I would like to thank my mother for supporting me in everything I've ever chosen to do. You have spent countless hours encouraging and mentoring me, and I treasure every minute of it.

I would also like to thank the faculty at the University of Florida's Department of Landscape Architecture for guiding me through this educational journey.
“Habitat fragmentation is the most serious threat to biological diversity and is the primary cause of the present extinction crisis.”

-Wilcox and Murphy
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Chapter One
Project Introduction
Abstract

Over the past 150 years the Longleaf Pine ecosystem has suffered a severe decline through logging, development, agriculture, human population, and fire suppression. This ecosystem once covered the majority of the southeastern states for thousands of years and has now been reduced to small remnant patches that equate to less than 3% of its original extent. The longleaf pine ecosystem supports some of the rarest vegetation and animal species in the United States. It is dire that conservation initiatives be implemented within human population communities through careful and well thought out management planning. Future land development for suburban communities will continue as the need for more human living spaces will be required to meet demands. Preserving what is left of the longleaf pine ecosystems through suburban planning requires mitigating techniques that leaves larger portions of the longleaf pines intact while grouping housing and other structures. Preserving larger portions of development properties for longleaf pine restoration will go a long way in saving the ecosystem from extinction. Given that the remaining 2% of longleaf pines represent critically endangered habitats, efforts must be made to conserve, restore, and manage as much of the remaining longleaf pine lands as possible, including small fragments in developed landscapes.
To revitalize the Longleaf Pine ecosystem in Alachua County's suburban areas while providing fire wise home design.
Goals & Objectives

1 Site Selection

2 Site Planning

3 Design Development

4 Management
Specific criteria were analyzed through GIS. Soils, topography, hydrology, and proximity to intensive urban and agriculture, yielding a lower impact from harmful smoke during needed routine prescribed burning, were analyzed to delineate a site within Alachua County.

Delineating the most important areas for conservation (through site specific analysis of topography, soils, hydrology, and natural opportunities/constraints) and the most suitable areas for development on the chosen site.

Design development such as specific plantings, construction guidelines and land zoning are all important factors for pyric design. Mitigation techniques is imperative throughout the property by incorporating fire resistant homes and other structures, instituting several defensible space processes, installing an adequate, but minimal, roadway, and utilizing underground systems for power lines, cable, telephone, water and waste treatment systems.

Active management plans are imperative for the remaining longleaf pine ecosystems within suburban areas. Continuous management will be implemented with aggressive guidelines ensuring mitigation within all defensible spaces. Initial eradication of native hardwoods and invasive species will be implemented within the longleaf pines conservation areas.
Research
Longleaf Pine Ecosystem & the Role of Fire

The longleaf pine ecosystem at one time expanded over approximately 90 million acres within the Southeastern United States. At present, there is less than two million acres left and still continues to decline – approximately 97 percent of this environmentally important ecosystem has been lost. The longleaf pine ecosystem evolved over thousands of years, for the most part as a single expansive ecosystem, through natural burnings every two to four years from the Carolinas down through Florida and across to Texas. Almost 900 plant species are found in longleaf forests and nowhere else in the world; in some longleaf forests 40 different species can be found in a single square yard. Now, it only exists in broken up patches throughout the Southeastern states, primarily in the coastal plains of the Carolinas, Georgia, Florida, Alabama, Louisiana, and Texas. Land clearing for development and agriculture, logging, other pine species introduced with faster growth and profits, and fire suppression are the leading culprits to the decline of this ecosystem. It is estimated that half of the longleaf pines are located on public lands. It is vital through active management, including prescribed burning, in order to preserve these species-rich systems before they are completely lost.

A mere 150 years ago the Longleaf Pine dominated the landscape of the American Southeast. By 1930, nearly all of the virgin longleaf forests had been felled. Today, only about 2 million acres remain. Longleaf pine ecosystem is one of the most ecologically diverse in the world (rivaling rainforests), and is home to some of the most rare and unique plants and animals on the North American continent.

Florida ecosystems have, over the course of millions of years, evolved adaptations to protect against natural occurrences of fire. Some plant species use fire as a control device, to diminish the amount of fuel such as duff and detritus, while other species use fire as a catalyst to open seedpods that have been lying dormant. The present forest communities have existed in Florida for the past 12,000 years and have relied heavily on the effects of fire. Without the frequent intervention of low-intensity fires the Longleaf Pine ecosystem along with all of its extent species will eventually vanish from existence.
Benefits of fire

- Cost-effective and environmentally friendly alternatives, especially to ecosystems that require routine burning, to mechanical or chemical methods of vegetation control
- Reduce undergrowth that delineates risk of wildfire that can cause property damage
- Frequent burning reduces pest insect density, such as ticks and chiggers.
- Creates more attractive landscapes due to increased flowering and reduces ground litter while improving the quality and esthetics of hiking trails
- Improved habitat for wildlife, especially endemic vegetative and animal species dependent on routine burns
- Environmental education opportunities focusing on restoration and conservation of the Longleaf Pine ecosystem

Effects of Fire Suppression

Active management plans are imperative for the remaining longleaf pine ecosystems within suburban areas. These scattered ecosystems support many plant and animal species that are specifically dependent upon the longleaf pine ecosystems. There is scientific, educational, and aesthetic value in conserving the longleaf pine ecosystems with a goal to restore habitat for at-risk species. Reducing hardwood densities, preventing further invasion of native hardwoods, and removing invasive species will require continual maintenance. The result of an open canopy and frequent fire also promotes the growth of herbaceous plants that animal species within the longleaf pine ecosystems depend on. Prescribed burning is cost-effective and an ecologically proactive measure that can be used to achieve results. Implementing management plan goals helps to enhance in biodiversity and natural community restoration.
Research
Prescribed Fire

Unfortunately, current fire-wise communities typically only burn once preventing the natural balance to be achieved within the longleaf pine ecosystems. Prescribed burning needs to occur on a regular schedule of every one to three years taking into account the growing season (April–early June), which promotes the more showy flowering species and eliminates unwanted fuels.

Fire suppression creates an unhealthy habitat in regards to the endemic vegetative and animal species. The absence of routine prescribed burning allows increased populations of hardwoods (Quercus nigra, Liquidambar styraciflua, Quercus hemisphaerica, Quercus falcata, Myrica cerifera, Vaccinium arboreum, Vaccinium stamineum, slashpines, etc…). Additionally, fire suppression also allows invasive species, and insect pest populations to take over the ecosystem while suppressing newer longleaf pines from germinating.

Routine prescribed burning is a management tool that reduces fuel for wildfire, reduces native hardwood populations, and promotes wire grass seed production, the opening of Longleaf Pine cones while maintaining the ecosystem’s natural balance of endemic vegetative and animal species.

Importantly, animal species like prairie gophers and gopher tortoises (endemic species) will leave the area if fire is suppressed.

http://www.landscape.org/explore/ecosystems/disappearing_landscapes/longleaf_pine/
The two major concerns regarding prescribed burning are firebrands and smoke. Smoke can cause major traffic accidents as well as health hazards. Firebrands are airborne burning materials or embers that are carried upward by a fire and deposited elsewhere. Firebrands are of special concern if Florida because of the tendency of saw palmetto, cabbage palm, and other vegetation to form airborne embers in a fire.

Although smoke and firebrands are a major concern fire bosses are trained to only burn within specific weather parameters that help to mitigate these issues.
The Ranch at Roaring Fork – Carbondale, Colorado

This 420 acre community retains 80% of its property dedicated to open space and the space is prohibited from future development. Biodiversity is unusually high in this community due to the large areas of preservation. Although this development does not manage using fire it is a good example of a community that uses mixed housing as well as retains a high portion of the site in preservation. The development has 77 single family homes and 66 attached condominium houses.

- Mix of single family and multi-family housing
- Education outreach provided by local extension offices
- Priority of protecting native habitats
- Waived traditional curb and gutter in exchange for grassy swales and shallow detention areas
RiverCamps on Crooked Creek

Panama City, FL
1,500 acres and less than 450 homes
2/3 of land in Conservation
Very Sprawled out
Selling point is Privacy. Almost every home is on 1 acre lot.
Good example of Architecture with FL character.
Developed from the beginning with wildland fire safety in mind:
  - Wildland fuels will be aggressively thinned
  - Underground utilities
  - Fire hydrants every 1,000 feet
  - Home sites designed with protective zone of defensible space
  - Fire resistant construction materials

http://firewise.org/
Case Studies
Lakewood – Bradford County, FL

In May of 2002, in the small community of Lakewood a 40-acre muck fire was naturally started on its southern border. The fire had smoldered for months before breaking out on the surface. Eventually costing the city and state hundreds of thousands of dollars. Once the residents of Lakewood organized and tasks were accomplished, a sense of community never before felt by the residents had developed.

Issues that contributed to Lakewood's very high wildfire hazard score:

- No pressurized or non-pressurized water system available
- Thick, highly flammable vegetation on most lots and on three sides of development
- One entrance/exit for the community
- Too narrow roads without shoulders, dead ends and small cul-de-sacs
- No defensible space around structures
- Structures have wooden siding and roofs with heavy accumulations of vegetative debris
- Unmanaged adjacent areas of forest or wildlands with high occurrences of wildfire
Summary:

During development planning it is important to devise plans that will allow for safe routine prescribed burning. Further, management planning through developing better techniques to control smoke hazards need to be implemented within intense urban areas. Any future development planning should include not only defensible space, but also locating structures within safe areas that have a reduced smoke hazard.

Smoke health hazards are of great concern during prescribed burning, especially within intensive urban and agricultural areas. Urban areas are a concern due to close proximity to hospitals, nursing homes, daycares, schools, and public roadways. Smoke hazards can cause or exacerbate existing respiratory conditions. In addition, smoke can cause automobile accidents on public highway systems when prescribed burning or wildfires. In respect to agriculture, smoke can cause damage crops coming into season. However, prescribed burning is an effective and cost effective management tool used in preventing wildfire and maintaining a healthy balance within pyric ecosystems.
Chapter Three
Soils are deep, acid, moderately well to excessively drained, and mostly coarse textured throughout. Representative soils are Candler, Tavares, etc.

Topography is nearly level to strongly sloping lands on rolling hills.

Hydrology of the longleaf pine community prefers dry to moderately wet conditions as water tends to move rapidly through the soils.

Proximity to intensive urban and agricultural areas
Hospitals, nursing homes, daycares, schools, and major roadways need to be at least 1 mile away from control burn areas due to smoke.
Synthesis:

Specific criteria were analyzed through GIS suitability modeling to delineate a site within Alachua County.

Further analysis revealed that the narrowed site was once dominated by longleaf pine in the recent past.
Existing Conditions:
This site is broken up into 12 parcels which are all privately owned. There are currently 9 mobile homes on the 241.5 acre site.
Site Mitigation

Presently, the density of the 241.5 acre site has overgrown with herbaceous hardwoods (Quercus nigra, Liquidambar styraciflua, Magnolia virginiana, Quercus hemisphaerica, Quercus falcata, Myrica cerifera, Vaccinium arboreum, Vaccinium stamineum, etc...) and are mixed in with sandhill pine species (Pteridium aquilinum, Aristida stricta, Yucca aloifolia, Pinus palustris, Quercus laevis, Pityopsis graminifolia, etc...).

Prior to any construction it is necessary to mitigate the site with respect to all four zones in creating effective defensible space that delineate fire hazard. Within the first zone, all hardwoods will be removed regardless of their density. In zone two, a two to three selected hardwoods, specifically Quercus hemisphaerica and Quercus nigra, will be preserved. In zone three, mitigation will be slightly less stringent in the number of hardwoods preserved, again specially Quercus hemisphaerica and Quercus nigra. In zone four, removal of hardwoods will be the least stringent compared to the first three zones giving way to preserving multiple hardwood species with consideration of their density. All four zones’ hardwoods will be given attention in pruning and thinning with a ground clearance of 10 feet from the lowest limbs emphasizing fuel ladder management.
Site Planning

Site Planning is important for delineating the most important areas for conservation (through site specific analysis of topography, soils, hydrology, and natural opportunities/constraints) and the most suitable areas for development on the chosen site.

- The synthesized analyses reveals some clear areas of suitability on the site.
- Steep slopes on the northwestern portion of the site prove to be hazardous to structures during prescribed burning as fire tends to move quickly uphill.
- The existing roadway to the northeast of the site (marked in red) provides the perfect opportunity for protection from fire for development directly to the south.
Site Synthesis:
Design Development

Design development such as specific plantings, construction guidelines and land zoning are all important factors for pyric design. Mitigation techniques is imperative throughout the property by incorporating fire resistant homes and other structures, instituting several defensible space processes, installing an adequate, but minimal, roadway, and utilizing underground systems for power lines, cable, telephone, water and waste treatment systems.

Design Guidelines for Roadways:

- Layout should include at least 2 access points, preferrably at opposite sides of site for safe evacuation during emergencies.
- Minimum 16' roadway width.
- All roadways double as fire breaks.
- Minimum 15' canopy break.
- Roadways composed of all-weather hard surface material to accommodate emergency vehicles.
≥ 15’ Break between Mature Canopies
Design Guidelines for Landscape

Vegetative fuel management is the key in lowering fire hazard to homes and other structures. Fuel management protects the landscape from fire and ignition to structures. Firewise has devised a 4 zone plan, as opposed to the more common 2 zoned concept that will further protect homes and structures from fire. The 4 zone plan will be utilized in this project for optimum safety measures.

**Zone 1:** 30' around structures. The defensible space is the most critical zone concentrating in highly reduced fuel capacity.
- Plants should be carefully spaced, low-growing and free of resins, oils and waxes that burn easily.
- Space conifer trees 30 feet between crowns. Trim back trees that overhang the house.
- Create a ‘fire-free’ area within 5’ of structure, using non-flammable landscaping materials and/or high moisture content annuals and perennials.

**Zone 2:** The reduced fuel zone is 30–60' away from structures. The concept of this zone is to break up the continuous fuel areas by thinning and grouping small to mid-sized vegetation (such as shrubs) making it less flammable.
- Leave 30 feet between clusters of two to three trees, or 20 feet between individual trees.
- Mix deciduous and coniferous trees.
- Create ‘fuel breaks’, like driveways, gravel walkways and lawns.

**Zone 3:** 60–100' The idea in this space is ensuring that vegetation is separated vertically and horizontally by removing selected vegetation and/or trimming tree limbs away from lower vegetation preventing fuel ladders.

**Zone 4:** Surrounds the first three zones and is 100 feet and beyond around the structure. This is the zone that is managed by prescribed fire and contains the majority of native longleaf pine plant materials.
Design Guidelines for Landscape

The suggested plants below reflect the needs of each zone.

Zones of Defensible Space

Plants

Zone One
- Zamia pumila
- Vaccinium arboreum
- Prunus sp.
- Viburnum sp.
- Cocoloba uvifera
- Persea borbonia
- Chionanthus virginicus
- Nerium Oleander
- Agave sp.

Zone Two
- Rhododendron sp.
- Callicarpa americana
- Cycas revoluta
- Aloe vera
- Acer rubrum
- Ulmus alata
- Diospyros virginiana
- Magnolia sp.
- Quercus nigra

Zone Three
- Cornus florida
- Cercis canadensis
- Prunus Serotina
- Celtis Laevigata
- Acacia farnesiana
- Conocarpus erectus
- Camellia sp.
- Rhododendron sp.

Zone Four
- Pinus palustris
- Quercus laevis
- Quercus incana
- Liatris tenuifolia
- Pteridium aquilinum
- Cassia spp.
- Sorghastrum nutans
- Panicum spp.
- Aristida stricta
- Andropogon virginicus
Implementing fire resistant materials to homes and conservatively implementing low-to-ground vegetation during designing, building, siting, and continual maintenance diminishes loss from fire.

**Roofing:**
Roofing material with a Class A, B or C rating is fire resistant and will help keep flames from spreading. Roofing materials such as composition shingle, metal, clay, or cement tile are all fire resistant.

**Eaves, Fascias, Soffits and Vents:**
‘Box’ eaves, fascias, soffits and vents, or enclose them with metal screens. Vent openings should be covered with 1/8” metal screen.

**Exterior Walls:**
Cement, plaster, stucco, and masonry (concrete, stone, brick or block) are all fire-resistant materials for exterior walls.

**Windows:**
Double-pane glass can help reduce the risk of fracture or collapse during an extreme fire. Tempered glass is the most effective. For skylights, glass is a better choice than plastic or fiberglass as these materials tend to melt.

**Fences** should be constructed of non-combustible materials like metal.
Chapter Four
Concept Development:

The findings gathered in the research, analysis, and guideline phases of this project were all utilized in the creation of program and a conceptual site plan.

The 3 trailheads are the perfect opportunity for educational signage. All signage should be composed of non-combustible materials. Sign shall include:

- Locational map
- Information about the ecosystem and the need for fire
- Information about the most recent prescribed burns
- Information about future prescribed burns
- Fun facts about the animals and insects within the ecosystem
Concept Diagram:

- Trailhead Opportunities
- Fire Managed Area
- Community Recreation Area
- Fire Break Opportunity
- Mixed Single Family & Attached Single Family Townhomes
• Mixing single family and attached single family housing decreases suburban sprawl
• 74 Housing Units on 1/2 acre – 3/4 acre lots
• Design retains 71% of site for preservation & proper maintenance
• A community recreation area provides residents with amenities to promote a sense of community such as tennis courts a swimming pool and a large picnic pavilion for small gatherings.
• Meandering trails provide 1.5 miles of hiking through the longleaf pine preservation area and the northern portion of the site.
• Two access points of the development provide multiple opportunities for safe entry and exit in case of emergency.
• Open green spaces throughout the development allow for park-like opportunities such as picnics and sports.
Site Plan:

- Community Recreation Area
- Trailhead Opportunities
- Open Green Spaces
- Single Family Homes
- Attached Single Family Townhomes
Active management plans are imperative for the remaining longleaf pine ecosystems within suburban areas. Continuous management will be implemented with aggressive guidelines ensuring mitigation within all defensible spaces. Initial eradication of native hardwoods and invasive species will be implemented within the longleaf pines conservation areas.

1) Existing utility corridor acts as a fire break.
2) No combustible materials within the burn zone.
3) Burn edge @ least 100’ from all structures.

Clustered housing is the most ideal way to maximize the preservation of longleaf pine and minimizes the amount of zoning required. Clustering the housing between the burn area and road allows for more control of fire and smoke during prescribed burning. Prescribed burning should occur once every 1-3 years during the growing season.
Management Diagram

The suggested management below reflect the needs of each zone.

Zone Four
This area should be maintained using prescribed fire on an annual basis during the growing season (April - early June). The overall concept within this defensible space is to impede fire, lower the intensity of fire, and keep fire close to the ground.

Zone Three
Maintain this area by thinning, pruning, and grouping smaller vegetation making them less vulnerable to ignition.

Zone Two
Prune trees up six to ten feet from the ground. Remove dead vegetation from under trees. Water plants, trees and mulch regularly.

Zone One
The lawn in this area should be mowed regularly. Prune trees up six to ten feet from the ground. Remove dead vegetation from under any decks and within 10 feet of house. Water plants, trees and mulch regularly.
Community Entrance
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