



NRC

**PLAN Pinellas _ NATURAL RESOURCE CONSERVATION
AND MANAGEMENT SUPPLEMENTAL**

NATURAL RESOURCE CONSERVATION AND MANAGEMENT SUPPLEMENTAL [NRC]

Because natural resources are fundamental to Pinellas County, many of the statutory requirements of the Conservation Element are covered in detail by other Comprehensive Plan Elements and are not addressed in-depth herein to avoid repetition, including:

Topic	Element
Barrier Islands	Coastal Management
Resource-based Parks	Recreation, Open Space and Culture
Water, water recharge areas, wetlands, water wells, estuaries, floodplains, rivers, bays, lakes, and other waterbodies	Surface Water Management
Beach and Shoreline Public Access	Recreation, Open Space and Culture
Sea Level Rise	Coastal Management

The maps provided as part of this supplemental chapter are valid as of the date identified on the respective map. Please visit the County's Geographic Information System (GIS) tool for the latest information as linked here: <https://egis.pinellas.gov/apps/egis/>

SUSTAINABLE PRACTICES AND ENVIRONMENTAL EDUCATION

Pinellas County strives to be a leader by implementing sustainable practices in County facilities, operations and projects and incentivizing these practices in the private sector. The County has a long-standing commitment to tracking and documenting sustainability progress. In 2006, the County became the first local government in Florida to be certified at the silver level under the Florida Green Building Coalition's Green Local Government Program, and in 2013 became the first to recertify, improving to the gold level. In 2017, the County pursued and achieved a Sustainability Tools for Assessing and Rating (STAR) Community 3 Star Rating, a nationally recognized program. Data from the STAR certification process informed PLAN Pinellas development.¹

In June 2018, STAR Communities merged with the U.S. Green Building Council (USGBC) and became part of the Leadership in Energy and Environmental Design (LEED) for Cities & Communities Team. LEED for Cities is a globally applicable program that combines performance standards and strategies for benchmarking, verification and recognition. The County will continue to track progress and improve sustainable practices through LEED.

Pinellas County is an urbanized, effectively built-out County nearly surrounded by water. The management of water is vital to the sustainability of the County. In 2017, the Pinellas County Stormwater Manual was adopted to promote an advanced stormwater management approach integrated with a contemporary Land Development Code. The Stormwater Manual incentivizes best practices beyond traditional structural solutions and incorporates a variety of green infrastructure and low impact development (LID) options to address stormwater. The County's innovative approaches to water management are discussed further in the Surface Water Management Chapter.

Effective planning for climate change and relative sea-level rise is also imperative for the physical and economic resiliency of the County and its natural resources. Pinellas County has implemented *Guidance for Incorporating Sea Level Rise into Capital Planning*, which provides a framework for evaluating sea level rise within the capital improvement program process.² The County is also preparing a comprehensive, countywide vulnerability assessment, which will identify long-

1. <http://www.pinellascounty.org/sustainability/pdf/resiliency-report.pdf>

2. <https://www.fsbpa.com/18AnnualConfPresentations/Levy.pdf>

term capital investments, policies and strategies to mitigate or adapt to the environmental shifts associated with climate change.

The County is committed to the conservation of the natural resources described in this comprehensive plan and the protection, restoration and enhancement of environmental quality. The environmental education of our residents and visitors is a critical component of that commitment. The County has a multifaceted approach to environmental education and continues to explore additional opportunities to raise environmental awareness and promote sustainable practices. Perhaps the greatest tool of environmental education is the County's significant natural resources found at parks and preserves and their associated educational facilities, including:

- The Pinellas County University of Florida Extension Resource Center
- Booker Creek Preserve
- Weedon Island Preserve
- The Florida Botanical Gardens
- Heritage Village

All these facilities include education centers and programs that are discussed in detail in the Recreation, Open Space and Culture Element.

Current partnerships and programs include:

- Pinellas County School District: Pinellas County works with the School Board to teach students about environmental issues through programs such as the Great American Teach-In and the Speaker's Bureau.
- University of South Florida: The County works with USF and multiple agencies on the Water Atlas, a one-stop data warehouse for water resources information for citizens and scientists.
- Non-Profit Organizations: Pinellas County has developed partnerships with many non-profit agencies in promoting environmental stewardship. For example, the Friends of the Brooker Creek Preserve provides support to the Brooker Creek Preserve through volunteer programs, fundraising and education. Keep Pinellas Beautiful is another important partner that works with volunteers on clean-up, improvement and beautification efforts across Pinellas County.
- Brochures and Videos – Many departments develop media that are available to the public through County offices, special events, civic meetings, PCC-TV, the County's website and YouTube. Many of these materials are related to environmental education.
- The Storm Drain Marking Program – Placards on storm drains explain they flow directly to a body of water to educate people that their actions can have a direct impact on water quality. Pinellas County typically utilizes volunteers to place the markers out in neighborhoods and include educational flyers for the homes in proximity.
- Social Media – County departments educate citizens about environmental issues through social media including Twitter, Facebook, and Nextdoor.
- Roadway Variable Message Boards – These boards are used to educate the traveling public about many pertinent issues, including environmental concerns. For example, variable message boards have been used to remind citizens of the fertilizer ban.

THE NATURAL LANDSCAPE OF PINELLAS COUNTY

GEOLOGY AND TOPOGRAPHY

Pinellas County is on the southwestern flank of the Ocala platform, and is underlain by a series of limestone formations that dip toward the south. Two formations reach the surface in Pinellas County, the Hawthorne and Tampa Limestone, while a third, the Suwannee, is beneath them throughout the County. These formations are the most important characteristics of the geology of the County.³

3. Lithostratigraphic and Hydrostratigraphic Cross Sections through \ Pinellas and Hillsborough Counties, Southwest Florida <https://ufdc.ufl.edu/UF00099436/00001/3j>

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The Suwannee Formation is the oldest geologic formation and is found at depths of 100 feet in the Tarpon Springs area and dips to over 250 feet under St. Petersburg. The formation consists of granular, porous limestone formed during ancient (Oligocene) times by carbonate secreting marine life. Moving toward the surface, the Tampa Formation also underlies the entire County. The Tampa Formation nearly reaches the surface north of a line from Palm Harbor to Safety Harbor. It dips as it moves southward to a depth of over 100 feet in St. Petersburg with two intermediate high points, the Coachman High and the St. Petersburg Plateau area. Ancient reefs are believed to have originated at these high points. Spreading from these points is the hard limestone of the Tampa Formation, intermixed with granules of sand and phosphate. In several areas in the north County, the formation is about 20 feet thick and widens to over 150 feet in the south. The water-soluble hard limestone is honeycombed with many interconnected solution channels that store large quantities of water.

Just under the surface is the Hawthorne Formation, which is absent north of a line from Safety Harbor to Palm Harbor. The Hawthorne Formation is dominated by layers of sandy clays. The top of the formation is gently rolling but exhibits a prominent ridge that extends from central Pinellas County (east of Dunedin) south to the vicinity of Walsingham and east to the St. Petersburg area. Surface elevations of the formation ridge range from 50 feet mean sea level (msl) near Coachman to 11 feet below msl in St. Petersburg. This subsurface ridge in western Pinellas County forms the core for the Pinellas Ridge and to the south it forms the core for the more elevated St. Petersburg Plateau area. The Hawthorne Formation is only about 10 feet thick in the north County near Coachman but is over 100 feet thick in St. Petersburg.⁴

Surface deposits top the Hawthorne Formation and the Tampa Formation in north County. Changes in the surface of the geologic formations occurred over time due to sea level changes, erosion and weathering. When sea levels remained relatively stationary for long time periods, waves and currents formed level surfaces called “terraces” from these

and additional sediment. Soils overlying the Tampa and Hawthorne Formation today comprise four marine terraces, consisting primarily of sand and shells with occasional deposits of clays and organics from decaying vegetation.⁵

The process of land formation continues today. The barrier beach islands represent recent deposits of sand formed by the currents and the action of the Gulf of Mexico. These islands and the marine terraces are discussed in the Coastal Management Element.

The most significant aspects of Pinellas County’s geology, apart from its coastal beaches, are the water holding capacity of the limestone formations, the propensity of limestone to collapse and form sinkholes, and the creation of the Pinellas Ridge and St. Petersburg Plateau.

SOILS

Soils in Pinellas County are important for their interrelationship with drainage and development constraints. The upper geological formations found in Pinellas County are covered with sand ranging from several feet to more than 50 feet in thickness. Few soils in the County are influenced by the underlying geological formations. Unconsolidated marine sediments were deposited by Gulf currents over these formations in four terraces associated with different sea levels. Each terrace is covered by a mantle of quartz sand. Organic deposits are found where sands supported plants during marine fluctuations. The topography and the depth to the water table affected the formation of these organic soils. Heavy rainfall leaches minerals and soluble particles resulting in soils that are sandy, acidic, with low organic matter content and limited natural fertility. The clay layers are not thick but are often of low permeability and create a hardpan layer.

4. *The lithostratigraphy of the Hawthorn Group (Miocene) of Florida* (FGS: Bulletin 59) <https://ufdc.ufl.edu/UF00000226/00001>

5. *Ibid.*

The Natural Resources Conservation Service (NRCS) of the U.S. Department of Agriculture produced the [2006 Soil Survey of Pinellas County, Florida](#).⁶ Soil surveys provide valuable information for general land use planning. The nature and properties of the soil at a given place determine its limitations for land use. The importance of any soil property may vary from one use to another.

SOIL ASSOCIATIONS

Core samples of soil phases were taken in the NRCS surveys and the sequence of natural layers, or horizons, were compared and grouped. Soils in a series consist of horizons similar in color, texture, structure, reaction, consistence, mineral and chemical compositions, and arrangement in the profile. Soil scientists dug many holes to study the soil profile, extending from the surface down into the unconsolidated material in which the soil is formed. For example, “Astatula fine sand, 0 to 5 percent slopes,” is one of several phases within the Astatula series. There are a total of 25 different soil series in Pinellas County, consisting of 31 different soil phases. After mapping each soil phase, a general soils map was prepared.

Five “associations” were identified for the County in a general soils map, each consisting of two or more soils phases usually found in close proximity to each other and within the same hydrologic soil group, describing the drainage capabilities of each soil type. The general soils map, Figure 1, is used to identify and compare major soils characteristics for planning purposes. Land use decisions consider soil characteristics to determine what kinds of uses can be supported by the soils in certain locations. Those areas of Figure 1 that do not have any assigned soil hydrologic group consist of Urban Land and Pits. The soils in these categories are so significantly altered due to development and use as landfills, that they no longer display any of the characteristics common to the other soil types.

Group ‘A’ Soils have a high infiltration rate with low runoff potential. Soils in this group have a high rate of water transmission and are well to excessively drained. This group includes: Astatula soils and Urban Land (0 to 5 percent slopes), Astatula soils and Urban Land (5 to 12 percent slopes), Palm Beach Fine Sand (0 to 8 percent slopes), Paola and St. Lucie Soils and Urban Land (0 to 5 percent slopes), Paola and St. Lucie Soils and Urban Land (5 to 12 percent slopes), and Tavares Soils and Urban Land (0 to 5 percent slopes).

Group ‘B’ Soils There are no soils in Pinellas County that are classified as Group ‘B’ soils.

Group ‘C’ Soils have a slow infiltration rate and consist chiefly of soils that have a layer that impedes the downward movement of water and have a slow rate of water transmission. This group includes: Adamsville Soils and Urban Land (0 to 5 percent slopes), Dumps, Matlacha and St. Augustine Soils and Urban Land, Pomello Soils and Urban Land (0 to 5 percent slopes), and Seffner Soils and Urban Land.

Group ‘D’ Soils have a very slow infiltration rate with high runoff potential. These soils have clays with high shrink-swell potential, a high water table, and that are shallow or nearly impervious. This group includes: Anclote Fine Sand (depressional), Beaches, Felda Fine Sand (depressional), Kesson Fine Sand (very frequently flooded), and Wulfert Muck (very frequently flooded).

Group ‘B/D’ Soils assigned to this group have dual hydrologic group letters because the first group letter describes the drained areas of the soils, while the second group letter describes the undrained areas of the soil. This group includes: Basinger Fine Sand (depressional), Basinger Soils and Urban Land, EauGallie Soils and Urban Land, Felda Soils and Urban Land, Immokalee Soils and Urban Land, Manatee Loamy and Fine Sand, Myakka Soils and Urban Land, Okeechobee Muck, Pineda Soils and Urban Land, Pinellas Soils and Urban Land, Placid Fine Sand (depressional), Samsula Muck, and Wabasso Soils and Urban Land.

6. https://www.nrcs.usda.gov/Internet/FSE_MANUSCRIPTS/florida/FL103/0/Pinellas.pdf

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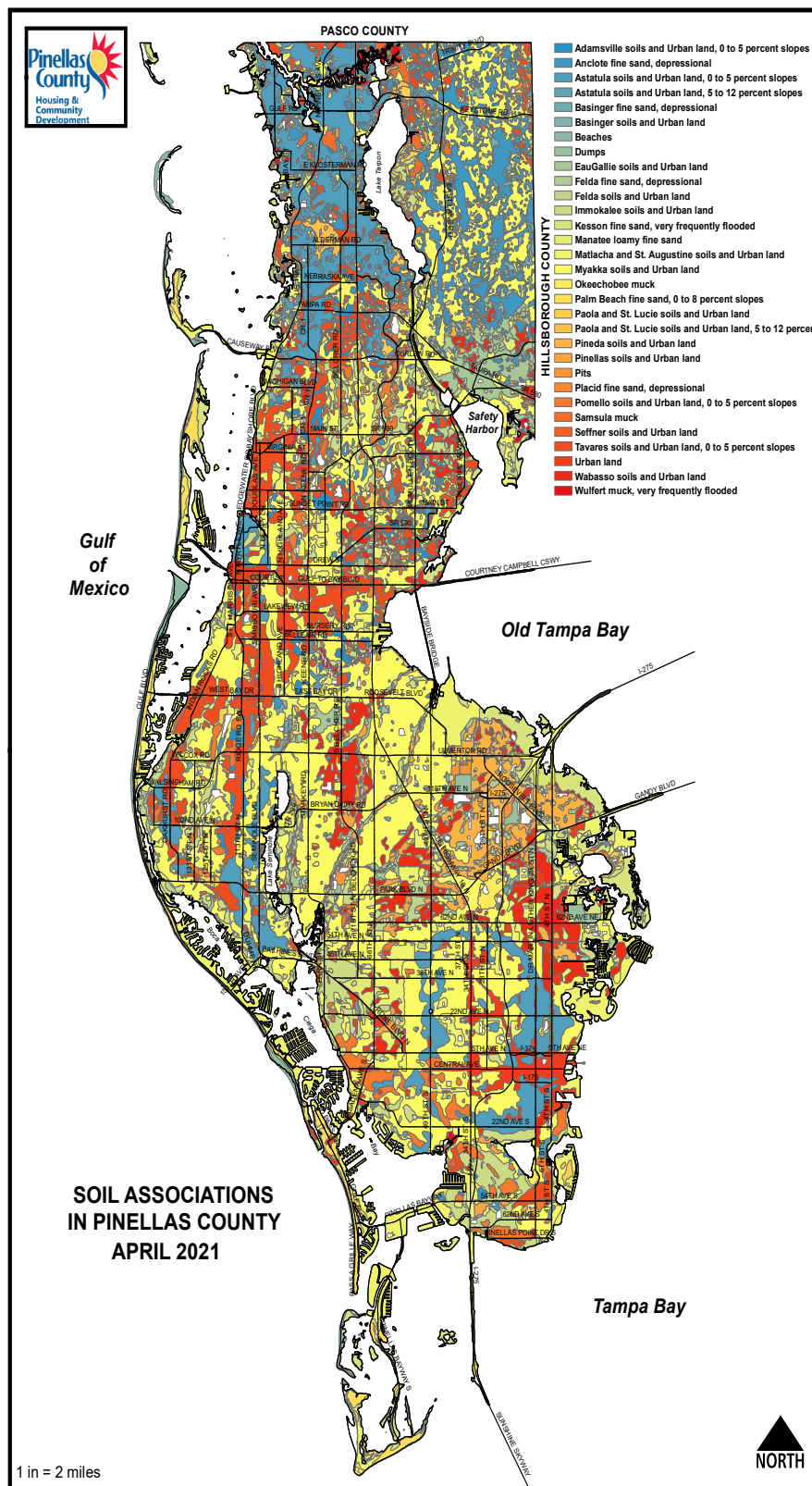


Figure 1: Soil Associations in Pinellas County.

SOIL PHASES AND LAND UTILIZATION

Although the soil association map is useful in the general delineation of areas with limiting characteristics, it is not specific enough to discuss areas of less than five to ten square miles. The limitations of the various soil phases is a land use consideration. Detailed analysis is required to determine specific development on the property can be supported by the underlying soils. See the NRCS Soil Survey of Pinellas County for detailed analysis of soils and suitability.

As can be seen on Figure 1, soil associations with the highest water tables (Group D) are commonly located in the coastal areas. These areas include the Weedon Island Gateway area, Joe's Creek Preserve, and other areas typically known to have large amounts of mangroves and high-water tables. These areas are the least suitable for development in Pinellas County and are mostly set aside as wetland areas for wildlife habitat and environmental preservation. The soils located in the Group 'A' soil association are typically well-drained and more suitable for development.

URBANIZATION CONSTRAINTS

Drainage and good soil permeability are important for construction. Highly permeable soils, however, may be subject to settling when structures or roads are placed on them. Mixtures of sand and silt are most subject to settling. Compaction, while not always the preferred method because of the impacts it can have on permeability and surface water runoff volumes, can be used to consolidate mixed sandy soils. Pressure is applied to the surface until soils reach an optimum volume. This method can improve the soil properties relative to the soil "bearing capacity," usually expressed in tons per square foot.

Although buildings can be designed to distribute the loading over multiple or continuous footings, even with compaction, the soil eventually reaches a point where overloading can lead to structural failure unless pilings are used. In Pinellas County, this means that a two or three-story structure on a conventional foundation is generally the highest allowable bearing on most soils without pilings. Typical commercial, multi-family, industrial or major transportation construction increases surface loads and the affected soil depth. Thus, the impact of unstable soils affecting a structure increases in depth as a structure increases in height or loading. Site specific analysis is needed to a depth corresponding with the structure type.

Lack of slope is a greater problem in the County. On-site urban drainage requires a sufficient topographic gradient to allow soils to drain. Soils with insufficient natural slope to drain properly are identified in the Soil Survey of Pinellas County. They correspond with those soils subject to annual flooding.

In addition to this, approximately 12 percent of the County is classified as being highly susceptible to erosion from wind and sheet flow of water. Conditions which lead to erosion are worsened by tree and shrub removal and by removal of the topsoil associated with surface vegetation. Construction and excavation practices can remove the topsoil from land surfaces. The Land Development Code requires a stormwater pollution prevention plan and/or an erosion control plan for construction activities that will include soil disturbance and/or clearing.

Erosion around foundations is also a potential problem encountered on sandy soils, especially with wet fine sand and silty soils, all of which are common in Pinellas County. Silt is not suitable as a foundation material and may become quicksand under wet conditions, flowing out from under a foundation. Roads are also subject to erosion problems of this nature. Mixing silts and fine sands with organics or placing a structure on footings or shallow pilings which reach below the silts can alleviate some of these problems. Preventing topsoil excavation is a strategy that both prevents erosion and environmental damage. Sediment transport rate is an important factor of environmental quality and ecosystem health. Imbalances in the sediment transport rate can lead to scour, erosion, build up, excessive turbidity, and pollution. Excessive suspended sediments in the water column can have damaging impacts to aquatic life. The East Lake Tarpon area in northeastern Pinellas County has generally low topography, poor drainage, and significant acreage of very limited soils and wetland vegetation. There are numerous constraints on urban development in this area that Pinellas County is addressing in the following ways:

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- Maintaining low residential densities on the Future Land Use Plan;
- Restricting intensive non-residential development;
- Minimizing Floor Area Ratio (FAR) / impervious surfaces
- Encouraging LID/green infrastructure through utility fee discounts
- Ensuring no development in wetlands/floodways
- Ensuring no increase in Base Flood Elevation (BFE) or discharge rate through stormwater regulations
- Public purchase of substantial tracts of land; and
- Designating major wetland systems as preservation on the Future Land Use Map.

All building sites should be checked against the Soil Survey of Pinellas County and appropriate soil tests conducted to determine soil constraints.

Less than one percent of the total land area in Pinellas County supports agricultural uses, although urban agriculture is gaining popularity. Currently in Pinellas County, there are 44 community gardens, urban or hydroponic farms.⁷ Demand for healthy, local, sustainable, and safe food is increasing, and the built-out nature of Pinellas County makes urban farming a potentially viable means to meet this demand. However, these operations are compact out of necessity and unlikely to significantly change the demand for agricultural land.

COMMERCIALLY VALUABLE MINERALS

There are no commercially valuable minerals in Pinellas County, and no active mining activities.

SINKHOLES^{8,9}

A sinkhole is a depression in the land surface formed either by solution of near-surface limestone or similar rocks, or by collapse of the roofs of underground channels and caverns. The Tampa Formation has been described by geologists as the most prone to development of sinkholes. Florida's warm, wet climate can quicken the process that forms sinkholes. This process, known as "carbonation" involves the dissolving of the calcium carbonate which makes up the limestone. Through constant movements caused by earth processes, the limestone cracks and breaks and develops fractures and weak layers. Carbonic acid, which is found in weak concentrations in rainfall, and in stronger concentrations in the soil humus layer, seeps into crevices in the limestone and chemically changes the calcium carbonate to calcium bicarbonate, a highly soluble salt. Eventually, passageways form and the salts are washed away into streams. This process of chemical erosion of limestone has been going on in the Tampa Formation for thousands of years.

Two types of sinkholes, cover-subsidence and cover-collapse are known to occur on ground surfaces. Cover-subsidence sinkholes tend to occur in areas where the sand layer is as deep as 50 to 100 feet. As limestone is dissolved, the resulting voids are filled by granules of overlaying sand. The process reduces the size of cavities in the limestone and results in less surface subsidence at the time of collapse. These sinkholes are typically only a few feet in diameter and depth. Cover-collapse sinkholes are caused by layers of clay rather than sand. The clay provides a cohesive material for soil that forms bridges of existing cavities in the limestone that can collapse and cause abrupt and deep sinkholes.

7. <https://sfyl.ifas.ufl.edu/pinellas/urban-agriculture/>

8. https://www.fnai.fsu.edu/PDFs/NC/Sinkhole_Final_2010.pdf, Scheidt, J. & Lerche, Ian & Paleologos, Evan. (2005). Environmental and economic risks from sinkholes in west-central Florida. *Environmental Geosciences*. 12. 207-217. 10.1306/eg.05130404009.

9. Sinkholes West-Central Florida, A link between surface water and ground water <https://pubs.usgs.gov/circ/circ1182/pdf/15WCFlorida.pdf>

Sinkholes are found primarily in the northern one-third of the County, inland of the Tarpon Springs area. The remainder of observed sinkholes appear to be distributed evenly about the County but are much less common. Geologists believe this pattern of occurrence is caused by the Tampa Limestone dipping to the south and becoming more deeply buried by the Hawthorne Formation, which is comprised of clay layers that prevent the fast percolation of rainwater. By the time the water seeps through the clay, it is neutralized and the thick clay formation acts as an additional support over any channels in the underlying limestone.

Clays in north County are discontinuous and allow the fast percolation of the rainwater directly to the limestone. Besides increasing the honeycombed character of the limestone, the lack of a consistent clay layer does not provide the support that the Hawthorne Formation does in south County. Areas of greatest sinkhole potential are believed to be where the soils lack a clay layer and have a much higher rate of permeability.

Activities that promote the formation of sinkholes may occur naturally or be induced by people. The most conducive natural condition for sinkholes to form is when rainy weather causes the water levels to increase dramatically following a drought. During the dry season, the clay layer consolidates into a dry, weakly cemented roof over the limestone. When rains soak this layer, the roof over the cavity becomes very heavy, it weakens and may collapse.

Sinkholes may be caused by human activities in several ways. The most common is when a new well extending into the aquifer begins to pump water. Water under high pressure in the aquifer is believed to act as an additional support to the roof of an open limestone chamber. When this water level is lowered sinks may form in the area surrounding a new well. Sinkholes can also result from test drilling when the hard clay layer or the limestone roof of a cavity is broken by the drill, vibrations from drilling, heavy traffic, planes landing, or construction. In some cases, sinkhole remediation is possible. In others, relocation is the only solution. While there is no reliable method to prevent or predict the formation of sinkholes, structures can be designed to mitigate the damage from potential sinkhole formation.

Sinkhole lakes and ponds perform positive environmental functions. Aside from aesthetics, they provide direct aquifer recharge in areas with high relief and maintain water table levels during dry seasons to protect surrounding areas from fire. Management of sink lakes and ponds with direct connections to the aquifer is needed to avoid the serious consequences of contaminating these lakes.

Over thousands of years cypress stands and ponds evolved in low areas formed by sinks and other depressions. In north County, many cypress wetlands are still found. Most are surrounded by pine flatwoods which are underlain by soils with hardened clay layers. During the dry season, water levels are maintained to a greater extent in the cypress pond due to the unique growth cycle of those trees. Water seeping from the cypress pond into the water table under the pines helps prevent the drying of the understory. Complete preservation of these sinkhole ponds is the best strategy for maintaining their important function.

Currently, there is no conclusive means of predicting where or when a sinkhole collapse may occur.¹⁰ Individual site analysis remains the best way to determine sinkhole potential and geological/geotechnical investigations should be conducted by a professional with specific knowledge of the processes involved in sinkhole collapses in the planning phase for site development.

VEGETATIVE COMMUNITIES

Wildlife habitat biodiversity is perhaps the largest benefit of the natural environment of Pinellas County. From the seagrass beds along the shores of the Gulf of Mexico to the pinelands of Brooker Creek Preserve, a variety of wildlife thrive because of the natural environment. While much of Pinellas County has been developed, Pinellas County still has several excellent examples of natural vegetative communities under public ownership and management. For example, Brooker Creek Preserve is home to a variety of upland forest communities, Weedon Island Preserve has extensive mangrove and wetland communities, and Shell Key Preserve is the location of a significant amount of coastal scrub

10. Gutiérrez, F., Cooper, A.H. & Johnson, K.S. Identification, prediction, and mitigation of sinkhole hazards in evaporite karst areas. *Environ Geol* 53, 1007–1022 (2008). <https://doi.org/10.1007/s00254-007-0728-4>

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vegetation and submerged aquatic vegetation. Each of these County properties has distinct vegetative characteristics that exemplify the diversity of natural vegetation present in Pinellas County.

The County owns and/or manages over 15,000 acres of environmental land for both public and natural benefit. The three major environmental land units are summarized in the Environmental Lands Management section of this element. Overall, the biodiversity, and preserving the lands that contribute to biodiversity, is very important for the environmental quality of both Pinellas County and the region. The incremental loss of native vegetative communities can have a detrimental effect on plant and animal species that are dependent on Pinellas County's natural areas, whether for migratory or yearlong habitat. Protecting the natural environment supports the survival of the County's diverse plant and animal species, and also provides the citizens of Pinellas County with opportunities to appreciate the natural environment.

VEGETATIVE COMMUNITIES INVENTORY

The following provides an overview of Pinellas County's vegetative communities. The Florida Natural Areas Inventory (FNAI) Guide to Natural Communities provides additional information (<https://www.fnai.org/species-communities/natural-communities>).

Rangeland¹¹

Description – Rangeland in Pinellas County is comprised predominantly of shrub and brushland with a few acres of herbaceous land. In such areas, the natural vegetation is predominately shrubs and grasses. The land is typically not irrigated, cultivated or fertilized and brush control is the general extent of management. This category includes some aspects of the Coastal Scrub community, discussed as its own community to note its importance in Pinellas County.

Associated soils are nearly level to strongly sloping, deep, moderately well to excessively drained. Representative soils in Pinellas County include the Coastal Beaches and Palm Beach series. Associated Vegetation consists mainly of palmettos, wax myrtle, and other shrubs and brush.

The rangeland community has historically been among the most desirable areas to develop because of its well-drained soils and lack of a dense tree canopy. As a result, this community has been exploited to a high degree for development.

This community has been heavily urbanized in Pinellas County throughout the years and very little remains. Many of the barrier islands in Pinellas County consisted of this vegetative community prior to their development. There are small amounts of rangeland remaining in Pinellas County, mainly on Fort DeSoto, Shell Key, Sand Key, Caladesi and Honeymoon Island. These areas are protected from future development through preservation and conservation land uses; however, sea level rise poses a threat to the remnants of this community.

Upland Forests¹²

Upland forest areas support a tree canopy closure of ten percent or more. This vegetative community includes both the dry sites (xeric) and moderately moist (mesic) forest communities. Wetland forests are categorized separately. In Pinellas County, there are several different upland forest community types. These include hardwood conifer mixed, longleaf pine-xeric oak, pine flatwoods, tree plantations, upland coniferous forests, and upland hardwood forests.

11. Florida Department of Transportation Florida Land Use, Cover and Forms Classification System Handbook, 1999.

12. Guide to the Natural Communities of Florida: 2010 edition – Florida Natural Areas Inventory (FNAI). www.fnai.org

Pine flatwoods is the most extensive upland forest community occurring in Pinellas County. This community occurs on nearly level land, and during the rainy season water may be on or near the soil surface. The longleaf pine-xeric oak habitat is generally situated on elevated, sandy soils and is a fairly open forest community influenced by fire, heat, and drought. Fire is crucial since it prevents competing hardwoods from regenerating.¹³

The upland hardwood habitat occurs on rolling terrain with nearly level to strong slopes. Readily identified by the occurrence of thick stands of shade-tolerant hardwoods and few pines, the community is characterized by moderately moist conditions without excessive water or drought conditions.

A variety of soil types are present in the upland forest vegetative community. In the pine flatwoods habitat, nearly level, deep, acidic, poorly to somewhat poorly drained soils, some of which typically develop an organic hardpan confining layer are present. These soils include Eau Gallie soils and Urban Land; Pinellas soils and Urban Land; Immokalee soils and Urban Land; and Wabasso soils and Urban Land. Nearly level to strongly sloping, deep, acidic, moderately well to excessively drained soils are common in the longleaf pine-xeric oak habitats. Soils underlying this habitat in Pinellas County include the Astatula and Tavares series. Soils in the hardwood forests are nearly level to strongly sloping, deep, somewhat poorly to well-drained. Soils underlying this habitat in Pinellas County are the Adamsville and Seffner series.

In Pinellas County, there is a wide variety of vegetation in the upland forest community. The pine flatwoods habitat is usually dominated by an open canopy of slash pine with understory vegetation composed chiefly of saw palmetto, staggerbush, wax myrtle, gallberry, and wire grass. The pine flatwoods habitat is perpetuated and rejuvenated by fire, which controls hardwoods and promotes the natural regeneration of pine. When fires do not occur, this community will succeed to a hardwood community. When in a climax stage, the upland hardwood habitat is dominated with hardwoods with only a few pines included. Commonly encountered species in Pinellas County are live oak, bluejack oak, turkey oak, persimmon, and cabbage palm in the more xeric or dryer locations; and sweetbay, wild olive, pignut hickory, sweetgum, and American hornbeam in the damper, cooler locations.

Examples of other species in the upland forest community include: longleaf pine, slash pine, sand pine, wax myrtle, laurel oak, live oak, and many others.

The Upland Forest community is a valuable wildlife habitat, provides shade and erosion control and is located throughout Pinellas County. This community provides a home for many species of wildlife including quail, rabbit, raccoons, and opossums along with a wide variety of songbirds. The County's undeveloped upland forests and County-owned well fields in the northeastern portion of Pinellas County are also known to support white-tailed deer and wild turkey. Threatened or endangered species known to exist within this upland community in Pinellas County include the Gopher Tortoise, the Eastern Indigo Snake, and the Gopher Frog. The Southern Bald Eagle and the Osprey may also occasionally nest in the tall trees of this community.

Upland forests are being depleted by development pressure in Pinellas County. While wetland communities have been heavily urbanized in Pinellas County these areas are either being purchased for public ownership or protected in other ways,

Although little agricultural or silvicultural land use occurs in Pinellas County, remnants of these once extensive activities still occur in portions of the County - primarily in the northeast sector. Pine flatwoods located in these areas have the potential for producing significant amounts of high-quality forage and have a moderate potential productivity for commercial wood production.

Water erosion can be a problem on the steeper slopes. Dense upland forests, however, can have extensive root systems which can help to stabilize the slopes and provide for erosion control. The cooler, moister and shadier conditions provided by the attractive hardwood vegetation creates an environment prized by people and often sought for residential development. Upland hardwood habitats are valuable for watershed protection. The upland hardwoods community is often depleted for development. Because wetland and mangrove areas are being protected as conservation areas,

13. https://www.fnai.org/PDFs/NC/Xeric%20Hammock_Final_2010.pdf

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development is being focused on other areas, namely upland forest areas.

Water

The Water category includes the following habitats: streams and waterways, lakes, reservoirs, bays and estuaries, major springs, slough waters, and major bodies of water, that are at least 1/8 of a mile wide or, if extended, cover at least 40 acres.

The waters of Pinellas County include the lakes of Pinellas County and the surrounding water bodies, including lakes Seminole and Tarpon, the Gulf of Mexico, Boca Ciega Bay and Tampa Bay. The soils included in this vegetative community in Pinellas County range from sand to mud, including Samsula muck, Okeechobee muck, and Manatee loamy fine sand. This community is home a diverse variety of fish species and invertebrates, which also serve to benefit shoreline birds. This community serves a vital role in the quality of life in Pinellas County, with both residents and tourists dependent upon these resources. The urbanization of Pinellas County has been so significant, due in part, to the Water community. An attractive view of beaches and the Gulf of Mexico create a prized location for residential, recreational, and tourist-related development.

Major threats to the waters of Pinellas County come from development pressures. Point-source and non-point-source discharges from developed urban areas, discussed in greater detail in the Surface Water Management Element, are the greatest threat to water quality in Pinellas County. Pollution from atmospheric deposition is also a contributing factor to water pollution problems in the area.

Wetlands¹⁴

Wetlands are all those waters, fresh and saline, or areas which are inundated or saturated by surface water or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation specifically adapted to life in saturated conditions.

Wetlands in Pinellas County consist of several different ecological habitats, including bay swamps, cypress strands and domes, emergent aquatic vegetation, freshwater marshes, mangrove swamps, salt flats, saltwater marshes, stream and lake swamps, vegetated non-forested wetlands, wet prairies, wetland coniferous forests, wetland forested mixed, and wetland hardwood forests.

These communities typically have poorly-drained soils, which are sometimes organic, depending upon the specific habitat. Soils vary somewhat depending on the habitat in the wetlands. Soils underlying wetlands in Pinellas County include Wulfert muck and Kesson Fine Sand.

In general, wetlands communities support a luxurious growth of vegetation with a diversity of species. Wetlands are a vulnerable resource requiring regulation to avoid loss of environmental and social benefits (food and habitat for fish and wildlife; water quality benefits; flood storage; shoreline erosion control; economically beneficial natural products for human use; and opportunities for recreation, education, and research)¹⁵. This community is rich in species diversity and represents one of the most productive and diverse wildlife habitats. While each individual habitat is distinct, wetland communities are a valuable asset and contribute to the County's overall biodiversity.

14. *Guide to the Natural Communities of Florida: 2010 edition – Florida Natural Areas Inventory (FNAI)*. <https://www.fnai.org/>

15. <https://www.epa.gov/sites/production/files/2016-02/documents/wetlandfunctionsvalues.pdf>

Wetland Hardwood Forests

Wetland hardwood habitats are dominated by the laurel, live, and water oaks, magnolia, and cabbage palm. Another dominant tree is the sweetgum. Although red maple, various bay trees, and cypress may also occur, they are not dominant in this community. In Pinellas County, commonly encountered tree species are laurel oak, water oak, sweetbay, red maple, American elm, and ash.

This habitat provides good habitat for wild hogs, deer, turkey, gray squirrel, woodpeckers, owls, and furbearers. Since it is very moist most of the year, it is also good for reptiles and amphibians. If undisturbed, this community provides good cover and a travel corridor for wildlife, as is true of the upland hammock.

Endangered or threatened species associated with the Hardwood Hammock Community within Pinellas County include the Gopher Tortoise and the Indigo Snake. The Southern Bald Eagle and the Osprey are also known to use tall trees in this community for nesting.

Cypress Strands and Domes

Cypress swamps are important as a wildlife refuge providing a wetland habitat during the dry season and roosting and breeding areas for many wildlife species found in adjacent upland habitats. This community enhances aquatic productivity in streams, rivers, lakes, and estuaries by releasing nutrients from its decomposing leaf litter.

In the cypress habitat in Pinellas County, two types of cypress exist - bald cypress, which predominates along rivers and lakes; and pond cypress, which predominates in the wet depressions forming cypress domes. Other tree species associated with the cypress swamps are blackgum, sweetbay, red, loblolly bay, and red bay. In the County, this community is predominantly comprised of cypress trees. The remaining acreage, however, consists of a mixture of cypress and other hardwood species.

Endangered or threatened species associated with the cypress swamp within Pinellas County are the Osprey, the Wood Stork, the Little Blue Heron, the American Alligator and the Southern Bald Eagle, both occasional nesting residents.

Freshwater Marsh

In freshwater marshes, the dominant vegetation includes cattails, sawgrass, and sedges. Other vegetation associated with this community include pickerelweed, duck potato, wax myrtle, maidencane, primrose willow, St. John's wort, and occasionally pines and palmettos along the edges of the marsh.

Freshwater marshes and ponds are maintained by fire and by water fluctuations. The elimination of fire and the permanent lowering of the water table will cause this community to convert into a woody community. Permanent inundation will tend to cause this community to become dominated by cattails and primrose willow.

This habitat is excellent for many wetland wildlife species, including several endangered species. Many birds use this habitat year-round, or for wintering. In Pinellas County, as in all of Florida, the freshwater marsh habitat is endangered through destruction or degradation. Consequently, their protection should be an important goal of resource management. Threatened or endangered animals associated with Pinellas County freshwater marshes and ponds include the Silver Rice Rat, the Florida Sandhill Crane, the Wood Stork, the Little Blue Heron and the Snowy Egret. The Southern Bald Eagle and the Red Shoulder and Red Tail Hawks are also known to be occasional residents of this community. Ephemeral ponds are important habitats for amphibians.

One of the most important benefits of this vegetative community is the control of water quality and quantity. This regulation of the hydrologic regime is especially important in coastal areas. Development pressures pose the greatest threat to wetland communities. While the County and other government entities pursue the purchase and protection of wetland area and restrict development directly on them, impacts from surrounding development and

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filling practices serve to threaten the wetlands and the vital function they serve. Additionally, development pressures on associated uplands functionally linked to wetlands can also threaten the ecologic function and quality of wetland systems.

Emergent Tidal Wetlands

Salt marsh occurs in the portion of the coastal zone affected by tides and seawater and protected from large waves, either by shoreline topography, barrier islands, or location along a bay or estuary. Smooth cordgrass and black needle rush are the predominate salt marsh species in Pinellas County. Wetlands located in the tidally influenced reaches of rivers or streams also include a mix of salinity tolerant freshwater species and saltwater species including cattails and sawgrass, leather fern, bulrush, and spider lily (*Hymenocallis palmeri*).¹⁶

In mangrove swamps in the Tampa Bay area, the most frequent species found in the community are three mangroves: red, black, and white. Also occasionally found in the mangrove community is the buttonwood. Mangrove swamps may contain mixtures of all local mangrove species or be monospecific. In Tampa Bay, however, there is generally considerable intermixing of these species.

Mangrove swamps dominate the seaward portion of the tidal zone (below mean high water) with salt marsh confined to the upper marsh zone. In Pinellas County, salt marsh species generally border mangroves or occur in tidally influenced bayous and streams.¹⁷

Barren Land

This community has very little or no vegetation and limited potential to support vegetation. Habitats included in this community include beaches other than swimming beaches and sand other than beaches. These areas exhibit little human encroachments and include dune areas and beaches in protected bay and marsh locations.

The soils in this vegetative community in Pinellas County consist mainly of sand. There is very little vegetation located within this community, except for some coarse grasses that may be in the dune areas. The dune area community serves a role in the protection of Pinellas County development from wave action. This community may host nesting turtles but has little other native habitat. Development adjacent to barren land areas, can cause significant erosion of the barren land. When this occurs, those areas lose their designation within this category and are reclassified to accurately reflect the characteristics of the area. The urbanization of Pinellas County has depleted much of this vegetative community, leaving only a few areas where barren land still exists.

Special Classification – Seagrass Meadows¹⁸

Although seagrass meadows are usually not technically defined as wetlands, they are an important link in the overall health of the marine resources of the County. The clarity of the Gulf of Mexico and Tampa Bay waters is one of the limiting factors for seagrass meadows because they need high light intensity. Water clarity is directly related to the ability of wetlands and stormwater treatment areas to filter out sediments and nutrients from runoff. The sediments and nutrients, which lead to excess algae production, reduce clarity and the depth of sunlight penetration thus limiting the depth to which the seagrasses can grow. For more information on seagrasses and the location of these natural resources

16. Yates, K.K., Greening, Holly, and Morrison, Gerold, eds., 2011, *Integrating Science and Resource Management in Tampa Bay, Florida*: U.S. Geological Survey Circular 1348, 280 p

17. https://www.fnai.org/PDFs/NC/Salt_Marsh_Final_2010.pdf

18. https://www.fnai.org/PDFs/NC/Marine_Estuarine.pdf

within the waters of Pinellas County, see the Seagrasses section of this Chapter.

Seagrasses are submerged flowering aquatic plants with true root systems and stems that live in marine and estuarine waters. Although they are vascular plants, seagrasses grow in underwater beds that resemble terrestrial meadows or grasslands. Soils associated with this vegetative community include sand to mud often with high organic content.

Seagrasses require high light intensities, as well as quiet coastal waters and estuaries. Seagrass loss is due mostly to filling of submerged areas and to the reduction of water clarity. This fact places seagrass directly in the path of development and recreational use of coastal water.

Five of the seven known species of seagrasses native to Florida waters are found in the marine environment of Pinellas County. These include turtle grass, manatee grass, shoal grass, widgeon grass, and star grass. The dominant species are turtle and shoal grass.

Seagrass plays a key role in the coastal marine community. Food and shelter are provided for many of Florida's invertebrate population by seagrasses, and many species depend on these meadows as a nursery for juveniles. These areas of mixed grasses and algae are known to contain many times the number of living organisms as unvegetated sandy areas. These same meadows are known to support eight different species of gamefish as juveniles.

Seagrasses bind shallow coastal sediments and decrease erosion by their physical interference with currents. Manatees feed on seagrasses, particularly those growing in soft unconsolidated sediments. Seagrasses, at one time or another, provide food and shelter to virtually every living species of sea life in the Tampa Bay area. Large numbers of birds (particularly wading birds) are known to frequent seagrass beds and make use of them as foraging grounds for food. Predators of all types find seagrass beds an abundant food source. Seagrasses play a vital role in the marine environment of Pinellas County. A great deal of the future of marine fishing, both commercial and recreational, depends on the existence of this coastal resource. Water quality issues and boating practices pose the greatest threat to seagrasses in Pinellas County. Poor water quality inhibits the growth and vitality of seagrasses and scarring from boat propellers causes the destruction of seagrass beds.

Special Classification – South Florida Coastal Strand¹⁹

This habitat includes those areas adjacent to the Gulf of Mexico and salt water bays that are affected by salt spray and high winds. This habitat is generally narrow, occurring upon the coastal beaches and dunes along the Gulf. The majority of this habitat in Pinellas County is on Shell Key, Caladesi Island and Honeymoon Island. Soils are nearly level to strongly sloping, deep, moderately well to excessively drained. Representative soils in Pinellas County include Beaches and Palm Beach fine sand.

The vegetation of the South Florida coastal strand is characterized by low growing grasses, vines, and pioneering herbaceous plants. There are few trees or large shrubs, and when they do occur, they are usually stunted due to the action of the wind. The beaches and foredunes are heavily influenced by wind, salt, and blowing sand and few plants successfully establish themselves. Those that can include beach morning glory (*Ipomoea stolonifera*), railroad vine, and sea oats. On the more protected back dunes, vegetation changes to saw palmetto, wax myrtle, dwarf scrubby oaks, sea grape, and cocoplum.

No vegetation community in Pinellas County is more desirable as a location for recreation. As a result, the beaches and dune systems have been exploited to a high degree for private residential and tourist-related commercial uses. In the process, much of the South Florida coastal strand community in the County has been destroyed. Remnants remain, primarily in state and County parks, but even here the recreation pressures have severely impacted much of what remains of this community.

19. https://www.fnai.org/PDFs/NC/Coastal_Grassland_Final_2010.pdf

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This community is located on the most dynamic landscape in the County. The vagaries of wind and waves (primarily the latter) can alter this landscape drastically, but such sculpturing is restrained significantly by the beach and dune systems and their associated vegetation. The dunes are especially important in the damping of storm-generated waves, and these fragile barriers are held together by the extensive root systems of their vegetation.

The coastal strand community is highly endangered. This community serves as a habitat for a variety of shorebirds, reptiles, and mammals. Several species of endangered and threatened plants may occur in this community, and those known to be present in Pinellas County are the beach star and the beach creeper. The Pinellas County coastal strand community also provides habitat for many of the County's threatened or endangered species of birds: the American Oystercatcher, Least Tern, Piping Plover, and the Snowy Plover.

This community also serves as a habitat for the Gopher Tortoise, which digs burrows that also provide shelter for several other dependent species: the Eastern Indigo snake, the Gopher Frog, and the Florida mouse. Undeveloped coastal beaches preserved in Fort De Soto Park provide nesting grounds for the Atlantic loggerhead and the Atlantic Green Turtle.²⁰

The threats to this vegetative community are very similar to those posed to Rangeland communities. Located in a desirable location for both residential and tourist development, this community has been significantly impacted by development practices and replaced with buildings and roadways. An attractive view of beaches and the Gulf of Mexico create a prized location for residential, recreational, and tourist-related development. Sea level rise threatens this community.

WETLANDS PROTECTION AND MANAGEMENT

The wetland resources of Pinellas County provide many benefits. Wetlands provide habitat for wildlife such as birds, mammals and reptiles, including some endangered species. Tidal wetlands function as the base of the detrital food chain and provide habitat, breeding areas and nurseries for commercial and recreational marine fisheries. Freshwater wetlands attenuate the damaging effects of storm and flood waters during peak runoff by slowing and storing those waters, then releasing them gradually. Coastal shorelines and uplands are buffered from the severity of tidal surge during a storm by the adjacent coastal wetlands.

Wetlands also function as a natural filtration system, cleansing storm water runoff before it enters Tampa Bay, the Gulf of Mexico or other surface water bodies. Sedimentation of down-stream waters is reduced by slowing the water velocity, allowing sediments to drop out of the water column while in the wetland. Subsequently, pollutants that are attached to the sediments are buried in the wetland soil. Excess nutrients and other chemicals may be filtered out of the water and soil by the wetland vegetation, stored in their biomass (leaves, stems and roots) and buried in the organic soil when the plants die. The associated birdlife and open vistas of wetlands provide aesthetic beauty and visual relief from the urbanized landscape of Pinellas County.

The County is active in the protection, preservation, restoration, enhancement and creation of wetland habitats because of their important functions. In Tampa Bay, the salt barrens and oligohaline/mesohaline salt marshes have suffered substantially greater acreage loss than mangrove swamps. Acknowledging the value of certain wetland types such as oligohaline/tidal habitats in the life cycle of important marine species, the County, whenever possible, directs their

²⁰ ~~There are historic~~ records of both loggerhead and green turtles nesting at Fort Desoto, with green turtles being less frequent. <https://myfwc.com/research/wildlife/sea-turtles/nesting/loggerhead/>, <https://myfwc.com/research/wildlife/sea-turtles/nesting/green-turtle/>, <https://myfwc.maps.arcgis.com/apps/webappviewer/index.html?id=8e6e45efc47a4c69941ddcb097cb195a>

wetland restoration and creation efforts toward these types. The St. Paul/Belleair oligohaline habitat restoration project in the Allen's Creek watershed, the Fort DeSoto water circulation improvement project, Lake Seminole restoration project, and the wetland rehabilitation project at St. Petersburg College are examples of such efforts.

Wetlands are regulated at the Federal, State and local levels. Regulation of wetlands falls under the jurisdiction of the Department of Environmental Protection (DEP) and the Water Management Districts (WMD). The DEP regulates dredging, filling, or construction within the waters of the State, and those bodies of water impacting them. The WMD are delegated authority for management of storm and surface waters.

For any activity to take place in or on a wetland area designated by the State, an Environmental Resource Permit (ERP) must be issued by either the DEP or the WMD. The ERP combines Wetland Resource permitting by the DEP and Management and Storage of Surface Waters permitting by the WMDs into a single process in order to streamline regulatory procedures. The ERP program has the goal of no-net-loss of wetlands or other surface water functions due to a permitted activity. Any regulated destruction of a wetland area requires mitigation to offset the loss of the wetland functions. Due to the temporary loss of ecological value and uncertainty regarding the ability to recreate certain functions, protection of wetlands is preferred to alteration and mitigation.

Florida's Mangrove Trimming and Preservation Act was enacted to protect and preserve mangrove resources valuable to the environment and economy from unregulated removal, defoliation and destruction. The Act encourages waterfront property owners to voluntarily maintain mangroves, encourage mangrove growth and plant mangroves along their shorelines. Pinellas County has been delegated authority by the State to regulate mangroves for both unincorporated and incorporated areas of the county.

One of the primary methods of protecting the major wetland systems of unincorporated Pinellas County is through the establishment of the Preservation category on the Future Land Use Map (FLUM). Preservation areas are designated on the FLUM, and conservation areas are generally placed under a Recreation/Open Space or low-density residential designation. Development in Preservation areas is prohibited. The Preservation-Resource Management designation on the FLUM was also established in order to recognize and protect valuable well field and recharge areas and their associated natural habitats. Only resource-based recreational and conservation uses are allowed within this category. Conservation areas can be developed to an intensity limited by their existing environmental constraints.

The County continues to designate crucial environmentally-sensitive areas as Preservation on the Future Land Use Map as additional site-specific information is gathered in the site plan process and through other mechanisms. Wetlands not initially identified may be determined worthy of preservation through the detailed analysis done in the site plan process. Once these areas are identified as worthy of preservation, the FLUM is amended to designate them as preservation.

The wetland areas of unincorporated Pinellas County are further protected by several County Land Development Regulations and the Site Plan Review Process. All development requires a 15 to 50 foot buffer around wetlands and other waterbodies. These buffers must be recorded as conservation or drainage easements in the official records of the County. In addition to fee simple acquisition, the use of such techniques as transfer of development rights, conservation easements, wetlands buffers, and preservation/conservation type future land use designations has enabled the County to protect wetland areas.

FLOODPLAINS

Floodplains perform vital ecologic functions. However, development of the natural floodplains in Pinellas County has significantly altered this natural system. The information provided in this section pertains primarily to the ecologic function of floodplains. The interaction between the human environment and floodplains, and the management thereof, are discussed in detail in the Surface Water Management and Coastal Management Elements of PLANPinellas.

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Floodplains provide a critical biologic, geologic and hydrologic link between diverse habitat systems, transport vital nutrients, detritus and flood waters between habitats, and serve important hydrologic functions by cleansing rivers and renourishing beaches.

Natural floodplains:

- Provide natural storage and conveyance of flood waters;
- Promote infiltration and aquifer recharge, and are a basic source of flow to rivers, streams, and estuaries;
- Provide temporary storage of surface waters on flood-prone lands regulates flood elevations and the timing, velocity, and rate of flood discharges;
- Reduce the frequency and duration of low surface flows;
- Contribute to water quality by reducing erosion, removing nutrients and other pollutants, and allowing sediment to settle;
- Export loose organic materials and other food sources to open water bodies, as well as being a vital habitat for fish, birds, wildlife, and native plant communities;
- Support a high rate of plant growth;
- Help maintain the integrity of ecosystems and biodiversity;
- Provide habitats for numerous and diverse species, including many that are rare and endangered; and
- Provide areas for outdoor recreation, open space, and aesthetic and scientific value.²¹

In a mutually supportive cycle, the living and nonliving parts of natural floodplains interact to form floodplain ecosystems. In recognizing the relationships between the hydrological, ecological and biological features of these systems, we can begin to understand how changes to one feature can alter the entire system in significant ways. For example, development in floodplains can alter historic water courses. In turn, this effects the animals and plants which depend on periodic water flows and can subsequently alter the entire floodplain ecosystem.

Natural floodplains can provide habitat for diverse ecological communities. The various plant species within an ecological community may share the need for a certain type or level of soil moisture that is available only in a particular portion of the floodplain. Cypress swamps, hardwood swamps and wetland hardwood hammocks are examples of such communities. The boundaries of these ecological communities can be identified by the landform, soil, and plant types that cover a portion of the floodplain.

The periodic inundation of water in the natural floodplain is extremely important to the integrity of the ecosystem and may be the primary reason for their biological richness. Flood waters carry nutrient-rich sediments and trigger chemical processes that cause beneficial changes in the soil, which contribute to a fertile environment for vegetation. The degree of soil saturation from flooding (and the resulting elevated groundwater levels) determines the types of vegetation that can grow throughout the floodplain and can create wetlands along stream and river channels.

The primary determinant of the structure of a viable floodplain ecosystem is the hydroperiod, or the timing (frequency and duration) and intensity of flooding. The hydroperiod, which is governed by the climate, soils and geology of the area, determines the amount and movement of water in soils across the floodplain. Acting as obstructions to, and often redirecting flood waters, the hydroperiod can also be influenced by development. The degree of urbanization in Pinellas County, including early development in floodplains, has significantly altered the hydrology of these areas and therefore the structure of floodplain ecosystems.

21. <https://www.floodsciencecenter.org/products/crs-community-resilience/green-guide/>

The distinctive attributes of soils in riparian ecosystems are directly influenced by the hydroperiod, which determines the soil aeration (or oxygen level) as well as nutrients and content of organic material. In turn, the soil affects the structure and function of plant communities in these ecosystems. The aeration of soils is extremely important for rooted vegetation. When an area is flooded for long periods of time, low oxygen conditions can be created. Some plants have adaptations that help them survive in such conditions. Soils in riparian areas (especially wetlands) generally have a high level of nutrients because of the continual replenishment of nutrients during flooding. The periodic wetting of soil also releases nutrients from the leaf litter.

The edge of two distinct natural communities (an ecotone) tends to be more biologically diverse than each individual community. This is the case with floodplains, as nutrients, energy and water provide for high biological productivity. The soil conditions that result from varying amounts of moisture in soils leads to a greater diversity of plant species in riparian areas. Floodplains may be characterized by different zones of vegetation, with shallow aquatic vegetation shifting gradually to shrubs and trees toward the upland elevations. This variety in plant life translates into greater diversity of habitats for wildlife.

Relatively small changes in geology, topography and hydrology create diverse natural wildlife and vegetative habitats in Pinellas County. For example, transitions from hardwood swamp to wetland hardwood hammocks, and in turn, to hardwood forests in Pinellas County can be subtle. However, they create varied habitats which can support a greater diversity of vegetation and wildlife. Diverse vegetation can support a wide variety of wildlife and smaller organisms that feed on the plants. In addition, the trees and shrubs of upland areas offer protection and nesting and rooting areas for many species. Trees standing or fallen adjacent to the river's edge act to stabilize its banks, while fallen branches and root masses create aquatic microhabitats in the form of pools, breaks, and ripples. A stream itself can be a source of food and cover for wildlife, and the corridors themselves offer pathways along which birds, mammals, and fish can migrate. Wetlands are particularly valuable as nesting and feeding areas for fish and waterfowl.

Plants in river corridors provide natural floodwater storage capacity by slowing runoff and increasing the rate at which water infiltrates soils. This can result in the reduction of flood peaks downstream. Vegetation also allows the water to spread horizontally and more slowly, rather than running directly from upland areas into rivers or streams. In addition, the leaf litter and soils associated with floodplain vegetation act as sponges in absorbing some flood waters. Vegetation also passes water to the atmosphere through transpiration.

Maintaining the ecological integrity of riparian areas can help protect and even enhance the quality of surface and ground water. Trees and shrubs along stream beds can maintain the temperature of water by shading it. This is important as lower temperatures increase the capacity of the water to carry oxygen, which is critical for the support of aquatic life and decomposition of organic material.

Floodplain vegetation filters sediment and nutrients that move toward rivers and streams from upland areas. This function is critical because excessive nutrients in aquatic ecosystems can disturb the balance and growth of species and reduce the availability of oxygen in the water. The results can include reduced diversity, unpleasant odors, and, ultimately, human health problems. The degree to which floodplain vegetation performs its filtration function is dependent on several factors, including the slope and width of the floodplain and the nature of the vegetation.

The slowing and dispersal of runoff and floodwater by floodplain vegetation allows additional time for this water to infiltrate and recharge groundwater aquifers. Floodplain soils and vegetation can also help to purify the water as it filters down to the aquifer. In addition, water can also flow from higher groundwater systems into lower surface waters during periods of low flow, so that the frequency and duration of extremely low flows may be reduced. Many wetlands store water that is important for wildlife.

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Intact upland areas serve a vital ecological function for Pinellas County, providing critical habitat for both plant and animal species that need to be preserved. Upland areas have previously been subject to destruction in efforts to meet wetland mitigation requirements. When this is done, wildlife habitat is destroyed, and species are displaced.

Upland areas also need protection because of the adverse impacts that their destruction can have on other ecosystems in the County. Excessive erosion from upland areas can have an adverse effect on adjacent aquatic habitats. Suspended sediment can block sunlight, killing seagrass beds. Erosion from upland development activities, typically the destruction or removal of vegetation, can significantly increase sedimentation in an adjacent floodplain. This can result in an adverse impact on the ability of the natural system to function and on the flora and fauna that inhabit these areas.

Pinellas County code has incorporated provisions that protect upland habitats and minimize the impacts of erosion due to development activities.

WATER RESOURCES AND AQUATIC COMMUNITIES MANAGEMENT

Water is essential to sustaining life. Pinellas County has significant water resources that must be conserved and enhanced to protect quality of life in the County. Water resources are so interconnected with other resources that the protection and management of water resources appears in multiple elements of this Comprehensive Plan, including: Surface Water Management; Potable Water Supply, Wastewater and Reuse; and Coastal Management. Other elements also consider water resources, including: Future Land Use; Recreation, Open Space and Culture; Economic Prosperity; Solid Waste and Recovery; Transportation; and Governance. Although some repetition is unavoidable, the Natural Resources Conservation and Management Element of PLANPinellas focuses on groundwater and aquatic communities' preservation, conservation, and management to reduce repetition in other elements.

GROUNDWATER SYSTEMS AND AQUIFER RECHARGE

Pinellas County obtains most of its potable water supply from groundwater sources via Tampa Bay Water (TBW), the regional water utility. Groundwater is located in geological formations known as aquifers, which are made up of porous rock, sand or gravel. These porous materials can store water and allow it to move within the aquifer. Several aquifers may be present below the surface at any one location. These aquifers are separated by confining layers that are impermeable or semi-permeable to water.

Rainfall is the source of groundwater. Rainfall percolates downward through porous surface soils to enter the aquifer strata. The permeability of different soils varies greatly; however, soils with a high degree of permeability will allow a better aquifer recharge by allowing more rain to percolate through the soil. Examples of typical values in Pinellas County include highly permeable sands and relatively impermeable clays.

The groundwater system in Pinellas County is composed of three hydro-geologic layers. The top layer is the water table aquifer composed mostly of unconsolidated sands located at or near the ground surface. The lowest component is the Floridan Aquifer, which is found in the porous limestone underlying the County. Between these aquifers are the confining deposits composed of the finer grained sands and clays of the Hawthorn Group.

Aquifer recharge areas are subject to alteration by development. Covering a recharge area with impervious surfaces, such as roads, parking lots and buildings reduces the area available for rainfall percolation, altering the total rate and volume of recharge to the underlying aquifer. Increasing the rate at which stormwater is drained from recharge areas can also reduce recharge potential.

THE HYDROLOGIC CYCLE

The hydrologic cycle is the process through which water moves from a surface water body to the atmosphere, to the land, and back to the water body. The source of much of the rain that falls on Pinellas County is air masses in the Gulf of Mexico colliding between sea breezes and easterly winds across the state. This occurs as air masses lying over the Gulf gain large quantities of moisture through evaporation. These air masses then move inward over the warm land surfaces. As the air rises, the moisture condenses, clouds develop and much of the water falls as precipitation.

Rainfall, after reaching the County, is conveyed in two ways. First, the processes of evaporation and transpiration return a major part to the atmosphere. The water may return to the air as a result of evaporation from vegetation, streams, ponds, soils and the Gulf. It may also return to the air as a result of evaporation while falling, or through transpiration from vegetation. The remaining rainfall that does not run off directly to the Gulf or to streams and lakes percolates downward to the Surficial Aquifer. The hydrologic cycle continues as groundwater is eventually processed through the cycle and recharges the aquifer or evaporates or is transpired. This may occur as the groundwater passes to vegetation, to the soil from which it evaporates, to streams, or directly to the water body. Evapotranspiration and drainage from the land are continuous processes, although they are variable in rate and amount.

The rainy season in Pinellas County generally lasts from June through September. During these four months, the County receives, on average, about 60% of its average annual rainfall. “Dry” season, is a relative term, since the County average rainfall for the October-May period is about 20 inches. However, rain events are much less frequent in the dry season and rainfall intensity generally lower than in the rainy season. Snow events are very rare in Pinellas County.²²

Most rainfall is lost by evapotranspiration, and the chief factor affecting the evapotranspiration rate within the area is the depth to the water table. Because rainfall is variable in the region, the net recharge to the groundwater system is difficult to estimate at different times and at different locations. Localized recharge to the Floridan Aquifer directly through surface water bodies occurs in places where the confining layer is absent. Dredging the bottom of surface water bodies can therefore have an impact on the system.

GROUNDWATER AS A POTABLE WATER RESOURCE

In response to the concerns related to environmental impacts of groundwater pumping, and the need to ensure adequate potable water supply for the future growth and development of the region, the West Coast Regional Water Supply Authority was re-organized as a regional water utility and became known as Tampa Bay Water, in 1998. This reorganization resulted from lengthy and historic negotiations between the six member governments (Hillsborough, Pasco, and Pinellas Counties, and the Cities of New Port Richey, St. Petersburg and Tampa).

As part of the interlocal agreement adopted by the member governments, most of the potable water resources owned by the members were transferred to Tampa Bay Water with the exception of the City of Tampa, which maintained exclusive rights to surface water withdrawals from the Hillsborough River and Sulfur Springs (Tampa Bay Water may access these sources only when surplus flows are available), New Port Richey, which retained rights to several small urban wells, and Pasco County, which maintained rights to several small production wells.

The 11 permitted regional wellfields were brought under a consolidated Southwest Florida Water Management District (SWFWMD) water use permit issued to Tampa Bay Water. Since Oct. 1, 1998, Tampa Bay Water has been the sole and exclusive water provider to the six governments it serves. The main goals of the agency’s creation were to reduce

22. http://www.pinellaslms.org/pdf/current_LMS_plan.pdf

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groundwater pumping from 11 long-producing wellfields, develop new water supply sources, end potable water litigation among various entities and obtain funding from the SWFWMD. Tampa Bay Water has successfully met those goals.

Tampa Bay Water is also charged with the responsibility of developing and implementing a Master Water Supply Plan to replace approximately 50% of the original permitted capacity of the regional wellfields and to meet the current and projected needs of the member governments. This Plan addresses the identification of and schedule for, implementing new sources of potable water and additional transmission mains for transfer of water between sources. The Interlocal Agreement effectively removed Pinellas County Utilities, and the other member governments, from water supply development activities, except for certain actions which may be undertaken if Tampa Bay Water fails to meet its obligations relating to production.

GROUNDWATER RECHARGE

Since rainwater percolating through the soil is the source for replenishing groundwater supplies, it is important that areas with high percolation rates be protected. These areas are known as recharge areas and have a direct influence on the quality and quantity of water within the aquifer. Measures should continue to be taken to ensure that the natural conditions of the recharge area (i.e., soil type, vegetation, amounts of impervious surfaces, pollution sources) remain relatively unaffected by human activities. Any detrimental changes to recharge areas could interfere with their proper hydrological function.

According to SWFWMD's groundwater resource availability inventory for Pinellas County, it appears that recharge to the Florida Aquifer is along the uplands of the Pinellas ridge and Northeastern Pinellas County. The area east of Lake Tarpon is influenced to a certain extent by draw down from the Eldridge-Wilde wellfield. This recharge area is separated from the Clearwater/Dunedin recharge area by Lake Tarpon and the Lake Tarpon outfall canal. Lake Tarpon is probably part of a discharge area due to its connection with the Floridan Aquifer. The Lake Tarpon outfall canal is a relatively recent addition to the hydrologic system.

The Clearwater/Dunedin recharge area found west and south of Lake Tarpon exists primarily because of limestone formations overlain by relatively thin sinkhole perforated clay deposits and sands. The potentiometric surface is relatively high in this area and is found near the Coachman and Countryside areas of Clearwater. These highs represent a high-water level in this area and have great potential for sustainable water withdrawals. Curlew Creek, with its deep stream bed, partially divides the north and south portion of the recharge area in the western portion of the County. Since much of the recharge in this area is derived from sinkholes, land use management practices must prevent contamination and alteration of these features, especially those in internally drained areas. The upland St. Petersburg area has also been identified as a recharge area. Very few individuals use wells in this area as a source of potable water, and most use this groundwater for lawn irrigation.

GROUNDWATER CONTAMINATION

One concern related to development within aquifer recharge areas is the potential for contamination of groundwater within the aquifer. Just as storm water runoff can carry pollutants into surface water, pollutants picked up by runoff which eventually enters an aquifer can degrade groundwater quality. Since water moves within an aquifer from higher pressure to lower pressure, down gradient portions of the aquifer have the potential to be polluted over time.

Pinellas County Utilities purchases 100 percent of its water from Tampa Bay Water. The Florida Department of Environmental Protection has performed a Source Water Assessment on the TBW system. These assessments were conducted to provide information about any potential sources of contamination in the vicinity of their wells or surface water intakes. The assessment results for TBW are available on the FDEP Source Water Assessment and Protection Program (SWAPP) webpage at <https://fldep.dep.state.fl.us/swapp/>

Contaminants that may be present in source water include:

- Microbial contaminants, such as viruses and bacteria, which may come from sewage treatment plants, septic systems, agricultural livestock operations, and wildlife.
- Inorganic contaminants, such as salts and metals, which can be naturally occurring or result from urban stormwater runoff, industrial or domestic wastewater discharges, oil and gas production, mining, or farming.
- Pesticides and herbicides, which may come from a variety of sources such as agriculture, urban stormwater runoff, and residential uses.
- Organic chemical contaminants, including synthetic and volatile organic chemicals, which are by-products of industrial processes and petroleum production, and can also come from gas stations, urban stormwater runoff, and septic systems.
- Radioactive contaminants, which can be naturally occurring or the result of oil and gas production and mining activities.

Pinellas County Utilities provides a detailed listing of potential contaminants in its Consumer Confidence Report, available online at <https://www.pinellascounty.org/utilities/publications-ccr.htm>

GROUNDWATER CONSERVATION

Pinellas County has developed a variety of tools for offsetting the use of groundwater, including an extensive reclaimed water program, for example. Pinellas County Utilities' water conservation program includes educational outreach efforts, incentives and special events designed to highlight the importance of conservation and waste reduction. For more detailed information about water conservation programs in Pinellas County, please refer to the Potable Water Supply, Wastewater and Reuse Element.

PINELLAS COUNTY WELLHEAD PROTECTION EFFORTS

Pinellas County is committed to conserving its natural resources by developing policies designed to maintain groundwater and natural systems by protecting groundwater, public supply wellheads and the watershed from substances that might cause degradation of the aquifer or system losses. Pinellas County will continue to control the use and storage of hazardous substances within its zone of protection for its wellfields through implementation of the wellhead protection provisions of the Pinellas County Code. Furthermore, Pinellas County will continue to utilize its emergency response program that includes provisions for responding to accidental pollution events and providing a list of toxic and hazardous substances subject to the restrictions of the program, and shall require that businesses within the wellhead protection zone include emergency response measures within their operating permits.

Pinellas County's Wellhead Protection Program creates a Zone of Protection around the Eldridge-Wilde wellfield. The wellfield is located in northeastern Pinellas County and northwest Hillsborough County, bordered on the north by Pasco County. The Board of County Commissioners decided in the 1970s that since the area surrounding the wellfield was mostly undeveloped, the most direct way to offer protection to the groundwater resource was through the acquisition of land and the establishment of land use controls.

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The Zone of Protection was defined by hydro-geologic studies to identify and describe the aquifer that is present in the wellfield areas, and potential yields were estimated by obtaining historical water level data from the U.S. Geological Survey and Pinellas County Utilities monitoring wells. The Zone of Protection for the Pinellas County wellfield encompasses portions of Pinellas, Pasco, and Hillsborough. Land use intensity and density in this zone were reduced. Pinellas County Utilities has acquired vacant land in the vicinity of the wellfield and subsequently applied a Preservation, or Preservation-Resource Management land use designation, in order to allow for expansion and/or relocation of potable wells and to protect the recharge areas of the existing wellfield.

Additional protections offered by the Ordinance include requiring existing commercial users that use, handle, produce, store or dispose of regulated substances to obtain permits, with annual renewal and inspection requirements. Commercial or industrial septic tank disposal systems are also prohibited. Underground storage facilities, stormwater discharge, commercial stormwater runoff, and golf courses are also regulated.

Pinellas County relies upon and coordinates with Tampa Bay Water to assess groundwater quality and the impacts of groundwater withdrawals. Pinellas County enforces zones of protection for regional wellfields within Pinellas County boundaries, consistent with the adopted Wellhead Protection Ordinance. This Ordinance was implemented to protect and safeguard the health, safety, and welfare of the residents and visitors of Pinellas County by providing criteria for regulating certain substances that may impair present and future public potable water supply wells and wellfields. It prohibits or restricts all non-residential activities that use, handle, produce, dispose, and/or store regulated substances within the Zone of Protection, except as provided under the General Exemption and Special Exemption provisions of the Ordinance. Residential activities and stormwater ponds are also regulated by this ordinance. Certain activities in noncompliance with this Ordinance may be required to cease operation.

Pinellas County developed a pollution prevention program to minimize the amount of liquid, solid and gaseous pollutants throughout the County, which further enhance groundwater quality. In this voluntary program, County staff works with private industry to help them identify pollution prevention methods that can be incorporated into their normal business practices, including the use of new technologies, substitute products, conservation practices, efficiency enhancements and recycling. The overall goal of the program is for industry to reduce costs by utilizing practices that benefit the environment.

Pinellas County cooperates with adjacent municipalities and counties to protect existing and future public potable water supplies. Pinellas County participates in several cooperative efforts to promote enhancement and restoration of the County's groundwater resources. These opportunities for conservation include joint efforts with the SWFWMD, the Florida Department of Environmental Protection's Pollution Recovery Trust Fund, and the Pinellas Anclote Basin Board's Cooperative Funding Program.

MARINE RESOURCES PROTECTION AND MANAGEMENT

SEAGRASSES

Pinellas County currently has designated protection zones for seagrass beds and has adopted associated protection measures and regulations to protect this natural resource. Seagrass Caution Areas are in place to alert boaters of the presence of seagrasses and the need to exercise caution in these areas. Combustion Motor Exclusion Zones are areas where combustion motors are not allowed in order to protect the seagrasses from propeller damage. The current seagrass protection areas are located in southern Pinellas County in the Shell Key Preserve, in areas around Fort De Soto, around Caladesi and Honeymoon Islands, and in the area surrounding the Weedon Island Preserve.

Pinellas County participates in a regional, multi-governmental seagrass monitoring program developed by the Tampa Bay Estuary Program (TBEP). The program was designed to characterize the general health and condition of seagrass meadows around the bay area. Pinellas County monitors seagrass in Tampa Bay, Boca Ciega Bay, Clearwater Harbor, and St. Joseph Sound. Results are summarized every two years, after compiling annual field data collected from various entities as well as aerial imagery. The acreage of seagrass in Tampa Bay has increased significantly in recent years after a drastic decline in the 1970s and continues to increase, as described in the most recent seagrass mapping summary.²³

MANATEES

The coastal waters of west central Florida provide an important year-round home to the West Indian (Florida) Manatee. There are several dozen manatees within Tampa Bay waters during the summer, but well over 300 during the winter months. Manatees are a charismatic species of concern protected under the federal Endangered Species Act and under the Marine Mammal Protection Act. When aerial surveys began in 1991, there were an estimated 1,267 manatees in Florida. Today there are more than 6,300 in Florida, representing a significant increase over the past 30 years.²⁴

Manatees live in freshwater, brackish water and the marine environment, moving easily between salinity regimes. Along the coast, manatees are generally found feeding in water depths of three to seven feet, but they remain close to deeper waters.

They generally travel along the coastline in waters ranging from 10 to 16 feet in depth. Manatees cannot endure temperatures below 66F (19C) for extended periods of time and will seek refuge in warmer waters. In the winter months, manatees congregate in larger groups near warm water canals, natural springs and outfalls, the latter often associated with local power plants. During the summer months, manatees may be found in small groups dispersed throughout nearshore waters, inlets and bays.

Manatees generally feed among seagrass beds, although they also enjoy marsh grasses, mangrove leaves, algae, hydrilla and water hyacinths. Access to fresh drinking water is critical and includes natural springs as well as stormwater outfalls. When calving, manatees seek out quiet, protected locations.

Pinellas County has identified several important manatee habitat locations, following the initiation of its detailed data collection and analysis effort in 1992. Important manatee habitats in Pinellas County include:

- Coffee Pot Bayou – Located in east St. Petersburg, this location is typified by freshwater springs, which manatees primarily use for drinking water.
- Fort DeSoto Park/Tierra Verde – The expansive seagrass beds provide prime feeding areas.
- Spring Bayou/Whitcomb Bayou – Located in Tarpon Springs, these bayous have freshwater springs that provide drinking water and warm water refuge during the winter.
- McKay Creek – Located in west Largo, this freshwater creek discharge provides drinking water. There are also seagrass beds located in the vicinity.
- Boca Ciega Bay – Portions of the bay have seagrass beds for feeding.
- Other designated minimum wake and no wake zones in the Intracoastal Waterway and Tampa Bay.

Although the Board of County Commissioners has not been required to adopt a formal Manatee Protection Plan, the County has a long record of taking actions, and adopting policies and regulations, that serve to protect the County's coastal resources and dependent species, including manatees. Manatees and boaters are constantly sharing the County's waterways. Where the overlap becomes critical is often in shallow waters where seagrass beds are located, and manatees have more trouble avoiding boats. The County's seagrass protection zones help to protect manatees in these prime feeding areas.

23. http://www.tampabay.wateratlas.usf.edu/shared/learnmore.asp?toolsection=lm_seagrass

24. <https://www.fws.gov/southeast/wildlife/mammals/manatee/>

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SEA TURTLES

All of the sea turtles that nest on Florida's beaches, including Pinellas County, are protected by Florida Statutes and the United States Endangered Species Act (ESA). The species include the loggerhead, the leatherback, the green turtle, the hawksbill, and the Kemp's Ridley.

Sea turtle nesting in the southeastern United States (of which Florida constitutes 90 percent), comprises the second largest nesting "assemblage" in the world. Florida plays an important role in the survival of sea turtle populations because it has the most diverse and abundant sea turtle population of any state or territory in the United States. While Pinellas County does not contain any major sea turtle nesting areas, its extensive coastline makes it an important location for sea turtle nesting. Since the early 1990's, Pinellas County has provided funds to the Clearwater Marine Aquarium to survey the beaches daily, from Clearwater Beach down to St. Pete Beach, for turtle nests during the nesting season to help ensure that proper protection measures are carried out when nests are identified. Of the five species of turtles that are found in Florida, only the loggerhead nests regularly on Pinellas County beaches. Although small in quantity, the maintenance of Pinellas County's current sea turtle nesting distributions is important. Even small nesting populations add to the overall maintenance of the genetic diversity of sea turtles.

Marine turtle nesting and hatching occurs each year from May 1st through October 31st. Female turtles come ashore in the dark, dig a hole using their flippers, and lay 100 to 150 eggs at a time. During the course of a season, a single female lays three to eight nests. After a 45 to 70-day gestation period, hatchlings emerge from the nest at night and follow the moonlight reflecting off the Gulf. Sea turtles can become disoriented from lights and illuminated objects visible from the beach. Most importantly, bright lights disorient hatchlings by attracting them inland where they often die of dehydration, predation, or are run over by motor vehicles. It is very important that occupants and managers of beachfront properties minimize the use lights that shine directly on the beach.

Pinellas County conducts a monitoring program to ensure that nests are not disturbed by beach nourishment activities. Daily early morning surveys are performed during the nesting season in search of nests. Pinellas County contracts with the Clearwater Marine Aquarium (CMA) and Sea Turtle Trackers (STT) to monitor sea turtle nesting along all nourished and non-nourished beaches. When nourishment projects occur during sea turtle nesting season, sea turtle nests are relocated from within the construction zone to areas outside of it in accordance with all permit requirements. Without the habitat provided by periodic nourishment projects, the number of nests laid each year likely would be much lower.

MARINE HABITAT PROTECTION, RESTORATION AND CREATION

The important nursery habitats utilized by fish, crabs, and other marine animals continue to be largely protected through public ownership or strict development regulations. These fisheries are not only important for environmental sustainability but are also the major contributor to the sustainability of the recreational and commercial fishing industries in the area.

The County's Watershed Management Planning process addresses restoration, habitat enhancement, and drainage improvements. The County also cooperatively participates in other efforts, such as the Surface Water Improvement and Management (SWIM) projects, the Pinellas Anclote River Basin Board Cooperative Funding projects, and the Department of Environmental Regulation-Pollution Recovery Trust Fund Projects, to improve coastal habitats and aid in the understanding of any future actions that may be needed.

Pinellas County has developed both inshore and offshore artificial reefs. The inshore reefs were designed by Pinellas County Utilities as part of an environmentally sensitive coastal enhancement program in the 1990's. Marine biologists and engineers hoped these reefs would replace hard bottom habitats impacted by beach restoration projects. Inshore reefs can be found anywhere from 100 to 900 yards offshore from Sand Key in approximately 15 feet of water, having a height of three to five feet.

Thirteen artificial offshore reef sites were developed by Pinellas County Utilities 3 to 38 miles offshore in the Gulf of Mexico. Each reef's individual design has different sized opening for different sized fish. These openings attract bottom dwellers like grouper, snapper, and grunt. The height of the structures attracts migratory species like mackerel, amberjack, cobia, barracuda, and baitfish. The reef sites can have a base diameter of up to 100 feet and reach up to half the water's depth. Approximately two weeks after placing the reef material on the ocean floor, barnacles and algae form on the reef. Soon, sea urchins and small fish come to feed on the new reef. Within the year (typically between six and nine months), the reef begins to support coral growth. After a year of coral growth, several types of invertebrates, such as sea squirts, inhabit the reef.

This artificial reef program allowed for the recycling of concrete and other materials that may otherwise have gone to a landfill with no useful purpose. The construction of artificial reefs has provided vital habitat for fishery resources, recycles obsolete materials, and has allowed for additional recreation opportunities for both residents and tourists through fishing and diving activities. For more information on the artificial reefs in Pinellas County, see the Pinellas County Solid Waste website, at www.pinellascounty.org/solidwaste.

WATER AND NAVIGATION REGULATIONS

County regulations exercise locational restrictions and site-specific development controls to ensure development is undertaken in a manner that does not compromise the County's goals for protecting coastal and marine habitats and dependent species. Regulations in The Pinellas County Code protects the natural resources of the County through sound management and the judicious issuance of permits. The County regulates all dredge and fill activity, the placement of seawalls, and the construction of commercial and private docking facilities, including boardwalks, in the waters of the County. In order to provide protection for habitats that have a high degree of ecological value, all proposed projects are reviewed for their impact on many natural resources, including wetland areas. The County may consider proposals for mitigation in the review of permit applications. The replacement requirements for legally impacted wetlands are based on square footage. At a minimum, one acre (or portion thereof) is required to be created for each acre that is adversely impacted. Each acre must contain sufficient wetland replants to reestablish the wetland habitat with 85 percent coverage within three years. Jurisdiction is Countywide, but municipal review and approval is required before applications for development are heard.

The Boca Ciega Bay and Pinellas County aquatic preserves (referred to collectively as the Pinellas County Aquatic Preserves) were designated by the Florida State legislature with the intent of preserving the submerged lands of the County and Boca Ciega Bay, in an essentially natural condition so that their ecological and aesthetic values may endure for the enjoyment of future generations. The Aquatic Preserves include the submerged bottom lands of Pinellas County and the water column upon such lands as well as all publicly owned islands within the boundaries of the Preserves. The Preserves are protected from further sale or transfer and dredging and filling except when it is in the dominant interest of the general public.²⁵

The Florida Coastal Office (FCO) is the unit within the Florida Department of Environmental Protection (FDEP) that submerged lands and select coastal uplands. Enforcement of state statutes and rules relating to the Aquatic Preserves rests with the Florida Fish and Wildlife Conservation Commission (FWC) law enforcement and local law enforcement agencies. Enforcement of administrative remedies related to rests with FCO, the DEP Districts, and Southwest Florida Water Management District (SWFMD). Aquatic preserve management relies on many agencies, and the Pinellas County Code includes language to support management efforts.²⁶

25. <http://publicfiles.dep.state.fl.us/CAMA/plans/Pinellas-County-Boca-Ciega-Bay-AP-Management-Plan.pdf>

26. *Ibid.*

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The public education program provides information to the boating public on the protection of aquatic habitats and the value of wetlands as natural resources. Large informational signs have been erected at the major boat ramps and informational brochures depicting the zones and the value of seagrass beds are distributed to the public at local boat ramps and bait shops. A monitoring program has recorded an increase in the seagrass beds in the protected areas.

ECOSYSTEMS MANAGEMENT

The Natural Resources and Conservation Management Element provides a policy framework for ecosystem planning and management strategies affecting the County's natural resources. Pinellas County is a highly urbanized area and requires strategies for maintaining and restoring its remaining natural resources. Ecosystems management requires activity coordination at all levels, including government planning, land management, environmental regulatory programs, volunteer programs, and the general public for the protection of Pinellas County's natural environment.

In the past, vegetation and wildlife were destroyed or degraded by development practices. An integrated systems approach to environmental planning and management has been implemented in order to effectively manage the complex interactions between human and natural systems in Pinellas County. The natural and human environments are interconnected systems that must be managed in a manner that is sustainable and adequate for both communities.

The preservation and restoration of natural systems will not only improve the environmental quality of the County, but also result in more cost-effective performance of urban functions such as water purification, flood damage protection, stabilization of water course banks, aquifer recharge, and air quality maintenance. The programs discussed below represent a few of the environmental initiatives underway based on a systems approach to environmental management.

WATERSHED MANAGEMENT PLANS

Watershed Management Plans take a holistic approach to watershed planning, including the protection of natural systems and resources, and drainage concerns. The development of these plans involves the coordination of various agencies and stakeholders, including environmental groups, private citizens, and government agencies. More detailed information on watershed management plans can be found in the Surface Water Management Element of this Comprehensive Plan in the Watershed Planning section.

ENVIRONMENTAL LAND MANAGEMENT PLANS

Currently, there are three environmental land units with Management Plans in the County. These management plans were designed to provide policy direction to stakeholders for the protection of the environmental lands of the County.

Brooker Creek Preserve is comprised of approximately 8,800 acres of undeveloped land in the northeastern corner of Pinellas County, and provides value locally and regionally, as it borders preservation areas in Hillsborough and Pasco counties. The Pinellas County Board of County Commissioners and the Southwest Florida Water Management District have acquired this land to preserve the quality of life for the citizens of Pinellas County. One of the missions of the Preserve is to create the opportunity for County residents to experience, understand, and enjoy native Florida. The preservation of this region will also help to protect groundwater supplies in the County's Eldridge-Wilde wellfield, surface water quality entering Lake Tarpon, and a wealth of native plants and animals.

Brooker Creek Preserve supports a variety of vegetative communities, according to the Florida Land Use, Cover and Forms Classification (FLUCCS), including Rangeland, Upland Forests and Wetlands. These communities allow over 600 species of plants, 21 species of amphibians, 39 species of reptiles, 183 species of birds and 20 mammals to be found within Brooker Creek Preserve. This range of vegetative and wildlife diversity contributes to the overall biodiversity of Pinellas County and the region, which protects plant and animal species that otherwise may not thrive because of the adverse impacts of development.

The Brooker Creek Preserve Management Plan provides direction to the County's future efforts in resource management, environmental education, and public use. The Brooker Creek Preserve Environmental Education Center provides innovative programs aimed at teaching the public about Florida's diverse natural systems.

Weedon Island Preserve is an approximately 3,164-acre preserve that extends along the west side of Tampa Bay in Pinellas County. It is the second largest environmental land unit in Pinellas County and the largest on Tampa Bay. Mangrove-dominated islands and shoreline define the eastern edge of the Preserve. The variety of FLUCCS vegetative communities that can be found within Weedon Island Preserve include Freshwater Marshes, Wetlands, and Upland Forests. Weedon Island Preserve is a dominant feature along the western bank of Tampa Bay. The Gateway Tract, the northernmost property, encompasses approximately five miles of shoreline, and is bisected by the Howard Frankland Bridge. The Gandy Bridge defines the southern boundary of the Gateway Tract and the northern boundary of Weedon Island Preserve. The islands, adjacent shoreline, and uplands that comprise the Preserve are also dotted with an impressive array of cultural features and artifacts, which illustrate the land's significant role in Florida's anthropological history.

The goal of the Weedon Island Preserve Management Plan is to effectively coordinate management of the site's ecological and cultural resources using methods that promote public education and encourage compatible recreational activities. This plan serves as the basic statement of policy and direction for the management of the Weedon Island Preserve. This plan provides for the effective management of the property to promote indigenous species use, maintain temporal and spatial ecological diversity through the application of management tools (e.g., prescribed burns, removal of exotic species), protect the site's cultural resources, encourage compatible recreational land uses, promote restoration, and provide education. The Weedon Island Preserve Cultural and Natural History Center supports education objectives and is dedicated to reconnecting people with the environment.

Shell Key Preserve protects approximately 1,800 acres of sensitive marine habitats and includes one of the County's largest undeveloped barrier islands and numerous mangrove islands. The Preserve has been designated as one of the State's most important areas for shorebird nesting and wintering and supports diverse migratory songbirds. The Preserve hosts a range of vegetative diversity. Shell Key Preserve contains five distinct plant communities, including Marine Tidal Marsh, Marine Tidal Swamp, Beach Dune, Marine Unconsolidated Substrate, Marine Grass Beds, and Developed (while no development is permitted within the Preserve, there are some previously- developed areas located at its eastern and northern boundaries). The Preserve also supports Coastal Strand vegetative classification. Over 100 species of birds have been observed within the Preserve, including nesting Least Terns, American Oystercatchers, and Black Skimmers.

The Shell Key Preserve Management Plan provides direction for the future management and public use within the boundaries of the Preserve. The same features that attract diverse wildlife also attracts thousands of human visitors annually. The challenge for Pinellas County is to balance the demands for recreation in the Preserve, including camping, boating, swimming, shelling, and fishing, with the high level of sensitivity of the Preserve's natural resources.

In addition to the fee-simple ownership acquisitions such as those discussed above that have been utilized to protect natural resources and wildlife habitat in Pinellas County, the Board of County Commissioners has utilized other tools to protect environmentally-sensitive lands. These techniques include the designation of these areas as Preservation, Preservation-Resource Management, or Recreation/Open Space on the Future Land Use Map. Also, the transfer of development rights of up to one unit per acre from lands designated as Preservation to the contiguous upland of a

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development is also allowed on a case-by-case basis. The areas on the Recreation and Open Space Map and the Future Land Use Map correspond with the Florida Fish and Wildlife Conservation Commission Updated Recommendations for Strategic Habitat Conservation Areas.²⁷

At all preserves, as well as at parks and other environmental lands, the County partners with scientists from across Florida and the region to conduct research. Results of these studies help identify opportunities to better protect and manage the diverse cultural and natural resources found at these properties.

GREENWAYS AND INTERCONNECTIVITY

Greenways are another environmental land management tool the County has used to protect the natural environment. A greenway is a linear open space established along either a natural corridor, such as a riverfront, stream valley, or ridgeline, or over land along a right-of-way, a canal, a scenic road, or other route; any natural or landscaped course for pedestrian or bicycle passage; an open space connector linking parks, nature reserves, cultural features, or historic sites with each other and with populated areas. Greenways not only protect environmentally sensitive lands and wildlife, but also can provide people with access to outdoor recreation and enjoyment close to home. Greenways provide connections and are important as conservation and recreation areas themselves.

Major functions of greenways include: protection and enhancement of natural, historic, and cultural resources; provision of linear open space areas that are compatible for human use; and provision of connections between conservation lands, parks, and other recreational facilities. Greenways that link parks provide valuable recreational opportunities. Greenways that link conservation areas help to reduce the fragmentation of valuable wildlife habitat. Ecological, social and economic benefits are derived from greenways. Greenways help to maintain native ecosystems and landscapes, as well as provide for public recreation and outdoor education. Greenways such as the Pinellas Trail act as transportation facilities and provide a focal point for community pride and identity. These benefits help to promote the economic prosperity, connectivity and overall wellbeing of the community.

Individual greenways and greenway segments are also an important component of an overall Greenway system or network. Greenway systems act to link significant community “hubs” and smaller sites such as regional parks and preserves, ecological sites, and cultural and historic resources. The Greenway system makes up the “green infrastructure” of the community. Pinellas County has officially designated Greenways, including the Pinellas Trail, Brooker Creek Preserve, Weedon Island Preserve, the Friendship Trail, and McKay Creek. For more information on greenways, see the Greenways section of the Recreation, Open Space and Cultural Element of this Comprehensive Plan.

URBAN TREE CANOPY PRESERVATION AND PROTECTION OF NATIVE VEGETATION

Pinellas County was once a rural peninsula with a dense tree canopy, dominated by coniferous/pine forests punctuated with sabal palms, live oak trees and mangrove forests along the coastline. With the completion of the Orange Line Railroad in 1888, development pressures began to increase and much of Pinellas County was cut for timber prior to 1935. Following the harvesting of timber, much of the remaining land in the County was utilized for citrus, cattle and turpentine production. Severe freezes in 1957 and again in 1962 decimated virtually the entire citrus crop in the County. Following the loss of this sector of the economy, rapid suburbanization of the County resulted in significant loss of trees, and the wilderness gave way to pavement and concrete.

27. <https://myfwc.com/media/12976/tr15whneeds.pdf>

Some areas of Pinellas County have managed to maintain a portion of their native tree canopy. As a result of Urban Forestry's program to inventory and maximize the retention of mature public trees, Pinellas County has developed strategies and updated land development regulations to protect and enhance the remaining urban tree canopy. However, much of the urban tree canopy in Unincorporated Pinellas County on private lands is still vulnerable to development pressures, and additional strategies are needed to better protect these resources.

The Urban Forestry and Landscape Services section of the Public Works Department operates to sustain and enhance the environmental quality and appearance of the County through the maintenance and management of the urban forest and landscapes. The Urban Forestry team is specifically responsible for the maintenance and management of public trees as part of a diverse, healthy and sustainable urban forest within Pinellas County.

Trees provide many economic and environmental benefits that improve both the natural and human environments. Ecosystem services provided by trees include:

- Removal of pollutants from the air, soil and water
- Reduction of the urban heat island effect through shading of surfaces and release of water vapor
- Interception of rainfall and reduction of storm water runoff, reducing the costs related to infrastructure required to manage stormwater runoff and associated pollutants
- Energy savings and reduced greenhouse gas emissions from cooling/shading buildings
- Carbon storage and annual sequestration of CO₂ from the atmosphere
- Important habitats for wildlife
- Increase property values of residential homes²⁸

Many of the ecosystem services listed above can be quantified into economic terms. The structural value of street trees alone in unincorporated Pinellas County is estimated \$319 million (based on a 2019 Council of Tree and Landscapers Appraisers [CTLA] method assessment) and they are estimated to provide \$7.4 million in ecosystem benefits (as described above) annually. Urban forests also provide equally important but less quantifiable benefits such as improving the physical and mental health and well-being of the people living amongst them. Urban trees can reduce the perception of noise pollution and provide visual buffers between roadways and disparate land uses. Access to green spaces, specifically with tree canopy, has been documented to reduce stress levels, lower blood pressure and increase immune systems of urban dwelling citizens. Urban trees contribute to social cohesion of communities and provide a sense of belonging.

The magnitude of ecosystem services provided is tied to many factors, including tree and stand characteristics, leaf physical traits and tree species composition.²⁹ Mature trees with larger crowns that are in good condition provide more services than younger, smaller trees. According to the U.S. Department of Agriculture Forest Service, a healthy 30-inch tree removes 70 times more air pollution annually, than a 3-inch tree.³⁰ Ideally, an urban forest is comprised of trees of varied ages, which includes trees in their prime of ecosystem services, as well as maturing trees that will provide these services in the future. Protection and maintenance of mature canopy and planting new trees is critical to maintain the environmental function and economic value of Pinellas County's urban forest. The urban tree canopy and other green infrastructure assets maintained and enhanced by Urban Forestry and Landscape Services improves the quality of life and significantly adds to the value and attractiveness of the County.

28. Nesbitt, Lorien, et al. "The social and economic value of cultural ecosystem services provided by urban forests in North America: A review and suggestions for future research." *Urban Forestry & Urban Greening* 25 (2017): 103-111.

29. Roeland, Samson, et al. "Towards an integrative approach to evaluate the environmental ecosystem services provided by urban forest." *Journal of Forestry Research* 30.6 (2019): 1981-1996.

30. Nowak, David J. "The effects of urban trees on air quality." *USDA Forest Service* (2002): 96-102.

NATURAL RESOURCE CONSERVATION AND MANAGEMENT SUPPLEMENTAL [NRC]

AIR QUALITY

Air pollution can have negative effects on public health, the environment, and the economy. Breathing pollutants like ground-level ozone (O₃) or tiny airborne particles (PM_{2.5}) can cause respiratory problems, especially for people with asthma, heart disease, or other respiratory problems. Air pollution can cause damage to trees, crops, wildlife, and negatively affect bodies of water and aquatic life. Planning plays a role in improving our air quality by promoting land use, development and transportation policies that support local pollution control efforts.

EPA DELEGATION

The U.S. Environmental Protection Agency (EPA), through the Clean Air Act (CAA), has established regulatory limits to the amount of pollution allowed in the ambient air and the amount of pollution a source is allowed to emit into the air. The Florida Department of Environmental Protection (FDEP) together with local agencies, including Pinellas County, implement the Clean Air Act locally to help ensure basic health and environmental protection from air pollution. This includes developing plans and solutions to pollution problems that are designed for specific geographical areas.

THE LOCAL AIR QUALITY PROGRAM

Pinellas County is considered part of a larger Metropolitan Statistical Area (MSA) that also includes Hillsborough, Pasco, and Hernando Counties. Certain industries that are sources of air pollution within this entire MSA can affect the levels of air pollutants released into the environment. Air pollution can be transported away from the immediate source and effect larger areas.

An area is considered to be in “attainment” with the National Ambient Air Quality Standards (NAAQS) if it has levels of pollution less than the primary standards set by EPA. If pollution levels are above the primary standard levels, an area is designated as “non-attainment.” Air quality has improved nationally and locally in Pinellas County over the years since the CAA was enacted. The Tampa Bay area MSA is currently in attainment/maintenance for the criteria pollutants. Pinellas County is in attainment for all criteria pollutants. Hillsborough County is currently designated as a maintenance area for SO₂ and lead. In order to achieve the air quality goals established in the Comprehensive Plan, Pinellas County maintains its accreditation as an approved local air quality program. The State of Florida and the EPA annually review the work plan and work products of the air quality program.

NAAQS are re-evaluated regularly by EPA. As recently as 2015, the EPA reduced the ozone primary and secondary standards to 0.070 ppm (from 0.075 ppm). Pinellas County meets this more stringent standard at the current time. Ongoing monitoring efforts by Pinellas County Air Quality are used to demonstrate the area’s designation for NAAQS attainment.

The Pinellas County Air Quality Division oversees the countywide Air Quality program, covering everything from monitoring, data analysis for proposed regulatory programs, regulatory inspection, to conducting education/outreach. The Air Quality Division implements the compliance and enforcement requirements for local industries and businesses. Facility inspections and enforcement procedures have been established to fulfill federal, state and local regulatory programs to minimize human exposure to carcinogens and toxic substances.

Air pollution does not respect jurisdictional boundaries. Although air quality in Pinellas County is affected by activities outside its borders, the oversight, reporting and administration of the compliance and enforcement program have contributed to the improvement of air quality and compliance with established NAAQS.

The Air Quality Division website is maintained and updated on an ongoing basis.³¹ The website is a key component of the Division's outreach and education program. It has detailed information relating to Division programs, an air quality complaint system, links to other environmental agencies, and provides access to historical and real-time monitoring data.



Image Source: Visit St. Pete Clearwater

31. <http://www.pinellascounty.org/environmental/airquality/default.htm>