Appendix F: Ecological Classification System

The national ecological classification, mapping, and inventory system describes and maps ecosystems at different scales. This type of multi-scale system is tied to the National Hierarchical Framework of Ecological Units, "a regionalization, classification, and mapping system for stratifying the Earth into progressively smaller areas of increasingly uniform ecological potential" (Ecomap 1993). It provides a framework for implementing ecosystem management across physiographic regions, subregions, and local landscapes. Individual ecosystem units can be compared with adjacent units and their patterns and relationships recognized at the landscape and land unit scales.

The United States is divided into four broad domains based on large ecological climate zones identified by Köppen (1931). Except for the southern tip of Florida, almost all of the eastern United States belongs in the Humid Temperate Domain. This domain is differentiated into six divisions according to the importance of winter frost (Bailey 1995), and these Divisions are differentiated into three provinces according to geomorphology (McNab and Avers 1994). Camp Lejeune is located in the Outer Coastal Plain Mixed Forest Province within the Subtropical Division .

At the subregional scale, ecological units termed sections and subsections further subdivide the land. The Outer Coastal Plain Mixed Forest Province is differentiated into seven sections according to important differences in potential natural vegetation, soil orders, and disturbance regimes. The Atlantic Coastal Flatlands Section, in which Camp Lejeune belongs, is differentiated into 55 Subsections according to important differences in local climate, landform, geological formation, and potential natural vegetation types (Keys et. al. 1995). Camp Lejeune is in the Lower Terraces
Subsection. Its place in the National Hierarchy of Ecological Units is therefore:

DOMAIN 200: Humid Temperate
DIVISION 230: Subtropical
PROVINCE 232: Outer Coastal Plain Mixed Forest
SECTION 232C: Atlantic Coastal Flatlands
SUBSECTION 232Cb: Lower Terraces

These subdivisions have proven useful for strategic planning and assessment of ecosystems at the national, regional, and state level. They may not be useful for addressing management issues such as fire, silviculture, native diversity, and wildlife habitat needs at the local scale. Below the subsection level, ecosystems can be further subdivided into Landtype Associations (LTAs) which are identified and mapped based on similarities and patterns of soil types, stream types, lakes, wetlands, and plant associations or potential natural vegetation. At the land unit scale, LTAs can then be subdivided into Landtypes (LTs) and Landtype Phases (LTPs), the smallest ecological units. These units identify land having different potential natural vegetation (PNV), landform, soil drainage, and site productivity. The following describes the ecological classification of Camp Lejeune.

Figure F-1. Aerial view of marsh lands aboard Camp Lejeune

Ecological Classification Methods on Camp Lejeune

The Ecological Classification System (ECS) developed for Camp Lejeune is a synthesis of available information on local climate, geology, soils, current vegetation, potential natural vegetation, fire regimes, and rare species occurrences. Basic sources of information include:

Ecological Units for the Eastern United States (Keys et. al. 1995),
Classification of the Natural Communities of North Carolina (Schafale and Weakley 1984),
Inventory of the Rare Species, Natural Communities, and Critical Areas on Camp Lejeune (LeBlond 1997),
Ecological Classification on the Croatan National Forest (USFS1999),
Pre-settlement Vegetation and Natural Fire Regimes on the Croatan National Forest (Frost 2001),
Pre-settlement Vegetation Community Types of Camp Lejeune (Frost 2001),
Onslow County Soil Survey (1992)(IGIR 2000),
Soil Survey for Camp Lejeune (1984), (IGIR 2000),
USFS Forest Inventory Plots (archived data 1990),
Forest Inventory Report (Carter 2000),
Element Occurrence Records (NC Natural Heritage 1999),
Timber Stands / Compartments (IGIR 2000),
RCW Cavity Tree Cluster/Buffer (IGIR 2000),
RCW Foraging Circles (IGIR 2000), and
Proposed Natural Area (IGIR 2000).

An initial list of the ecological types for Camp Lejeune was derived from several sources: the "Classification of Natural Communities of North Carolina" (Schafale and Weakley 1990), the "Inventory of the Rare Species, Natural Communities, and Critical Areas on Camp Lejeune", and the "Pre-settlement Vegetation and Natural Fire Regimes on the Croatan National Forest." The organization of these ecological types (the concepts), into ecological LTs (the units of land), followed the classification scheme developed for the Croatan National Forest, a landscape in close proximity to Camp Lejeune. These two areas have similar environmental conditions and soil types because they are in the same ecological

Subsection. Landtypes were chosen to "crosswalk" these two areas because they should be the closest match of ecological conditions at a similar scale and because they are intermediate in size between LTAs and LTPs, the largest and smallest ecosystems respectively that could be defined for both areas

A preliminary map of the distribution of LTs on Camp Lejeune was developed from known relationships between potential natural vegetation, soil types, natural fire regimes, and potential natural vegetation maps (Frost 1996, 2000) in the Atlantic Coastal Flatwoods Section, Lower Terraces Subsection. The GIS coverage (IGIR 2000) for the 1992 Onslow County Soil Classification was used to produce hardcopy maps at 1:40,000 scale of the initial ecological LT classification units for the Base. This map was then used as the starting point to define LTPs and LTAs on Camp Lejeune; essentially the "top down" and "bottom up" approach described in ECOMAP (1993). Potential Natural Vegetation maps, soil surveys, and current vegetation, timber productivity, and species diversity data, were then used to refine, validate, and delineate the ecological units on Camp Lejeune. For a full reporting of this process, see "Ecological Classification, Mapping, and Inventory for Camp Lejeune," prepared by Steve Simon of the USDA Forest Service in Asheville, NC.

There are 5 LTAs, 15 LTs, and 31 LTPs identified on Camp Lejeune (Figure F-2, Figure F-4, and Table F-1). Three of the Landtypes and six of the LTPs describe altered land such as urban areas.

Landtype Associations

On Camp Lejeune the following LTAs were described:

LTA 232Cb03 – **Stella-White Oak Dissected Lowlands**
LTA 232Cb04 - **Bogue-Topsail Coastal Sandridge**
LTA 232Cb09 - **Onslow Maritime Zone**
LTA 232Cb12 - **New River Dissected Uplands**
LTA 232Cb13 - **Great Sandy Run Pocosin**

Table F.1 describes the primary characteristics of these LTAs. Figure F-2 shows LTAs on Camp Lejeune and Figure F-3 shows a regional map of LTAs.

Landtypes and Landtype Phases

Descriptions

Landtype descriptions include a discussion of the major landforms, moisture regimes, and potential natural vegetation dominants, all phases defined for the type and the size of the LT on Camp Lejeune and in Onslow County. In addition, landscape/landform pattern, disturbance factors, pre-settlement vegetation, existing vegetation, and management

considerations for each LT are described. Landtype Phase descriptions include a photograph of a typical stand; number of map units, their range in size, total extent, primary associates, and location; soil series, drainage, texture, and productivity for major pine species; and pre-settlement vegetation type, composition and condition with a comparison to existing dominant species.

Table F.2 summarizes the LTs and LTPs aboard Camp Lejeune. The following pages also contain these tables relating to ecological classification on Camp Lejeune:

Composition of LTAs in Onslow County and on Camp Lejeune,
Dominant Tree Species Occurring in LTP on Main Base, Camp Lejeune,
Dominant Tree Species Occurring in LTP on GSRA, Camp Lejeune,
Crosswalk Between LTs and Frost's (2000) PNV Community Type Groups,
Relative Site Index Class for Important Pine Species on Camp Lejeune, and
Natural Areas, Rare Species, and Natural Communities on Camp Lejeune.

Use of the Ecological Classification System

Like all maps, those produced for the ECS are imperfect representations of the land, and accuracy depends upon the application and scale being used. On Camp Lejeune, LTAs can accurately describe landscape patterns at the broadest scale, which can help to separate land having distinct management opportunities and limitations based on dominant ecological factors such as topography and landform/vegetation diversity. Since the ECS was derived from soil maps, map unit reliability at the finer scales is controlled by the accuracy of the Onslow County and Base soil surveys. As a result, on site investigation is needed to plan for intensive uses in small areas.

Use on Camp Lejeune

The ECS can be thought of as a snapshot of what the landscape may have looked like at a given moment in history. The Southeastern Coastal Plain is a dynamic system, constantly responding to large-scale disturbances such as hurricanes and fire. Because of the disturbance regime, portions of the landscape would inevitably be in different successional stages of a fire maintained sub-climax ecosystem. This being the case, the ECS cannot be interpreted as an exact representation of a desired future condition.

Table F.1 Landtype Associations Located on MCB Camp Lejeune, NC

232Cb03 STELLA WHITE OAK DISSECTED LOWLANDS (LTA 3)

Location: ~200,000 acres in Jones, Onslow, Carteret Co.; ~160,000 acres in Onslow Co., ~400 acres on Camp Lejeune

Distinguishing Features: Dissected landscape w/major streams, aquults and udults; diverse flora; large proportion of mesic longleaf pine, mixed wet
pine, swamp forests

Primary design criteria: Topography (dissected and undissected interstream flats w/low relief), stream density (high), diversity and complexity (diverse
veg., complex soils)

Associated criteria: soil series associations (Rains-Goldsboro-Lynchburg, Torhunta-Pantego-Rains, Baymeade-Onslow-Lynchburg)

Vegetation: potential communities: dry to wet longleaf pine savannas, mixed wet pine/evergreen shrubs, pond-pine-loblolly bay, cypress-gum swamps,
tidal marshes

232Cb04 BOGUE-TOPSAIL COASTAL SANDRIDGE (LTA 4)

Location: ~67,000 acres in Carteret and Onslow Co.; ~29,750 acres in Onslow Co., ~15,000 acres on Camp Lejeune

Distinguishing Features: Highly patterned landscape dom. by broad ridges and swales that reflect old ocean shoreline. Large proportion of deep
sandy, very poorly drained soils w/o organic surface horizon but w/a spodic horizon (aquods) and soils on well-sorted sands (psamments).
Dom. by pond pine/evergreen shrubs and longleaf pine savannas.

Primary design criteria: Landscape pattern (matrix of pocosin w/patches of pine savanna), extensive ridge and swale network in eastern portion LTA

Associated criteria: soil series associations (Leon-Murville-Mandarin, Wando-Seabrook-Kureb)

Vegetation: potential communities: wet longleaf pine savanna, xeric longleaf pine savanna, dry-mesic longleaf pine savanna, mucky pocosin

232Cb09 ONSLOW MARITIME ZONE (LTA 9)

Location: ~78,000 acres in Onslow, Carteret Co.; ~49,250 acres in Onslow Co., ~16,000 acres on Camp Lejeune

Distinguishing Features: Active beach, barrier islands, sound, coastal rivers. Dominated by deep sands (psamments)

Primary design criteria: Landform (low terrace, ocean and river shorelines, barrier islands). Proximity to ocean and salt influence

Associated criteria: soil series associations (Newhan-Corolla-Duckston, Bohicket-Carteret-Hobucken-Lafitte)

Vegetation: potential communities: salt and oligohaline marsh, Maritime Evergreen Forest, Coastal Fringe Evergreen Forest, live oak and yaupon,
longleaf pine savanna

232Cb12 NEW RIVER DISSECTED UPLANDS (LTA 12)

Location: ~173,000 acres in Onslow, Daplin, Pender Co.; ~72,000 acres on Camp Lejeune

Distinguishing Features: Well-drained stream network with large river, extensive urban and urban-woodland areas, broad pine uplands

Primary design criteria: Landform (upland terrace w/numerous small streams and New River). PNV (distinct small stream swamps bordering drainage
slopes w/pine-hardwood forests below dry-mesic to mesic pine savannas

Associated criteria: soil series associations (Baymeade, Onslow, Marvyn). Drainage (mostly well drained and moderately well-drained soils.

Vegetation: potential communities: dry-mesic and mesic longleaf pine/wiregrass savanna, cypress-gum small stream swamps, mixed longleaf pine-oak
slopes

232Cb13 GREAT SANDY RUN POCOSIN (LTA 13)

Location: ~70,000+ acres in Onslow and Pender Co.; ~42,000 acres on Camp Lejeune

Distinguishing Features: Large, slightly raised peatland w/parent material consisting almost entirely of decomposed plant material and saturated
w/water for 6+ months/yr.

Peatlands bordered by very poorly drained mineral soils. In recent past, extensive ditching, drainage, and intensive forestry operations.

Primary design criteria: Topography-soils (mod. deep organics in raised domes). Vegetation (pocosin, pond pine woodlands). Drainage (very poorly-
drained and poorly-drained soils).

Associated criteria: soil series associations (Croatan (saprist), Torhunta (aquent), Woodington (aquult), Leon (aquod), and Murville (aquod)).

Vegetation: potential communities: high and low pond pocosin, wet longleaf pine savanna, pond pine woodlands.

Table F.2. Landtypes and Landtype Phases on MCB Camp Lejeune, NC

LT #	LTP #	**LANDTYPE** Landtype Phase	LT extent (acres)	LTP extent (acres)	soil map units
1		**INLAND TIDAL MARSHES and TIDAL SWAMPS**	1,399		
	101	Very poorly drained, loamy, sandy, or deep organic, inland tidal marsh		319	La, Bo
	102	Very poorly drained, deep organic, tidal cypress-gum swamp		1,080	Da
2		**SMALL STREAM SWAMPS and STREAMHEAD POCOSINS**	8,686		
	201	Poorly drained, mucky, small stream swamp		8,196	Mk
	202	Poorly drained, sandy muck, stream head pocosin		490	Mk
4		**DRAINAGE SLOPES**	8,771		
	401	Well-drained, sandy, pine-hardwood slope		8,618	MaC
	402	Moderately well-drained, clayey, hardwood slope		153	CrC
6		**INTERSTREAM FLATS**	8,462		
	601	Somewhat poorly to poorly drained, sandy, loamy or clayey, mixed pine savanna		1,089	Pa, Ra, Le
	602	Poorly drained, sandy, pond pine and mixed pine savanna		7,373	Wo
7		**POCOSIN FRINGES**	7,726		
	701	Very poorly drained, mucky and loamy, pond pine woodland		7,726	Pn, To
8		**BROAD POCOSINS**	16,822		
	801	Very poorly drained, pond pine pocosin, on peat		8,662	Ct
	802	Very poorly drained, sandy muck, pond pine pocosin		8,160	Mu
9		**WET-MESIC and WET PINE SAVANNAS**	17,826		
	901	Somewhat poorly drained, sandy and loamy, longleaf-mixed pine savanna		4,022	St,Ly
	902	Poorly drained, sandy, longleaf pine savanna		13,804	Ln
10		**MESIC PINE SAVANNAS**	13,916		
	1001	Well-drained, loamy, longleaf pine and mixed pine savanna		1,280	NoA, NoB
	1002	Moderately well-drained, loamy, longleaf pine and mixed pine savanna		12,636	CrB, GoA, FoA, On
11		**XERIC and DRY-MESIC PINE SAVANNAS**	24,314		
	1101	Excessively drained, sandy, longleaf pine		6,094	KuB,

		savanna			AnB
	1102	Excessively drained, sandy, dry-mesic, longleaf pine savanna		614	WaB
	1103	Well-drained, sandy, longleaf pine savanna		17,606	BmB
13		**MARITIME INFLUENCED WOODLANDS and SAVANNAS**	7,400		
	1301	Excessively drained, sandy, maritime influenced pine-oak woodland		3,728	WaB
	1302	Well drained, sandy, maritime influenced longleaf pine savanna		1,009	BmB
	1303	Well drained, sandy, maritime influenced mixed pine-oak slope		1,000	MaC
	1304	Moderately well and somewhat poorly drained, sandy, maritime mixed pine flat		1,663	Pa
14		**MARITIME DUNES, SWALES, and MARSHES**	3,595		
	1401	Excessively to poorly drained, maritime dunes and swales		1,369	NeE, Co, Dc
	1402	Very poorly drained, loamy, maritime salt marsh		2,226	Bo
16		**URBAN AREAS**	976		
	1601	Highly developed urban area		976	Ur
17		**URBAN-WOODLAND COMPLEX**	4,939		
	1701	Urban-woodland complex		4,939	GpB, BaB
18		**OTHER ALTERED LANDS**	1,658		
	1801	Landfill (udorthents)		46	Ud
	1802	Excessive to somewhat poorly drained, dredged, deposited soil		558	YaA, NfC
	1803	Poorly drained excavated pit		175	Pt
	1804	Main Base perimeter, not mapped		879	ND, NM
30		**WATER**	18,917		
	3001	Rivers, lakes, ponds		18,917	Water
		---- total Camp Lejeune Marine Corps Base area ---	145,406		

Figure F-2 Landtype Associations aboard MCB Camp Lejeune, NC

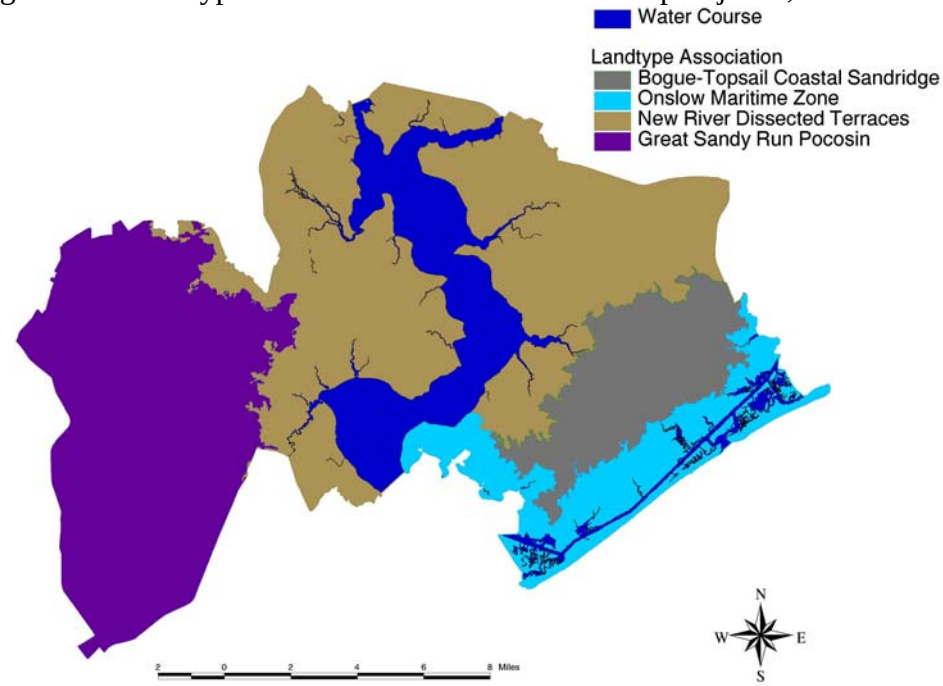
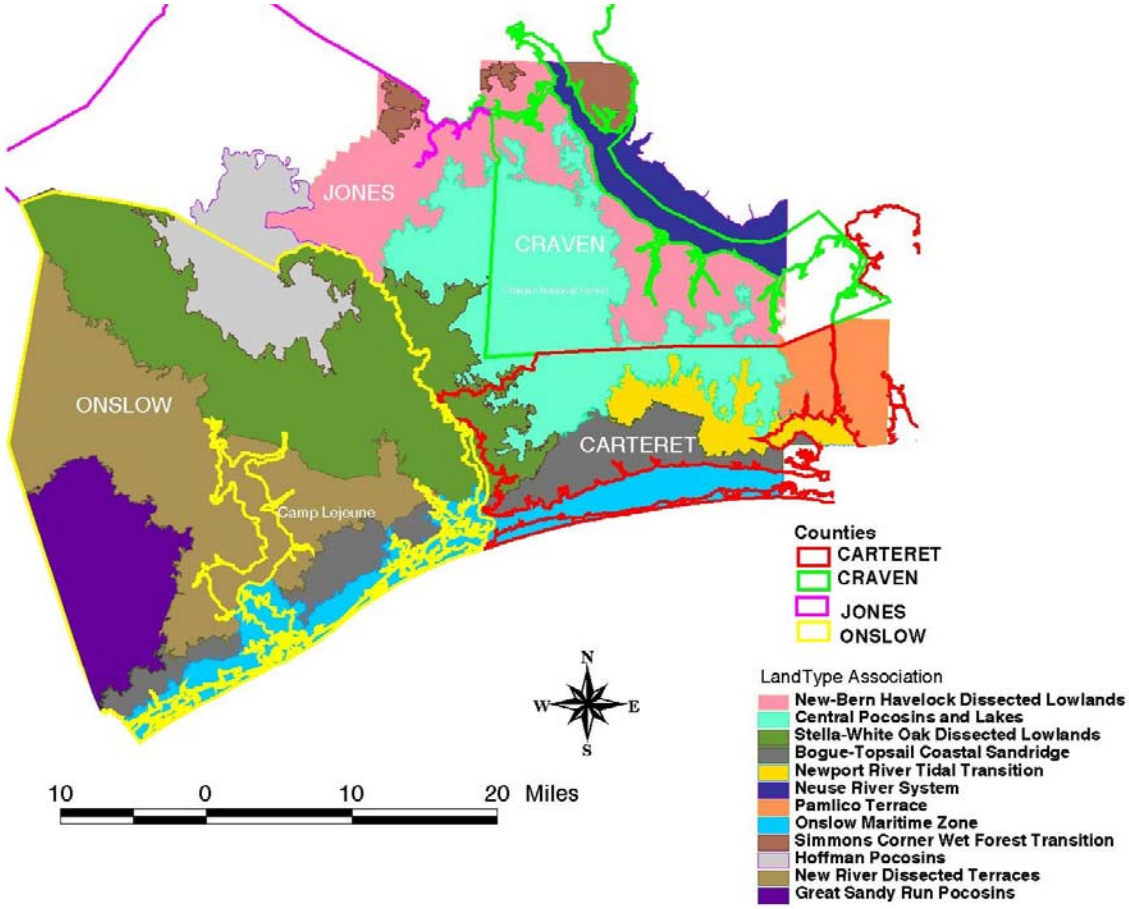


Figure F-3 Landtype Associations in Onslow, Jones, Craven, and Carteret Counties, NC



It is neither practical nor possible to develop a management strategy based solely on the ecological potential of the landscape. This would not account for the human component of the ecosystem. The ECS must be interpreted based on information that includes but is not limited to mission requirements, endangered species recovery, recreational opportunities, management constraints, and trends in facilities development. Therefore, on a particular piece of land, the ECS depicts a potential future condition that may or may not be achievable given these other considerations. The ecological potential does provide land managers the necessary information to development short and long-term management strategies on three landscape scales.

Camp Lejeune is comprised of portions of five distinct LTAs. When the LTAs within the boundary of Camp Lejeune are characterized based on land use and current land conditions. Distinctive features suggest that differing management strategies are called for to achieve a balance between ecological potential and land use.

The general management strategy for an LTA can be further defined by examining the Land Types, which are the fundamental components of that land type association. The LTs can be used to identify those land uses and resources that would most benefit from prioritized management of the particular landscape. To effectively manage at a landscape level, it is necessary to be aware of to what larger system the landscape will contribute and what smaller components must be represented in the landscape.

The finest scale of management will be at the level of LTP. The LTP depicts a potential future condition of a discrete area that can be managed to contribute to the landscape goals. Short-term management activities may or may not directly return an area to its depicted ecological potential though management will not move an area away from that potential.

Considering the large scale differences in LTAs, the next step is to consider the component landscapes. For example, the Coastal Ridges LTA includes longleaf pine savannas across all moisture gradients, along with broad pocosins and streamhead swamps. The pine savannas support intense ground training activities as well as a concentration of RCW clusters. Further these vegetative communities and their ecotones support a large diversity of endemic plants. In determining what the management focus should be for this landscape, a desirable approach would: (1) maintain the open character of the pine savannas conducive to training; (2) support continued health of the RCW groups; and (3) conserve and enhances plant diversity. With these broad objectives accounted for, site-specific decisions at the LTP level can be made within a framework developed at the landscape level.

Consider for example two stands within a mesic pine savanna landscape contributing Coastal Ridges LTA. One stand supports 40-year-old loblolly pine that is not currently used for RCW foraging due to a tall midstory and shrubby understory. The other stand, located at the periphery of an RCW foraging area, supports 60-year-old loblolly pine and is known for occasional use as a bivouac site. Because longleaf pine is the native species for this landscape, both stands would be candidates for conversion.
Following the logic of determining priorities based on land use and ecological potential, the easy choice may be to convert the 40-year-old stand since it won’t impact RCW nor result in

the loss of valuable training location. Perhaps the 60-year-old stand would be thinned now and re-evaluated at the next compartment entry to determine if the shorter longevity of loblolly pine outweighs the temporary loss of a training location and RCW foraging habitat. *Ultimately, the decision would be made based on the current capacity of the landscape to support training requirements and prioritized resource objectives.* A site-specific decision cannot be made on ecological potential alone.

Project Level Planning and Analysis

The ECS can be an important tool at the project level for project planning, design, and analysis of the effects of proposed actions. Landtype Phase map units represent the greatest amount of detail on site and biological factors. Because these map units are derived from soil surveys but combine fire disturbance regimes and vegetation potentials, they can be used to interpret each component separately or together as a unit. The ECS is therefore not just an inventory and evaluation of the soils on Camp Lejeune, but also the biological components and potentials of ecosystems. As with a soil survey, "it can be used to adjust land uses to the limitations and potentials of natural resources and the environment" (USDA 1992).

Information in Table E.3 and the ECS tables can be used to evaluate the feasibility and probable effects of a proposed action in all or part of the Base. Combined with the ecological maps and descriptions, opportunities and limitations are apparent for a variety of proposed actions including timber stand improvement, wildlife habitat manipulation, timber harvest, and the siting of new training facilities.

Although the ECS identifies and describes distinct land units and their biological potential, it does not describe the current vegetation condition. This information is provided in the compartment and stand maps and in Carter's (2000) maps of the Main Base. By combining the ECS and these data, one can map areas of the landscape where current condition differs from potential condition and begin to locate opportunities for change and evaluate the range of options available for individual sites. The ECS presents potential future conditions, not a prescription for management; rather a template condition that is subject to modifications based on management considerations and constraints. Land use decisions will be improved by use of the ECS, but they should not be dictated by it.

Reliability of Mapping

Although soils occur in an orderly pattern that is related to geology, landform, relief, climate, and plant associations, soil scientists must determine the boundaries based on an understanding of the soil-landscape relationships. The ECS incorporates this boundary along with an understanding of the relationships between landscape, vegetation, and fire regimes to determine the boundary of ecological units.

Most ECS map units are dominated by one major soil type having the same potential vegetation and fire regime. Inclusions of other soil-vegetation types mostly have properties and behavior similar to those of the dominant type. However, these differences may be

important at the project level and field review and county soil surveys should be consulted to determine how extensive these differences might be.

Additional factors may affect mapping accuracy. Order 2 soil surveys are considered to have an 80% mapping reliability and a minimum map unit size of 5-10 acres. The soil survey for Camp Lejeune is a refinement of the Onslow County Order 2 soil survey and the minimum map unit size is considerably less than 5 acres. There are also some inconsistencies in soil mapping between the Base and the county. Because of these inconsistencies, a buffer called the “Main Base Perimeter” (LTP 1803) was identified to separate the soil surveys from the two areas. This zone may include some important features that were not placed correctly in the ecological classification. In addition, landscapes with complex patterns, such as along river bluffs, other highly dissected topography, or wetlands along streams and rivers, have more inclusions and finer-scale mosaics than have been identified. Soil maps, and consequently the ECS, do not therefore identify all small swampy floodplains, limestone outcrops, marshes, or small drainage slopes. Some of these micro-sites may limit management opportunities. Some may contain rare and unique species and could provide opportunities to add to the overall biological diversity of the Lejeune.

Reliability of Interpretation

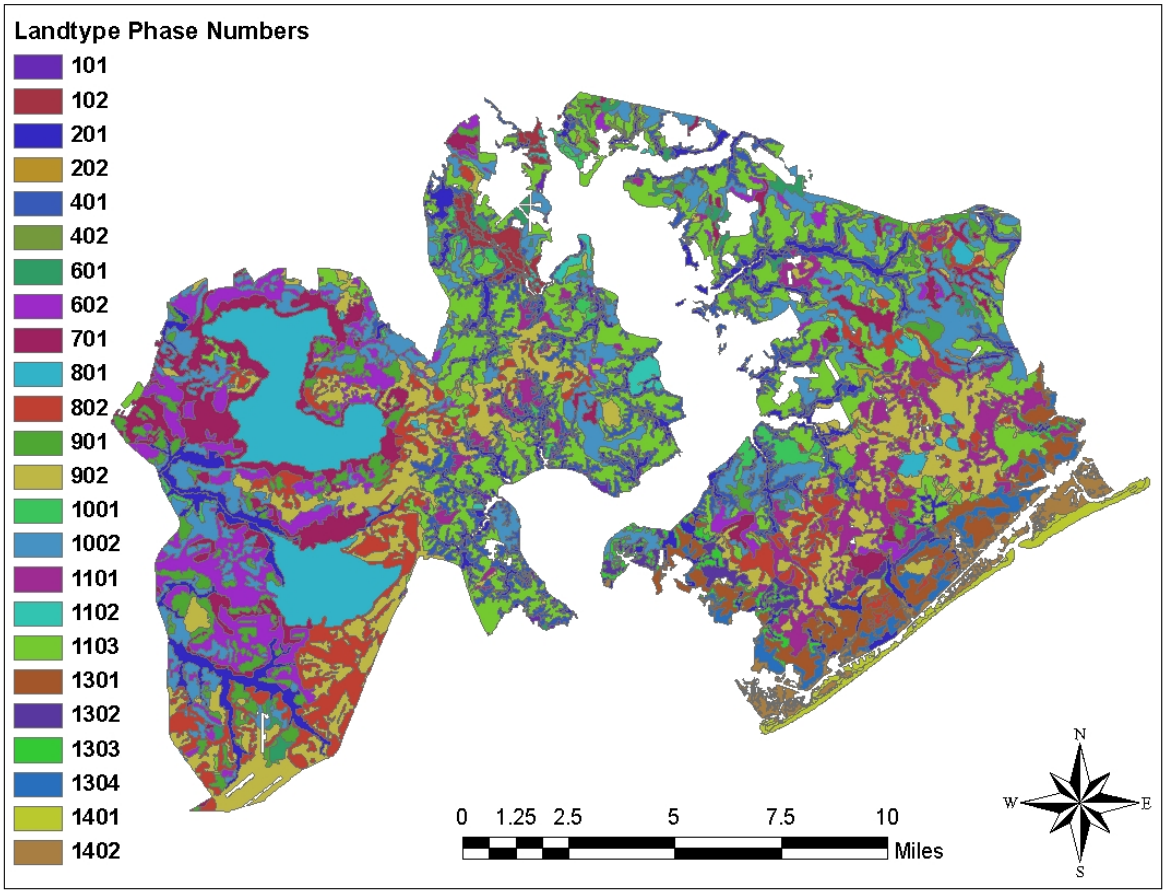
Interpretations of ECS map units were derived from county soil surveys, from Frost's (2000) "Presettlement Vegetation Community Types of Camp Lejeune”, the “Vegetation of the fire-dependent pinelands of the North Carolina Coastal Plain” (Peet, R.K. and others 1996), and from overlaying resource maps (rare species, forest inventory, etc.) with the ECS. These interpretations are generally rather broad but still applicable for project level planning. For example, soil scientists can state with a fairly high degree of probability that a given soil will have a high water table within a certain depth in most years, but they cannot assure that a high water table will always be at a specific level in the soils on a specific date (USDA 1992). Likewise, the occurrence of rare species described for ecological units can be used to judge the probability of rare species occurrence within an ecological type but can not predict with 100 percent accuracy their presence within an individual mapping unit. Similarly, site index derived from both Lejeune stands data and forest inventory plots, can be used to judge the relative productivity of ecological units at the LTP level. However, it is not possible to make a more exact prediction of growth and yield without more intensive field measurements.

Potential natural vegetation types are broad classes of vegetation derived from the pre-settlement vegetation maps. As with soil types, landscape variability and minimum map unit size will affect the reliability of PNV prediction. Furthermore, where past land use has altered site capability especially through erosion, these potentials may no longer exist. The greatest variability in PNV occurs in Interstream Flats (LT 6) and Mesic Pine Savannas (LT 10). These LTs can support longleaf pine and mixed pine communities but their exact composition and placement on the landscape is problematic. This is partly because only small remnants persist of these mixed pine communities to help predict their natural pattern. In addition, they are readily confused with fire-suppressed former longleaf pine communities that have been logged and invaded by other pine species. Their interpretation as distinct

ecological units is therefore less precise than other types. Most LTPs in the Onslow Maritime Zone (LTA 9) also fall into this category.

LANDTYPE AND LANDTYPE PHASE DESCRIPTIONS, AND RELATED TABLES

Figure F-4 Landtype phases and their occurrence on Camp Lejeune.



INLAND TIDAL MARSHES and TIDAL STREAMS - LT # 01

GENERAL DESCRIPTION – This LT is restricted to the outer southeastern coastal plain on the furthest inland sites influenced by tidal waters. It occurs primarily in low lying floodplains adjacent large rivers and a few major tributary streams. These wetlands are either flooded daily or are flooded frequently and have a water table at or near the surface throughout the year. They are influenced by fresh to slightly brackish water and occur on clay loams and deep muck soil. The potential natural vegetation dominants include both marsh plants such as sawgrass (*Cladium jamicense),* black needlerush *(Juncus roemerianus),* southern cattail (*Typha latifolia*), and swamp forest trees.

There are two phases of this LT: (1) inland tidal marshes on mineral soil, and (2) inland tidal swamps on mucky soils. The marshes occur along major rivers and are flooded daily while the swamps occur along streams and may be flooded less frequently. In Onslow County the LT occurs along the New and White Oak rivers, Queens Creek, and a few major tributary streams. On Camp Lejeune, it covers only 1,400 acres and in Onslow County outside of the Base, it covers about 5,000 acres.

LANDSCAPE/LANDFORM PATTERN - Tidal marshes are small and mostly oval shaped; tidal swamps are long, irregular and broad shaped and follow the pattern of streams.

DISTURBANCE - Flooding is the major disturbance. Tidal waters affect salinity somewhat and influence the distribution of communities and species along a salt tolerance gradient. Frequently flooded swamps along streams are mostly fire-protected except along their margins with fire-prone uplands.

PRESETTLEMENT VEGETATION – Periodic fire in marshland habitat would have been sufficient to reduce woody shrub and trees and these areas would have been dominated by marsh sedges, grasses, and herbaceous species. Under pre-settlement fire regimes marsh areas would have been dominate. Swampland supported baldcypress (*Taxodium distichum*), swamp tupelo (*Nyssa biflora*), sweetbay (*Magnolia virginiana*), swamp redbay (*Persea palustris*), dwarf palmetto *(Sabal minor*), Virginia chainfern (*Woodwardia virginica*), and netted chainfern (*Woodwardia areolata*). There may have been patches of Atlantic white cedar *(Chamaecyparis thyoides*) in fire-influenced upper slope margins.

EXISTING VEGETATION – Lack of fire in all but the black needlerush marshes has led to invasion by various hardwood species from the adjacent uplands. In most swamp areas, cypress has been removed through logging before the end of the 19th century. This led to rapid closure of the canopy by hardwoods, most notably swamp tupelo (*Nyssa biflora*) and water tupelo (*Nyssa aquatica*).

MANAGEMENT CONSIDERATIONS – All sites in this LT experience flooding and are too wet to safely operate logging equipment. Flooding also reduces the probability of cypress regeneration. Management concerns in this LT relate to plant community restoration needs in marshes where fire return intervals have been reduced in the past and dense hardwood vegetation now exists.

LANDTYPE PHASES (LTPs) - This Landtype includes two LTPs separated on differences in landform position and pre-settlement plant community types.

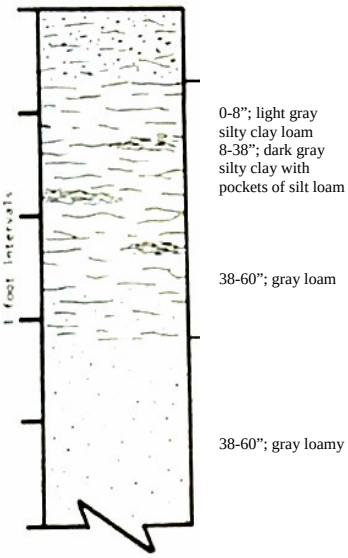
LTP #	soil type	extent (acres)	drainage	surface texture	surface depth	subsurface texture	permeability
101	Lafitte Bohicket	3 316	very poorly drained very poorly drained	muck silty clay loam	80” 8”	muck silty clay, loamy sand	moderate very slow
102	Dorovan	1,080	very poorly drained	muck	80”	sandy loam	moderate

LTP # 0101 -VERY POORLY DRAINED, LOAMY, SANDY, or DEEP ORGANIC, INLAND TIDAL MARSH

This LTP is identified in 22 map units, seven are greater than 20 acres in size. The largest are at Catfish Point, Muddy Creek, and the east fork of Mill Creek. Total extent is about 320 acres distributed along the length of the New River but curiously not on its eastern banks. This LTP occurs only in the New River Dissected Terraces (LTA 12) and is mostly associated with small stream swamps.

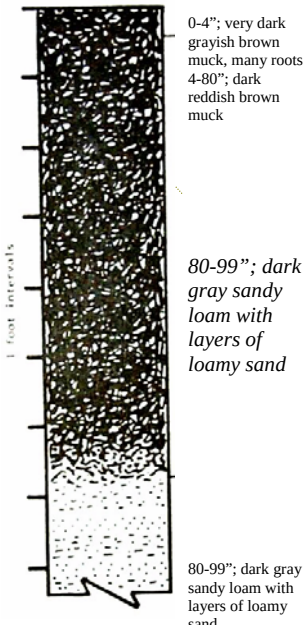
There are two soil series comprising this type. The very poorly drained Lafitte muck is the smallest (less than 3 acres) and is mapped in only two areas, the south end of the runway at the New River Marine Corps Air Station and at the mouth of Stick Creek. This deep mucky soil is more common along the White Oak River at elevations less than 5 feet above sea level. The very poorly drained Bohicket silty clay loam is the most common soil and map units may include areas of the Lafitte muck. Bohicket soils are more common adjacent to the Intracoastal Waterway. Sampled areas are dominated by hardwoods (Table 2).

The Bohicket soil map units are generally inaccessible and observations were not as detailed as in most other map units (Lejeune Soil Survey, 1984). In addition, no detailed vegetation mapping has been completed in these areas. Therefore, caution should be observed when making interpretations based solely on the ecological classification or the Soil Survey.



A typical pedon of Bohicket silty clay loam

0102-VERY POORLY DRAINED, DEEP ORGANIC, TIDAL CYPRESS-GUM SWAMP



A typical pedon of Dorovan muck

This LTP is mapped in 12 units and dominates the floodplain along Southwest Creek. It also occurs below Wilson Bay on the west bank of the New River. Total extent is about 1,080 acres. It occurs only in the New River Dissected Terraces (LTA 12) and is always associated with pine-hardwood drainage slopes.

Soils are Dorovan mucks and have a deep organic surface at times exceeding 80 inches in depth. Subsoils are sandy loam. Included with this soil are narrow areas of Muckalee soil near stream banks. The included soils make up about 10 percent of the unit.

Pre-settlement plant communities were dominated by bald cypress (*Taxodium distichum*), swamp tupelo (*Nyssa biflora*) and water tupelo (*Nyssa aquatica*). Forests were multi-layered, with an open cypress canopy, a closed subcanopy of gum (*Nyssa sylvatica*) and red maple (*Acer rubrum*), and an open shrub and sedge understory (Frost 2000). The are no areas in this LTP that contain cypress as either the primary or secondary dominant species (Table 2).

SMALL STREAM SWAMPS AND STREAMHEAD POCOSINS - LT # 02

GENERAL DESCRIPTION – Swamp forests on flood plains occur throughout the southeastern U.S. However, this LT with its gradient from pocosin streamheads to brackish tidal marsh at sea level estuaries is peculiar to the outer southeastern coastal plain. These wetlands are seasonally to semi-permanently flooded, associated with small to moderately large streams, strongly fire-influenced only at their origin and where they empty into marshland, and occur on loamy to mucky loam soils. The potential natural vegetation dominants include Bald cypress (*Taxodium distichum*), Oaks (*Quercus laurifolia*, *Quercus michauxii*), Swamp tupelo (*Nyssa biflora*), giant cane (*Arundinaria gigantea*), and Pines (*Pinus taeda, Pinus serotina*).

There are two phases of this LT: (1) poorly drained swamps on mucky soils, and (2) poorly drained streamhead pocosins on sandy muck soils originating in sandhill terrains. These wetlands are commonly referred to as 'swamps' and have a water table mostly at or near the soil surface. Associated streams have variable flow regimes, with floods of short to long duration and periods of very low flow. Water is colored by tannins but relatively clear, mostly very acidic, low in mineral sediment, and low in nutrients.

This LT is located throughout Camp Lejeune but is uncommon on the coastal sandridge. The most extensive small stream swamps and streamhead pocosins occur in Great Sandy Run. Total extent on Camp Lejeune is about 8.700 acres. There are an additional 25,000 acres outside the Base in Onslow County. This LT occurs along all tributaries of the New River, White Oak River, Shelter Swamp Creek, and Juniper Creek.

LANDSCAPE/LANDFORM PATTERN - Swamps appear as meandering linear features with many small tributary branches. On Camp Lejeune, they radiate out from the New River, raised peatlands, and the coastal sandridge. Streamhead pocosins are scattered, rounded patched at the upper ends of these drainages in sandhill landforms.

DISTURBANCE - Low intensity, small-scale disturbances (windthrow, flood erosion) are most common although occasional large-scale hurricanes may effect vegetation more extensively. These normally result in major losses to early successional hardwoods. Except during years of extreme drought, swamp sites are protected from fire due to their wetness or position adjacent other wetlands. Streamhead pocosins are exposed to fire and may burn as often as the adjacent longleaf pine upland.

PRESETTLEMENT VEGETATION - This LT supported a variety of pocosin, swamp, and bottomland forest types, with mixtures of baldcypress (*Taxodium distichum*), swamp tupelo (*Nyssa biflora*) , Laurel oak, (*Quercus laurifolia*), Loblolly pine (*Pinus taeda*), and Pond pine (*Pinus serotina*). Stream swamps included sweetbay (*Magnolia virginiana*), swamp redbay (*Persea palustris*), ti-ti (*Cyrilla racemiflora*), fetterbush (*Lyonia lucida*), coastal sweet-pepperbush (*Clethra alnifolia*), American holly (*Ilex opaca*), ironwood (*Carpinus caroliniana*), dwarf palmetto *(Sabal minor*), Virginia chainfern (*Woodwardia virginica*), netted chainfern (*Woodwardia areolata*), and sphagnum moss (*Sphagnum* spp.). Near tidal areas, eastern red cedar (*Juniperus virginiana*), wax myrtle (*Myrica heterophylla*), and giant cane (*Arundinaria gigantea*) dominated patches in the understory.

EXISTING VEGETATION - In most areas, cypress has been removed through logging before the end of the 19th century. This led to rapid closure of the canopy by hardwoods, most notably swamp tupelo (*Nyssa biflora*) and water tupelo (*Nyssa aquatica*). Former pocosin shrubs like loblolly bay (*Gordonia lasianthus*), red bay (*Persea borbonia*), sweetbay (*Magnolia virginiana*), and red maple (*Acer rubrum*) have grown up into trees and the pocosin shrub layer has become dominated by fetterbush (*Lyonia lucida*) and tall gallberry (*Ilex coriaca*).

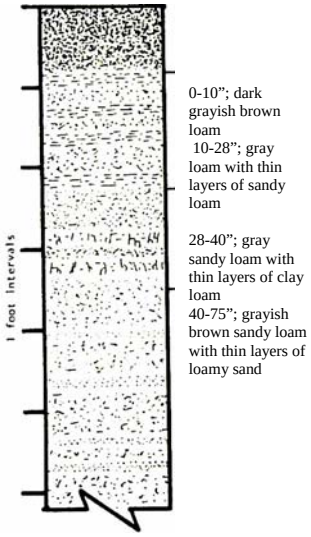
MANAGEMENT CONSIDERATIONS - Flooding occurs frequently for long periods and reduces the probability of cypress regeneration but also curtails invasion of more shade tolerant species. Stocking levels may be low, and tree height growth increment is generally high for sweetgum and loblolly pine. Management concerns in this LT relate to plant community restoration needs in streamhead pocosins where fire return intervals have been reduced in the past and dense pocosin vegetation now exists.

LANDTYPE PHASES - This Landtype includes two LTPs separated on differences in pre-settlement plant community types and the position of sites along a streams elevational gradient.

LTP #	soil type	extent (acres)	drainage	surface texture	surface depth	subsurface texture	permeability
201	Muckalee	8,196	poorly drained	loam	10”	sandy loam, clay loam	moderate
202	Muckalee	490	poorly drained	loam	10”	sandy loam, clay loam	moderate

LTP # 0201-POORLY DRAINED, MUCKY, SMALL STREAM SWAMP

Wallace Creek: Camp Lejeune, NC (with red cedar)



A typical pedon of Muckalee loam

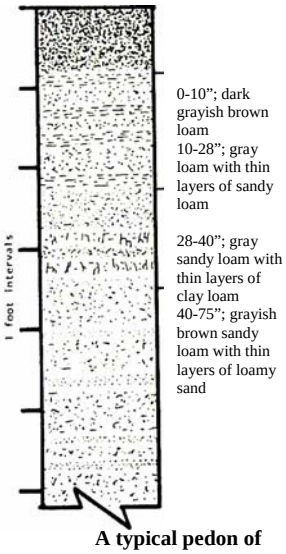
This LTP is identified in 140 map units on Camp Lejeune. Only 22 are greater than 100 acres in size; the largest are in Great Sandy Run. Total extent is about 8,200 acres distributed widely across all LTAs except the Bogue-Topsail Coastal Sandridge (LTA 4). This LTP is nearly always associated with pine-oak drainage slopes.

Soils are poorly drained Muckalee loams. They have loamy surface and sandy loam subsurface horizons. The organic mater content in the surface layer varies from high to low (Lejeune Soil Survey 1984). Included with this soil in mapping are small areas of sandier soil near the stream banks and soil with a mucky fine sand surface layer at the foot of side slopes. The included soils make up about 25% of the unit.

Pre-settlement vegetation was predominantly swamp and bottomland types (Frost 2000): Cypress/mixed bottomland hardwoods/ironwood/giant cane-mixed spp., Cypress/laurel oak/giant cane, Mixed bottom land hardwoods/ ironwood/ swamp red bay-waxmyrtle/sedge, Cypress/swamp tupelo-red maple/mixed spp, Mixed bottomland hardwoods/giant cane. Currently, on the Main Base, loblolly pine is the primary dominant species in 69% of these areas while hardwoods are the primary dominant species in 21% of the LTP (Table 2). In Great Sandy Run, the majority of this LTP is dominated by hardwoods (Table 3).

LTP # 0202-POORLY DRAINED, SANDY MUCK, STREAMHEAD POCOSIN

Mile Hammock Bay Road, Camp Lejeune (streamhead pocosin in background)



A typical pedon of Muckalee loam

This LTP has been identified in only 50 map units on Camp Lejeune. Nearly 90% are less than 20 acres in size. Total extent is about 490 acres distributed infrequently across all LTAs. This type is always associated with sandhill terrain, i.e., xeric to dry-mesic longleaf pine savanna.

Soils are poorly drained Muckalee loams. They have loamy surface and sandy loam subsurface horizons. The organic mater content in the surface layer varies from high to low (Lejeune Soil Survey).

Pre-settlement vegetation was predominantly pond pine high pocosin. Schafaly (2000) distinguishes streamhead pocosins from other pocosin communities by topographic position and likely presence of Tulip poplar (*Liriodendron tulipifera*), coastal sweet-pepperbush (*Clethra alnifolia*), and poison sumac (*Toxicodendron vernix*). Currently, loblolly pine is the primary dominant species in 56% of this LTP on the Main Base and pond pine is the primary dominant species in 32% of the LTP (Table 2).

DRAINAGE SLOPES- LT #04

GENERAL DESCRIPTION - This LT occurs on side slopes along small to large streams and rivers, and in drainage headlands. These sites are above floodplains, have good drainage, are partly protected from periodic burning, and occur on soils having loamy or sandy texture. The potential natural vegetation dominants include oaks (*Quercus stelata*, *Quercus falcata, Quercus alba*), hickories (*Carya glabra*, *Carya tomentosa*), other hardwoods (*Liriodendron tuplifera*, *Oxydendrum orboreum, Carpinus caroliniana, Cornus florida*) and Pines (*Pinus palustris*).

There are two phases of this LT: (1) sandy, well-drained pine-hardwoods, and (2) clayey, moderately well-drained hardwoods. These phases are commonly called 'hardwood slopes' and are dominated by hardwood, pine, and mixed hardwood-pine forests mostly with a hardwood-dominated understory. The sandy phase is more common on mid and upper slope positions where it is associated with upland dry mesic longleaf pine savanna. The clayey phase is more common on lower slope positions with small stream swamps and is dominated by hardwoods.

This LT is common throughout Onslow and adjacent counties. In Onslow County, outside of Camp Lejeune, it covers over 23,000 acres. Within the base, it extends along all of the small tributaries of the New River on about 8,700 acres. In general, this type occurs anywhere there is a downcutting drainage and sufficient elevation to provide topographic relief.

LANDSCAPE/LANDFORM PATTERN - Although many sites are too small to map, the type is conspicuous from the air and on the ground. It consists of narrow sinuous bands on rolling slopes along drainages in highly dissected topography.

DISTURBANCE - Disturbance regimes include periodic fire, windthrow gaps of one or a few overstory trees, and periodic larger-scale hurricane disturbance. Fires reaching this LT are backing fires originating from the uplands. The steep slopes and moist floodplains below the type restrict fire flow. Some degree of fire protection is afforded by the slopes and this results in small narrow zones of forests transitional between the better protected floodplains and the fire-exposed uplands.

PRESETTLEMENT VEGETATION - In pre-settlement forests, vegetation composition was controlled by landform and slope steepness. Mesic and dry-mesic longleaf pine savannas, similar to those in the adjacent uplands, would have been common in upper and mid slopes where frequent fire occurred. In lower slopes and especially on cooler and wetter north-facing slopes, more mesic hardwoods such as swamp chestnut oak (*Quercus michauxii),* mockernut hickory (*Carya tomentosa)*, and beech (*Fagus grandifolia*) could persist. In fact, Frost (2000) believes that the scarcity of such fire refugial hardwoods, despite decades of fire reduction on Camp Lejeune, is evidence of the predominance of fire in the original landscape.

EXISTING VEGETATION – In general, species diversity has decreased on these sites as past timber harvest and fire suppression favored pines over hardwoods. On the Main Base at Camp Lejeune, a majority of this LT is dominated by loblolly pine but longleaf still prevails as the primary dominant on nearly 10% of this landscape (Table 2).

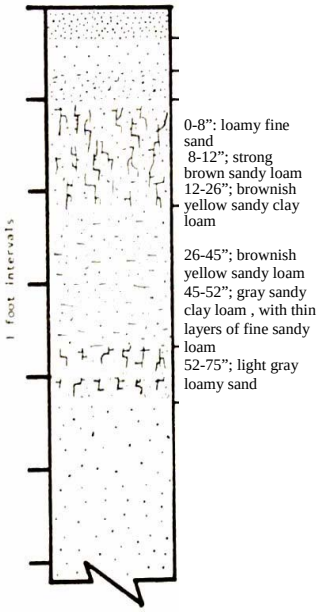
MANAGEMENTS CONSIDERATIONS – This LT may function as important wildlife habitat and travel corridors in addition to providing a unique Marine Corp training area. Little timber harvest has occurred in this LT during the last 50 years although the slopes are relatively gentle and would not restrict equipment use. Many silvicultural systems for managing hardwoods have proven successful elsewhere and could be used to maintain and improve ecological function in this LT. Perhaps the greatest challenge in this LT is restoring pre-settlement vegetation types and fire regimes.

LANDTYPE PHASES - This Landtype includes two LTPs separated on differences in soil drainage and pre-settlement plant community types.

LTP #	soil type	extent (acres)	drainage	surface texture	surface depth	subsurface texture	permeability
401	Marvyn	8,618	well drained	loamy fine sand	8"	sandy loam, sandy clay loam	moderate
402	Craven	153	mod. well-drained	fine sandy loam	8"	clay loam, clay, sandy loam	moderate

LTP # 401-WELL-DRAINED, SANDY, PINE-HARDWOOD SLOPE

Tributary of Southwest Creek: Camp Lejeune, NC



A typical pedon of Marvyn loamy fine sand

This LTP occurs in over 200 map units on Camp Lejeune. Nearly 50% are less than 20 acres in size and only 18 are greater than 100 acres in size; the largest are at Mill Run and Whitehurse Creeks. Total extent is about 8,600 acres distributed across the upland terrace predominantly. The type does not occur in the Great Sandy Run Pocosin (LTA 13) or in the Onslow Maritime Zone (LTA 9). This LTP is always associated with small stream swamps and longleaf pine savannas.

Soils are well drained Marvyn loamy fine sands. They have a sandy surface and predominately sandy loam subsurface. Included in the soil mapping are some areas that have short slopes greater than 15% and small areas that are eroded (Lejeune Soil Survey 1984). Height growth increment for loblolly pine is high, and for longleaf and pond pine it is medium (Table 4). These sites can support the highest stocking and growth of dry-mesic and mesic oaks and hickories on the Base.

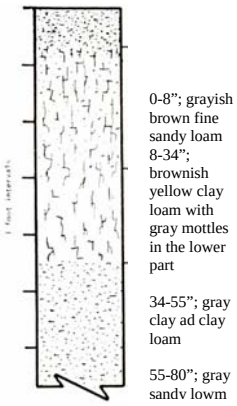
Pre-settlement vegetation was predominantly mesic or dry-mesic longleaf pine savanna grading to mixed pine-hardwood where oaks increased in importance on the midslope and more mesic hardwoods on the toeslope. This gradient of species composition varied somewhat by site exposure with steeper south-facing slopes supporting canopy oaks, scrub oaks and loblolly pine with scattered longleaf pine. Today many of these sites are dominated by loblolly pine with hardwoods in a subordinate crown position. Loblolly pine is the primary and secondary dominant species in over one-half of this LTP (Table 2).

LTP # 402- MODERATELY WELL DRAINED, CLAYEY, HARDWOOD SLOPE

This LTP is very limited in size, occupying less than 200 acres on Camp Lejeune but over 3,400 acres outside the Base in Onslow County. It occurs only in the New River Dissected Terrace (LTA 12) and is most extensive north of Camp Johnson associated with mucky small stream swamps and well-drained sandy longleaf pine savannas.

Soils are moderately well-drained Craven silt loams. They have a sandy loam surface and a clay to clay loam subsurface. About 20% of soil map units include other soil types such as Marvyn and Goldsboro (Lejeune Soil Survey 1984).

Pre-settlement vegetation was predominantly mesic hardwoods except on more moderately sloping and fire-exposed sites that supported longleaf pine savanna. In the most fire sheltered areas, these slopes supported mixed mesic hardwood forests with species such as White oak (*Quercus alba)*, Southern Red Oak (*Quercus falcata)*, Post Oak (*Quercus stellata),* Mockernut Hickory (*Carya tomentosa)*, Tulip Poplar (*Liriodendron tulipifera)* and American Beech (*Fagus grandifoilia)* (Frost 2000). Today loblolly pine (*Pinus taeda*) is the dominant canopy tree in over three-quarters of this LTP on the Main Base (Table 2).



A typical pedon of Craven fine sandy loam

INTERSTREAM FLATS-LT06

GENERAL DESCRIPTION - This LT occurs throughout the southeastern coastal plain within the upland coastal terrace on broad interfluvs and narrow depressions in slightly convex landforms. These somewhat poorly to poorly drained sites are subject to occasional ponding of surface water in low places, periodic burning, and have loamy to sandy soils. The potential natural vegetation dominants include pond pine (*Pinus serotina*), longleaf pine (*Pinus palustris*), and loblolly pine (*Pinus taeda*) usually growing together in mixed stands.

There are two phases of this LT and they are often found on the same landscapes: (1) somewhat poorly to poorly drained, sandy, loamy or clayey, mixed pine savanna, and (2) poorly drained, sandy, pond pine and mixed pine savanna. These moist to wet sites are often referred to as 'mixed pine flatwoods' and have tall pond pine, longleaf pine, and loblolly pine. With fire suppression, dense hardwood and evergreen shrub and small tree understories are common. In Onslow County, outside of Camp Lejeune, it covers over 53,000 acres. On the base it occurs on about 8,500 acres mostly in the Great Sandy Run Pocosin area.

LANDSCAPE/LANDFORM PATTERN – This LT forms small to very large irregularly-shaped patches from fifty to hundreds of acres in size situated between drainages. They are typically not dissected by streams.

DISTURBANCE - Fire was the most common disturbance in this LT and its frequency was variable, ranging from every 5 to 12 years or in more fire exposed situations every 1 to 3 years. Historically, these moist mineral flats, too wet to farm, were logged, planted to loblolly or slash pine, and were fire suppressed. This is the situation for most of this LT in the Great Sandy Run Pocosin. Today, hurricanes may cause extensive damage in overstocked older loblolly stands in this LT.

PRESETTLEMENT VEGETATION - This LT includes the wettest soils that can support longleaf pine. They were typically mixed pine forests that included pond pine, longleaf pine, and loblolly pine. Density ranged from savanna to closed canopy forest. Loblolly pine was present but more common on the margins of drainageways. Understory vegetation often had a considerable amount of giant cane (*Arundinaria gigantea)* but were more commonly rich savanna herbs with wiregrass (*Aristida stricta)* and bluestems *(Andropogon* sp.).

EXISTING VEGETATION – Only small remnants of mixed pine savanna persist today in Onslow and adjacent counties. With fire suppression there is a rapid succession to loblolly pine, sweetgum (*Liquidambar styraciflua*), red maple (*Acer rubrum*), red bay (*Persea borbonia*), sweet bay (*Magnolia virginiana*), Blue huckleberry (*Gaylussacia frondosa*), Coastal Sweet-pepperbush (*Clethra alnifolia*), and Inkberry (*Ilex glabra*). Current vegetation is hard to distinguish from fire-suppressed former longleaf pine communities that have been logged and succeeded to other pine species. Most are dominated by loblolly pine and pond pine with a dense tall shrub and hardwood layer in the understory.

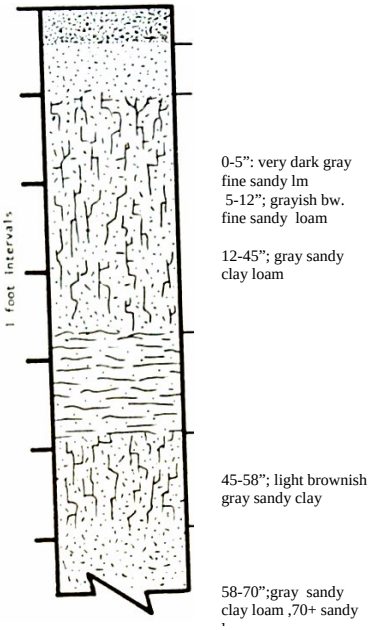
MANAGEMENTS CONSIDERATIONS - Management concerns in this LT relate to site wetness and operability, midstory competition, and hurricane damage. Equipment use may be limited to only the drier months since the somewhat clayey subsoils are prone to compaction. Plant community restoration opportunities may be difficult to achieve in this LTP without considerable site alteration.

LANDTYPE PHASES (LTPs) - This Landtype includes two LTPs separated on differences in soil drainage, soil texture, and pre-settlement plant community types.

LTP	Soil type	Extent ac.	drainage	surface texture	surface	Subsurface texture	permeability
601	Pactolus	219	mod.well-sw poorly drained	fine sand	30"	fine sand clay, sandy	rapid
	Lenoir	110	somewhat poorly drained	loam, sandy loam	7"	clay loam	slow
	Rains	760	poorly drained	fine sandy loam	12"	s. clay loam, s. clay	moderate
602	Woodington	7,373	poorly drained	loamy fine sand	12"	f. sandy loam, s. loam	mod. rapid

LTP # 0601 SOMEWHAT POORLY TO POORLY DRAINED, SANDY LOAMY, OR CLAYEY MIXED PINE SAVANNA

Billfinger Road, Croatan National Forest



A typical pedon of Rains fine sandy loam

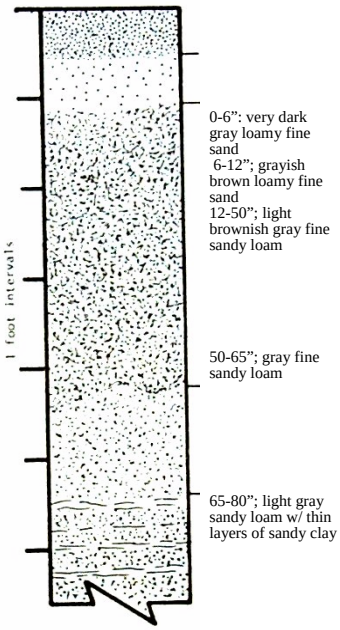
This LTP is identified in 31 map units, only three exceed 100 acres in size: most are less than 50 acres in size. Total extent is about 1,100 acres distributed across the northern portion of the New River Dissected Terraces LTA (12). It occurs only there and in Great Sandy Run Pocosin LTA (13), with the exception of one map unit in LTA 4. It is much more common outside the Base in Onslow and surrounding counties. This LTP is commonly associated with mesic pine savannas and pond pine woodlands.

There are three soil series comprising this type. The somewhat poorly drained Lenoir loam is the least common, occupying only about 110 acres on the Base. The most extensive is the very poorly drained Rains fine sandy loam, the wettest loam soil that can support longleaf pine. Height growth increment is only moderate for loblolly pine, longleaf pine, and pond pine (Table 4). Compaction may be a concern in the Lenoir soil. The moderately well to somewhat poorly drained Pactolus fine sand that is mapped on the broad upland terrace is also included in this LTP. It is not very extensive in this LTP and covers only about 220 acres. This soil is much more common seaward below the scarp where it often dominates upland margins adjacent marshes near the Intracoastal waterway. It is placed in LTP 1304 in those situations.

Pre-settlement vegetation in this LTP was predominately mixed pine with longleaf pine more common in drier sites and pond pine more abundant in wetter sites. There are very few examples of this LTP that have not succeeded to loblolly pine and hardwoods. Currently longleaf pine is the primary dominant species in only 4% of the mapped area on the Main Base. Furthermore, in 80-98% of the LTP neither pond pine nor longleaf pine, the two principal trees in pre-settlement forests, are considered the primary or secondary canopy trees and have been replaced by loblolly pine (Tables 2 and 3).

LTP # 0602-POORLY DRAINED, SANDY, POND PINE AND MIXED PINE SAVANNA

Phills Trail Road, Great Sandy Run Pocosin Area, Camp Lejeune, NC



A typical pedon of Woodington loamy fine sand

This LTP is identified in 74 map units, two of which are greater than 1,000 acres in size. Most map units are smaller than this; over three-quarters are less than 100 acres in size and over one-half are less than 50 acres in size. Total extent is about 7,400 acres concentrated mainly in the Great Sandy Run Pocosin LTA (13) along Davis Tram, Dons Trail, and Prince Trail. It occurs in small amounts in both the New River Dissected Terraces (LTA 12) and the Bogue-Topsail Coastal Sandridge (LTA 4). This LTP occurs on broad interfluvs occupying sites in transition between very poorly drained pocosins or poorly drained pond pine woodlands and poorly drained or moderately well-drained longleaf pine savannas.

Soils are poorly drained Woodington loamy fine sands, a deep loam soil that is subject to occasional ponding of surface water in low places. Other soil inclusions occur in about 15% of map unit areas. The Rains is intermingled, the Torhunta is in small, shallow depressions, and the Stallings is on the outer edges of map units near drainageways (Lejeune Soil Survey 1984). This is one of the most productive sites for loblolly pine. Height growth increment is very high for this species, only medium for slash pine, and high for longleaf pine (Table 4).

Woodington soils are one of the wettest series that will support longleaf pine. The pre-settlement communities were likely mixed pine savanna (longleaf and pond pine over diverse wet savanna herbs and grasses). Frost (2000), however, describes this composition as only a variation that occurred in mixed patches and that the most common original vegetation was a two-layered wet pine savanna with pond pine dominant. This is the only significant disagreement between Frost (2000) and the ecological classification for Camp Lejeune. With reduced fire frequency, a dense woody understory has developed on nearly all sites within this LTP on Camp Lejeune. Currently longleaf pine on the Main Base is found as the primary dominant species on only 7% and pond pine on 14% of sampled stands (Table 2). Over 80% of stands have neither species described as primary or secondary dominants; most of these stands are dominated by loblolly pine. Similarly, this is the condition in Great Sandy Run in over 90% of the sampled stands (Table 3).

POCOSIN FRINGES - LT # 07

GENERAL DESCRIPTION - This LT is restricted to the southeastern coastal plain, occurring on very poorly drained soils in peat-mantled uplands, and broad interstream flats. These wetlands have a seasonal high water table at or near the soil surface, water ponding during the winter, periodic burning (under natural fire regimes), and loamy or mucky loam soils. The potential natural vegetation dominants include giant cane (*Arundinaria gigantea*), broadleaf evergreen shrubs and small trees (*Gordonia lasianthus, Persea palustris, Magnolia virginiana, Ilex glabra, Lyonia lucida*), and pond pine (*Pinus serotina*).

Only one phase of this LT is found on Camp Lejeune: (1) very poorly drained, mucky and loamy, pond pine woodlands; a second phase, (2) poorly drained, loamy, pond pine woodlands, is common in adjacent Jones and Craven counties. These wetlands are often referred to as "pond pine woodlands", and have tall pond pine and, with fire suppression, a tall dense evergreen understory.

The LT is most extensive in the Great Sandy Run Pocosin and east of Camp Lejeune at Horse Swamp. On Camp Lejeune the type covers about 7,700 acres and outside the Base about 36,000 acres in Onslow county. It is most often associated with pocosins.

LANDSCAPE/LANDFORM PATTERN - This type forms narrow to wide bands partially to entirely encircling the broader, domed peatlands. In the upland interstream zones in more dissected landforms it is more irregular in shape and appears to be confined by stream courses.

DISTURBANCE - Livestock grazing, and ditching to improve drainage for timber production has significantly altered much of the Pocosin Fringe LT. The larger pond pine in this LT was extensively logged at the turn of the century. Cutover sites were quickly reforested since pond pine regenerates by epicormic and basal sprouts as well as by seed from serotinous cones. Under pre-settlement fire regimes, pond pine forests burned nearly as frequently as the adjacent and often intergrading longleaf pine forest. These forests are considered fire dependent and in the absence of fire may eventually be replaced by hardwoods.

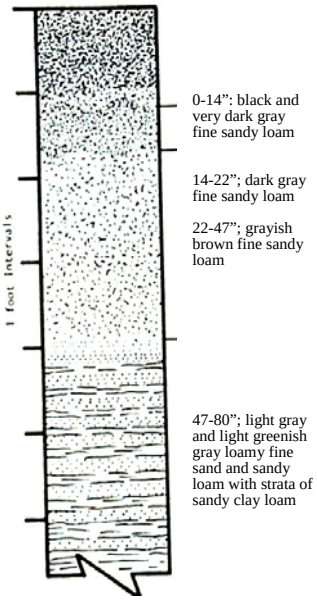
PRESETTLEMENT VEGETATION - This LT once supported a pond pine complex comprising a distinct group of forest and wet savanna communities. Under the original fire regime, pre-settlement vegetation on fire exposed upland flats ranged from tall pond pine forest to open pond pine savanna and zones of canebrake near their margins (Frost 2000). Where frequent fires occurred over a long period, the pond pine forest understory was dominated by giant cane, with few shrubs (Schafaly and Weakley 1990). Remnants of giant cane are relatively common on Camp Lejeune and are evidence that canebrakes may once have been more widespread in the pre-settlement landscape.

EXISTING VEGETATION - Fire suppression has led to dense forest conditions with a thick tree and shrub midstory on these wet sites. Most pond pine forests in this LT have a nearly closed tree canopy, sometimes codominant with loblolly bay. The shrub layer is tall and very dense. Many pond pine woodlands have succeeded to pine-hardwoods, dense tall pocosin, and bay forest. Herbs are generally of low cover or absent.

MANAGEMENTS CONSIDERATIONS - Management concerns in this LT relate to plant community restoration needs, site wetness and operability for forestry operations, and midstory competition. These wet mineral soils can support different vegetation types depending upon differences in moisture and degree of protection from fire. However, there are seasonally severe equipment limitations due to extreme site wetness. On Camp Lejeune, sites in this LT offer the best opportunities for restoring canebrakes and the rare species that these communities could support. These species include Saint Francis' satyr *(Neonympha mitchellii francisci*), Swainson's Warbler (*Limnothylpis swainsonii*), Rough-leaf loosestrife (*Lysimachia asperulifolia*) and Golden sedge (*Carex lutea*).

LTP # 0701-VERY POORLY DRAINED, MUCKY & LOAMY, POND PINE WOODLAND

Rawls Road, Great Sandy Run Pocosin, Camp Lejeune, NC



A typical pedon of Torhunta fine sandy loam

This LTP occurs in 48 map units on Camp Lejeune, one of which is nearly 3,500 acres in size and surrounds the northern pocosin in Great Sandy Run. Over three-quarters of the map units are less than 100 acres in size. Total extent is about 7,700 acres distributed unevenly across three of the four Landtype Associations found on Camp Lejeune. The type is most extensive in the Great Sandy Run Pocosin LTA and does not occur in the Onslow Maritime Zone (LTA 9). This LTP is mostly associated with deep organic pocosins but also occupies the wet end of the gradient associated with wet and wet-mesic mixed pine and longleaf pine savannas.

There are two soil series comprising this type. The very poorly drained Pantego mucky loam is the least common (less than 200 acres) and has a black, mucky surface layer and a sandy clay loam subsoil. It is mapped in only six areas, the largest is within the K-2 Impact area. The very poorly drained Torhunta fine sandy loam is the most common (greater than 7,500 acres) and has a black to very dark gray loamy surface layer and a loamy fine sand and sandy loam subsoil. Pond pine height growth increment is higher on this soil than on all others found on the Base (Table 4). Productivity is only moderate for loblolly pine, and low in both longleaf pine and slash pine.

A recent intensive field survey by Carter (2000) confirmed the generally held opinion that most pond pine woodlands are now dominated by loblolly pine or hardwoods. On the Main Base, loblolly pine is the primary canopy dominant on over 60% of the area sampled in this LT (Table 2). In Great Sandy Run, hardwoods are the primary dominant trees on 58% of this LTP (Table 3).

BROAD POCOSINS - LT # 08

GENERAL DESCRIPTION - This LT is primarily restricted to the southeastern coastal plain from Virginia to Georgia, occurring in broad, shallow basins, in drainage basin heads, and on broad, flat uplands (Wells 1928). These wetlands have long hydroperiods, temporary surface water, periodic burning, and soils of sandy humus, muck or peat. The potential natural vegetation dominants include broadleaf, evergreen shrubs (*Cyrilla racemiflora, Lyonia lucida, Ilex glabra, Myrica heterophylla, Smilax laurifolia*) and pines (*Pinus serotina*).

On Camp Lejeune, there are two phases of this LT and they are often found in close proximity: (1) high pocosin on moderately deep organic soils and (2) high pocosin on mineral soils having a mucky surface; a third phase, (3) low pocosin on very deep organic soils, occurs in nearby Craven county. These wetlands are commonly referred to as 'pocosins' and have characteristic dense, often stunted evergreen vegetation. The soils are saturated or shallowly flooded primarily during the cool seasons (Daniels and others 1975). In the deep organic phase, soils are deficient in available nutrients (Richardson and others 1981). In the mucky phase, organic matter and aluminum layers (spodic horizon) tend to make the mineral soils naturally infertile (USDA 1999).

The LT is most extensive in the Great Sandy Run Pocosin, north of Camp Lejeune on the Hoffman Forest, and on the Croatan National Forest. On Camp Lejeune, the type covers 16,800 acres and about 33,000 acres outside the Base in Onslow County. Within larger pocosins, bog expansion caused by the gradual rising of the water table as peat accumulates has proceeded for several thousand years in broad interstream areas in which natural drainage was blocked (Daniel 1981, Richardson and others 1981). Today, on the most well developed peatland areas, on the nearby Croatan National Forest, stunted pond pine occurs with dense, widely spaced, short evergreen shrubs on 2 to 4 feet of white cedar peat overlain with 4 to 5 feet of pocosin peat. This condition is rare on Camp Lejeune.

LANDSCAPE/LANDFORM PATTERN – In Great Sandy Run, pocosins occupy uplands that are slightly elevated above the surrounding landscape and reflect their Algonquian meaning, "swamp-on-a-hill" (Tooker 1899). On the main base of Camp Lejeune, they occur in both upland flats and in irregularly-shaped depressions or more rarely in elongated elliptical depressions on a northwest-southeast axis. These latter landforms are often referred to as Carolina bays.

DISTURBANCE - Historically, vegetation in this LT burned at regular 2-4 year intervals similar to the adjacent uplands. Although the water table is high and the soils may frequently be saturated, pocosins occasionally become dry enough to burn and some of the organic surface may be lost in combustion. Ditching, drainage and conversion to pine plantations has occurred within the Great Sandy Run Pocosin and this can alter peatland hydrology for long periods. Otmar and Bucher (1996) found that organic soils in the zone adjacent to drainage ditches have a greater probability of igniting during wildfire conditions.

PRESETTLEMENT VEGETATION – This LT in the original landscape was occupied by open pocosin vegetation only about .5 to 1 meter tall (Frost 2000). The stature and structure of organic and mucky pocosins were maintained by frequent fire and, to a lesser extent on Camp Lejeune, by extreme scarcity of soil nutrients.

EXISTING VEGETATION - In general, the stature of trees and shrubs in peatlands has increased and obscured the natural pattern of vegetation structure controlled by fire and nutrient gradients in these systems. Low pocosin has been replaced by high pocosin and bay forest, dominated by swamp red bay (*Persea palustris*), loblolly bay (*Gordonia lasianthus*), and sweet bay (*Magnolia virginiana*) has increased. On some of the shallower peats, pond pine has formed closed canopy woodlands that resemble the Pond Pine Forest community type. However, approximately 18% of the mucky pocosins recently sampled by Carter (2000) on the Main Base are dominated by longleaf pine, a composition apparently the result of frequent prescribed burning.

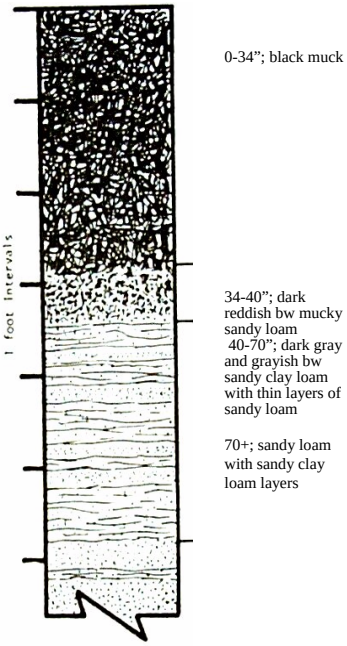
MANAGEMENTS CONSIDERATIONS - Most management concerns in this LT relate to wildfire suppression, impacts to rare species in the ecotone with more well-drained sites, and prescribed burning. Decades of fire suppression have led to a build up of volatile fuels in much of this LT. Recent fire research work on the Croatan National Forest has demonstrated that the window for safe burning in the pocosins may be greater than previously thought (Otmar and Bucher 1996). In general, the concern of organic matter consumption during prescribed burning is significantly reduced when water tables are closer than 18" from the soil surface.

LT PHASES (LTPs) - This LT includes two LTPs separated on differences in soil texture and vegetation stature.

LTP #	soil type	extent (acres)	drainage	surface texture	surface depth	subsurface texture	permeability
801	Croatan	8,662	very poorly drained	muck	34”	sandy loam, sandy clay loam	moderate
802	Murville	8,160	very poorly drained	fine sand	55”	sand, layers of sandy loam	rapid

LTP # 801-VERY POORLY DRAINED, POND PINE POCOSIN on PEAT

Bear Alley, Great Sandy Run Pocosin, Camp Lejeune, NC



A typical pedon of Croatan muck

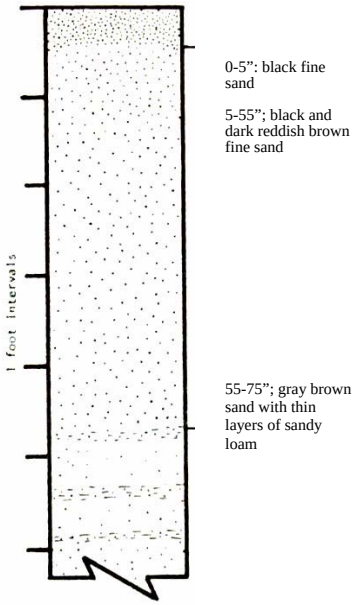
This LTP occurs in only 12 map units on Camp Lejeune, two of which exceed 2,800 acres in size. The largest are at the Great Sandy Run Pocosin. Total extent is about 8,600 acres distributed across three of the four Landtype Associations found on Camp Lejeune. The type is most extensive in the Great Sandy Run Pocosin (LTA 13) and does not occur in the Onslow Maritime Zone (LTA 9). It is commonly associated with mucky pocosins and pond pine woodlands in pocosin fringes.

Soils are very poorly drained Croatan mucks and typically have a deep to moderately-deep organic surface layer. The Croatan series are classic pocosin soils, with stature under the original fire regime mostly limited to low pocosin by the combination of extreme infertility and fire (Frost 2000). On the domed landforms, precipitation is virtually the only source of plant nutrients. As a result, nutrients are scarce and the ecosystem is referred to as ombrotrophic (i.e. nutrient poor) with stunted, open pocosin vegetation.

Current vegetation may vary from low to high pocosin with a dense shrub layer 5 to 15 feet tall, except when recovering from recent fire (Schafale and Weakley 1990). The overstory is often scattered pond pine and loblolly bay from 20-40+ feet in height. Frost (2000) believes that canebrake plant communities once occurred on the less infertile Croatan muck soils in the eastern part of Camp Lejeune. When fire is excluded for long periods, they may form a temporary dense canopy. In Great Sandy Run, the Forest Stands / Compartments database (IGIR 2000) indicates that the primary dominant species in 25% of pocosins is loblolly or slash pine. Furthermore, in over 60% of pocosins the primary dominant species are hardwoods (Table 3). Although extensive ditching, drainage, timber harvest, bedding, and pine plantation management has occurred in this area, the least impacts across the Camp Lejeune landscape have occurred in the pocosins. It is likely that the database figures overestimate the amount of pocosins dominated by species other than pond pine.

LTP # 802-VERY POORLY DRAINED, SANDY MUCK, POND PINE POCOSIN

Longleaf Pine Ridge, Camp Lejeune, NC



A typical pedon of Murville fine sand

This LTP occurs in over 80 map units; one exceeds 2,500 acres in size however most are less than 100 acres in size. Total extent is about 8,200 acres distributed across all Landtype Associations found on Camp Lejeune. This LTP is least common in the Onslow Maritime Zone (LTA 9) and most common in the Great Sandy Run Pocosin (LTA 13) and the Bogue-Topsail Coastal Sandridge (LTA 4). The type occurs in association with deep organic pocosins and as a distinct mosaic with wet-mesic to xeric longleaf pine savannas.

Soils are Murville mucky sands. These soils have a dark surface but not a well-developed organic layer and therefore a low risk of soil ignition during prescribed or wildfire. The surface may be slightly mucky especially after prolonged absence of fire. Height growth increment is poor for all tree species (Table 4).

Vegetation may appear similar to that found on pocosins on deep peat but grades into tall pocosin and pond pine forest in the slightly more fertile situations when bordered by mineral soils. On 56% of the map units on the Main Base, the primary dominant species is pond pine (Table 2). Open, low pocosin in this LTP occurs in the G-10 impact area.

WET-MESIC AND WET PINE SAVANNAS - LT # 09

GENERAL DESCRIPTION - This LT occurs throughout the southeastern coastal plain in upland flats and interstream areas. These somewhat poorly to poorly drained sites have a seasonal high water table, periodic to frequent burning, and mostly sandy soils. The potential natural vegetation dominants include longleaf pine (*Pinus palustris*), pond pine (*Pinus serotina*), and wiregrass (*Aristida stricta*).

There are two phases of this LT and they are often found in close proximity: (1) somewhat poorly drained, sandy and loamy, longleaf pine and mixed pine savanna, and (2) poorly drained, sandy, longleaf pine savanna.. These moist to wet sites are commonly referred to as 'wet pine flatwoods' or 'wet pine savannas' and have on open grassy understory when burned and a scattered longleaf pine tree canopy somewhat stunted in size due to site infertility. They occur on the wet end of the moisture gradient for longleaf pine. Without periodic burning, the more fertile sites are rapidly invaded by shrubs and hardwood trees. In Onslow County, outside of Camp Lejeune they extend over 42,000 acres and across the base on about 17,800 acres. They are most common on the coastal sandridge and in the Great Sandy Run Pocosin area.

LANDSCAPE/LANDFORM PATTERN - This type occurs in small to very large, irregular shaped patches, and less often in narrow, linear patches in ridge and swale topography or linear sand lenses within large peatlands.

DISTURBANCE - The major natural disturbance was frequent low intensity fire at intervals of 1 to 3 years. Under natural fire regimes, fires occurred early in the growing season. Other disturbances include lightening, wind events from tornadoes, tropical storms, and microbursts. Much of this LT has been entirely cleared, planted to loblolly pine or slash pine, and fire suppressed. This is the situation in much of the Great Sandy Run Pocosin.

PRESETTLEMENT VEGETATION – Under the pre-settlement fire regime, this LT supported open pine savannas. In southeastern fire-adapted communities the term savanna applies to any fire-maintained two-layered community in which the two layers are a tree layer with up to 50% cover, over a continuous, usually grassy herb layer (Frost, Walker and Peet 1986). This LT supported predominately longleaf pine savanna, but also mixed longleaf pine – pond pine savanna. The herb layer was often dominated by wiregrass (*Aristida stricta.* These savannas had only scattered inkberry (*Ilex glabra*), blue huckleberry (*Gaylussacia frondosa*) and creeping blueberry (*Vaccinium crassifolium*

EXISTING VEGETATION - Many of these moist communities have become shrubby or densely wooded because of fire suppression. Species diversity in the understory has been significantly reduced. On many sites, loblolly pine and hardwoods now dominate in the absence of fire. With longer fire suppression, some pine savannas may succeed to pond pine woodland.

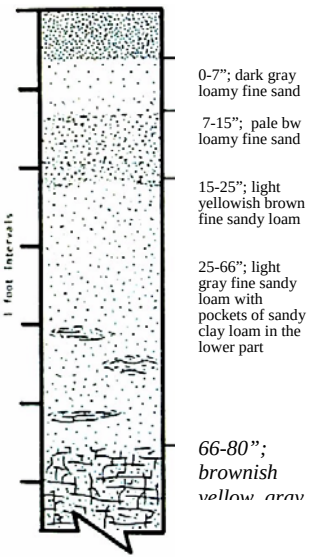
MANAGEMENT CONSIDERATIONS - These are some of the wettest soils that are capable of supporting longleaf pine. Slightly greater site moisture and organic matter, that may occur within this ecological type, will discourage longleaf pine and favor pond and loblolly pine. Seasonal wetness may also limit equipment use. Periodic fire and reduction of plows lines in ecotones is necessary for maintenance of rare plant and animal species that occur in this zone. Low-lying areas are subject to flooding, however, these sites may be droughty during the growing season and tree growth may be suppressed. Seasonal drought can affect seedling survival.

LT PHASES - This LT includes two LTPs separated on differences in soil drainage and soil texture.

LTP	soil type	extent (acres)	drainage	surface texture	surface depth	subsurface texture	permeability
901	Stallings	3,864	somewhat poorly drained	loamy fine sand	15"	fine sandy loam	mod. Rapid
	Lynchburg	158	somewhat poorly drained	fine sandy loam	13"	sandy clay loam	moderate
902	Leon	13,804	poorly drained	fine sand	17'	cemented fine sand	moderate

LT # 901-SOMEWHAT POORLY DRAINED, SANDY and LOAMY, LONGLEAF PINE and MIXED PINE SAVANNA

This LTP is mapped in 93 map units, only 10 exceed 100 acres in size: one-third are less than 20 acres in size. Total extent is about 4,000 acres concentrated mainly in the Great Sandy Run Pocosin (LTA 13). It is located in small areas in the New River Dissected Terraces (LTA 12) and the Bogue-Topsail Coastal Sandridge (LTA 4). This LTP occurs on interstream flats and is commonly associated with mixed pine savanna and pond pine woodlands.



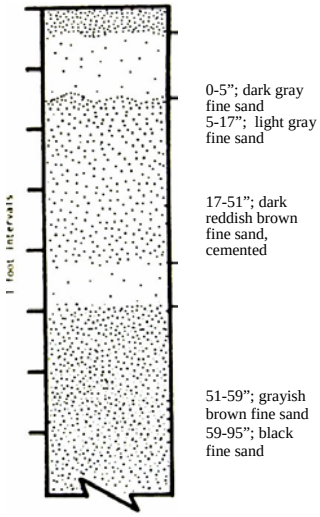
A typical pedon of Stallings loamy fine sand

There are two soil series comprising this type. The somewhat poorly drained Lynchburg fine sandy loam is the least common, occupying only about 160 acres on the Base. The seasonal high water table is between .5 and 1.5 feet below the soil surface. The most extensive soil is the somewhat poorly drained Stallings loamy fine sand where the seasonal high water table ranges from 1.5 to 2.5 feet below the soil surface. Although this soil is somewhat poorly drained, internal drainage is moderately rapid especially in the sandy surface horizons. As a result, seasonal drought may be an important management consideration. Other soil inclusions occur in about 20% of the map units. The somewhat poorly drained Pactolus and Lynchburg soils are intermingled, the moderately well drained Foreston and Onslow soils occur along edges of drainageways, and the poorly drained Woodington is in small depressions. Productivity of loblolly pine, pond pine, and slash pine is only moderate and low in longleaf pine (Table 4).

Pre-settlement vegetation in this LTP was predominately longleaf pine or mixed pine savanna. These sites are rapidly invaded by shrubs, sweetgum (*Liquidambar styraciflua*) and red bay (*Persea borbonia*). There are very few examples of this LTP that have not succeeded to loblolly pine and hardwoods. Currently longleaf pine is the primary or secondary dominant species in only 16% of the mapped area on the Main Base and about 5% of the LTP in the Great Sandy Run Pocosin area (Tables 2 and 3). Most areas are dominated by loblolly, pond pine, or hardwoods.

LTP # 902-POORLY DRAINED, SANDY, LONGLEAF PINE SAVANNA

Longleaf Pine Natural Area, Camp Lejeune, NC



A typical pedon of Leon fine sand

This is the second largest LTP on Camp Lejeune and is mapped in 124 map units; three exceed 1,000 acres in size and only one-quarter are less than 10 acres in size. Total extent is about 13,800 acres concentrated mainly in the Bogue-Topsail Coastal Sandridge (LTA 4) where it is the predominant LTP. It is also common in the Great Sandy Run Pocosin (LTA 13). This type is located on interstream flats where it is mainly associated with xeric longleaf pine savannas, wet pine savannas, and pocosins.

Soils are poorly drained Leon fine sands, deep sandy soils with a weakly cemented subsoil horizon. These soils are relatively infertile especially on sites surrounded by pocosin. The seasonal high water table is at or near the soil surface. Although this soil is poorly drained, internal drainage is moderately rapid especially in the sandy surface horizons. Seasonal drought is therefore an important management consideration. On low, narrow ridges, inclusions of somewhat poorly drained Stallings and Pactolus soils may occur. These inclusions make up about 15% of the map units. Tree growth is slow on these sites. Height growth increment is very low in loblolly pine, moderate for slash pine, and low for both longleaf pine and pond pine (Table 4).

Pre-settlement vegetation in this LTP was longleaf pine savanna with wiregrass (*Aristida stricta*) and bracken fern (*Adiantum pedatum*) often dominating the understory layer. Other characteristic species included yellow pitcher plant (*Sarracenia flava*), and Carolina yellow-eyed grass (*Xyris caroliniana*). Plant diversity was high and rare plants such as Venus's flytrap (*Dionaea muscipula*) and rough-leaved loosestrife (*Lysimachia asperulifolia*) were maintained by frequent burning through the ecotone between this LTP and pocosin. Fire suppression on the more nutrient-poor sites, such as those surrounded by pocosin, has lead to a buildup of litter and a dense shrub layer resembling pocosin. This buildup in fuels may increase the probability of crown replacement fires even where longleaf pine is the dominant overstory species. Succession is even more rapid on less-sterile sites. Red maple (*Acer rubrum*) sweetgum (*Liquidambar styraciflua*), red bay (*Persea borbonia*), sweet bay (*Magnolia virginiana*) and tall gallberry (Ilex coreaca) quickly invade these sites within 5 to 10 years of burning. However, due to the extensive use of prescribed burning on Camp Lejeune, longleaf pine is currently the primary or secondary dominant species in over 50% of this LTP on the Main Base (Table 2).

MESIC PINE SAVANNAS - LT # 10

GENERAL DESCRIPTION - This LT occurs throughout the southeastern coastal plain on upland terraces in broad flats and rolling topography. Sites are mesic, have a seasonal high water table within 1.5 to 2 feet from the soils surface, frequent burning, and are found on well-drained to moderately well-drained deep loam soils. These sites have optimal drainage and soil texture for agriculture and have been sought out for that purpose. The potential natural vegetation dominants include longleaf pine (*Pinus palustris*), wiregrass (*Aristida stricta*), and a diverse mixture of graminoids and forbs. Community structure was savanna. Both loblolly pine (*Pinus taeda*) and pond pine (*Pinus serotina*) were common codominants but have now become the dominant species.

There are two phases of the LT and they can be found in the same landscapes: (1) well-drained, loamy, longleaf pine savanna, and (2) moderately well-drained, loamy, longleaf pine savanna. These savannas are often referred to as "flatwoods" and represent the most productive savannas because of the combination of available moisture and nutrients. This is one of the more extensive LTs found on Camp Lejeune and the most extensive type found outside of the Base in Onslow county where is covers over 85,000 acres. On the base, it is roughly 14,000 acres in size and is found primarily in the upland terrace and at Great Sandy Run Pocosin.

LANDSCAPE/LANDFORM PATTERN – This LT occurs in medium to large, irregularly shaped patches most often in a mosaic with other longleaf pine dominated LTs or as small patches in a matrix with pond pine forests.

DISTURBANCE - In pre-settlement forests, the major disturbance was frequent low intensity fire at intervals of 1 to 3 years. Under natural fire regimes, fires occurred early in the growing season. Other disturbances include lightening, wind events from tornadoes, tropical storms, and microbursts, and periodic droughts that may result in intense fire (Landers and Boyer in Draft). Much of the former longleaf pine stands in this LT were cut over in the early to mid-1800s, farmed or managed as pine plantations.

PRESETTLEMENT VEGETATION - This LT supported Pine Savannas and Mesic Pine Flatwoods (Schafale and Weakley 1990). On the more mesic loam soils in this LT, frequent burning created pure longleaf pine dominated stands with dense wiregrass and high species diversity in the herb layer. These forests were distinctly 2-layered and included mixed pine stands with longleaf, loblolly, and pond pine growing on the same site.

EXISTING VEGETATION - Most longleaf pine savannas in this LT have been displaced by development, loblolly pine plantations, or following long-term fire exclusion, succeeded to a dense multi-storied pine-hardwood forest with a dense shrub cover. Succession to woody shrubs and hardwood trees is more rapid on these mesic sites in the absence of fire than on other sites that support longleaf pine savannas. On Camp Lejeune, most of these areas are dominated by loblolly pine. In these stands, understory trees may be dense and include black oak (*Quercus velutina*), southern red oak (*Quercus falcata),* and sweetgum (*Liquidambar styraciflua*).

MANAGEMENT CONSIDERATIONS - These are the most productive longleaf pine sites on Camp Lejeune and the most altered from past land use practices. They have some of the greatest potential for restoration of longleaf pine, improvement of species richness, and greatest number of management options. Frequent fire is necessary to maintain savanna structure and control competing shrubs and trees.

LT PHASES - This LT includes four LT phases separated on differences in soil drainage and texture.

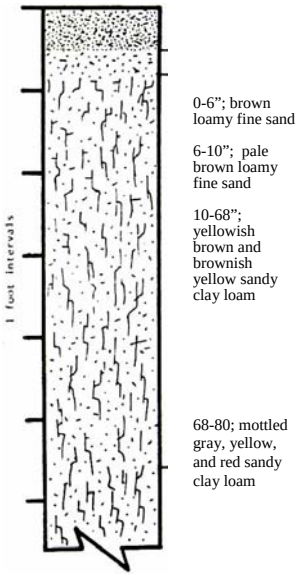
LTP	soil type	extent ac	drainage	surface texture	depth	subsurface texture	permeability
1001	Norfolk	1,280	well drained	loamy fine sand	10"	sandy clay loam	moderate
1002	Craven -B	288	moderately well drained	fine sandy loam	8"	clay loam, clay	Slow
	Goldsboro	518	moderately well drained	fine sandy loam	13"	sandy clay loam	Moderate
	Foreston	5,144	moderately well drained	loamy fine sand	12"	fine sandy loam	mod. Rapid
	Onslow	6,686	moderately well drained	loamy fine sand	17"	sandy clay loam	moderate

LTP # 1001-WELL-DRAINED, LOAMY, LONGLEAF PINE and MIXED PINE SAVANNA

This LTP is identified in only 27 map units, 3 exceed 100 acres in size; most are less than 50 acres in size. The largest occur along Well Point Road and at the Base Camp on Race Track Range Road. Total extent on Camp Lejeune is about 1,280 acres. This type occurs only on the New River Dissected Terrace (LTA 12) and in a few areas at the Great Sandy Run Pocosin (LTA 13). It is associated with pine-hardwood slopes, other mesic pine savannas, and dry-mesic pine savannas.

Soils are well-drained Norfolk loamy fine sand. The seasonal high water table ranges from 3.5 to 6 feet below the surface. About 15% of the mapping units have inclusions of moderately well drained Goldsboro and Foreston soils. These are probably the most productive soils on the Base and they support the highest site index for loblolly pine (Table 4).

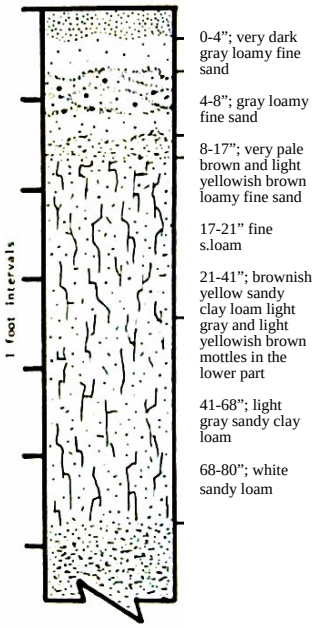
Pre-settlement vegetation in this LTP included forests dominated by longleaf pine (*Pinus palustris*) and those having mixed pine species such as longleaf, pond pine (*Pinus serotina*) and loblolly pine (*Pinus taeda*). Wiregrass (*Aristida stricta*) was the dominant understory species occurring with a diverse mix of grasses and forbs. Creeping blueberry (*Vaccinium crassifulium*), yellow-fringed orchid (*Platanthera ciliaris*), and bluestems (*Andropogon spp*.) are characteristic species. Few scrub oaks were present perhaps due to hotter burns carried by the dense grass and forb understory. Most of these sites have succeeded to loblolly pine and hardwoods. Currently, only 2% of sampled areas where this type occurs on the Main Base have longleaf pine identified as the primary or secondary dominant species while 28% are dominated by longleaf pine in the Great Sandy Run Pocosin area (Tables 2 and 3). One of the higher quality stand conditions exists on both sides of Pocosin Road in the northeast corner of Camp Lejeune.



A typical pedon of Norfolk loamy fine sand

LTP # 1002-MODERATELY WELL-DRAINED, LOAMY, LONGLEAF PINE and MIXED PINE SAVANNA

Holston-Hunter Creek Road, Croatan National Forest, NC



A typical pedon of Onslow loamy fine sand

This LTP is widespread and has been identified in 157 map units on Camp Lejeune; three-quarters are less than 100 acres in size but four exceed 500 acres in size. The largest is located at Starrets Meadow, the name perhaps a reminder of the past condition of this area. Total extent is about 14,000 acres, one of the largest LTs on the Base. The type occurs mostly on the New River Dissected Terrace (LTA 12) where it is associated with dry-mesic pine savannas, pine-oak drainage slopes, pond pine woodlands, and mixed pine savannas. In the Great Sandy Run Pocosin (LTA 13), it is primarily associated with pond pine and mixed pine savannas.

There are four soil series comprising this type and they are all deep loams and often occur in a mosaic on broad, upland flats. The Onslow and Foreston loamy fine sands are the most extensive. Onslow soils are located across LTA 12. Foreston Soils are located primarily in LTA 13. Minor soils in this type cover less than 1,000 acres and include the Goldsboro and Craven fine sandy loam. This LTP represents one of the most productive sites on the Base. Height growth increment for all the major pines is higher than in all other types (Table 4).

Pre-settlement vegetation was longleaf pine (*Pinus palustris*) or mixed longleaf pine, pond pine (*Pinus serotina*), and loblolly pine (*Pinus taeda*) over a diverse mixture of mesic savanna graminoids and forbs. Characteristic species include little bluestem *(Andropogon scoparius),* big bluestem (*Andropogon gerardii*), bracken fern (*Pteridium aquilinum*), skeleton grass (*Gymnopogon brevifolius*), switch cane (*Panicum virgatum*), green sicklescale (*Anthaenantia villosa*), and yellow Indian grass (*Sorghastrum nutans*). These were some of the most species-rich sites in the coastal plain but few remain today in good condition. Fire exclusion has resulted in rapid succession to loblolly pine and hardwoods. On the Croatan National Forest, there are a few remnants of frequently burned Goldsboro soils within this LTP. These areas have some of the highest plant species diversity on the Forest. On Camp Lejeune, the best restoration opportunities are along highway 17 south of Hicks Creek, Ragged Point, and around Old Bear Creek Road.

XERIC AND DRY-MESIC SAVANNAS - LT# 11

GENERAL DESCRIPTION - This LT occurs in the southeastern coastal plain on upland terraces, sandhills, and other undulating uplands. These xeric to dry-mesic habitats have a seasonal high water table below a depth of five feet, frequent burning, and are found on well-drained to excessively drained deep sands. The potential natural vegetation dominants include longleaf pine (*Pinus palustris*), wiregrass (*Aristida stricta*), and scrub oaks (*Quercus laevis*, *Quercus incana*, *Quercus marilandica, Quercus margarettae*). Community structure is most always an open savanna often dominated by only longleaf pine and wiregrass.

There are three phases of the LT and they may be found in close proximity: (1) excessively drained, sandy longleaf pine savanna, (2) excessively drained, dry-mesic, longleaf pine savanna, and (3) well-drained, sandy, longleaf pine savanna. These savannas are commonly referred to as 'barrens', 'sandhills' or 'xeric sandhill scrub' and have characteristic scattered scrub oaks, fairly open grown pines, and exposed surface sand. The more xeric sites are normally low or deficient in moisture available to support vigorous tree growth. Although they receive adequate rainfall, they experience a rapid loss of available moisture because of percolation, evaporation, runoff, and transpiration.

This LT is the most extensive ecological type found on Camp Lejeune and covers 24,000 acres but occurs in only two LTAs. It is the predominant type in the coastal sandridge and in the upland terrace on both sides of the New River. Outside of the Base in Onslow County, it occurs on an additional 32,000 acres.

LANDSCAPE/LANDFORM PATTERN - Sites are irregularly shaped and variable in size, most often occurring as narrow to broad bands associated with small to medium-sized streams or as linear patches associated with ridge and swale topography.

DISTURBANCE - In the pre-settlement landscape, the major disturbance was frequent low intensity fire at intervals of 1 to 3 years. Under natural fire regimes, fires occurred early in the growing season. The most xeric and barren sites may have produced too little fuel to sustain extensive fires at this frequency. Other natural disturbance includes wind events from tornadoes and tropical storms. Early use of longleaf pine in this LT for turpentine production during the colonial era was followed by widespread logging near the turn of the century. Pinchot and Ashe (1915) noted that "along the great sand hills just within the sounds, the longleaf pine occurs in open forests of small trees, now largely removed".

PRESETTLEMENT VEGETATION - This LT supports communities defined as savanna and share vegetative characteristics with Schafale and Weakley's (1990) Xeric Sandhill Scrub, Pine/Scrub Oak Sandhill, and Mesic Pine Flatwoods. Typical sites were dominated by a somewhat open longleaf pine canopy and wiregrass (*Aristida stricta*) understory. Bluejack oak (*Quercus marilandica*), a characteristic species on the less xeric sites, commonly occurred only as scattered individuals. The more xeric sites typically had an open canopy of stunted longleaf pine with low growing turkey oak (*Quercus laevis*), and a sparse herb layer dominated by wiregrass (*Aristida stricta*), Carolina sandwort (*Arenaria caroliniana*), sand spikemoss (*Selaginella arenicola*), and common prickly pear (*Opuntia compress*). Also common were more open and barren conditions without shrub species and only longleaf pine, scattered turkey oak, and wiregrass. Dry-mesic sites included dwarf huckleberry (*Gaylussacia dumosa*), thread-softly *(Cnidoscolus stimulosus*), big bluestems (*Andropogon spp*.), sweet goldenrod, (*Solidago odora*), and summer farewell (*Petalostemum pinnatum*).

EXISTING VEGETATION - Fire suppression has led to changes in community structure and species diversity. Although succession is much slower in this LT than on more mesic sites, the midstory can become very dense where less xeric sites are fire-suppressed for long periods (> 10 years). Under these conditions, a multi-layered subcanopy can develop that is dominated by loblolly pine (*Pinus taeda*), turkey oak (*Quercus laevis*), and bluejack oak (*Quercus incana*). On the more infertile sands, only turkey oak has developed such dense understories. Such prolonged exclusion of fire may lead to dense pine needle and oak leaf litter accumulation up to one foot deep, which eliminates the herb layer. Fire carries poorly in oak litter, reducing the effectiveness of surface fires to consume woody competition to grasses and herbs.

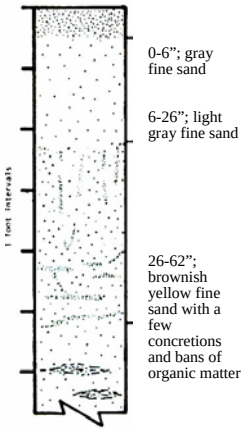
MANAGEMENT CONSIDERATIONS - Management emphasis should be on maintaining a regular fire regime of understory burning. Although sites have rather low fertility, the litter layer is normally continuous and fires carry well through the stand. Longleaf pine savannas within this LT provide important habitat conditions for the red-cockaded woodpecker. Other species such as wild turkey and fox squirrel benefit from the significant production of acorns by turkey oak within this LT. Balancing the needs of these species may require a change in traditional burning methods that emphasize 'blackening' every available acre within a burn unit. A more mosaic type burn that uses the irregular pattern of fuels distribution typical on these xeric sites would retain scattered mast-producing species to develop into larger subcanopy trees.

LANDTYPE PHASES (LTPs) - This Landtype includes three LTPs separated on differences in soil drainage and pre-settlement plant community types.

LTP	soil type	extent (acres)	drainage	surface texture	surface depth	subsurface texture	permeability
1101	Alpin	969	excessively drained	fine sand	13”	fine sand, loamy fine sand	very rapid
	Kureb	5,125	excessively drained	fine sand	26”	fine sand, bands of organic	rapid
1102	Wando	614	excessively drained	fine sand	6”	fine sand	rapid
1103	Baymeade	17,606	well drained	fine sand	30”	fine sand, fine sandy loam	mod. rapid

LTP # 1101-EXCESSIVELY DRAINED, SANDY, LONGLEAF PINE SAVANNA

G-10 Buffer Zone, Camp Lejeune, NC



A typical pedon of Kureb fine sand

This LTP is identified in 81 map units; most are less than 100 acres in size but two exceed 600 acres in size. Total extent is about 6,100 acres occurring mainly in the Bogue-Topsail Coastal Sandridge (LTA 4) where it accounts for one-third of the landscape. In that area, it occupies the highest landscape positions and is always associated with wet pine savannas and sandy muck pocosins. In the New River Dissected Terrace (LTA 12), it is also associated with dry-mesic pine savannas and pine-hardwood slopes.

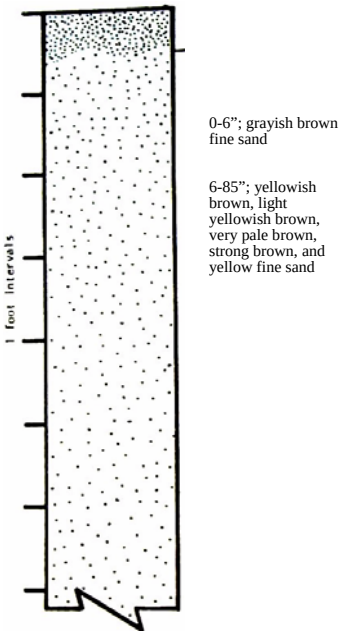
There are two soil series comprising this type; both are excessively drained, deep sands. Alpin fine sand is the least common and occurs on less than 1,000 acres. The Kureb fine sand is the most common and is less fertile than other soils having similar drainage partly due to accumulations of aluminum and organic matter in the subsoil. These spodic horizons can severely affect nutrient availability. Furthermore, moisture availability for both soils is limited because infiltration is rapid and permeability is very rapid. These sites are therefore some of the least productive for tree growth on Camp Lejeune (Table 4).

Pre-settlement vegetation was open longleaf pine (*Pinus palustris*) over a nearly continuous layer of wiregrass (*Aristida stricta*). Scattered scrub oaks, especially turkey oak (*Quercus laevis*), were present. Other characteristic species include: thread softly (*Cnidoscolus stimulosus*), wax myrtle (*Myrica cerifera*), whip nuthatch (*Scleria triglomerata),* Carolina ipecac *(Euphorbia ipecacuanhae*), goats’ rue (*Tephrosia virginiana*), and stiffleaf aster (*Aster leariifolius*). With a reduction in fire frequency low shrubs such as blue huckleberry (*Gaylussacia frondosa*), sparkleberry (*Vaccinium arboreum*), and stunted turkey oak (*Quercus laevis*) become established. Succession, however, proceeds slowly on these infertile and droughty sites and vegetation even without periodic fire never reaches the density of nearby wet sites.

Understory plant cover is sparse and there is always some sand exposed at the soil surface. Many good examples of open xeric pine savanna remain on Camp Lejeune. Some of the best are between the G10 and highway 172, and south of Lyman road near the junction with highway 172. Currently over 60% of the forests in this type have longleaf pine as the primary dominant species. This type of dominance by longleaf pine is not found in any other type. Nevertheless, there are still opportunities to restore about one-third of the stands in this type where longleaf is neither the primary nor the secondary dominant species (Table 2).

LTP # 1102-EXCESSIVELY DRAINED, SANDY, DRY-MESIC LONGLEAF PINE SAVANNA

Near Rhodes Point Road, Camp Lejeune, NC



A typical pedon of Wando fine sand

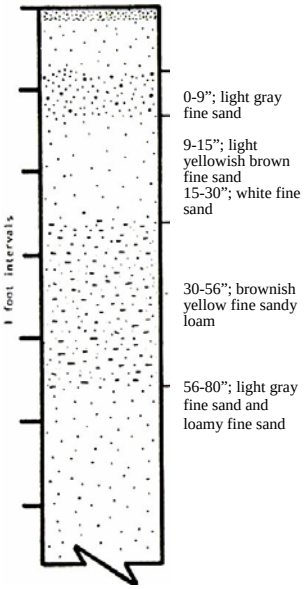
This LTP is one of the smallest types found on Camp Lejeune and is identified in only 14 map units. One-half of the map units are less than 10 acres in size, however, there are two large map units exceeding 100 acres in size. These units occur just south of the mouth of Town Creek, and north of Rhodes Point Road. This LTP is found only on the west side of the New River in the New River Dissected Terrace (LTA 12) and is associated with a variety of types. Associates include pine-hardwood slopes, wet pine savannas, dry-mesic savannas, and small stream swamps.

Soils are excessively drained Wando fine sand, deep sandy soils having a seasonal high water table 6 feet below the soil surface. This soil is much more common below the coastal scarp that separates the low coastal flats from the extensive upland terrace. Other soil inclusions occur in about 15% of map units. The excessively drained Alpin and Kureb are intermingled while the Baymeade is on small flat areas (Lejeune Soil Survey 1984). Height increment for both loblolly and longleaf pine is high in this LTP (Table 4).

This LTP is a typical longleaf pine/wiregrass savanna but is intermediate in moisture and species diversity between xeric and dry-mesic types. Pre-settlement vegetation included wiregrass (*Aristida stricta,),* turkey oak (*Quercus laevis*) and some mesic savanna grasses and herbs. Although more common in the maritime zone, live oak (*Quercus virginiana*) is another characteristic species in this type and scattered individuals can still be found north of Rhodes Point Road. Currently, in the area sampled by Carter (2000), loblolly pine is the primary dominant species in this LTP (Table 2).

LTP # 1103-WELL DRAINED, SANDY, LONGLEAF PINE SAVANNA

Spring Branch Limesinks, Camp Lejeune, NC



A typical pedon of Baymeade fine sand

This is the largest LTP found on Camp Lejeune and it is identified in over 150 map units; 44 are greater than 100 acres in size. The largest map units are greater than 500 acres in size and are located in the K-2 Impact Area and south of Stone Bay. Total extent is about 17,600 acres distributed throughout the New River Dissected Terrace (LTA 12). It also occurs in LTA 4 and in a few areas in LTA 13. Because of its extent, it can be found in association with nearly all other LTPs but is primarily associated with other pine savannas (wet, mesic, and xeric) and with pine-hardwood drainage slopes. There are an additional 3,560 acres of Baymeade soil mapped in the urban-woodland complex (LT 17).

Soils are well-drained Baymeade fine sands. These soils have deep sand surface horizons and a sandy loam subsurface. The seasonal high water table ranges from 4 to 5 feet below the surface. Included with this soil in mapping are small areas of at least six other soil series, which make up about 15% of the map unit (Lejeune Soil survey 1984). The sandier Alpin and Kureb soils are on small, slightly higher ridges. The Foreston, Leon, and Pactolus are in narrow depressions and the Muckalee soil is in narrow drainageways. The Baymeade soils are generally productive for longleaf pine and loblolly pine. Along with the Onslow and Norfolk, these soils have the greatest height increment for longleaf pine than all other types (Table 4).

Pre-settlement vegetation was longleaf pine savanna but with greater stocking than more xeric sites. Typical understory was wiregrass (*Aristida stricta*), and scattered bluejack oak (*Quercus incana*) often with few other species. Bluejack oak (*Quercus incana*) is a characteristic species and is usually present in modern landscapes. Species diversity is usually low. Succession is also relatively slow and the effect of fire suppression may not be evident for 4 to 5 years. However, sites that are more diverse may contain flowering dogwood (*Cornus florida*) and other scattered oaks such as blackjack (*Quercus marilandica*), sand post oak (*Quercus margarettae*) and turkey oak (*Quercus laevis*). Characteristic understory species include thread softly (*Cnidoscolus stimulosus*), bluestems (*Andropogon* spp.) and Carolina ipecac (*Euporbia ipecacuanhae*). Some of the best examples of this LTP are located between the G10 and Lyman Road, and around the headwaters of French's creek.

MARITIME INFLUENCED WOODLANDS AND SAVANNAS - LT# 13

GENERAL DESCRIPTION - This LT occurs throughout the southeastern coastal plain within lowland terraces adjacent to ocean-influenced wetlands. These landscapes are a complex of excessively drained and well drained low ridges and somewhat poorly drained broad interstream flats. In general, all upland landscapes that are maritime-influenced are placed in this LT including uplands fringing salt or brackish waters that are dominated by live oak communities. The potential natural vegetation dominants include live oak (*Quercus virginiania*), longleaf pine (*Pinus palustris*), pond pine (*Pinus serotina*), and loblolly pine (*Pinus taeda*).

There are four phase of this LT and they are often found in close proximity: (1) excessively drained, sandy pine-oak woodlands, (2) well-drained, sandy, longleaf pine savanna, (3) well-drained, sandy, mixed pine-oak slopes, and (4) somewhat poorly drained, mixed pine flats. This LT is located only in the Onslow Maritime Zone (LTA 9) and is one of the primary types used to differentiate this area. Total extent on Camp Lejeune is about 7,400 acres. In Onslow County, outside the Base, it covers about 8,150 acres.

LANDSCAPE/LANDFORM PATTERN – This LT forms large irregular patches associated with upland pine and hardwood sites and marshes near large water bodies.

DISTURBANCE - Under natural fire regimes, most mainland maritime zones experienced frequent fires that spread from interior fire communities or more likely from adjacent saltmarsh grasses. They are susceptible to wind and flooding caused by hurricanes because of their location in low areas near the coast. Furthermore, aerosol salt may be a continuous stress factor and significant source of mineral nutrients.

PRESETTLEMENT VEGETATION - This LT can support vegetation communities ranging from longleaf pine (*Pinus palustris*) sandhills and savanna to hardwood slopes and mixed live oak (*Quercus virginiana*) – pine.
Some of the more low-lying areas especially near marshland may have supported Coastal Fringe Evergreen Forests (Schafale and Weakley 1990). In general, characteristic species in the maritime zone include: yaupon (*Ilex vomitoria*), Virginia red-cedar (*Juniperus virginiana*), maxmyrtle (*Myrica cerifera*), dwarf palmetto *(Sabal minor*), and live oak (*Quercus virginiana).*

EXISTING VEGETATION - Sites within the maritime zone have experienced nearly three centuries of human exploitation and disturbance. All the live oak in the region was sought out and removed for ship timber during the 18th and 19th century (Wood 1981). Furthermore, sites that still had some of the second growth live oak, have been used for houses and farmsteads since the early 1700s. The reduction in fire frequency especially below the coastal scarp has led to an increase in loblolly pine (*Pinus taeda*), numerous hardwoods, and pocosin shrubs.

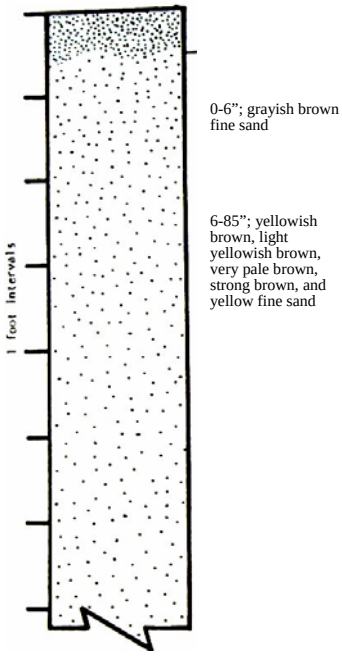
MANAGEMENTS CONSIDERATIONS – Restoration of native plant communities is perhaps the largest challenge in this LT. Salt water inundation and hurricane winds will always shape the overall vegetation structure in this zone, however, without periodic fire, dense shrub lands will persist and the once dominant live oak woodlands and open longleaf pine sandhills will be absent from the landscape. Some of the best opportunities to return fire to maritime marsh and upland zones exists around Bear Creek.

LANDTYPE PHASES (LTPs) - This Landtype includes four LTPs separated on differences in soil drainage and pre-settlement plant community types.

LTP	soil type	extent ac.	drainage	surface	depth	subsurface texture	permeability
1301	Wando	3,728	excessively drained	fine sand	6”	fine sand	rapid
1302	Baymeade	1,009	well drained	fine sand	30”	fine sand, fine sandy loam	mod. rapid
1303	Marvyn	1,000	well drained	loamy fs	8”	sandy loam, sandy clay lm	moderate
1304	Pactolus	1,663	mod.well-sw poorly drained	fine sand	30”	fine sand	rapid

LTP # 1301-EXCESSIVELY DRAINED, SANDY MARITIME-INFLUENCED PINE-OAK WOODLAND

Near Mile Hammock Bay Sandhills, Camp Lejeune, NC



A typical pedon of Wando fine sand

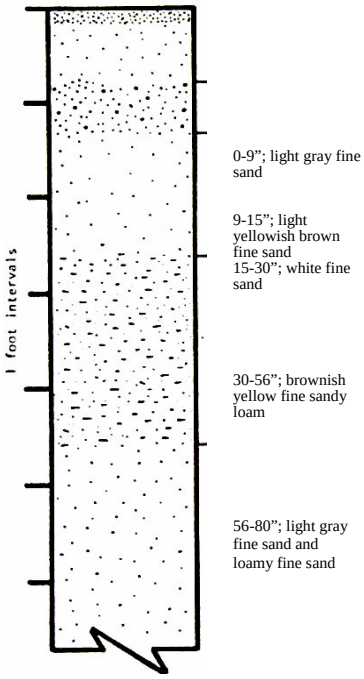
This LTP is identified in 39 map units on Camp Lejeune. Over one-half are less than 50 acres in size but nine are greater than 200 acres in size; the largest are near Salliers Bay Road. Total extent is about 3,700 acres distributed across the Onslow Maritime Zone (LTA 9). This type does not occur elsewhere on the Base and is one of the primary types used for delineating this LTA. Major associates are maritime-mixed pine flats, sandy muck pocosins, maritime influenced pine savannas, and maritime influenced pine-oak woodlands.

Soils are excessively drained Wando fine sands. These deep sands have a seasonal high water table 6 feet below the soil surface. This soil is common below the coastal scarp that separates the low coastal flats from the extensive uplands. There are about 600 acres of Wando find sand that occur in the New River Dissected Terrace (LTA 12). In that area, it has been placed in the dry-mesic, longleaf pine savanna type (LTP 1102) and height increment for both loblolly and longleaf pine is high. However, within the coastal scarp, height increment for loblolly pine is moderately low and for longleaf pine only moderate (Table 4).

Pre-settlement vegetation varied from pure longleaf on the inland, more fire-exposed sites, to true maritime forest with live oak (*Quercus virginiana*) and yaupon (*Ilex vomitoria*) near and along shorelines. Other characteristic species include dwarf huckleberry (*Gaylussacia dumosa*), stiffleaf aster *(Aster linarifolius*), slender spikegrass (*Chasmanthium laxum*) and butterfly pea (*Clitoria mariana*). Good examples of this type occur between highway 172 and Bear Creek and in small areas along Bear Creek to the north. A reduction in fire frequency, as has happened below the coastal scarp, has led to an increase in "off-site" pines and hardwoods. Currently nearly, 80% of the sampled area in this type had neither longleaf pine nor live oak as the primary or secondary dominant species (Table 2). Most of this type is dominated by loblolly pine

LTP # 1302-WELL DRAINED, SANDY, MARITIME INFLUENCED LONGLEAF PINE SAVANNAS

South of Sneads Ferry Road-east of Marines Road, Camp Lejeune, NC



A typical pedon of Baymeade fine sand

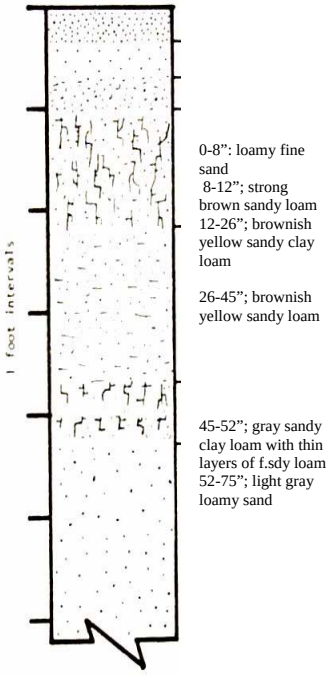
This LTP is identified in just 14 map units on Camp Lejeune. Over one-half are greater than 50 acres in size; the largest are located south of highway 172 between Traps Bay and Courthouse Bay and at the Osprey Artillery Gun position. The type is located only in the Onslow Maritime Zone (LTA 9) and most map units occur in the northern periphery of this area. This LTP is associated with maritime influenced pine-oak slopes and pine-oak woodland, wet pine savannas, xeric pine savannas, and pocosin fringes.

Soils are well-drained Baymeade fine sands. These soils have deep sand surface horizons and a sandy loam subsurface. The seasonal high water table ranges from 4 to 5 feet below the surface. There are inclusions in the map units of more poorly drained soils. This soil is very extensive in the upland terrace (LTA 12), dominating landscapes there. In that area, it has been placed in a dry-mesic longleaf pine savanna type (LTP 1103) and height increment for both loblolly and longleaf pine is high. However, height increment for loblolly pine is moderately low and for longleaf pine only moderate on these soils below the coastal scarp (Table 4).

Pre-settlement vegetation was longleaf pine (*Pinus palustris*) over wiregrass (*Aristida stricta)* in a typical savanna structure. Bluejack oak (*Quercus incana*) is a characteristic species and most sites are somewhat sterile; species diversity is usually. Succession is also relatively slow and the effect of fire suppression may not be evident for 4 to 5 years. However, below the coastal scarp, fire return intervals have exceeded this time period and many sites have been invaded by loblolly pine, shrubs, and midstory hardwood saplings. Over 70% of this area was sampled recently and 90% of the LTP has loblolly pine as the primary dominant species and in only 6% of the area is longleaf pine the primary dominant species (Table 2).

LTP # 1303-WELL DRAINED, SANDY MARITIME INFLUENCED MIXED PINE-OAK DRAINAGE SLOPE

Mile Hammock Bay Road, Camp Lejeune, NC



A typical pedon of Marvyn loamy fine sand

This LTP is identified in 44 map units; only one is greater than 100 acres in size; over 50% of are less than 20 acres in size. Total extent is about 1,000 acres distributed mainly along first and second order drainages of the New River within the maritime zone. Most map units are on the peninsula north of the lower New River. This LTP only occurs in the Onslow Maritime Zone (LTA 9) and is commonly associated with maritime influenced pine-oak woodlands, mesic pine savannas, and maritime influenced longleaf pine savannas.

Soils are well-drained Marvyn loamy fine sands on sloping land. They have a sandy surface and predominately sandy loam subsurface. Included in the soil mapping are steeper sites and eroded sites. This soil is very extensive in the upland terrace (LTA 12), and characterizes slopes above drainages. In that area, it has been placed in LTP 401 and height increment for loblolly pine is high. Height increment for loblolly pine is only moderate on these soils within the coastal scarp (Table 4).

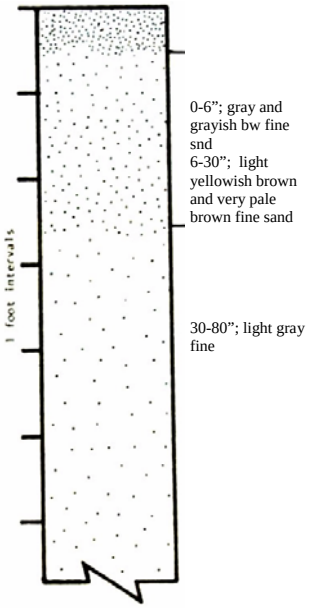
Pre-settlement vegetation was predominantly dry-mesic to mesic longleaf pine savanna and mixed pine-hardwood. Oaks increased in importance in the mid and lower slope positions. Today most of these sites are dominated by loblolly pine. Recent surveys indicate that loblolly pine is the primary dominant species in 85% of this type. Longleaf pine is the primary dominant species in only 6% of the surveyed area (Table 2.)

LTP # 1304-MODERATELY WELL DRAINED AND SOMEWHAT POORLY DRAINED, SANDY, MARITIME, MIXED PINE FLAT

This LTP is identified in 16 map units and nearly one-half of them exceed 100 acres in size. The largest is over 400 acres and occurs from Freemans Creek Road northeast along highway 172. Total extent is about 1,660 acres distributed across the lower lying areas in the Onslow Maritime Zone (LTA 9), the only LTA where the type occurs. This LTP is primarily associated with maritime saltmarsh and maritime influenced pine-oak woodland.

Soils are moderately well to somewhat poorly drained Pactolus fine sands. These deep sands occur on broad interstream areas and have a seasonal high water table ranging from 1.5 to 2.5 feet below the soil surface. About 10% of mapped areas have inclusions of excessively drained Wando and poorly drained Leon soils. Loblolly pine height growth increment is moderately low on this soil.

Pre-settlement plant communities were mostly mixed pine with longleaf pine (*Pinus palustris*) the predominant species. Other pines included loblolly pine (*Pinus taeda*), and pond pine (*Pinus serotina*). Structure was an open, two layered savanna with a diverse mix of wet mesic graminoids and forbs. Characteristic species include Carolina yellow-eyed grass (*Xyris caroliniana*), savanna meadow-beauty (*Rhexia alifanus*), deer's tongue (*Trilisa paniculata*), orange milkwort (*Polygala lutea*), and pine lily (*Lillium catesbaei*). Most all of the area covered by this LTP has now succeeded to loblolly pine, shrubs, and swamp hardwoods because of the reduction in fire frequency (Table 2). The best opportunities for restoration of this type are near the marshes of Bear Creek where marsh communities could provide the fuel for frequent burning.



A typical pedon of Pactolus fine sand

MARITIME DUNES, SWALES, AND MARSHES -LT # 14

GENERAL DESCRIPTION –This LT includes shores and dunes of barrier islands, margins of estuaries, other upland margins, and old flood tide deltas near closed inlets. These salt-influenced sea level wetlands and upland sand ridges are strongly influenced by daily tides and wind, and by periodic severe hurricanes and storm wave action. The dominant vegetation is graminoids (*Uniola paniculata*, *Panicum amarum*, *Eragrostis* spp., *Spartina patens*) and, in more stabilized area, shrubs and trees (*Juniperus virginiana, Quercus virginiana, Myrica cerifera, Iva Frutescen*).

LANDSCAPE/LANDFORM PATTERN – This LT is long and linear and runs parallel to the shoreline.

DISTURBANCE - Flooding is the major continual disturbance. Tidal waters affect salinity and influence the distribution of communities and species along a salt tolerance gradient. Periodic hurricanes, however, have the greatest influence on this landscape, shifting dunes, creating new ocean inlets, and temporarily devastating shrub and tree cover.

PRESETTLEMENT VEGETATION – In pre-settlement landscapes, vegetation in most marshes (except true salt marshes), shoreline vegetation, and maritime forest hummocks were influenced by fire. The marsh-upland transition today shows signs of fire suppression, being dominated in places by cedar, loblolly pine, and wax myrtle (*Myrica cerifera*). Loblolly pine marsh may have once dominated these fringe areas. This 2-layered community had a canopy of pure loblolly pine over an open grassy layer of marsh graminoids such as slender spikegrass (*Chasmanthium laxum*). They were kept open by frequent fire spreading from the uplands or adjacent marsh (Frost 2000).

EXISTING VEGETATION – This complex of soils and disturbance regimes support a variety of vegetation types that include permanently inundated saltmarsh cordgrass (*Spartina alterniflora*) at sea level, hummocks and flats of maritime live oak (*Quercus virginiana*), and beach grasses on shifting sand dunes. Near upland margins where salinity is reduced by fresh groundwater input there are small stands of loblolly pine and maritime live oak forest. These Estuarine Fringe Loblolly Pine Forests (Schafaly and Weakley 1990) provided one of the original locations for naturally occurring loblolly pine in the southeastern coastal plain.

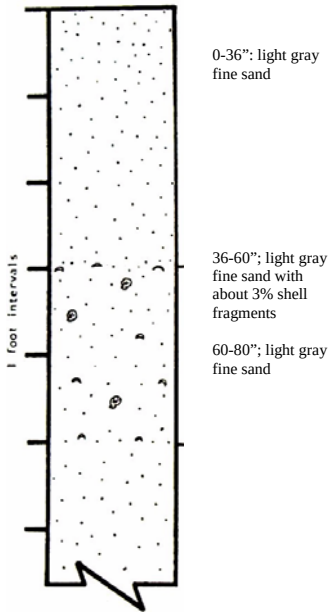
MANAGEMENTS CONSIDERATIONS - Management concerns relate to protection of the important functions that these coastal estuarine systems provide, especially nutrient cycling, energy production, and habitat. Areas with regular daily lunar tides have a regular input of nutrients, which makes them highly productive. The marsh plants contribute nutrients to the estuaries benefiting fish and shellfish and provide habitat for wetland wildlife. Stabilization of backdunes may interfere with normal cycles of barrier island erosion and aggradation.

LANDTYPE PHASES (LTPs) - This Landtype includes two LTPs separated on differences in soil drainage, landform, and pre-settlement plant community types.

LTP	soil type	extent (acres)	drainage	surface texture	surface depth	subsurface texture	permeability
1401	Newhan Corolla Duckston	909 198 235	excessively drained somewhat poorly drained poorly drained	fine sand fine sand fine sand	36” 44” 19”	fine sand fine sand fine sand	very rapid very rapid very rapid
1402	Bohicket	2,186	very poorly drained	silty clay loam	8”	silty clay, loamy sand	very slow

LTP # 1401-EXCESSIVELY DRAINED TO POORLY DRAINED, MARITIME DUNES AND SWALES

Onslow beach foredunes, backdunes, and swales, Camp Lejeune, NC



A typical pedon of Newhan fne sand

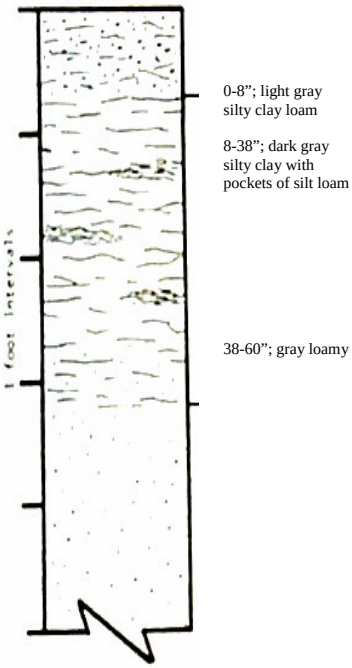
This LTP is mapped in only 17 map units, two exceed 400 acres in size (Newhan soils); most are less than 50 acres in size. Total extent is about 1,370 acres distributed across the length of the Onslow Maritime Zone (LTA 9). This complex of ocean-side landforms and soils are associated inland with a marshland complex.

There are three soils comprising this LTP: 1) excessively drained Newhan fine sand which is the most extensive and forms taller dunes along the coast, 2) moderately well drained Corolla fine sand which forms low dunes mostly inland from the Newhan soil, and 3) poorly drained Duckston fine sand which fills swales to temporarily form flats behind the dunes. These complex landscapes are strongly influenced by ocean tides and storm overwash and are constantly in motion as the forces of erosion and wind shift the sands perpendicular to and along the main axis of the shoreline.

Current vegetation is often temporary. Fresh dunes are colonized by Sea oats (*Uniola paniculata*). Other grasses include panic grass (*Panicum amarum*) and Lovegrass (*Eragrostis* spp.). Saltmeadow cordgrass (*Spartina patens*) is more common on the lower dunes in wet transition areas. Stabilized dunes may succeed to shrubby red cedar-live oak (*Juniperus virginiana – Quercus virginiana*) or maritime shrubs such as waxmyrtle (*Myrica cerifera*), mulletbush (*Baccharis halimifolia)*, or bigleaf marsh elder (*Iva frutescens*). Where flats and slight swales are protected, common marsh grasses such as salt marsh cordgrass (*Spartina alternifolia*), black needle-rush (*Juncus roemerianus*) and seaside goldenrod (*Solidago semperviren*) may become established.

LTP # 1402-VERY POORLY DRAINED, LOAMY, MARITIME MARSH

Gillets Creek, Camp Lejeune, NC



A typical pedon of Bohicket silty clay loam

This LTP is mapped in nearly 80 map units, seven of which exceed 100 acres in size (mouth of Bear Creek, Howard Bay); most are less than 10 acres in size. Total extent is 2,226 acres distributed across the entire Onslow Maritime Zone (LTA 9); the inland units are scattered along the lower New River. This LTP occurs mostly at elevations less than 2 feet above sea level between the seaward maritime dunes and swales and the inland maritime influenced mixed pine flats, small stream swamps and pine oak woodlands.

Soils are very poorly drained Bohicket silty clay loams and some are locally referred to as "mud flats". There may be inclusions of other soil series in this map unit including Laffitte muck and Carteret sand. Sites are strongly influenced by tidal flooding and have a broad range in salinity varying from seawater near inlets to brackish marshes in mouths of upland drains.

Current vegetation is highly variable and includes permanently saturated marshes and shoreline marsh-maritime forest hummocks. Brackish marsh is dominated by black needlerush (*Juncus roemerianus*) or saltmeadow cordgrass (*Spartina patens*) with Big cordgrass (*Spartina cynosuroides*) and sawgrass (*Cladium mariscus ssp jamaicense*). Salt marsh is strongly dominated by saltmarsh cordgrass (*Spartina alterniflora*) with zones of black needlerush and saltmeadow cordgrass. Salt flats have a sparse cover of saltworts (*Salicornia* sp.) and salt grass (*Distichlis spicata*). Shoreline marsh-maritime forest hummocks include live oak (*Quercus virginiana),* Loblolly pine (P*inus taeda),* and Gum-Bay-Magnolia (*Nyssa-Persea-Magnolia)* communities. With exception of the saline Saltmarsh cordgrass, all marshes, shoreline vegetation, and maritime forest hummocks have been strongly affected by fire suppression. Many areas are now dominated by pocosin – like thickets of Swamp tupelo (*Nyssa biflora*), Swamp red bay (*Persea palustris*), red maple (*Acer rubrum*), sweetbay (*Magnolia virginiana*), and loblolly pine.

Table F.1. Composition of Landtype Associations (LTA) in Onslow County and on Camp Lejeune (% of total LTA extent) [1/]

		---------- Onslow County ----------						---------- Camp Lejeune ----------					
	LTA ac →	**161,206**	**29,750**	**49,252**	**42,354**	**172,504**	**70,413**		**404**	**14,697**	**15,924**	**72,472**	**41,905**
LTP	LTP acres ↓	LTA 3	LTA 4	LTA 9	LTA 11	LTA 12	LTA 13	Total acres	LTA 3	LTA 4	LTA 9	LTA 12	LTA 13
101	1,911	0.7	0.4	--	--	0.4	--	319	--	--	--	0.4	--
102	4,558	1.1	0.3	--	--	1.5	--	1,080	--	--	--	1.5	--
201	33,418	7.5	5.6	2.7	--	7.0	8.8	8,196	2.3	2.2	6.0	6.0	6.1
202	646	0.1	0.3	0.1	--	0.2	--	490	--	0.6	0.4	0.4	0.1
401	28,566	6.5	5.1	--	--	9.6	--	8,618	2.8	2.4	--	11.4	--
402	3,631	1.7	--	--	--	0.6	--	153	--	--	--	0.2	--
601	34,677	18.3	1.2	--	1.1	2.4	0.3	1,089	1.3	0.3	--	1.1	0.5
602	27,435	4.8	2.7	0.1	0.1	4.2	16.5	7,373	--	1.3	--	1.9	13.9
701	44,377	6.7	2.6	0.1	41.9	4.4	10.5	7,726	--	2.0	--	2.4	13.6
801	34,138	1.0	1.0	--	56.0	0.3	11.4	8,662	--	2.1	--	0.5	19.2
802	15,756	0.4	7.8	0.9	--	3.2	9.7	8,160	--	11.1	1.5	1.6	12.3
901	29,324	9.4	3.2	0.2	0.2	4.3	8.2	4,022	1.7	0.4	--	1.2	7.3
902	30,843	0.9	18.2	1.7	0.1	7.4	14.7	13,804	--	32.8	2.1	3.4	14.7
1001	28,594	11.4	3.8	0.2	--	5.1	0.3	1,280	2.8	--	--	1.6	0.3
1002	70,568	20.2	12.3	1.2	0.6	12.7	16.5	12,636	10.7	2.0	1.5	11.1	9.7
1101	9,728	0.2	16.5	0.3	--	2.4	0.3	6,094	--	29.9	0.6	2.2	--
1102	1,562	--	2.8	--	--	0.4	--	614	--	--	--	0.9	--
1103	45,424	3.8	15.4	--	--	19.3	2.3	17,606	1.9	12.5	--	20.9	1.5
1301	6,035	--	--	12.3	--	--	--	3,728	--	--	23.4	--	--
1302	4,462	--	--	9.1	--	--	--	1,009	--	--	6.3	--	--
1303	1,900	--	--	3.9	--	--	--	1,000	--	--	6.3	--	--
1304	3,157	--	--	6.4	--	--	--	1,663	--	--	10.5	--	--
1401	3,645	--	--	7.4	--	--	--	1,369	--	--	8.6	--	--
1402	9,646	--	--	19.6	--	--	--	2,226	--	--	14.0	--	--
1601	2,008	0.5	--	0.2	--	0.6	0.2	976	7.0	--	0.6	1.0	0.3
1701	10,983	2.7	--	1.0	--	3.5	--	4,939	--	--	--	6.8	--
1801	78	--	--	--	--	--	--	46	--	--	--	0.1	--
1802	1,566	--	--	3.1	--	--	--	558	--	--	3.4	--	--
1803	809	0.2	0.5	0.1	--	0.1	0.2	175	--	0.2	0.3	0.1	--
1804	879	0.2	--	0.1	--	0.3	0.2	879	69.5	--	0.2	0.6	0.3
3001	34,459	1.5	0.3	29.5	--	10.1	--	18,917	--	0.4	14.6	22.8	0.1

[1/] Dominant LTPs within each LTA are highlighted.

Table F.2. Dominant tree species occurring in Landtype Phases (LTP) on the Main Base, Camp Lejeune[1/]

LTP	Total Map Unit Area (ac.) Main Base	Percent of Map unit area inventoried	Inventory Area (ac.)	Percent Area Longleaf Pine Primary Dominant	Percent Area Loblolly or Slash Pine Primary Dominant	Percent Area Pond Pine Primary Dominant	Percent Area Hardwood Primary Dominant	Potential Natural Vegetation (PNV) **Principal** Dominant(s)	Percent of area without the PNV Principal Species as Primary or Secondary Dominant
101	319	52	168	0	1	0	99	marshland	-
102	1,080	94	1,014	0	3	0	97	cypress	100%
201	5,587	24	1,368	6	69	5	21	hardwood	76%
202	484	31	152	11	56	32	1	pond pine	68%
401	8,519	47	4,017	9	83	2	6	longleaf-hardwood	79%
402	150	97	145	0	88	0	12	hardwood	76%
601	860	69	593	4	84	11	1	pond pine-longleaf	80%
602	1,158	77	890	7	79	14	0	pond pine-longleaf	86%
701	1,989	59	1,172	4	62	34	0	pond pine	66%
801	659	48	315	4	7	89	0	pond pine	11%
901	940	75	701	16	56	28	0	longleaf-pond pine	84%
902	8,053	54	4,329	51	25	23	1	longleaf pine	48%
1001	1,128	84	944	2	95	1	2	longleaf-pond pine	98%
1002	8,048	68	5,481	13	76	11	0	longleaf-pond pine	86%
1101	6,077	57	3,461	63	27	9	1	longleaf pine	35%
1102	614	57	352	0	100	0	0	longleaf pine	100%
1103	17,086	66	11,241	22	73	4	1	longleaf pine	77%
1301	3,713	44	1,644	10	80	0	10	hardwood-longleaf	79%
1302	1,005	72	726	6	91	0	3	longleaf pine	94%
1303	993	64	639	6	85	0	9	longleaf-hardwood	82%
1304	1,654	29	484	1	62	0	37	pond pine-longleaf	99%

[1]/ data for LTPs 101-102 from Timber Stand Compartments (IGIR 2000); data for all other LTPs from Forest Inventory Report (Carter 2000)

Table F.3. Dominant tree species occurring in Landtype Phases (LTP) in Great Sandy Run, Camp Lejeune[1/]

LTP	Total Map Unit Area (ac.) Main Base	Percent of Map unit area inventoried	Inventory Area (ac.)	Percent Area Longleaf Pine Primary Dominant	Percent Area Loblolly or Slash Pine Primary Dominant	Percent Area Pond Pine Primary Dominant	Percent Area Hardwood Primary Dominant	Potential Natural Vegetation (PNV) **Principal** Dominant(s)	Percent of area without the PNV Principal Species as Primary or Secondary Dominant
201	2,557	96	2,443	1	9	1	88	hardwood	4%
401	55	84	46	0	54	0	46	longleaf-hardwood	0%
601	223	90	201	0	70	2	28	pond pine-longleaf	98%
602	6,180	84	5,173	3	67	2	28	pond pine-longleaf	93%
701	5,714	94	5,374	1	38	3	58	pond pine	93%
801	7,997	90	7,223	0	16	13	71	pond pine	86%
802	4,800	95	4,552	2	24	5	69	pond pine	90%
901	3,055	86	2,613	5	69	1	25	longleaf-pond pine	91%
902	5,688	90	5,130	14	50	4	32	longleaf pine	84%
1001	142	82	116	28	9	0	63	longleaf-pond pine	72%
1002	4,536	88	4,012	16	57	0	27	longleaf-pond pine	84%
1103	475	87	415	0	74	0	26	longleaf pine	100%

[1]/ data from Timber Stand Compartments (IGIR 2000)

Table F.4. Crosswalk Between Landtypes and Frost's (2000) Presettlement Vegetation Community Type Groups

Landtypes soil components, (drainage class) extent on Camp Lejeune	**Presettlement Vegetation Community Group**
Inland Tidal Marshes and Tidal Swamps Bohicket silty clay loam (very poorly drained) 316 ac. Lafitte muck (very poorly drained) 3 ac. Dorovan muck (very poorly drained) 1,080 ac.	Maritime Dune, Swale, and Marsh System (Bohicket, Lafitte) Tidal Cypress-Gum Swamps (Dorovan)
Small Stream Swamps and Streamhead Pocosins Muckalee loam (poorly drained) 8,196 ac.	Small Stream Swamps (Muckalee) Pocosin (Muckalee)
Drainage Slopes Craven-C fine sandy loam (moderately well drained) 153 ac. Marvyn loamy fine sand (well drained) 8,618 ac. .	Mixed Mesic Hardwood Forest & Pyrophytic Woodland Complex on fire sheltered slopes (Craven) Mesic Longleaf Pine-Pyrophytic Woodland Complex on slopes (Marvyn)
Interstream Flats Pactolus fine sand (mod. well- somewhat poorly drained) 219 ac. Lenoir loam (somewhat poorly drained) 110 ac. Woodington loamy fine sand (poorly drained) 7,373 ac. Rains fine sandy loam (poorly drained) 760 ac.	Mixed Pine Savanna (Rains, Lenoir) Wet Longleaf Pine Savanna (Rains, Pactolus) Maritime Influenced Pyrophytic Communities (Rains) Pond Pine Forest and Canebrake (Woodington)
Pocosin Fringes Pantego mucky loam (very poorly drained) 186 ac. Torhunta fine sandy loam (very poorly drained) 7,539 ac.	Pond Pine Forest and Canebrake (Pantego, Torhunta)
Broad Pocosins Murville fine sand (very poorly drained) 8,160 ac. Croatan muck (very poorly drained) 8,662 ac.	Pocosin (Murville, Croatan)
Wet and Wet-Mesic Pine Savannas Leon fine sand (poorly drained) 13,804 ac. Lynchburg fine sandy loam (somewhat poorly drained) 158 ac. Stallings loamy fine sand (somewhat poorly drained) 3,864 ac.	Wet Longleaf Pine Savanna (Leon) Mesic Pine Savannas on Upland Terraces (Stallings)
Mesic Pine Savannas Norfolk loamy fine sand (well drained) 1,280 ac. Goldsboro fine sandy loam (moderately well drained) 518 ac. Foreston loamy fine sand (moderately well drained) 5,144 ac. Onslow loamy fine sand (moderately well drained) 6,686 ac. Craven-B fne sandy loam (moderately well drained) 288 ac.	Mesic Pine Savannas on Upland Terraces (Norfolk, Goldsboro, Foreston, Onslow, Craven-B)
Xeric and Dry-Mesic Pine Savannas Alpin fine sand (excessively drained) 969 ac. Kureb fine sand (excesively drained) 5,125 ac. Wando fine sand (excessively drained) 614 ac. Baymeade fine sand (well drained) 17,606 ac.	Xeric & Dry Mesic Longleaf Pine / Wiregrass Savanna (Alpin, Kureb, Baymeade) Mesic Longleaf Pine on Pamlico Terrace (Wando)
Maritime Influenced Woodlands and Savannas Wando fine sand (excessively drained) 3,728 ac. Baymeade fine sand (well drained) 1,009 ac. Marvyn loamy fine sand (well drained) 1,000 ac. Pactolus fine sand (mod. well- somewhat poorly drained) 1,663 ac.	Maritime Influenced Pyrophytic Communities (Wando, Baymeade, Marvyn, Pactolus)
Maritime Dunes, Swales, and Marshes Newhan fine sand (excessively drained) 910 ac. Corolla fine sand (moderately well drained) 224 ac. Duckston fine sand (poorly drained) 235 ac. Bohicket silty clay loam (very poorly drained) 2,226 ac	Maritime Dune, Swale, and Marsh System (Newhan, Duckston, Corolla, Bohicket)

Table F.5: Relative Site Index Class[1/] for Important Pine Species on Camp Lejeune.
Source: Forest Inventory plots (1990), Camp Lejeune Forest Stands (2000).

LTP	**Loblolly Pine**	FIA plots	GIS stands	**Slash Pine**	FIA plots	GIS stands	**Longleaf Pine**	FIA plots	GIS stands	**Pond Pine**	FIA plots	GIS stands
102	**very high**	1	0	**-**	0	0	**-**	0	0	**-**	0	0
201	**high**	12	21	**high**	7	0	**medium**	0	3	**medium**	0	4
202	**med. low**	1	0	**-**	0	0	**-**	0	0	**-**	0	0
401	**high**	19	56	**-**	0	0	**medium**	0	6	**medium**	0	4
402	**medium**	0	2	**-**	0	0	**-**	0	0	**-**	0	0
601	**medium**	5	5	**-**	0	0	**medium**	0	1	**medium**	1	4
602	**very high**	2	3	**medium**	5	0	**high**	1	2	**medium**	0	1
701	**medium**	1	5	**low**	6	0	**low**	0	3	**high**	3	4
801	**-**	0	0	**-**	0	0	**-**	0	0	**very low**	2	0
802	**med. low**	2	18	**low**	5	0	**low**	1	3	**low**	4	7
901	**medium**	4	18	**medium**	5	0	**low**	0	1	**medium**	1	1
902	**med. low**	10	26	**medium**	6	0	**low**	6	16	**low**	9	13
1001	**very high**	2	16	**-**	0	0	**-**	0	0	**-**	0	0
1002	**high**	18	35	**high**	9	0	**high**	1	15	**high**	0	6
1101	**medium**	3	23	**-**	0	0	**low**	10	29	**low**	0	6
1102	**high**	3	8	**-**	0	0	**high**	0	1	**-**	0	0
1103	**high**	45	101	**medium**	1	0	**high**	13	17	**medium**	2	6
1301	**med. low**	9	13	**-**	0	0	**medium**	0	5	**-**	0	0
1302	**med. low**	4	0	**-**	0	0	**medium**	1	0	**-**	0	0
1303	**medium**	6	4	**-**	0	0	**medium**	0	1	**-**	0	0
1304	**med. low**	5	3	**-**	0	0	**-**	0	0	**-**	0	0

1/ Loblolly Pine site index (SI) classes: very high = SI > 85, high = SI 81-84, medium = SI 76-80, med. low = SI < 75
Slash Pine site index (SI) classes: high = SI > 75, medium = SI 70-75, low = SI < 70
Longleaf Pine and Pond Pine site index (SI) classes: high = SI > 67, medium = SI 63-66, low = SI 55-62, very low = SI < 55

Table F.6: Natural Areas, Rare Species and Natural Communities on Camp Lejeune.

Extent of Habitats on Camp Lejeune					Documented Element Occurrences [1/]				
LTP	**LTP acres**	**NC Heritage Program Natural Areas (acres)**	**RCW Cluster Area (acres)**	**RCW Forage Area (acres)**	**Plants**	**Animals [2/]**	**Commu n-ities**	**Total EOs**	**EO Density [3/]**
101	1,911	0	0	0	0	0	0	0	0
102	4,558	831	0	0	0	0	2 – 2	2 – 2	1.2
201	33,41	609	2	408	2 – 2	5 – 2	3 – 2	10 – 6	.8
202	646	77	12	176	0	0	1 – 1	1 – 1	1.3
401	28,56	861	61	900	6 – 5	1 – 1	6 – 3	13 – 9	1.0
402	3,631	0	0	4	0	0	0	0	0
601	34,67	21	0	130	0	0	1 – 1	1 – 1	.6
602	27,43	78	0	268	12 – 8	0	0	12 – 8	1.0
701	44,37	804	5	661	10 - 10	1 – 1	1 – 1	12 – 12	1.0
801	34,13	6,831	3	334	3 – 2	0	7 – 4	10 – 6	.7
802	15,75	941	81	1,996	51 - 25	5 – 4	4 – 3	60 – 32	4.7
901	29,32	26	3	219	3 – 2	1 – 1	0	4 – 3	.6
902	30,84	1,678	502	4,903	112 - 33	16 – 5	15 – 7	143 – 45	7.6
1001	28,59	164	1	40	4 – 4	1 – 1	1 – 1	6 – 6	3.0
1002	70,56	293	95	1,850	37 - 19	7 – 4	7 – 6	51 – 29	2.5
1101	9,728	1,387	490	3,550	52 - 18	9 – 6	7 – 6	68 – 30	8.6
1102	1,562	47	0	0	0	0	1 – 1	1 – 1	1.0
1103	45,42	1,217	272	2,798	24 - 14	12 – 6	10 – 6	46 – 26	2.0
1301	6,035	37	7	161	4 – 4	1 – 1	0	5 – 5	.9
1302	4,462	0	0	26	0	0	0	0	0
1303	1,900	0	0	14	0	0	0	0	0
1304	3,157	88	0	6	1 – 1	2 – 2	1 – 1	4 – 4	1.5
1401	3,645	126	0	0	1 – 1	4 – 4	1 – 1	6 – 6	2.8
1402	9,646	425	0	0	1 – 1	2 – 1	1 – 1	4 – 3	1.2
water[4/]	34,45	-	-	-	32 - 15	12 - 6	8 - 4	52 – 25	-

[1/] Number of documented rare species and natural community Element Occurrences; # of occurrences - # of species
(NC Heritage Program 1999). LTPs with the greatest number of occurrences are highlighted.
[2/] Excludes Red-cockaded Woodpecker element occurrences.
[3/] Number of Element Occurrences per square mile.
[4/] Element occurrences associated with ponds, streams, and the New River.