Fly Creek Watershed
Restoration Project

March 2013 | Proposed by the City of Fairhope

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Executive Summary

Introduction and Background

The Fly Creek watershed area has witnessed intensive population growth and land cover disturbances. The area from the northern portion of Fairhope, north towards Daphne continues to experience expanding residential housing development and business growth. The natural resources of Fly Creek provide vitally important intertidal habitat for marine/estuarine species. The stream also contributes clean freshwater and organic materials that serve to fuel the Mobile Bay ecosystem. The resilience of Fly Creek has enabled this coastal stream to contribute positively to the Mobile Bay ecosystem in spite of continued economic development and human population growth. However, if Fly Creek is to continue its vital contributions to Mobile Bay, certain restoration measures and conservation techniques must be applied for the long-term protection of this watershed. The information compiled for this report is to assist the City of Fairhope in identification of restoration projects and conservation opportunities being considered along the Gulf Coast to address adverse environmental and human impacts related to the 2010 BP Deepwater Horizon Oil Spill – whether through the Natural Resources Damage Assessment (NRDA) process, the Recovery Act process, or the National Fish and Wildlife Foundation (NFWF) process (based on settlement of federal criminal charges).

If Fly Creek is to continue it's vital contributions to Mobile Bay, certain restoration measures and conservation techniques must be applied for the long-term protection of this watershed.

Watershed Description

Fly Creek is a relatively small perennial stream that flows into Mobile Bay within the city limits of Fairhope in Baldwin County, Alabama. The watershed area that feeds Fly Creek is approximately 2 miles wide and 4 miles long, encompassing approximately 5,018 acres. The lower end of Fly Creek (estimated 1 mile) is within the tidal influence associated with Mobile Bay and the Gulf of Mexico, with the remaining water courses consisting of approximately 18 miles of perennial stream, intermittent streams, and 20 man-made lakes/ponds. The water quality within the Fly Creek watershed is generally good. Vegetative buffers of native forest have been shown as highly effective in reducing and eliminating the flow of nutrients from upslope within the watershed into streams such as Fly Creek (City of Fairhope 2003). The elevations within the watershed range from zero/sea level at the mouth of Fly Creek to approximately 140 feet above sea level in the eastern side of the watershed near State Highway 181. The total average annual rainfall is approximately 64 inches, being among the highest in the United States. Rainfall is usually of the shower type with long periods of continuous rainfall being less common. Tropical summer thunderstorm events are capable of producing localized heavy rainfall totals of several inches with a 1-2 hour timeframe.

Some of the subsoil strata in the watershed contains fine sand and silty stratum which are both highly erodible when exposed to precipitation and stormwater runoff. Throughout the Fly Creek watershed, economic development and growth continues to increase with each passing year.

The health of the watersheds, such as Fly Creek, that feed into Mobile Bay is strategically important to the long-term restoration and preservation of the economy and ecology of communities like Fairhope.

The watershed is being transformed from woodlands, pastures, and cropland into residences, subdivisions, schools, shopping centers, and expanding roadways (ADEM, 2004). A serious consequence of urban growth is increased stream sedimentation causing siltation. Rainfall runoff from constructions sites is a major source of soil erosion in urban areas under development. When the vegetation is removed at construction sites, bare soils are exposed to raindrop impact and are more vulnerable to erosion. Another result of continued urban growth is the increase of impervious surface cover. Impervious surfaces are any surfaces that prevent or impede the infiltration of water to the soils. They include roadways, parking lots, rooftops, and sidewalks. Areas with more impervious surfaces generate more runoff during rainfall events, which increases the potential for degrading stream channels and banks (ADEM, 2004) and contribute to increased pollutants entering the creek.

The aquatic and terrestrial ecosystems in and around Fairhope have provided a diverse and productive area for recreational and commercial harvest of marine species such as shrimp, crabs, and oysters and key upland areas that produce outputs such as economically important pine timber, pastures for cattle farming, and key agricultural row crops/orchards such as pecans, corn, cotton, soy beans, wheat, etc. The natural resources associated with Fly Creek are crucial to the economic engine of Fairhope and neighboring municipalities. In addition, the ecological integrity and habitat/species diversity are paramount to the quality of life in this rich coastal area. The health of watersheds, such as Fly Creek, that feed into Mobile Bay is strategically important to the long-term restoration and preservation of the economy and ecology of communities such as Fairhope. The streams and riparian habitats along coastal water courses such as Fly Creek not only provide spawning and nursery areas for a number of important estuarine/marine species, but these water courses provide key nutrients, microorganisms, and natural organic materials to fuel the food chain within Mobile Bay and adjacent Gulf of Mexico.

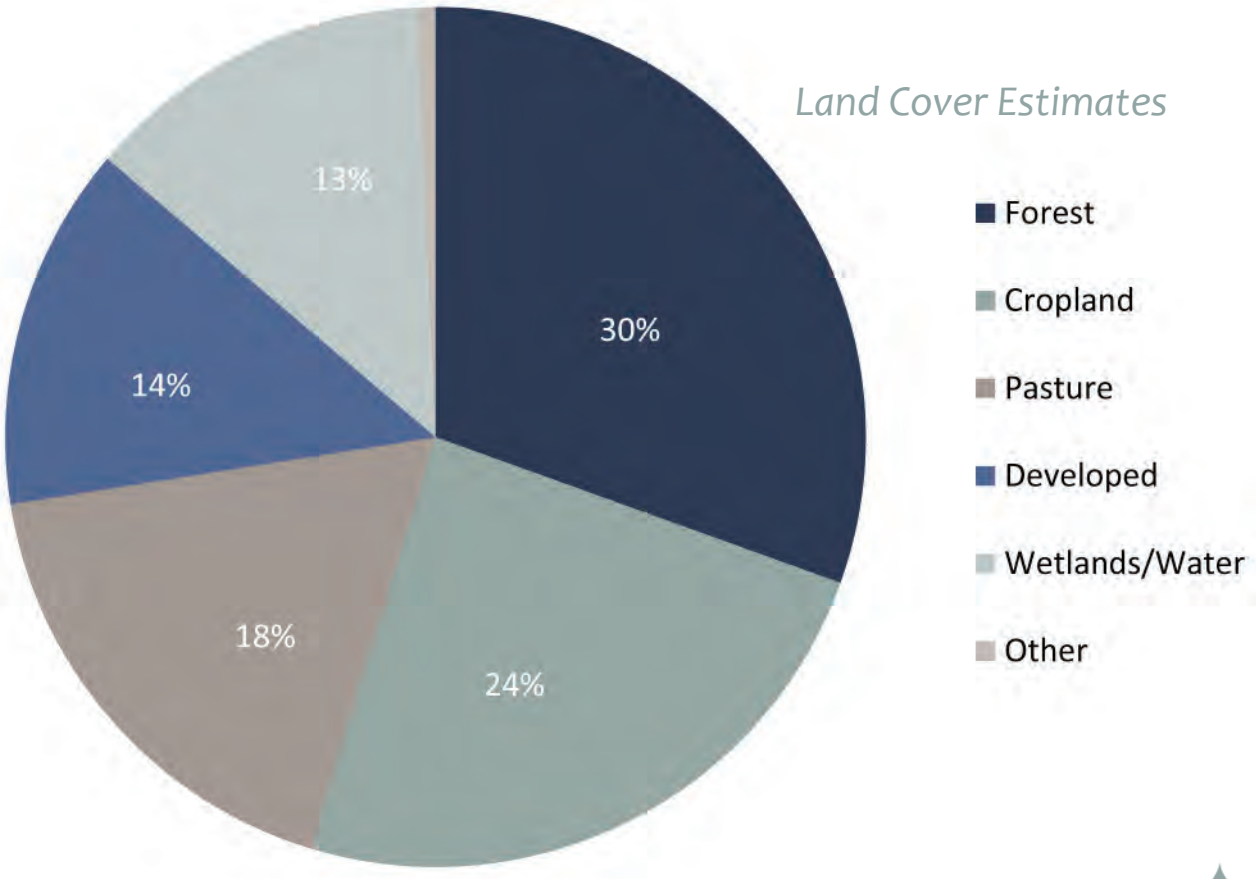
Watershed Description (cont...)

Based upon the U.S. Fish and Wildlife Service's (USFWS) National Wetland Inventory, there are approximately 285 acres of wetlands within the Fly Creek watershed. These wetlands are located within and adjacent to the water courses within the watershed and provide environmental services to the community such as flood storage, groundwater replenishment, water quality improvement, habitat for freshwater and marine species and for key terrestrial animals, corridors for wildlife passage, and aesthetic green space for residents of the area. The USFWS lists 18 species on their Endangered Species website for Baldwin County; however, based on the habitats available within the Fly Creek watershed the most likely species could include transients such as the recovered bald eagle (Haliaeetus leucocephalus) and endangered wood stork (Mycteria americana), or residents such as the threatened eastern indigo snake (Drymarchon corais couperi) and candidate gopher tortoise (Gopherus polyphemus). A healthy and diverse fish population within a stream requires an unimpeded channel open to upstream and downstream migration without the presence of major barriers. An example of a major fish migration barrier is the eroded culvert overfall present at the downstream end of the box culverts for Fly Creek under Business Highway 98. Habitats found within the watershed include southern forested wetlands, ponds and lakes, pine forest (including longleaf, slash, and loblolly), mixed pine and hardwood, cultivated crops, pasture, and residential/business developed areas. Some of these habitats have been recognized on a national level as imperiled and are worthy of restoration and preservation, including southern forested wetlands and longleaf pine forests.

Transients of Fly Creek Watershed include the recovering bald eagle, endangered wood stork and threatened gopher tortoise.

Invasive species threaten the integrity of the ecosystems by crowding out native species and creating large monoculture stands. Major invasive plant species within the Fly Creek watershed include: cogon grass (Imperata cylindrica); kudzu (Pueraria montana);Chinese privet (Ligustrum sinense); Japanese climbing fern (Lygodium japonicum); Chinese tallow tree (Triadica sebifera); bamboo (Bambusa multiflora); coral ardesia (Ardesia crenata); and torpedo grass (Panicum repens). An invasive animal species that is present within the watershed and is significantly impacting the environment is the wild hog (Sus scrofa).

The land uses within the Fly Creek watershed have changed with increased population from an area that historically was dominated by forest and agricultural land to one that has experienced relatively rapid residential and business development, particularly along major transportation corridors and within subdivisions such as Rock Creek, The Woodlands, and The Waters. Land cover estimates for the Fly Creek watershed, based on the National Land Cover Database (2006) analysis, are shown on the chart below.



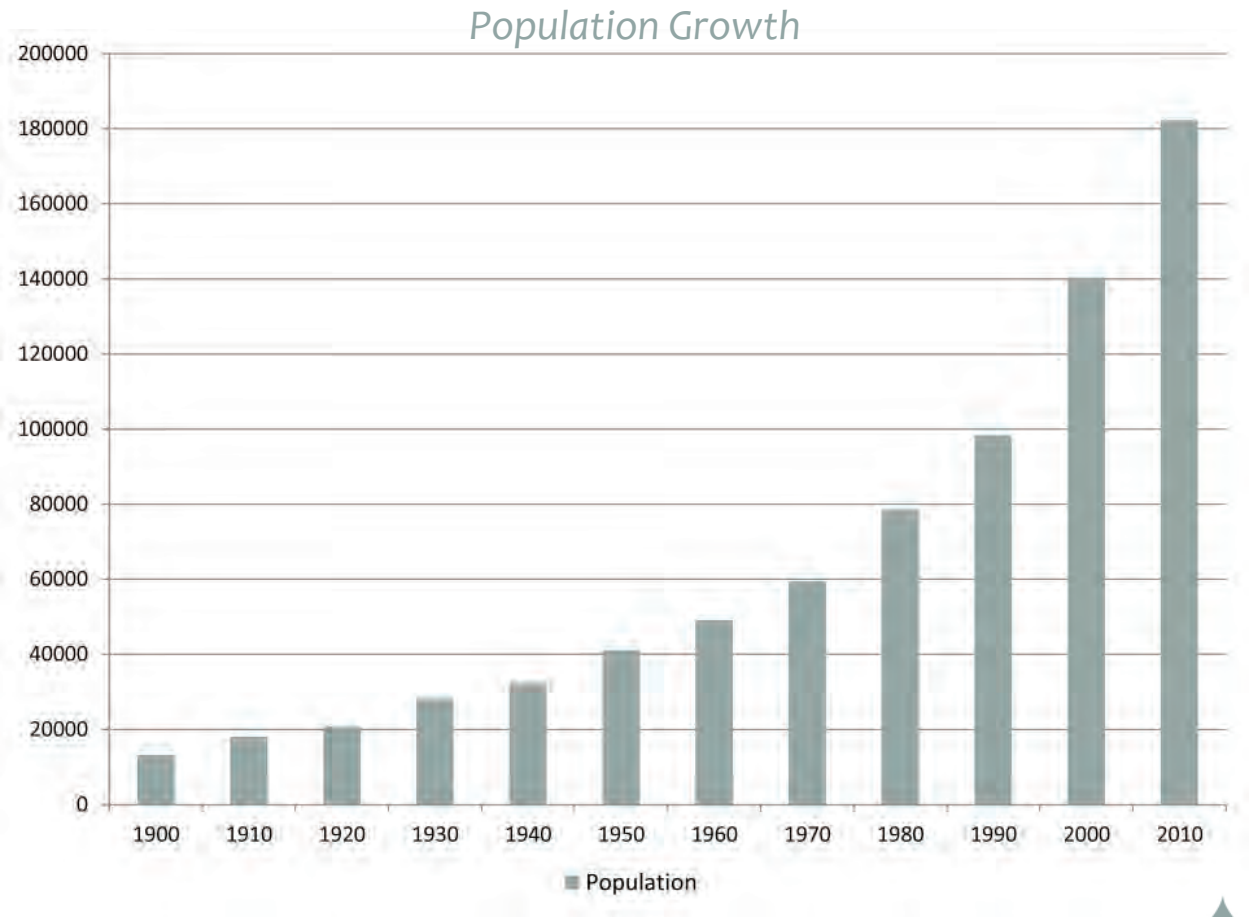
Watershed Description (cont...)

The majority of the Fly Creek watershed is within the unincorporated area of Baldwin County (3,655 acres), followed by the City of Fairhope (1,318 acres) and City of Daphne (44 acres). Zoning for the area within the watershed is divided according to political jurisdiction, incorporated areas of the City of Fairhope and City of Daphne, with the remainder covered by the unincorporated area of Baldwin County. All three of these entities have zoning regulations. The following is a listing of major zoning districts /types within the watershed based on acreage:

- 2,400 acres, Baldwin County Rural Agricultural District
- 1,129 acres, Baldwin County Unzoned
- 523 acres, City of Fairhope Planned Unit Development
- 443 acres, City of Fairhope (434 acres) and City of Daphne (9 acres) Low Density Residential
- 208 acres, City of Fairhope (196 acres) and City of Daphne (12 acres) Medium Density Residential
- 32 acres, City of Fairhope (15 acres) and City of Daphne (17 acres) High Density Residential
- 23 acres, City of Fairhope Shopping, Business, and Commercial Services

Some of the habitats have been recognized on a national level as imperiled and are worthy of restoration and preservation.

The majority of the land within the Fly Creek watershed is held in private ownership. Much of the land (approximately 2,600 acres) in the northeastern portion of the watershed is owned by members of the extended Corte family. The Corte family has maintained a large family farming and timber operation in this area since the late 1800's. The Dyas family owns 108 acres north and west of Highway 104 and Business Highway 98 that is critically located in the watershed. Publicly owned land within the watershed is very limited. The City of Fairhope owns approximately 65 acres of which approximately 60 acres is in the Fairhope Municipal Park and Municipal Pool complex at Business Highway 98 and Volanta Avenue, and about 3 acres at the mouth of Fly Creek, and a couple of other small parcels. The later area is not in use as recreational or open space. The 60 acre park is developed principally for team sports and is not natural park land. Baldwin County, particularly the Eastern Shore area along Mobile Bay including Fairhope and Daphne, has experienced rapid population increases over the past 50 years especially since 1990. The county is one of the fastest growing counties in Alabama. The following bar chart presents the Baldwin County population growth since 1900:



Watershed Restoration Issues

The past rapid population growth in this area of Baldwin County and the likely continuation of this pattern highlight the need to restore and preserve the natural resources within the watershed. Three critical conservation focus areas/items previously identified by the City of Fairhope (2003), include the following:

1) Restoration and preservation of ecologically significant natural communities, e.g., tidal streams, forested wetlands, and longleaf pine forests are very important to overall protection of the quality of life along this eastern shore of Mobile Bay.
2) Establishment of corridors linking various ecosystem preserves, e.g., establishing natural habitat connections along coastal streams and associated riparian areas with upland forests that remain in this area.
3) Management of invasive species that have spread extensively throughout the area and threaten to further diminish the biotic integrity and diversity.

Addressing these critical issues will not only serve to restore and protect the Fly Creek watershed, but also serve the broader goal of restoration of Mobile Bay and the Gulf Coast area. Key areas of restoration identified in this watershed evaluation are grouped into the following categories:

- Degraded Streams
- Degraded Wetlands
- Stormwater Management
- Land Use Practices
- Preservation of Natural Areas/ Open Space
- Creation of Riparian Buffer

The majority of the current stream degradation within the Fly Creek watershed relates to the sedimentation that has occurred as the result of erosion of soils from upland and riparian areas within the watershed and the fish barrier created by the culvert underneath Business Highway 98. The historic wetland plants and riparian vegetation along Fly Creek have been adversely affected by increased clearing for residential growth, replacement with turfgrass and other ornamental trees and shrubs, and expansion of invasive plant species such as Chinese tallow tree, kudzu, and Chinese privet. As roads, subdivisions, and businesses have been constructed within the watershed, there have often been rainfall events that have overwhelmed the capability of the installed stormwater management measures.

Although stormwater management practices are better than historically evidenced within the watershed, there continues to be opportunities for improvement as construction sites expand into previously undeveloped areas of the watershed. In addition, there are numerous opportunities to restore areas that have been negatively impacted in the past due to failed stormwater management practices. Land use practices on the various types of land cover within the watershed have a direct bearing on soil stability of that specific area of land, plus can also cause significant effects downslope/downstream within the watershed. As mentioned previously within this report, there is very little public land within the Fly Creek watershed (approximately 1%). With the majority of land within the watershed being private coupled with the continuing high growth rate for this area, current natural areas and open space will come under intense pressure for conversion and development as residential, business, and infrastructure rights of way. These land use conversions will not only change the land cover on some of the current natural areas, but will also fragment them, making them less valuable for wildlife habitat and incapable of providing wildlife corridors. The preservation of natural areas has numerous human benefits as well. The health of Fly Creek is highly dependent upon the protection of its riparian buffers, the last barrier of defense from environmental stressors located upstream in the watershed. A well vegetated riparian buffer (with native plants) along the creek functions to filter pollutants before they reach the stream, improve water quality within the stream, and preserve an aesthetically pleasing natural area.

There are numerous opportunities to restore areas that have been negatively impacted in the past due to failed stormwater management practices.

Restoration Measures

1) The 108 acre tract of undeveloped land is critically located in the watershed. Acquisition should be considered for the tract of land located west of Business Highway 98 and north of Highway 104. The tract is bounded by Fly Creek (north), Business Highway 98 (east), Highway 104 (south), and Scenic Highway 98 (west). This forestland includes a diversity of habitats along Fly Creek from Scenic Highway 98 to Business Highway 98. Habitats include the riparian corridor/forested wetlands on the south side of the creek, and a large continuous tract of mature longleaf pine. Scattered throughout the longleaf forest are some unique tree communities including species such as southern magnolia, sweetbay magnolia, American beech, live oak, southern red oak, water oak, sweetgum, blackgum, tulip poplar, wild persimmon, black cherry, eastern red cedar, and American holly. The proximity of this tract of land to the Eastern Shore Trail makes it ideal for passive recreation trail development, human use improvements, arboretum development, wildlife photography, etc.

2) Other land protection avenues should be explored to protect remaining natural areas and open space within the watershed. Several options, in addition to purchase, are available for local governments and private foundations to work with property owners to preserve these areas of natural beauty (City of Fairhope 2003):

   - Land Trust Ownership
   - Conservation Easements
   - Purchase or Donation of Development Rights
   - Transfer of Development Rights
   - Property Tax Incentives

   High priority areas should be considered for protection by one of the above methods.

3) Stormwater runoff from highways and streets northwest of the Highways 98 and 104 has contributed to significant gully erosion across private land in this property. Measures should be designed and implemented to rehabilitate this erosion site. Following restoration of that large erosion site, identify others within the watershed and develop plans to address stabilization measures. Stabilization of these erosional features will reduce the sediment load into the creek, improve water quality, and restore habitat for this important coastal stream.

4) The Alabama Department of Transportation should be contacted regarding the erosion that has occurred at the downstream side of the culverts under Business Highway 98. The approximately 30 foot gap in the grouted riprap has significantly eroded to the point that a 5-foot overfall exists and prohibits upstream fish passage. The construction of a rock ramp fish passage structure consisting of alternating pools and steps would allow fish and other aquatic organisms to freely pass upstream and reconnect with the several miles of free flowing waters upstream of the culvert.

5) Sediment impaired stream reaches should be identified and prioritized where it is appropriate to remove sediments that have been deposited. Whether sediment removal is by hand (bucket and shovel), or on a larger scale by mechanical dragline or hydraulic pipeline dredge, the disposal of the sediments must be in an appropriate location, possibly in some erosional areas upslope within the watershed. Wherever the sediment is deposited, it should be stabilized to prevent the erosional process from repeating itself. All sediment removal activities and sediment disposal must be in compliance with appropriate Corps of Engineers and ADEM regulations.

6) Develop an integrated program between Federal, State, and local entities to manage invasive plant species that are present within the Fly Creek watershed. This program should incorporate a combination of physical/ mechanical removal, herbicides, and biological control methods. Subject matter experts should be consulted to develop the toolbox for managing these invasive species to make sure that the "cure" is not worse than the "disease," e.g, some forms of mechanical removal can actually further spread the invasive plant. Also the herbicides used in wetland and aquatic environments must be properly labeled for aquatic site use and applied by a licensed pesticide applicator with credentials to work within special aquatic sites.

7) Work with City of Fairhope, City of Daphne, and Baldwin County to plan for on-site stormwater storage requirements in excess of what might have been experienced in the past to address increasing levels of impervious surface and increased intensity of storms.

8) A system should be developed to support and recognize farmers that continue to use and further expand usage of "no-till" agriculture crop practices. This practice has significantly reduced erosion from cropland within the watershed. Another measure that should be encouraged within the cropland areas is installation of grassed buffer strips in the large agricultural fields.

9) Identify and implement measures to restrict cattle and feral hogs from trampling creek bank areas and feeding on riparian corridor vegetation. Incentives could be established to assist cattle owners and other landowners. Incentives/bounties could also be established for removal of feral hogs from the watershed.

10) Establish incentives for inspection/repair and pump-out of residential septic tanks within the watershed.

11) Although the stream banks along the creek currently appear relatively stable and well vegetated, there may be opportunities for restoration of more natural stream sinuosity between Scenic Highway 98 and Business Highway 98. Stream restoration measures should incorporate natural materials such as root wads and planting of native plant materials.

12) Consideration should be given for an inventory of the existing riparian buffers along the miles of streams within the Fly Creek watershed. Use of recent aerial photographs will facilitate this effort greatly and establish priority stream reaches where actions are required to restore or reestablish healthy riparian buffers.

13) Consider a mechanism to support the NRCS in identification of appropriate locations within the watershed where lake and pond construction could significantly reduce downstream sediment transport and improve water quality. Lake and pond construction has been implemented by some landowners within the watershed and water quality improvements have been observed. The NRCS has worked with these landowners on measures such as tilling practices and impoundment construction to improve downstream water quality and reduce sediment transport. The trapping efficiency of these impoundments, particularly the impoundments larger than 10 acres, has proven to be very effective as evidenced by the December 2012 site inspection at County Road 13 – the water clarity of the creek at this location was excellent in spite of a large rainfall event just 1 day prior to that inspection.

14) Develop an educational outreach for members of the public to emphasize the importance of not applying excessive quantities of herbicides, pesticides, and fertilizer.

15) Opportunities should be taken to partner with environmental stewardship groups such as the Alabama Clean Water Partnership and non-profit conservation organizations to ensure the protection and preservation of the Fly Creek watershed through public outreach and participation. Outreach topics should include the preservation of forested areas, reduction of NPS pollution, monitoring of water quality, and stream bank stabilization/ preservation.

Action Plan

Based on the above list of restoration measures, the City of Fairhope recommends adoption of the top 6 priority measures as the Action Plan for restoration of the Fly Creek watershed. While Measures 7-15 are considered important, they are deemed as less urgent at the present time than the top tier of Measures 1-6.

Implementation

Implementation of the Fly Creek Watershed Action Plan must be matched with both the resource priority needs and funding sources for carrying out the identified measures. The "windows of opportunity" for the various measures are defined by circumstances of the situational urgency, funding opportunity, and political/public acceptability. Given these considerations the highest priority restoration measure of the 6 recommended for the Action Plan is to purchase the 108-acre tract of land located northwest of Highway 104 and Business Highway 98.

Conclusion

A number of restoration measures have been developed in this evaluation of the natural and human resources in the Fly Creek watershed, and the top 6 have been formulated into the Action Plan. Based on the historic trend of rapid population growth in this area, accompanied by continuing residential and business developments, development conducive zoning regulations, and extremely limited public land within the watershed, development and growth are anticipated to continue. These recommendations also were developed in accordance with criteria approved by the NRDA Trustees in the Framework Agreement. The top 6 restoration measures identified were combined into the Action Plan for the Fly Creek watershed. The highest priority restoration measure of the 6 measures combined into the Action Plan is to purchase the last remaining large tract of land in the lower Fly Creek area, the 108 acre block located northwest of the Highways 98 (Business) and 104 intersection. The property is adjacent to a significant reach of undeveloped Fly Creek and its riparian corridor, plus contains a diversity of scarce habitats such as forested wetlands and longleaf pine forest. This purchase would not only provide long-term protection from development and associated adverse impacts on stormwater runoff, water quality, and sedimentation but would also provide multiple opportunities for the City of Fairhope to significantly enhance the natural area and open space within the watershed. The opportunity for acquisition of this property is currently available; however, because of the development pressure and the approved development plan on the property (circa 2000) that opportunity is not likely to exist long term. Implementation of the other recommendations within this report should concurrently be pursued as funding opportunities are identified.

Introduction

The Fly Creek watershed area has been the subject of intensive population growth and land cover disturbances. This area from the northern portion of Fairhope, north towards Daphne continues to be an area of expanding residential housing development and business growth. The natural resources of this coastal stream's watershed provide vitally important intertidal habitat for marine/estuarine species and also contributes clean freshwater and organic materials that serve to fuel the Mobile Bay ecosystem. The resilience of Fly Creek has enabled this coastal stream to contribute positively to the Mobile Bay ecosystem in spite of continued economic development and human population growth. In order for Fly Creek to continue its vital contributions to Mobile Bay, certain restoration measures and conservation techniques must be applied for the long-term protection of this watershed.

RESTORATION MEASURES AND CONSERVATION TECHNIQUES ARE REQUIRED FOR THE LONG-TERM PROTECTION OF THE FLY CREEK WATERSHED

Purpose

The purpose of this Fly Creek watershed evaluation is to provide relevant information for decision makers related to the status of natural and human resources within the watershed and to identify efforts that can contribute to restoration of natural resources in this strategic coastal stream and its associated watershed. The information compiled for this report is to assist the City of Fairhope in identification of restoration projects and conservation opportunities being considered along the Gulf Coast to address adverse environmental and human impacts related to the 2010 BP Deepwater Horizon Oil Spill – whether through the Natural Resources Damage Assessment (NRDA) process, the Recovery Act process, or the National Fish and Wildlife Foundation (NFWF) process (based on settlement of federal criminal charges). Specifically, this report provides supplemental information on the Fly Creek Restoration Project nominated by the City of Fairhope as part of the NRDA, as found on the NOAA website: http://www.gulfspillrestoration.noaa.gov/restoration/give-us-your-ideas/view-submitted-projects/. The Fly Creek Restoration Project is one of 809 projects submitted for review by the NRDA Trustees.

Document Overview

This Fly Creek watershed document strives to follow the "template" that was established in the NRDA process. The early restoration projects that have been approved by the NRDA Trustees were evaluated using criteria included in applicable damage assessment and restoration regulations and programs (Framework Agreement). The Framework Agreement provided that early restoration projects meet the following criteria:

- Contribute to making the environment and the public whole by restoring, rehabilitating, replacing, or acquiring the equivalent of natural resources or services injured as a result of the Spill, or compensating for interim losses resulting from the incident;

- Address one or more specific injuries to natural resources or services associated with the spill incident;
- Seek to restore natural resources, habitats, or natural resource services of the same type, quality, and of comparable ecological and/or human-use value to compensate for identified resource and service losses resulting from the incident;
- Are not inconsistent with the anticipated long-term restoration needs and anticipated final restoration plan; and
- Are feasible and cost-effective.

In early restoration planning, the Trustees took into account several practical considerations that while not legally mandated were nonetheless useful and permissible to help screen the large number of potential qualifying projects. None of these practical considerations are used as a "litmus test;" rather, they were used as flexible, discretionary factors to supplement the decision criteria described above. For example, Trustees:

- Take into account how quickly a given project is likely to begin producing environmental benefits;
- Seek a diverse set of projects providing benefits to a broad array of potentially injured resources;
- Focus on types of projects with which they have significant experience, allowing them to predict costs and likely success with a relatively high degree of confidence and making it easier to reach agreement with BP on the offsets attributed to each project, as required by the Framework Agreement; and
- Give preference to projects that were closer to being ready to implement.

It should be noted that site specific project information required to meet many or all of the above criteria may not be readily available; therefore, additional site specific studies may be required.

2 Fly Creek Watershed Description

Watershed Boundary

FLY CREEK WATERSHED ENCOMPASSES 5,018 ACRES

Fly Creek is a relatively small perennial stream that flows into Mobile Bay within the city limits of Fairhope in Baldwin County, Alabama. The watershed area that feeds Fly Creek is about 2 miles wide and 4 miles long, encompassing approximately 5,018 acres. The creek itself is approximately 5.3 miles long based on the U.S. Geological Survey (USGS) National Hydrography Dataset (NHD). Figure 1 shows the watershed area on the USGS topographic map. Figure 2 shows an aerial photograph of the watershed. The watershed is located generally east, thence northeast from the mouth of the creek where it enters Mobile Bay.

Figure 1. Topographic Map of Fly Creek Watershed

Figure 2. Aerial Photograph of Fly Creek Watershed

Hydrology

Surface Water

The lower end of Fly Creek (estimated 1 mile) is within the tidal influence associated with Mobile Bay and the Gulf of Mexico (Photo 1), with the remaining water courses consisting of perennial stream, intermittent streams, and man-made lakes and ponds. Flow measurements by the Alabama Department of Environmental Management (ADEM 2004) show that Fly Creek flow is generally to be in the 10-15 cubic feet per second range.

Photo 1. Marina Area on Lower Fly Creek

The lowermost portion of Fly Creek has been developed into a marina and yacht club area, and is an authorized U.S. Army Corps of Engineers small craft harbor. The harbor provides for a 6-feet deep by 80-feet wide by 1,500-feet long channel within Mobile Bay, a 6-feet deep by 60-feet wide by 300-feet long entrance channel just

inside the mouth of Fly Creek, and a 6-feet deep by 100-feet wide by 400-feet long turning basin (USACE 1974). The Fly Creek harbor project was last dredged in 2005 with a volume of 25,000 cubic yards removed and placed in an open water disposal site to the south of the Fly Creek entrance channel. Typically, this project gets dredged infrequently such as after a major storm event (USACE personal communication 2013).

The lower portion of the creek is also known as Devil's Hole, named for a naturally deep area within the creek located upstream of the shrimp boat fleet docking area within the harbor. Numerous private boat docks, bulkheads, and piers are located along Fly Creek upstream to the Scenic Highway 98 bridge, a distance of about 1 mile (Photo 2). Water depths upstream of the Scenic Highway 98 bridge currently limit navigation to very shallow draft boats such as canoes and kayaks (Photo 3). Historically, the stream channel was deeper upstream of the Scenic Highway 98 bridge, according to ADEM (2004), a boat was used to access water quality sampling points up to approximately 300 yards downstream/west of the four-lane Business Highway 98.

Photo 2. Shoreline Protection and Docks

WITHIN THE WATERSHED THERE ARE 18 MILES OF STREAMS AND 20 LAKES AND PONDS.

Photo 3. Fly Creek Shallows Above Scenic 98

The length of water courses within the watershed include not only the 28,078 feet (5.3 miles) within Fly Creek, but also 65,739 feet (12.5 miles) of other perennial tributary streams according to USGS hydrologic data. Based on recent aerial photography, 20 lakes and ponds are found within the watershed.

Figure 3 shows the location of the stream, lakes, and ponds within the Fly Creek watershed. The surface area of these lakes and ponds total 144 acres and range from 0.4 acre up to 49 acres. The larger lakes are located in the northern portion of the watershed. The slope of the Fly Creek stream channel is approximately 50 feet per mile of channel in the upper mile of the stream near Highway 104, thence decreasing to approximately 12 feet per mile for the lower 4.3 miles of stream channel to Mobile Bay.

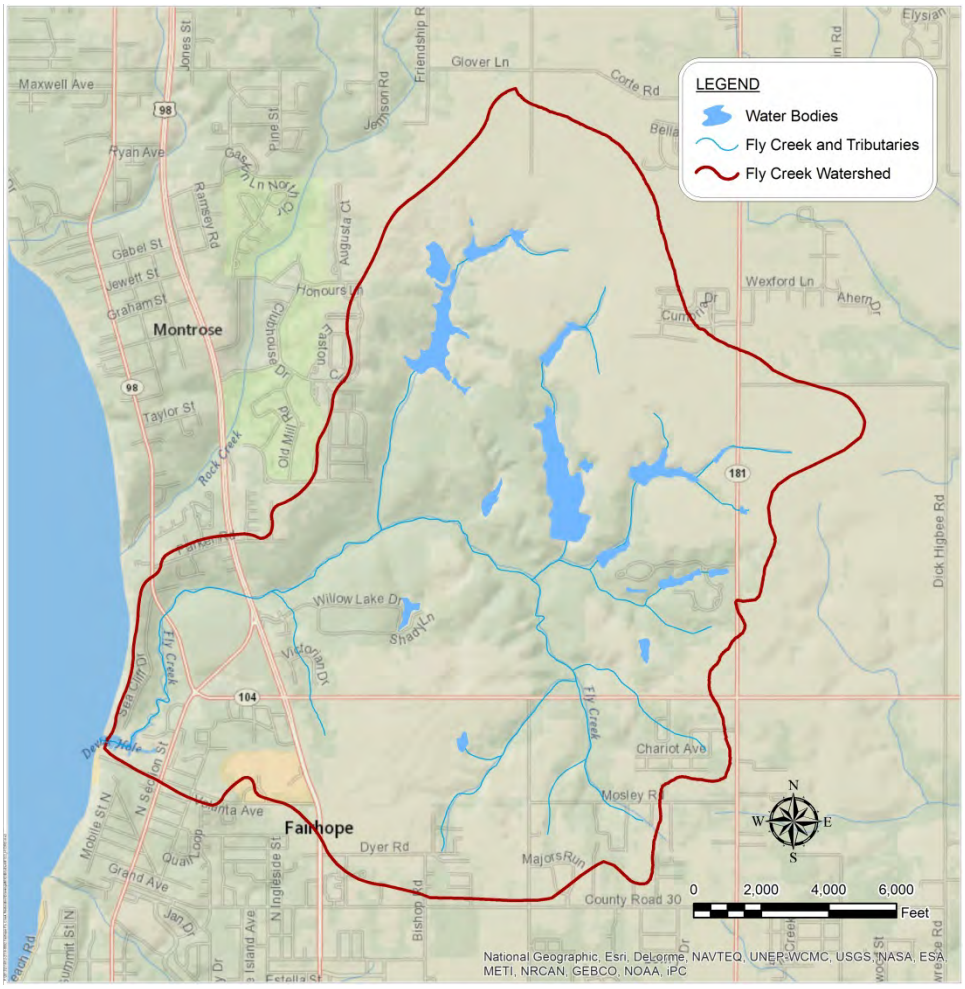


Figure 3. Hydrologic Features in Fly Creek Watershed

Water Quality

According to ADEM, the water use classification for Fly Creek is Swimming and Fish and Wildlife from its source to its mouth at Mobile Bay. There are no municipal or industrial discharges into Fly Creek or its tributaries. The water quality within the Fly Creek watershed is generally good. Vegetative buffers of native forest have been shown as highly effective in reducing and eliminating the flow of nutrients from upslope within the watershed into streams such as Fly Creek (City of Fairhope 2003). Non-Point Source (NPS) pollution can be difficult to identify and quantify. However, the Environmental Protection Agency (EPA) cites NPS pollution as one of the leading contributors to water pollution nationwide. Residential, agricultural, and construction areas are all sources of NPS pollution in the form of excess herbicides, pesticides, and fertilizers; excess nutrients and biologically hazardous organisms; and sediment. Sources of nutrients within the Fly Creek watershed can be generated by cattle and improperly functioning septic tanks. A 1998 report by the Baldwin County Soil and Water Conservation District showed that the eastern shore area (including the 5,018 acre Fly Creek watershed) from Daphne to Point Clear (23,000 acres) had approximately 2,500 cattle and 3,266 septic tanks.

THE WATER QUALITY WITHIN FLY CREEK WATERSHED IS GENERALLY GOOD.

Field data were collected by ADEM at least monthly at seven stations from just upstream of the Fly Creek marina to a location within 300 yards of the four-lane Business Highway 98 (ADEM 2004). The following is a summary of some of the water quality parameters that serve as indicators of the level of pollutant stress or other watershed issues.

Water temperature in Fly Creek averaged 19.5°C, while ranging from 12.4°C in winter at the headwaters to 28.8°C in summer near the mouth. Fly Creek's average water temperature compared with lower temperatures (average 17.8°C) in Bay Minette Creek, a watershed with less development/impervious surface, yet lower than the highly developed/impervious surface of Three Mile Creek (average 20.3°C). Conductivity and salinity measurements within Fly Creek demonstrate that the effects of seawater reach almost to the Scenic Highway 98 bridge – average specific conductivity of 1,473 uS/cm, ranging from a low of 33 uS/cm upstream to a high of 48,880 uS/cm in the lower creek. Salinity ranged from 0 parts per thousand (ppt) at the upstream stations to 38 ppt (seawater strength) in the lower creek during the dry fall months. Dissolved oxygen measurements in Fly Creek demonstrated to be very good, with higher values than either Three Mile or Bay Minette Creeks, with an average of 9.02 ppm, ranging from 6.6 to 11.7 ppm. A measure of the water's acidity is term pH. Fly Creek averaged a pH value of 5.9, compared with 6.3 for Three Mile Creek and 5.2 for Bay Minette Creek, and had consistent pH levels from headwaters to the mouth. Turbidity is a measure of water clarity and Fly Creek had the lowest average turbidity for the ADEM study, with 8.7 NTU, compared with 17 NTU for Three Mile Creek and 11.4 NTU for Bay Minette Creek. Turbidity measurements in Fly Creek ranged from a low of 1.9 NTU to a high of 51.4 NTU. The ADEM criteria for turbidity is not to exceed 50 NTU's above the background level. Fecal coliform bacteria levels were the lowest in Fly Creek (average of 393 col/100ml) compared with the Three Mile and Bay Minette Creek sampling areas (averages of 849 and 476 col/100ml, respectively). Nitrate/nitrite concentrations exhibited the highest average within Fly Creek (0.942 ppm), compared with Three Mile and Bay Minette Creeks (0.67 ppm and 0.05 ppm, respectively). Phosphate levels for all three streams were comparable except at the most downstream stations (highest levels in the tidally influenced stations). Average phosphate levels ranged from Fly Creek at 0.134 ppm, Three Mile Creek at 0.042 ppm, and Bay Minette Creek at 0.022 ppm.

Groundwater Hydrology

According to Gillett et al. (2000), the major aquifer underlying the Fly Creek watershed is the Miocene-Pliocene aquifer. The aquifer consists of the Miocene-Series undifferentiated and the Citronelle Formation. The Miocene-Pliocene aquifer consists of beds of sand, gravel, and clay that are irregular in thickness and have limited lateral extent. Groundwater flows through these sand and gravel beds. The clay intervals between the sand beds are considered "aquitards" because the clays are not laterally extensive enough to prevent the downward movement of groundwater. The clay intervals do provide a semi-confining layer for many of the deeper sand and gravel intervals.

Rain is the primary source of recharge to the aquifer. Of the 60+ inches of rain per year in Baldwin County about 28 inches per year runs off during and immediately after storms (Reed and McCain, 1971); a small percentage of rainfall infiltrates the subsurface as recharge to the aquifer; and the remainder is returned to the atmosphere by evaporation and transpiration from trees and other plants. The recharge area for the aquifer includes all of Mobile and Baldwin Counties. The amount of water that infiltrates the soil depends on the permeability and hydraulic conductivity of the soil, the amount of water present in the soil during rainfall, and the slope of the land surface. Infiltration is greater in a flat area that is underlain by gravel and coarse sands rather than in an area with a sloping land surface that is underlain by dense clay (Gillett et al., 2000).

Baldwin County is 100% dependent on groundwater for drinking water supplies and the City of Fairhope is the largest single water supplier with about 13,000 connections serving approximately 39,000 people (Sasaki 2006). Fairhope Public Utilities operates 8 public wells to supply this water demand.

Topography

The elevations within the watershed range from zero/sea level at the mouth of Fly Creek to approximately 140 feet National Geodetic Vertical Datum (NGVD) in the eastern side of the watershed near State Highway 181.

Climate

The climate in this area of Baldwin County consists of typically hot and humid summers and relatively mild winters. The average summer temperature is 81°F, with an average daily high of 91°F. The winter average temperature is 53°F, with an average daily low of 43°F. Rainfall occurs throughout the year with the most precipitation during the months of April through September. The total average annual rainfall is approximately 64 inches, which among the highest in the United States. Rainfall is usually of the shower type. Storms with long periods of continuous rainfall are less common. Tropical summer thunderstorm events are capable of producing localized heavy rainfall totals of several inches with a 1-2 hour timeframe.

Geology and Soils

The Fly Creek watershed is located within the Coastal Lowlands District in the East Gulf Coastal Plain physiographic section. The Coastal Lowlands district in Alabama includes the coastal areas and the mainland plains sunken by many tidal streams and edged by tidal marshes and barrier islands. These barrier islands and tidal marshes are continually being modified by erosion and deposition. The Coastal Lowlands district is characterized by flat to gently undulating, locally swampy plains (Gillett, Raymond, Moore, and Tew, 2000).

The principal soil association located within the Fly Creek watershed includes the Marlboro-Faceville-Greenville association. The Marlboro-Faceville-Greenville association is characterized by nearly level to gently sloping well drained soils. The

soils in this association developed in unconsolidated Coastal Plain material and are highly developed for agriculture in the area (McBride and Burgess, 1964).

Geologic Materials

The most commonly exposed geologic formations occurring within the Fly Creek watershed are the Miocene Undifferentiated Series, Citronelle Formation, and the Alluvium, low-terrace, and coastal deposits. These strata were deposited as a result of sea level variations and fluvial and deltaic deposition that occurred over millions of years. Figure 4 shows the major geologic formations within the watershed.

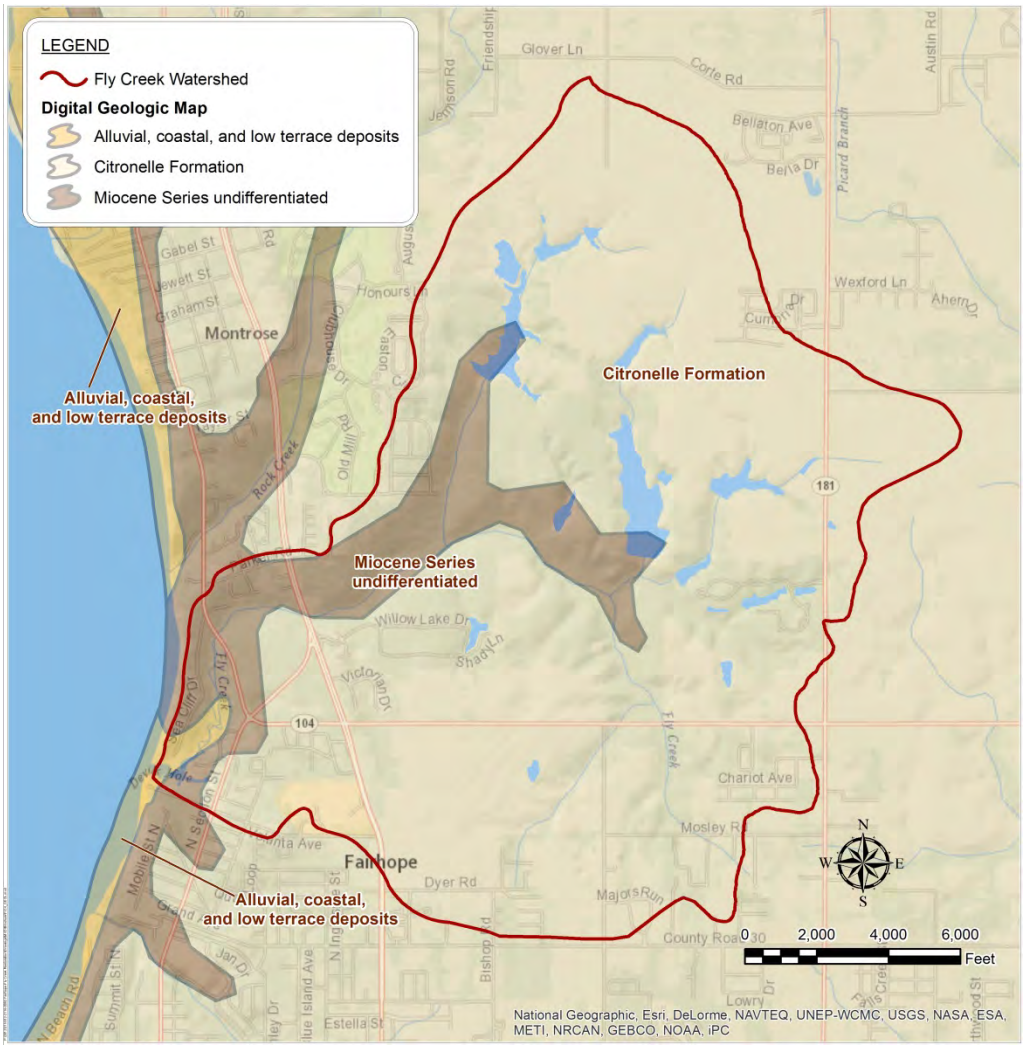


Figure 4. Geologic Formations in Fly Creek Watershed

The deepest materials exposed by the watershed streams and creeks are of the Miocene Undifferentiated Series. According to Gillett et al. (2000), sediments of the Miocene Series outcrop in central and northern Mobile and Baldwin Counties. The unit ranges in thickness from 100 feet in northern Baldwin County to 3,400 feet in the subsurface in southern Mobile County. According to Reed (1971),

> "…the Miocene Series consists of light-gray, yellowish-gray, yellow, and white laminated to thin-bedded and massive clay, sand, and sandy clay. The sands generally range from fine- to coarse-grained and are locally cross-

> bedded. Distinct beds of light-gray massive sandy clay at the top of the Miocene Series contrast sharply with the gravelly sand in the overlying Citronelle Formation."

The Miocene Series was subdivided into the Ecor Rouge Sand and the Mobile Clay formations by Isphording (1977). According to Isphording (2011), the Miocene aged geologic unit exposed in the watershed is the Ecor Rouge Sand. The Ecor Rouge Sand consists of white, pale yellow, pink, and light gray sands, silty sands, and white, thin to massive bedded clay and sandy clays and locally occurring gravel composed of quartz or light colored chert.

The majority of the Fly Creek watershed overlies the Citronelle Formation which is Pliocene in age and overlies the Miocene materials. The Citronelle Formation outcrops in the central and southern parts of Mobile and Baldwin Counties. The formation is confined to higher elevations in these counties due to erosion that has occurred along streams and the edges of Mobile Bay, so that the Miocene Undifferentiated is exposed along the bay and instream channels.

The Citronelle Formation sediments were deposited under a combination of fluvial and estuarine conditions and vary both laterally and vertically (Gillett et al., 2000). The Citronelle Formation consists of layers and lenses of interbedded sands and clays with occasional beds of gravel. Sediment type often changes abruptly over short distances. According to Reed (1971), the Citronelle Formation

> "…is as much as 130 feet thick and consists of dark reddish-brown gravelly sand, which locally contains light-gray clay balls and partings, and light-gray, orange, and brown sandy clay. Gravel in the Citronelle in Baldwin County generally is light-colored quartz that is, in some exposures, as much as 1 inch in diameter. Lenticular (lens shaped) beds of light-gray to orange-brown sandy clay and clayey sand that are 5 to 15 feet thick are interbedded with gravelly sands in many areas. The base of the formation is marked in many exposures by a dark yellowish-brown sandstone bed that locally contains gravel. A similar gravelly sand overlying massive clay is present about 25 feet below the contact; however, the upper horizon was mapped as the Citronelle-Miocene boundary because it is exposed over a broader area and because the clay is present throughout the area and is not lenticular and discontinuous as are clays in the Citronelle."

The Alluvium, low terrace, and coastal deposits of Holocene age are exposed along the Mobile Bay banks and at the mouth of Fly Creek. The Alluvial, low terrace, and coastal deposits unconformably overlie older geologic units in lowland areas in parts of Baldwin County (Reed, 1971). An unconformity is a buried erosion surface separating two types of strata of different ages, indicating that sediment deposition was not continuous. This may indicate a time of regression, in which the sea level falls relative to the land and exposes former sea bottom.

The Alluvial, low terrace, and coastal deposits represent complex beach, dune, lagoonal, estuarine, and deltaic depositional environments (Szabo and Copeland, 1988). The deposits consist of white, gray, orange, and brown very fine to coarse

sand that is gravelly in many exposures. Gray and orange clay and sandy clay are interbedded with the sand locally. The alluvial, low terrace, and coastal deposits are estimated to range in thickness from 0 to 200 feet, based on the first occurrence of coarse siliciclastic sediments (Gillett et al., 2000).

The sand and gravel beds represent buried channel deposits. Their widths and depths are similar to those of present river bed sediments. The length of individual sand and gravel beds probably range from a few hundred to a few thousand feet. These buried channel deposits are surrounded by silt and clay sediment similar to those being deposited on the present flood plain of the Mobile River (Gillett et al., 2000).

Soil Characteristics

The principal soil types encountered in the Fly Creek watershed are the Marlboro very fine sandy loam, the Faceville fine sandy loam, and the Greenville loam and sandy clay loam. Figure 5 shows the major soil groups within the watershed.

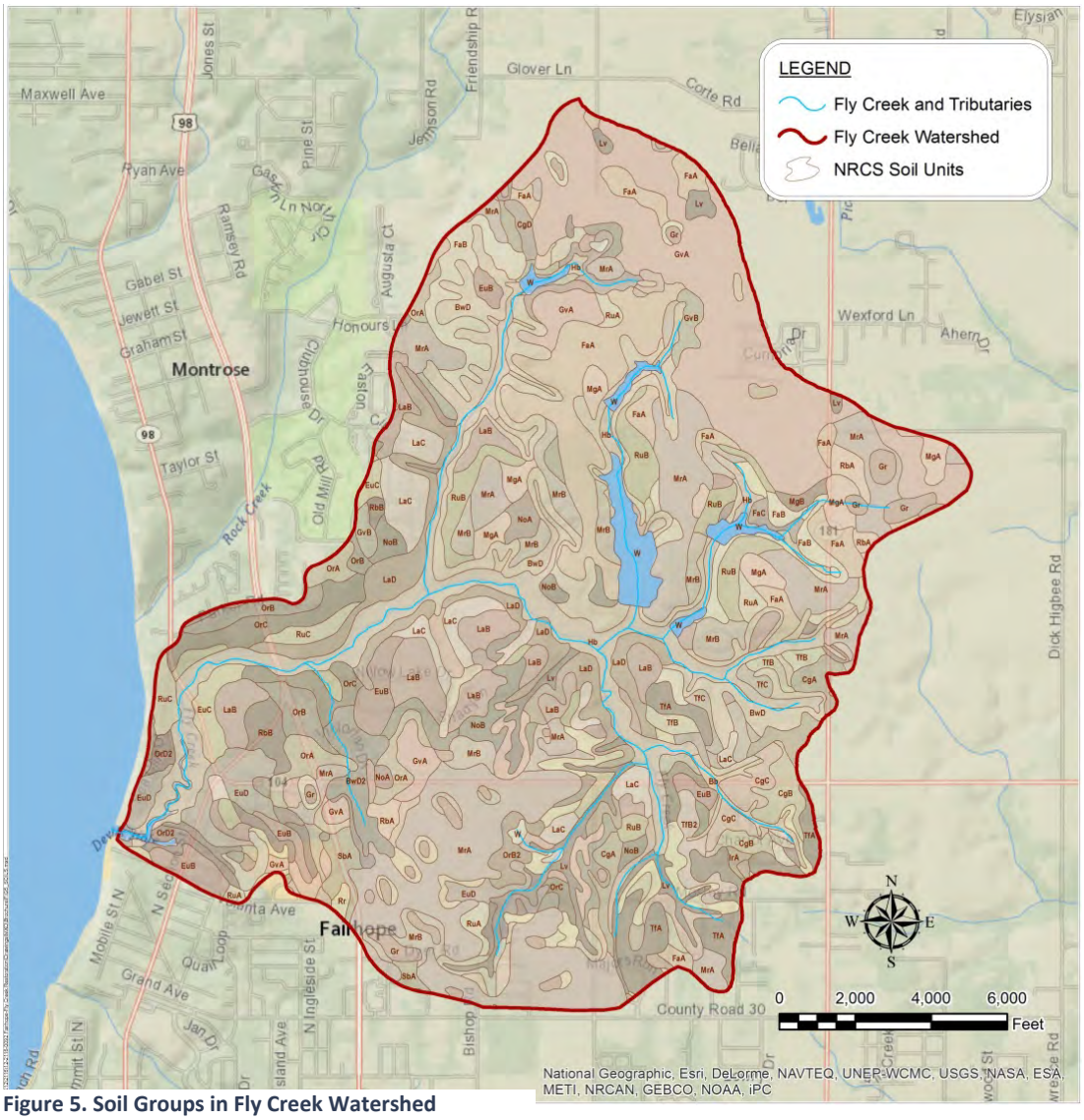


Figure 5. Soil Groups in Fly Creek Watershed

Loam is soil composed of sand, silt, and clay in relatively even concentrations. Minor soils in the Marlboro-Faceville-Greenville association that are found in the watershed include the Carnegie and Tifton, which are similar to the Marlboro, Faceville, and Greenville in textures and drainage. Other minor soils that are also well drained, but that contain more sand are the Orangeburg, Ruston, and Norfolk. Additional minor soils within the watershed include Eustis loamy fine sand, Bibb and Mantachie alluvium, Bowie, Lakeland and Cuthbert fine sandy loam, Hyde and Bayboro soils and muck, Wet loamy alluvial land (Web Soil Survey).

Soils are classified by use of an erodibility factor (i.e., K-Factor) that is related to how much soil is lost due to the kinetic energy displaced during raindrop impact and stormwater runoff. The K-Factor is based primarily on the grain size of soil particles. Soils consisting of fine sand and silt size particles have higher K-factors than cohesive clay particles. Fine sands and silty soils are more easily detached by raindrop impact and stormwater runoff than are cohesive clays and medium to coarse grained sands. The amount of organic matter in soils also influences the K-Factor because organic matter acts as a glue to hold soil particles together into clumps which water can infiltrate therefore decreasing runoff.

Typically subsoils have higher K-factors and are more erodible than topsoils. When land clearing and grading activities expose subsoils, the K-Factor increases. Exposed subsoils can be expected to erode faster because they have less organic matter and plant root mass to hold the soil particles together structurally. The formation of micropores that allow percolation of rainfall is reduced in subsoils, resulting in increased runoff. Increased runoff produces greater sheer forces for detaching soil particles from the surface, and accelerating erosion.

The parent subsoil materials within the Fly Creek watershed are more highly variable with clay, silt and sand strata than are the weathered and more homogenous superficial soils. As such, some of these subsoil strata contain highly erodible fine sand and silty stratum which are highly erodible when exposed to precipitation and stormwater runoff.

The K factors for the soil series occurring within the Fly Creek watershed vary from 0.10 to 0.37 (Web Soil Survey). Soils having K factors less than 0.23 are considered to have low erodibility, soils with K factors from 0.23 to 0.36 are considered to be moderately erodible, and soils with K factors greater than 0.36 are considered to be highly erodible (DeWiest and Livingston, 1999). Figure 6 presents a visual summary of the soil erodibility within the watershed based on the soil K-Factors.

SOME OF THE SOILS WITHIN THE WATERSHED ARE HIGHLY ERODIBLE.

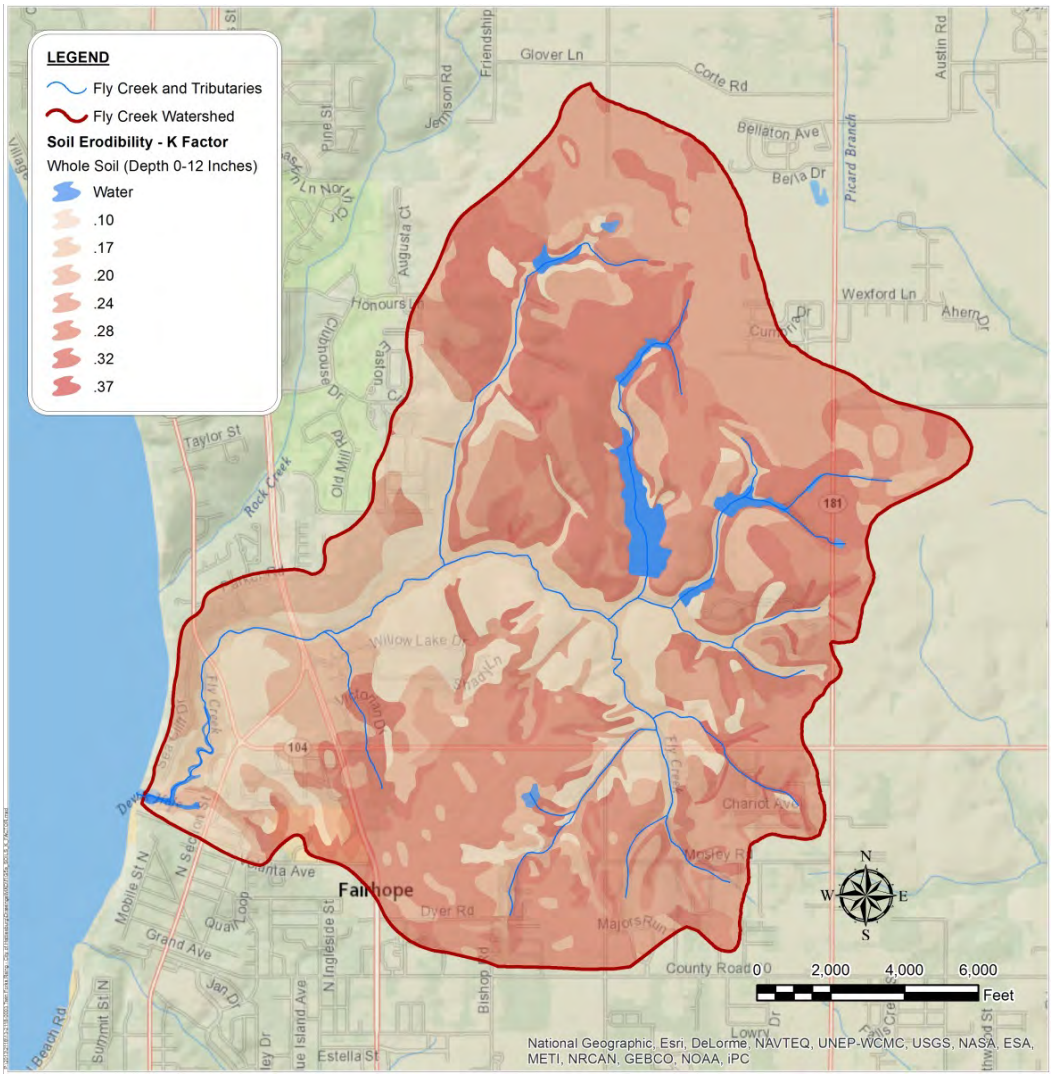


Figure 6. Soil Erodibility in Fly Creek Watershed

Erosion and Sedimentation Hazards

DEVELOPMENT WITHIN THE WATERSHED HAS CREATED EROSION AND SEDIMENTATION PROBLEMS.

Throughout the Fly Creek watershed, economic development and growth continues to increase. The watershed is being transformed from woodlands, pastures, and cropland into residences, subdivisions, schools, shopping centers, and expanding roadways (ADEM, 2004). A serious consequence of urban growth is increased stream sedimentation causing siltation. Sedimentation is the natural process of suspended sediment settling out of the water column and depositing along the bottom of a flowing water body. Siltation, a stream pollutant, is an increase in suspended sediments and sediment accumulation mainly caused by increased soil erosion.

Rainfall runoff from construction sites is a major source of soil erosion in urban areas under development. When the vegetation is removed at construction sites, bare soils are exposed to raindrop impact and are more vulnerable to erosion. If soil stabilization, runoff management, and sediment controls are not in place at these

sites, sediment could be washed into receiving waters causing increased sedimentation.

Another result of continued urban growth is the increase of impervious surface cover. Impervious surfaces are any surfaces that prevent or impede the infiltration of water to the soils. They include roadways, parking lots, rooftops, and sidewalks. Areas with more impervious surfaces generate more runoff during rainfall events, which increases the potential for degrading stream channels and banks (ADEM, 2004).

Natural Resources

The aquatic and terrestrial ecosystems in and around Fairhope have provided a diverse and productive area for recreational and commercial harvest of marine species such as shrimp, crabs, and oysters and key upland areas that produce outputs such as economically important pine timber, pastures for cattle farming, and key agricultural row crops/orchards such as pecans, corn, cotton, soy beans, wheat, etc. The natural resources associated with Fly Creek are crucial to the economic engine of Fairhope and neighboring municipalities. In addition, the ecological integrity and habitat/ species diversity are paramount to the quality of life in this rich coastal area. The health of the watersheds that feed into Mobile Bay, such as the Fly Creek watershed is strategically important to the long-term restoration and preservation of the economy and ecology of the Fairhope area. The streams and riparian habitats along coastal water courses such as Fly Creek not only provide spawning and nursery areas for a number of important estuarine/marine species, but also provide key nutrients, microorganisms, and natural organic materials to fuel the food chain within Mobile Bay and adjacent Gulf of Mexico.

NATURAL RESOURCE HEALTH IS IMPORTANT TO SUSTAINING THE ECOLOGICAL CONTRIBUTIONS OF FLY CREEK TO MOBILE BAY.

Wetlands

Based upon the U.S. Fish and Wildlife Service's (USFWS) National Wetland Inventory, there are approximately 285 acres of wetlands within the Fly Creek watershed composed of the following wetland types: Estuarine and Marine Deepwater (15 acres); Riverine (2 acres); Freshwater Forested/Shrub (102 acres); Freshwater Emergent (38 acres); and Freshwater Ponds and Lakes (128 acres). These wetlands are shown on Figure 7. These wetlands are located within and adjacent to the water courses within the watershed and provide environmental services to the community such as flood storage, groundwater replenishment, water quality improvement, habitat for freshwater and marine species, plus habitat for key terrestrial animals, corridors for wildlife passage, and aesthetic green space for residents of the area.

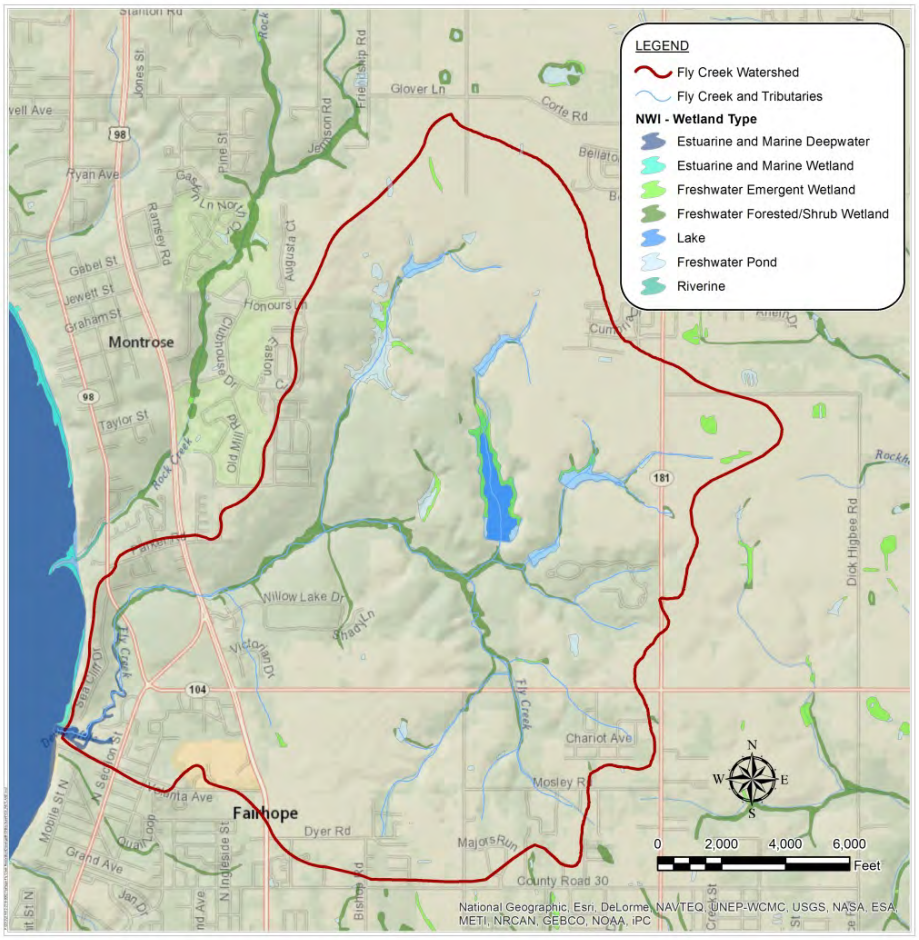


Figure 7. Wetlands in Fly Creek Watershed

Species of Concern

The plant and animal species that exist within a watershed can number in the thousands and many can serve to indicate the health of the area or point to trends that could lead to future problems. Some species have shown serious reduction in numbers to the point where they have been identified for protection by federal and state regulatory agencies, such as the Endangered Species Act. Other species may only exist within a very small area (endemic) compared with others that are common nationally or globally. In addition, some species are sensitive to human disturbance or other environmental factors (indicator species) that can signal the health/status or trend of an ecosystem, e.g., the canary in the coal mine. Somewhat the reverse, some species are adapted to rapid population increases based on ecosystem disturbances and/or introduction into habitats without the presence of their natural enemies (invasive species).

The USFWS lists 18 species on their Endangered Species website for Baldwin County; however, based on the habitats available within the Fly Creek watershed the most likely species present could include transients such as the recovered bald eagle (*Haliaeetus leucocephalus*) and endangered wood stork (*Mycteria americana*), or residents such as the threatened eastern indigo snake (*Drymarchon corais couperi*) and candidate gopher tortoise (*Gopherus polyphemus*). According to a

retired representative of Auburn University's Gulf Coast Research and Extension Center, there have been numerous gopher tortoises observed on the Center's property.

Indicator species for the Fly Creek watershed could include animals such as the brown pelican (*Pelecanus occidentalis*) (Photo 4), belted kingfisher (*Megaceryle alcyon*), and striped mullet (*Mugil cephalus*). For example, one long-time resident within the lower watershed reports that the striped mullet were once common within the creek, but have all but disappeared. ADEM staff noted great blue herons (*Ardea herodias*), great egrets (*Ardea alba*) , green herons (*Butorides virescens*) , and American bitterns (*Botaurus lentiginosus*) on all field patrols as part of their water quality analysis (ADEM 2004). They also noted various hawk species including osprey (*Pandion haliaetus*), kingfisher, and turkey vulture (*Cathartes aura*). All of these bird species are indicative of a healthy ecosystem by providing the life requisites of food and habitat. Popular sport fish species in lower Fly Creek estuarine zone include speckled trout (*Cynoscion nebulosus*), flounder (*Paralichthys lethostigma*), and red fish (*Sciaenops ocellatus*), while fish in the upstream freshwater area of Fly Creek include species such as largemouth bass (*Micropterus salmoides*) and bream (*Lepomis* spp.). A healthy and diverse fish population within a stream requires an unimpeded channel open to upstream and downstream migration without the presence of major barriers. An example of a major fish migration barrier is the eroded culvert overfall present at the downstream end of the box culverts for Fly Creek under Business Highway 98 (Photo 5).

Photo 4. Brown Pelican

INDICATOR SPECIES SUCH AS THE PELICAN, KINGFISHER, OSPREY, AND BLUE HERON POINT TO THE OVERALL HEALTH OF THE WATERSHED.

Photo 5. Eroded Culvert Fish Barrier at Highway 98

FISH BARRIERS SUCH AS ERODED CULVERTS RESULT IN HABITAT FRAGMENTATION

Habitats

Habitats found within the watershed include southern forested wetlands, ponds and lakes, pine forests (including longleaf, slash, and loblolly), mixed pine and hardwood, cultivated crops, pasture, and residential/business developed areas. Some of these habitats have been recognized on a national level as imperiled and are worthy of restoration and preservation, including southern forested wetlands and longleaf pine forests.

Invasive Species

Invasive species threaten the integrity of the ecosystems by crowding out native species and creating large monoculture stands. Major invasive plant species within the Fly Creek watershed include:

- cogon grass (*Imperata cylindrica*)
- kudzu (*Pueraria montana*)
- Chinese privet (*Ligustrum sinense*) (Photo 6)
- Japanese climbing fern (*Lygodium japonicum*)
- Chinese tallow tree (*Triadica sebifera*)
- bamboo (*Bambusa multiflora*)
- coral ardesia (*Ardesia crenata*)
- torpedo grass (*Panicum repens*)

INVASIVE SPECIES THREATEN THE ECOLOGICAL INTEGRITY OF THE WATERSHED.

An invasive animal species that is present within the watershed and is significantly impacting the environment is the wild hog (*Sus scrofa*). The population of this disruptive animal has significantly increased over the past decade and causes severe disturbance to native plants and shrubs in the natural riparian and forest areas, in addition to some croplands and pastures.

Photo 6. Chinese privet

Land Use/Land Cover

The land uses within the Fly Creek watershed have been changing from an area that historically was dominated by forest and agricultural land to one that has experienced increased population and relatively rapid residential and business development. This is particularly true along major transportation corridors and within subdivisions such as Rock Creek, The Woodlands, and The Waters. The land cover within the Fly Creek watershed, while changing over the past few decades, has maintained some relatively large areas of natural landscape. In contrast, the nearby D'Olive Creek watershed, located a few miles to the north, has had much more conversion to residential subdivisions (such as Lake Forest). The erosion from these developed areas has contributed to poor water quality and to significant increases of sediment within D'Olive Creek, D'Olive Bay and Mobile Bay (MBNEP 2010).

Natural vegetated habitats and agricultural lands are important for providing intrinsic values such as groundwater storage, habitat provision, climate moderation, flood control, storm damage prevention, and air/water pollution abatement (Sasaki 2006). Auburn University, as represented at the Gulf Coast Research and Experimental Center, has long recognized the need to preserve open space and agricultural lands for their regional importance for not only researching food

products, but also ecosystem services, public amenities, recreation, pastureland, and natural hazard mitigation (Sasaki 2006).

Existing Conditions

Land cover estimates for the Fly Creek watershed, based on the National Land Cover Database (2006) analysis, are shown on the Figure 8 pie chart.

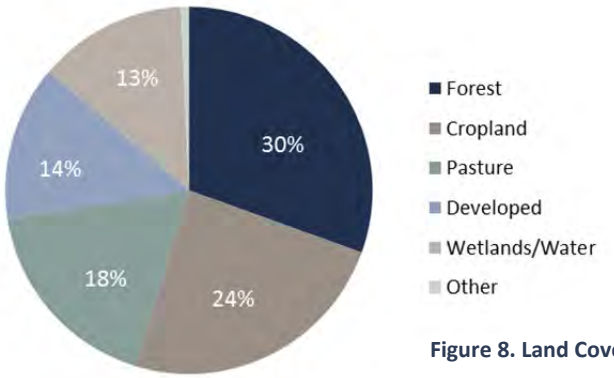


Figure 8. Land Cover Percentages

Figure 9 illustrates the land cover within the watershed. As evidenced from this figure, most of the natural forested landscape lies within the central part of the watershed along Fly Creek and its tributaries. As previously discussed in the soil section of this evaluation, the amount of impervious cover within a watershed contributes to the ability of the land surface to absorb rainfall, hence modifying the runoff capability and stream flow dynamics. Highly developed watersheds have a significant percentage of impervious cover, resulting in rainfall to rapidly runoff into streams causing increased erosion, stream channel modification, and downstream sedimentation. According to ADEM (2004), the Fly Creek watershed has 5.4% impervious surface, compared with the highly developed Three Mile Creek watershed's 34% (located in Mobile, Alabama) and the less developed Bay Minette Creek watershed's 1% (located approximately 15 miles north). The D'Olive Creek watershed in the Daphne/Spanish Fort area, which has experienced significant development and erosion/sedimentation issues, has an estimated impervious cover of 19% (MBNEP 2010).

IMPERVIOUS COVER INCREASES CORRESPOND TO INCREASED EROSION AND SEDIMENTATION PROBLEMS

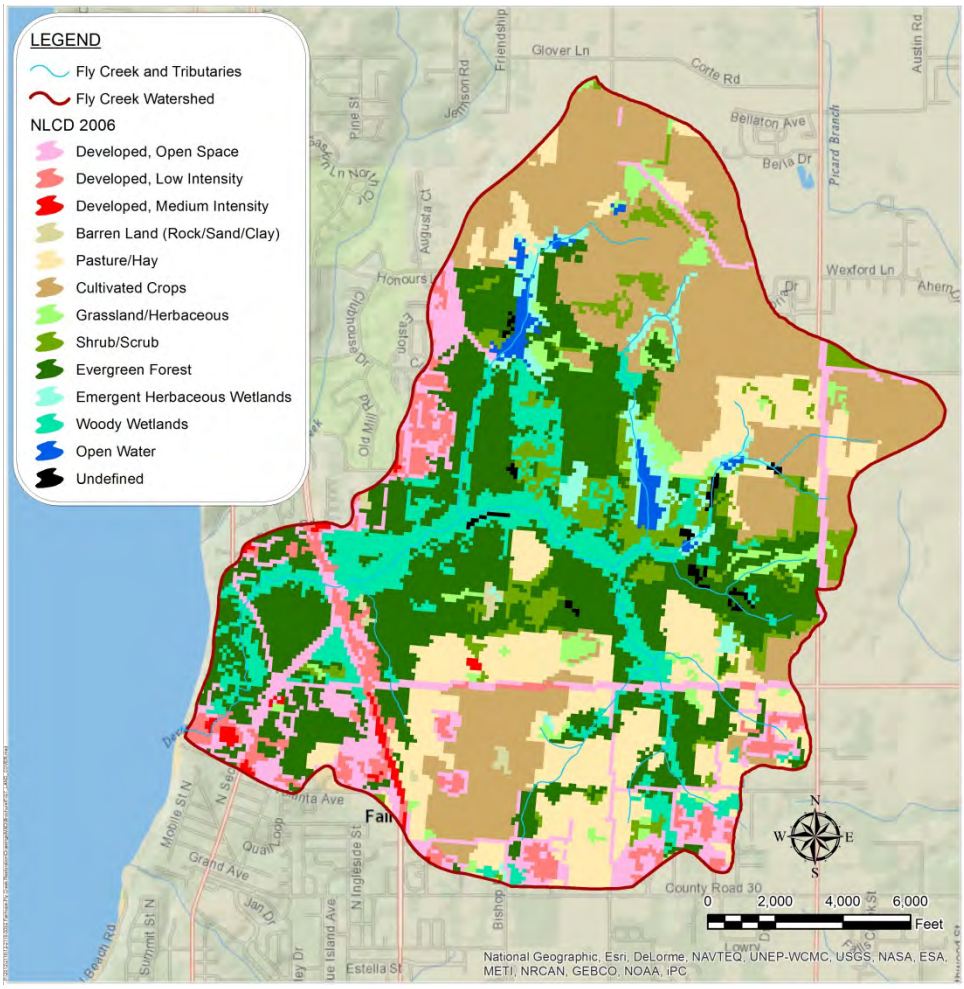


Figure 9. Land Cover in Fly Creek Watershed

Trends

The rapid population growth all along the eastern shore area of Baldwin County from Spanish Fort south to Point Clear has shown tremendous expansion of residential developments along the transportation corridors and conversion of forest and agricultural lands into single-family residential areas. As population continues to grow in these areas, there will be additional conversion of these types of land from Highway 98 further eastward into Baldwin County.

With 24% of the watershed being in the cropland category, agricultural methods and technology were reviewed with some key land managers within the watershed – the Gulf Coast Research and Extension Center (a unit of the Auburn University Agricultural Experiment Station) and the Corte Farms. Historically, as crops were planted the entire soil surface was tilled, thus exposing hundreds of acres to the erosive forces of rainfall events. The NRCS (formerly the Soil Conservation Service) lead the way to introduce no-till agriculture to these large cropland areas within the watershed – significantly reducing the amount of soil surface exposed during the crop planting process.

Zoning and Subdivision Regulations

Zoning regulations for the area within the watershed are divided according to political jurisdiction: incorporated areas of the City of Fairhope and City of Daphne, with the remainder covered by the unincorporated area of Baldwin County. All three of these entities have zoning regulations. Figure 10 shows the zoning classifications within the watershed.

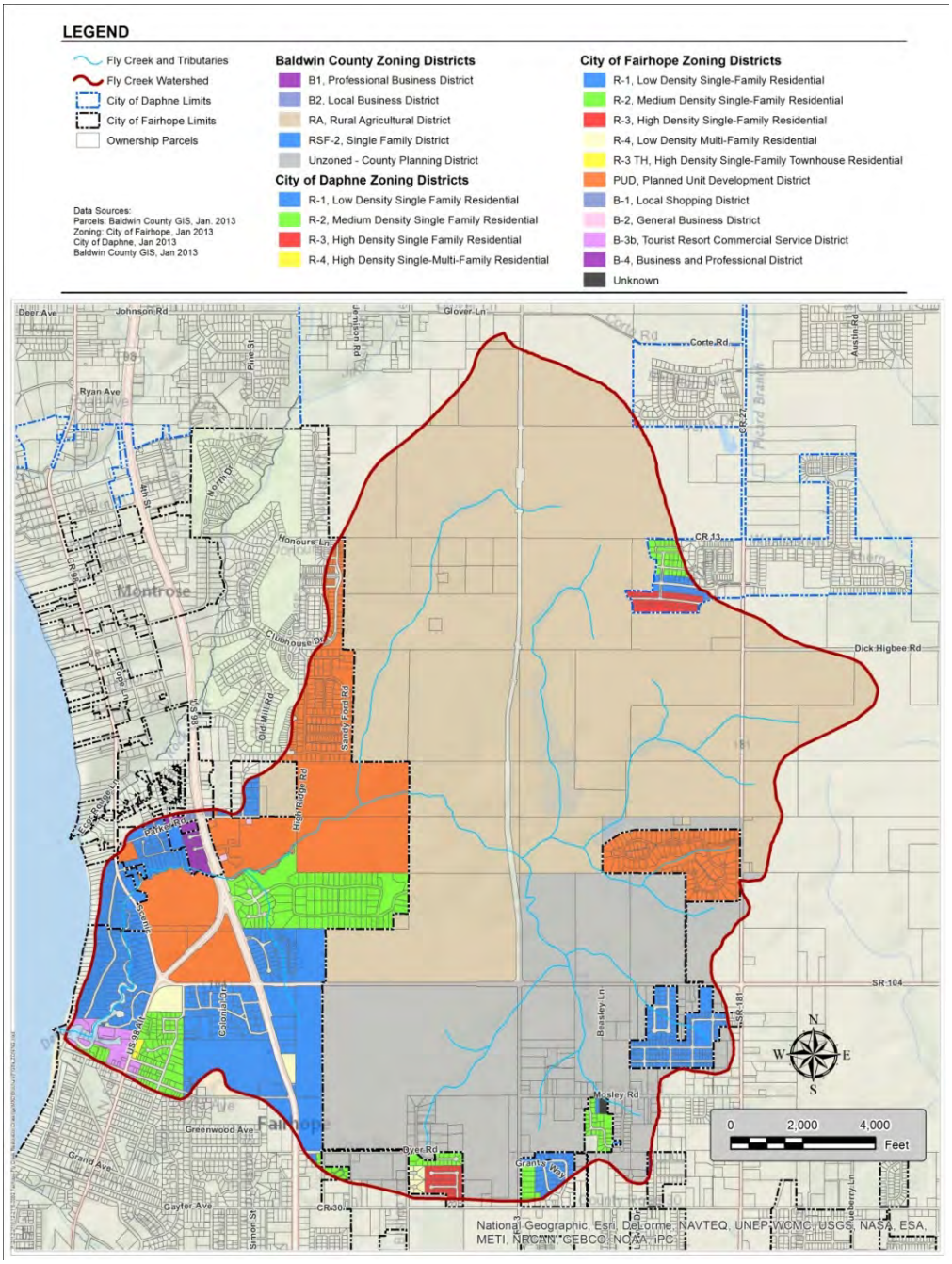


Figure 10. Zoning in Fly Creek Watershed

In addition to the zoning regulations, the subdivision regulations for the City of Fairhope do extend five miles beyond the city limits (City of Fairhope 2003). In other words, the City of Fairhope can develop a density plan for the unzoned areas of

their planning jurisdiction but cannot control land uses. The following is a listing of major zoning blocks/types within the watershed based on acreage:

- 2,400 acres, Baldwin County Rural Agricultural District
- 1,129 acres, Baldwin County Unzoned
- 523 acres, City of Fairhope Planned Unit Development
- 443 acres, City of Fairhope (434 acres) and City of Daphne (9 acres) Low Density Residential
- 208 acres, City of Fairhope (196 acres) and City of Daphne (12 acres) Medium Density Residential
- 32 acres, City of Fairhope (15 acres) and City of Daphne (17 acres) High Density Residential
- 23 acres, City of Fairhope Shopping, Business, and Commercial Services

Land Ownership

Photo 7. Agricultural Experiment Station

The majority of the land within the Fly Creek watershed is held in private ownership. The major exception is Auburn University's Gulf Coast Research and Extension Center (Photo 7) in the central portion of the watershed that contains approximately 800 acres (split by Highway 104). This Center started operation in 1930, and has research emphasis on beef cattle, cotton, citrus, peanuts, pecans, and soybeans. Much of the land in the northeastern part of the watershed is owned by members of the extended Corte family (approximately 2,600 acres – about half of the watershed) who have maintained a large family farming and timber operation in this area since the late 1800's. Publicly owned land within the watershed is very limited – the City of Fairhope owns approximately 65 acres of which approximately 60 acres is in the Fairhope Municipal Park and Municipal Pool complex at Business Highway 98 and Volanta Avenue, and about 3 acres at the mouth of Fly Creek, and a couple of other small parcels. The later areas are not in use as recreational or open space. The 60 acre park is developed principally for team sports and is not natural park land.

FLY CREEK WATERSHED HAS VERY LIMITED PUBLIC PARK LAND AND OPEN SPACE.

Political Institutions

The majority of the Fly Creek watershed is within the unincorporated area of Baldwin County (3,655 acres) followed by the City of Fairhope (1,318 acres) and City of Daphne (44 acres). Figure 11 shows the boundaries of the incorporated areas of Fairhope and Daphne.

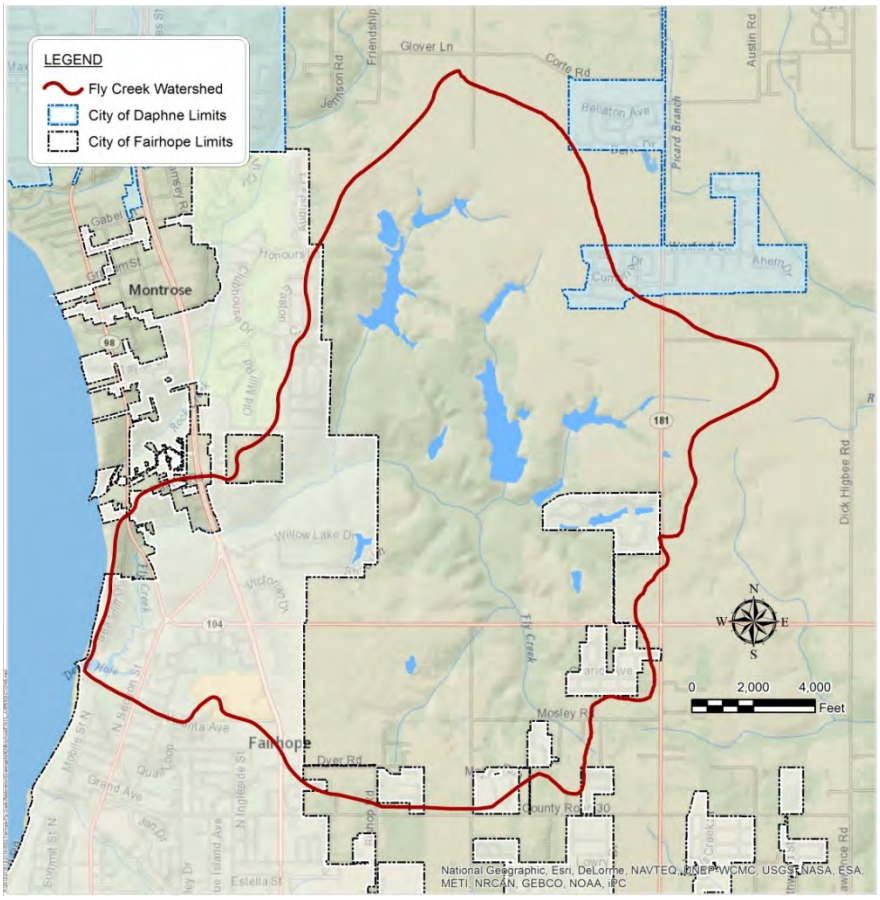


Figure 11. Political Boundaries in Fly Creek Watershed

Population

Baldwin County, particularly the eastern shore area along Mobile Bay including Fairhope and Daphne, has experienced rapid population increases over the past 50 years especially since 1990. The county is one of the fastest growing counties in Alabama. The following bar chart (Figure 12) presents the Baldwin County population growth since 1900:

POPULATION INCREASES IN THE WATERSHED CONTINUE AT A RAPID PACE.

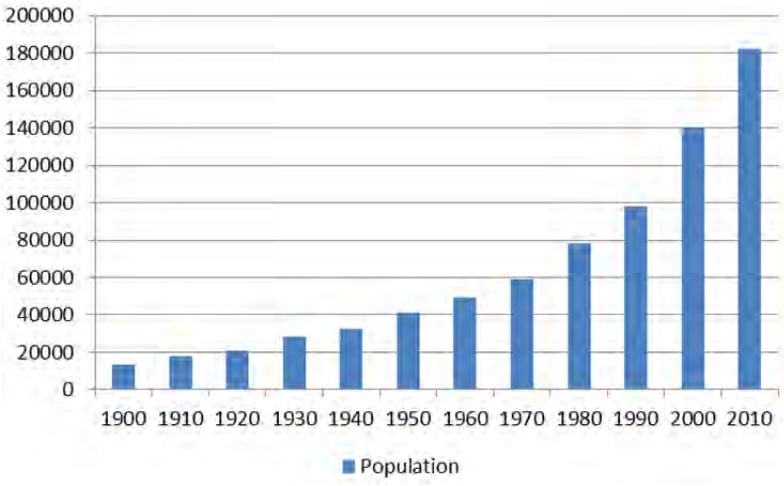


Figure 12. Baldwin County Population Growth

The specific population growth for Fairhope and Daphne between 1990 and 2010 is shown on Table 1.

Year	Fairhope	Daphne
1990	8,490	11,291
2000	12,480	16,581
2010	15,326	21,570

Table 1. Fairhope and Daphne Population Growth

Figure 13 depicts the 2010 census block population density per square mile that is wholly or partially within the Fly Creek watershed. The total 2010 census population for the 147 blocks located wholly or partially within the watershed was 4,034. The population counts for the various census blocks range from zero (for 64 of the blocks) to 333.

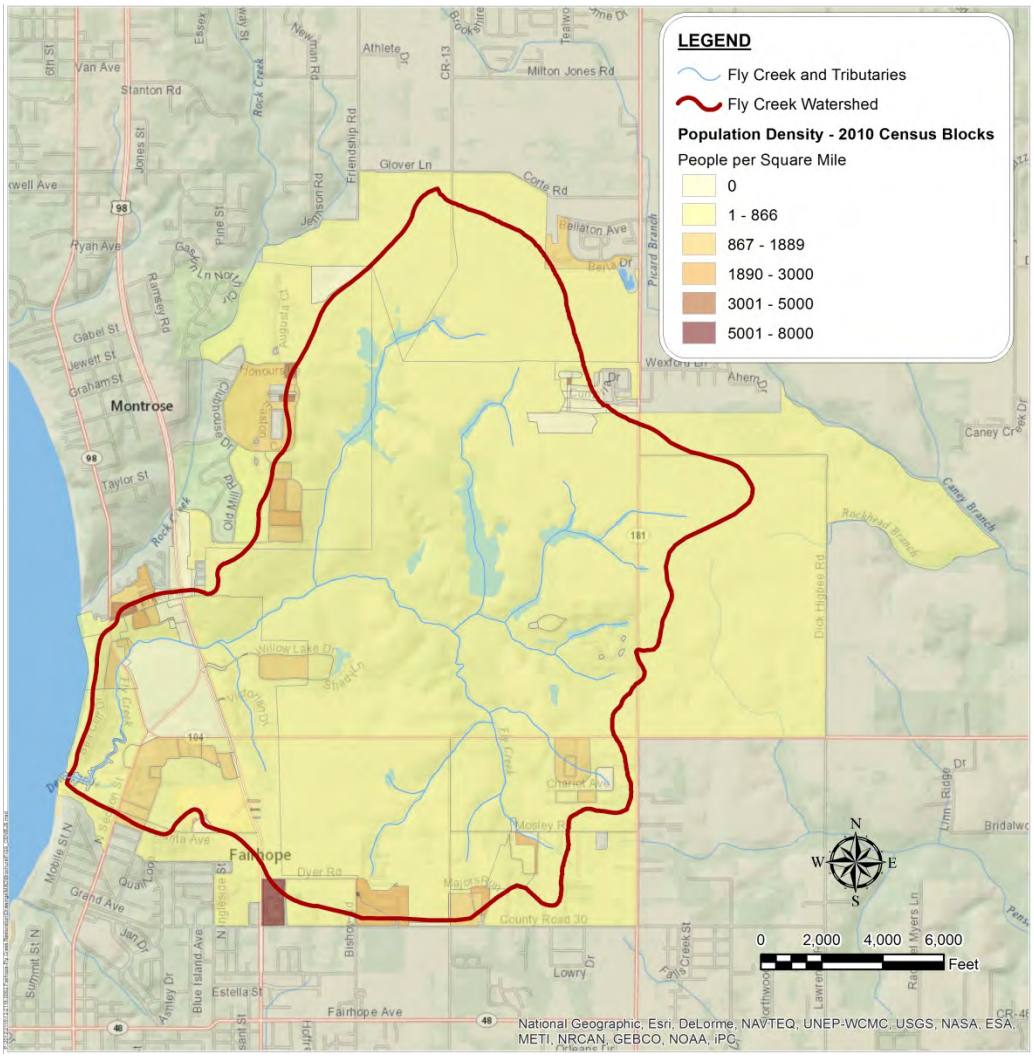


Figure 13. Population Density Per Square Mile in Fly Creek Watershed

Infrastructure

Several highways and city streets bisect the watershed. Major north-south roadways consisting of Scenic U.S. Highway 98 and Business U.S. Highway 98 within the western side of the watershed, County Road 13 in approximately the middle of the watershed, and State Highway 181 on the eastern side of the watershed. Major east-west roads include County Road 30 immediately south of the watershed, State Highway 104 crossing the lower third of the watershed, and Corte Road/Glover Lane immediately north of the watershed. There are no railroads or public airports within the watershed. Although utilities such as electricity, water, sewer, and gas cover most of the populated areas of the watershed, some residences still utilize private water wells and septic tanks.

3 Identification of Critical Areas and Issues

Past rapid population growth in this area of Baldwin County and the likely continuation of this pattern highlight the need to restore and preserve the natural resources within the watershed. As identified in the Natural Resource Inventory for the City of Fairhope (2003), the following are critical conservation focus areas/items and issues facing this area:

1. Restoration and preservation of ecologically significant natural communities, e.g., tidal streams, forested wetlands, and longleaf pine forest, are very important to overall protection of the quality of life along this eastern shore of Mobile Bay.
2. Establishment of corridors linking various ecosystem preserves, e.g., establishing natural habitat connections along coastal streams and associated riparian areas with upland forests that remain in this area.
3. Management of invasive species that have spread extensively throughout the area and threaten to further diminish the biotic integrity and diversity.

RESTORATION AND PROTECTION OF KEY NATURAL RESOURCES IS VITALLY IMPORTANT FOR FLY CREEK WATERSHED.

Addressing these critical issues will not only serve to restore and protect the Fly Creek watershed, but also serve the broader goal of restoration of Mobile Bay and the Gulf Coast area.

Degraded Streams

The majority of the current stream degradation within the Fly Creek watershed relates to the sedimentation that has occurred as the result of erosion of soils from upland and riparian areas within the watershed and the fish barrier created by the culvert underneath Business Highway 98. The sediment buildup within the streambed smothers the naturally diverse benthic invertebrates and shifts the aquatic biota to species that are tolerant of rapidly shifting sand substrates. As a result, the stream health is degraded and the beneficial contribution to the Mobile Bay ecosystem is reduced -- degraded habitat and spawning/nursery areas for

estuarine biota and diminished contributions of benthic drift and beneficial organic materials to Mobile Bay. The increased sedimentation resulting from poor stormwater management in upstream areas of the watershed has also aggravated the stream channel sinuosity – a local long-time resident along the creek reports a decrease in "oxbow" stream meanders within Fly Creek following a major rainfall event in 1977 and deposition of large quantities of sediment from upstream sources. Removal of these sediment deposits would help restore stream channel depths.

The culvert overfall fish barrier at Business Highway 98 has resulted from erosion at the downstream end of box culverts that carry the routine low water flows in Fly Creek. Those culverts were installed in the late 1960's/early 1970's and the downstream outlets were armored with concrete grouted riprap stone. Since installation, the center portion of the grouted riprap apron has been undercut by erosion and a section approximately 30 feet wide has collapsed, creating an impassable 5-foot barrier for fish moving upstream in Fly Creek.

Non-Point Source (NPS) pollution can be difficult to identify and quantify. However, the EPA cites NPS pollution as one of the leading contributors to water pollution nationwide. Residential, agricultural, and construction areas are all sources of NPS pollution in the form of excess herbicides, pesticides, and fertilizers; excess nutrients and biologically hazardous organisms; and sediment. Although the current water quality within Fly Creek is good, there are measures that can be taken to insure that the conditions do not deteriorate. Maintenance of good riparian buffers is critical to stream health. Trees along the creek help to stabilize the banks and the tree canopy provides shade/cooling to the stream during the hot summer months. Senescing leaves, dead limbs, and trees provide organic material, e.g, woody debris and leaf-packs that serve as habitat for many aquatic organisms.

Degraded Wetlands

The historic wetland plants and riparian vegetation along Fly Creek have been adversely affected by increased clearing for residential growth, sediment deposition, replacement with turfgrass and other ornamental trees and shrubs, and expansion of invasive plant species such as Chinese tallow tree, kudzu, and Chinese privet. Native species could be restored through a proactive and systematic process to remove invasive species through mechanical and/or chemical methods. In addition, creation of wetland habitats could be pursued in upland and marginal habitats through grading to the appropriate elevation and planting of native wetland vegetation.

Stormwater Management

Prevention of future damage is proactively addressed through zoning ordinances and subdivision regulations which require on-site storage and slow release of stormwater (City of Fairhope 2003). As roads, subdivisions, and businesses have been constructed within the watershed, there have often been rainfall events that have overwhelmed the capability of the installed stormwater management

measures. Although stormwater management practices are better than historically evidenced within the watershed, there continue to be opportunities for improvement as construction sites expand into previously undeveloped areas. In addition, there are numerous opportunities to restore areas that have been negatively impacted in the past due to failed stormwater management practices. Sediment management can take place at many points along the path of sediment particles from their source to their deposition within the creek. The optimal practice is to stop the sediment as close to its place of origin as possible – hence implementation of effective erosion control and stormwater management practices should be enacted, enforced, and maintained.

A great example of innovative and effective stormwater measures that were successfully implemented within the watershed is the extension of County Road 13 northward from Highway 104 for approximately 2.5 miles that was completed in May 2010. Auburn University, one of the key landowners in the road corridor, was instrumental in identification of a number of Low Impact Development (LID) roadway techniques to lessen environmental impacts on this pristine natural area of forested wetlands and upland pine forest (Sasaki 2006). Examples of LID techniques included conservation buffers; infiltration trenches; stone check dams; open bottom culverts; wildlife protection fences; vehicle, pedestrian, and wildlife underpasses; and open graded fraction courses.

Land Use Practices

Land use practices on the various types of land cover within the watershed have a direct bearing on soil stability of that specific area of land and can also cause significant effects downslope/downstream. For example, installation and maintenance of Best Management Practices is essential for site stabilization and prevention of erosion from practices such as residential or business development, roadway construction, timber harvesting activity, or planting of an agricultural crop.

Preservation of Natural Areas/Open Space

The importance of establishing key natural areas/open space within the watershed in a timely manner is critically important. As mentioned previously within this report, there is very little public land within the Fly Creek watershed (approximately 1%). With the majority of land within the watershed being private coupled with the continuing high growth rate for this area, current natural and open space areas will come under intense pressure for conversion to development as residential, business, and infrastructure rights of way. These land use conversions will change the land cover on some of the current natural areas and also fragment these areas making them less valuable for wildlife habitat. In addition to preservation of natural areas for ecological purposes, these areas provide human uses as well. Natural areas and open spaces within an urban/suburban area provide space for active recreation such as sports, gatherings, and for passive recreation like walking and

INCREASED PUBLIC NATURAL AREAS AND OPEN SPACE IS NEEDED WITHIN THE WATERSHED.

sitting (City of Fairhope 2003). These areas provide opportunities for walkers, runners, and cyclists who choose the eastern shore area and Fairhope because of its ability to support a lifestyle that is closer to nature. Ideally, these natural areas and open spaces that are attractive to people benefit by being connected, free from motorized vehicles, and safe.

Creation of Riparian Buffer

The health of Fly Creek is highly dependent upon the protection of its riparian buffers, the last barrier of defense from environmental stressors located upstream in the watershed. The importance of a well vegetated riparian buffer (with native plants) along the creek is paramount in providing wildlife corridors, filtering pollutants before they reach the stream, improving water quality within the stream, and preservation of an aesthetically pleasing natural area.

Restoration Measures and Action Plan Development

Restoration Measures

Based on the current environment within the watershed and the trends evidenced by human and natural resources an interdisciplinary team compiled a list of measures that focus on resource needs in this area. The following is an ordered priority listing of restoration measures to address the Fly Creek watershed:

Measure 1

The 108 acre tract of undeveloped land is critically located in the watershed. Acquisition should be considered for the tract of land located west of Business Highway 98 and north of Highway 104. The tract is bounded by Fly Creek (north), Business Highway 98 (east), Highway 104 (south), and Scenic Highway 98 (west). This forestland includes a diversity of habitats along Fly Creek from Scenic Highway 98 to Business Highway 98. Habitats include the riparian corridor/forested wetlands on the south side of the creek, and a large continuous tract of mature longleaf pine. Scattered throughout the longleaf forest are some unique tree communities including species such as southern magnolia, sweetbay magnolia, American beech, live oak, southern red oak, water oak, sweetgum, blackgum, tulip poplar, wild persimmon, black cherry, eastern red cedar, and American holly. The proximity of this tract of land to the Eastern Shore Trail makes it ideal for passive recreation trail development, human use improvements, arboretum development, wildlife photography, etc.

Measure 2

Other land protection avenues should be explored to protect remaining natural areas and open space within the watershed. Several options, in addition to purchase, are available for local governments and private foundations to work with property owners to preserve these areas of natural beauty (City of Fairhope 2003):

- Land Trust Ownership
- Conservation Easements
- Purchase or Donation of Development Rights
- Transfer of Development Rights
- Property Tax Incentives

High priority areas should be considered for protection by one of the above methods.

Measure 3

Stormwater runoff from highways and streets northwest of the Highways 98 and 104 has contributed to significant gully erosion across private land in this property. Measures should be designed and implemented to rehabilitate this erosion site. Following restoration of that large erosion site, identify others within the watershed and develop plans to address stabilization measures. Stabilization of these erosional features will reduce the sediment load into the creek, improve water quality, and restore habitat for this important coastal stream.

Measure 4

The Alabama Department of Transportation should be contacted regarding the erosion that has occurred at the downstream side of the culverts under Business Highway 98. The approximately 30 foot gap in the grouted riprap has significantly eroded to the point that a 5-foot overfall exists and prohibits upstream fish passage. The construction of a rock ramp fish passage structure consisting of alternating pools and steps would allow fish and other aquatic organisms to freely pass upstream and reconnect with the several miles of free flowing waters upstream of the culvert.

Measure 5

Sediment impaired stream reaches should be identified and prioritized where it is appropriate to remove sediments that have been deposited. Whether sediment removal is by hand (bucket and shovel), or on a larger scale by mechanical dragline or hydraulic pipeline dredge, the disposal of the sediments must be in an appropriate location, possibly in some erosional areas upslope within the watershed. Wherever the sediment is deposited, it should be stabilized to prevent the erosional process from repeating itself. All sediment removal activities and

sediment disposal must be in compliance with appropriate Corps of Engineers and ADEM regulations.

Measure 6

Develop an integrated program between Federal, State, and local entities to manage invasive plant species that are present within the Fly Creek watershed. This program should incorporate a combination of physical/mechanical removal, herbicides, and biological control methods. Subject matter experts should be consulted to develop the toolbox for managing these invasive species to make sure that the "cure" is not worse than the "disease," e.g, some forms of mechanical removal can actually further spread the invasive plant. Also the herbicides used in wetland and aquatic environments must be properly labeled for aquatic site use and applied by a licensed pesticide applicator with credentials to work within special aquatic sites.

Measure 7

Work with City of Fairhope, City of Daphne, and Baldwin County to plan for on-site stormwater storage requirements in excess of what might have been experienced in the past to address increasing levels of impervious surface and increased intensity of storms.

Measure 8

A system should be developed to support and recognize farmers that continue to use and further expand usage of "no-till" agriculture crop practices. This practice has significantly reduced erosion from cropland within the watershed. Another measure that should be encouraged within the cropland areas is installation of grassed buffer strips in the large agricultural fields.

Measure 9

Identify and implement measures to restrict cattle and feral hogs from trampling creek bank areas and feeding on riparian corridor vegetation. Incentives could be established to assist cattle owners and other landowners. Incentives/bounties could also be established for removal of feral hogs from the watershed.

Measure 10

Establish incentives for inspection/repair and pump-out of residential septic tanks within the watershed.

Measure 11

Although the stream banks along the creek currently appear relatively stable and well vegetated, there may be opportunities for restoration of more natural stream sinuosity between Scenic Highway 98 and Business Highway 98. Stream restoration

measures should incorporate natural materials such as root wads and planting of native plant materials.

Measure 12

Consideration should be given for an inventory of the existing riparian buffers along the miles of streams within the Fly Creek watershed. Use of recent aerial photographs will facilitate this effort greatly and establish priority stream reaches where actions are required to restore or reestablish healthy riparian buffers.

Measure 13

Consider a mechanism to support the NRCS in identification of appropriate locations within the watershed where lake and pond construction could significantly reduce downstream sediment transport and improve water quality. Lake and pond construction has been implemented by some landowners within the watershed and water quality improvements have been observed. The NRCS has worked with these landowners on measures such as tilling practices and impoundment construction to improve downstream water quality and reduce sediment transport. The trapping efficiency of these impoundments, particularly the impoundments larger than 10 acres, has proven to be very effective as evidenced by the December 2012 site inspection at County Road 13 – the water clarity of the creek at this location was excellent in spite of a large rainfall event just 1 day prior to that inspection.

Measure 14

Develop an educational outreach for members of the public to emphasize the importance of not applying excessive quantities of herbicides, pesticides, and fertilizer.

Measure 15

Opportunities should be taken to partner with environmental stewardship groups such as the Alabama Clean Water Partnership and non-profit conservation organizations to ensure the protection and preservation of the Fly Creek watershed through public outreach and participation. Outreach topics should include the preservation of forested areas, reduction of NPS pollution, monitoring of water quality, and stream bank stabilization/preservation.

Action Plan

Based on the above list of 15 Restoration Measures, the City of Fairhope recommends adoption of the top 6 priority measures as the Action Plan for restoration of the Fly Creek watershed. While Measures 7-15 are considered important and noteworthy, they are deemed as less urgent at the present time than the top tier of Measures 1-6.

ACTION PLAN FOR FLY CREEK WATERSHED CONSISTS OF THE TOP 6 RESTORATION MEASURES

5 Cost Estimates

At the time of this evaluation, the preliminary cost estimate for the 6 restoration measures identified for the Action Plan for the Fly Creek watershed is $12.8 million.

6 Implementation Strategies

Implementation of the Action Plan recommendation enumerated earlier in this report must be matched with not only the resource priority needs but also on funding sources for carrying out the identified measures. The "windows of opportunity" for the various measures are defined by circumstances of the situational urgency, funding opportunity, and political/public acceptability.

Given these considerations, the highest priority restoration measure of the 6 identified for the Action Plan is for purchase of the 108-acre tract of land located northwest of Highways 104 and Business 98 property). The opportunity for acquisition of this property is currently available; however, because of the development pressure and the approved development plan on the property (circa 2000) that opportunity is not likely to exist long term.

PURCHASE OF THE 108 ACRE TRACT IS THE TOP PRIORITY MEASURE IN THE WATERSHED ACTION PLAN

Implementation of the remaining recommendations should be pursued by the appropriate governmental entities and/or private organizations as specific project opportunities arise and funding assets become available. Some of the recommended measures fall under the authority for various local, State, and Federal agencies. Implementation funding opportunities should be sought from these agencies, private foundations, and non-profit organizations.

7 Financing Alternatives

Funding improvements on a watershed basis is a challenging proposition. The political jurisdictions necessary to provide such funding do not necessarily follow watershed boundaries, as is the case for the Fly Creek watershed. A watershed approach to the design, construction, and maintenance of measures requires a significant and steady stream of funding. Municipalities and other political subdivisions should consider and compare various funding options for the recommended watershed restoration measures. Funding to support these recommendations should initially be sought from the following three potential sources:

- Natural Resources Damage Assessment process
- Recovery Act process
- National Fish and Wildlife Foundation (NFWF) process

A number of other alternative funding and financing options are available for the highest priority recommendation (purchase 108 acre tract northwest of Business Highway 98 and Highway 104 intersection) and the other watershed restoration recommendations including: Federal grants, loans, and revenue sharing; non-

governmental organizations and other private funding; mitigation banks, water use service fees, property, sales, or other taxes paid into general funds; impact fees; special assessments; system development charges; environmental tax shifting; municipal bonds; capital improvement cooperative districts; Alabama improvement districts; and tax increment financing districts (MBNEP 2010). The following subsections briefly describe the first three of these financing options for the restoration recommendations.

Federal Grants, Loans, and Revenue Sharing

There are a number of different financial structures that could facilitate funding for the restoration measures identified in this report. The United States Federal government provides numerous sources of grants, loans, and revenue sharing that may be used by municipalities and non-profit groups to conduct studies and construct projects related to watershed protection, stream restoration, and stormwater management.

The following two searchable electronic databases are available:

- The Clearinghouse for Federal Grant Opportunities (also known as Grants.gov) is a central storehouse for information on over 1,000 grant programs providing approximately $500 billion in annual awards.
- The EPA Catalog of Federal Funding Sources for Watershed Protection is a searchable database of financial assistance sources available to fund a variety of watershed protection projects.

Also, 38 specific funding programs offered by 9 different Federal agencies are summarized in Table 2.

Acronym	Agency Name	Number of Programs
EPA	Environmental Protection Agency	8
FEMA	Federal Emergency Management Agency	2
NOAA	National Oceanic and Atmospheric Administration	5
USACE	U.S. Army Corps of Engineers	7
USDA	U.S. Department of Agriculture	6
USDOI	U.S. Department of the Interior	2
USDOT	U.S. Department of Transportation	1
USFWS	U.S. Fish and Wildlife Service	5
USHUD	U.S. Housing and Urban Development	2

Table 2. Federal Agencies Offering Funding Programs

The restoration recommendations described in this report can and will result in incremental environmental improvements. However, one objective of this watershed report is to coordinate the various projects and studies so that the overall needs of the Fly Creek watershed are met. Once the priority areas are identified, local governmental entities and non-profit groups will be better empowered to identify priority projects; choose potential funding opportunities and sources; coordinate the respective grant/loan application processes; and ultimately improve the chances of successfully obtaining funding from those sources.

Governmental grants are popular because the funds received do not have to be repaid to the grantor agency. However, grants discourage consideration of long-term costs. The effort to apply for a grant may not pay off. Grant parameters are often force-fitted by grant writers in order to qualify for a particular opportunity. The matching funds required by some grants can be problematic. As dollars for grant funding decrease in the current economy, the grant writing process becomes highly competitive (Berahzer, 2010).

The EPA State Revolving Fund (SRF) Loan program offers a more reliable source of funding (Berahzer, 2010). There are separate SRFs for Clean Water and Drinking Water. Funds are provided annually to each state by the Federal government, with the states providing a 20% match. In order to be funded, a project must be on the State's annual "Intended Use Plan" (IUP) list. The IUP contains a "comprehensive" list and a shorter "fundable" or "priority" list. A public comment process is required for the IUP. Since 2007, the SRF has moved beyond the traditional "water treatment works" projects and has begun to emphasize nonpoint sources and estuary protection as funding priorities.

Non-Governmental Organizations and Other Private Funding

Private foundations and corporations may be another source of funding for improvements in the Fly Creek watershed. Three such sources are searchable electronic databases of foundation and corporate grants in various fields: (1) the Chronicle of Philanthropy Guide to Grants; (2) the Community of Science Database; and (3) the Foundation Center. Local governmental entities and non-profit agencies involved with the Fly Creek watershed should investigate these databases with specific project objectives in mind.

The Kodak American Greenways Program, RBC Bank Blue Water Project Grants, and Surdna Foundation Sustainable Environmental Grants offer specific funding opportunities for environmental improvement projects related to watershed protection and Green Infrastructure (GI). These programs are listed because of their direct applicability to ongoing efforts in the watershed.

The Water Environmental Research Foundation Cooperative Agreement has been allocated $10 million in EPA funds to evaluate new technologies that will help utilities cope with aging and failing water and wastewater systems, including $6.25

million in research grants for innovative treatment technologies for stormwater and water reuse. This source of funds may prove useful to Baldwin County and to the Cities of Fairhope and Daphne.

Mitigation Banking

A mitigation bank is a designated and approved wetland or stream area that has been created, restored, enhanced, or preserved and set aside in perpetuity to compensate for future unavoidable impacts to wetlands and waters of the United States. Credits are purchased at the bank as compensatory mitigation for other development projects ideally within the same watershed. Mitigation banking provides opportunities for a county or city to partner with land owners and land trusts, accrue financial resources for community improvements, create natural amenities in an urban setting, and enhance education about restoration and water quality (Leo and Tillery, 2010).

Authorized under federal environmental law and regulations, a mitigation bank provides an asset that can be sold to developers and government entities whose projects require mitigation of stream and/or wetland damage. If formed for all or part of an affected watershed, a mitigation bank effectively allows the sale of credits that can be used to offset some portion of the costs of the initial set-aside area. The regulatory process involves a prospectus and public notice, the development of a banking instrument, restrictive covenants, and coordination with various agencies that have jurisdiction over the process.

Municipalities are a major user of mitigation banks. The mitigation banking concept is based on supply and demand. The demand is determined by regulatory activities that require mitigation for impacts of specific projects and the price of mitigation credits is variable and determined by the market (Leo and Tillery, 2010). Impacts to streams and wetlands are required to be mitigated per federal statutes including Sections 404/10 of the Clean Water Act and the 2008 Federal Compensatory Mitigation Rule. Compensatory mitigation can be satisfied through mitigation banks, in-lieu fee programs, or permittee-specific mitigation.

In coordination with the USACE, unavoidable impacts to waters of the United States are determined by the loss of amount, function, and/or type. The loss is converted into a required credit value to offset the impact (adverse impact factors). The impacts must be offset through mitigation credits created by restoration activities. Credits impacts and credits generation are calculated based on USACE standard operating procedures, which may vary by region. Net benefit factors may be included in the calculation of mitigation credits (Leo and Tillery, 2010). A major factor affecting mitigation credit values is the “market” demand for wetland and stream mitigation and the extent of the “service area” designated for specific mitigation banks.

8 Conclusions

A number of restoration measures have been developed in this evaluation of the natural and human resources in the Fly Creek watershed, and the top 6 have been formulated into the Action Plan. Based on the historic trend of rapid population growth in this area, accompanied by continuing residential and business developments, development conducive zoning regulations, and extremely limited public land within the watershed, development and growth are anticipated to continue. These recommendations also were developed in accordance with criteria approved by the NRDA Trustees in the Framework Agreement.

THE HIGHEST PRIORITY RESTORATION MEASURE IS ACQUISITION OF THE 108 ACRE TRACT OF PROPERTY.

The top 6 restoration measures identified were combined into the Action Plan for the Fly Creek watershed. The highest priority restoration measure of the 6 measures combined into the Action Plan is to purchase the last remaining large tract of land in the lower Fly Creek area, the 108 acre block located northwest of the Highways 98 (Business) and 104 intersection. The property is adjacent to a significant reach of undeveloped Fly Creek and its riparian corridor, plus contains a diversity of scarce habitats such as forested wetlands and longleaf pine forest. This purchase would not only provide long-term protection from development and associated adverse impacts on stormwater runoff, water quality, and sedimentation but would also provide multiple opportunities for the City of Fairhope to significantly enhance the natural area and open space within the watershed. The opportunity for acquisition of this property is currently available; however, because of the development pressure and the approved development plan on the property (circa 2000) that opportunity is not likely to exist long term.

Implementation of the other recommendations within this report should concurrently be pursued as funding opportunities are identified.

Literature Cited

Alabama Department of Environmental Management (ADEM). 2004. *An Impervious Surface Study over Three Regimes: Three Mile Creek, Fly Creek, and Bay Minette Creek Subwatersheds*. Alabama Department of Environmental Management. Mobile, Alabama.

Berahzer, S.I. April 2010. *State Revolving Fund for Stormwater Projects – A Primer*. Presented at the Southeast Stormwater Association Seminar. Creative Alternatives for Stormwater Funding.

City of Fairhope. 2004-2008. *Fairhope Comprehensive Plan*. Fairhope, Alabama.

City of Fairhope. 2003. *Natural Resource Inventory for the City of Fairhope, Alabama*. Prepared by Lawrence L. Woolbright, Audubon International and Gena Todia, Wetland Resources. Fairhope, Alabama.

DeWiest, Daniel R. and Eric H. Livingston. 1999. *The Florida Stormwater, Erosion, and Sedimentation Control Inspector's Manual*. Florida Department of Environmental Protection, in cooperation with the Florida Department of Transportation. First Edition.

Fry, J., Xian, G., Jin, S., Dewitz, J., Homer, C., Yang, L., Barnes, C., Herold, N., and Wickham, J., 2011. *Completion of the 2006 National Land Cover Database for the Conterminous United States*, PE&RS, Vol. 77(9):858-864. website: http://www.mrlc.gov/nlcd2006.php .

Gillett, B., Raymond, D.E., Moore, J.D., and Tew, B.H., 2000, *Hydrogeology and Vulnerability to Contamination of Major Aquifers in Alabama: Area 13*: Geological Survey of Alabama in cooperation with the Alabama Department of Environmental Management.

Isphording, W. C., 1977, *Petrology and stratigraphy of the Alabama Miocene*: Trans., Gulf Coast Assn. Geol. Soc., v.27.

Isphording, Wayne C. 2011. *Environmental Impact of Regency Centers/Fairhope LLC Shoppes at Fairhope Village Construction on Fly Creek, Baldwin County, Alabama*. Report of Investigation prepared by Consulting Geologist Wayne Isphording for David A. Ludder, Attorney at Law. Mobile, Alabama.

Leo, S. and J. Tillery. April 2010. *Mitigation Banking*. Presented at the Southeast Stormwater Association Seminar: Creative Alternatives for Stormwater Funding.

McBride, E.H. and Burgess, L.H., 1964, *Soil Survey of Baldwin County, Alabama*: United States Department of Agriculture Soil Conservation Service, Series 1960, No. 12.

Mobile Bay National Estuary Program. 2010. *Watershed Management Plan for the D'Olive Creek, Tiawasee Creek, and Joe's Branch Watersheds, Daphne, Spanish Fort, and Baldwin County, Alabama*. Prepared under contract by Thompson Engineering. Mobile, Alabama.

Reed, P.C. and McCain, J.F., 1971, *Water availability of Baldwin County, Alabama*: Geological Survey of Alabama.

Robinson, James L., Moreland, Richard S, and Clark, Amy E., 1996, *Groundwater Resources Data for Baldwin County, Alabama*: U.S. Geological Survey, Open-File Report 96-487.

Sasaki Associates, Incorporated. May 2006. Memoranda #1, #2, and #3 Prepared for Auburn University regarding the Proposed County Road 13 Extension Across Gulf Coast Research and Experimental Center. Watertown, MA.

Szabo, M.W., and Copeland, C.W., Jr. 1988. *Geologic map of Alabama: southwest sheet*: Alabama Geological Survey Special Map 220.

U.S. Army Corps of Engineers, Mobile District. 1974. *Final Environmental Impact Statement for Fly Creek, Alabama (Maintenance Dredging).* Prepared under contract by the Dauphin Island Sea Lab. Mobile, Alabama.

U.S. Department of Agriculture, Natural Resource Conservation Service. *Web Soil Survey*: http://websoilsurvey.nrcs.usda.gov/app/WebSoilSurvey

U.S. Department of Commerce, Census Bureau. 2012. *Population and Housing Unit Counts, Alabama: 2010.*

U.S. Fish and Wildlife Service. 2013. *Endangered Species Program website*: http://www.fws.gov/endangered/ .

U.S. Fish and Wildlife Service. 2013. *National Wetlands Inventory website*: http://www.fws.gov/wetlands/ .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