

NOTICE TO
FLOOD INSURANCE STUDY USERS

Communities participating in the National Flood Insurance Program have established repositories of flood hazard data for floodplain management and flood insurance purposes. This Flood Insurance Study (FIS) may not contain all data available within the repository. It is advisable to contact the community repository for any additional data.

Part or all of this FIS may be revised and republished at any time. In addition, part of this FIS may be revised by the Letter of Map Revision process, which does not involve republication or redistribution of the FIS. It is, therefore, the responsibility of the user to consult with community officials and to check the community repository to obtain the most current FIS components.

Initial Countywide FIS Effective Date:

Revised Countywide FIS Date:

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FLOOD INSURANCE STUDY
HILLSBOROUGH COUNTY, FLORIDA AND INCORPORATED AREAS

1.0 INTRODUCTION

1.1 Purpose of Study

This countywide Flood Insurance Study (FIS) investigates the existence and severity of flood hazards in, or revises and updates previous FISs/Flood Insurance Rate Maps (FIRMs) for the geographic area of Hillsborough County, Florida, including: the Cities of Plant City, Tampa, and Temple Terrace, and the unincorporated areas of Hillsborough County (hereinafter referred to collectively as Hillsborough County).

This FIS aids in the administration of the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973. This FIS has developed flood risk data for various areas of the county that will be used to establish actuarial flood insurance rates. This information will also be used by Hillsborough County to update existing floodplain regulations as part of the Regular Phase of the National Flood Insurance Program (NFIP), and will also be used by local and regional planners to further promote sound land use and floodplain development. Minimum floodplain management requirements for participation in the NFIP are set forth in the Code of Federal Regulations at 44 CFR, 60.3.

In some States or communities, floodplain management criteria or regulations may exist that are more restrictive or comprehensive than the minimum Federal requirements. In such cases, the more restrictive criteria take precedence and the State (or other jurisdictional agency) will be able to explain them.

1.2 Authority and Acknowledgments

The sources of authority for this FIS are the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973.

This FIS was prepared to include the unincorporated areas of, and incorporated communities within, Hillsborough County in a countywide format. Information on the authority and acknowledgments for each jurisdiction included in this countywide FIS, as compiled from their previously printed FIS reports, is shown below.

Hillsborough County
(Unincorporated Areas):

the hydrologic and hydraulic analyses for the FIS report dated January 16, 1987, were performed by the Nelson Consulting Group, with cross section data obtained by Ghioto, Singhofen & Associates, Inc. (Federal Emergency Management Agency [FEMA], 1987). For the FIS report dated August 15, 1989, the hydrologic and hydraulic analyses were performed by the

Southwest Florida Water Management District (SWFWMD) for Trout Creek and Cypress Creek. That work was completed in June 1986. Ghioto, Singhofen & Associates, Inc., performed the hydrologic and hydraulic analyses for Delaney Creek. That work was completed in April 1986 (FEMA, 1989). The hydrologic and hydraulic analyses for the FIS report dated August 3, 1992, excluding the wave height analysis, were performed by Tetra Tech, Inc., for the Federal Insurance Administration under Contract No. H-4510. That study was completed in July 1979. The wave height analysis was performed by Gee & Jenson, Inc., for FEMA under Contract No. EMW-88-C-2612. That work was completed in July 1989 (FEMA, 1992).

Tampa, City of:

the hydrologic and hydraulic analyses for the FIS report dated March 1980 were performed by Tetra Tech, Inc., for the FIA, under Contract No. H-4510. This work, which was completed in June 1979, covered all significant flooding sources affecting the City of Tampa (FEMA, 1980).

Temple Terrace, City of:

the hydrologic and hydraulic analyses for the FIS report dated June 18, 1990, were conducted by the U.S. Department of the Army, U.S. Army Corps of Engineers, Jacksonville District, at the request of the FIA, U.S. Department of Housing and Urban Development. Authority and financing are contained in Inter Agency Agreement Nos. IAA-H-19-74 and IAA-H-16-75, Project Order Nos. 17 and 4, respectively (FEMA, 1990).

The authority and acknowledgments for the City of Plant City are not available because no FIS report was ever published for this community.

For this countywide FIS, floodway analyses were prepared for FEMA by Dewberry & Davis LLC, under Contract No. EMW-2000-CO-0003. The Dewberry floodway analyses were incorporated into revised hydrologic and hydraulic (H&H) analyses that were originally prepared by various companies as shown in Table 1, "Study Analysts."

TABLE 1 – STUDY ANALYSTS

<u>Watershed</u>	<u>H&H Analyst</u>	<u>H&H Completion Date</u>	<u>Floodway Date</u>
Alafia River	Parsons Engineering Science, Inc.	August 2002	March 2003
Brooker Creek	Advantage Engineering, Inc.	July 2002	March 2003
Bullfrog/Wolf Branch Creek	Dames & Moore	September 2001	November 2002
Curiosity Creek	Kisinger Campo and Associates, Inc. Corporation	October 2001	March 2002
Cypress Creek	URS Southern Corporation	June 2002	February 2003
Delaney Creek	Hillsborough County Engineering Department	April 2002	July 2003
Double Branch Creek	Advantage Engineering, Inc.	September 2002	March 2003
Duck Pond Area	URS Southern Corporation	January 2002	January 2003
East Lake	Hillsborough County Engineering Department	January 2002	June 2002
Hillsborough River	Ayers Associates, Inc.	March 2002	January 2003
Little Manatee River	PBS&J	June 2002	February 2003
Lower Sweetwater Creek	Hillsborough County Engineering Department	December 2002	March 2003
Pemberton Creek/ Baker Canal	Hillsborough County Engineering Department	December 2001	March 2004
Rocky/Brushy Creek	Hillsborough County Engineering Department	December 2001	June 2004
Silver & Twin Lakes	Hillsborough County Engineering Department	March 2002	May 2002
Sweetwater Creek	Ayres Associates, Inc.	September 2002	March 2003
Tampa Bypass Canal	Ayres Associates, Inc.	March 2002	January 2003

For the Alafia River watershed, revised 1-percent annual chance (100-year) floodplain boundaries were compared to the previously effective boundaries, and the more conservative result in each area was depicted on this countywide FIRM.

Base map information shown on this FIRM was derived from multiple sources. Road centerlines were provided by the City of Tampa Geographic Information System (GIS) group. These data were aligned to aerial imagery at 6-inch pixel resolution dated 2004. Surface water features were provided by the Hillsborough County Information Technology & Services GIS Section. These data were digitized from aerial imagery at 1-foot and 6-inch pixel resolution dated February 2000 and April 2004. Political boundaries were provided by the Hillsborough County Real Estate Department, Survey Division, GIS Section. These data were compiled in 2003. Public Land Survey System (range, township, and sections) were provided by the Florida Geographic Data Library. These data were produced at a scale of 1:24,000.

The projection used in the preparation of this map was Florida State Plane west zone (FIPZONE 0902). The horizontal datum was NAD 83, GRS80 spheroid. Differences in datum, spheroid, projection or State Plane zones used in the production of FIRMs for adjacent jurisdictions may result in slight positional differences in map features across jurisdiction boundaries. These differences do not affect the accuracy of this FIRM.

1.3 Coordination

Consultation Coordination Officer's (CCO) meetings may be held for each jurisdiction in this countywide FIS. An initial CCO meeting is held typically with representatives of FEMA, the community, and the study contractor to explain the nature and purpose of a FIS, and to identify the streams to be studied by detailed methods. A final CCO meeting is held typically with representatives of FEMA, the community, and the study contractor to review the results of the study.

The dates of the initial and final CCO meetings held prior to this countywide FIS for Hillsborough County and the incorporated communities within its boundaries are shown in Table 2, "Pre-Countywide CCO Meetings."

TABLE 2 – PRE-COUNTYWIDE CCO MEETINGS

<u>Community</u>	<u>Initial CCO Date</u>	<u>Final CCO Date</u>
Hillsborough County (Unincorporated Areas)	*	August 21, 1979
City of Tampa	*	August 21, 1979
City of Temple Terrace	May 23, 1975	December 17, 1975

*Data not available

2.0 AREA STUDIED

2.1 Scope of Study

This FIS covers the geographic area of Hillsborough County, Florida.

All or portions of the flooding sources that were studied by detailed methods prior to this countywide FIS are listed in Table 3, "Pre-Countywide Flooding Sources Studied by Detailed Methods." Limits of detailed study are indicated on the Flood Profiles (Exhibit 1) and on the FIRM (Exhibit 2).

TABLE 3 – PRE-COUNTYWIDE FLOODING SOURCES STUDIED BY DETAILED METHODS

Alafia River	Cypress Creek	Little Manatee River
North Prong Alafia River	Delaney Creek	Rice Creek
South Prong Alafia River	Gulf of Mexico	Rocky Creek
Blackwater Creek	Hillsborough River	Ruskin Inlet
Bullfrog Creek		

As part of this countywide FIS, updated analyses were included for the watersheds shown in Table 4, "Scope of Revision." The watersheds have been listed rather than individual flooding sources because several of the newly studied flooding sources are unnamed.

TABLE 4 - SCOPE OF REVISION

<u>Watershed</u>	<u>Communities Affected</u>
Alafia River	City of Plant City Unincorporated Areas of Hillsborough County
Brooker Creek	Unincorporated Areas of Hillsborough County
Bullfrog/Wolf Branch Creek	City of Plant City Unincorporated Areas of Hillsborough County
Curiosity Creek	City of Tampa Unincorporated Areas of Hillsborough County
Cypress Creek	Unincorporated Areas of Hillsborough County
Delaney Creek	City of Tampa Unincorporated Areas of Hillsborough County
Double Branch Creek	City of Tampa Unincorporated Areas of Hillsborough County
Duck Pond Area	City of Tampa City of Temple Terrace Unincorporated Areas of Hillsborough County
East Lake	City of Tampa City of Temple Terrace Unincorporated Areas of Hillsborough County

TABLE 4 – SCOPE OF REVISION (continued)

<u>Watershed</u>	<u>Communities Affected</u>
Hillsborough River	City of Plant City City of Tampa City of Temple Terrace Unincorporated Areas of Hillsborough County
Little Manatee River	Unincorporated Areas of Hillsborough County
Lower Sweetwater Creek	City of Tampa Unincorporated Areas of Hillsborough County
Pemberton Creek/Baker Canal	City of Plant City Unincorporated Areas of Hillsborough County
Rocky/Brushy Creek	City of Tampa Unincorporated Areas of Hillsborough County
Silver/Twin Lakes Area	City of Tampa Unincorporated Areas of Hillsborough County
Sweetwater Creek	City of Tampa Unincorporated Areas of Hillsborough County
Tampa Bypass Canal	City of Tampa City of Temple Terrace Unincorporated Areas of Hillsborough County

The areas studied by detailed methods were selected with priority given to all known flood hazard areas and areas of projected development and proposed construction.

This FIS also incorporates the determinations of letters issued by FEMA resulting in map changes (Letter of Map Revision [LOMR], Letter of Map Revision - based on Fill [LOMR-F], and Letter of Map Amendment [LOMA]). A summary of these letter determinations has been prepared for this countywide FIS and FIRM and is located with each community's map repository and FEMA.

All or portions of numerous flooding sources in the county were studied by approximate methods. Approximate analyses were used to study those areas having a low development potential or minimal flood hazards. The scope and methods of study were proposed to, and agreed upon by, FEMA and Hillsborough County.

2.2 Community Description

Hillsborough County occupies an area of approximately 1,062 square miles in west-central Florida. The study area is bounded on the north by Pasco County, on the east by Polk County, on the south by Manatee County, and on the west by Pinellas County and Tampa Bay. Tampa, the county seat and largest city, is located approximately 210 miles northwest of Miami, approximately 170 miles southwest of Jacksonville, and approximately 205 miles southeast of Tallahassee. The 2003 population of Hillsborough County was estimated to be 1,073,407 (U.S. Census Bureau, 2005).

The inland areas of the county are primarily agricultural, with citrus groves in the well-drained upland areas in the northwestern and west-central portions, and truck crops and pasture grasses in the lower flatlands. Phosphate mining in the central and southeastern areas also makes substantial contributions to the county economy. New inland developments, especially in the Sun City area in southern Hillsborough County, and in the Trout Creek area west of the Hillsborough River State Park in northern Hillsborough County, are becoming more extensive. The coastal areas are primarily urban and are well developed.

The study area is located in the subtropical climatic zone, which is characterized by mild, dry winters and warm, wet summers. The wet season extends from June through September and coincides with the hurricane season. During this period, the study area receives nearly two-thirds of its annual precipitation. The average annual precipitation in the western part of the county is approximately 50 inches, and in the eastern part approximately 56 inches. The average annual temperature is approximately 72 degrees Fahrenheit (National Oceanic and Atmospheric Administration [NOAA], 1973).

The subtropical climate allows for the growth of many varieties of vegetation. The higher regions of the county provide suitable habitat for pine, saw palmetto, huckleberry bushes, and grasses, with occasional hummocks of cabbage palmetto. In the wetter regions, the principal growth consists of mixed hardwood forests, vines, shrubs, and grasses. Along the coastal areas that are sometimes covered by high tides, mangrove trees and salt-tolerant plants form the vegetative cover.

The terrain of Hillsborough County ranges from nearly level areas with numerous intermittent marshes, swamps, sinks, lakes, and springs, to gently undulating areas that extend from the northwestern corner southeastward across the county. The county gradually slopes southwestward toward Tampa Bay. The elevations in the study area range from sea level at Tampa Bay to approximately 160 feet in the eastern part of the county.

The major streams within the county are the Hillsborough, Alafia, and Little Manatee Rivers. The Hillsborough River, which originates at the edge of Green Swamp north of Lakeland, Florida, flows southwesterly for approximately 54 miles through the north-central portion of Hillsborough County into Hillsborough Bay at Tampa. The total drainage area of the Hillsborough River is approximately 690 square miles. Cypress Creek, the main tributary of the Hillsborough River, has a

drainage area of 164 square miles. It originates in south-central Pasco County and flows southerly through numerous swamps to join the Hillsborough River approximately 1 mile below the Lower Hillsborough Flood Detention Area.

The Alafia River headwaters are located in Polk County, from where the river flows in a generally westerly direction into Tampa Bay at East Tampa. The South Prong and North Prong Alafia Rivers are the two main tributaries of the Alafia River; Rice and Bell Creeks are its minor tributaries. The total drainage area of the Alafia River at Tampa Bay is approximately 420 square miles.

The Little Manatee River headwaters are located in southeastern Hillsborough County, from where the river flows in a westerly direction into Tampa Bay near Ruskin. The Hillsborough, Alafia, and Little Manatee Rivers drain approximately 84 percent of Hillsborough County.

The small coastal basins of Rocky, Sweetwater, Double Branch, Bullfrog, and Delaney Creeks, and Ruskin Inlet drain several miles inland. Both Rocky and Sweetwater Creeks have many shallow lakes in their upper reaches, ranging in size from 1 to 2 acres up to approximately 250 acres. Double Branch is well defined near Old Tampa Bay, but branches out in at least three directions with poorly defined subwatershed boundaries. Bullfrog Creek originates slightly northeast of Wimauma in a marshy area. It flows westerly, then northerly and westerly, finally emptying into Hillsborough Bay approximately 2 miles south of the Alafia River mouth. Its drainage area is approximately 40 square miles.

2.3 Principal Flood Problems

Flooding in Hillsborough County results primarily from overflow of streams caused by rainfall and runoff, and from tidal surge in the coastal areas of the county caused by hurricanes and tropical storms. Not all storms that pass close to the study area produce extremely high tides. Similarly, storms that produce flooding conditions in one area may not necessarily produce flooding conditions in other parts of the study area.

The Alafia, Little Manatee, and Hillsborough Rivers are broad estuaries, and, under certain conditions, tides generated at their mouths in Tampa Bay can intrude far upstream. Rainfall that accompanies hurricanes can aggravate the tidal flood situation, particularly in areas where the secondary drainage system is poorly developed.

Storms passing Florida in the vicinity of Hillsborough County have produced severe floods as well as structural damage. A brief description of several significant tropical storms provides historic information to which coastal and riverine flood hazards and the projected flood depths can be compared (NOAA, 1975; Ross and Anderson, 1972-3; USACE, 1974, 1961, 1956).

The September 25, 1848, hurricane entered the western coast of Florida in the vicinity of Tampa Bay. The tide at Fort Brooke, the military post at the present site of Tampa, was estimated at approximately 14 feet. High winds and tides

destroyed all the wharves and most public buildings at the post. A second hurricane on October 12 affected the same area, causing tides estimated at 9 feet.

The tropical storm of October 21 to 31, 1921, originated in the western Caribbean Sea and entered Florida north of Tarpon Springs. Flooding conditions were prolonged because of the slow forward movement of the storm. At Tampa, peak winds of 75 miles per hour were recorded, and a tide height of 9.6 feet was observed. A combination of high tides with wave action resulted in heavy damage in Hillsborough County.

Intense rainfall associated with the tropical hurricane of September 4, 1933, which passed across central Florida northwesterly from the Atlantic Ocean, caused extensive damage in Hillsborough County, particularly to citrus trees and transportation facilities. Urban damage was severe in the Tampa suburb of Sulphur Springs following failure of the Tampa Electric Company dam on the Hillsborough River. Sudden release of the stored waters washed out bridges and overflowed banks in the lower river reaches. The river flowed out of its banks for approximately 5 weeks. Much of the area experienced maximum stages and discharges of record, with estimated frequencies of occurrence greater than once in 50 years. At the 40th Street bridge in Tampa, a discharge of 16,500 cubic feet per second (cfs) was measured near the flood crest (26.3 feet) in the Hillsborough River.

The small but severe hurricane of September 1 to 7, 1950, struck the west coast of Florida. It was accompanied by intense rainfall which caused streams and lakes in the vicinity of Tampa to overflow their banks, inundating and causing washouts on highways and damage to buildings and pastureland. Tampa also experienced the highest tides reported in the area since the 1921 hurricane. The Courtney Campbell Causeway across the northern end of Old Tampa Bay was damaged by wave action.

From March 15 through March 18, 1960, thunderstorms and heavy rainfall averaging more than 10 inches over a 10,000-square mile area occurred in central Florida. The most intense rains occurred in the area between Tampa and Brooksville, where unofficial reports indicate over 27 inches of rain fell during the 4 days. Damage to agricultural and urban land in the Hillsborough River basin was estimated at that time at more than \$6 million.

Hurricane Donna occurred on September 10 and 11, 1960. Tampa received 13.96 inches of rainfall in 2 days. Also, a pre-storm rainfall of approximately 10 inches in the previous 3 weeks had saturated the ground, and, consequently, considerable flooding resulted. Damage to the Hillsborough River basin was estimated at that time at more than \$1 million.

Hurricane Agnes originated on the northeastern tip of the Yucatan Peninsula on June 19, 1972, and traveled westward. The storm was of large diameter, and, although the center of this storm passed approximately 150 miles west of the Florida peninsula, it produced a high, damaging tidal surge. In Hillsborough

County, tides were approximately 5.6 feet at Tampa. An accompanying tornado caused minor damage to trees and buildings on the eastern side of Tampa Bay.

2.4 Flood Protection Measures

The U.S. Army Corps of Engineers (USACE) has initiated construction of the Four River Basin Project (USACE, 1974), which includes stream improvement, systems of canals, flood detention areas, and auxiliary water control structures. The construction of the Tampa Bay Bypass Canal and the Lower Hillsborough Flood Detention Area has prevented significant hurricane flooding.

The Hillsborough Soil Conservation District, Hillsborough County Board of Commissioners, with assistance from the U.S. Department of Agriculture, Soil Conservation Service (SCS), developed a watershed work plan for improving the Upper Tampa Bay watershed in western Hillsborough County (Hillsborough Soil Conservation District, 1961). The improvement includes land treatment measures for watershed protection and structural measures for flood prevention, diversion channels, and agricultural water management. These measures have a minimal effect on the larger floods considered in this report. The Tampa Water Works Dam located approximately 10 miles above the mouth of the Hillsborough River was constructed in 1945 to provide water supply impoundment for Tampa. Impoundment elevations range from 20 to 22 feet above mean sea level. The effects of regulation are detectable as far upstream as Temple Terrace Highway, a distance of nearly 7 miles above Tampa Dam; however, the Tampa Water Works Dam does not provide flood protection to Temple Terrace.

In areas where mangrove stands front the bay, waves with heights of 3 feet or greater are dissipated within approximately 200 feet of the shoreline. Along portions of Apollo Beach and the Tampa Electric Company plant, waves greater than 3 feet are dissipated at the shoreline by rapidly rising ground elevations.

Seawalls and bulkheads have been constructed along portions of the shoreline on Tampa Bay in Hillsborough County. These structures are expected to remain intact during a 1% annual chance storm tide and are considered to be effective wave energy dissipaters when of sufficient elevation.

This study has taken all existing improvements into consideration.

3.0 ENGINEERING METHODS

For the flooding sources studied in detail in the county, standard hydrologic and hydraulic study methods were used to determine the flood hazard data required for this FIS. Flood events of a magnitude which are expected to be equaled or exceeded once on the average during any 10-, 50-, 100-, or 500-year period (recurrence interval) have been selected as having special significance for floodplain management and for flood insurance rates. These events, commonly termed the 10-, 50-, 100-, and 500-year floods, have a 10-, 2-, 1-, and 0.2-percent chance, respectively, of being equaled or exceeded during any year. Although the recurrence interval represents the long term average period between floods of a specific

magnitude, rare floods could occur at short intervals or even within the same year. The risk of experiencing a rare flood increases when periods greater than 1 year are considered. For example, the risk of having a flood which equals or exceeds the 100-year flood (1-percent chance of annual exceedence) in any 50-year period is approximately 40 percent (4 in 10), and, for any 90-year period, the risk increases to approximately 60 percent (6 in 10). The analyses reported herein reflect flooding potentials based on conditions existing in the county at the time of completion of this FIS. Maps and flood elevations will be amended periodically to reflect future changes.

3.1 Hydrologic Analyses

Hydrologic analyses were carried out to establish the peak discharge-frequency relationships for the flooding sources studied in detail affecting the county.

Pre-Countywide Analyses

The City of Tampa, the City of Temple Terrace, and the unincorporated areas of Hillsborough County had previously printed FIS reports. The hydrologic analyses described in those reports have been compiled and are summarized below.

For the stream flooding in the Hillsborough River downstream of the Lower Hillsborough Flood Detention Area, the study was conducted on the premise that the detention area and the Tampa By-Pass Canal would be able to detain and divert floods up to and including the 0.2-percent annual chance flood. Consequently, the magnitude and frequency of floods up to the 0.2-percent annual chance return period downstream from the detention area may be determined based on the local runoffs only. The study began with the consideration of natural conditions with the flood control gates on the Hillsborough River closed at the detention area (S-155) and at Harney (S-161). The effects of the gate operations during the floods were then incorporated (USACE, 1974). To investigate the natural flood discharges, an incremental procedure based on the regression estimates developed by the U.S. Geological Survey (USGS) was used (USGS, 1978). Adjustment due to the effects of urbanization near the Tampa area was performed using the procedure outlined by Leopold (USGS, 1968) in conjunction with the rainfall data from the National Weather Service (NOAA, 1961). The flood diversion gate along the Hillsborough River at Harney (S-161) was assumed to be open whenever flow through the Tampa Waterworks Dam exceeded 6,200 cfs, the estimated non-damaging bankfull capacity downstream of the dam.

Floodflow frequencies for the Alafia River, the North Prong and South Prong Alafia River, Blackwater Creek, the Hillsborough River, and Ruskin Inlet were based on standard log-Pearson Type III analyses as outlined by the U.S. Water Resources Council (U.S. Water Resources Council, 1977). Data used in the analyses were obtained from gage records on the Alafia River at Lithia (45 years of record), the North Prong Alafia River at Keysville (27 years of record), the South Prong Alafia River near Lithia (15 years of record), Blackwater Creek near Knights (26 years of record), and the Hillsborough River at Zephyrhills (38 years of record). On reaches of the streams for which no gage records were available, streamflow data were synthesized from nearby gages within the same basin.

Discharges for Bullfrog Creek, Delaney Creek, and Rocky Creek were derived by using the Clarke unit hydrograph method (Clark, 1945). Rainfall data used in this analysis were obtained from the National Oceanic and Atmospheric Administration (NOAA, 1961 and 1977).

Floodflow frequencies for Rice Creek were obtained by using the Soil Conservation Service (SCS) small watershed method (SCS, 1975).

Discharge values for Cypress Creek and the Little Manatee River were taken from previous reports prepared by the USGS (1978) and Dames & Moore (1974), respectively.

Inundation from the Gulf of Mexico caused by passage of storms (storm surge) was determined by the joint probability method (NOAA, 1970). The storm populations were described by probability distributions of 5 parameters that influence surge heights. These were central pressure depression (which measures the intensity of the storm), radius to maximum winds, forward speed of the storm, shoreline crossing point, and crossing angle. These characteristics were described statistically based on an analysis of observed storms in the vicinity of Hillsborough County. Primary sources of data for this were the National Climatic Center (NOAA, 1975); Cry (NOAA, 1965); Ho, Schwerdt, and Goodyear (1975); the National Hurricane Research Project (NOAA, 1957); and the Monthly Weather Review (NOAA, 1964-1977). Digitized storm information for all storms from 1886 through 1977 was used to correlate statistics (NOAA, 1886-1977).

This procedure utilizes a grid pattern approximating the geographical feature of the study area and the adjoining areas. Surges were computed utilizing grids of 5 nautical miles, or 1 nautical mile, depending on the resolution required.

Surge levels in the Hillsborough River, the Alafia River, Bullfrog Creek, and the Little Manatee River were computed with the aid of a one-dimensional unsteady-flow model. Then values for the mouth were taken from the results of the coastal model.

Revised Analyses

Information on the methods used to determine peak discharge-frequency relationships for the streams restudied as part of this countywide FIS is shown below.

The U.S. Soil Conservation Service (SCS) Runoff Curve Number method has been used to generate runoff hydrographs from rainfall data and watershed parameters. Runoff hydrographs have been developed by the SCS Dimensionless Unit Hydrograph Method. The U.S. Army Corps of Engineers' (USACE's) hydrologic computer model HEC-1 was used, with a modified shape factor to account for the relatively flat terrain of Hillsborough County. Rainfall depths were derived from isohyetal maps shown in the Southwest Florida Water Management District's (SWFWMD's) *Environmental Resource Permitting Information Manual*, 1998.

The design storm rainfall distribution used was the SCS 24-hour Type II Florida Modified, as required by SWFWMD and Hillsborough County. SWFWMD GIS soil coverage was developed from data in the *SCS Soil Survey of Hillsborough County, Florida, 1989*. SWFWMD GIS land use coverage designated classifications from the Florida Land Use Classification System. Runoff curve numbers were then calculated based on a GIS intersection of soil coverage and land use coverage. Time-of-concentration estimates were made by adding travel times for segments of homogeneous flow paths. Travel time methodologies are based on the *Hillsborough County Stormwater Technical Manual*.

A summary of the drainage area-peak discharge relationships for all the streams studied by detailed methods is shown in Table 5, "Summary of Discharges."

TABLE 5 - SUMMARY OF DISCHARGES

<u>FLOODING SOURCE AND LOCATION</u>	<u>NODE NUMBER</u>	<u>PEAK DISCHARGES (cfs)</u>			
		<u>10-PERCENT</u>	<u>2-PERCENT</u>	<u>1-PERCENT</u>	<u>0.2-PERCENT</u>
BROOKER CREEK					
At Tarpon Springs Road At approximately 9,250 feet upstream of Tarpon Springs Road	490070	N/A	786	913	N/A
	490290	N/A	536	626	N/A
BULLFROG CREEK					
Main					
Just downstream of CSX RR Transport System	810115	3,550	5,870	6,570	N/A
Just upstream to State Highway 301	811080	2,880	4,960	5,680	N/A
BULFROG CREEK					
TRIBUTARY 2					
Downstream of West Lake Drive	811154	610	632	635	N/A
BULFROG CREEK					
TRIBUTARY 1					

TABLE 5 - SUMMARY OF DISCHARGES - continued

<u>FLOODING SOURCE AND LOCATION</u>	<u>NODE NUMBER</u>	<u>PEAK DISCHARGES (cfs)</u>			
		<u>10-PERCENT</u>	<u>2-PERCENT</u>	<u>1-PERCENT</u>	<u>0.2-PERCENT</u>
At approximately 1,445 feet upstream of confluence	811260	1,180	2,080	2,400	N/A
TUCKER RHODINE					
At approximately 1,525 feet upstream of confluence	812230	258	467	548	N/A
NORTH PRONG BULLFROG CREEK					
At approximately 250 feet upstream of confluence	819000	385	754	884	N/A
TADPOLE CREEK					
Approximately 1475 feet upstream of confluence	814000	745	1,320	1,540	N/A
LITTLE BULLFROG CREEK					
Approximately 1,027 feet downstream of State Highway 301	817010	2,000	3,230	3,680	N/A
Just downstream of Big Bend Road	817415	651	776	817	N/A
BIG BEND					
Just downstream of Simmons LP	816040	575	684	786	N/A
CURIOSITY CREEK					
At Jeanal Place	550200	588	921	1,050	N/A
Approximately 500 feet downstream of 138 th Avenue	551800	296	410	466	N/A
DELANEY-ARCHIE CREEK					
Just downstream of State Highway 41	280010	399	474	489	N/A
Just upstream of I-75	290000	88	137	150	N/A
ELANEY CREEK (MAIN)					

TABLE 5 - SUMMARY OF DISCHARGES - continued

<u>FLOODING SOURCE AND LOCATION</u>	<u>NODE NUMBER</u>	<u>PEAK DISCHARGES (cfs)</u>			
		<u>10-PERCENT</u>	<u>2-PERCENT</u>	<u>1-PERCENT</u>	<u>0.2-PERCENT</u>
Just downstream of CSX RR Transportation System	210020	1,530	2,270	2,540	N/A
Just downstream of State Highway 301	210250	542	818	900	N/A
DELANEY CREEK TRIBUTARY 6 Approximately 252 feet downstream of 24 th Ave. S.	211020	123	170	183	N/A
DELANEY CREEK TRIBUTARY 4 Approximately 1,050 feet upstream of mouth	212000	402	626	697	N/A
DELANEY CREEK TRIBUTARY 3 Just downstream of Tidewater Place	213000	252	390	433	N/A
NORTH ARCHIE CREEK TRIBUTARY B Approximately 515 feet upstream of mouth	263000	150	233	257	N/A
NORTH ARCHIE CREEK Just downstream of 41 Highway South	260030	402	658	741	N/A
Just upstream of Robert Tolle Drive	260370	105	146	159	N/A
BLACKWATER CREEK Approximately 1,625 feet upstream of mouth	680000	2,830	5,140	6,650	N/A
Just downstream of Canaan Avenue	680890	296	574	770	N/A
BASSETT BRANCH					

TABLE 5 - SUMMARY OF DISCHARGES - continued

<u>FLOODING SOURCE AND LOCATION</u>	<u>NODE NUMBER</u>	<u>PEAK DISCHARGES (cfs)</u>			
		<u>10-PERCENT</u>	<u>2-PERCENT</u>	<u>1-PERCENT</u>	<u>0.2-PERCENT</u>
BARNETT BRANCH TRIBUTARY Approximately 3,543 feet upstream of mouth	671225	7	12	15	N/A
CLAY GULLEY EAST Just downstream of 301 Highway N/S	660030	269	458	564	N/A
CLAY GULLEY EAST TRIBUTARY 7 Just downstream of St. Francis Lane	660110	209	276	350	N/A
CLAY GULLEY EAST TRIBUTARY 5 Just downstream of Five Acre Road	662290	174	284	338	N/A
CLAY GULLEY EAST TRIBUTARY 6 Approximately 1,607 feet upstream of mouth	662999	133	186	217	N/A
CLAY GULLEY EAST TRIBUTARY 2 Approximately 796 feet upstream of mouth	660440	11	29	36	N/A
CLAY GULLEY EAST TRIBUTARY 4 Just downstream of Five Acre Road	663650	35	58	67	N/A
CLAY GULLEY WEST Just downstream of Flatwoods Park TL	635290	164	252	327	N/A
EAST CANAL Approximately 1,171 feet upstream of mouth	686000	907	1,550	1,970	N/A
Just upstream of Sam Allen Road East	686550	103	115	118	N/A

TABLE 5 - SUMMARY OF DISCHARGES - continued

<u>FLOODING SOURCE AND LOCATION</u>	<u>NODE NUMBER</u>	<u>PEAK DISCHARGES (cfs)</u>			
		<u>10-PERCENT</u>	<u>2-PERCENT</u>	<u>1-PERCENT</u>	<u>0.2-PERCENT</u>
HOLLOMANS BRANCH Approximately 1,715 feet above mouth	650000	1,000	1,510	1,920	N/A
Approximately 579 feet upstream of Kelly Road	650700	183	277	353	N/A
HOLLOMANS BRANCH TRIBUTARY 2 Approximately 510 feet upstream of mouth	654005	340	483	527	N/A
HOLLOMANS BRANCH TRIBUTARY 1 Approximately 510 feet upstream of mouth	655000	74	105	181	N/A
ITCHEPACKESASSA CREEK Approximately 1,590 feet upstream of mouth	684000	1,560	2,580	3,300	N/A
ITCHEPACKESASSA CREEK TRIBUTARY 2 Approximately 517 feet upstream of mouth	684500	87.7	129	163	N/A
ITCHEPACKESASSA CREEK TRIBUTARY 1 Just downstream of Knights Griffin Road East	685000	37	81	109	N/A
NEW RIVER EAST Approximately 2,166 feet above mouth	674000	335	517	716	N/A
NEW RIVER WEST Approximately 2,326 feet upstream of mouth	673000	601	913	1,200	N/A

TABLE 5 - SUMMARY OF DISCHARGES – continued

<u>FLOODING SOURCE AND LOCATION</u>	<u>NODE NUMBER</u>	<u>PEAK DISCHARGES (cfs)</u>			
		<u>10-PERCENT</u>	<u>2-PERCENT</u>	<u>1-PERCENT</u>	<u>0.2-PERCENT</u>
TROUT CREEK Approximately 7,302 feet upstream of mouth	630000	930	1,660	2,270	N/A
TWO HOLE BRANCH Just upstream of 301 Highway North	665050	210	305	386	N/A
TWO HOLE BRANCH TRIBUTARY 1 Approximately 7,295 feet upstream of mouth	667300	52	78	89	N/A
LITTLE MANATEE RIVER-ALDERMAN CREEK Approximately 2,282 feet upstream of mouth	985100	440	965	1,180	N/A
LITTLE MANATEE RIVER, CARLTON BRANCH Approximately 2,657 feet upstream of mouth	965150	1,210	2,270	2,650	N/A
LITTLE MANATEE RIVER, CURIOSITY CREEK Just downstream of Light Foot Road	930760	1,030	1,500	1,680	N/A
LITTLE MANATEE RIVER, CURIOSITY CREEK TRIBUTARY 2 Approximately 3,844 feet upstream of mouth	930275	1,230	1,980	2,210	N/A

TABLE 5 - SUMMARY OF DISCHARGES - continued

<u>FLOODING SOURCE AND LOCATION</u>	<u>NODE NUMBER</u>	<u>PEAK DISCHARGES (cfs)</u>			
		<u>10-PERCENT</u>	<u>2-PERCENT</u>	<u>1-PERCENT</u>	<u>0.2-PERCENT</u>
LITTLE MANATEE RIVER, CURIOSITY CREEK TRIBUTARY 2.1 Just downstream of Butch Cassidy TL	930610	373	688	787	N/A
CYPRESS CREEK Approximately 4,457 feet upstream of mouth	940200	1,060	1,570	1,720	N/A
LITTLE MANATEE RIVER, DRY CREEK Approximately 1,255 feet downstream of Saffold Road	946115	1,240	2,010	2,230	N/A
LITTLE MANATEE RIVER, DRY CREEK TRIBUTARY 1 Just downstream of Crestview Road	946575	179	365	438	N/A
LITTLE MANATEE RIVER, GULLY BRANCH Approximately 2,772 feet upstream of mouth	960263	577	1,130	1,130	N/A
LITTLE MANATEE RIVER Just downstream of CSX Railroad Transportation System	900225	7,370	12,000	13,600	N/A
Just upstream of 579 Highway South	901950	4,480	7,410	8,420	N/A
Approximately 375 feet downstream of Taylor Gill Road	904150	653	1,040	1,170	N/A

TABLE 5 - SUMMARY OF DISCHARGES - continued

<u>FLOODING SOURCE AND LOCATION</u>	<u>NODE NUMBER</u>	<u>PEAK DISCHARGES (cfs)</u>			
		<u>10-PERCENT</u>	<u>2-PERCENT</u>	<u>1-PERCENT</u>	<u>0.2-PERCENT</u>
LITTLE MANATEE RIVER, TRIBUTARY 3 Just downstream of Lightfoot Road	935330	1,250	2,050	2,290	N/A
LITTLE MANATEE RIVER, TRIBUTARY 3.1 Approximately 450 feet downstream of Lightfoot Road	935105	14	24	28	N/A
LITTLE MANATEE RIVER, TRIBUTARY 3.2 Just downstream of Lightfoot Road	935130	403	594	686	N/A
LITTLE MANATEE RIVER, TRIBUTARY 5 Approximately 982 feet upstream of mouth	905940	471	724	776	N/A
LITTLE MANATEE RIVER, TRIBUTARY 6 Approximately 1,254 feet upstream of mouth	906400	557	1,030	1,200	N/A
LITTLE MANATEE RIVER, TRIBUTARY 7 Approximately 1,579 feet upstream of mouth	959150	1,080	1,210	1,350	N/A
LITTLE MANATEE RIVER, TRIBUTARY 7.1 Approximately 3,000 feet upstream of mouth	960241	226	342	381	N/A

TABLE 5 - SUMMARY OF DISCHARGES - continued

<u>FLOODING SOURCE AND LOCATION</u>	<u>NODE NUMBER</u>	<u>PEAK DISCHARGES (cfs)</u>			
		<u>10-PERCENT</u>	<u>2-PERCENT</u>	<u>1-PERCENT</u>	<u>0.2-PERCENT</u>
LITTLE MANATEE RIVER, TRIBUTARY 8 Approximately 1,792 feet upstream of mouth	906650	559	903	1,000	N/A
LITTLE MANATEE RIVER, TRIBUTARY 10 Approximately 3,233 feet upstream of mouth	975250	983	1,760	2,030	N/A
LITTLE MANATEE RIVER, TRIBUTARY 10.1 Just downstream of Hobbs Road	975330	202	340	386	N/A
Approximately 2,171 feet upstream of mouth	907800	1,000	1,780	2,060	N/A
LITTLE MANATEE RIVER, TRIBUTARY 15.1 Approximately 758 feet upstream of mouth	908040	644	1,050	1,190	N/A
LITTLE MANATEE RIVER, TRIBUTARY 15 BRANCH Approximately 1,445 feet upstream of mouth	908200	644	1,050	1,190	N/A
LITTLE MANATEE RIVER, TRIBUTARY 18 BRANCH					
LITTLE MANATEE RIVER, PIERCE BRANCH Just downstream of 674 Highway	970140	1,270	2,410	3,040	N/A

TABLE 5 - SUMMARY OF DISCHARGES - continued

<u>FLOODING SOURCE AND LOCATION</u>	<u>NODE NUMBER</u>	<u>PEAK DISCHARGES (cfs)</u>			
		<u>10-PERCENT</u>	<u>2-PERCENT</u>	<u>1-PERCENT</u>	<u>0.2-PERCENT</u>
LITTLE MANATEE RIVER, PIERCE BRANCH TRIBUTARY 1 Approximately 2,090 feet upstream of mouth	970600	211	348	394	N/A
LITTLE MANATEE RIVER, PIERCE BRANCH TRIBUTARY 2 Approximately 1,070 feet upstream of mouth	970850	180	488	612	N/A
RUSKIN INLET MARSH BRANCH Approximately 3,060 feet upstream of mouth	900130	980	1,450	1,610	N/A
SOUTH FORK LITTLE MANATEE RIVER Just downstream of 579 Highway South	950110	3,070	5,790	6,760	N/A
LITTLE MANATEE RIVER, WILDCAT BRANCH Approximately 4,090 feet downstream of Stephens Road	915150	1,540	1,540	1,710	N/A
LOWER SWEETWATER CREEK Approximately 1,533 feet upstream of Hillsborough Avenue West	402100	1,640	2,420	2,800	N/A

TABLE 5 - SUMMARY OF DISCHARGES - continued

<u>FLOODING SOURCE AND LOCATION</u>	<u>NODE NUMBER</u>	<u>PEAK DISCHARGES (cfs)</u>			
		<u>10-PERCENT</u>	<u>2-PERCENT</u>	<u>1-PERCENT</u>	<u>0.2-PERCENT</u>
BAKER CANAL					
Approximately 1,208 feet upstream of mouth	330150	306	656	711	N/A
Just upstream of Jaudon Road	390400	288	328	354	N/A
Just upstream of CSX Railroad Transportation System	391890	41	47	49	N/A
CAMPBELL BRANCH					
Approximately 263 feet upstream of mouth	320008	989	1,690	1,890	N/A
Just downstream of Thonotosassa Road	321120	256	288	294	N/A
FLINT CREEK					
Approximately 2,854 feet upstream of 301 Highway North	300100	563	906	1,000	N/A
LAKE THONOTOSASSA					
Approximately 4,116 feet upstream of Thonotosassa Road	301095	521	628	645	N/A
MILL CREEK TRIBUTARY 1					
Approximately 869 feet upstream of mouth	342800	129	224	254	N/A
MILL CREEK TRIBUTARY 2					
Approximately 30 feet or just upstream of Cason Street	346100	102	118	118	N/A
MILL CREEK TRIBUTARY 3					
Approximately 929 feet upstream of Cason Street	346200	171	267	296	N/A

TABLE 5 - SUMMARY OF DISCHARGES - continued

<u>FLOODING SOURCE AND LOCATION</u>	<u>NODE NUMBER</u>	<u>PEAK DISCHARGES (cfs)</u>			
		<u>10-PERCENT</u>	<u>2-PERCENT</u>	<u>1-PERCENT</u>	<u>0.2-PERCENT</u>
PEMBERTON CREEK					
Just upstream of Pemberton Creek Drive	340100	769	1,100	1,110	N/A
Just downstream of Wallace Branch Road	342540	232	337	377	N/A
SPARTMAN BRANCH					
Just downstream of Harvey Tew Road	360010	345	519	590	N/A
Just downstream of CSX Railroad Transportation System	361480	134	206	232	N/A
BRUSHY CREEK					
Approximately 2,461 feet upstream of mouth	440000	2,280	3,170	3,740	N/A
Approximately 1,771 feet downstream of Northdale Boulevard	440240	1,460	1,460	1,460	N/A
HALF MOON LAKE BRANCH					
Approximately 698 feet downstream of Turtle Creek Boulevard	452500	129	172	199	N/A
MAIN A					
Just downstream of Sheldon Road	420010	1,490	2,180	2,580	N/A
ROCKY CREEK					
Approximately 8,891 feet downstream of Waters Avenue West	420510	3,150	4,450	5,220	N/A
Approximately 1,694 feet upstream of Ehrlich Road	450060	905	1,220	1,400	N/A
Approximately 1,774 feet upstream of Downs Drive	450200	602	760	851	N/A

TABLE 5 - SUMMARY OF DISCHARGES - continued

<u>FLOODING SOURCE AND LOCATION</u>	<u>NODE NUMBER</u>	<u>PEAK DISCHARGES (cfs)</u>			
		<u>10-PERCENT</u>	<u>2-PERCENT</u>	<u>1-PERCENT</u>	<u>0.2-PERCENT</u>
SWEETWATER CREEK CHANNEL H Approximately 496 feet downstream of Anderson Road	414050	572	824	928	N/A
SWEETWATER CREEK Just downstream of Webb Road	410000	1,230	1,900	2,360	N/A
Just downstream of Linebaugh Avenue West	410250	437	689	879	N/A
Just upstream of Ehrlich Road	410510	190	273	324	N/A
SWEETWATER CREEK TRIBUTARY I Approximately 65 feet upstream of mouth	413900	89	119	122	N/A

The stillwater elevations have been determined for the 10-, 2-, 1-, and 0.2-percent annual chance floods for the flooding sources studied by detailed methods. The 1-percent annual chance stillwater elevations have been shown on the FIRM (Exhibit 2). Parameters used for the surge elevation computations are shown in Table 6 and the surge elevations are shown in Table 7.

3.2 Hydraulic Analyses

Analyses of the hydraulic characteristics of flooding from the source studied were carried out to provide estimates of the elevations of floods of the selected recurrence intervals. Users should be aware that flood elevations shown on the FIRM represent rounded whole-foot elevations and may not exactly reflect the elevations shown on the Flood Profiles or in the Floodway Data tables in the FIS report. For construction and/or floodplain management purposes, users are encouraged to use the flood elevation data presented in this FIS in conjunction with the data shown on the FIRM.

Cross sections were determined from topographic maps, field surveys, and other private sources. Bridges, dams, and culverts were field surveyed to obtain elevation data and structural geometry. All topographic mapping used to determine cross sections is referenced in Section 4.1.

Table 6 – Parameter Surge Values

Table 7 – Summary of Surge Elevations

7 – SUMMARY OF COASTAL STILLWATER ELEVATIONS

<u>FLOOD SOURCE & LOCATION</u>	<u>PEAK ELEVATION (feet NAVD*)</u>			
	<u>10-YEAR</u>	<u>50-YEAR</u>	<u>100-YEAR</u>	<u>500-YEAR</u>
GULF OF MEXICO				
OLD TAMPA BAY				
Near mouth of Boat Bayou	4.6	7.8	9.2	12.3
Near mouth of Rocky Creek	4.4	7.7	9.3	12.5
HILLSBOROUGH BAY				
Near mouth of Delaney Creek	4.8	8.4	10.1	13.3
Near mouth of Alafia Creek	5.1	8.4	10.2	13.4
TAMPA BAY				
Near Apollo Beach Road	4.4	7.9	9.4	12.6
Near mouth of Little Manatee River	4.1	8.3	8.6	11.7
Near Mill Bayou on the Little Manatee River	4.1	7.2	8.5	11.5
Near intersection of Cockroach Bay Road and Gulf City Road	4.1	7.1	8.5	11.4
Near mouth of Piney Point Creek	3.9	6.8	8.1	10.7

*North American Vertical Datum of 1988

Locations of selected cross sections used in the hydraulic analyses are shown on the Flood Profiles (Exhibit 1). For stream segments for which a floodway was computed (Section 4.2), selected cross section locations are also shown on the FIRM (Exhibit 2).

The hydraulic analyses for this FIS were based on unobstructed flow. The flood elevations shown on the profiles are thus considered valid only if hydraulic structures remain unobstructed, operate properly, and do not fail.

All qualifying bench marks within a given jurisdiction that are cataloged by the National Geodetic Survey (NGS) and entered into the National Spatial Reference System (NSRS) as First or Second Order Vertical and have a vertical stability classification of A, B, or C are shown and labeled on the FIRM with their 6-character NSRS Permanent Identifier.

Bench marks cataloged by the NGS and entered into the NSRS vary widely in vertical stability classification. NSRS vertical stability classifications are as follows:

- Stability A: Monuments of the most reliable nature, expected to hold position/elevation well (e.g., mounted in bedrock)
- Stability B: Monuments which generally hold their position/elevation well (e.g., concrete bridge abutment)
- Stability C: Monuments which may be affected by surface ground movements (e.g., concrete monument below frost line)
- Stability D: Mark of questionable or unknown vertical stability (e.g., concrete monument above frost line, or steel witness post)

In addition to NSRS bench marks, the FIRM may also show vertical control monuments established by a local jurisdiction; these monuments will be shown on the FIRM with the appropriate designations. Local monuments will only be placed on the FIRM if the community has requested that they be included, and if the monuments meet the aforementioned NSRS inclusion criteria.

To obtain current elevation, description, and/or location information for bench marks shown on the FIRM for this jurisdiction, please contact the Information Services Branch of the NGS at (301) 713-3242, or visit their Web site at www.ngs.noaa.gov.

Pre-Countywide Analyses

The City of Tampa, the City of Temple Terrace, and the unincorporated areas of Hillsborough County have previously printed FIS reports. The hydraulic analyses described in those reports have been compiled and are summarized below.

Water-surface profiles for the Alafia River and Cypress Creek were developed using the USACE HEC-2 step-backwater computer program (USACE, 1976). The USACE program was used to develop water-surface profiles for the remaining streams studied in detail in the county.

Cross-section data for the Alafia River, North Prong Alafia River, and the South Prong Alafia River were obtained by field surveys and supplemented with data from the USGS report of the area (USGS, 1978). All cross sections used in the hydraulic analyses for Cypress Creek were taken from the USGS study (USGS, 1978). The Little Manatee River cross sections were taken from the Dames & Moore report (Dames & Moore, 1974). Cross section data for Delaney Creek were obtained from Hillsborough County. All other streams in detail were field surveyed.

Roughness coefficients (Mannings "n") used in this study were determined from aerial photographs (SWFWMD, et al) and calibrated using high-water marks. Roughness values ranged from 0.030 to 0.080 in the channels and from 0.050 to 0.200 in the overbank areas.

Starting elevations for the Alafia River, Bullfrog Creek, Delaney Creek, the lower reach of the Hillsborough River, the Little Manatee River, Rocky Creek, and Ruskin Inlet were taken as mean high tide on Tampa Bay. Normal depth calculations were used to determine starting elevations for Rice Creek. Starting elevations for Blackwater Creek, Cypress Creek, the North Prong Alafia River, and the South Prong Alafia River were taken to be the main stream elevations at their respective confluence. For the upper reach of the Hillsborough River, starting elevations were taken from the USGS rating curve for the Tampa Water Works Dam (USGS, 1974).

Computations for flood levels along the streams studied in detail that are subject to flooding caused by both coastal surges and runoff were performed independently. The independent results were combined statistically to obtain flood levels for each selected return period.

During the dry winter months, water is stored upstream of the Tampa Water Works Dam at a level in excess of the expected stage during a 0.2-percent annual chance event with the flood diversion gate at Harney open. The dry season stage, approximately 22.5 feet, therefore represents all frequency events up to and in excess of the 0.2-percent annual chance event upstream of the dam for approximately 25,000 feet.

Hydraulic analyses, considering storm characteristics and the shoreline and bathymetric characteristics of the flooding sources studied, were carried out to provide estimates of the elevations of floods of the selected recurrence intervals along each of the shorelines.

The methodology for analyzing the effects of wave heights associated with coastal storm surge flooding is described in a report prepared by the National Academy of Sciences (National Academy of Sciences, 1977). This method is based on the following major concepts. First, depth-limited waves in shallow water reach a maximum breaking height that is equal to 0.78 times the stillwater depth. The wave

crest is 70 percent of the total wave height above the stillwater level. The second major concept is that wave height may be diminished by dissipation of energy due to the presence of obstructions, such as sand dunes, dikes and seawalls, buildings, and vegetation. The amount of energy dissipation is a function of the physical characteristics of the obstruction and is determined by procedures prescribed by the National Academy of Sciences. The third major concept is that wave height can be regenerated in open fetch areas due to the transfer of wind energy to the water. This added energy is related to fetch length and depth.

Wave heights were computed along transects (cross section lines) that were located along the coastal areas, as illustrated in Figure 1, Transect Location Map, in accordance with the "Users Manual for Wave Height Analysis" (FEMA, 1981). The transects were located with consideration given to the physical and cultural characteristics of the land so that they would closely represent conditions in their locality. Transects were spaced close together in areas of complex topography and dense development. In areas having more uniform characteristics, they were spaced at large intervals. It was also necessary to locate transects in areas where unique flooding existed and in areas where computed wave heights varied significantly between adjacent transects.

Each transect was taken perpendicular to the shoreline and extended inland to a point where wave action ceased. Along each transect, wave heights and elevations were computed considering the combined effects of changes in ground elevation, vegetation, and physical features. The stillwater elevations for the 1-percent annual chance flood were used as the starting elevations for these computations. Wave heights were calculated to the nearest 0.1 foot, and wave elevations were determined at whole-foot increments along the transects. The location of the 3-foot breaking wave for determining the terminus of the V zone (area with velocity wave action) was also computed at each transect.

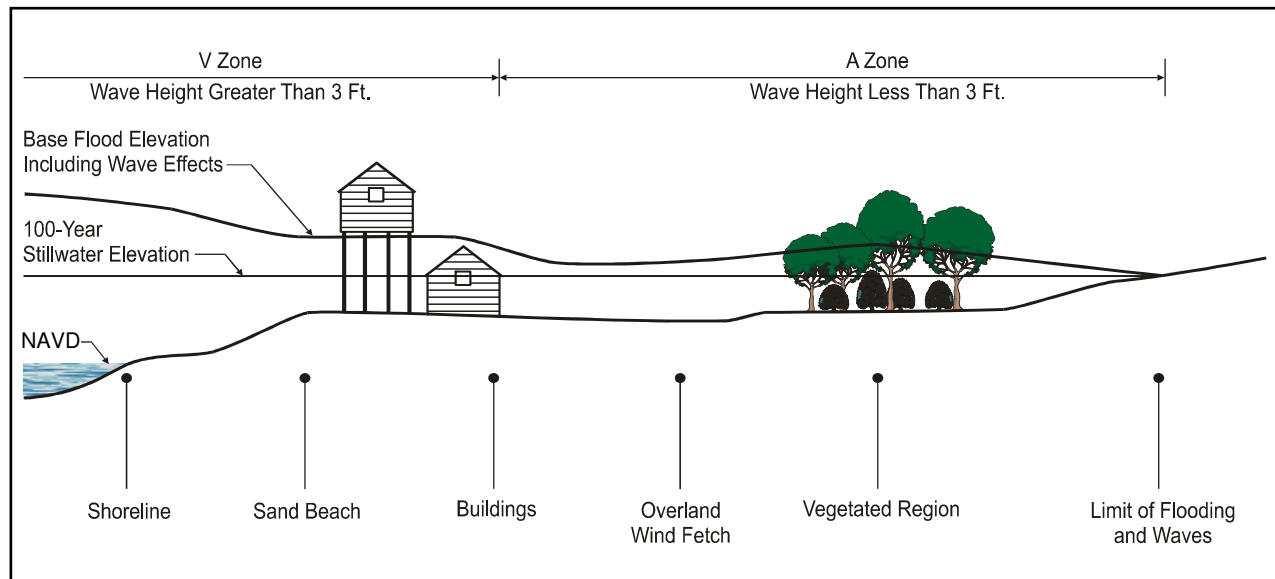
After analyzing wave heights along each transect, wave elevations were interpolated between transects. Various source data were used in the interpolation, including topographic maps (USGS, et al), aerial photographs (SWFWMD, et al), and engineering judgment. Controlling features affecting the elevations were identified and considered in relation to their positions at a particular transect and their variation between transects.

Figure 2 represents a sample transect that illustrates the relationship between the stillwater elevation, the wave crest elevation, the ground elevation profile, and the location of the V/A zone boundary.

Revised Analyses

Information on the methods used to determine peak discharge-frequency relationships for the streams restudied as part of this countywide FIS is shown below.

Figure 1 “Transect Location Map”



TRANSECT SCHEMATIC

Figure 2

The overbanks of the cross section data used in the hydraulic analyses were obtained from SWFWMD aerial topographic maps, most at a scale of 1"=200' with a contour interval of 1 foot. Elevations taken from these maps include, but are not limited to, tops of roads; stage-area data for lakes, wetlands, and other storage areas; inverts of channels; control elevations for overland flow evaluation; and site and road elevations for level-of-service determinations. Survey information was obtained from the Hillsborough County Survey and Mapping Section of the Real Estate Department and from other private sources. The survey elevations were used for culvert and bridge dimensions and channel geometries.

The U.S. Environmental Protection Agency's (EPA's) hydraulic model Storm Water Management Model (SWMM), version 4.31, was used to compute water-surface elevations and discharges at designated links and nodes. The EXTRAN block of SWMM was used for hydraulic routing. The SWMM model was modified to directly integrate the SCS method to generate runoff hydrographs, entrance and exit loss coefficients, and conduit stretch factors. EXTRAN uses the cross section data to obtain the shape geometry and invert elevations to determine the channel slope. Tailwater boundary conditions were determined by methods established in the *Hillsborough County Stormwater Technical Manual*. Results of the hydrologic and hydraulic analyses were calibrated against USGS and/or SWFWMD gages, where available.

Flood profiles were drawn showing computed water-surface elevations for floods of the selected recurrence intervals.

Roughness factors (Manning’s “n”) used in the hydraulic computations were established by Hillsborough County engineers based on photographs and field observations of the streams and floodplain areas. Roughness factors for all streams studied by detailed methods are shown in Table 8, “Manning’s “n” Values.”

TABLE 8 – MANNING’S “n” VALUES

<u>Stream</u>	<u>Channel “n”</u>	<u>Overbank “n”</u>
Brooker Creek	0.04-0.05	0.07-0.08
Bullfrog Creek	0.025-0.08	0.16
Curiosity Creek	0.035-0.045	0.04-0.08
Cypress Creek	0.09-0.16	0.17-0.25
Delaney Creek Watershed	0.025-0.10	0.025-0.24
Delaney Creek	0.025-0.10	0.025-0.24
Delaney Pof-off	0.035-0.08	0.035-0.85
North Archie Watershed	0.03-0.08	0.025-0.08
Double Branch Creek	0.025-0.10	0.025-0.10
Duck Pond	0.011-0.24	0.011-0.024
East Lake	0.01-0.045	0.01-0.045
Hillsborough River Watershed	0.02-0.14	0.025-0.45
Hillsborough River	0.025-0.06	0.025-0.25
Blackwater Creek	0.02-0.10	0.04-0.09
Tiger Creek	0.02-0.045	0.03-0.081
Itchepackesassa Creek	0.02-0.05	0.035-0.08
East Canal	0.02-0.04	0.045-0.45
Hollomans Branch	0.03-0.12	0.03-0.12
Clay Gully East	0.035-0.06	0.035-0.08
Clay Gully West	0.045-0.10	0.075-0.08
Two Hole Branch	0.035-0.09	0.04-0.09
Trout Creek	0.045-0.065	0.045-0.10
Bassett Branch	0.035-0.085	0.035-0.10
New River	0.045-0.08	0.04-0.075
Corey Lake Isles	0.055-0.14	0.045-0.16
Little Manatee River Watershed	0.011-0.15	0.02-0.80
Curiosity Creek	0.05-0.08	0.07-0.14
Sun City and Wildcat Creek	0.03-0.09	0.02-0.17
Marsh Branch	0.04-0.09	0.07-0.10
Cockroach Bay	0.029-0.08	0.10-0.14
South Fork	0.013-0.04	0.03-0.14
Little Manatee River	0.011-0.15	0.025-0.80
Lower Sweetwater	0.015-0.04	0.025-0.05
Pemberton Creek Watershed	0.025-0.11	0.02-0.20
Campbell Branch/Antioch/Flint Creek System	0.025-0.11	0.03-0.20
Baker Canal	0.025-0.11	0.03-0.20
Pemberton Creek System	0.04-0.11	0.02-0.20

TABLE 8 - MANNING'S "n" VALUES - continued

<u>Stream</u>	<u>Channel "n"</u>	<u>Overbank "n"</u>
Rocky/Brushy Creek Watershed	0.025-0.11	0.035-0.125
Brushy Creek System	0.025-0.11	0.035-0.125
Rocky Creek System	0.035-0.09	0.05-0.125
Lake Ruth System	0.04	0.08
Silver Twin Lake	0.025-0.04	0.025-0.04
Tampa By-Pass	0.03-0.10	0.032-0.10
Sweetwater Creek	0.015-0.095	0.03-0.12
Wolf Branch Basin	0.04-0.05	0.08-0.16

3.3 Vertical Datum

All FISs and FIRMs are referenced to a specific vertical datum. The vertical datum provides a starting point against which flood, ground, and structure elevations can be referenced and compared. Until recently, the standard vertical datum in use for newly created or revised FISs and FIRMs was the National Geodetic Vertical Datum of 1929 (NGVD 29). With the finalization of the North American Vertical Datum of 1988 (NAVD 88), many FIS reports and FIRMs are being prepared using NAVD 88 as the referenced vertical datum.

All flood elevations shown in this FIS report and on the FIRM are referenced to NAVD 88. Structure and ground elevations in the community must, therefore, be referenced to NAVD 88. It is important to note that adjacent communities may be referenced to NGVD 29. This may result in differences in base flood elevations across the corporate limits between the communities.

Prior versions of the FIS report and FIRM were referenced to NGVD 29. When a datum conversion is effected for an FIS report and FIRM, the Flood Profiles, base (1-percent annual chance) flood elevations (BFEs), and Elevation Reference Marks reflect the new datum values. To compare structure and ground elevations to BFEs shown in the FIS and on the FIRM, the subject structure and ground elevations must be referenced to the new datum values. The conversion to NAVD 88 resulted in an elevation decrease of 0.89 foot across the entire county for the riverine areas and 1.00 foot for the coastal areas.

For more information on NAVD 88, see Converting the National Flood Insurance Program to the North American Vertical Datum of 1988, FEMA Publication FIA-20/June 1992, or contact the Vertical Network Branch, National Geodetic Survey, Coast and Geodetic Survey, National Oceanic and Atmospheric Administration, Rockville, Maryland 20910 (Internet address <http://www.ngs.noaa.gov>).

4.0 FLOODPLAIN MANAGEMENT APPLICATIONS

The NFIP encourages State and local governments to adopt sound floodplain management programs. To assist in this endeavor, each FIS provides 1-percent annual chance floodplain data, which may include a combination of the following: 10-, 2-, 1-, and 0.2-percent annual chance flood elevations; delineations of the 1- and 0.2-percent annual chance floodplains; and 1-percent annual chance floodway. This information is presented on the FIRM and in many components of the FIS, including Flood Profiles, Floodway Data tables, and Summary of Stillwater Elevation tables. Users should reference the data presented in the FIS as well as additional information that may be available at the local community map repository before making flood elevation and/or floodplain boundary determinations.

4.1 Floodplain Boundaries

To provide a national standard without regional discrimination, the 1-percent annual chance flood has been adopted by FEMA as the base flood for floodplain management purposes. The 0.2-percent annual chance flood is employed to indicate additional areas of flood risk in the county. For the streams studied in detail, the 1- and 0.2-percent annual chance floodplain boundaries have been delineated using the flood elevations determined at each cross section. Between cross sections, the boundaries were interpolated using topographic maps at scales of 1:2400, 1:12000, and 1:24000 with contour intervals of 1 foot, 2 feet, and 5 feet, respectively (SWFWMD, et al). For each coastal flooding source studied in detail, the 1- and 0.2-percent annual chance floodplain boundaries have been delineated using the flood elevations determined at each transect. Between transects, the boundaries were interpolated using topographic maps (USGS, et al), aerial photographs (SWFWMD, et al), and engineering judgment.

For this countywide FIS, between cross sections, the boundaries were interpolated using topographic maps at a scale of 1:2400 with a contour interval of 1 foot (SWFWMD).

The 1- and 0.2-percent annual chance floodplain boundaries are shown on the FIRM (Exhibit 2). On this map, the 1-percent annual chance floodplain boundary corresponds to the boundary of the areas of special flood hazards (Zones A, V, AE and VE), and the 0.2-percent annual chance floodplain boundary corresponds to the boundary of areas of moderate flood hazards. In cases where the 1- and 0.2-percent annual chance floodplain boundaries are close together, only the 1-percent annual chance floodplain boundary has been shown. Small areas within the floodplain boundaries may lie above the flood elevations but cannot be shown due to limitations of the map scale and/or lack of detailed topographic data.

For the streams studied by approximate methods, only the 1-percent annual chance floodplain boundary is shown on the FIRM (Exhibit 2).

4.2 Floodways

Encroachment on floodplains, such as structures and fill, reduces flood-carrying capacity, increases flood heights and velocities, and increases flood hazards in areas beyond the encroachment itself. One aspect of floodplain management involves balancing the economic gain from floodplain development against the resulting increase in flood hazard. For purposes of the NFIP, a floodway is used as a tool to assist local communities in this aspect of floodplain management. Under this concept, the area of the 1-percent annual chance floodplain is divided into a floodway and a floodway fringe. The floodway is the channel of a stream, plus any adjacent floodplain areas, that must be kept free of encroachment so that the 1-percent annual chance flood can be carried without substantial increases in flood heights. Minimum federal standards limit such increases to 1.0 foot, provided that hazardous velocities are not produced. The floodways in this FIS are presented to local agencies as minimum standards that can be adopted directly or that can be used as a basis for additional floodway studies.

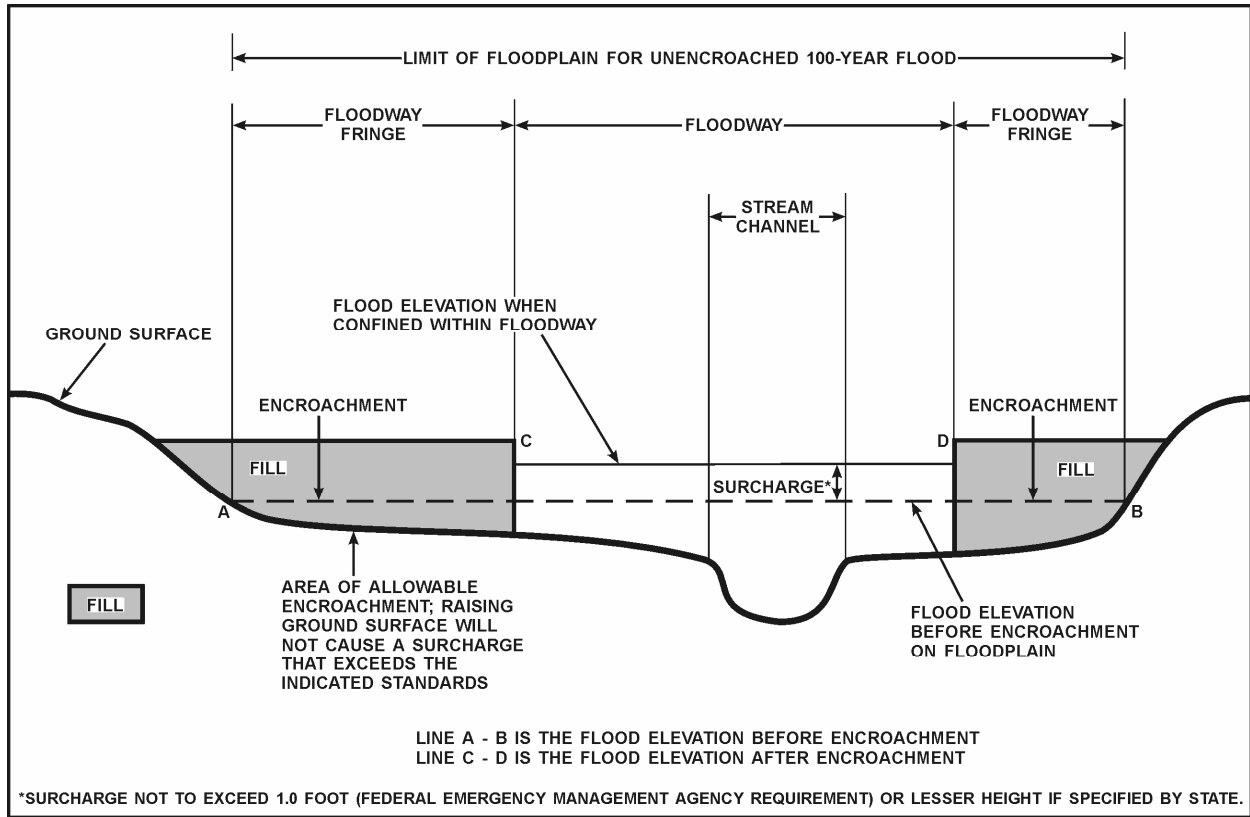
The floodways presented in this FIS were computed for certain stream segments on the basis of equal conveyance reduction from each side of the floodplain.

Floodway widths were computed at cross sections. Between cross sections, the floodway boundaries were interpolated. The results of the floodway computations are tabulated for selected cross sections (Table 9). The computed floodways are shown on the FIRM (Exhibit 2). In cases where the floodway and 1-percent annual chance floodplain boundaries are either close together or collinear, only the floodway boundary is shown.

Near the mouths of streams studied in detail, floodway computations are made without regard to flood elevations on the receiving water body. Therefore, "Without Floodway" elevations presented in Table 9 for certain downstream cross sections are lower than the regulatory flood elevations, which must take into account the 1-percent annual chance flooding due to backwater from other sources.

Encroachment into areas subject to inundation by floodwaters having hazardous velocities aggravates the risk of flood damage, and heightens potential flood hazards by further increasing velocities. A listing of stream velocities at selected cross sections is provided in Table 9, "Floodway Data." In order to reduce the risk of property damage in areas where the stream velocities are high, the community may wish to restrict development in areas outside the floodway.

The area between the floodway and 1-percent annual chance floodplain boundaries is termed the floodway fringe. The floodway fringe encompasses the portion of the floodplain that could be completely obstructed without increasing the water-surface elevation of the 1-percent annual chance flood by more than 1.0 foot at any point. Typical relationships between the floodway and the floodway fringe and their significance to floodplain development are shown in Figure 3.



FLOODWAY SCHEMATIC

Figure 3

5.0 INSURANCE APPLICATIONS

For flood insurance rating purposes, flood insurance zone designations are assigned to a community based on the results of the engineering analyses. The zones are as follows:

Zone A

Zone A is the flood insurance rate zone that corresponds to the 1-percent annual chance floodplains that are determined in the FIS by approximate methods. Because detailed hydraulic analyses are not performed for such areas, no base flood elevations or depths are shown within this zone.

Zone AE

Zone AE is the flood insurance rate zone that corresponds to the 1-percent annual chance floodplains that are determined in the FIS by detailed methods. In most instances, whole-foot base flood elevations derived from the detailed hydraulic analyses are shown at selected intervals within this zone.

Zone AH

Zone AH is the flood insurance rate zone that corresponds to the areas of 1-percent annual chance shallow flooding (usually areas of ponding) where average depths are between 1 and 3 feet. Whole-foot base flood elevations derived from the detailed hydraulic analyses are shown at selected intervals within this zone.

Zone AO

Zone AO is the flood insurance rate zone that corresponds to the areas of 1-percent annual chance shallow flooding (usually sheet flow on sloping terrain) where average depths are between 1 and 3 feet. Average whole-foot depths derived from the detailed hydraulic analyses are shown within this zone.

Zone AR

Area of special flood hazard formerly protected from the 1-percent annual chance flood event by a flood control system that was subsequently decertified. Zone AR indicates that the former flood control system is being restored to provide protection from the 1-percent annual chance or greater flood event.

Zone A99

Zone A99 is the flood insurance rate zone that corresponds to areas of the 1-percent annual chance floodplain that will be protected by a Federal flood protection system where construction has reached specified statutory milestones. No base flood elevations or depths are shown within this zone.

Zone V

Zone V is the flood insurance rate zone that corresponds to the 1-percent annual chance coastal floodplains that have additional hazards associated with storm waves. Because approximate hydraulic analyses are performed for such areas, no base flood elevations are shown within this zone.

Zone VE

Zone VE is the flood insurance rate zone that corresponds to the 1-percent annual chance coastal floodplains that have additional hazards associated with storm waves. Whole-foot base flood elevations derived from the detailed hydraulic analyses are shown at selected intervals within this zone.

Zone X

Zone X is the flood insurance rate zone that corresponds to areas outside the 0.2-percent annual chance floodplain, areas within the 0.2-percent annual chance floodplain, and to areas of 1-percent annual chance flooding where average depths are less than 1 foot, areas of 1-percent annual chance flooding where the contributing drainage area is less than 1 square mile, and areas protected from the 1-percent annual chance flood by levees. No base flood elevations or depths are shown within this zone.

Zone D

Zone D is the flood insurance rate zone that corresponds to unstudied areas where flood hazards are undetermined, but possible.

6.0 FLOOD INSURANCE RATE MAP

The FIRM is designed for flood insurance and floodplain management applications.

For flood insurance applications, the map designates flood insurance rate zones as described in Section 5.0 and, in the 1-percent annual chance floodplains that were studied by detailed methods, shows selected whole-foot base flood elevations or average depths. Insurance agents use the zones and base flood elevations in conjunction with information on structures and their contents to assign premium rates for flood insurance policies.

For floodplain management applications, the map shows by tints, screens, and symbols, the 1- and 0.2-percent annual chance floodplains. Floodways and the locations of selected cross sections used in the hydraulic analyses and floodway computations are shown where applicable.

The current FIRM presents flooding information for the entire geographic area of Hillsborough County. Previously, separate Flood Hazard Boundary Maps and/or FIRMs were prepared for each identified flood-prone incorporated community and the unincorporated areas of the county. This countywide FIRM also includes flood hazard information that was presented separately on Flood Boundary and Floodway Maps (FBFMs), where applicable. Historical data relating to the maps prepared for each community, up to and including this countywide FIS, are presented in Table 10, "Community Map History."

7.0 OTHER STUDIES

FISs have been prepared for Pinellas County (FEMA, 2005) and Pasco County (FEMA, 1992).

Information pertaining to revised and unrevised flood hazards for each jurisdiction within Hillsborough County has been compiled into this FIS. Therefore, this FIS supersedes all previously printed FIS Reports, FHBMs, FBFMs, and FIRMs for all of the incorporated and unincorporated jurisdictions within Hillsborough County.

8.0 LOCATION OF DATA

Information concerning the pertinent data used in the preparation of this study can be obtained by contacting FEMA, Mitigation Division, Koger Center - Rutgers Building, 3003 Chamblee Tucker Road, Atlanta, Georgia 30341.

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