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Bo4. Integrated Land Management

Bo4.1 Introduction

B04.1.1 Restorative & Resilient Base Restoration

Tyndall Air Force Base (AFB) is dedicated to achieving mission readiness, improved base resilience, and enhanced quality of life through optimized land management practices. These integrated land management design guidelines advance the creation of a base landscape that reflects the restorative partnership between the U.S. Air Force (USAF) and the U.S. Fish and Wildlife Service (USFWS) to advance best management practices employed within Tyndall AFB's *Integrated Natural Resources Management Plan* (INRMP).

These guidelines provide a framework of best practices and performance goals to create sustainable outcomes rather than prescribe site-specific solutions. The designer/contractor will use these guidelines as applicable to their specific project. This effort requires collaboration with Tyndall AFB Natural Resources staff for plant species selection and collaboration with base plan reviewers in incorporating landscapes that perform measurable outcomes in environmental, social, and economic goals. Performance landscapes can provide benefits such as flood protection, maintenance reductions, and mental wellbeing.

B04.1.2 Goals

Integrated land management practices will be employed to:

- Restore and maintain natural base hydrology
- Align with current efforts in native Longleaf Pine forest restoration
- Improve walkability
- Enhance base character and quality of life
- Minimize environmental impacts to Tyndall AFB's vital coastal ecosystem
- Attract and retain base personnel and staff by making a positive first impression of a sustainable, coastal installation
- Improve mental and physical health and wellbeing
- Design for greater connection to nature which has been proven in reduce stress levels and a decrease in suicide rates
- Reduce infrastructure costs by using grey stormwater infrastructure.
- Implement Low-Impact Development (LID) principles

B04.1.3 Objectives

If adhered to properly, an integrated land management approach to overall base construction and maintenance operations will help Tyndall AFB meet numerous key objectives:

- Improve stormwater management and soil health for reduced maintenance and capital costs
- Reduce heat island effect for walkability and energy conservation by increased shade from tree canopy
- Increase biodiversity and biomass through use of native plants to align with Tyndall AFB Natural Resources Section efforts

- Develop a plant palette that maximizes greater wind resistance and natural stormwater absorption
- Reduce the use of harmful chemicals, pesticides, and herbicides
- Reduce landscape maintenance costs
- Improve air quality
- Minimize tree failures by placing trees in masses, designed as a system with native groundcover vegetation, rather than singular tree installations
- Maximize the use of native groundcover vegetation rather than turf
- Maximize tree rooting strategies to minimize occurrence of uprooting during high winds



Promoting a native landscape contributes to the base's resiliency

Bo4.2 Planning Approach

B04.2.1 Installation-Wide Integrated Land Management

In applying an integrated land management approach one must consider the following as parts of an overall functioning system:

- Soils
- Water and stormwater management
- Vegetation
- Materials and hardscape
- Human health and wellbeing

These elements must be balanced across the planning, design, construction, procurement, and operations/maintenance phases of implementation. As shown on Exhibit B04-1, these parts influence and impact the installation-wide ecosystems, the planning and maintenance for the different Landscape Zones, and the design and implementation of projects on individual construction sites throughout Tyndall AFB. Most importantly through proper application of this approach, integrated land management will offer Tyndall AFB multiple lines of nature-based storm defense through creation of a Stormwater Treatment Train.

B04.2.2 Installation-Wide Ecosystem Categories

At a installation-wide scale, Tyndall AFB is categorized into four broad-based ecosystem categories (see Exhibit B04-1) including dry forest, wet forest, wetlands, and coastal. The restoration of historical ecosystems or natural landscapes provides multiple lines of defense against the effects of storm surge and high winds brought by hurricanes, increasing base resilience and mission readiness. Altogether these lines of defense create a Stormwater Treatment Train, that will help mitigate the impacts of future storm events.

B04.2.3 Landscape Zones

Employed from the building scale to the base scale, the base is divided into five landscape zones (see Exhibit B04-1). Each zone is defined by a number of factors including land use, maintenance intensity, funding sources, and their general visual characteristics. When integrated within building sites, open space, and roadways, these community zones can reduce maintenance while providing synchronized co-benefits for the base and mission readiness.

B04.2.4 Additional Resources

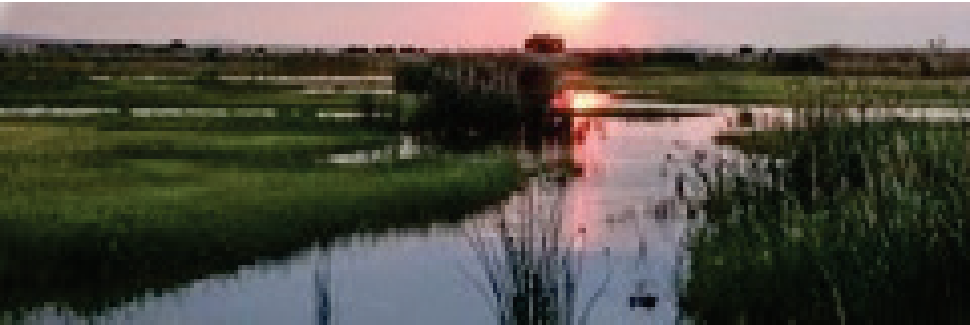
In implementing integrated land management on Tyndall AFB, refer to the following sections for further guidance:

- **C01, Site Design**, for guidelines on layout and circulation integration
- **C04, Stormwater**, for guidelines on design and siting criteria of stormwater management elements
- **C06, Landscape**, for guidelines on plant selection and design
- Tyndall AFB Coastal Resiliency Program
- Tyndall AFB INRMP

Exhibit B04-1. Integrated Land Management Approach



B04.3 Components of an Integrated Land Management Approach



B04.3.1 General Soils Planning Criteria

Soils are the foundation to a healthy, functioning integrated land management approach. Properly managed, they support healthy plants, biological communities, and water quality. They are also critical to stormwater management practices by supporting proper water storage, filtration, and infiltration. Restoring damaged soils, protecting healthy soils, and limiting soil disturbance during construction also provides a number of benefits including reduced design complexities, decreased construction costs, and ease of maintenance. The following are best soil management practices recommended for Tyndall AFB.

- Do not compact planting soils more than 85%
- Stabilize soils against soil erosion during and after construction
- Use planting soils that contain 1% to 5% of organic matter content
- Use organic soil amendments such as mature stable compost from local and renewable sources
- Use compost that has a carbon-to-nitrogen ratio lower than 25:1, pollutant concentrations below U.S. Environmental Protection Agency (EPA) regulations, and no viable weed seeds or invasive plant propagules
- Balance quantities of cut-and-fill used in site grading and reuse existing soils instead of importing soils
- Protect stockpiled soil by seeding or covering
- Restore compacted soil to a minimum depth of 12 inches by amending it with organic matter, tilling or ripping to reduce compaction, and restoring nutrient profile of the soil

B04.3.2 General Water & Stormwater Management Planning Criteria

Restoring natural hydrology patterns, implementing water reuse irrigation systems, and protecting and preserving natural water features is critical for advancing stormwater management strategies within an integrated land management approach. Strategies to manage onsite stormwater are critical. These strategies will, promote onsite infiltration, increase evapotranspiration, lower grey infrastructure capital costs, reduce precipitation runoff volumes, and capture pollutant discharges. The following are best stormwater management practices recommended for Tyndall AFB:

- Reduce impervious surfaces and implement pervious pavements in parking spots, pedestrian circulation routes, or in low traffic areas
- Where pervious pavements cannot be used, drain impervious surfaces to vegetated areas that use native species
- Minimize turf areas to reduce irrigation demand
- Do not use turf in Maintained and Managed zones where nature-based infrastructure is employed
- Reduce pesticide and herbicide use in land clearing and maintenance activities to protect natural waterways and water bodies, while protecting pollinator habitats vital to Florida’s agricultural industry
- Use onsite infiltration strategies, increase evapotranspiration, and reduce precipitation runoff volumes and pollutant discharges by incorporating nature-based infrastructure

B04.3.3 General Vegetation Planning Criteria

An integrated land management approach considers trees, shrubs, and herbaceous perennials as an ecological system that works together. The use of native plants provides ecosystem benefits, such as pollutant interception and removal, better water management, and the provision of habitat for vital regional pollinator species. Preserving and protecting existing natural vegetated systems with thoughtful building siting and site design will also decrease construction and maintenance costs. The following are best vegetative practices recommended for Tyndall AFB:

- Plan and design using common native plant assemblages incorporating trees, shrubs, groundcovers, and other plantings listed in **Section C05, Landscape**
- Minimize turf use in the Manicured Zone and use low groundcovers or native grasses over turf
- Coordinate tree plantings with light pole planning and siting to minimize tree canopy interference with street and pedestrian lighting for maximum shade and walkability
- Coordinate tree plantings with utility planning and siting to maximize tree canopy on the base, while protecting utility infrastructure against root interference and hurricane damage from downed trees
- Eliminate turf from streambanks and wetland edges



B04.3.4 General Materials & Hardscape Planning Criteria

An integrated land management approach uses material resources that are regionally sourced. Local materials reflect the northern Florida context, while their use supports the local economy. In addition, to reduce energy costs and promote walkability materials must promote stormwater permeability and exhibit a low percentage of solar reflectance for maintaining cooler surfaces. Landscape design around hardscape and along corridors should also incorporate the tree canopy to maximize shade and reduce the heat island effect. The following are material and hardscape planning best practices recommended for Tyndall AFB:

- Maximize hardscape materials with a minimum Solar Reflective Index of 29 to reduce energy demand and increase walkability
- Use materials and products that have recycled content or seek opportunities to reuse or repurpose materials slated for disposal



B04.3.5 General Health & Wellbeing Planning Criteria

The retention of personnel and attraction of recruits to Tyndall AFB is vital to the sustainability of mission and resilience in executing mission. Planning and designing the base using an integrated land management approach fosters a greater connection to nature and its natural processes which has been linked to stress reduction, healthier lifestyles, and reduced anxiety, depression, and suicide rates. To help accomplish this, the following health and wellbeing planning practices are recommended for Tyndall AFB:

- Plan and design outdoor spaces to promote social interaction with favorable views of nature, shaded, and conducive to relaxing activity
- Locate public spaces away from mechanical systems, traffic noise, and unsightly views when possible
- Use plant species that provide varying textures, fragrance, and color in public spaces

Bo4.4 Categorization of Ecosystems

B04.4.1 Alignment to the Tyndall AFB Integrated Natural Resources Management Plan

Tyndall AFB is in a unique position to align best management practices in the INRMP and apply them across USAF building sites, corridors, and open space. These best practices mirror the implementation goals in the design and maintenance of performance landscapes, which rely on natural assemblages of native plants that must be applied within built environments.

Native plant communities are assemblages of plant species whose composition are typical of indigenous plant communities in an Ecoregion. A plant palette has been developed in close coordination with Tyndall Natural Resources personnel to align with mission and safety specific requirements which are adapted to Tyndall AFB Florida Natural Area Inventory (FNAI) Plant Communities assemblages.

The 13 major natural resources identified by FNAI are categorized into Dry Forest, Wet Forest, Wetlands, and Coastal. This will guide all future development at Tyndall AFB when identifying native plant assemblages to align with the INRMP. The full Tyndall AFB Master Plant List palettes draw from the following ecosystem categories are appropriate for use on the base.

Dry Forest

Corridors and open space with soils and hydrology conditions allowing infiltration of overland water flows within 72 hours or less. Roadway corridors and parking areas must balance elements of aesthetics, safety, site disturbances, and ecology that use desirable native vegetation within regularly maintained areas of the base. These areas are considered the Urban Forest. Areas of the Urban Forest that have an herbaceous groundcover but do not include tree canopy are Groundcover Dominant.

Dry forests use native plant assemblages found in FNAI Plant Communities, such as Sandhill-Longleaf Pine Forest, Mixed Hardwood-Coniferous, Upland Hardwood Forest, and Scrubby Flatwoods.

Wet Forest

Wet forest is a diverse category that includes wet and mesic flatwoods and wet prairies and can include a diverse herbaceous understory with little or no midstory shrub component. Wet forests also include open space with soils and hydrology that exhibit standing water within the subsurface or at the surface with a maximum depth of 2 feet, and do not infiltrate overland water flows within 72 hours. Wet forests are also found in open space with high groundwater conditions.

These areas maximize base-scale amenity strategies in stormwater design by incorporating a balance of moisture tolerant trees, shrubs, and groundcover species.

Wetlands

Open space with soils and hydrology influenced by high groundwater depths and/or standing water within the subsurface or at the surface greater than 2 feet deep, and do not infiltrate overland water flows within 72 hours.

Wetland areas incorporated within Maintained zones must include base-scale amenity strategies within open areas for managing stormwater with vegetated littoral zones where water depths or other conditions limits tree canopy installations to water edges. Wetlands use native plant assemblages found FNAI Plant Communities such as Mixed Scrub-Shrub Wetland, Depression Marsh, and Natural Lakes and Ponds.

Coastal

Coastal areas are open space within the Managed Zone that comprise tidally influenced lands near the Gulf of Mexico and the East Bay.

These areas contain native plant assemblages conducive only to the coastal environment at Tyndall AFB and contain FNAI Plant Communities such as Salt Marsh, Sand Dunes, Coastal Dune Lakes, and Tidal Flats.



Tyndall AFB’s coastal areas contain native plant assemblages conducive only to the coastal environment at the base

Exhibit B04-2. Land Cover

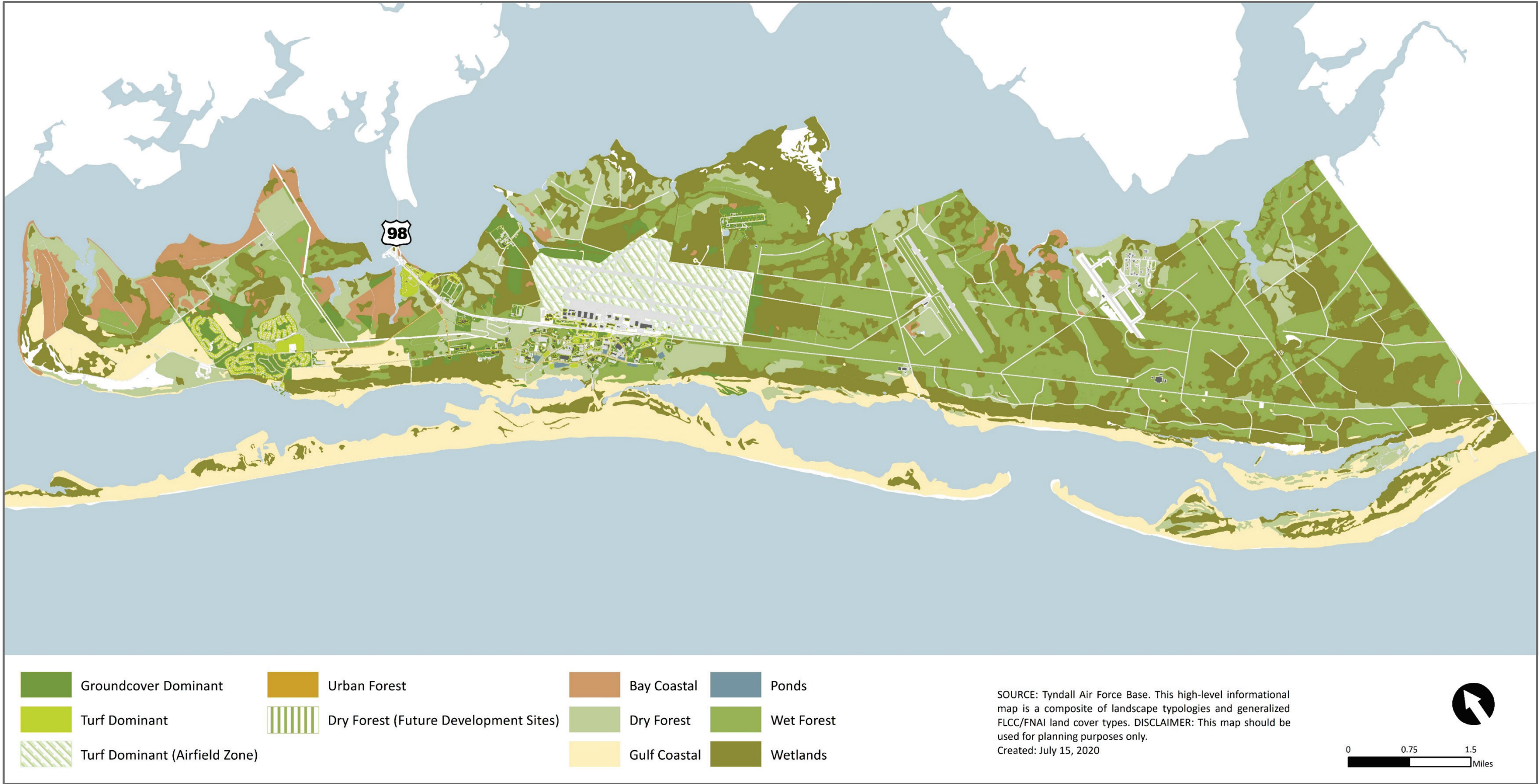
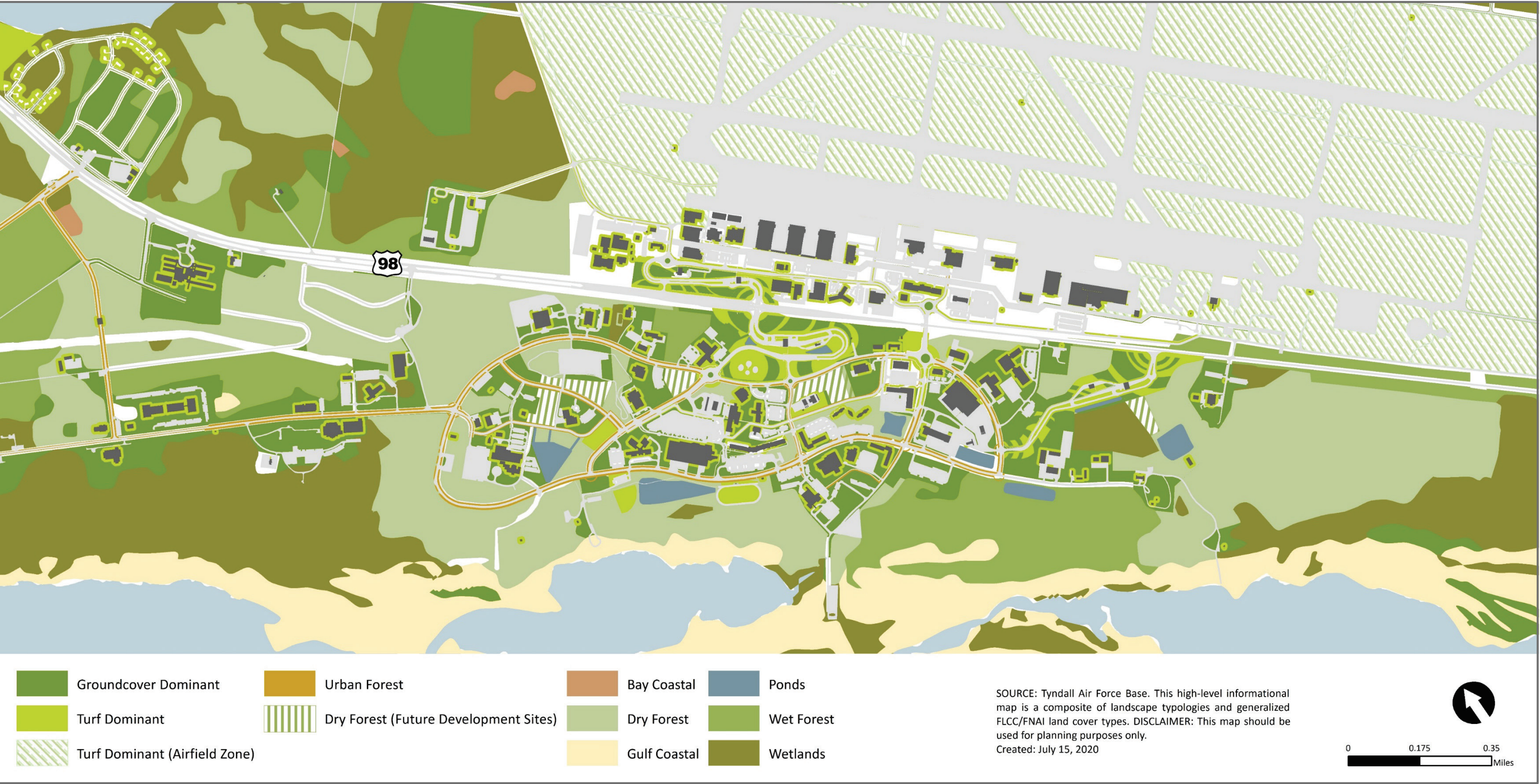


Exhibit B04-3. Land Cover – Support/Flightline



Bo4.5 Landscape Community Zones

B04.5.1 Landscape Zones with USAF Building Sites

Tyndall AFB is divided into five landscape zones that have specific characteristics and aesthetics based on land use, maintenance intensity, funding sources, and their general visual characteristics. This translates into different and specific landscape requirements across the base.

Manicured Zone

The Manicured Zone is the most highly maintained landscape on Base and is located within building perimeters and within entrance points around the base. This zone must balance mission safety and clearance antiterrorism (AT) standards with landscape performance and aesthetics. The AT zone is a subzone of the Manicured Zone and is located adjacent to buildings (a minimum of 20 feet wide). Landscape in this zone will have vegetation that meets the AT regulations. Vegetation in the other areas of the Manicured Zone must be drought-resistant and contain native trees for shade and ornamental grasses and native shrubs for color and variety. The different characteristics for this zone will need to be implemented in the Flightline and Support Districts because of their different mission requirements.

Maintained Zone

The Maintained Zone comprises low native herbaceous groundcover plant material, along with trees and shrubs, occurring near buildings such as parking, common public open space, and corridors. Turf area must be minimized or eliminated within the Maintained Zones to reduce maintenance costs, labor, and complexities and to exhibit a Florida panhandle appearance. Nature-based infrastructure such as vegetated stormwater basin and vegetated swales are included in this zone.

Managed Zone

The Managed Zone encompasses all perimeter areas upland of the peninsula coastline, as well as large open areas in between facilities on the base. This zone includes areas of mesic/wet flatwoods, wet prairie, freshwater wetlands, and inland ponds and lakes. According to the INRMP, areas of this zone include work to transform Slash Pine areas into native Longleaf Pine plantations. This effort has expanded in size and scope due to the damage from Hurricane Michael. Installation-wide landscape will first and foremost aim to restore itself to a condition in which it can sustain the demands of nature and society.

Airfield Zone

This zone includes the runways on the Flightline District and the natural areas between the runways and areas surrounding the perimeter extending to the Pine Forest. The work in this area includes repair to the surface that is disturbed by installation of utilities or for stormwater areas. This area also includes the Flightline. Refer to **Section C06, Landscape**, for design guidance within the Airfield Zone to meet mission safety and clearance standards for vegetation.

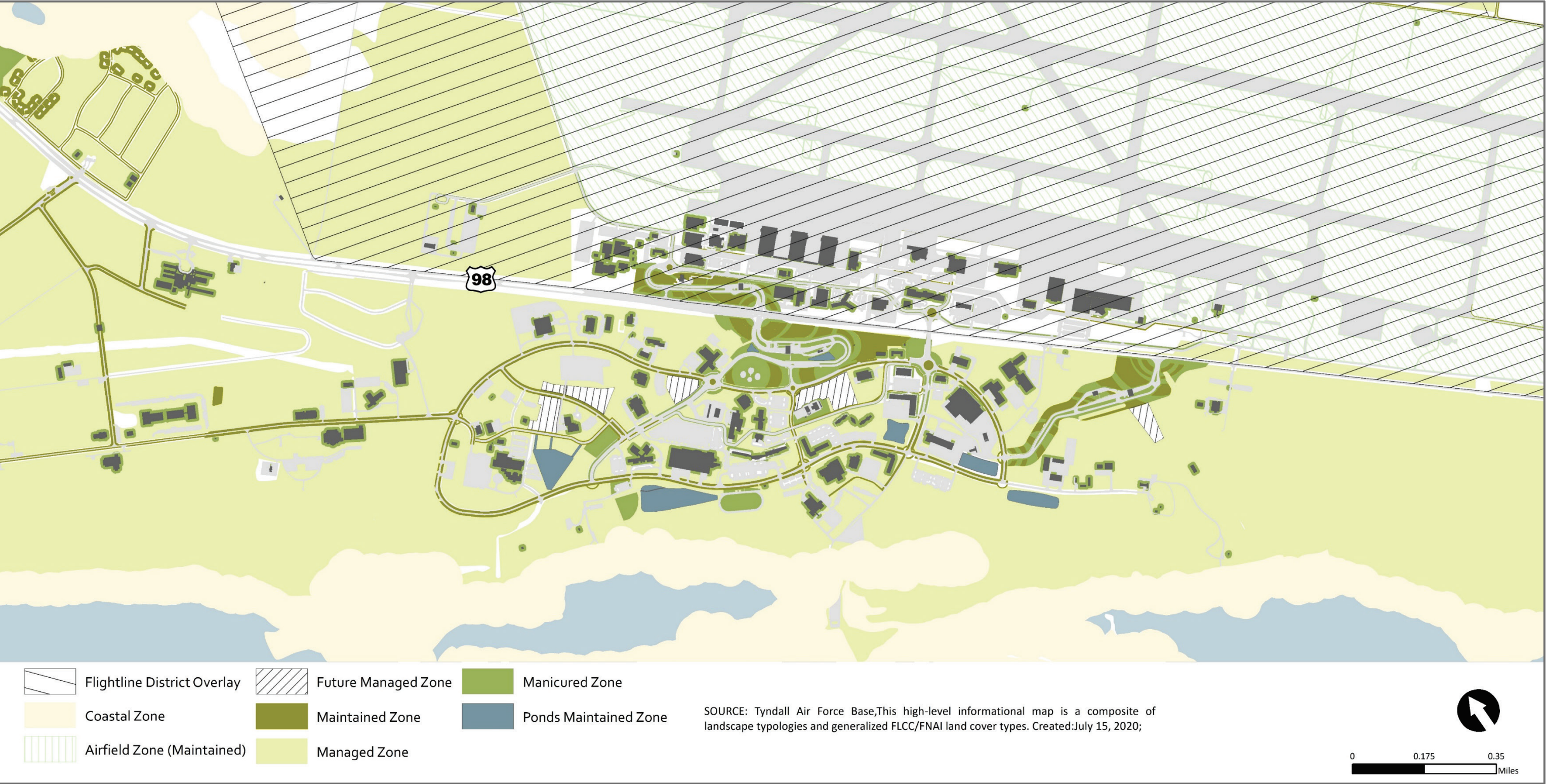
Coastal Zone

This zone encompasses all areas from the ocean shoreline back to the second line of defense, including beaches, coastal dunes, coastal wetlands, salt marshes, estuaries, coastal dune lakes, and coastal upland. Any work or maintenance proposed in this zone is part of the INRMP or Coastal and Marine Construction Guidelines contained in the IFS *Design Intent: Coastal Resiliency* appendix.



Aerial view of Tyndall AFB as seen above U.S. Highway 98

Exhibit B04-4. Landscape Management Strategy



Bo4.6 Integrated Land Management Framework

B04.6.1 Integrated Land Management Application from the Building Site to the Coast

An integrated land management approach requires a balance of healthy soils, natural stormwater management, use of native vegetation, incorporation of locally sourced materials and hardscape, and site design that fosters health and wellbeing.

The "treatment train" (as shown on Exhibit B04-5) uses a systems-based design approach that plans for stormwater management in the selection and placement of vegetation, a thorough understanding of existing conditions such as soil and existing vegetation, site design which limits pervious surfaces and incorporates human comfort and scale, plans and designs for the human senses, and building siting that maximizes natural hydrology patterns. Soil contamination must be understood early in the planning process to plan and design for a treatment train approach as groundwater resources, and adjacent water bodies and waterways can be significantly impacted. For example, nature-based infrastructure must be considered in mitigation of contaminated soils through the use of constructed wetlands.

When incorporated, this approach reduces:

- Traditional stormwater capital and system maintenance costs
- Flooding and building damage resulting from high winds
- Establishes a more self-sustaining landscape for lower maintenance costs

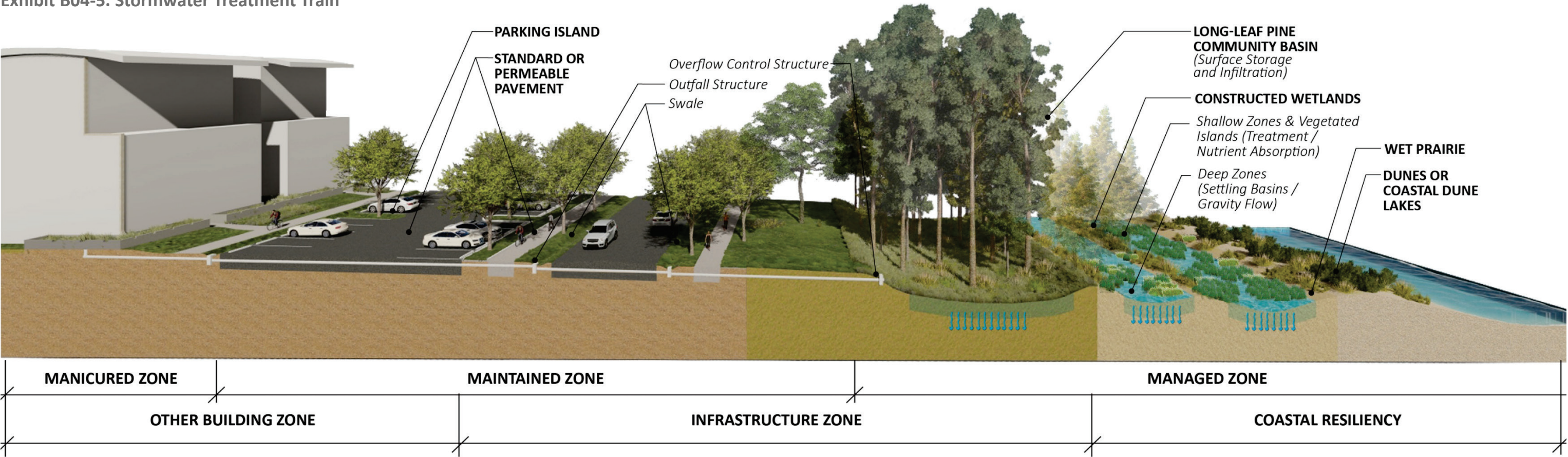
Planning and design must replicate natural hydrologic conditions and manage precipitation onsite by meeting or exceeding the requirements for low-impact development as outlined in EPA's *Technical Guidance on Implementing the Stormwater Runoff Requirements for Federal Projects* (under Section 438), as well as Northwest Florida Water Management District's *St. Andrew Bay Watershed Surface Water Improvement and Management Plan*.

Sites must be restored and/or designed to retain a site's predevelopment hydrology by employing techniques that filter, infiltrate, store, and evaporate stormwater at or near its source in a natural way vs. conventional "pipes and pond" infrastructure utilizing pipes, storm drains, curbs, and gutters which distribute stormwater to one centralized point elsewhere or within adjacent water bodies and waterways.

Promote onsite infiltration, increase evapotranspiration, and reduce precipitation runoff volumes and pollutant discharges with the following strategies:

- Use bioswales, constructed wetlands, riparian buffers, or simple shallow depressions to intercept runoff
- Improve water retention of soils through by adding 1% to 5% organic matter
- Incorporate pervious pavement in parking areas, plazas, and large expanses of pavement with low traffic loads
- Drain impervious surfaces into onsite landscape areas
- Rehabilitate lost or degraded stream channels, wetlands, and associated native plant communities
- Protect riparian and shoreline buffers where required by law and/or where feasible exceed requirements

Exhibit B04-5. Stormwater Treatment Train



B04.6.2 Bridging the INRMP’s Best Management Practices within the Support District for Greater Resilience along the Gulf of Mexico

Employing a nature-based infrastructure strategy across the base produces multiple lines of natural defense against high winds and tidal surge typically experienced during hurricanes.

First Line of Defense: Dunes

Within the Coastal Zones, dunes are act as wave attenuators, slowing the initial force of tidal surge as it reaches land.

Second Line of Defense: Wetlands

Coastal dune lakes and wet prairies act as sponges to absorb waters brought by surge and provide further wave attenuation as tidal surge moves inland.

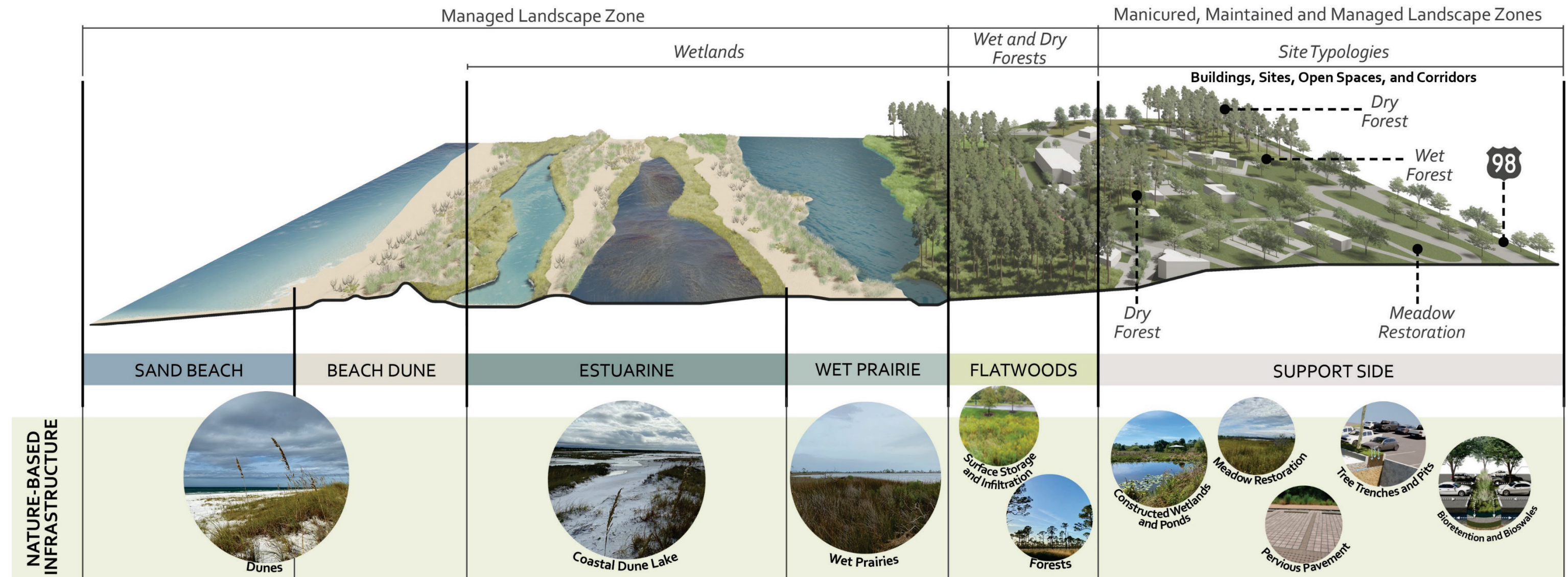
Third Line of Defense: Longleaf Pine Forests

Forests provide not only further wave attenuation during strong hurricanes but provide a continuous canopy of wind protection which slows and obstructs projectiles carried from high winds.

Inland Defenses: Urban Forests

Within the Support District areas of dry and wet forest and wet (retention) ponds (refer to **Section C04, Stormwater** for wet ponds description,) provide further protection for installation buildings and structures against wind damage and overland flooding resulting from increased storm events. Maximizing nature-based infrastructure elements within buildings, sites, corridors, and open space within the Support District provides greater absorption and filtration of stormwater for smaller storm events, freeing capacities within the stormwater system for larger storm events.

Exhibit B04-6. Best Management Practices in the Support District



B04.6.3 Bridging INRMP’s Best Management Practices within the Flightline District for Greater Resilience along the Back Bay

Continuing the strategy of implementing multiple lines of defense within the Back Bay includes a greater focus on rising waters from surge and higher winds.

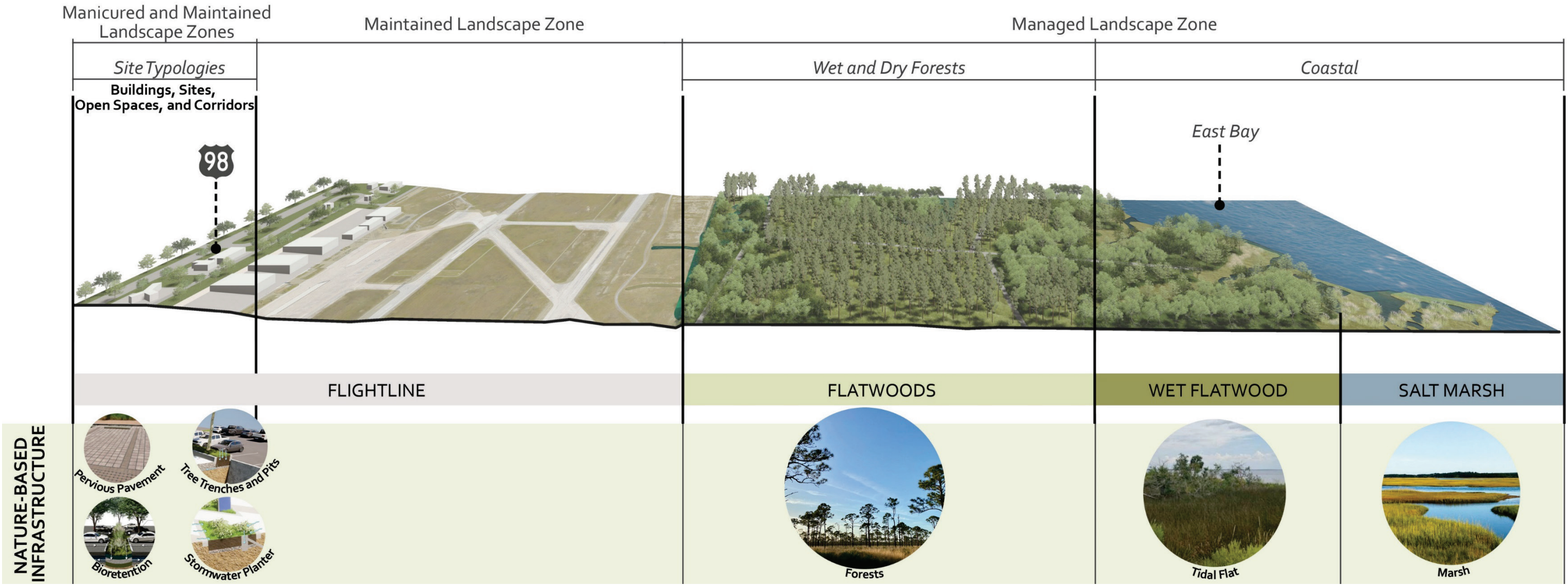
First Line of Defense: Marshes and Wet Forests

As waters swell within the Back Bay, salt marshes and the wet forest absorb tidal surges and act as a natural water filter as tides subside.

Inland Defenses: Urban Forests

Much like the maximizing nature-based infrastructure elements within buildings, sites, corridors, and open space within the Support District, urban forests provide greater absorption and filtration of stormwater for smaller storm events, freeing capacities within the Flightline District’s stormwater system for larger storm events.

Exhibit B04-7. INRMP Best Management Practices in the Flightline District



Bo4.7 Benefits & Advantages

B04.7.1 Native Landscape Approach Benefits

Using an integrated land management approach to revegetate Tyndall AFB achieve the following benefits:

Approved Native Plant Palette Vegetation

- Maximizes wind resistance and natural stormwater absorption
- Reduces use of harmful chemicals, pesticides, and herbicides

Native Longleaf Pine Forest Canopy

- Minimizes tree failures when trees are placed in masses with natural groundcover vegetation
- Increases shade, resulting in reduced temperature and lower energy costs at base assets and facilities
- Improves wind and coastal surge resilience during hurricanes

Native Longleaf Pine Forest Understory

- Reduces maintenance costs, labor, and complexities
- Improves soil quality and biomass supports Tyndall AFB Natural Resources Section forest ecosystem restoration efforts
- Reduces grey infrastructure costs and maintenance from natural stormwater filtration and absorption
- Supports local pollinator habitats vital to Florida’s agriculture industry

Exhibit B04-8. Integrated Land Management Sunny Day Benefits



Stormwater & Groundwater Benefits

- Restored native herbaceous groundcover provides large expanses of stormwater detention and infiltration
- Designed to infiltrate within 48-72 hours
- Stormwater infiltration replenishes fresh groundwater resources, critical to the survival of the forest on Tyndall AFB
- Stormwater detention and infiltration minimizes the intrusion of brackish saltwater in restored native forest areas, which—in turn—minimizes tree loss

Exhibit B04-9. Integrated Land Management Rainy Day Benefits

