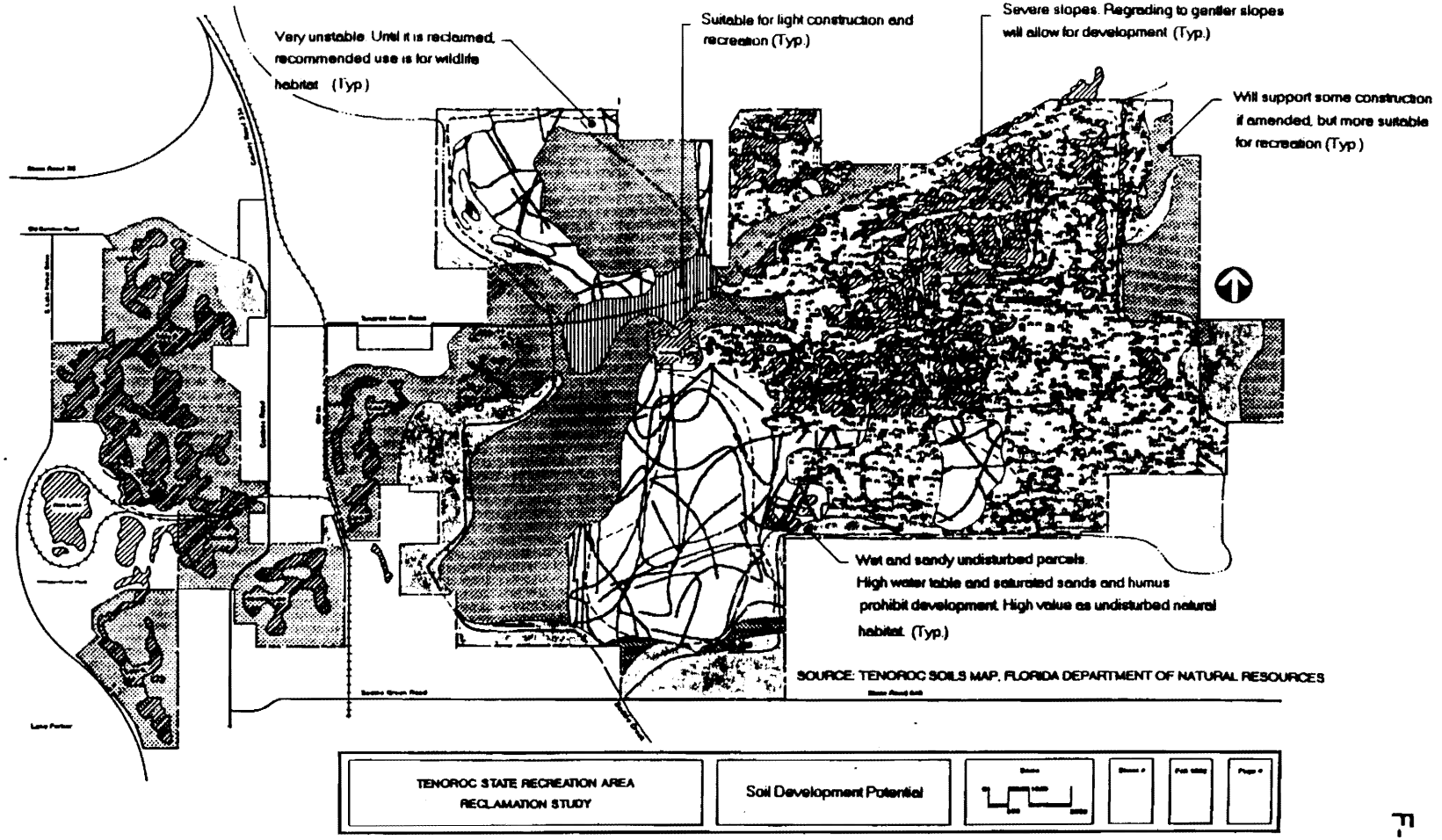
SCALE: 1"=1 MILE

1927 SOILS MAP

F-12

F-13

TENOROC STATE RECREATION AREA
RECLAMATION STUDY
Soils Map
SOURCE: 1988 SOIL CONSERVATION SERVICE POLK COUNTY SOIL SURVEY
Legend
MANAGEMENT ZONE
5B
4B
4A
5A
3A
3B
2
6
7A
7B


Very unstable. Until it is reclaimed, recommended use is for wildlife habitat (Typ.)
Suitable for light construction and recreation (Typ.)
Severe slopes. Regrading to gentler slopes will allow for development (Typ.)
Will support some construction if amended, but more suitable for recreation (Typ.)
Wet and sandy undisturbed parcels. High water table and saturated sands and humus prohibit development. High value as undisturbed natural habitat. (Typ.)
SOURCE: TENOROC SOILS MAP, FLORIDA DEPARTMENT OF NATURAL RESOURCES
TENOROC STATE RECREATION AREA RECLAMATION STUDY
Soil Development Potential

chance of survival of these communities is greatly increased. Equally as important is the consideration of other aspects of the site such as hydrology, and topography.

Topography

No accurate, updated topographic information on Tenoroc could be obtained. All available contour maps are based on photography that occured prior to the mining operation. The following sketches (see figure F-15) are representational of the post-mining and reclamation landforms.

Vegetation

Historically, the site of Tenoroc Recreation Area hosted several native plant communities such as pine flatwoods, swamp, cypress ponds, and mesic flatwoods.

Past reclamation included the planting of various species of trees such as slash pine, black gum, persimmon, loblolly bay and bald cypress. Unfortunately, many of these species have failed to survive. This low survival rate may be attributed to a variety of problems including: drought, poor soil conditions, improper transplanting, poor quality saplings, or invasion of exotic species.

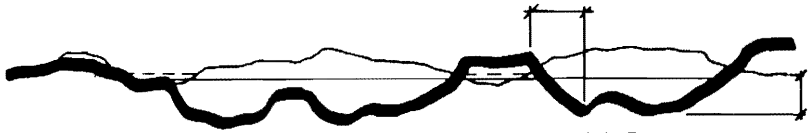
The existing vegetation at Tenoroc consists primarily of exotic and nuisance species such as brazilian pepper, rattlebox, saltbush and various other trees and grasses (see Appendix A-11-17). Exotic species are those species not native to the area which have spread in great numbers, causing a decline in the native vegetation. These species usually have little wildlife value except for sheltering small animals.Nuisance plants are native species that, under the right conditions, proliferate to the point of becoming a problem. Some exotic species are beneficial. For example, the Hydrilla, a water species, may be beneficial in enhancing fish habitat. In such cases, a carefully monitored management program is needed to assure that the benefits are not outweighed by its potential problems. (see figure F-16)

The following, provided by the Tenoroc State Reserve Management Plan, is a description of existing vegetation at Tenoroc:

REPRESENTATIONAL TOPOGRAPHY SKETCHES

LAND AND LAKES (ZONES 6, 7A, 7B)

4:1 Max. Slope



Lake Depths From 25 - 40 Ft

Legend

- EXISTING GRADE
- EXISTING WATER LEVEL
- ORIGINAL GRADE
- ORIGINAL WATER LEVEL

RECLAIMED CLAY SETTLING POND (ZONES 3A, 1)

Dikes 12 - 20 Ft

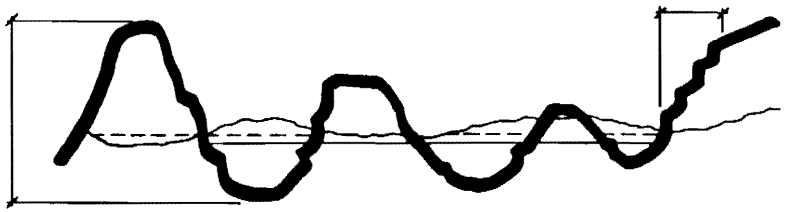
RECLAIMED SETTLING POND PASTURE (ZONE 2)

Sand Tailings Up To 25 Ft

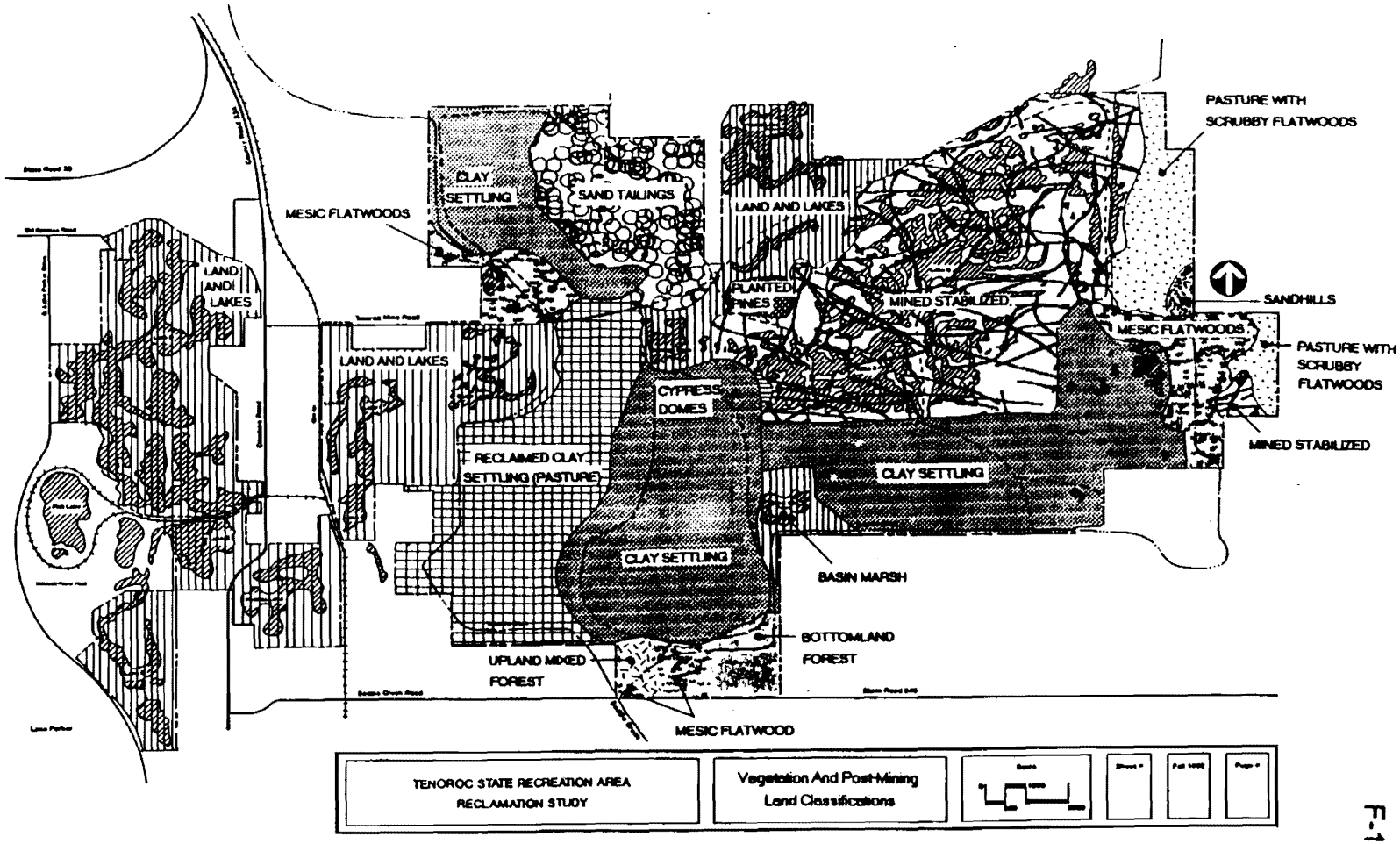
FINGER LAKES (ZONES 5A, 4A, 4B)

Spoil Piles Up To 25 Ft

3:1 - 1:1 Slopes



Lake Depths Up To 50 Ft


PASTURE WITH
SCRUBBY FLATWOODS
CLAY
SETTLING
SAND TAILINGS
MESIC FLATWOODS
LAND AND LAKES
LAND AND LAKES
PLANTED PINES
MINED STABILIZED
SANDHILLS
MESIC FLATWOODS
PASTURE WITH
SCRUBBY
FLATWOODS
MINED STABILIZED
LAND AND LAKES
CYPRESS
DOMES
RECLAIMED CLAY
SETTLING (PASTURE)
CLAY SETTLING
CLAY SETTLING
BASIN MARSH
BOTTOMLAND
FOREST
UPLAND MIXED
FOREST
MESIC FLATWOOD
TENOROC STATE RECREATION AREA
RECLAMATION STUDY
Vegetation And Post-Mining
Land Classifications

F-16

Mesic Flatwood

Slash pine, St. John's wort, gopher apple, saw palmetto and yellow eyed grass are examples of vegetation found on this relatively flat, moderately drained soils. Fire is needed every 3-8 years to maintain this community.

Sandhill

Slash pine, turkey oak, persimmon and gopher apple occur on hills and slopes of rolling terrain, with well-drained, sterile soils. These areas are important for aquifer recharge. Fire is necessary every 2-5 years to maintain this association.

Upland Mixed Forest

This is a closed canopy containing southern magnolia, sweet gum, red maple, flowering dogwood, live oak, hackberry and persimmon. It consists of rolling hills with outcrops of limestone and clayey, organic soils which attribute to runoff.

Land and Lakes Reclamation Areas

Wax myrtle, willow, saltbush and rattlebush (seeds are toxic to birds and wildlife) provide a limited overstory along the perimeter of the areas, with the reduced spoil pile slopes containing bermuda grass, dog fennel, camphorweed, natal grass and crab grass.

Scrubby Flatwoods

This is an open canopy of slash pine, sand live oak, wax myrtle, saw palmetto with an understory containing goldenaster, goldenrod, tarflower and wiregrass. Fires normally occur every 8-25 years.

Clay Settling Areas

Much of the area is in grasses and groundcovers such as virginia creeper, muscadine, bermuda grass dog fennel caesar weed and especially cogan grass which is an exotic species. There is some overstory consisting of wax myrtle, saw palmetto, brazilian pepper (exotic), lantana and rattlebox (toxic seeds).
The wetland areas contain carolina willow, saltbush, cattails, water lettuce, duck weed and water primrose.
Planted Pine

An experiment with longleaf pine which has not been very successful.

Cypress Domes

These areas are post-mining remnants of pre-existing communities at Tenoroc. They are comprised of bald cypress, swamp tupelo, slash pine, red maple, sweet bay, loblolly bay and fetterbush.

Bottomland Forest

Low-lying, closed-canopy forest consisting of bald cypress, black gum, reed bay, sweet bay, cabbage palm, water oak, live oak, laurel oak, wax myrtle, saw palmetto and saltbush. Periodoc flooding is necessary to maintain this association.

Basin Marsh

These areas are remnants of the original wetland communities. They consist of carolina willow, saltbush, elderberry, buttonbush, cattails, dog fennel, pickerelweed and yellow eyed grass. Some exotics such as water lettuce and water hyacinth have found there way into these communities.

Serious consideration should be given to the removal of exotic species.The removal of exotics should coincide with a revegetation program, including controlled burns. Revegetation should be an organized process that concentrates on the final outcome of a complete environmental ecosystem, rather than individual vegetative communities.

Wildlife

The wildlife value of phosphate mined lands ranges from being poor to very good, depending on the specific area mined, its use during mining, and its current successional stage (Rimmer, 1988). Important factors in wildlife habitat are diversity, habitat corridor, amount and quality of edge and the supply of food, water and shelter.

It is important to understand the zones created by the mining process. While each zone is very different from one another, generally, they all lack diversity in vegetation and topography. There are tracts of land created that are stark and barren or overgrown with one or two types of vegetation, of which provide little wildlife value (brazilian pepper, willow, cogan grass). The niches that once existed and protected wildlife are gone. Areas of vastly different character abut one

another along a straight line and are frequently separated by dikes or steep drainage ditches, preventing a continuous habitat corridor.

Some areas, in and of themselves, provide good habitat for particular species. For example, the clay settling ponds, with their large, expanses of shallow water, provide habitat for wading birds and waterfowl. However, these ponds are often temporary because of the reclamation process of dewatering, which most often leaves an area of mud flats, covered with willow and vines (Florida Institute of Phosphate Research, #04-039-087).

The 'finger lakes' provide excellent fish habitat due to their depths, but their steep sides and lack of a littoral shelf, where wading birds often breed, are difficult to access. The islands are either too steep or thickly covered with vegetation with little wildlife value.

Presently, upland wildlife at Tenoroc is limited due to a lack of suitable habitat.The greatest concentration of wildlife is centered at a bird rookery located at the southern end of Lake 5. An estimated 500 white ibis, 200 cattle egret and 10 great blue heron were found to be nesting there (Sessions, 1992). Additionally, osprey nest on constructed platforms and fish in the lakes.

Reclamation at Tenoroc will greatly increase wildlife habitat in the future. The planting of hardwoods and pines will provide food and shelter. The replacement of exotic species with indigenous shrubs and herbs will attract wildlife. The restoration of Saddle Creek will provide habitat corridor, connecting Tenoroc to the larger context of the Saddle Creek-Lake Hancock Basin. A list of wildlife species, provided by the Tenoroc Draft Management Plan, is located in the appendix (A-18-23).

Hydrology

The Tenoroc State Recreation Area is located in the Peace River basin in central Florida. Most of Tenoroc lies in the Saddlecreek headwaters. Saddle Creek, a tributary of the Peace River, flows into Lake Hancock before joining Peace Creek to form the Peace River (see figure F-17).

Historically, Tenoroc and property to the north of Tenoroc were part of a large wetland system. These wetlands consisted of hardwood swamps, cypress stands, shallow marshes and pine flatwoods.Today, due to the phosphate mining that has occured, the historical drainage patterns in the Saddle Creek drainage basin have been severely altered. The large amounts of water required by the mining process

must be detained until waste products silt out, which may take years in the case of waste clays. The use and detention of this water alters the normal flow of water to the downstream areas. Stream beds are channelized and discharge points are blocked. At Tenoroc, over the course of the mining operations, land downstream within the original watershed has dried up, resulting in a change in land use such as pasture, meadows, citrus groves and residential development (Martin, 1992).

The Tenoroc property west of County Road 33A consists of reclaimed "land and lakes" areas. These areas currently function as closed systems; that is, there is no surface water ouflow, resulting in relatively stagnant water. This fact combined with fertilizer and pesticide runoff from adjacent agricultural lands has created a problem with water hyacinth and water lettuce growth. Currently, the management program at Tenoroc controls these exotics with herbicides. Alternative control methods that are more natural should be considered, such as stocking with grass carp or manual removal of the invasive species.

The water requirements of a mining operation result in a system of ditches, pipes and structures installed for temporary usage of drawing both surface and groundwater supplies. On Tenoroc, there are two major ditches that converge just north of State Road 546. These ditches contain drainage control structures that are remaining from the mining operation. These drainage control structures do not function properly, thus detention of water during a significant storm is not possible. However, the actual amount of water flow off the site is less today than before the mining operations when Tenoroc was part of a major wetland (see figure F-18) (Martin, 1992).According to M.T. Brown's and F.R. Best's manual titled "Landscape Restoration - A Reclamation Manual for Phosphate Mined Lands, Executive Summary"; based on their findings from three monitored phosphate watersheds and two natural watersheds, surface runoff from mined watersheds is less than from natural watersheds and groundwater flows are greater from mined watersheds than from natural watersheds.

Beneath Tenoroc State Recreation Area is a multilayered aquifer system consisting of the surficial aquifer, the intermediate aquifer and the Floridan aquifer. The surficial aquifer is the coarse, sandy layer (matrix) of the phosphate deposits, and is confined by the heavy clays of the Bone Valley Formation.

The intermediate aquifer, lying between the suficial aquifer on top and the Floridan aquifer below, consists of three hydrogeologic layers: 1) a lower layer that lies directly on the Floridan aquifer, 2) a middle layer consisting of dolomites, sands, clays and limestones, and 3) an upper layer separating it from the surficial aquifer. The intermediate aquifer has a depth of approximately 100 feet.

The Floridan aquifer is well confined by the lower layer of the Hawthorn group (Scott, 1988).

Generally, the water quality of these three aquifers is within the Florida Department of Environmental Regulation minimum standards (Polk County Surface Water Management Plan).

Tenoroc is an important site in that it is at the headwaters of Saddle Creek which feeds into Lake Hancock and then into the Peace River. Both Lake Hancock and the Peace River are suffering from increased pollution levels and interrupted flow caused by both phosphate mining and agricultural practices (citrus groves, cattle ranching) within the Peace River drainage basin. Thus, Tenoroc's location at the head of the watershed becomes an important part of alleviating problems downstream.

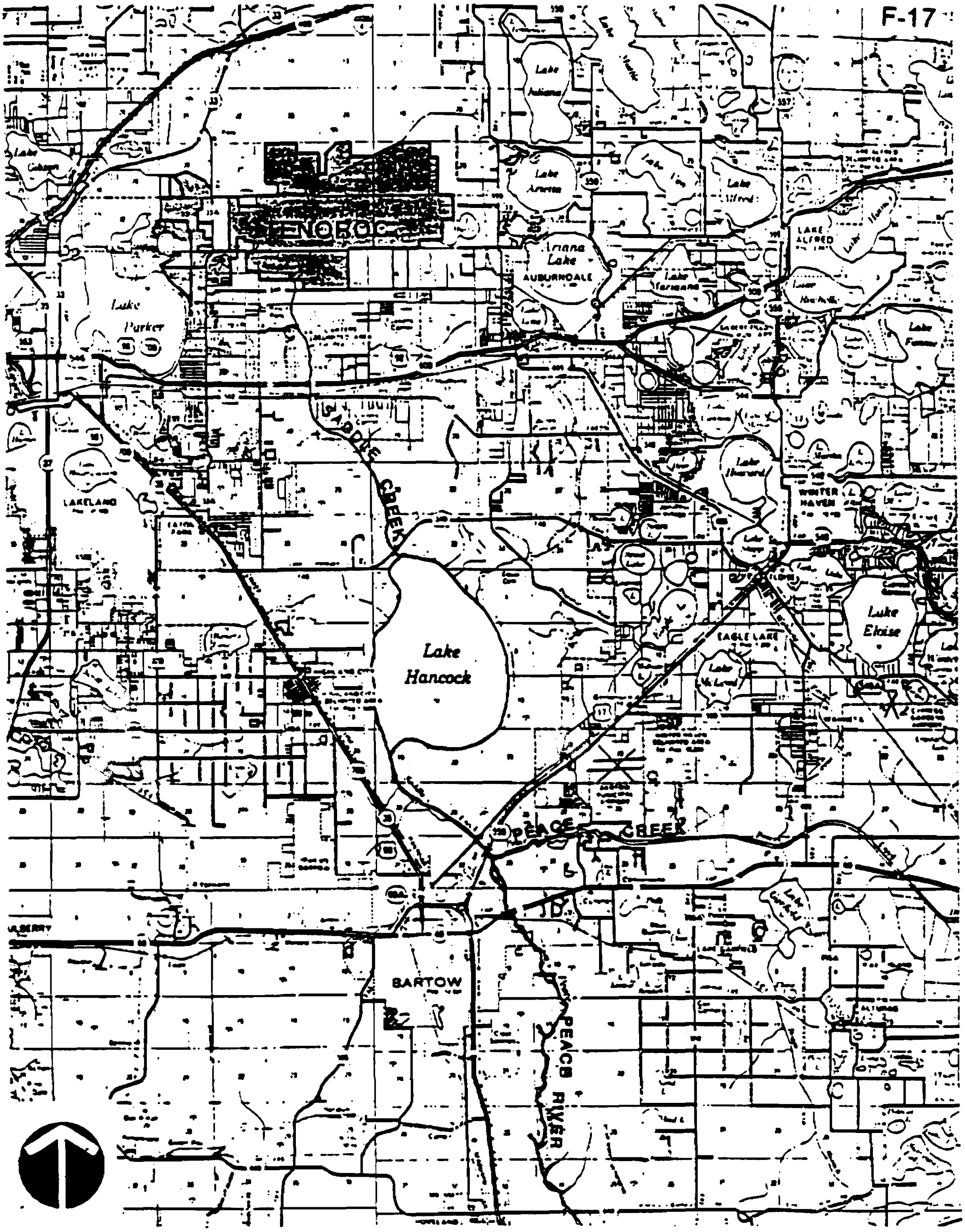
Research Programs

There are several research programs that have been taking place at Tenoroc:

As described previously, the Florida Game and Freshwater Fish Commission has a management program which is designed to study the effects that restricted fishing has on the quality of the fishing experience as well as attitude of fishermen on such restrictions.

A Gopher Tortoise Relocation project was begun at Tenoroc on a former clay settling area topped with overburden and sand tailings. Some of the original tortoises have been found to relocate into other areas of Tenoroc. The results of the study indicate that Tenoroc has suitable habitat for the gopher tortoise and location preference seems to vary among individual tortoises (Macdonald thesis).

The Florida Institute for Phosphate Research is involved in a study evaluating the hydrological impacts of phosphate-mined land reclamation and data are still being collected and analyzed. Additionally, data is being collected on one of the basins of the Tenoroc property to study the flow characterisitics of reclaimed phosphate mines. A drainage model has been developed, and the data collected is being used to calibrate this model.(Richardson, 1992).



REGIONAL HYDROLOGY

F- 18

Legend
Main Channel Flow
Secondary Channel Flow
Sheet Flow
Drainage Structures
TENOROC STATE RECREATION AREA
RECLAMATION STUDY
Hydrology

ANALYSIS

Reclamation

Through increasing awareness and regulation, the process of mine reclamation is changing. Those in the field are developing a more holistic view of a project area and utilizing past and ongoing research to aid in their planning. Knowledge and understanding of natural communities and techniques to recreate these areas is also expanding. By utilizing these techniques together with proper design, Tenoroc State Recreation Area has the opportunity of becoming a model for today's reclamation practices.

Hydrology

The historic Saddle Creek bore little resemblance to the existing system of channels. Most likely, the Creek was contained within a broad spanse of cypress trees with a wide floodplain as it meandered its way toward Lake Hancock (Sessions, 1992). Efforts to recreate these natural system characteristics would greatly enhance the environmental aspects of Tenoroc.

As mentioned earlier, the lake systems in the western portion of Tenoroc (west of County Road 33A) function as a closed system. However, the majority of lakes in the eastern portion of the site are presumed to be open systems, as there is some type of outfall structure at each lake. A flow-through system is preferred in that the movement of water prevents stagnation, thus maintaining water quality. An open system also allows for better flood control management (Martin, 1992). Due to the mining process, almost all of the lakes at Tenoroc currently lack a littoral shelf. The littoral shelf is a shallow-water region where light penetrates to the lake bottom. This shelf is usually inhabited by rooted aquatic plants which function as filtration systems. The shelves also serve as important food sources and habitat for freshwater-dependent fauna, as well as fish which are recreationally important to Tenoroc.

Reclamation of some of the lakes by re-grading shorelines to create littoral shelves could prove beneficial in attracting wading birds and improving diversity among faunal species.

Local and state agencies are in the process of preparing a management plan for Lake Hancock which is located south of Tenoroc. Background study thus far has indicated a need for increased volume of water to Lake Hancock to prevent further eutrophication.(Martin, 1992).

One method that can be considered to increase the volume of flow out of Tenoroc would be to open the closed lake systems. Detention of the increased flow could be controlled through the use of existing lakes and by the creation of additional valley storage. These detention devices would be utilized during heavy storms so that off-site peak flow rates would not increase.

Another method to seriously consider in the re-creation and/or enhancement of natural drainage systems is stream reclamation. Stream reclamation can be defined as a natural, meandering watercourse created or enhanced with vegetation to provide a drainage function as well as a resource management benefit (Robertson, 1988). This type of reclamation is still very new, with only a handful of projects being completed. A stream reclamation project requires an in-depth analysis of on-site hydrologic conditions and considerable research concerning such topics as: configuration for the stream channel, revegetation, and the hydrologic characteristics of the watershed. Additionally, because of the infancy of this type of reclamation, The Florida Department of Environmental Regulation is reluctant to issue dredge and fill permits for such projects because there is little to no data supporting the claim that a stream in central Florida can be returned to a condition similar in characteristic to that prior to mining. (Robertson, 1988).

Within Tenoroc, the two major ditches that converge just north of State Road 546 have potential for enhancement or re-creation of a more natural stream system. Further hydrologic and soil studies would be needed before this type of project could begin. The outcome would be greatly dependent on the amount of water flow, topography and the type of soil presently found. Some of the communities that may be appropriate are: mixed hardwood wetland/bottomland, an intermittant stream, a shallow marsh system or a slough. Typical cross sections of these communities and decriptions follow (Ruesch, 1983 and Robertson, 1988).

Due to expense, the proceeding of this project would greatly depend on the availability of funding as well as the cooperation of the various interested agencies.

Descriptions

These descriptions are provided by the City of Lakeland Planning Department (1990):

Bottomland - This wetland community would include such plant species as cypress, willow, black gum, swamp chestnut oak, water oak, red maple and sweetgum (see figure F-19).

To assure survival of this type of community, studies would be needed to determine that enough water would be entering the reclaimed stream bed, that the surrounding area of the stream bed would be seasonally flooded and that the groundwater table would be high enough to keep the soil wet year round.

Shallow Marsh - These areas occur throughout Polk County. This community appears as an open expanse of grasses, sedges and other herbaceous plants in areas where soils are usually saturated with surface water for two or more months during the year (see figure F-20). Examples of shallow freshwater marshes found in Florida are: Flag marshes dominated by pickerel weed, Arrowhead marshes, Spike-rush marshes, Bulrush marshes and Maidencane marshes (Center for Wetlands).

Slough - These areas serve as drainage ways for water during periods of heavy rainfall. They appear as open expanses of grasses, sedges and rushes in areas that are saturated during the rainy season (see figure F-21). Most sloughs are long and narrow and slightly lower in elevation than the surrounding flatwoods or hammocks (Soil and Water Conservation Society, 1989). The soils are poorly drained, with an underlayer of clay or sand. During dry periods the slough would retain its characterisitics, yet would also survive during periods of heavy rainfall.

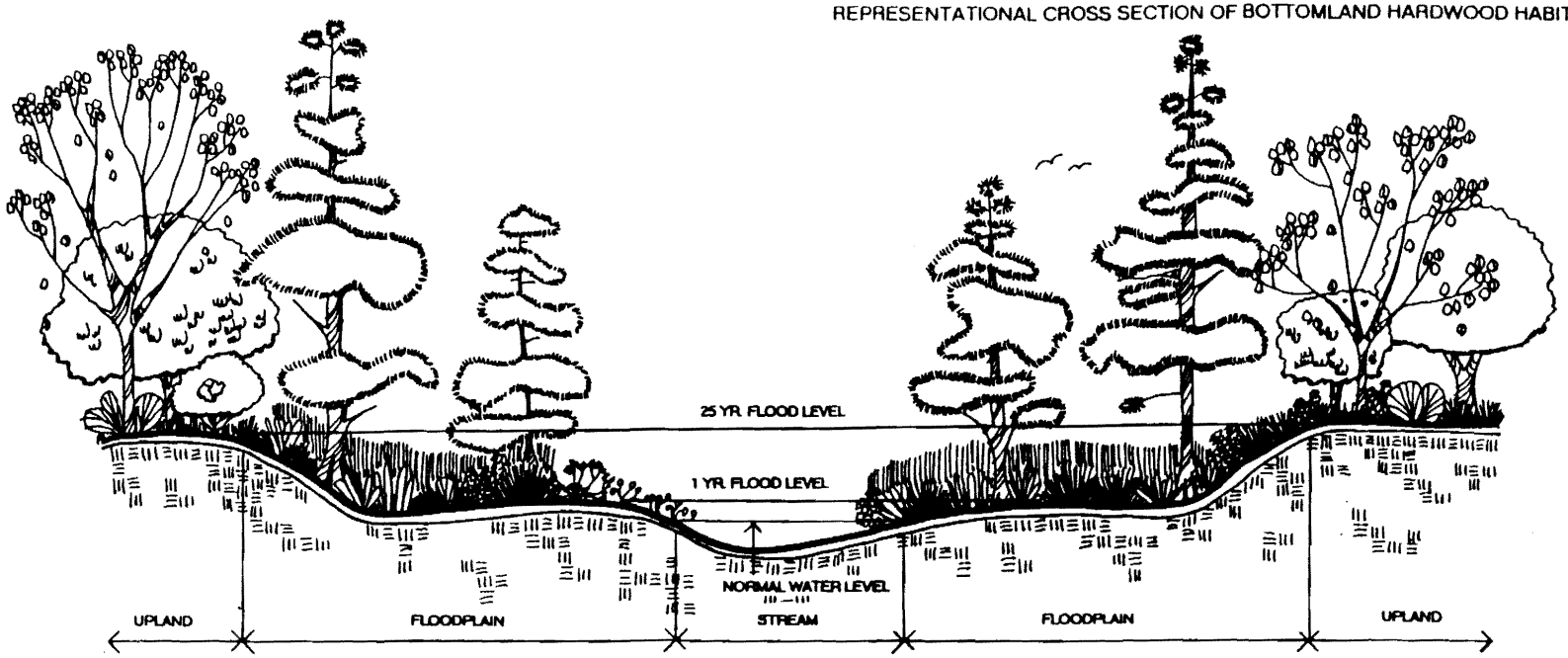
Sloughs support a diverse wildlife population. Many larger animals inhabit sloughs that are adjacent to flatwoods and hammocks.

Sloughs also serve as natural drainageways during high water periods, they have great value in improving water quality (nutrient uptake of plants) and they retain water and help slow down water flows, thereby providing a natural flood control (Soil and Water Conservation Society, 1989).

Revegetation

In order to increase the success of any revegetation project, some soil amendments will be necessary. Because of the expense of this process and the scale of Tenoroc, it may only be feasible to revegetate in certain key areas, where a faster rate of succession is needed for habitat establishment, stabilization or aesthetics. Some methods to be considered are mulching an area with cut vegetation that contains seeds or spreading topsoil obtained from communities similar to those proposed, which would contain necessary nutrients and indigenous seed stores. For areas where this is not possible, the process of soil building can begin with the establishment of indigenous grasses, herbs and legumes that would create an organic humus layer and would add nitrogen to the

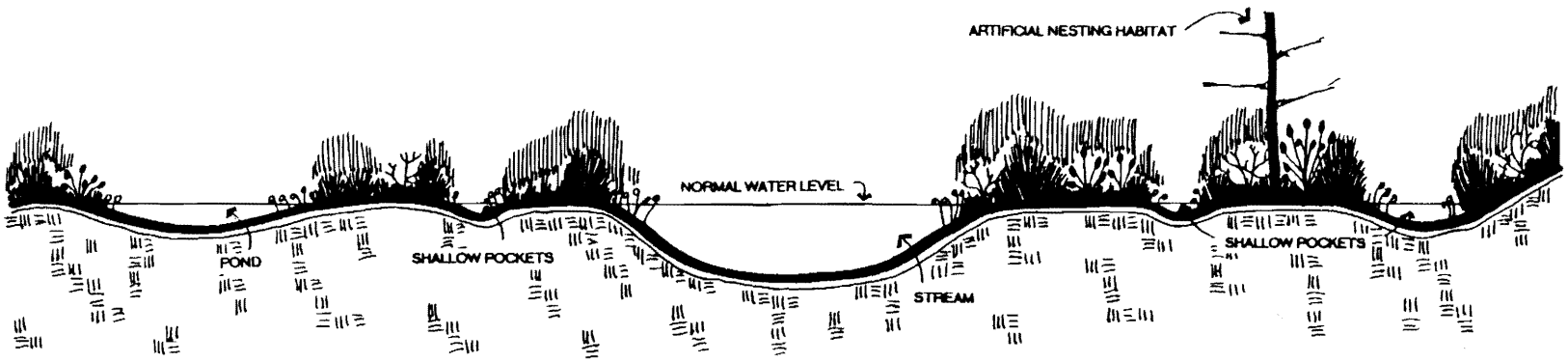
REPRESENTATIONAL CROSS SECTION OF BOTTOMLAND HARDWOOD HABITAT



RECOMMENDED PLANT SPECIES

TREES (CANOPY)		SHRUBS (MIDSTORY)		HERBACEOUS (UNDERSTORY)	
RED MAPLE	ACER RUBRUM	AMERICAN BEAUTYBERRY	CALICARPUS AMERICANA	SEDGES	CYPERUS SPP.
CAROLINA ASH	FRAXINUS CAROLINIANA	BUTTONBUSH	CEPHALANTHUS OCCIDENTALIS	RUSHES	JUNCUS SPP.
BLACK GUM	NYSSA SYLVATICA	DAHOON HOLLY	ILEX CASSINE	CINNAMON FERN	OSMUNDA CINNAMOMEA
RED BAY	PERSEA PALUSTRIS	WAX MYRTLE	MYRICA CERIFERA	ROYAL FERN	OSMUNDA REGALIS
BALD CYPRESS	TAXODIUM DISTICHUM	ELDERBERRY	SAMBUCUS CANADENSIS	CORD GRASS	SPARTINA BAKERI
SWEET GUM	LIQUIDAMBAR STYRACIFLUA	SAW PALMETTO	SERENOA REPENS		
SWAMP CHESTNUT OAK	QUERCUS PRINUS				
LOBLOLLY BAY	GORDONIA LASIANTHUS				

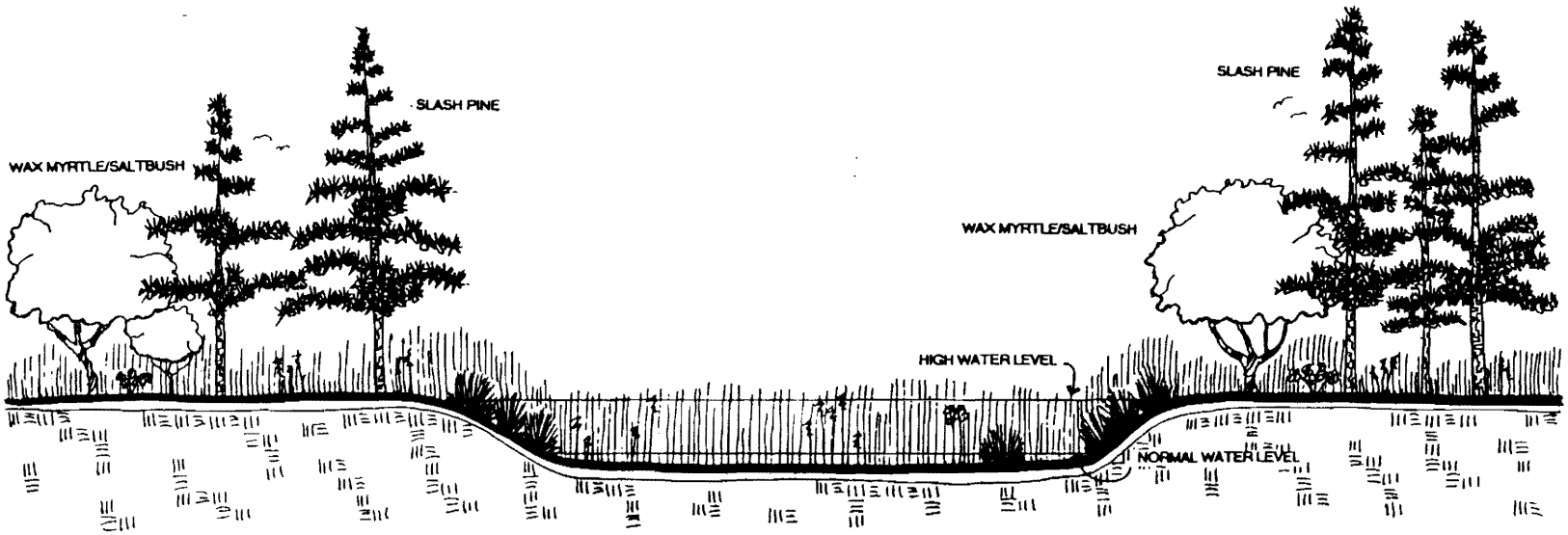
REPRESENTATIONAL CROSS SECTION OF SHALLOW MARSH



RECOMMENDED PLANT SPECIES

SAW GRASS	CLADIUM JAMAICENSE
SPIKE RUSHES	ELEOCHARIS SPP.
SOFT RUSH	JUNCUS EFFUSUS
FRAGRANT WATERLILY	NYMPHEA ODORATA
MAIDENCANE	PANICUM HEMITOMON
PICKERELWEED	PONTEDERIA LANCEOLATA

REPRESENTATIONAL CROSS SECTION OF SLOUGH



RECOMMENDED PLANT SPECIES

SLASH PINE	PINUS ELLIOTTII	SAND CORDGRASS	SPARTINA BAKER
WAX MYRTLE	MYRICA CERIFERA	SLOUGHGRASS	SCLERIA SPP.
SALTBUSH	BACCHARIS HALIMIFOLIA	SOFT RUSH	JUNCUS EFFUSUS
BEAK RUSHES	RYNCHOSPORA SPP.	MEADOWBEAUTY	RHEXIS SPP.
MILKWORT	POLYGALA SPP.	YELLOW-EYE GRASSES	XYRIS SPP.
PANICUM GRASSES	PANICUM SPP.	PICKERELWEED	PONTEDERIA CORDATA

soil over time. Management of these areas might include periodic burns or planting of shrubs and overstory trees as the soil quality improves. The process of revegetation is long-term, and management programs should remain flexible and accomodating (Perry, 1992).

Upland Restoration

There are three types of vegetative communities that may be appropriate for upland restoration at Tenoroc (Florida Phosphate Council):

1. Sand Pine Scrub - This community consists primarily of a dense sand pine overstory with an understory that is predominantly evergreen shrubs. This community is dry and infertile, supporting vegetation that is adapted for conserving water and nutrients in the harsh environment (EcoImpact. 1981). Survival of this community is dependent on a cycle of growth, fire and regeneration.

At Tenoroc, the sand tailings produced as a waste product in the mining process should provide an ideal setting for sand pine scrub communities. Examples of plant material found in a sand pine scrub are: sand pine, saw palmetto, sand live oak, gallberry myrtle oak and prickly- pear cactus.

2. Longleaf Pine/Turkey Oak Communities - This community occurs on rolling lands with level to steep slopes. Water movement through the soil is rapid. This community is fairly open and is mostly influenced by fire which occurs frequently. The natural vegetation has adapted to this, with large areas covered by grasses that provide fuel for the fires and prevent the hardwoods from regenerating. Typical plant species of this community are: longleaf pine, turkey oak, aster, partridge pea, wire grass, saw palmetto and buckwheat.

3. Pine Flatwoods - This community occurs on nearly level land and is identified by pine and palmetto vegetation. The soils are poorly drained, and fire and water are the major influences of this community. Fire controls the hardwoods and allows for the natural regeneration of pines, thus, these communities would require frequent burns to control the succession toward hardwoods. An advantage with this type of community is the fast rate of growth of the pines.

This type of community may be feasible on older clay settling ponds that have been provided with soil enhancers. Examples of plant species of this community are: live oak, slash pine, gallberry, sumac, creeping bluestem and low panicum.

Wildlife Habitat

Due to the mining that has occured at Tenoroc, there is a need for the creation and/or enhancement of wildlife habitat throughout the site. These habitats should be carefully developed to provide a balance between recreation and resource needs.

During their early stages, the clay settling ponds were filled with shallow waters and provided habitat for many wading and shore birds. These areas are now drying up, and are becoming inhabited with invasive plant material. These areas can be enhanced as wildlife habitat by planting selected wetland and transitional wetland plant species.

Throughout Tenoroc, there is a need for plant material that will provide wildlife value such as food, shelter and roosting. Through seed distribution, these areas would help accelerate the spread of native plant material such as oak, yaupon and ash.

Land Use

As mentioned previously, in 1989 Tenoroc State Reserve was reclassified as a state recreation area. This means that the major emphasis of Tenoroc State Recreation Area is to maximize the recreational potential of the site with preservation of resources being of secondary importance; however, depletion of a resource that directly supports a recreational activity is not permitted. Thus, the management program of Tenoroc State Recreation Area should be aimed at providing facilities that are safe, accessible and convenient. Emphasis of the program should be placed on promoting recreational use of the park's natural, aesthetic and educational attributes.

In 1990, the Florida Department of Natural Resources conducted a survey of both park visitors and area parks and recreation officials. The purpose of the survey was to determine the desires of potential Tenoroc users. The results are included in the Appendix (A-24-27).

In general, the majority (64%) of visitors were residences of Polk County. Most (71%) said they would stay overnight in Tenoroc is camping and/or lodging were provided. Many welcomed the idea of improved boat ramps, picnic areas and restroom facilities. The survey indicates a particular interest in bait and tackle shops and concession stands that would complement their fishing activities. Additionally, more nature trails, paved roads, swimming areas, horse trails and archery areas were desired.

Trails

There is the opportunity and interest in making Tenoroc part of a state-wide trails system. Currently, the Polk County Planning Department, the Polk County Rails-To-Trails, Inc. and the Florida Department of Natural Resources are considering the development of a major trail through the area that would utilize abandoned railroad beds.

The trails could provide separate paths for pedestrian/bike traffic and horses, taking advantage of the various landforms left by the mining process such as dikes and ridges. Additionally, these landforms could be used to offer the greatest number of vistas possible (Cennon, 1992) (see figure F-22).

Accomodations

According to the user surveys, many visitors to Tenoroc would like to stay overnight or spend a few days. Accomodations such as a lodge, cabins and camping areas should be considered.

A sportman's lodge should be centrally located and convenient to fishing lakes. The lodge should provide a family atmosphere and should include swimming facilities, playgrounds and direct access to trails. Ideally, the lodge should be sited to allow for views of the lakes.

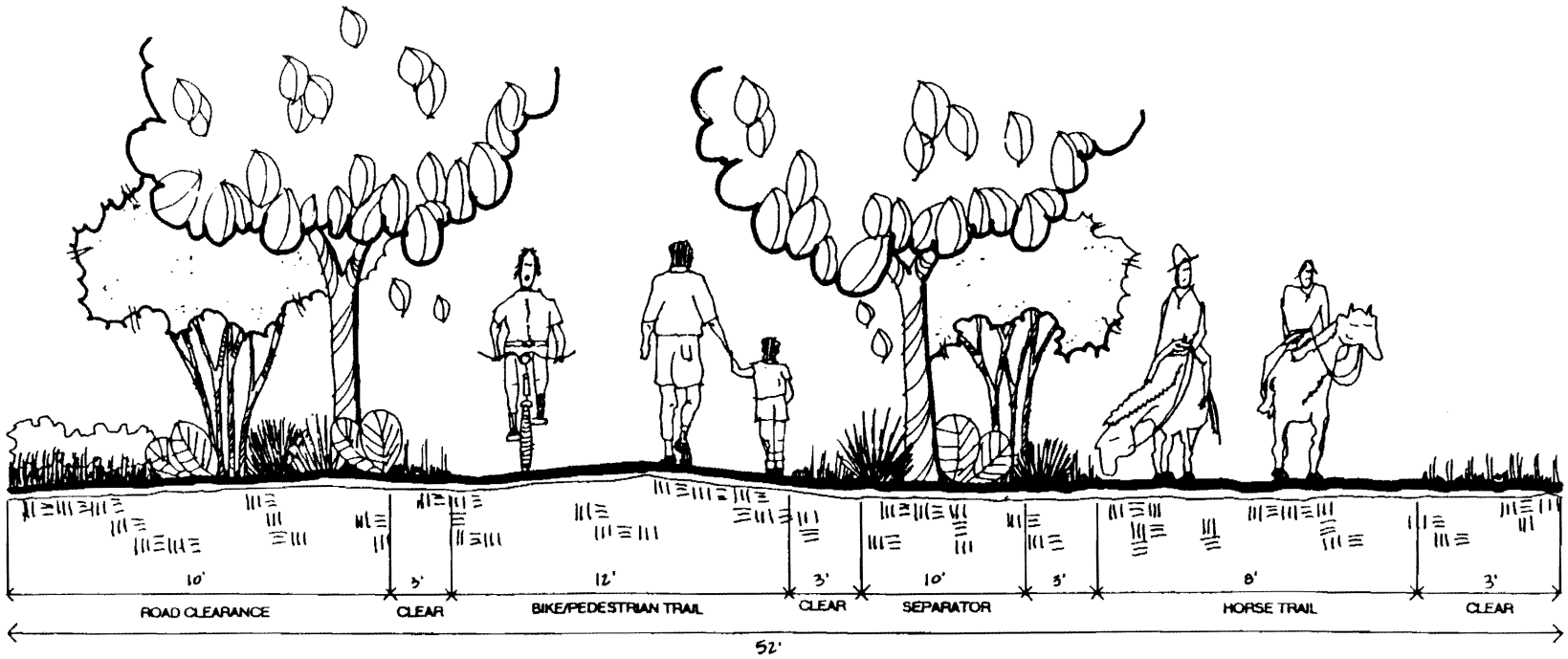
Cabins should be located near fishing lakes and should be spread along the lakes edges as much as possible. A rustic style, including fireplaces and porches would be appropriate. A sense of privacy for each individual cabin can be provided through proper screening with trees and shrubs.

Camping areas should take advantage of the natural resources available such as wooded areas and lake areas. The open lake areas would be more appropriate for RV camping as they provide easy access.

Fishing

Fishing will presumably remain the main attraction at Tenoroc. Consideration should be given to both boat fishing and bank fishing. Bank fishing will require some reconstruction of shoreline to enhance the safety of fishing while providing habitat areas for the fish themselves. Additionally, some lakes may be used as nurseries to provide stock for the fishing lakes at Tenoroc.

REPRESENTATIVE MULTI-USE TRAIL SECTION



BASED ON FLORIDA DEPARTMENT OF NATURAL RESOURCES TRAIL STANDARDS

Any proposed plan should strive at maintaining the quality of the fishing experience. This could be achieved by controlling the dispersal of fishermen over an area and/or limiting the horsepower of motorboats (Florida Department of Natural Resources).

Picnic Areas

Picnic areas should be dispersed throughout Tenoroc and should take advantage of landscape values such as lakes and forested areas.

Picnic areas requiring structures such as parking and restrooms will be limited to areas where soils are stable.

Horseback Riding and Stables

There is considerable opportunity at Tenoroc to develop extensive horseback riding trails. Additionally, an equestrian center which offered stables for boarding, fenced areas, riding lessons and rentals would generate revenue for Tenoroc.

Open Space

Many of the flat areas of Tenoroc such as the sand tailings areas and reclaimed pasture lands can provide opportunity for activities that require large open expanses. Activities such as hot air ballooning, kite festivals and running events would spur interest in Tenoroc, thereby increasing its user base.

Tree Farm/Nursery

Serious consideration should be given to a nursery that would support the reclamation and reforestation efforts at Tenoroc. The nursery would have to be located in relatively good soils, such as within a reclaimed pasture area, and ideally close to a lake to provide a water supply. Addtionally, horse manure obtained from the stables could be used to fertilize the plant material within the nursery.

Revenue Generation

Revenue-generating activities might include: entrance fees, campsites, boat rentals, bait and tackle, stable use and boarding, riding lessons, food and drink concessions, cabins, sportsman's lodge, meeting room rentals, bicycle rentals, restaurants, marina, special events entrance fees and pavilion rentals.

RECLAMATION GUIDELINES

Management and reclamation efforts at Tenoroc State Recreation Area are dependent on many factors, including: expected use, availability of funding, proposed land uses, proposed recreational activities, local land use considerations, time and scale of the project.

The size or scale of Tenoroc is a key issue in that total reclamation in the near future is not feasible. The cost of such a large project prohibits total reclamation, and therefore, a more passive, long-term management and reclamation program should be considered. The goal of habitat development is to establish diversity. This could be accomplished through revegetation of patches within zones (i.e. replanting wetland species in clay settling ponds) and introducing new seed sources. From this initiation, the natural processes of dispersion and succession would spread the vegetation into the surrounding area. The issue of time becomes important in that this process of succession and maturity of vegetative communities is a long-term process. The management and reclamation programs must respond to this issue of time by remaining flexible and carefully monitoring conditions in order to respond to changes as they occur.

The following guidelines are general recommendations for reclamation at Tenoroc and are derived from the Florida Game and Freshwater Fish Commission Habitat Reclamation Guidelines, 1985.

Stream Restoration Guidelines

The objectives of a stream restoration program to recreate part of the headwaters of Saddle Creek are as follows:

- to improve the water quality of the Saddle Creek stream system both on and off the site
- to establish a natural wildlife corridor along the stream
- to restore wildlife habitat in and along the stream corridor

The stream restoration program should achieve the following:

1. increase floodplain boundaries in order to reduce erosion and habitat destruction

2. increase the stream length by allowing the channel to meander through the stream valley, thereby reducing the velocity of the stream which would help increase wildlife habitat

3. increase habitat diversity within the stream channel by such techniques as: varying depth, widths and gradients of the stream channel and providing artificial shelters (snags, log piles, obstructions that create sandbars) (see figure F-23).

4. incorporate wetlands into the stream channel which act as filters for sediment and pollution, reduce stream velocity, provide floodwater storage and increase habitat diversity

Revegetation Guidelines

The objectives of a revegetation reclamation program are as follows:

- to re-establish vegetative communities that will, over time, become self-generating
- to increase the diversity and quality of wildlife habitat at Tenoroc

Certain factors should be considered when selecting vegetative communities for specific areas:

- existing soil characteristics
- availability of moisture
- topographic characteristics
- sunlight
- adjacent and proposed uses
- management practices

The revegetation-reclamation program should achieve the following:

1. development of "edges" between vegetative communities to provide wildlife with the ability to travel, under cover, from community to community (see figure F-24)

2. include trees, shrubs and groundcovers in each revegetated community to establish immediate diversity (see figures F-25,26)

3. consider the use of topsoil or vegetative litter taken from communities similar to the community it is being applied to increase seed source, soil quality and speed of succession

4. consider the proposed recreation uses of certain areas and plantcommunities that are appropriate (i.e. hardwood hammocks around structures, grassy pasture for an equestrian area)

5. create an open system of lakes by removing control structures to allow a more natural flow of water and wildlife between lakes as well as increasing flow downstream to Lake Hancock

6. create littoral shelves on lakes to provide habitat and to increase recreational safety. Vegetative enhancement should be appropriate for wildlife habitat and improved water quality (see figure F-27)

Wildlife Guidelines

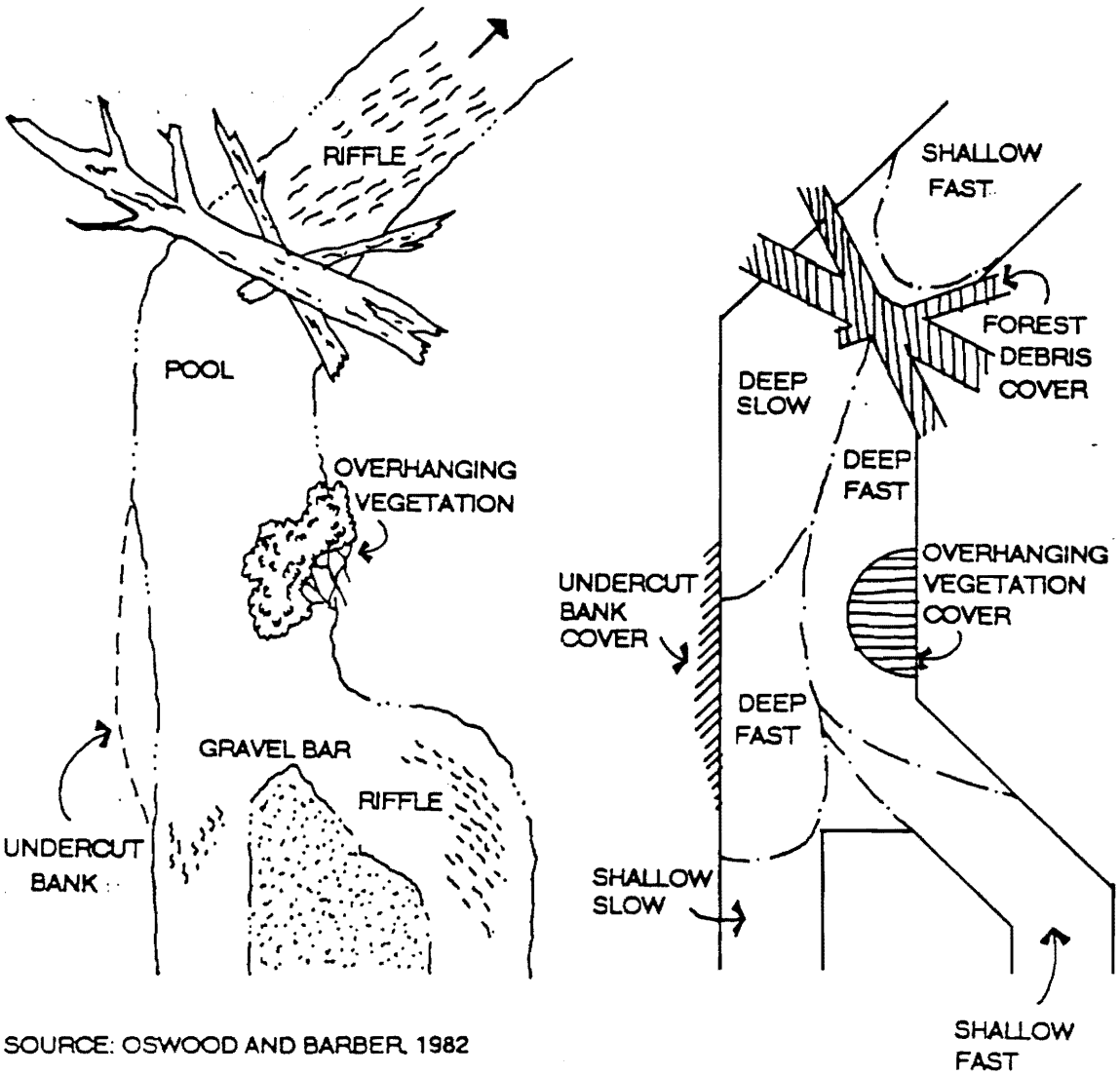
The objective of a wildlife program is as follows:

- to provide wildlife habitat that will support a wide range of species
- to provide wildlife habitat that will provide for the needs of those species that have been selected for recreational value.

The wildlife program should achieve the following:

1. provide vegetative communities that have wildlife value, providing food, shelter and roosting

2. restrict recreational activities in areas of high quality habitat, and exclude recreation from areas used for nesting and breeding



SOURCE: OSWOOD AND BARBER, 1982

3. establish wildlife corridors throughout Tenoroc

4. provide nesting structures such as duck boxes, nesting poles and brush-piles, especially during the initial stages of revegetation

5. introduce wildlife research programs like the gopher tortoise project that will increase the opportunity of using Tenoroc as wildlife habitat for rare or endangered species

6. re-introduce native wildlife species from off-site donors to reestablish populations

7. enhance lake beds by planting littoral shelves with aquatic and wetland plant species as well as providing submerged features such as rockpiles, limbs and stumps. These actions will provide food, habitat and shelter for various types of aquatic species

8. monitor revegetation and habitat development projects to determine their success in terms of wildlife habitat

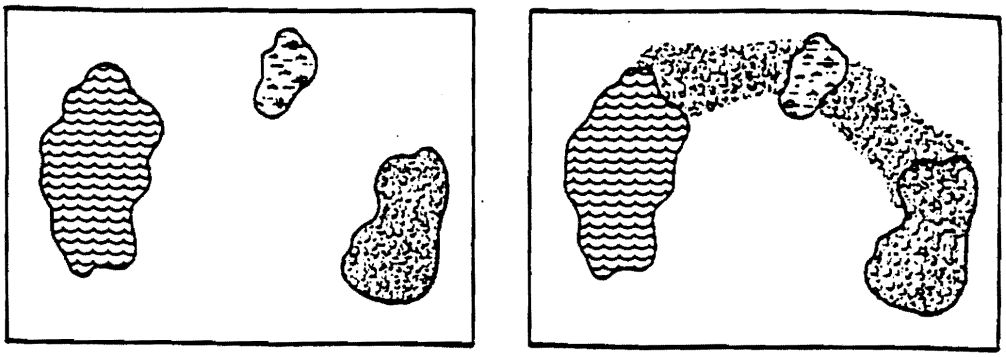
9. provide brochures and place signs at appropriate locations to educate visitors about the dangers of feeding wild animals and to make them aware of sensitive nesting areas (i.e. bird rookeries)

CONCEPT

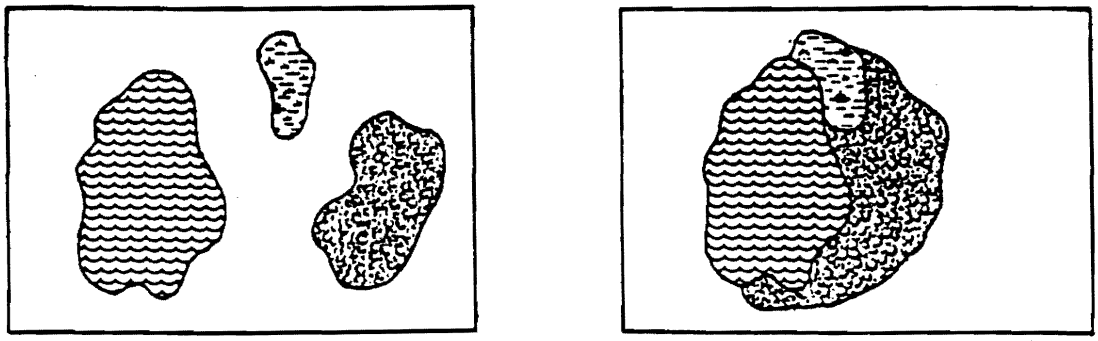
The basis for this proposed concept plan for Tenoroc State Recreation Area is integration of proposed recreational land uses with both the hydrologic and reclamation concepts discussed earlier. The primary goal is to create a balance between the managed succession of natural systems and the recreational program of a state recreation area. A secondary goal of this plan is to provide revenue-generating activities which are user-supported.(see figures F-28-34).

The heart of Tenoroc will be a "park center" where most activities will revolve or at least be initiated. This center will include administrative offices, meeting rooms, a sportsman's lodge, trailhead, information services, parking, an interpretive museum and concessions previously discussed.

Circulation is based on keeping access as simple as possible while avoiding excessive road development. Additionally, separation of different circulation routes according to use (equestrian, pedestrian and vehicular) has been achieved wherever possible.



Where site or land use constraints do not permit joining proposed habitats (A), linking them with forested travel corridors (B) will help improve their usability by cover dependent wildlife.

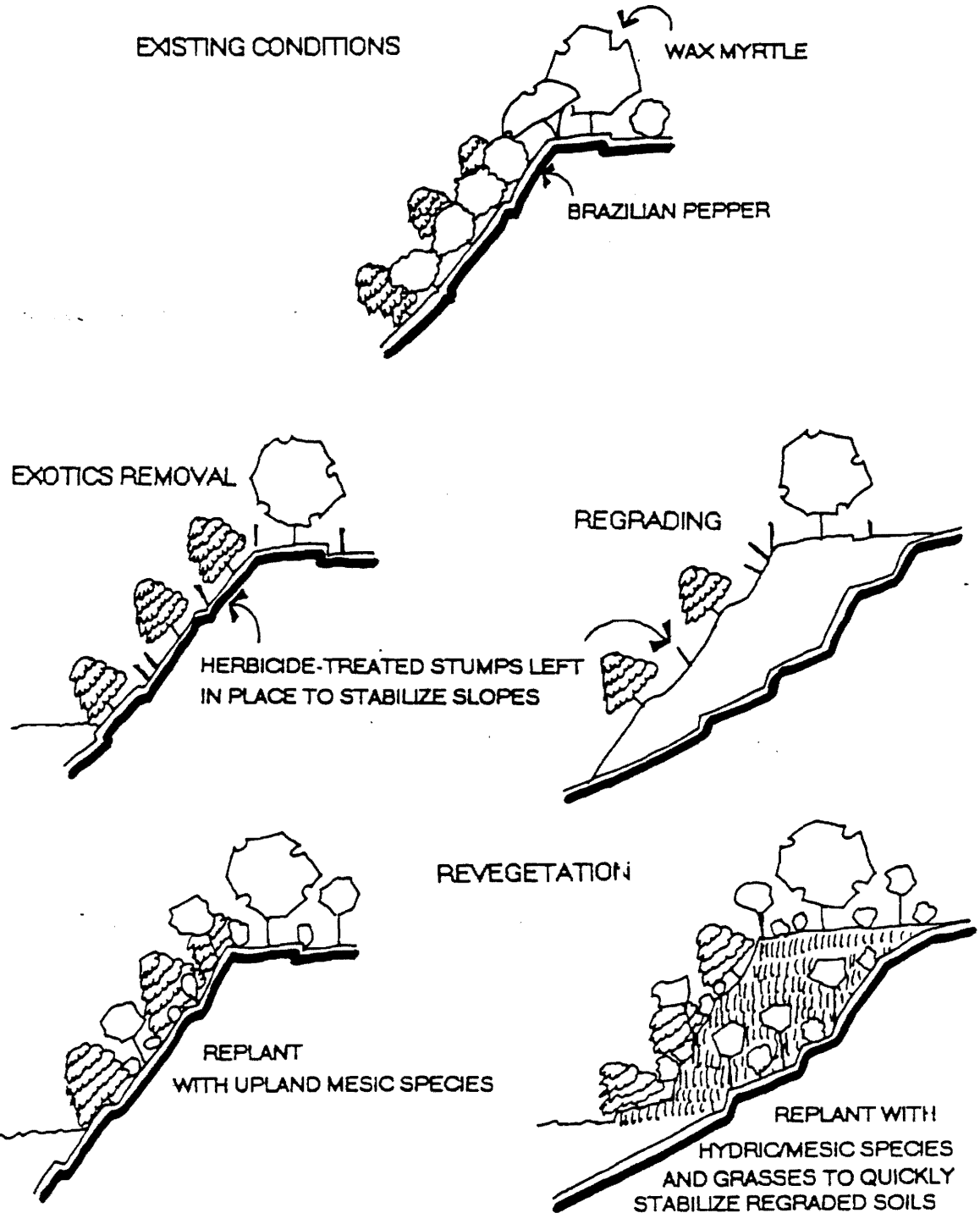


Isolated lake, wetland, and forest habitats (A) can be made more valuable by blending these communities (B).

SOURCE: FGFWFC, 1985

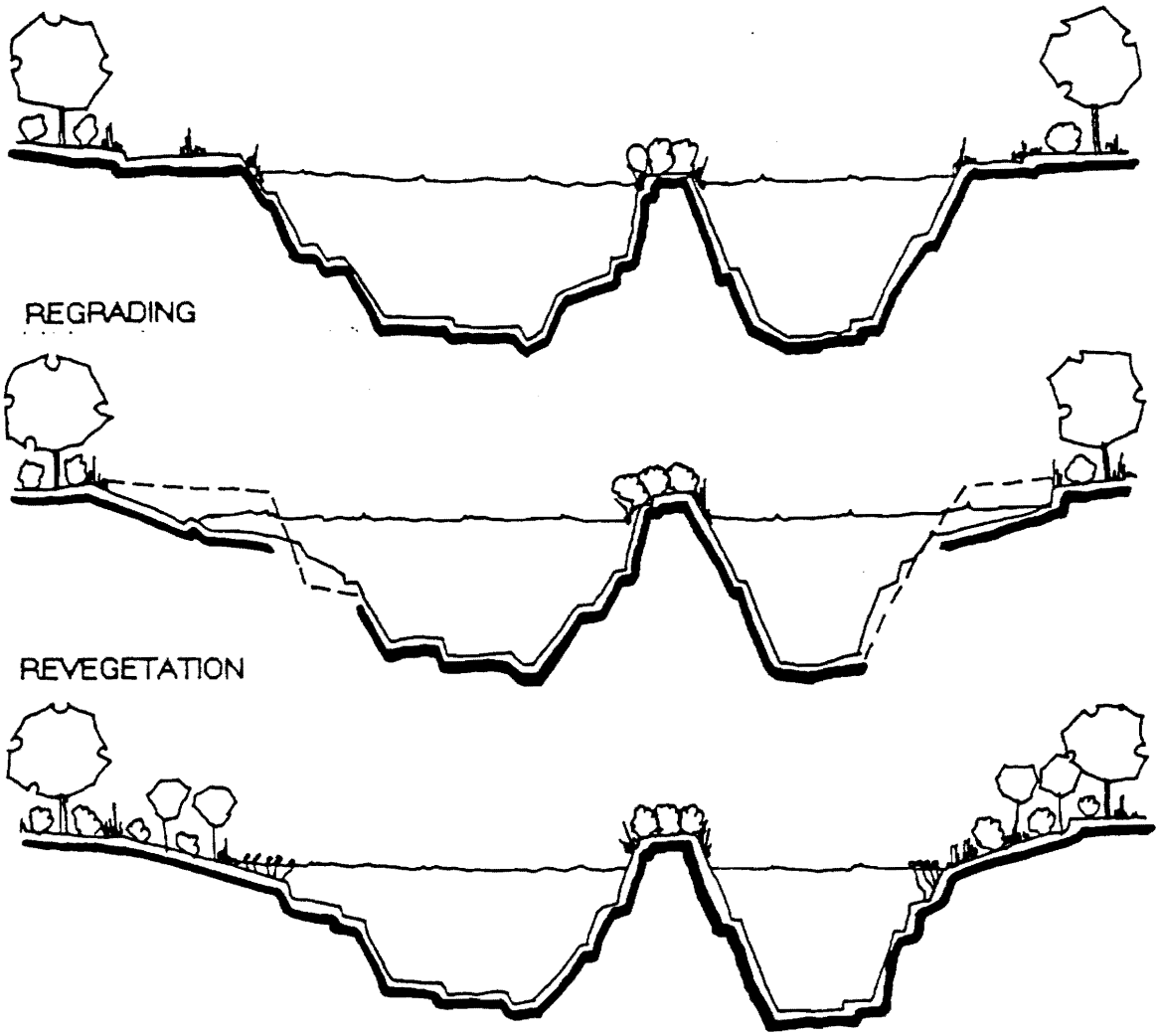
F-25

FINGER LAKES RECLAMATION



SOURCE: FIPR #03-033-060

F-26



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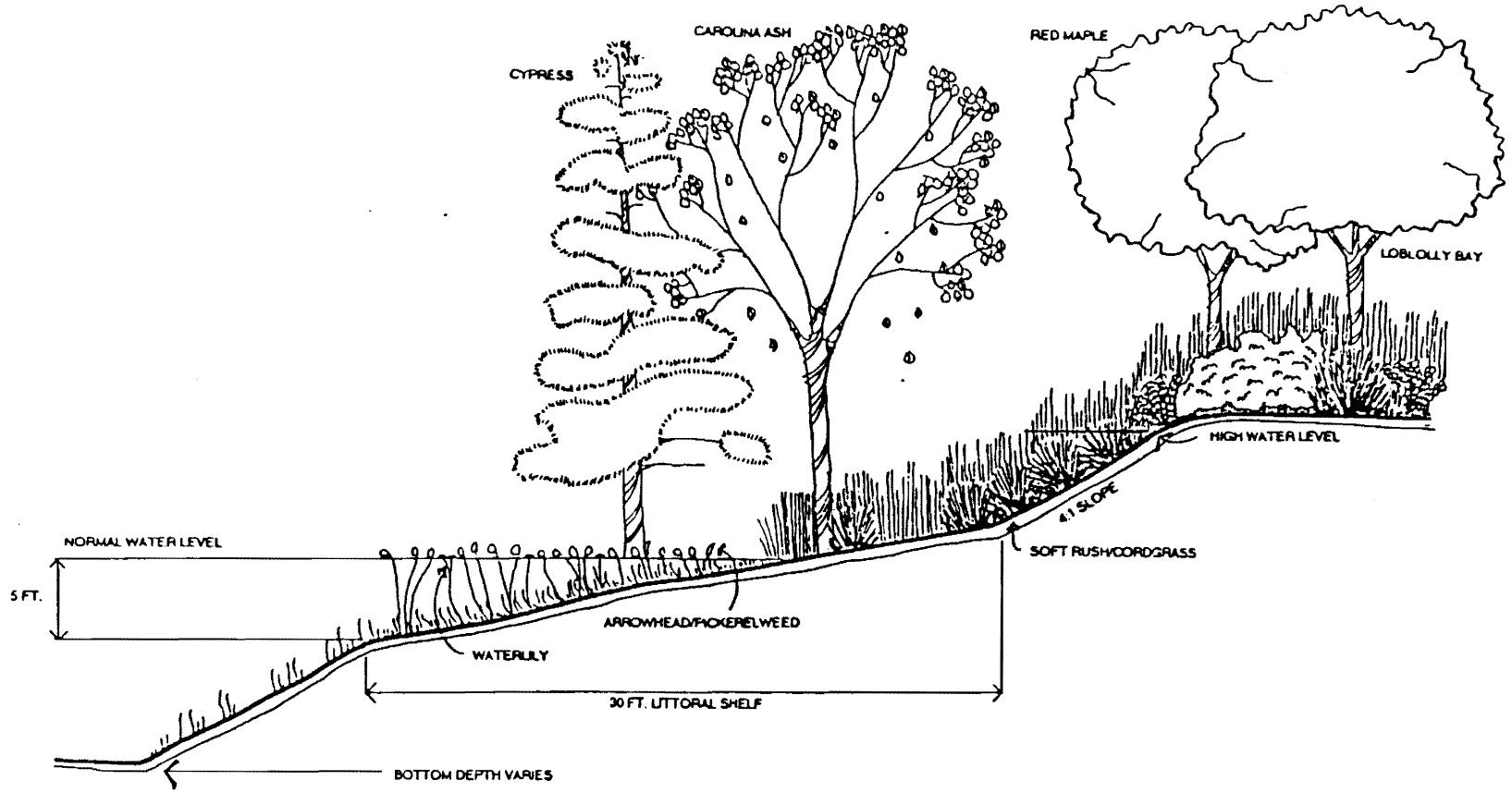
LAND AND LAKES RECLAMATION



REPRESENTATIVE SECTION OF LITTORAL SHELF

F-27

The main entry road to the east tract of Tenoroc is located near the current entrance; from Combee Road, then east on Tenoroc Mine Road. This route avoids most of the residential development on Tenoroc Mine Road and promotes a more natural entry.

Access to the western tract of Tenoroc is proposed from the intersection of Combee Road and Tenoroc Mine Road, only turning west. This provides a dual access point to both tracts of Tenoroc. Additional access to Lakes C and D would be provided south on County Road 33A.

Secondary roads would be provided to access various lakes for boating and fishing.

All hiking, equestrian and biking trails are routed to take advantage of site features.

A main camping area has been provided with access from the main entry road. A secondary, primitive campground requires hiking to a more remote area of the site. Both campsites are located near lakes for recreational activities.

Boat access to lakes in the east tract are provided at key points adjacent to the park center. As an open system, this makes the lake system accessible while minimizing the need for an abundance of secondary roads. Each reclaimed lake on the western tract is provided with boat access.

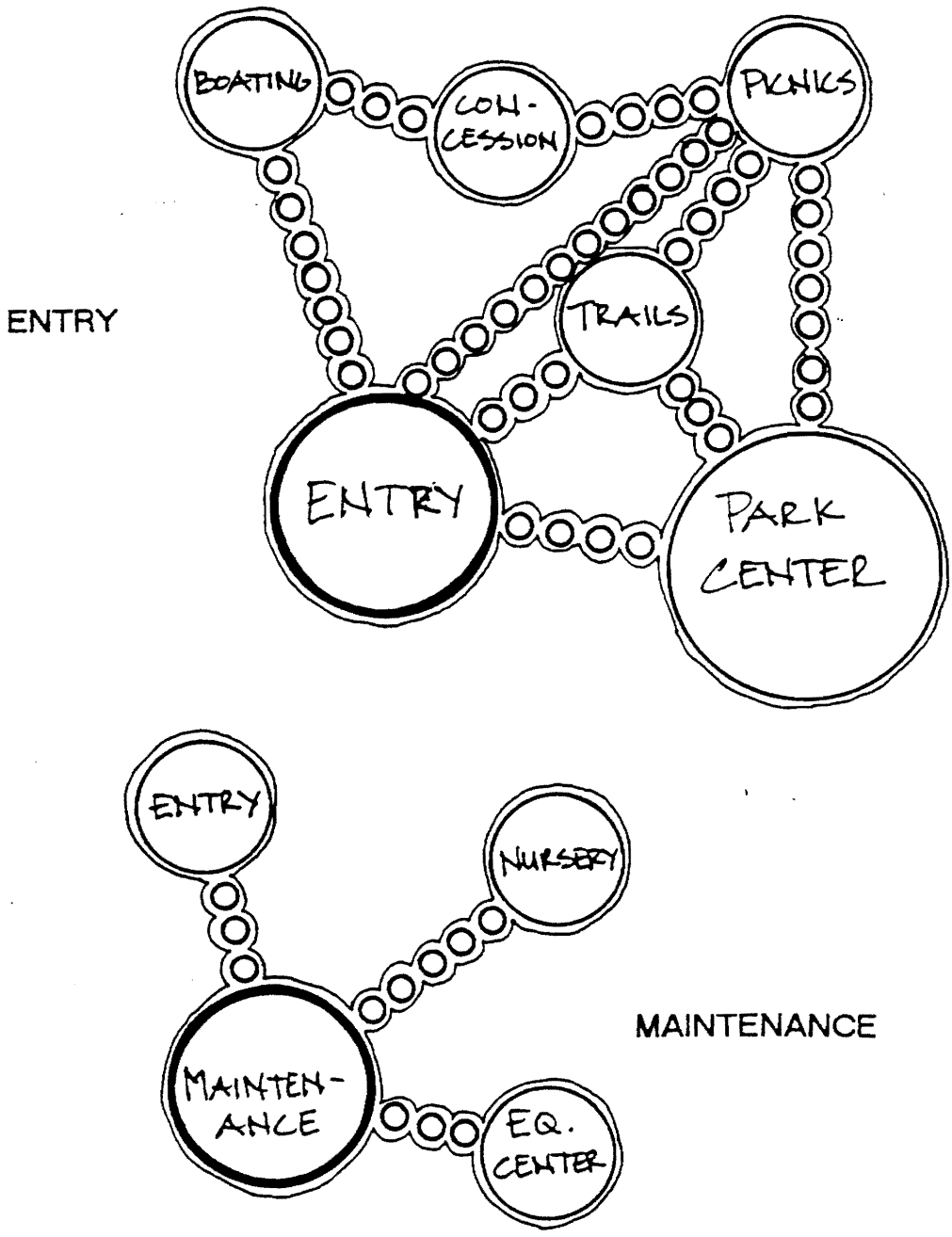
Cabins are located adjacent to the park center but far enough away to provide a sense of privacy. They are also located near lakes for optimal view and settings, as well as easy boat access.

There are three forces that will influence the development of Tenoroc State Recreation Area as a stable, natural system and recreation area. These forces are: time, program and management.

Over time, Tenoroc will change to some degree due to natural succession. Left on its own, this succession can take hundreds of years, if it ever fully succeeds. This time frame can be greatly reduced through man's intervention of planning and management. While program dictates the needs of a population base, it must also reflect the physical and temporal limits of Tenoroc. Once this is determined, management becomes the determining factor in the final outcome of the project. Management of Tenoroc must be resilient enough to respond to Tenoroc's developmental goals, objectives, time frame, natural succession, needs and problems efficiently and sensitively. As the program reaches maturity,

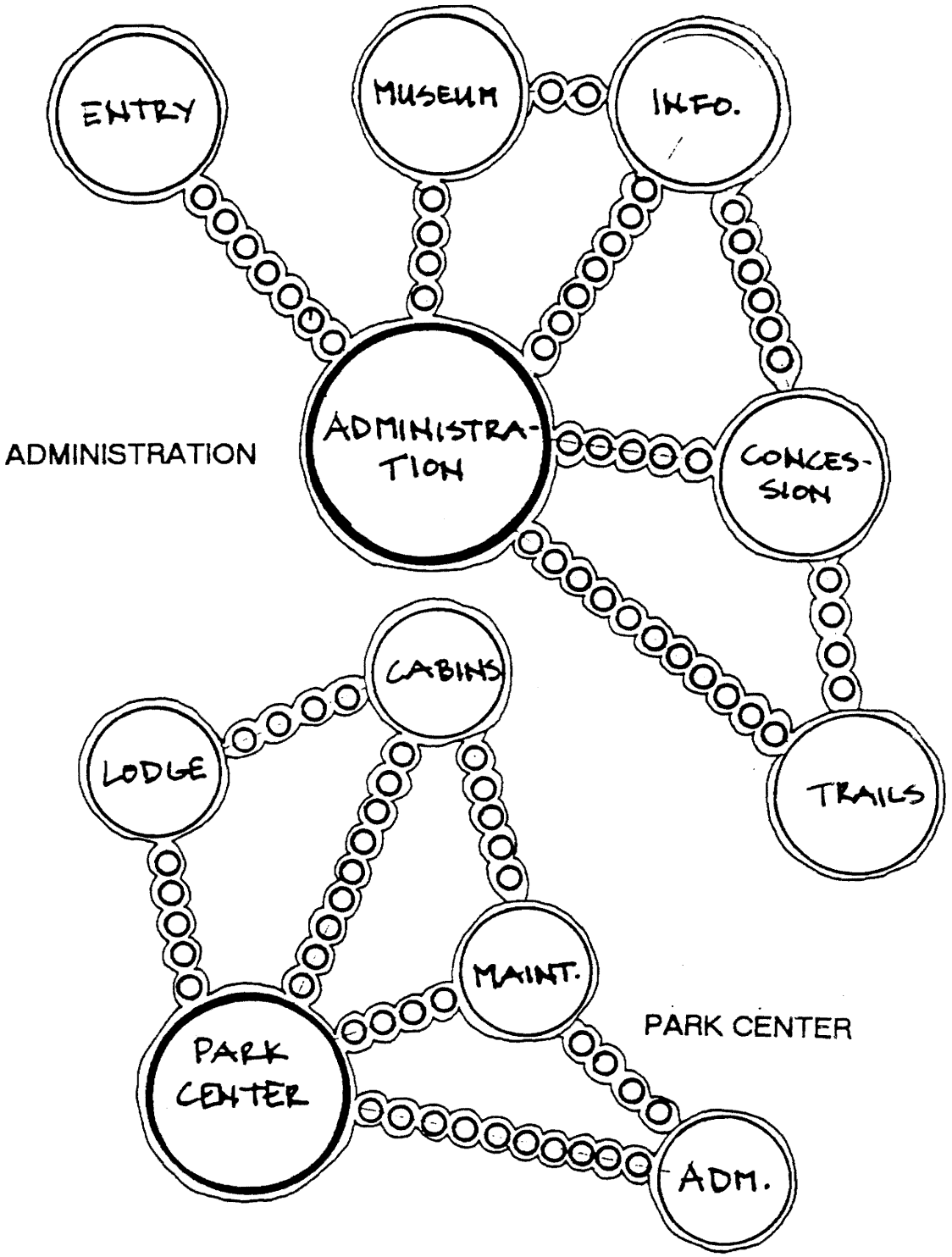
F-28

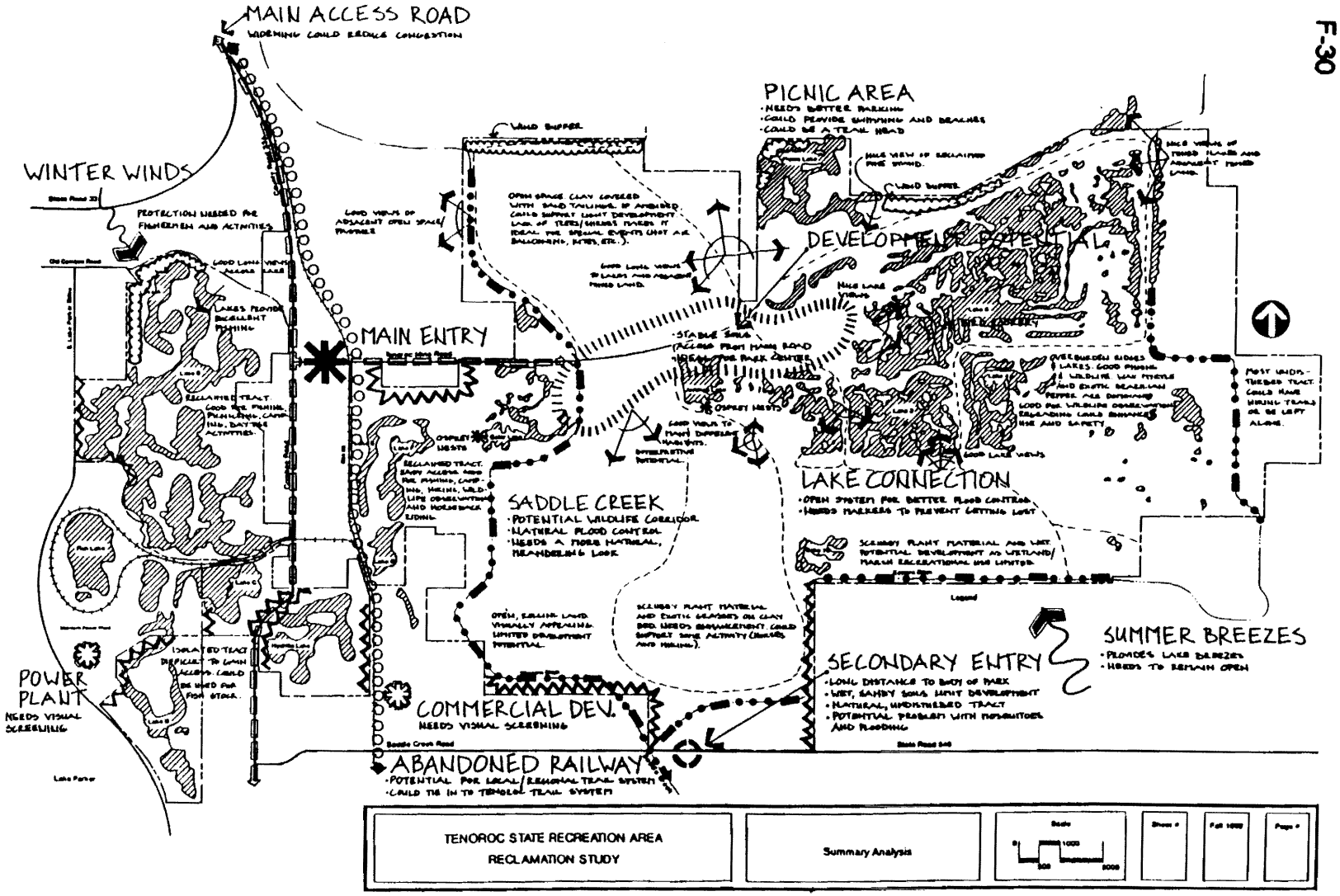
IDEAL FUNCTIONAL DIAGRAM



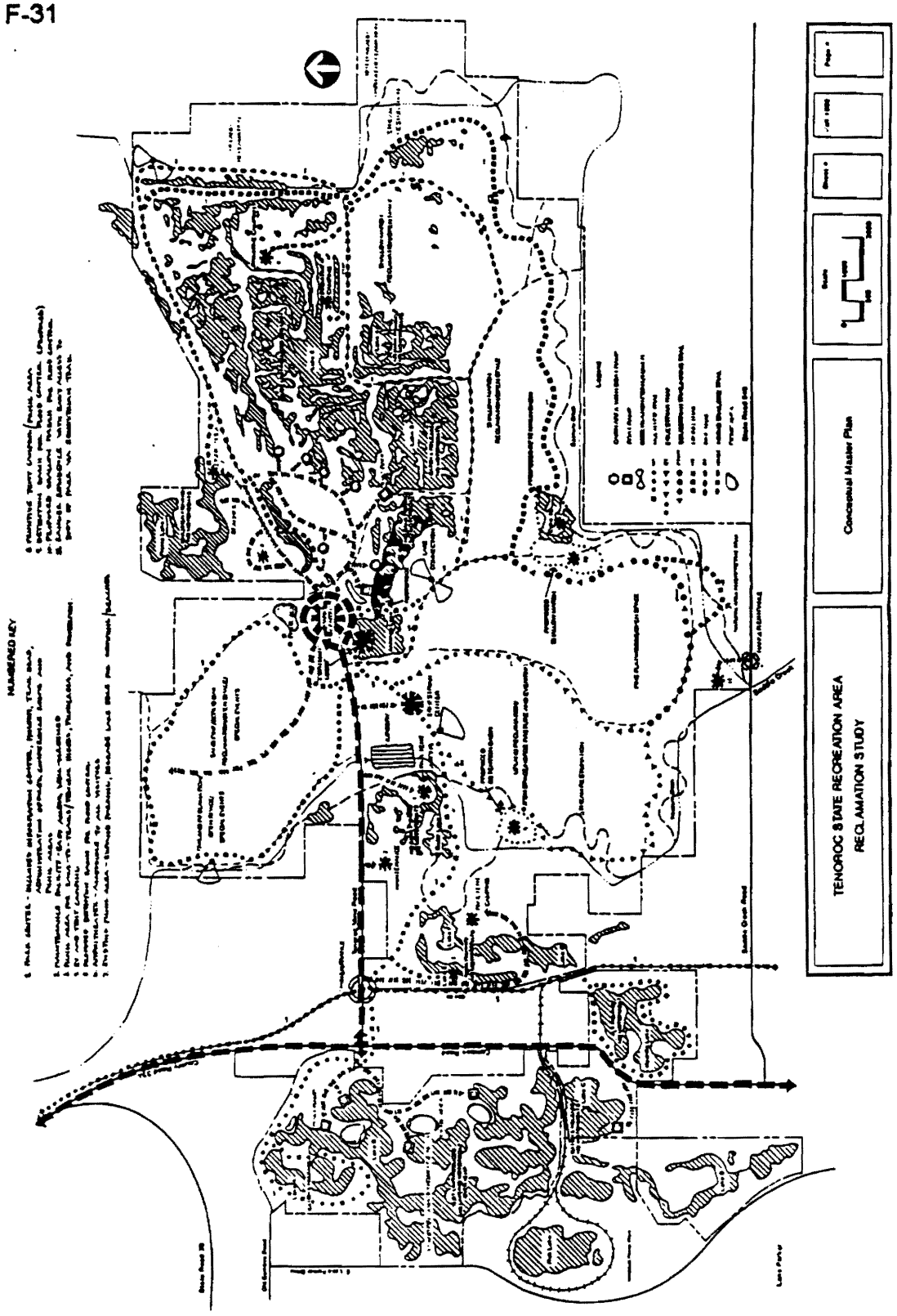
F-29

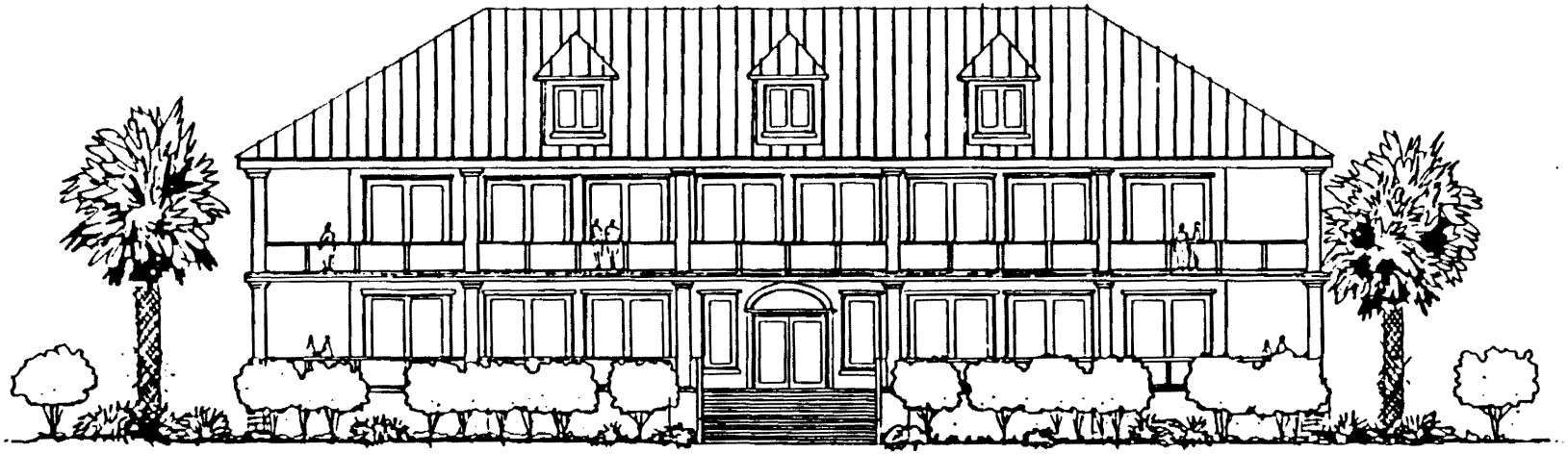
IDEAL FUNCTIONAL DIAGRAM




MAIN ACCESS ROAD
WINTER WINDS
PICNIC AREA
DEVELOPMENT POTENTIAL
MAIN ENTRY
LAKE CONNECTION
SADDLE CREEK
SUMMER BREEZES
SECONDARY ENTRY
POWER PLANT
COMMERCIAL DEV.
ABANDONED RAILWAY
TENOROC STATE RECREATION AREA
RECLAMATION STUDY
Summary Analysis

F-31


TENOROC STATE RECREATION AREA
RECLAMATION STUDY
Conceptual Master Plan



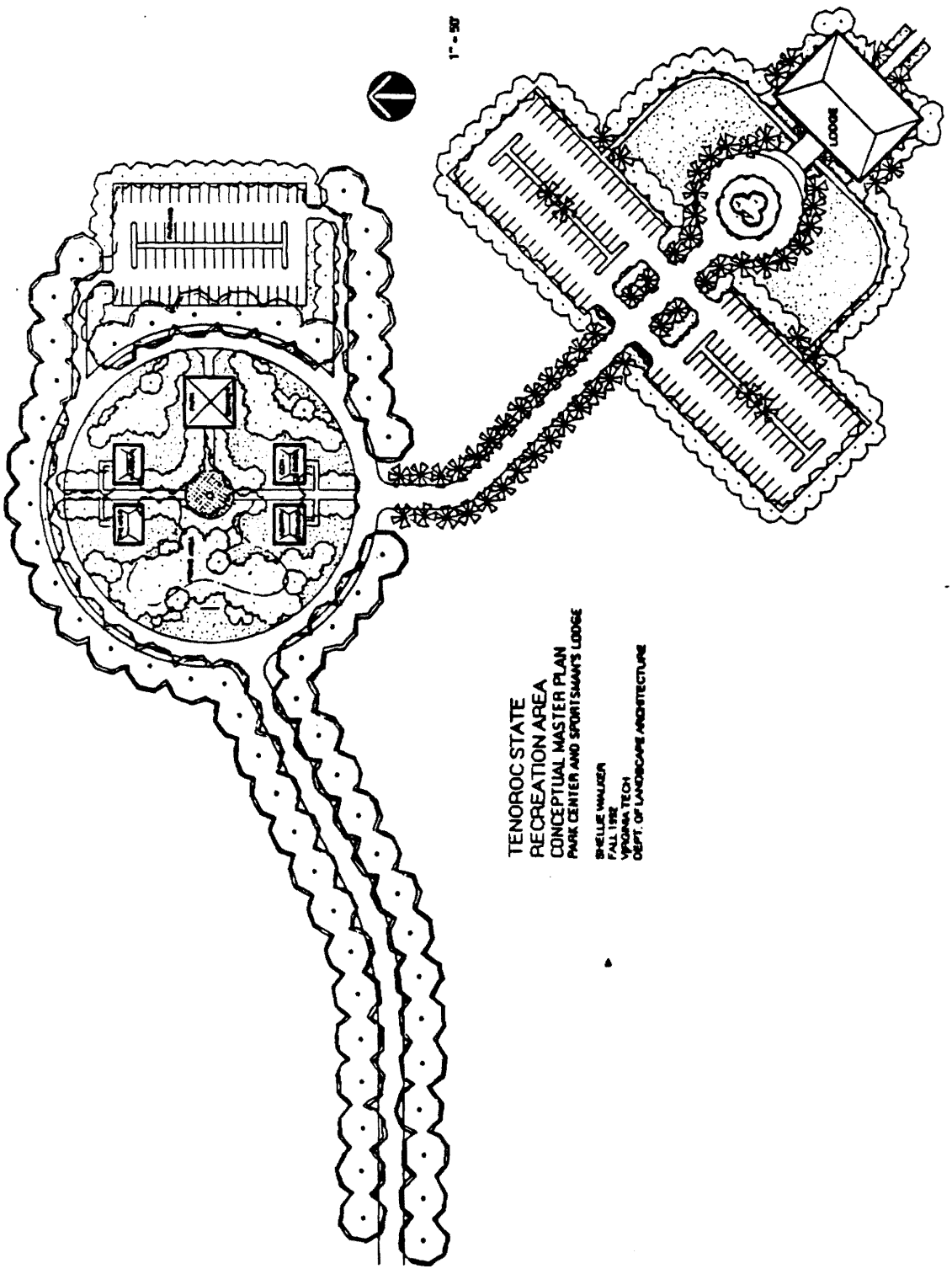
TENOROC STATE RECREATION AREA

SPORTSMAN'S LODGE/ARCHITECTURAL STUDY

SHELLIE WALKER
FALL 1992
VIRGINIA TECH
DEPT. OF LANDSCAPE ARCHITECTURE

1/8" = 1'-0"

F-33


1" = 50'
LODGE
TENOROC STATE
RECREATION AREA
CONCEPTUAL MASTER PLAN
PARK CENTER AND SPORTSMAN'S LODGE
SHELLIE WALKER
FALL 1992
VIRGINIA TECH
DEPT. OF LANDSCAPE ARCHITECTURE

F-34

USER CAPACITY

ACTIVITY	SIZE	LAND BASE NEEDED	AREA RE-QUIRE-MENTS	PEOPLE/ UNIT	USER/ DAY	MAX. USER
HIKING TRAILS	18 MILES	450 ACRES	15 GROUPS PER MILE	2 PER GROUP	4 PER DAY	540
EQUEST-RIAN TRIALS	15 MILES	1143 ACRES	6 GROUPS PER MILE	4 PER GROUP	3 PER DAY	360
BIKE TRAILS	18 MILES	450 ACRES	15 BIKES PER MILE	1 PER GROUP	4 PER DAY	270
*PARK CENTER	3800 SQ. FT.	3 ACRES PER BLDG.	.5 ACRE PER BLDG.	1/20 SQ. FT. OF EXHIBIT AREA	4 PER DAY	190
RV & TENT CAMPING	67 ACRES	3 ACRE PER SITE	5 SITES PER ACRE	4 PER SITE	1 PER DAY	111
PRIMITIVE CAMPING	85 ACRES	25 ACRES PER SITE	4 SITES PER ACRE	4 PER SITE	1 PER DAY	14
CABINS	172 ACRES	3 ACRES PER CABIN	4 SITES PER ACRE	4-12 PER CABIN	1 PER DAY	178
SWIMMING	10 ACRES	1/8 ACRE LAND PER SWIMMER			2 PER DAY	250
**BOATING	912 ACRES SURFACE AREA		***1 BOAT PER 7 ACRES	2 PER BOAT	2 PER DAY	512

* Park Center includes welcome/information center, museum, administration, restrooms and theatre.

** This assumes boat use on all lakes. Not all lakes currently allow boat use, nor is boat use proposed for all lakes.

*** Based on Florida Department of Natural Resources standard for boats of less than 10 horsepower.

NOTE: Total capacities are considered maximums which may be reached through phasing.

Source: Florida Department of Natural Resources Carrying Capacity for Outdoor Recreation Activities

management will become crucial in maintaining an equilibrium between the succession of natural systems and the goals of a recreational program.

CONCLUSION

Unlike many other species on this earth, man has become dependent not only on our renewable resources but on our non--renewable resources as well. Metals and fuels of the earth become essential in maintaining our modern day quality of life and as populations rise, these needs begin to threaten our sustainability.

In Florida, land values vary tremendously. While land may remain relatively inexpensive in remote areas such as the Panhandle, oceanfront lots on the Atlantic coast, or prime residential or business lots in the larger cities are priced by the square foot as opposed to the acre. As these limited commodities (both naturally and artificially) became high in demand, people began to have different views of what was the best use for "desirable" land tracts. This set the stage for zoning laws and land use disputes between people of different value systems and/or different priorities of society's needs.

In the phosphate mining areas of central Florida, there are unique opportunites to do better than we have elsewhere. Once the phosphate rock is mined, the land becomes available for other uses. It can be restored as wilderness, developed into urban, industrial or residential land - whatever society chooses.

However, the slate is not entirely clean. After the mining is over, the clay silt takes years to settle and dehydrate, thus settling ponds become a feature of the landscape for many years to come. Gypsum stacks, being slightly radioactive, create artificial mountains in Florida and will remain indefinitely until their use or disposal can be determined. The clay settling ponds provide significant wildlife value as ducks, fish and turtles establish habitat. On the other hand, the gypsum stacks remain feebly vegetated with exotic vegetation that has little value.

But with the land itself, many things can be done. With abandonment no longer legal, the land must be reclaimed. But how, into what, and for whom? If returned to its pre-mining condition, much of the land may become pasture, which may not be appropriate. On the other hand, much of the land was wetlands, which, according to reclamation rules must be replaced, acre for acre. The rules are good, requiring revegetation, habitat for endangered species and reduction of downstream pollution. The rules are strict, but do they succeed in providing the best use for reclaimed land?

It is essential that the sometimes competing needs of people and wildlife be addressed. The options for a given mined area can be anything from industrial development to residential development to golf courses to cattle pasture to habitat. Which is most appropriate? For example, it may not be best to dedicate most of the land to wildlife habitat because this may force development into virgin habitats, which would be even worse.

The identification and designation of certain types of lands to meet future needs of wildlife and human recreation is an important element in land use planning. Population studies of threatened and endangered wildlife species are critical in determining habitat needs. Based on these studies, sanctuaries of proper size can be designated to insure survival of these species in the future.

Recreational lands for hunting, fishing, athletics and passive activities such as bird watching, hiking and picnicking need to be identified and, if necessary, acquired before they are used for other development or become too expensive to purchase.

The first step in this process of planning at the regional scale is to determine what exists and how secure it is at remaining in its current function. We need to determine what lands and how much is wanted and needed for the future, and where they should be located.

All of this necessitates planning from the very smallest municipal agency to the very largest state agency that has imput into the region. Currently, there is a lack of comprehensive planning occurring among these agencies. Each mining company and municipality, for the most part, is planning independently of each other, and of the systems and natural features that exist beyond their boundaries. For example, clay settling ponds currently provide replacement habitat for former habitats along the Gulf coast and interior wetlands that have been lost to human development.

Additionally, there is a lack of consultants or pools of expertise that can provide support, planning and technical assistance.There are few guidelines available for reclamation and a shortage of experts that can assist in the long-term planning process that is now required by regulation. It is at this level that the landscape architect can be especially useful.

In order to achieve sufficient, in-depth information to assist in the development of a long-term comprehensive plan, a team of professionals needs to be involved. This would include, to name a few, civil and mining engineers, geologists, surface

water and ground hydrologists, soils specialists, ecologists, wildlife specialists, socioeconomists, planners and landscape architects (LATIS, Vol. 1, No. 3).

The role of the landscape architect would be to synthesize the information and develop concepts that would assist in visualizing many of the land use alternatives. These alternatives could then be translated into design, based on the physical landforms, biological constraints and general needs and desires of society.

Unfortunately, the land at Tenoroc State Recreation Area was mined for phosphate prior to the rules and regulations that exist today. Consequently, the result has been piecemeal reclamation projects that not only lack in cohesiveness within the site, but do not address the region and its land use needs. Tenoroc serves as a good example of the current lack of conceptual planning among various agencies. As property donated to the Florida Department of Natural Resources, Tenoroc has been designated for future use as a recreational area. This decision was arrived at exclusively of local planning agencies. Essentially, the State of Florida needs more freshwater fishing areas, thus Tenoroc was designated as such, and while this plan for a recreational area does fulfill a need in the state of Florida, as well as a regional need, perhaps a different end use would have been determined had all agencies involved participated in its land use planning. For example, the City of Lakeland Planning and Polk County Planning Departments have worked closely in putting together the 1990 comprehensive plan for the City of Lakeland. They have found that with the increasing number of people moving inland, many of their natural features are being threatened by development, and have thus worked together in planning for long-term development that preserves these special features. Of particular importance is the Green Swamp, containing extensive wetland hammocks and wildlife habitats (and, incidentally is listed by the State of Florida as an "Area of Critical Concern"). This precious swamp (one of the last of its kind) is located almost adjacent to Tenoroc's northern boundary, and is currently being threatened by intense development. Perhaps a closer look at the land use of Tenoroc would have determined that its use be better suited for light development (such as golf courses, which are greatly diminishing the natural landscapes of Florida), thereby alleviating some of the developmental pressures on the Green Swamp.

This section essentially discusses the need for more comprehensive and intergrated planning that goes beyond property line or municipality boundary - a problem in which Tenoroc has become a part of. The following are suggestions as to how these needs can be accomplished:

1. Regional land use plans should be carefully reviewed by local, state and regional planning bodies in relation to future needs, and should be based on a) an Endangered and Threatened Species Plan that allows for habitat inventory and sanctuary designations, b) a regional recreation plan that provides for a variety of parks, refuges, preserves, etc., and c) a forest industry plan that allows for forest restoration and utilization (Cennon, 1992).

2. Comprehensive planning involving reclamation should be based on hydrological systems which serve as preservation cores.

3. Care must be taken to insure that preservation areas do not become isolated or fragmented, resulting in further loss of habitat corridors.

4. Incentives (e.g. financial or permission to mine) are needed to promote revegetation with hardwoods.

5. A review of unreclaimed mined lands that are excluded from the reclamation rules of 1975 should be conducted by local and regional planning bodies to determine their suitable land use. Their land use evaluation should then be incorporated into the appropriate local comprehensive plan.

6. Comprehensive planning should involve state, local and federal agencies where appropriate, with mandatory participation of mining operators where reclamation/land use is concerned.

7. Phosphate companies would benefit by, and should support, the funding of a project which would maintain a data base of land ownership, a display of conceptual plans, company plans that border their property and land use changes (McFarlin, 1990). This data base would require continual updating.

8. Clarification of reclamation rules at all regulatory levels is needed to avoid misinterpretation and to smooth out the permitting process. A common set of guidelines issued to all regulatory agencies involved would reduce oreliminate misinterpretations.

9. A team of professionals/consultants, which could represent and understand all aspects of the mining industry and its technolgy (including reclamation) is needed to develop guidelines that can be followed by the industry as well as providing a source of expertise that the industry can

contact. Open communication with the mining industry and all governmental agencies involved would be required of this team, including up-to-date knowledge of changes in policy or research breakthroughs.

10 At the university level, coursework could be developed which brings together teams of professionals, so that an understanding and interaction of their professional roles in the mining industry would begin at the introductory level of advanced education. Additionally, current issues and research could be introduced for application, further promoting discovery and development of technologies of the mining industry.

The process of reclamation starts the moment man begins to explore the earth for its minerals. Since mining is here to stay, reclamation should be looked upon as a continuation of succession of the landscape, rather than repair of a damaged landscape. By approaching reclamation holistically, as just another step in the mining process; through proper planning, management and program, the strife for achieving a balance between our quality of life and our sustainability becomes that much more of a reality.

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APPENDIX

DEPARTMENT OF NATURAL RESOURCES
MANAGEMENT ZONES FOR TENOROC STATE RESERVE

Zone 1

Zone 1 has a 570 acre clay settling area (BDN-T-01), which was last mined in 1953. The remaining 137 acres of the total 707 acre zone is somewhat disturbed and a small portion in the southwest is undisturbed. This clay settling area is somewhat unique in that approximately 50 percent of its surface is covered by a sand tailings pile 25 feet high. Less than 5 percent of the area is forested. The major vegetation in the clay settling area is willow (Salix caroliniana) and cattails (Typha sp.) The dominant vegetation on the sand tailings pile is wax myrtle (Myrica cerifera), Natal grass (Rhynchelytrum repens) and camphorweed (Heterotheca subaxillens).

This zone, in its presently unreclaimed condition, is conceptually programmed for minor recreation potential such as hunting, hiking and wildlife/birding observation. More extensive recreation with the addition of camping could be possible with reclamation. A reclamation program is advised for this zone.

Zone 2

Zone 2 is a reclaimed clay settling area, which was last mined in 1952. This zone also has unmined, but generally disturbed areas in the southwestern and southern parts of the zone. The total area of zone 2 is approximately 700 acres. This reclaimed area can generally support light to medium-light structural loads. Camping facilities and road systems will require careful planning and engineering design due to its previous clay settling area condition.

The area was reclaimed for pasture use and is vegetated in grasses with very few trees; those present are generally along the perimeter. More extensive reforestation will be required for development of the zone's full recreational and wildlife potential.

Zone 3A

Zone 3A boundaries are generally the boundaries of a unreclaimed clay settling area (BDN-T-03), which is now an active reclamation project initiated by Bordens, Inc. under the Old Land Reclamation Program. Zone 3A was last mined in 1956. The reclamation project involves the capping of the clay surface crust with the surrounding dike material and revegetating the entire area. The original project under Bordens was designed for agricultural pasture use, but with minor modification of the planting design the plan will work for both recreational and wildlife uses. The clay content of the settling area does not allow the use of water features, but part of the reclamation plan does include a wetland area useful for wildlife management. The vegetation of this zone is dominated by cattails (Typha sp.), willow (Salix caroliniana), and wax myrtle (Myrica cerifera). The vegetation plan will include the planting of trees such as oaks, maples and cypress. The present recreational use of zone 3A is severely restricted due to the conditions within the clay settling area. Limited

recreations, such as hunting, hiking and wildlife/bird observation may be possible. After reclamation the area will be able to support more extensive use such as those of zone 2.

Zone 3B

Zone 3B is an unmined and basically an undisturbed area. The area is somewhat isolated from the rest of the reserve at the present time due to its location next to zone 3A's clay settling area and dikes. This zone's location offers good access from State Road 546 and may, in the future, become an alternative entrance. With access problems solved, this zone could offer picnicking, hiking, wildlife/bird observation, scenery appreciation and a full range of camping opportunities. The zone's location also could lend itself to future ranger residences and administration buildings. The programmed management use for this zone could include wildlife tours.

Zone 4A

Zone 4A encloses another clay settling area (BDN-T-04), which is similar in condition to zone 3A. This area was last mined in 1953. This area is eligible for the Old Land Reclamation Program but was never proposed. The wetlands of this area cover approximately 80 percent of the zone. These areas are dominated by cattails (Typha sp.), willow (Salix caroliniana) and ludwigia (Ludwigia sp.). The terrestrial areas of the zone are dominated by wax myrtle (Myrica cerifera), live oaks (Quercus virginiana), sea myrtle (Baccharis halimifolia), some bald cypress (Taxidium distichum) and exotic Brazilian pepper (Achinus terebinthifolius). The location of zone 4A in respect to zone 5A allows more use of this clay settling area due to the attractiveness of 5A.. The limited recreational uses for zone 4A could include picnicking (along forested dike areas), hunting, hiking, wildlife observation and horseback riding. These areas along with the possibility of camping and other uses will be possible with the reclamation of this zone.

Zone 4B

Zone 4B (BDN-T-06) is much like 4A in its clay settling area condition. This clay settling area was last mined in 1960. Part of the western end of this zone may not have been used for clay settling and may be in zone 5A's lake condition. The history of its use is not fully understood. The wetland clay settling areas are dominated by cattails (Typha sp.) and willow (Salix caroliniana). The upland terrestrial areas are dominated by wax myrtle (Myrica cerifera) and exotic Brazilian pepper (Schinus terebinthifolus). The location of zone 4B, in respect to zone 5A, allows more use of this clay settling area due to the attractiveness of zone 5A. The limited recreational uses for zone 4B could include picnicking (along forested dikes), hunting, wildlife observation and horse back riding. These uses along with the possibility of camping and other uses will be possible with the reclamation of this zone.

Zone 5A

Zone 5A is an extensive (1,085 acres) mined out section that was last mined in 1964. There are overburden ridges throughout the zone with interspersed water filled pits. The exposed ridges have naturally revegetated and the waters have been developed into valuable fishery areas. These overburden ridges and vegetated islands within the extensive

convoluted water bodies form a maze of ponds, lakes and channels. The fishing potential in these water bodies has been described as better than in the natural lakes of the area (Zellers-Williams, 1980). The areas distinctive topography and fishery resources has attracted a wide variety of waterfowl. The overburden ridges and islands are dominated by wax myrtle (Myrica cerifera), sea myrtle (Baccharis halimifolia) and exotic Brazilian pepper (Schinus terebinthifolus). The edge of the water bodies have willow (Salix caroliniana) and ludwigia (Ludwigia sp.). This zone will potentially offer the widest range of day-use recreation. These recreational activities might include picnicking, fishing, hiking, canoeing, limited power boating, wildlife/bird observation and scenery appreciation. This area will not have camping facilities due to its radical topography. The programmed use of this zone will include wildlife tours, research and fish management. This zone is expected to be a major attraction for the tract.

Zone 5B

This zone is one of the most relatively undisturbed zones in the tract. The 468 acre zone is generally well-vegetated except for a thirty acre reclaimed area in the north, a small ten acre area on the western edge and a forty acre portion in the southeast portion of the zone. This zone, with improved access from the rest of the tract, will offer a wide variety of day-use recreation and camping. The day-use recreational activities might include picnicking, hunting, hiking, horseback riding, wildlife/bird observation and scenery appreciation. There could also be a wide range of camping potential with standard facility camping, scout group camping and primitive camping. The programmed use of the zone could include wildlife tours.

Zone 6

This zone is a reclaimed mining area generally reclaimed in the land and lakes method. This 474 acre zone will offer the widest range of uses due to its location at the present main entrance and with its reclaimed topography. The land is presently in pasture. The potential recreational day uses include picnicking, hunting, hiking, horseback riding and wildlife/bird observation. This zone could also offer a full range of camping facilities, and also be a possible site for a museum/visitor center. The location would also be appropriate for administrative, maintenance and support uses.

Zone 7B

This zone has the land and lakes character of 7A, but is somewhat isolated by its boundary configuration. This zone is also scheduled for immediate fishing use in Phase 1. The day use recreation might also include picnicking, canoeing, wildlife/bird observation an scenery appreciation. Other uses may be limited due to its location.

TENOROC STATE RESERVE FISH MANAGEMENT AREA
Specific Regulations

Lake A - Catch and Release

1. Quota: Four boats and 20 bank fishermen.
2. No person shall operate any boat propelled by an internal combustion engine.
3. Bag limit (catch and release): All largemouth bass shall be returned to the water immediately after capture.
4. All other regulations not covered are subject to general state regulations.

Lake B - Slot Limit / Reduced Bag Limit

1. Quota: Fifteen boats and 30 bank fishermen.
2. No person shall operate any boat propelled by an engine of more than 10 horsepower
3. Bag limit: No person shall possess more than four largemouth bass per day only one of which may be 22 inches or more in total length.
4. Size limit (slot limit): Largemouth bass 16 inches or more and less than 22 inches total length shall be returned to the water immediantly after capture.
5. All other regulations not covered are subject ot general state regulations.

Lake C - Catch and Release

1. Quota: Four boats and 20 bank fishermen.
2. No person shall operate any boat propelled by an internal combustion engine.
3. Bag limit (catch and release): All largemouth bass shall be returned to the water immediately after capture.
4. All other regulations not covered are subject to general state regulations.

Lake D - Closed to Fishing

Due to unsafe conditions, Lake D is closed to fishing at this time.

Hydrilla Lake - Fly Fishing Only

1. Quota: 10 boats. Unrestricted number of bank fishermen.
2. No person shall operate any boat propelled by an internal combustion engine.
3. Bag limit: No person shall possess more than 10 largemouth bass per day. (No size limit.)
4. Fishing gear restrictions: Fishing gear will be limited to the use of flyrods and artificial lures only.
5. Bait restriction: The use of bait other than artificial lures is prohibited.
6. All other regulations not covered are subject to general state regulations.

Lake E - High Minimum Size / Children Fishing Area

1. Quota: 10 boats. Bank fishing prohibited.
2. No person shall operate any boat propelled by an internal combustion engine.
3. Bag limit: No person shall possess more than two largemouth bass 18 inches or more in total length.
4. Size limit: All largemouth bass less than 18 inches total length shall be returned to the water immediately after capture.
5. Special restriction: At least one person younger than 16 years of age must be present in each boat in order to obtain a permit to fish.
6. All other regulations not covered are subject to general state regulations.

Lake 3 - Catch and Release

1. Quota: 12 boats. Bank fishing prohibited.
2. No person shall operate any boat propelled by an internal combustion engine.
3. Bag limit (catch and release): All largemouth bass shall be returned to the water immediately after capture.
4. All other regulations not covered are subject to general state regulations.

Lake 4 - General State Regulations on Bass Apply

1. Quota: 12 boats. Bank fishing prohibited.
2. No person shall operate any boat propelled by an internal combustion engine.
3. Bag limit: No person shall possess more than 10 largemouth bass per day. (No size limit.)
4. All other regulations not covered are subject to general state regulations.

Lake 5 - Slot Limit / Reduced Bag Limit

1. Quota: 20 boats. Bank fishing prohibited.
2. No person shall operate any boat propelled by an engine of more than 10 horsepower.
3. Bag limit: No person shall possess more than four largemouth bass per day only one of which may be 22 inches or more in total length.
4. Size limit (slot limit): Largemouth bass 16 inches or more and less than 22 inches total length shall be returned to the water immediately after capture.
5. All other regulations not covered are subject to general state regulations.

Picnic Lake - High Minimum Size / Children Fishing Area

1. No person shall operate any boat propelled by an internal combustion engine.
2. Bag Limit: No person shall possess more than two largemouth bass 18 inches or more in total length.
3. Size Limit: All largemouth bass less than 18 inches in total length shall be returned immediately after capture.
4. Special Restrictions: Persons 16 years of age or older must be accompanied by a child under 16 years of age in order to fish from a boat. Bank fishing is restricted to fishermen less than 16 years of age.
5. All other regulations not covered are subject to general state regulations.

**********I M P O R T A N T**********

1. CHECK WITH RESERVE HEADQUARTERS DAILY FOR ADDITIONAL RESTRICTIONS OR REGULATIONS NOT COVERED.

2. DAILY PERMIT REQUIRED TO FISH.

3. ALL FISHERMEN MUST INDIVIDUALLY FILL OUT AND RETURN COMPLETED CREEL SHEETS.

Polk County Soil Survey Soils Description

#3 - Chandler Fine Sand, 0-5 percent slopes, is a nearly level to gently sloping, excessively drained soil that usually occurs in large areas. This upland soil is usually undulating or gently rolling. The water table is greater than 80 inches year round.

#6 - Eaton Mucky Fine Sand, depressional, is a very poorly drained, wetland soil with a mucky surface, found on low flat areas that are depressional. This soil is affected by a high seasonal water table which, under natural conditions, is within a depth of 10 inches of the surface for periods of 1 to 4 months and above the surface for 6 months or more during most years.

#7 - Pomona Fine Sand is a poorly drained soil found in the flatwood areas of the County. This soil has a water table that rises to within 10 inches of the surface for periods of 1 to 4 months and is within 40 inches for more than 6 months. Special measures are required to overcome excessive wetness for use of septic tank absorption fields.

#8 - Hydraquents, clayey are areas of slicken (colloidal clay) holding ponds. The slickens are the fine textured materials remaining after the phosphate has been removed from the mined material (matrix). The slickens are approximately 5 percent solids and 95 percent water. The slickens are pumped into fairly large holding ponds from 300 to 1,000 acres. Based on studies, the solids are principally clay (about 88%) with montmorillonite the dominant clay material. The dikes around the holding ponds are constructed so that the slickens are relatively easily dewatered.

#9 - Lynne Sand is a poorly drained flatwood soil with a water table usually at depths of 10 to 40 inches. It rises above 10 inches during wet seasons and drops below 40 inches during dry seasons.

#11 - Arents-Water Complex consist of overburden material (material removed to get to the "matrix" material or phosphate bearing strata) piled into mounds or narrow ridges with very steep sides separated by narrow pits that may or may not contain water. The water table of this complex is variable but primarily the arents part has a water table greater than 80 inches from the surface.

#12 - Neilhurst Sand, 1 to 5 percent slopes, consists of sand tailings from phosphate mining that may have been leveled and with or without slickens added. (Phosphate companies sometimes add some fine to some of the sand tailings by pumping slickens onto the tailings.) Sand tailings are the extracted and discarded sand portion of the material mined for the phosphate. The water table generally is expected to remain below 6 feet.

#13 - Samsula Muck is a very poorly drained, organic soil found in the wetland areas of the County. The water table is at or above the surface for most of the years. In dry seasons, the water table is lower, but seldom falls below a depth of 30 inches. The depth of the muck averages 36 inches.

#14 - Sparr Sand, 0 to 5 percent slopes, is a somewhat poorly drained upland soil with a water table at depths of 20 to 40 inches for periods of 1 to 4 months that rises to within about 20 inches for brief periods.

#15 - Tavares Fine Sand, 0 to 5 percent slopes is a moderately well drained, upland soil with a water table at a depth of 40 to 80 inches for more than 6 months in most years. In dry seasons it is below 80 inches.

#16 - Urban Land, consists of areas where the original soil has been modified through cutting, grading, filling, and shaping or has been generally altered for urban development. Major soil properties that originally limited urban uses have been overcome to an acceptable extent. Urban facilities, including paved parking areas, streets, industrial buildings, houses, other structures and underground utilities have been constructed on 75 percent or more of these altered areas. Areas not covered by urban facilities generally have been altered. Identification of soil within these areas is not feasible.

#17 - Smyrna and Myakka Fine Sands are poorly drained soils found in the flatwood areas of the County. The water table is at depths of less than 10 inches for 1 to 4 months duration in most years and recedes to depths of more than 40 inches during very dry seasons. Special measures are required to overcome excessive wetness for use of septic tank absorption fields.

#19 - Floridana Mucky Fine Sand, depressional, is a very poorly drained, nearly level soil found in the wetland areas of the County in small to large depressions and along poorly defined drainageways. This soil has a water table at depths of less than 10 inches below the surface and is flooded for more than 6 months during most years.

#21 - Immokalee Sand is a poorly drained, flatwood soil with a water table at depths of less than 10 inches for 2 months duration in most years, and within depths of 10 to 40 inches for periods of more than 8 months each year. The water table is at depths of more than 40 inches during dry periods.

#24 - Nittaw Sandy Clay Loam, frequently flooded, is a very poorly drained soil that occurs in drainageways, depressions and broad flood plains in wetland areas. This soil has a water table within 10 inches of the surface for more than 6 months and is flooded during the rainy season during most years.

#25 - Placid and Myakka Fine Sands, depressional, are very poorly drained soils that occur in wet depressions and along poorly defined drainageways. These soils have water tables at depths of less than 10 inches for more than 6 months and are covered with water for 6 months or more annually.

#26 - Lochloosa Fine Sand is a somewhat poorly drained, nearly level soil found mostly on lower elevations of uplands. This soil has a water table at depths of 30 to 60 inches for periods of 1 to 4 months during most years. It rises to depths of about 15 inches for 1 to 3 weeks. It recedes to depths of more than 60 inches during drier seasons.

#31 - Adamsville Fine Sand is a somewhat poorly drained flatwood soil that has a water table at depths of 20 to 40 inches for periods ranging from 2 to 6 months. It is within a depth of 60 inches for more than 9 months in most years.

#35 - Hontoon Muck is a very poorly drained organic soil that occurs in swamps and poorly defined drainageways in the wetland areas of the County. The water table is at or above the surface except during extended or dry periods. The depth of the muck averages 60 to 80 inches.

#40 - Wauchula Fine Sand is a poorly drained nearly level soil which occurs on low, broad ridges and slight depressions in the flatwoods. This soil has a water table at depths of less than 10 inches for 1 to 4 months during most years and it is at depths of 10 to 40 inches for periods as long as 6 months. During the driest season, it recedes to depths of more than 40 inches. Special measures are required to overcome excessive wetness for use of septic tank absorption fields.

#42 - Felda Fine Sand is a poorly drained, nearly level soil found on broad low flats and in sloughs and poorly defined drainageways in the flatwoods. This soil has a water table at depths of 0 to 10 inches from the surface for 2 to 6 months each year.

#43 - Oldsmar Fine Sand is a poorly drained, nearly level flatwood soil that has a water table at depths of less than 10 inches for 1 to 3 months during the wet season in most years, and it is within 10 to 40 inches during extended dry seasons.

#44 - Paisley Fine Sand consists of poorly drained, nearly level soils found in the flatwood areas of the County. This soil has a water table at depths of less than 10 inches for 2 to 6 months each year. Due to high clay content at shallow depths, a perched water table often occurs during the rainy season that adversely effects the use of septic tank absorption fields.

#57 - Haplaquents, clayey are areas of slickens that have been dewatered or dried out. These areas are undergoing gradual change as they are dewatered. After being dewatered, these areas will support plants, but from a practical standpoint, they change significantly in a period of a few years.

#58 - Udorthents, excavated are pits formed usually from the mining of clay or limestone.

#68 - Arents, 0 to 5 percent slopes consist of overburden from phosphate mining that has been leveled to 0 to 5 percent slopes. Overburden consists of soil material that overlies the matrix or phosphate bearing strata. The soils are quite variable due to mixing and mounding by earth moving machinery. The soil is a mixture of brown and yellowish sandy clay, sandy loam, loamy sand or sand. The water table is within 60 inches for 2 to 6 months during most years in most areas.

#76 - Millhopper Fine Sand is a moderately well drained soil found in the upland areas of the County. This soil has a water table at a depth of 40 to 60 inches for 1 to 4 months and below 60 inches for the remainder of the year. The slopes associated with this soil range from 0 to 5 percent.

#39 - Arents-Clayey Substratum consists of areas that have been mined for phosphate. Typically, it consists of 2 to 4 feet of sand or sandy loam over several feet of clay in the old open pits.

PLANT SPECIES FOUND WITHIN THE TENOROC STATE RECREATION AREA

PLANT SPECIES FOUND WITHIN THE CLAY SETTLING AREAS

OVERBURDEN RIDGES

Trees and Shrubs

*Tongue-tree	Albizia lebbeck
Sweetgum	Liquidambar styraciflua
Wax Myrtle	Myrica cerifera
Black Cherry	Prunus serotina
Live Oak	Quercus virginiana
Cabbarge Palm	Sabal palmeeto
*Brazilian Pepper	Schinus terebinthefolius
Bald-cypress	Taxodium distichum
Saltbush	Baccharis halimifolia
Lantana	Lantana camara
Dewberry	Rubus betulifolius
Saw Plametto	Serenoa repens
**Rattlebox	Crotalaria purshii

Herbaceous

Virginia Creeper	Parthenocissus quinquefolia
Greenbrier	Smilax bona-nox
Muscadine	Vitis rotundifolia
Bermuda Grass	Cynodon dactylon
Begger's Tick	Bidens pilosa
Dog Fennel	Eupatorium capillifolium
Caesar Weed	Urena lobata
*Cogan Grass	

WETLANDS

Trees and Shrubs

Carolina Willow	Salix caroliniana
Saltbush	Baccharis halimifolia

Herbaceous

Primrose Willow	Luqwigia peruviana
Water Fern	Salvinia rotundifolia
Duck Weed	Lemna sp.
Water Primrose	Ludwigia leptocarpa
Cattails	Typha sp.
Water lettuce	Pistia stratiotes

*Exotic and/or nuisance species.
**Seeds are toxic to birds and wildlife, exotic/nuisance species.

PLANT SPECIES FOUND WITHIN THE SAND TAILING AREAS

Trees and Shrubs

*Camphor-Tree	*Cinnamomum camphora*
Saltbush	*Baccharis halimifolia*
Slash Pine	*Pinus elliottii*
Persimmon	*Diospyros virginiana*
**Rattlebox	*Crotalaria purshii*

Herbaceous

Crabgrass	*Digitaria ciliaris*
Bahia grass	*Paspalum notatum*
Low paspalum	*Paspalum setaceum*
Natal grass	*Rhychelytrum repens*
Drop seed	*Sporobolus indicus*
Ragweed	*Ambrosia artemisiifolia*
Dog Fennel	*Eupatorium cappillifolium*
Bermuda grass	*Cynodon dactylon*
*Cogan grass	
Sedges	*Cyperus* spp.
Muscadine grape	*Vitis* sp.
Prickly pear	*Opuntia* sp.
Beggar's tick	*Bidens bipinnata*
Horseweed	*Conyza canadensis*
Camphorweed	*Heterotheca subaxillaris*
Hairy indigo	*Indigofera hirsuta*

PLANT SPECIES FOUND WITHIN THE "LAND AND LAKES" RECLAMATION AREAS

Trees and Shrubs

Wax Myrtle	*Myrica cerifera*
Willow	*Salix caroliniana*
Saltbush	*Baccharis halimifolia*
**Rattlebush	*Daubentonia punicea*

Herbaceous

Bahia grass	*Paspalum notatum*
Low paspalum	*Paspalum setaceum*
Bermuda grass	*Cynodon dactylon*
Dog Fennel	*Eupatorium capillifolium*
Camphorweed	*Heterotheca subaxillaris*
Natal grass	*Rhychelytrum repens*
Crab grass	*Digitaria ciliaris*
Drop seed	*Sporobolus indicus*

*Exotic and/or nuisance species.
**Seeds are toxic to birds and wildlife, exotic/nuisance species.

*Cogan grass	
Cattails	Typha spp.
Hydrilla	
*Water lettuce	Pistia stratiotes
*Water hyacinth	Echhorinia crassipes
Duck Weed	Lemna sp.
Pickerelweed	Pontederia lanceolata
*Frog's bit	Limnobium spongia

PLANT SPECIES FOUND WITHIN THE MINED OUT AREAS

OVERBURDEN RIDGES

Trees and Shrubs

*Tongue-tree	Albizia lebbeck
Red maple	Acer rubrum
Sweetgum	Liquidambar styraciflua
Chinaberry	Melia azedarach
Wax myrtle	Myrica cerifera
Slash pine	Pinus elliottii
Black cherry	Prunus serotina
Live oak	Quercus virginiana
Cabbage palm	Sabal palmetto
*Brazilian pepper	Schinus terebinthefolius
Bald cypress	Taxodium distichum
Saltbush	Baccaris halimifolia
**Rattlebox	Daubentia punicea

Herbaceous

Lantana	Lantana camara
Dewberry	Rubus betulifolia
Peppervine	Ampelopsis arborea
Virgina creeper	Parthenocissus quinquefolia
Greenbrier	Smilax bona-nox
Muscadine	Vitis rotundifolia
Bermuda grass	Cynodon dactylon
Crabgrass	Digitaria seotinum
*Cordgrass	
Yard grass	Eleusine indica
Low paspalum	Paspalum urvillei
Natal grass	Rhynchelytrum repens
Dropseed	Sporobolus indicus
Three-sided mercury	Acalypha gracilens
Shy leaves	Aeschnomene americana
Ragweed	Ambrosia artemisiifolia
Begger's tick	Bidens pilosa

*Exotic and/or nuisance species.
**Seeds are toxic to birds and wildlife, exotic/nuisance species.

Mexican tea	Chenopodium ambrosioides
Dog fennel	Eupatorium capillifolium
Hairy indigo	Indigofera hirsuta
Sida	Sida rhombifolia
Caesar weed	Urena lobata

WETLANDS

Trees and Shrubs

Carolina Willow	Salix caroliniana
Primrose Willow	Ludwigia peruviana
Wax Myrtle	Myrica cerifera

Herbaceous

Sedge	Cyperus surinamensis
Marsh pennywort	Hydrocotyle umbellata
Cattails	Typha sp.
Water hyacinth	Echhornia crassipes

PLANT SPECIES FOUND WITHIN THE SCRUBBY FLATWOODS

Trees and Shrubs

Slash pine	Pinus elliottii
Sand live oak	Quercus geminata
Wax myrtle	Myrica cerifera
Saw palmetto	Serenoa repens
Staggerbush	Lyonia fruticosa
Dwarf blueberry	Vaccinium sp.

Herbaceous

Goldenaster	Heterotheca graminifolia
Goldenrod	Solidago spp.
Gopher apple	Licania michauxii
Tarflower	Befaria racemosa
Wiregrass	Aristida stricta

PLANT SPECIES FOUND WITHIN THE SANDHILLS

Trees and Shrubs

Slash pine	Pinus elliottii
Turkey oak	Quercus laevis
Bluejack oak	Quercus incana
Sand post oak	Quercus margaretta
Persimmon	Diospyros virginiana
Gopher apple	Licania michauxii
Runner oak	Quercus pumila

Herbaceous

Sparkleberry	Vaccinium arboreum
Wire grass	Aristida stricta
Winged sumac	Rhus copallina
Bracken fern	Pteridium aquilinum
Partidge pea	Cassia fasciculata
Goldenaster	Heterotheca graminifolia
Wild buckwheat	Eriogonum tomentosum
Dollarweed	Rhynchosia reniformis
Milk pea	Garlactia elliottii
Yellow foxglove	

PLANT SPECIES FOUND WITHIN THE BOTTOMLAND FOREST AREAS

Trees and Shrubs

Bald cypress	Taxodium distichum
Black gum	Nyssa biflora
Slash pine	Pinus elliottii
Red bay	Persea borbonia
Sweet bay	Magnolia virginiana
Cabbage palm	Sabal palmetto
Red maple	Acer rubrum
Water oak	Quercus nigra
Sweetgum	Liquidambar styraciflua
Live oaks	Quecus virginiana
Laurel oaks	Quercus hemisphaerica
Wax myrtle	Myrica cerifera
Eldenberry	Sambucus simponii
Saw palmetto	Serenoa repens
Saltbush	Baccharis halimifolia

Herbaceous

Greenbrier	Smilax bona-nox
Poison ivy	Toxicondendron radicans
Muscadine grap	Vitis rotundifolia
Caesar weed	Urena lobata
Gallberry	Ilex glabra
Virginia creeper	Parthenocissus quinquefolia

PLANT SPECIES FOUND WITHIN THE UPLAND MIXED FOREST AREAS

Trees and Shrubs

Southern magnolia	Magnolia virginiana
Pignut hickory	Carya glabra
Sweetgum	Liquidambar styraciflua
Red maple	Acer rubrum
Flowering dogwood	Cornus floridana
Live oak	Quercus virginiana
Hackberry	Celtis laevigata
Common persimmon	Diospyros virginiana

Red cedar	Juniperus silicicola
Red mulberry	Morus rubra
Black cherry	Prunus serotina
Water oak	Quercus nigra
Cabbage palm	Sabal palmetto
Florida elm	Ulmus americana var. floridana
Sparkleberry	Vaccinium arboreum
Beauty berry	Callicarpa americana
Partridge berry	Mitchella repens

Herbaceous

Devils' walking stick	Aralia spinosa
Greenbrier	Smilax bona-nox
Passion flower	Passiflora incarnata
Fringe tree	Chionanthus virginicus
Horse sugar	Symplocos tinctoria
Muscadine grape	Vitis rotundifolia
Caesarweed	Urena lobata
Virginia creeper	Parthenocissus quinquefolia

PLANT SPECIES FOUND WITHIN THE MESIC FLATWOODS COMMUNITES

Trees and Shrubs

Slash pine	Pinus elliottii
Wiregrass	Aristida stricta
Runner oak	Quercus pumila
St. John's wort	Hypericum spp.
Saw palmetto	Serenoa repens
Fetterbush	Lyonia ferruginea
Blueberry	Vaccinium spp.
Gopher apple	Licania michauxi

Herbaceous

Tar flower	Befaria racemosa
Bog buttons	Lachnocaulon anceps
Blackroot	Pterocaulon pycnostachyum
False foxglove	Agalinas purpurea
White tap aster	Aster reticulatus
Yellow eyed grass	Xyris fimriata

PLANT SPECIES FOUND WITHIN THE CYPRESS DOME COMMUNITES

Trees and Shrubs

Bald cypress	Taxodium distichum
Swamp tupelo	Nyssa biflora
Slash pine	Pinus elliottii
Red maple	Acer rubrum
Sweetbay	Magnolia virginiana
Loblolly bay	Gordonia lasianthus
Fetterbush	Lyonia lucida

Herbaceous

Netted chain fern	Woodwardia areolata
Poison ivy	Toxicodendron radicans
Spanish moss	Tillandsia usneoides
Wild pine	Tillandsia setacea
Royal fern	Osmunda regalis
Cinnamon fern	Osmunda cinnomomea
Coastal plain willow	Salix caroliniana
Wax myrtle	Myrica cerifera
St. John's wort	Hypericum sp.
Lizard's tail	Saururus cernuus
Water hyssop	Bacopa monnieri
Buttonbush	Cephalanthus occidentalis
Red root	Lacnanthes sp.

PLANT SPECIES FOUND WITHIN BASIN MARSH COMMUNITES

Trees and Shrubs

Carolina willow	Salix caroliniana
Primrose willow	Ludwigia peruviana
Saltbush	Baccharis halimifolia
Elderberry	Sambucus simpsonii
Buttonbush	Cephalanthus occidentials
Wax myrtle	Myrica cerifera

Herbaceous

Cattails	Typha sp.
Pennywort	Hydrocotyle umbellata
Coinwort	Centella asiatica
Dog Fennel	Eupatorium capillifolium
Pickerelweed	Pontedaria lanceolata
Yellow eyed grass	Xyris spp.
*Water lettuce	Pistia stratioles
*Water hyacinth	Eichhornia crassipes
Duckweed	Lemna spp.
*Frog's bit	Limnobium spongia

*Exotic and/or nuisance species.
**Seeds are toxic to birds and wildlife, exotic/nuisance species.

WILDLIFE SPECIES WHICH INHABIT OR MAY INHABIT THE TENOROC STATE RECREATION AREA

Common Name	Scientific Name	Species Known to be Present	Status USFWS	Status FGFWFC
MAMMALS				
ARMADILLO	Dasypus novemcinctus	X		
BOBCAT	Lynx rufus			
COTTON MOUSE	Peromyscus gossypinus			
COTTONTAIL RABBIT	Sylvilagus floridanus	X		
COTTON RAT	Sigmodon hipidus			
FERAL HOG	Sus scrofa	X		
FLORIDA MOUSE	Peromyscus floridana		UR2	SSC
FLORIDA PANTHER	Felis concolor coryi	*	E	E
GRAY FOX	Urocyon cinereoargenteus	X		
GRAY SQUIRREL	Sciurus carolinensis			
MARSH RABBIT	Sylvilagus palustris	X		
OPOSSUM	Didelphis virginiana			
RACCOON	Procyon lotor	X		
RIVER OTTER	Lutra canadensis			
SOUTHEASTERN SHREW	Sorex longirostris			
STRIPED SKUNK	Mephitis mephitis	X		
WHITE-TAILED DEER	Odocoileus virginianus	X		
BIRDS				
AMERICAN BITTERN	Botyaurus lentiginosus			
AMERICAN COOT	Fulica americana	X		
AMERICAN ROBIN	Turdus migratorius	X		
AMERICAN KESTREL	Falco sparverius			
ANHINGA	Anhinga anhinga	X		
BALD EAGLE	Haliaeetus leucocephalus		E	T
BARN OWL	Tyto alba pratincola	X		
BARRED OWL	Strix varia	X		
BELTED KINGFISHER	Ceryle alcyon			

WILDLIFE SPECIES WHICH INHABIT OR MAY INHABIT THE TENOROC STATE RECREATION AREA

Common Name	Scientific Name	Species Known to be Present	Status USFWS	Status FGFWFC
BLACK-CROWNED NIGHT HERON	Nycticorax nycticorax	X		
BLACK DUCK	Anas rubripes	X		
BLACK-NECKED STILT	Himantopus mexicanus	X		
BLACK VULTURE	Coragyps atratus	X		
BLUE-GRAY GNATCATCHER	Polioptila caerulea	X		
BLUE JAY	Cyanocitta cristata	X		
BLUE-WINGED TEAL	Anas discors			
BOAT-TAILED GRACKLE	Quiscaluis major	X		
BOBWHITE QUAIL	Colonus virginianus	X		
BURROWING OWL	Athene cunicularia			SSC
CARDINAL	Cardinalis cardinalis	X		
CATTLE EGRET	Bubulcus ibis	X		
CEDAR WAXWING	Bombycilla cedrorum	X		
CHUCK-WILLS WIDOW	Caprimulgas carolinensis	X		
CAROLINA WREN	Thryothorus ludovicianus	X		
COMMON CROW	Corvus brachyrhynchos	X		
COMMON MOORHEN	Gallinula chloropus	X		
COMMON SNIPE	Gallinago gallinago			
COMMON YELLOW THROAT	Geothlypis trichas			
COOPER'S HAWK	Accipiter cooperii			
DOUBLE-CRESTED CORMORANT	Phalacrocoras auritus	X		
EASTERN PHOEBE	Sayornis phoebe	X		
EASTERN MEADOWLARK	Sturnella magna	X		
FISH CROW	Corvus ossifragus			
GRAY CATBIRD	Dumatella cardinensis	X		
GREAT BLUE HERON	Ardea herodias	X		
GREAT EGRET	Casmerodius albus	X		
GREAT HORNED OWL	Bubo virginianus	X		
GREEN-BACKED HERON	Butorides striatus	X		
GREEN-WINGED TEAL	Anas discors			
GROUND DOVE	Columbina passerina	X		
HOODED MERGANSER	Lophodytes cucullatus			
HOODED WARBLER	Wilsonia citrina			

WILDLIFE SPECIES WHICH INHABIT OR MAY INHABIT THE TENOROC STATE RECREATION AREA

Common Name	Scientific Name	Species Known to be Present	Status USFWS	Status FGFWFC
KILLDEER	Charadrius vociferus			
KING RAIL	Rallus elegans			
LAUGHING GULL	Larus atricilla			
LEAST BITTERN	Ixobrychus exilis			
LOGGERHEAD SHRIKE	Lanius ludovicianus	X		
LIMPKIN	Aramus guarauna	X		SSC
LITTLE BLUE HERON	Egretta caerulea			
LOUISIANA WATERTHRUSH	Sciurus motacilla			
MALLARD	Anas platyrhynchos	X		
MARSH HAWK	Circus cyaneus	X		
MARSH WREN	Cistothorus palustris			
MOCKING BIRD	Mimus polyglottos	X		
MOTTLED DUCK, FLORIDA DUCK	Anas fulvigula	x		
MUSCOVY DUCK	Anas, spp.	X		
NORTHERN CARDINAL	Cardinalis cardinalis	X		
NORTHERN PARULA	Parula americana			
NORTHERN SHOEVELER	Anas carolinensis			
NORTHERN WATERTHRUSH	Sciurus noveboracensis			
OSPREY	Pandion haliaetus	X		
PIED-BILLED GREBE	Podilymbus podiceps	X		
PILEATED WOODPECKER	Dryocopus pileatus	X		
PINE WARBLER	Dendroica pinus			
PROTHONOTARY WARBLER	Prothonotaria citrea			
PURPLE GALLINULE	Porphyrula martinica	X		
RED-BELLIED WOODPECKER	Melanerpes erythocephalus	X		
RED-SHOULDERED HAWK	Buteo lineatus	X		
RED-TAILED HAWK	Buteo jamaicensis	X		
RED-WINGED BLACKBIRD	Agelaius phoeniceus	X		
RING-BILLED GULL	Larus delawarensis	X		
RING-NECKED DUCK	Anthya collaris	X		
RUFOUS-SIDED TOWHEE	Pipilo erythrophthalmus	X		
RUSTY BLACKBIRD	Euphagus carolinus			
SANDHILL CRANE	Grus candensis	X		T

WILDLIFE SPECIES WHICH INHABIT OR MAY INHABIT
THE TENOROC STATE RECREATION AREA

Common Name	Scientific Name	Species Known to be Present	Status USFWS	Status FGFWFC
SAVANNAH SPARROW	Passerculus sandwichensis	X		
SHARP-SHINNED HAWK	Accipiter striatus			
SNOWY EGRET	Egretta thula	X		SSC
SWAINSON'S WARBLER	Limnothlypis swainsonii			
SWAMP SPARROW	Melospiza georgiana			
TREE SWALLOW	Tachycineta bicolor	X		
TREE SWALLOW	Iridoprocne bicolor	X		
TRICOLORED HERON	Egretta tricolor	X		
TURKEY VULTURE	Cathartes aura	X		
WARBLERS	Dendroica spp.	X		
WHIP-POOR-WILL	Caprimulgas vociferus	X		
WHITE-EYED VIREO	Vireo griseus	X		
WHITE IBIS	Eudocimus albus			
WILSON'S PLOVER	Charadrius wilsonia			
WOOD DUCK	Aiz sponsa	X		
WOOD STORK	Mycteria americana		E	E
WOOD THRUSH	Hylocichla mustelina			
YELLOW-THROATED WARBLER	Dendroica dominica	X		
REPTILES				
AMERICAN ALLIGATOR	Alligator mississipiensis	X	T(S/A)	SSC
BANDED WATER SNAKE	Nerodia fasciata			
BLACK RACER	Coluber constrictor			
BROWN SNAKE	Storeria dekayi			
BROWN WATER SNAKE	Nerodia taxispilota			
CORAL SNAKE	Micrurs filvius			
DUSKY PYGMY RATTLESNAKE	Sistrurus miliarius			
EASTERN COTTONMOUTH	Agkistrodon piscivorus			
EASTERN DIAMONDBACK RATTLESNAKE	Crotalus adamanteus	X		
EASTERN GARTER SNAKE	Thamnophis sirtalis	X		
EASTERN INDIGO SNAKE	Dyrmarchon corais couperi		T	T

WILDLIFE SPECIES WHICH INHABIT OR MAY INHABIT THE TENOROC STATE RECREATION AREA

Common Name	Scientific Name	Species Known to be Present	Status USFWS	Status FGFWFC
FIVE-LINED SKINK	Eumeces inexpectatus			
FLORIDA COOTER	Pseudemys floridana			
FLORIDA KINGSNAKE	Lampropeltis getulus			
FLORIDA MUD TURTLE	Kinosternon subrubrum			
FLORIDA RED-BELLIED TURTLE	Pseudemys nelsoni	X		
FLORIDA SOFTSHELL TURTLE	Trionyx ferox			
GOPHER TORTOISE	Gopherus polyphemus	X	UR	SSC
GREEN ANOLE	Anolis carolinensis			
GROUND SKINK	Scincella guttata			
RED RAT SNAKE	Elaphe guttata			
SCARLET KINGSNAKE	Lampropeltis triangulum			
SLENDER GLASS LIZARD	Ophisaurus attentuatus			
SOUTHERN RINGNECK SNAKE	Diadophis punctatus			
YELLOW RAT SNAKE	Elaphe obsoleta	X		
AMPHIBIANS				
BULL FROG	Rana castesbeiana			
DUSKY SALAMANDER	Desmognathus auriculatus			
DWARF SALAMANDER	Eurycea quadridigitata			
GOPHER FROG	Rana areolata		UR2	SSC
GREEN TREE FROG	Hyla cinerea	X		
GREENHOUSE FROG	Eleutherodactylus planirostris			
LEOPARD FROG	Rana utricularia			
LESSER SIREN	Siren intermedia			
LITTLE GRASS FROG	Limnaoedus ocularis			
SOUTHERN CHORUS FROG	Pseudacris nigrita			
SOUTHERN TOAD	Bufo terrestris	X		
SQUIRREL TREEFROG	Hyla squirella			

E= Endangered

WILDLIFE SPECIES WHICH INHABIT OR MAY INHABIT
THE TENOROC STATE RECREATION AREA

Common Name	Scientific Name	Species Known to be Present	Status USFWS	Status FGFWFC

T= Threatened
R= Rare
SSC= Species of Special Concern
C= Commercially Exploited
UR1= Under review for federal listing, with substantial evidence in existence indicating at least some degree of biological vulnerability and/or threat.
UR2= Under review for listing, but substantial evidence of biological vulnerability and/or threat is lacking.
UR3= Still formally under review for listing, but no longer being considered for listing due to existing pervasive evidence of extinction.
UR4= Still formally under review for listing, but no longer being considered for listing because current taxonomic understanding indicates species in an invalid taxon and thus ineligible for listing.
UR5= Still formally under review for listing, but no longer considered for listing because recent information indicates species is more widespread or abundant than previously believed.

Sources:
FGFWFC, Official lists of Endangered and Potentially Endangered Fauna and Flora in Florida January 1, 1990.

USFWS, Checklist of Vertebrates of the United States, the U.S. territories, and Canada 1987. RP#166.

USFWS, Endangered and Threatened Wildlife and Plants 50 CFR 17,11 and 17.12, January 1, 1989.

ECFRPC, Buffer zones for Water, Wetlands and Wildlife in the East Central Florida Region by M. Brown, J. Schaefer and K. Brandt Center for Wetlands University of Florida, Final Report, October, 1989
FDNR, Tenoroc Management Plan, preliminary draft.

Florida Department of Natural Resources

TENOROC CURRENT USER SURVEY

Final Results

There were 195 responses for the survey given to Tenoroc visitors from 4/21 to 5/13.

1. When you come to fish/visit now, where do you stay?

Live in the area	190	(97%)
With relatives or friends	2	(1%)
Commercial Campsite	0	
Other State Park	0	
Hotel	3	(2%)

2. Would you stay at Tenoroc if facilities were developed?

County Residents: 86 Yes (70%) Other 52 Yes (72%)
Total 138 of 195 YES (71%)

If yes which kinds of facilities would you use:
(More than one answer allowed)

	RESPONSE			
	County Res	Other	Total	
Lodge	11	10	21	(9.5%)
Cabin	27	25	52	(23.5%)
RV/Trailer	33	22	55	(25.0%)
Tent	62	31	93	(43.0%)

3. What kinds of support facilities would you like to see developed?
(More than one answer allowed)

	RESPONSE			
	County Res	Other	Total	
Better Boat Ramps	33 (13%)	27 (20%)	60	(17%)
Docks	37 (15%)	21 (15%)	58	(16%)
Bait & Tackle Shop	67 (27%)	34 (24%)	101	(26%)
Concessions	43 (18%)	31 (22%)	74	(19%)
More Picnic Areas	34 (14%)	10 (7%)	44	(11%)
Other Responses				
Paved Parking	5 (2%)	5 (4%)	10	(2%)
Playground area	8 (3%)	0	8	(2%)
More Bank Fishing Area	2 (.8%)	1 (.7%)	3	(.8%)
Leave As Is/No changes	1 (.8%)	1 (.7%)	1	(.2%)
Primitive Camping	2 (.8%)	1 (.7%)	3	(.8%)
Handicapped docks	1 (.4%)	0	1	(.2%)
Nature Center	2 (.8%)	0	2	(.5%)
No Response	6 (2%)	7 (5%)	13	(3%)
Trash Cans @ Lakes	1 (.4%)	1 (.7%)	2	(.5%)

3 cont'd

More Horseback Trails	1 (.4%)	0	1 (.2%)
Sign @ Picnic Area	2 (.8%)	0	2 (.5%)
Restrooms @ Lakes	1 (.8%)	0	1 (.2%)

4. Which of the following would you like to see developed at Tenoroc?
(More than one answer allowed)

	RESPONSE		
	County Res	Other	Total
Swimming/Beach Areas	40 (18%)	17 (16%)	57 (17%)
Nature Trails	66 (30%)	37 (36%)	103 (32%)
Bike Trails	22 (10%)	9 (8%)	31 (10%)
Horse Trails	20 (9%)	8 (7%)	28 (8%)
Archery Range	24 (11%)	6 (6%)	30 (9%)
Open Use Areas	36 (16%)	15 (14%)	51 (16%)
No Response	14 (6%)	14 (13%)	28 (8%)

5. On an average I fish/visit Tenoroc: CHECK ONE

	RESPONSE		
	County Res	Other	Total
One day/week	31 (25%)	11 (16%)	42 (22%)
Two days/week	13 (10%)	3 (4%)	16 (8%)
More than two days/week	2 (2%)	3 (4%)	5 (3%)
Once a month	23 (19%)	9 (12%)	32 (16%)
Two or more times/month	27 (22%)	18 (25%)	45 (23%)
Only occasionally	27 (22%)	28 (39%)	55 (28%)

6. I usually fish/visit:

	RESPONSE		
	County Res	Other	Total
Alone	6 (5%)	4 (5%)	10 (5%)
With spouse and family	33 (27%)	12 (17%)	45 (23%)
With friends	79 (64%)	44 (61%)	123 (63%)
No Response	5 (4%)	12 (17%)	17 (9%)

7. How many are usually in your party?

		RESPONSE		
		County Res	Other	Total
# in party	1	6 (5%)	4 (5%)	10 (5%)
	2	59 (48%)	38 (53%)	97 (50%)
	3	38 (31%)	17 (24%)	55 (28%)
	4	12 (10%)	0	12 (6%)
No Response		8 (6%)	13 (18%)	21 (11%)

8. If you were the planner for this park what other facilities or programs would you like to see developed?

46 People responded with the following answers:

RESPONSE	# People
Drinking water/trails & boat ramps	2
Trash cans at boat ramps	1
Better roads-paved	6
More fish attractors	1
Playground area	6
Duck & Dove hunting area	4
Family camping	7
Swimming	5
Bait Shop	3
More picnic areas and tables	1
No changes wanted at all	9
Archery hog hunting	1
More bank fishing areas	2
Nature programs	1
Bird sanctuary	1
More/better bathrooms	3
Better lake access	1
Open/natural areas	1
Education Center	1
More Horseback Trails	1
Camping Area	2
More Bathrooms	3
More Trails	2

DEMOGRAPHICS

	County Res	Other	Total
Male	102	55	157
Female	16	7	23
No Response	5	10	15
Age Under 18	3	1	4
18-25	15	4	19
26-35	34	21	55
36-45	35	17	52
46-55	12	5	17
56-65	9	3	12
65 +	5	0	5
No Response	10	21	31
Marital Status:			
Single	30	16	46
Married	82	41	123
Seperated	2	0	2
Divorced	4	1	5
No Response	5	14	19
Education:			
No High School	7	1	8
Some High School	12	2	14
High School Graduate	40	26	66
Some College	38	15	53
College Graduate	11	10	21
Graduate/Professional	7	4	11
No Response	8	14	22
Household Income :			
Less than $ 10,000	9	6	15
10,000 to 19,999	26	6	32
20,000 to 29,999	27	12	39
30,000 to 39,999	19	9	28
40,000 to 49,999	14	11	25
50,000 or over	13	13	26
No Response	15	15	30

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EDUCATION

Master of Landscape Architecture
Virginia Polytechnic Institute, 1993

Bachelor of Science, Home Economics
Florida State University, 1983

WORK EXPERIENCE

Manager / Designer for retail plant nursery. Duties include development of business plan, nursery site design, nursery crew supervision, client contact involving landscape design, budget and implementation.
The Greenery Station, Gulf Breeze, FL
August 1992 - current

Internship with landscape architectural firm. Participated in residential designs, computerized tree inventory and urban reforestation project.
Granger + Johnson Partnership, Pensacola, FL
June 1992 - August 1992

Internship involving downtown street tree inventory and proposal for beautification project. Responsibilities included developing proposal and budget for ten year project.
City of Saskatoon, Canada
June 1991 - August 1991

VOLUNTEERISM

Investigative Board of the Virginia Polytechnic Institute Graduate Honor System; Secretary of student ASLA at Florida International University; St. Mark's Wildlife Refuge.