COMPARISON OF ESTIMATED AND OBSERVED STORMWATER RUNOFF FOR FIFTEEN WATERSHEDS IN WEST-CENTRAL FLORIDA, USING FIVE COMMON DESIGN TECHNIQUES

By J.T. Trommer, J.E. Loper, K.M. Hammett, and Geronia Bowman

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CONVERSION FACTORS, VERTICAL DATUM, AND ACRONYMS

Multiply	By	To obtain
inch (in.)	25.40	millimeter
foot (ft)	0.3048	meter
mile (mi)	1.609	kilometer
inch per hour (in./hr)	25.40	millimeter per hour
inch per year (in/yr)	25.40	millimeter per year
feet per mile (ft/mi)	0.1894	meter per kilometer
square mile (mi^2)	2.590	square kilometer
acre	0.4047	hectare
acre-foot (acre-ft)	1.233	cubic meter
acre-inch per hour (acre-in./hr)	0.10275	cubic meter per hour
cubic foot (ft^3)	0.02832	cubic meter
cubic foot per second (ft^3/s)	0.02832	cubic meter per second

Temperature can be converted between degrees Fahrenheit (°F) and degrees Celsius (°C) as follows:

°F = 9/5 (°C) + 32

°C = 5/9 (°F - 32)

Sea level: In this report "sea level" refers to the National Geodetic Vertical Datum of 1929 (NGVD of 1929)--a geodetic datum derived from a general adjustment of the first-order level nets of the United States and Canada, formerly called Sea Level Datum of 1929.

Acronyms

AMC I	Antecedent Moisture Condition I
AMC II	Antecedent Moisture Condition II
AMC III	Antecedent Moisture Condition III
CN	Curve Number
EPA	Environmental Protection Agency
NOAA	National Oceanic and Atmospheric Administration
NRCS	Natural Resources Conservation Service (formerly the Soil Conservation Service)
PC	Personal Computer
SWFWMD	Southwest Florida Water Management District
SWMM	Storm Water Management Model
TR-20	Soil Conservation Service Technical Release No. 20
USGS	U.S. Geological Survey

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ABSTRACT

Hydrologists use several traditional techniques for estimating peak discharges and runoff volumes from ungaged watersheds. However, applying these techniques to watersheds in west-central Florida requires that empirical relationships be extrapolated beyond tested ranges. As a result there is some uncertainty as to their accuracy.

Sixty-six storms in 15 west-central Florida watersheds were modeled using (1) the rational method, (2) the U.S. Geological Survey regional regression equations, (3) the Natural Resources Conservation Service (formerly the Soil Conservation Service) TR-20 model, (4) the Army Corps of Engineers HEC-1 model, and (5) the Environmental Protection Agency SWMM model. The watersheds ranged between fully developed urban and undeveloped natural watersheds. Peak discharges and runoff volumes were estimated using standard or recommended methods for determining input parameters. All model runs were uncalibrated and the selection of input parameters was not influenced by observed data.

The rational method, only used to calculate peak discharges, overestimated 45 storms, underestimated 20 storms and estimated the same discharge for 1 storm. The mean estimation error for all storms indicates the method overestimates the peak discharges. Estimation errors were generally smaller in the urban watersheds and larger in the natural watersheds.

The U.S. Geological Survey regression equations provide peak discharges for storms of specific recurrence intervals. Therefore, direct comparison with observed data was limited to sixteen observed storms that had precipitation equivalent to specific recurrence intervals. The mean estimation error for

all storms indicates the method overestimates both peak discharges and runoff volumes. Estimation errors were smallest for the larger natural watersheds in Sarasota County, and largest for the small watersheds located in the eastern part of the study area.

The Natural Resources Conservation Service TR-20 model, overestimated peak discharges for 45 storms and underestimated 21 storms, and overestimated runoff volumes for 44 storms and underestimated 22 storms. The mean estimation error for all storms modeled indicates that the model overestimates peak discharges and runoff volumes. The smaller estimation errors in both peak discharges and runoff volumes were for storms occurring in the urban watersheds, and the larger errors were for storms occurring in the natural watersheds.

The HEC-1 model overestimated peak discharge rates for 55 storms and underestimated 11 storms. Runoff volumes were overestimated for 44 storms and underestimated for 22 storms using the Army Corps of Engineers HEC-1 model. The mean estimation error for all the storms modeled indicates that the model overestimates peak discharge rates and runoff volumes. Generally, the smaller estimation errors in peak discharges were for storms occurring in the urban watersheds, and the larger errors were for storms occurring in the natural watersheds. Estimation errors in runoff volumes; however, were smallest for the 3 natural watersheds located in the southernmost part of Sarasota County.

The Environmental Protection Agency Storm Water Management model produced similar peak discharges and runoff volumes when using both the Green-Ampt and Horton infiltration methods. Estimated peak discharge and runoff volume data calculated with the Horton method was only slightly higher than those calculated with the Green-Ampt method. The mean estimation error for all the storms modeled indicates the model using the Green-Ampt infiltration method overestimates peak discharges and slightly underestimates runoff volumes. Using the Horton infiltration method, the model overestimates both peak discharges and runoff volumes. The smaller estimation errors in both peak discharges and runoff volumes were for storms occurring in the five natural watersheds in Sarasota County with the least amount of impervious cover and the lowest slopes. The largest errors were for storms occurring in the three small natural watersheds in the eastern part of the study area. The mean estimation errors for peak discharge ranged from an underestimation of 63 percent to an over estimation of 224 percent. For runoff volume, the mean estimation errors range from an underestimation of 63.3 percent to an overestimation of 267 percent.

INTRODUCTION

Low topographic relief and intense or prolonged rainfall events associated with tropical storms can produce recurring problems with storm-water flooding in west-central Florida. These naturally-occurring problems are being further compounded by rapid increases in population and the accompanying development.

Local, state, and federal agencies have recognized the potential impacts of population growth and development, and have imposed regulations on storm-water discharges. To comply with regulations and permit requirements, hydrologist commonly use several traditional techniques for estimating peak discharge and volume of stormwater runoff from ungaged watersheds; however, applying these techniques to watersheds in west-central Florida requires that empirical relationships be extrapolated beyond tested ranges. Watersheds in this area typically have flatter slopes, more permeable soils, lower stream gradients, higher ground water levels, and larger wetland areas than watersheds used in the development of many of these empirical relationships. Rainfall events are typically short duration, high intensity thunder storms rather than the 24 hr, specific recurrence interval storm used for design purposes. Because watersheds and rainfall events in west-central Florida are not typical of those used to develop most standard techniques there is uncertainty as to the accuracy of the estimates.

Underestimating the peak flow or storm volume can cause detrimental environmental and possibly severe economic consequences, while overestimation can result in unnecessary economic burdens on the community. The U.S. Geological Survey (USGS) began a cooperative study in April 1991 with the Sarasota County Environmental Stormwater Utility to better understand the uncertainty of five of these traditional estimating techniques when applied to low-gradient watersheds common in west-central Florida.

Purpose and Scope

The specific objectives of this report are to: (1) describe the methods used to collect rainfall and runoff data from 15 low-gradient watersheds in west-central Florida, (2) describe the techniques used to estimate peak discharge and runoff volumes for specific storms that occurred in these watersheds, and (3) present comparisons of the estimated and observed peak discharges and runoff volumes for those storms.

The overall purposes of the study were to evaluate the reliability and accuracy of techniques commonly used to estimate stormwater runoff when those techniques are applied to the low-gradient watersheds found in west-central Florida, and, to develop techniques to estimate runoff from watersheds with characteristics that are outside the range for which traditional techniques can be reliably applied. A subsequent report will present modifications of techniques for estimating stormwater runoff.

Data from 15 watersheds in Sarasota, Hardee, Hillsborough, and Pinellas Counties were used for this study. Continuous rainfall and stream-flow data were collected for each watershed. Stage and discharge relationships were developed for each station. Seven new gaging stations were installed in Sarasota County and data collected during previous investigations in 8 watersheds in Hillsborough, Pinellas, and Hardee Counties were also used. Physiographic characteristics for each watershed were compiled from aerial photographs, U.S. Geological Survey topographic maps, County drainage maps, consultant's reports, and field observations.

Estimated peak discharges and runoff volumes were computed using techniques commonly applied by design engineers. The design techniques were applied according to quidelines specified in user manuals or standard engineering textbooks, as though no field data were available. Computed estimates were compared to observed peak discharges and runoff volumes, so that the accuracy of the techniques could be evaluated.

Acknowledgments

This study was coordinated with J.P. Marchand, Deputy Director of the Sarasota County Environmental Stormwater Utility. The authors gratefully acknowledge the cooperation and assistance of Mr. Marchand and his staff, without whom this study would not have been conducted. Thanks are also extended to the land owners who allowed access to the streams and construction of the rainfall/runoff stations, particularly the Palmer and Taylor Ranches. Special thanks are extended to Stephen M. Suau, consulting engineer, Kimley-Horn and Associates, Inc., for providing extensive information and maps for the Catfish Creek and South Creek watersheds.

Description of the Study Area

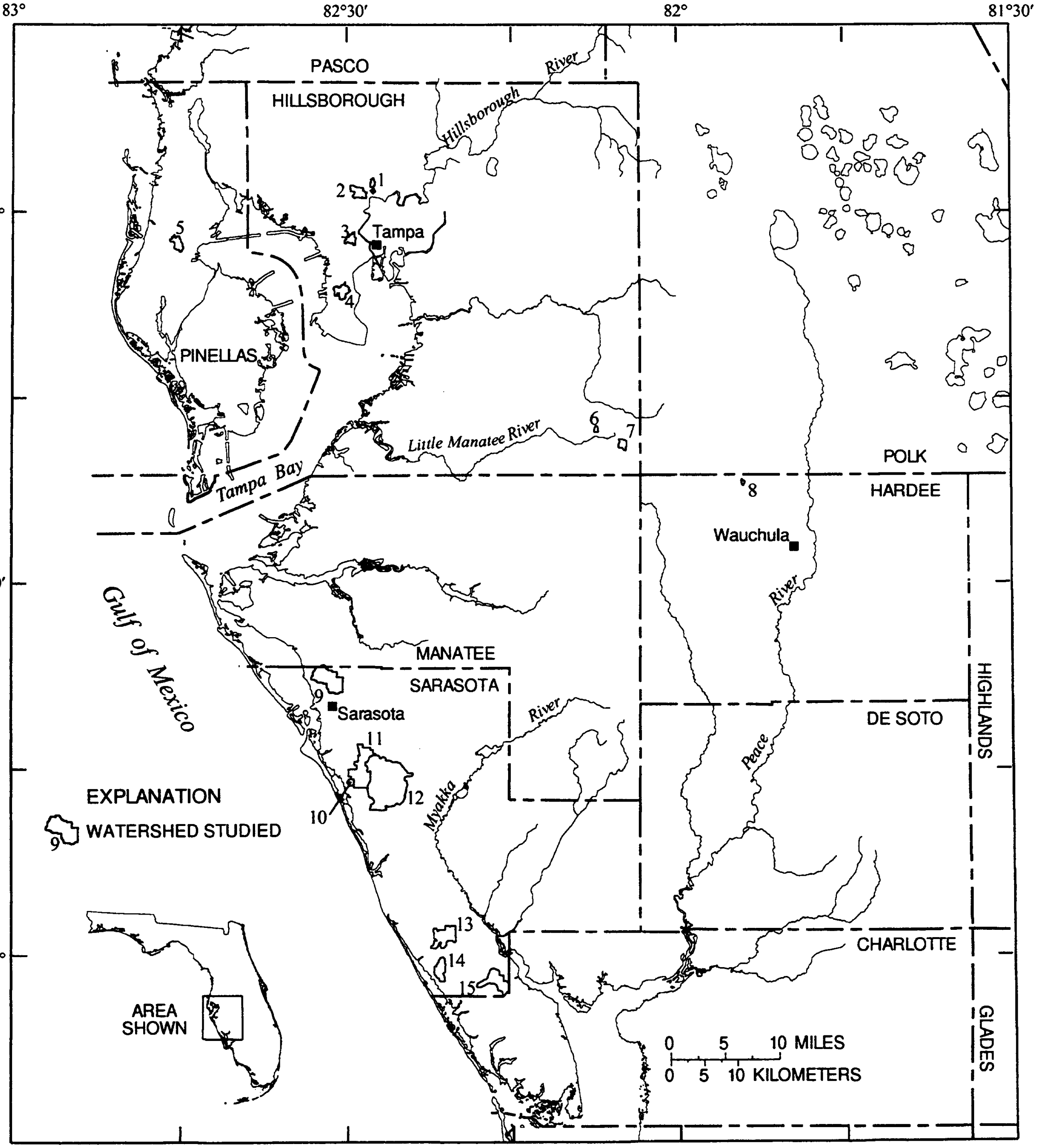
The study area includes watersheds located in Sarasota, Hardee, Hillsborough, and Pinellas Counties (fig. 1) and lies within the Gulf Coastal Lowlands and Central Highlands physiographic regions (fig. 2) described by White (1970). The Gulf Coastal Lowlands consist of a broad, sandy, gently sloping marine plain containing creeks, swamps, and sloughs. Land-surface elevation in this region ranges from sea level to about 70 ft (feet) above sea level. The watersheds lying within the Central Highlands are located in the area where Hillsborough, Manatee, and Hardee Counties intersect (fig. 1). This part of the Central Highlands consists of relatively flat plains that contain swamps and widely branching streams. Land-surface elevation generally ranges from 100 to 130 ft above sea level in the vicinity of these watersheds (Lewelling and Wylie, 1993, p.4).

The climate in west-central Florida is subtropical and is characterized by long humid summers and mild winters. Mean monthly temperatures range from about 50 $^{\circ}$F (degrees Fahrenheit) in January to about 90 $^{\circ}$F in August. Mean annual (normal) rainfall is 53.10 inches (in.) in St. Petersburg, 55.67 in. in the Sarasota area, and 53.09 in. in Wauchula (National Oceanic and Atmospheric Administration (NOAA), 1992). More than one-half of all rainfall occurs from June to September as high intensity, short duration thunder storms or occasional hurricanes or tropical storms. Rainfall from winter frontal activity is generally of longer duration and lower intensity. Figure 3 shows the mean monthly rainfall in the St. Petersburg, Sarasota, and Wauchula areas.

Watershed Descriptions

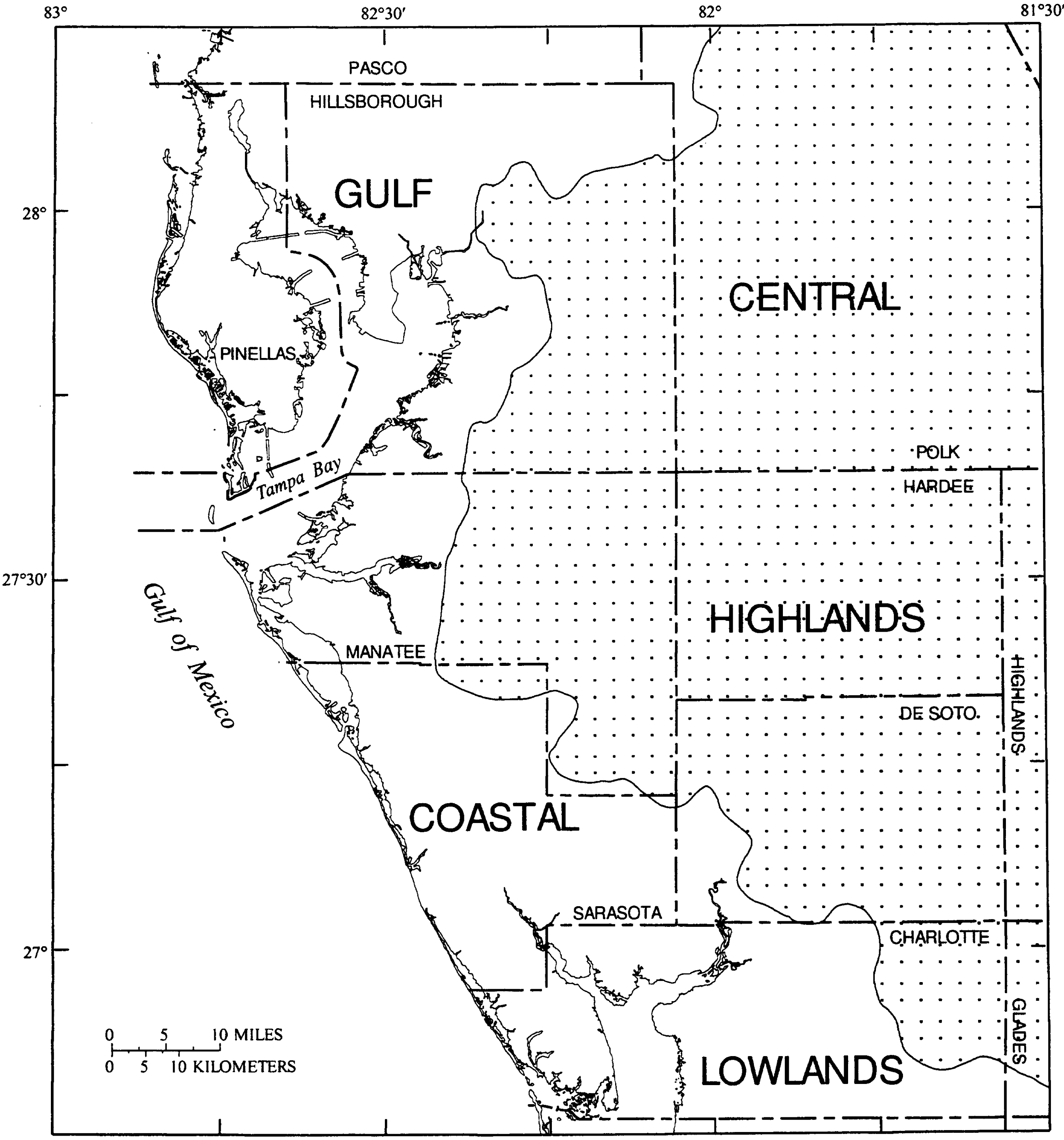
The 15 watersheds included in this study range in size from 0.14 mi^2 (square miles) to 15.22 mi^2. Six watersheds are urban, six are natural, and the remaining three have varying degrees of development associated with them. Table 1 summarizes the characteristics for each watershed.

Twelve of the watersheds are located near the coast. Nine of these drain directly to coastal waters. The remaining three (1,2 and 3), located in Hillsborough County, drain to the Hillsborough River. Three watersheds are located inland; two are in eastern Hillsborough County (6 and 7) and drain to the Little Manatee River. The third watershed is located in Hardee County (8) and drains through tributaries to the Peace River.



Base from Southwest Florida Water Management District digital data, 1:500,000, 1992
Universal Transverse Mercator projection, Zone 17

Figure 1. Location of the study area. (Watersheds listed on table 1)



Base from Southwest Florida Water Management District digital data, 1:500,000, 1992
Universal Transverse Mercator projection, Zone 17

Figure 2. Physiography of the study area (White, 1970).

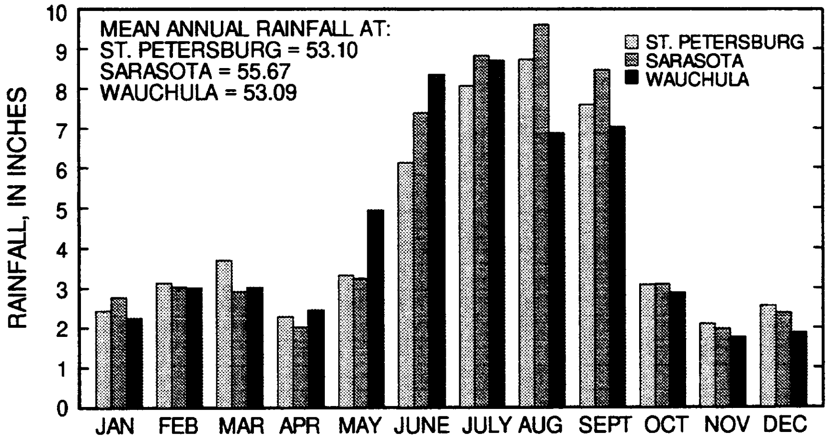


Figure 3. Mean monthly rainfall (1951-80) at St. Petersburg, Sarasota, and Wauchula, Florida.

Table 1. Watershed characteristics

[DA, drainage area (mi^2); SL, slope (ft/mi); EIA, effective impervious area (mi^2); Wet, wetlands; Res, residential; Com, commercial (includes commercial, industrial, and roads); Ag, agricultural; Pas, pasture or rangeland; For, forest or woodland; Open, open space; U, urban; N, natural; M, mixed]

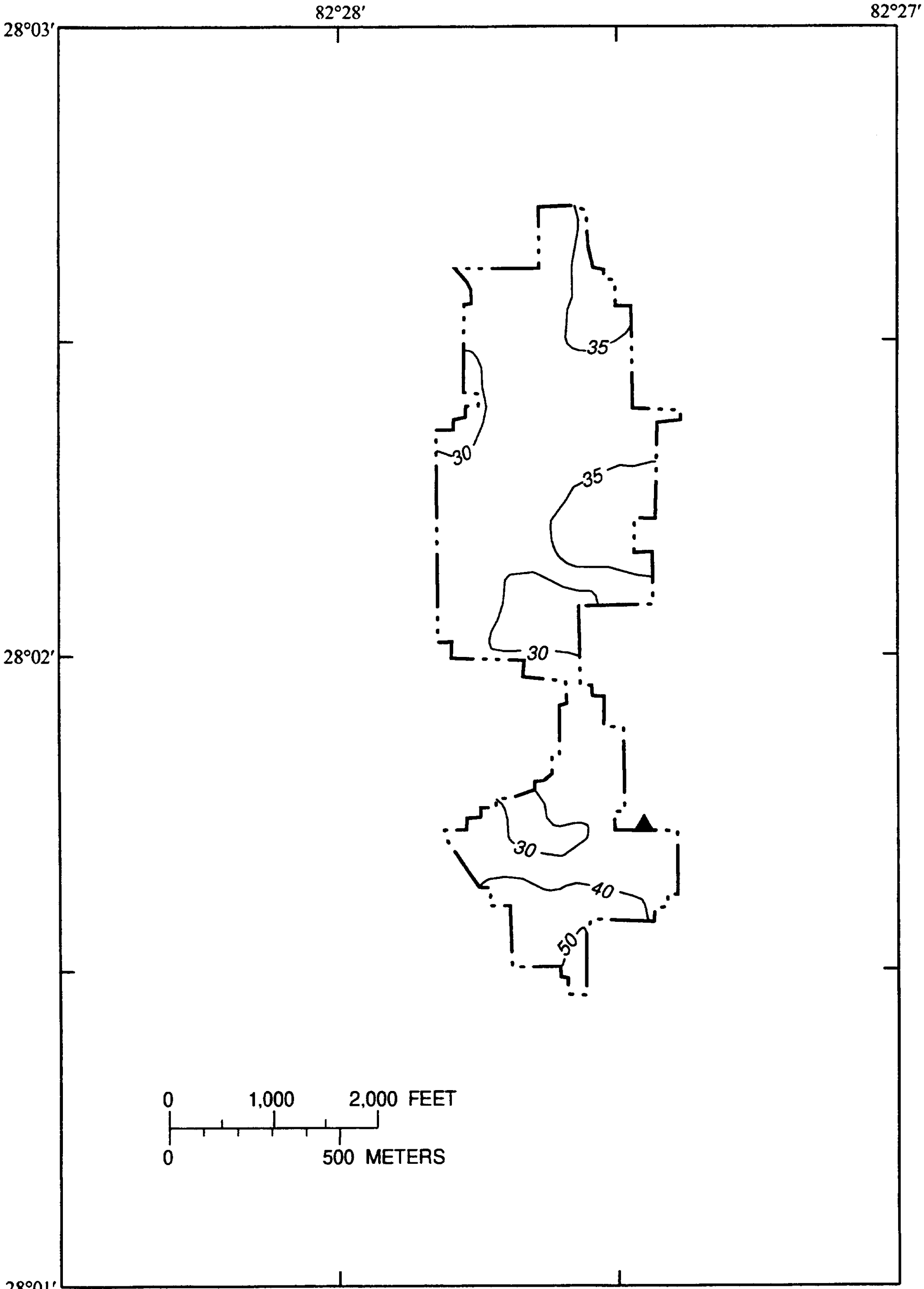
							Land use, in percent of total area						
Map no.	Identification no.	Watershed name	Watershed classification	DA	SL	EIA	Wet	Res	Com	Ag	Pas	For	Open
1	02306002	Arctic Street storm drain	U	0.34	12.3	40.0	0	50.0	50.0	0	0	0	0
2	02306006	Kirby Street drainage ditch	U	1.15	8.1	5.5	3.1	72.3	11.1	0	0	0	13.5
3	02306021	St. Louis Street drainage ditch	U	0.51	10.2	9.0	0	68.0	16.0	0	0	0	16.0
4	02306071	Gandy Boulevard drainage ditch	U	1.29	4.6	20.0	0.9	42.3	33.4	0	0	0	23.4
5	02307731	Allen Creek	U	1.79	23.4	20.0	0.9	63.0	20.0	0	0	0	16.1
6	274215082072000	IMC Creek	N	0.17	47.0	0	0	0	0	0	67.0	33.0	0
7	274141082051300	Grace Creek	N	0.66	26.0	0	0	0	0	33.0	33.0	34.0	0
8	273806081535000	CFI-3 Creek	N	0.14	36.0	0	0	0	0	0	67.0	33.0	0
9	02299861	Walker Creek	M	4.78	6.3	40.0	1.0	52.0	16.0	0	0	16.0	15.0
10	02299742	Clower Creek	U	0.35	3.7	85.0	0.1	14.9	85.0	0	0	0	0
11	02299741	Catfish Creek	M	4.77	3.5	10.0	0.5	25.0	10.0	0	10.0	30.0	25.0
12	02299737	South Creek	N	15.2	2.9	0	31.0	10.0	0	0	35.0	24.0	0
13	02299684	Forked Creek	N	2.7	2.8	0	15.0	0	0	30.0	55.0	0	0
14	02299681	Gottfried Creek	M	2.00	1.4	10.0	15.0	50.0	10.0	0	0	0	25.0
15	02299680	Rock Creek	N	2.6	2.9	0	25.0	0	0	0	0	25.0	0

The Arctic Street Storm Drain (site 1, fig. 1), located in Hillsborough County, within the City of Tampa, drains a 0.34 mi^2 area. The watershed is urban and land use is about evenly divided between older single-family residences and commercial businesses. Land surface elevation ranges from about 50 ft above sea level at the southern boundary of the watershed to about 30 ft above sea level at the gaging station. The watershed is about 2,650 ft wide by 7,400 ft long (fig. 4) and has a slope of 12.3 ft/mi. Drainage is through an underground storm-sewer system (Lopez and Michaelis, 1979, p. 5) that is about 6,600 ft in length. Maximum recorded discharge from the watershed was 142.0 ft^3/s (Lopez and Woodham, 1983).

The Kirby Street drainage ditch (site 2, fig. 1), located in Hillsborough County, in the City of Tampa, drains a 1.15 mi^2 area. Over 70 percent of land use in the watershed is residential. About 13.5 percent of the watershed contains open areas and the remaining area is commercial. Land surface elevation ranges from 50 ft above sea level at the western boundary of the watershed to 25 ft above sea level at the gaging station. The watershed is about 5,500 ft wide by 6,000 ft long (fig. 5) and has slope of 8.1 ft/mi. The stream channel is about 12,700 ft in length and is well defined. Maximum recorded discharge from the watershed was 192 ft^3/s (Lopez and Woodham, 1983).

The St. Louis Street drainage ditch (site 3, fig. 1), located in Hillsborough County, within the City of Tampa, drains a 0.51 mi^2 area. Older single-family residences account for 68 percent of the land use in the watershed. The remaining area is about equally divided between commercial and open land. Land surface elevation ranges from 35 ft above sea level at the northern and western watershed boundaries to about 25 ft above sea level at the gaging station. The watershed is about 5,200 ft wide by 4,500 long (fig. 6) and has a slope of 10.2 ft/mi. Drainage is through an underground storm-sewer system (Lopez and Michaelis, 1979, p. 7) that is about 5,900 ft in length. Maximum recorded discharge from the basin was 357 ft^3/s (Lopez and Woodham, 1983).

The Gandy Boulevard drainage ditch (site 4, fig. 1), located in Hillsborough County, within the City of Tampa, roughly in the center of the Interbay Peninsula, drains a 1.29 mi^2 area. Land use is divided between small, single-family residences, commercial centers with large parking lots and lightly vegetated or grassy open areas. Land surface elevation ranges from 15 ft above sea level at the eastern boundary of the watershed to about 6 ft above sea level at the gage. The watershed is about 7,500 ft wide by 6,500 ft long (fig. 7) and has a slope of 4.6 ft/mi. Drainage is through a combination of open ditches and underground storm-sewers (Lopez and Michaelis, 1979, p. 7) that is about 8,600 ft in length.



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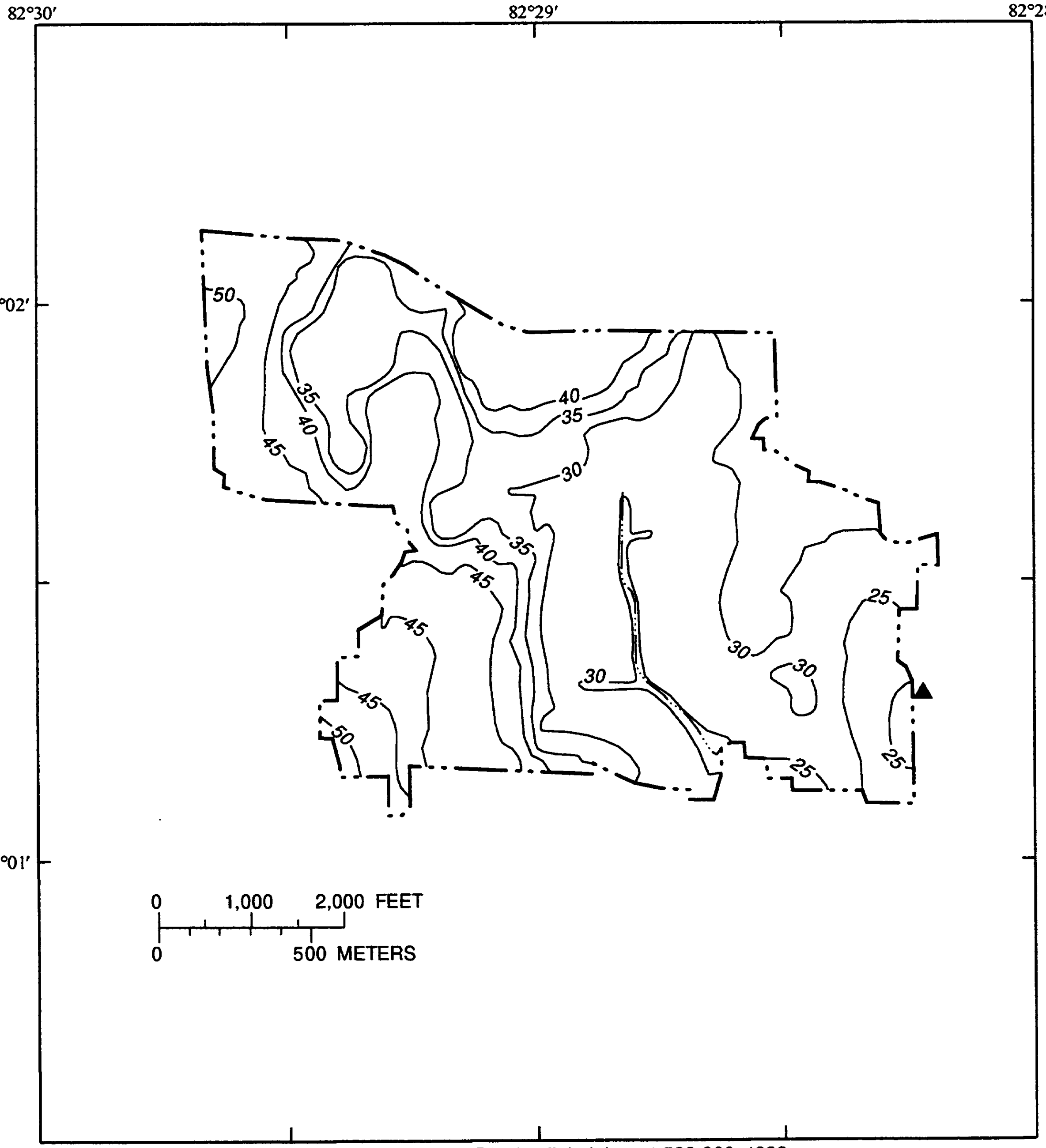
Universal Transverse Mercator projection, Zone 17

EXPLANATION

———	TOPOGRAPHIC CONTOUR-Showing altitude of land surface. Contour intervals 5 and 10 feet. Datum is sea level
——· ·	APPROXIMATE WATERSHED BOUNDARY ABOVE THE GAGING STATION
▲	STREAM GAGING STATION

Figure 4. Arctic Street storm drain watershed.



Base from Southwest Florida Water Management District digital data, 1:500,000, 1992
Universal Transverse Mercator projection, Zone 17

EXPLANATION

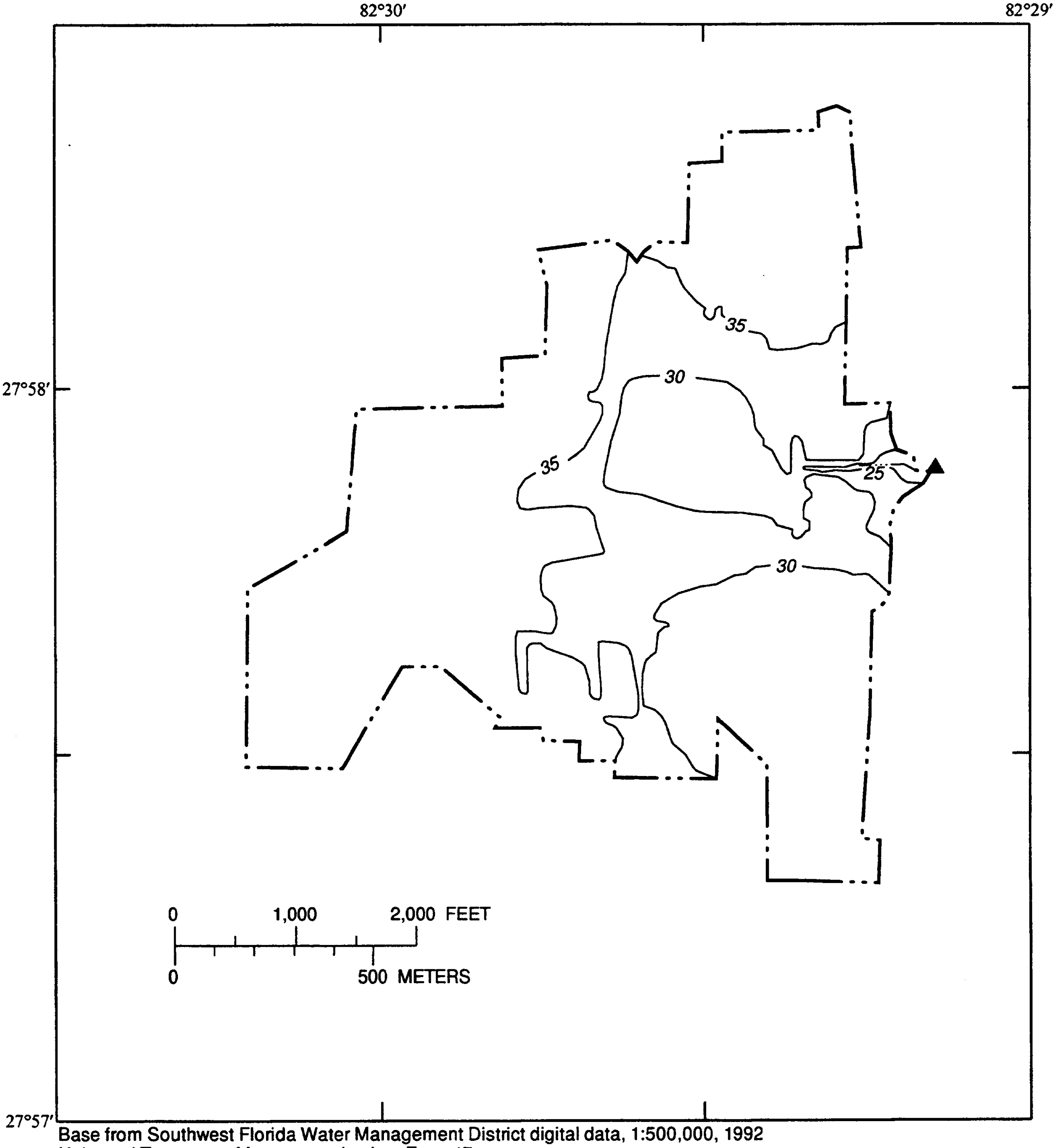
TOPOGRAPHIC CONTOUR- Showing altitude of land surface. Contour intervals 5 feet. Datum is sea level

APPROXIMATE WATERSHED BOUNDARY ABOVE THE GAGING STATION

APPROXIMATE LOCATION OF THE STREAM CHANNEL

STREAM GAGING STATION

Figure 5. Kirby Street drainage ditch watershed.



Base from Southwest Florida Water Management District digital data, 1:500,000, 1992
Universal Transverse Mercator projection, Zone 17

EXPLANATION

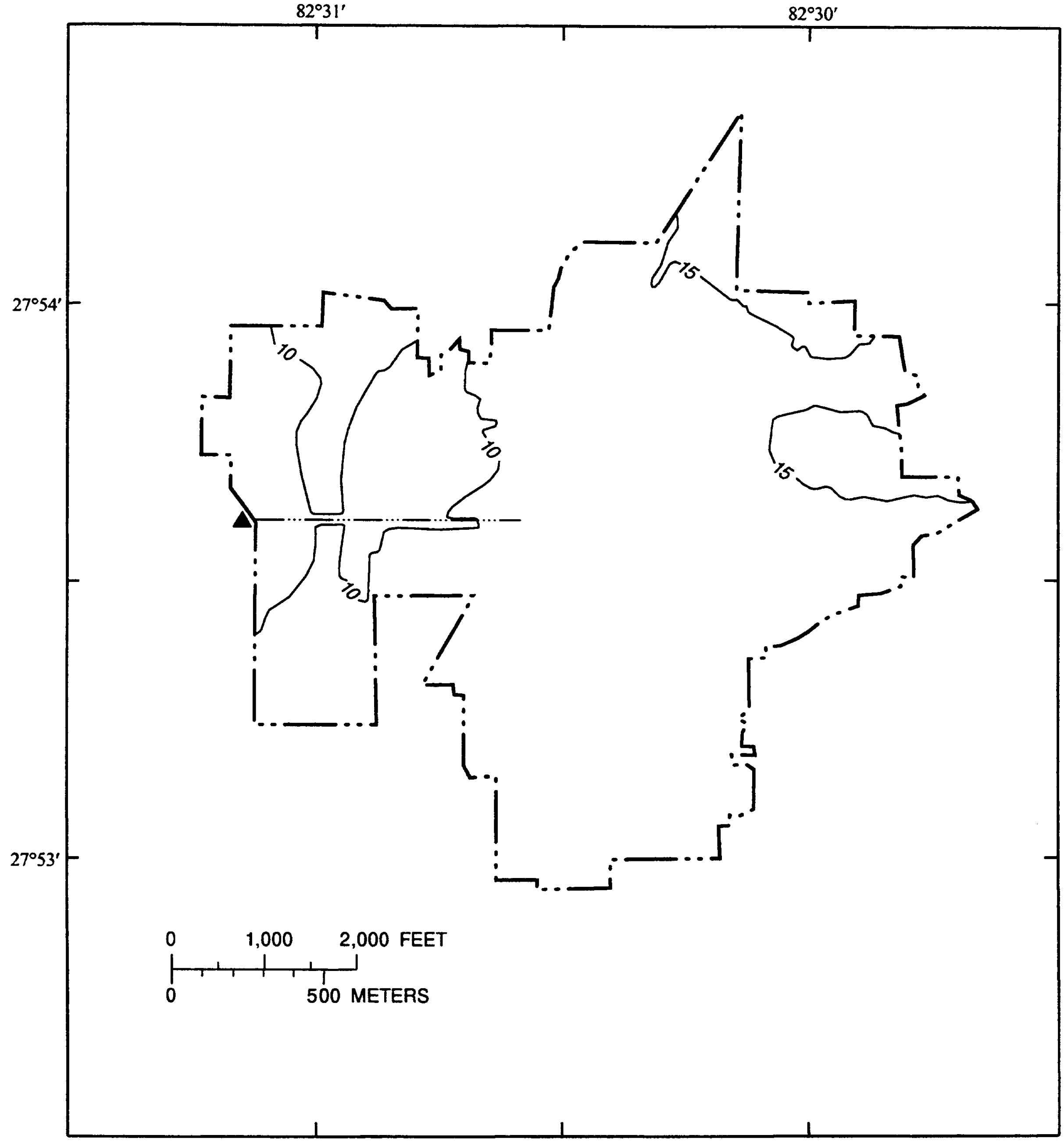
TOPOGRAPHIC CONTOUR- Showing altitude of land surface. Contour intervals 5 feet. Datum is sea level

APPROXIMATE WATERSHED BOUNDARY ABOVE THE GAGING STATION

APPROXIMATE LOCATION OF THE STREAM CHANNEL

▲ STREAM GAGING STATION

Figure 6. St. Louis Street drainage ditch watershed.



Base from Southwest Florida Water Management District digital data, 1:500,000, 1992
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EXPLANATION

TOPOGRAPHIC CONTOUR-Showing altitude of land surface. Contour intervals 5 feet. Datum is sea level

APPROXIMATE WATERSHED BOUNDARY ABOVE THE GAGING STATION

APPROXIMATE LOCATION OF THE STREAM CHANNEL

▲ STREAM GAGING STATION

Figure 7. Gandy Boulevard drainage ditch watershed.

Maximum recorded discharge from the watershed was 692 ft^3/s (Lopez and Woodham, 1983).

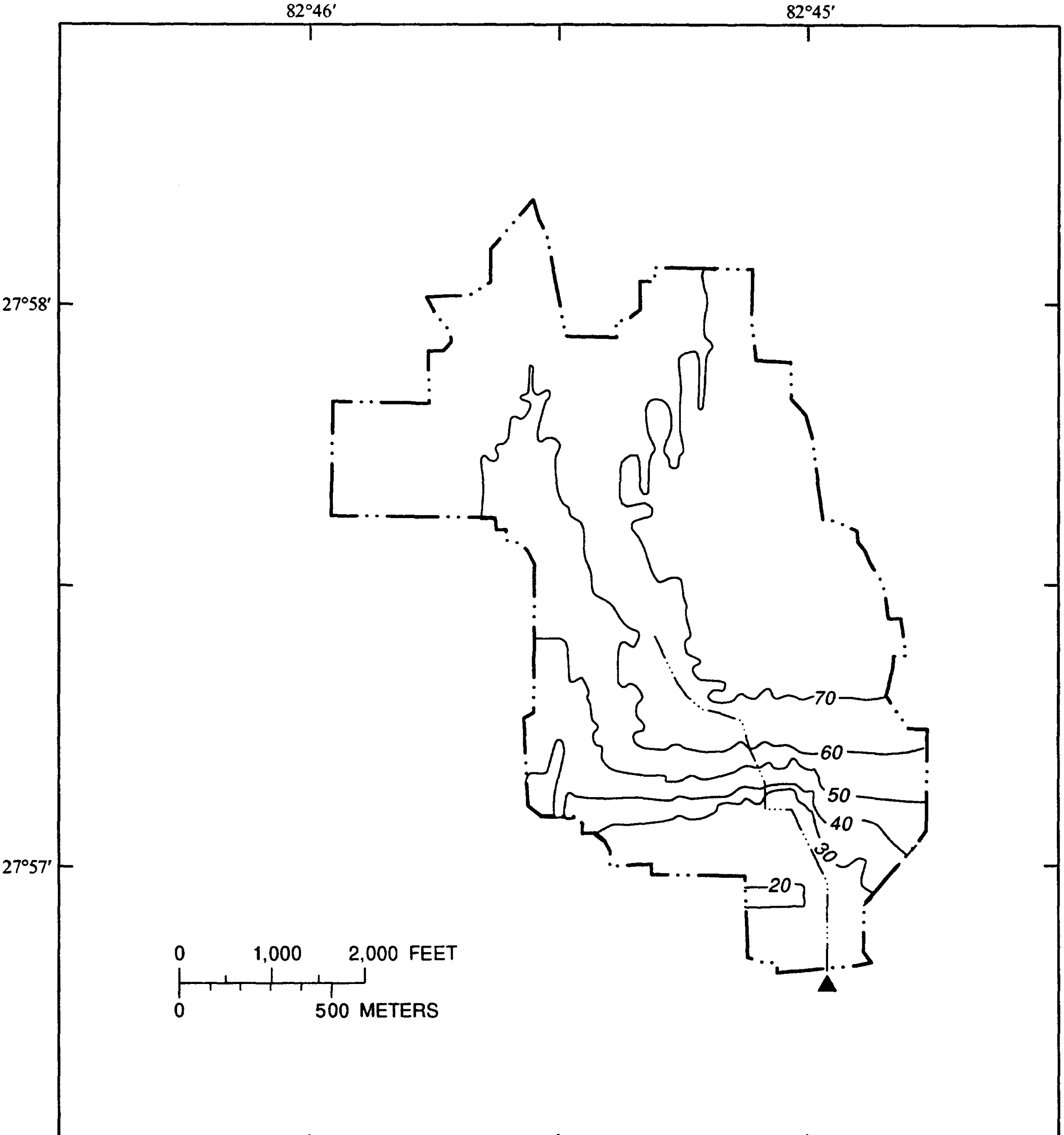
The Allen Creek watershed (site 5, fig. 1), located in northwestern Pinellas County, drains a 1.79 mi^2 area. Land use is predominantly residential. Land surface elevation ranges from 75 ft above sea level in the northern part of the watershed to 20 ft above sea level at the gaging station. The watershed is about 4,500 ft wide by 6,600 ft long (fig. 8) and has a slope of 23.4 ft/mi. The northern part of the watershed is drained by an underground storm sewer, and the southern part by an open ditch (Lopez and Michaelis, 1979, p. 11). The main channel is about 7,400 ft in length. Maximum recorded discharge from the watershed was 852 ft^3/s (Lopez and Woodham, 1983).

The IMC Creek watershed (site 6, fig. 1), located in southeastern Hillsborough County, drains a 0.17 mi^2 area and consists of gently sloping pastureland and a wooded area of cultivated pine trees. Land surface elevations range from about 115 ft above sea level at the watershed boundary to 95 ft above sea level at the gaging station. The watershed is approximately 2,000 ft wide by 2,800 ft long (fig. 9) and has a slope of 47.0 ft/mi. Drainage channels are poorly defined, except in the area of the gaging station. Maximum recorded discharge from the watershed was 10.5 ft^3/s (Lewelling and Wylie, 1993, p. 13).

The Grace Creek watershed (site 7, fig. 1), located in southeastern Hillsborough County, drains a 0.66 mi^2 area. Land use in the watershed is divided equally between citrus, pastureland, and wooded areas. Topography is flat to gently sloping with land surface elevation ranging from 135 ft above sea level at the watershed boundary to 110 ft above sea level at the gaging station. The watershed is approximately 4,200 ft wide by 4,400 ft long (fig. 10), and has a slope of 26.0 ft/mi. The main stream channel is about 7,200 ft in length and is generally well defined throughout the watershed. Maximum recorded discharge from the watershed was 47.0 ft^3/s (Lewelling and Wylie, 1993, p. 17).

The CFI-3 Creek watershed (site 8, fig. 1), located in northwestern Hardee County, drains a 0.14 mi^2 area. Pastureland covers 67 percent of the watershed. The remaining land is covered by palmetto scrub and forest. Land surface elevation ranges from 130 ft above sea level at the watershed boundary to about 115 ft above sea level at the gaging station. The watershed is approximately 2,200 ft wide by 2,100 ft long, (fig. 11) and has a slope of 36.0 ft/mi. The stream channel is about 2,200 ft in length and is well defined. Maximum recorded discharge from the watershed was 62.7 ft^3/s (Lewelling and Wylie, 1993, p. 21).

The Walker Creek watershed (site 9, fig. 1), located in Sarasota County, within the City of



Base from Southwest Florida Water Management District digital data, 1:500,000, 1992
Universal Transverse Mercator projection, Zone 17

EXPLANATION

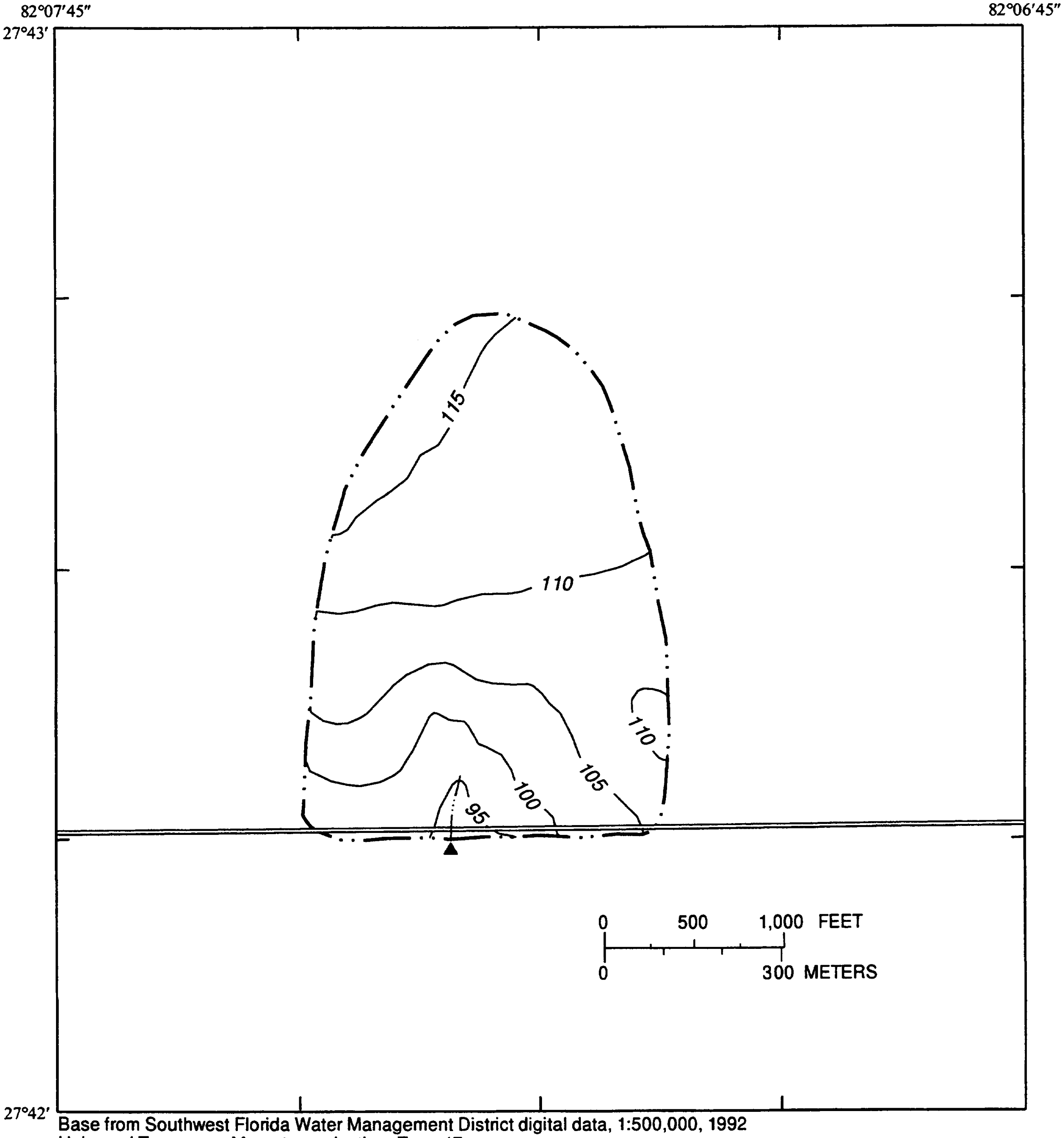
TOPOGRAPHIC CONTOUR-Showing altitude of land surface. Contour intervals 10 feet. Datum is sea level

APPROXIMATE WATERSHED BOUNDARY ABOVE THE GAGING STATION

APPROXIMATE LOCATION OF THE STREAM CHANNEL

▲ STREAM GAGING STATION

Figure 8. Allen Creek watershed.



Base from Southwest Florida Water Management District digital data, 1:500,000, 1992
Universal Transverse Mercator projection, Zone 17

EXPLANATION

———	TOPOGRAPHIC CONTOUR- Showing altitude of land surface. Contour intervals 5 feet. Datum is sea level
—— · ·	APPROXIMATE WATERSHED BOUNDARY ABOVE THE GAGING STATION
—···—	APPROXIMATE LOCATION OF THE STREAM CHANNEL
▲	STREAM GAGING STATION

Figure 9. IMC Creek watershed.

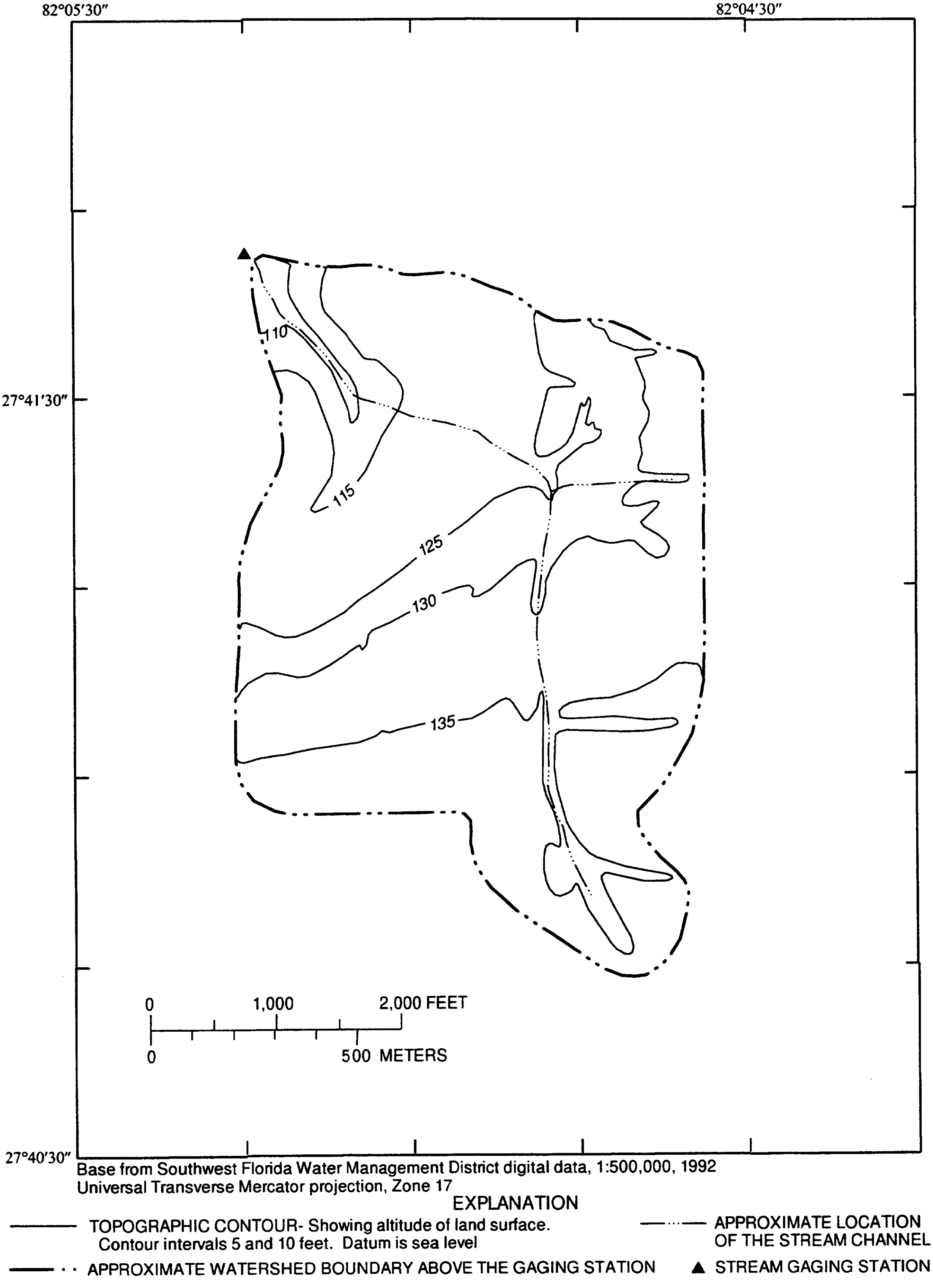
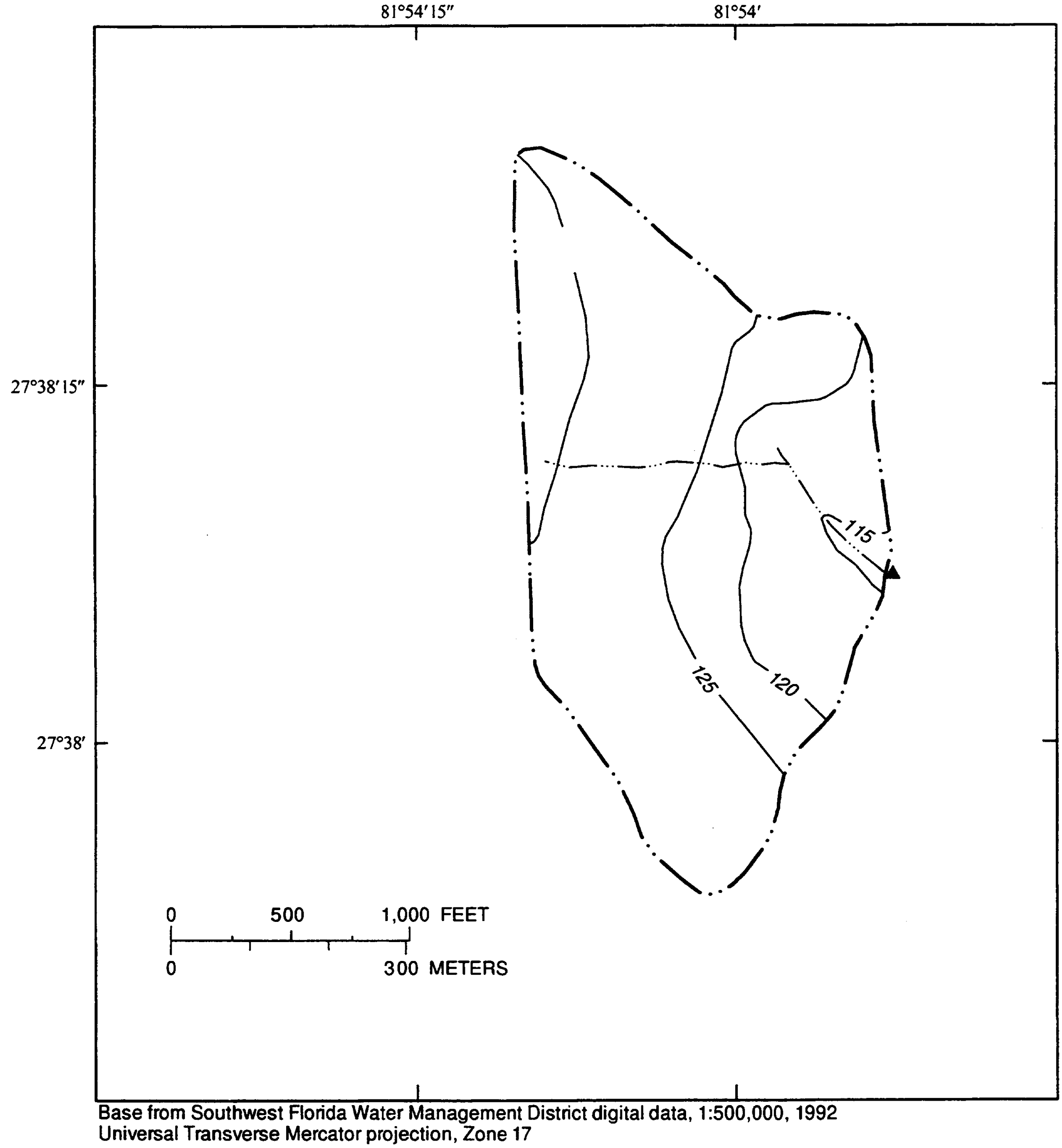


Figure 10. Grace Creek watershed (modified from Lewelling and Wylie, 1993).



EXPLANATION

TOPOGRAPHIC CONTOUR- Showing altitude of land surface. Contour intervals 5 feet. Datum is sea level

APPROXIMATE WATERSHED BOUNDARY ABOVE THE GAGING STATION

APPROXIMATE LOCATION OF THE STREAM CHANNEL

▲ STREAM GAGING STATION

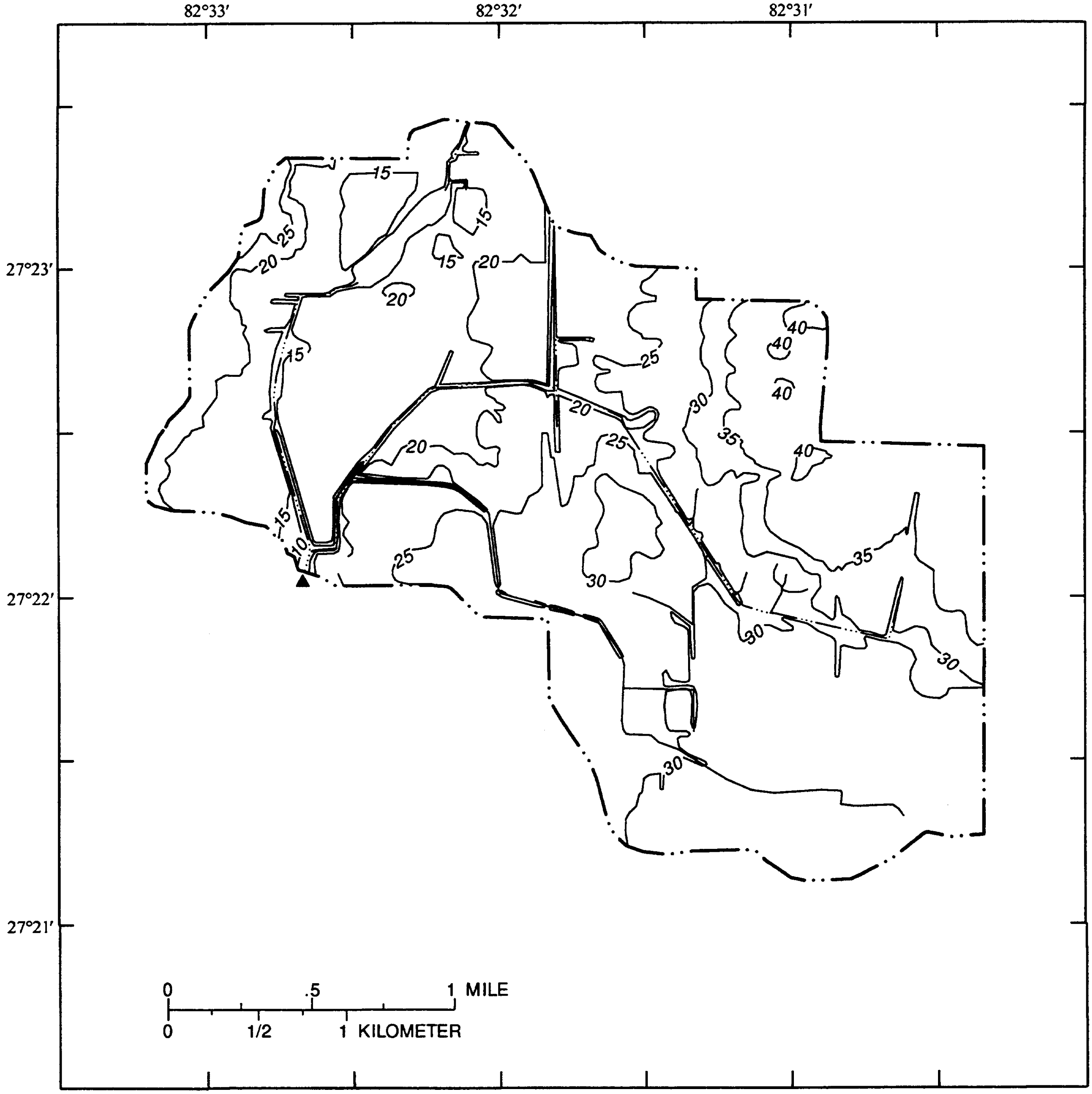
Figure 11. CFI-3 Creek watershed (modified from Lewelling and Wylie, 1993).

Sarasota, drains a 4.78 mi^2 area. Residential development accounts for 52 percent of the land use in the watershed. About 16 percent is commercial or industrial. The remaining area consists of wooded or grassy open areas. Ponds or wetlands cover less than 1 percent. Land surface elevation ranges from 40 ft above sea level on the eastern side of the watershed to 10 ft above sea level at the gaging station. The watershed is about 4,500 ft wide by 9,000 ft long and is subdivided by 3 tributaries that converge upstream from the gaging station (fig. 12). All stream channels are well defined and the slope of each tributary averages about 6.3 ft/mi. The lengths of the western, eastern, and southern tributaries are 9,800 ft, 15,500 ft, and 12,500 ft respectively. Maximum recorded discharge from the watershed was 971 ft^3/s.

The Clower Creek watershed (site 10, fig. 1), located in west-central Sarasota County, drains a 0.35 mi^2 area. Land use is predominantly commercial and high-density residential. About 85 percent of the watershed is covered by impervious surfaces. Retention ponds cover about 0.1 percent of the watershed. Land surface elevation averages about 15 ft above sea level throughout most of the watershed, except in the western part of the watershed where the land surface elevation drops to about 5 ft above sea level (fig. 13). The watershed is approximately 3,200 ft square and has a slope of about 3.7 ft/mi. Drainage is through an underground storm-sewer system in the vicinity of the shopping malls and the trailer park. The length of the drainage system is about 3,000 ft. Maximum recorded discharge from the watershed was 205 ft^3/s.

The Catfish Creek watershed (site 11, fig. 1), borders the Clower Creek watershed and drains a 4.77 mi^2area. About 50 percent of the watershed has been developed as golf and country club communities. Commercial development makes up about 10 percent. The remainder is undeveloped. Land surface elevation ranges from 35 ft above sea level in the northern part of the watershed to about 15 ft above sea level at the gaging station. The watershed is about 7,000 ft wide by 21,500 ft long (fig. 14). Slope in the watershed is about 3.5 ft/mi. The main channel is about 23,500 ft in length. Maximum discharge from the watershed for the period of record (October 1992 to September 1993) is 300 ft^3/s; however, an instantaneous discharge of 467 ft^3/s was measured on June 27, 1992.

The South Creek watershed (site 12, fig. 1), borders the Catfish Creek watershed and drains a 15.22 mi^2 area. A golf course resort, and residential and commercial development make up about 15 percent of the watershed in the northern part. The remainder is undeveloped. Ponds or wetlands cover about 31 percent of the total area. Land surface elevation ranges from 35 ft above sea level to 15 ft at the



Base from Southwest Florida Water Management District digital data, 1:500,000, 1992
Universal Transverse Mercator projection, Zone 17

EXPLANATION

TOPOGRAPHIC CONTOUR- Showing altitude of land surface. Contour intervals 5 feet. Datum is sea level

APPROXIMATE WATERSHED BOUNDARY ABOVE THE GAGING STATION

APPROXIMATE LOCATION OF THE STREAM CHANNEL

▲ STREAM GAGING STATION

Figure 12. Walker Creek watershed.

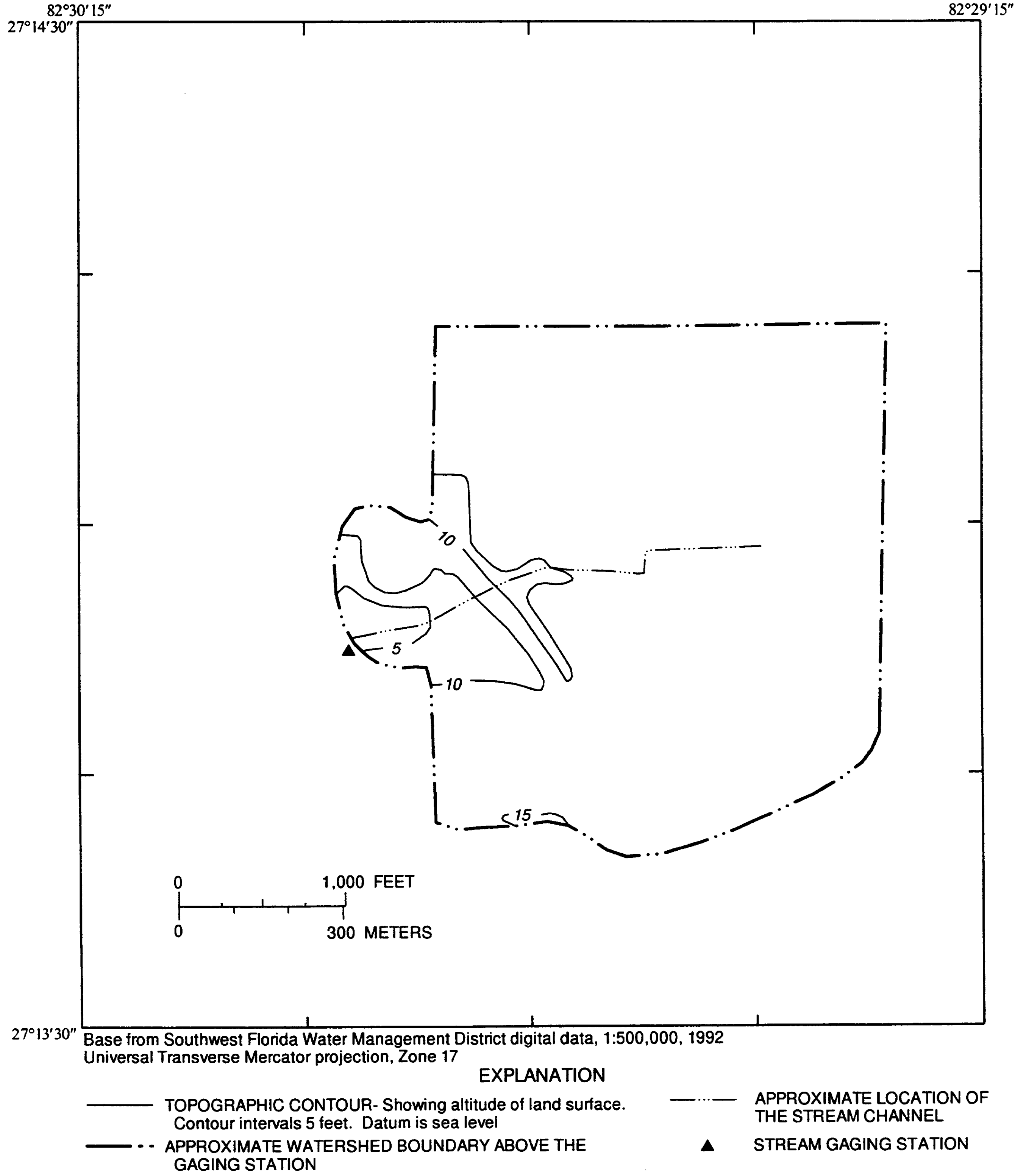


Figure 13. Clower Creek watershed.

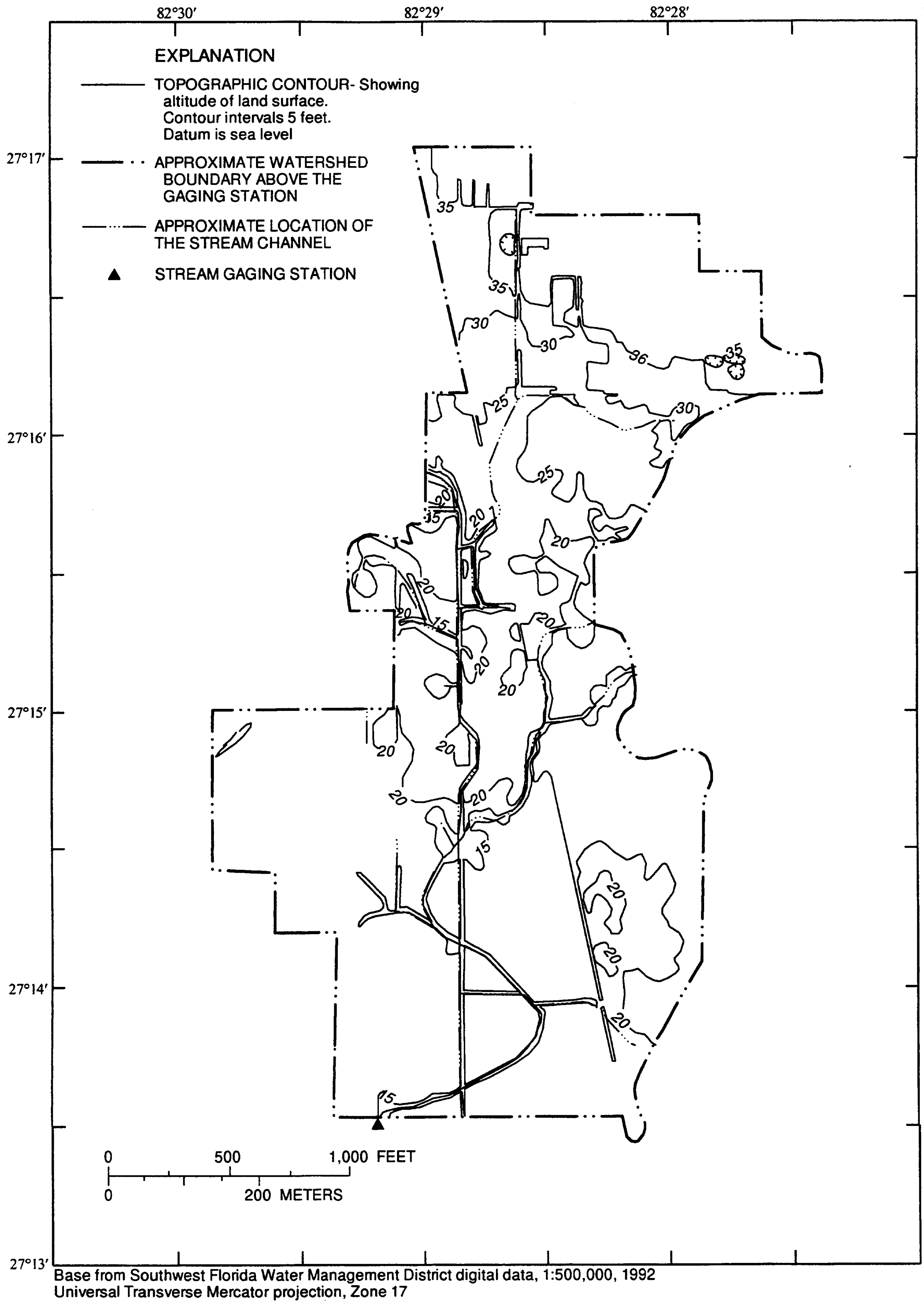


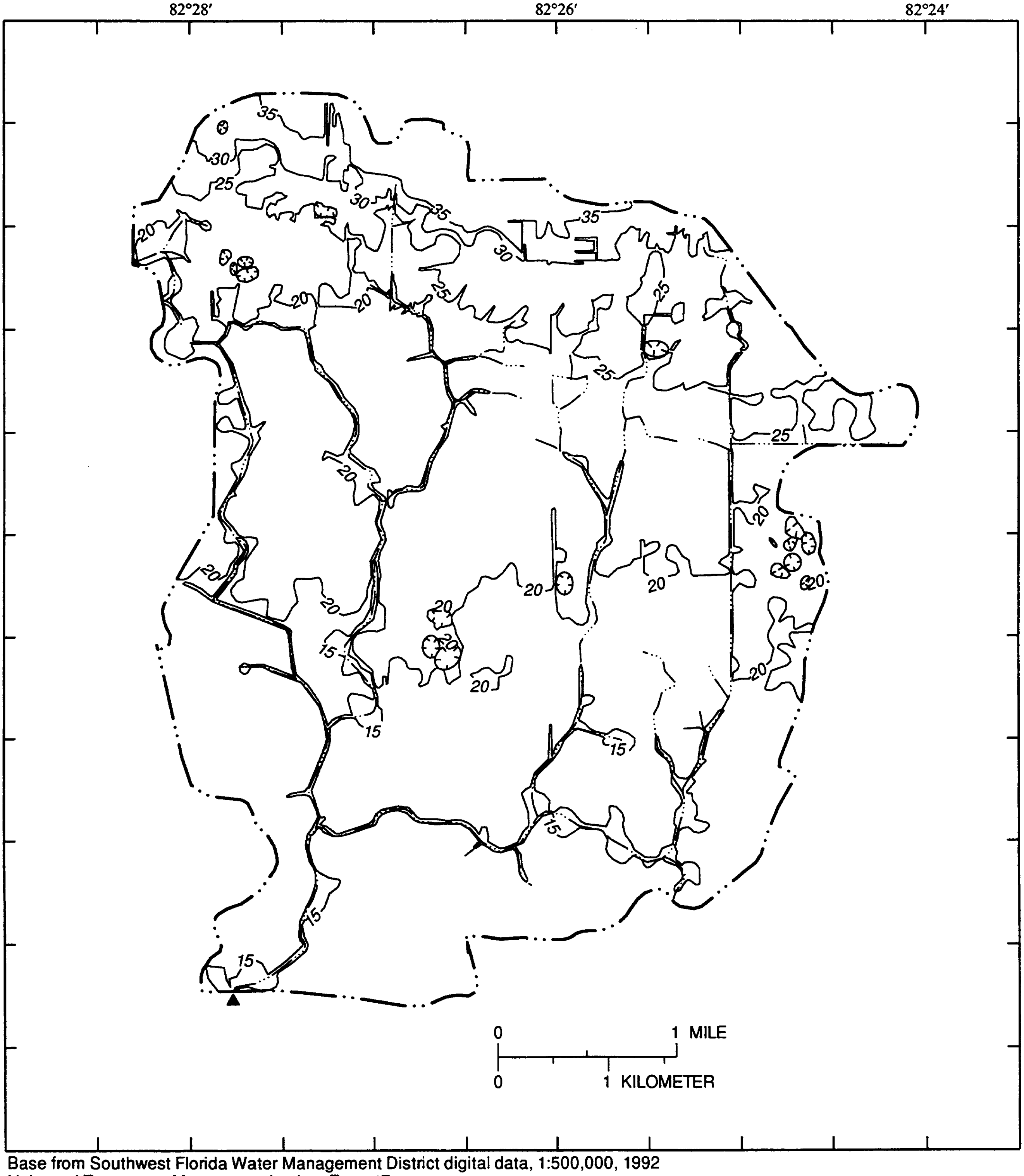
Figure 14. Catfish Creek watershed.

gaging station. The watershed is about 19,000 ft wide by 26,000 ft long. Average watershed slope is about 2.9 ft/mi. It is subdivided by 3 tributaries that converge upstream from the gaging station (fig. 15). The lengths of the main channel, lateral no.1, and lateral no. 2 are approximately 23,000 ft., 16,000 ft and 15,900 ft respectively. Maximum recorded discharge from the watershed was 442 ft^3/s.

The Forked Creek watershed (site 13, fig. 1), located in the southern part of Sarasota County, drains a 2.72 mi^2 area. About 30 percent of the watershed is cultivated in citrus and sod. Extensive cross ditching is present in this part of the watershed. The remainder is undeveloped native pastureland. Ponds or wetlands cover about 15 percent of the watershed. Land surface elevation ranges from 15 ft above sea level at the northwestern and southwestern watershed boundary to about 10 ft above sea level at the gage. The watershed is approximately 10,500 ft wide by 10,000 ft long (fig. 16). The slope in the watershed averages about 2.8 ft/mi. The main channel is about 12,400 ft long. Maximum recorded discharge from the watershed was 287 ft^3/s.

The Gottfried Creek watershed (site 14, fig. 1), located in the southern part of Sarasota County, drains a 2.0 mi^2 area. Land use is primarily residential with some commercial development. About 25 percent of the watershed consists of undeveloped land. Ponds or wetlands cover about 15 percent. Land surface elevation averages about 13 ft above sea level. The watershed is about 5,000 ft wide by 11,000 long (fig. 17). The slope is about 1.4 ft/mi. The main channel is about 11,000 ft in length. Maximum recorded discharge from the watershed was 119 ft^3/s.

The Rock Creek watershed (site 15, fig. 1), located in the southeastern corner of Sarasota County (fig. 1) is also known as Ainger Creek, and drains a 2.63 mi^2 area. It is an undeveloped natural watershed consisting of native pastureland and palmetto prairies, pine woods, and wetlands. Wetlands cover about 25 percent of the watershed. Land surface elevation averages about 12 ft above sea level. The watershed is approximately 6,000 ft wide by16,000 ft long (fig. 18). The slope is about 2.9 ft/mi. The main channel is about 16,000 ft in length. Maximum recorded discharge from the watershed was 109 ft^3/s.



Base from Southwest Florida Water Management District digital data, 1:500,000, 1992
Universal Transverse Mercator projection, Zone 17

EXPLANATION

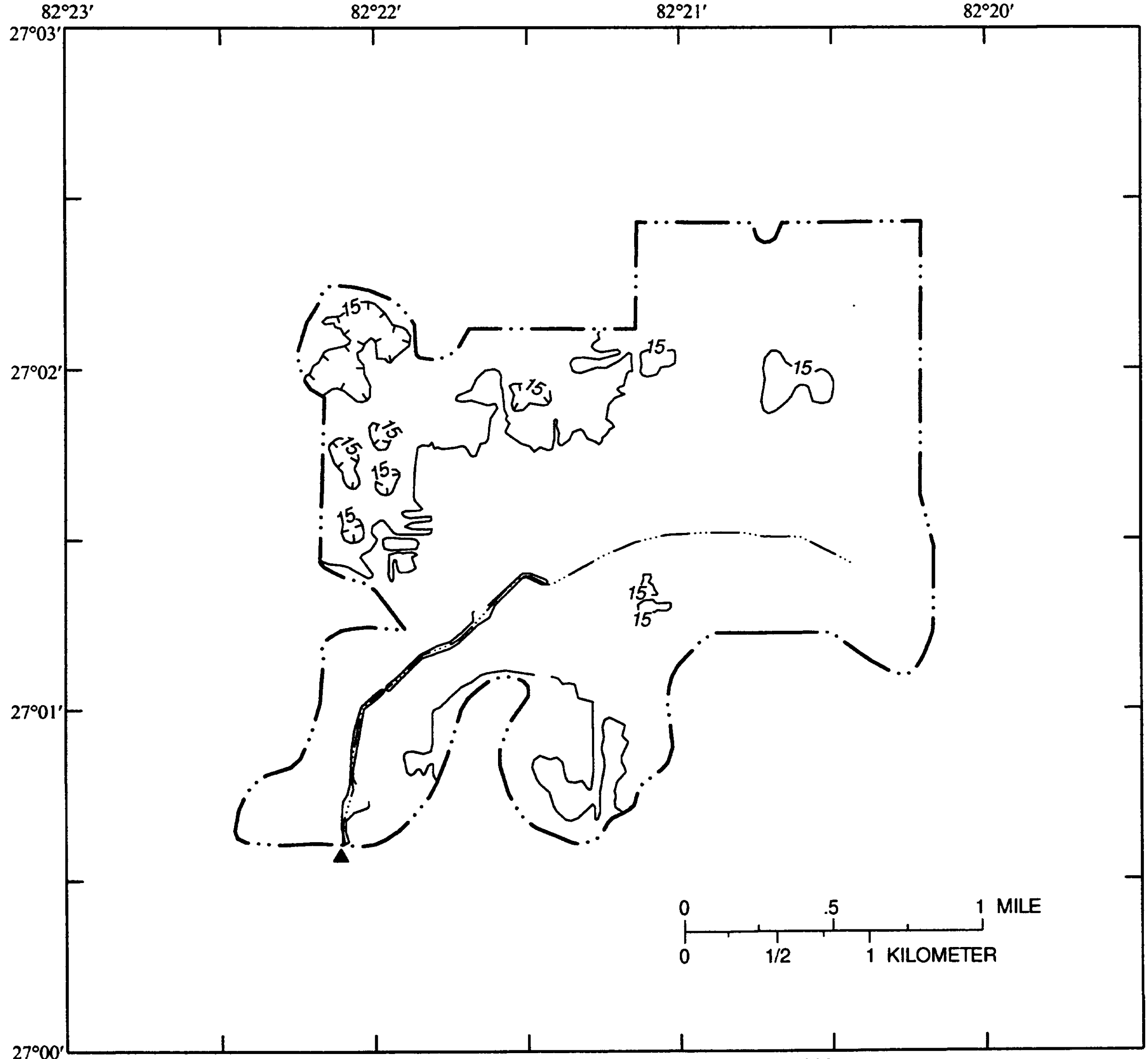
——— TOPOGRAPHIC CONTOUR- Showing altitude of land surface. Contour intervals 5 feet. Datum is sea level

—— · · APPROXIMATE WATERSHED BOUNDARY ABOVE THE GAGING STATION

—·· — APPROXIMATE LOCATION OF THE STREAM CHANNEL

▲ STREAM GAGING STATION

Figure 15. South Creek watershed.



Base from Southwest Florida Water Management District digital data, 1:500,000, 1992
Universal Transverse Mercator projection, Zone 17

EXPLANATION

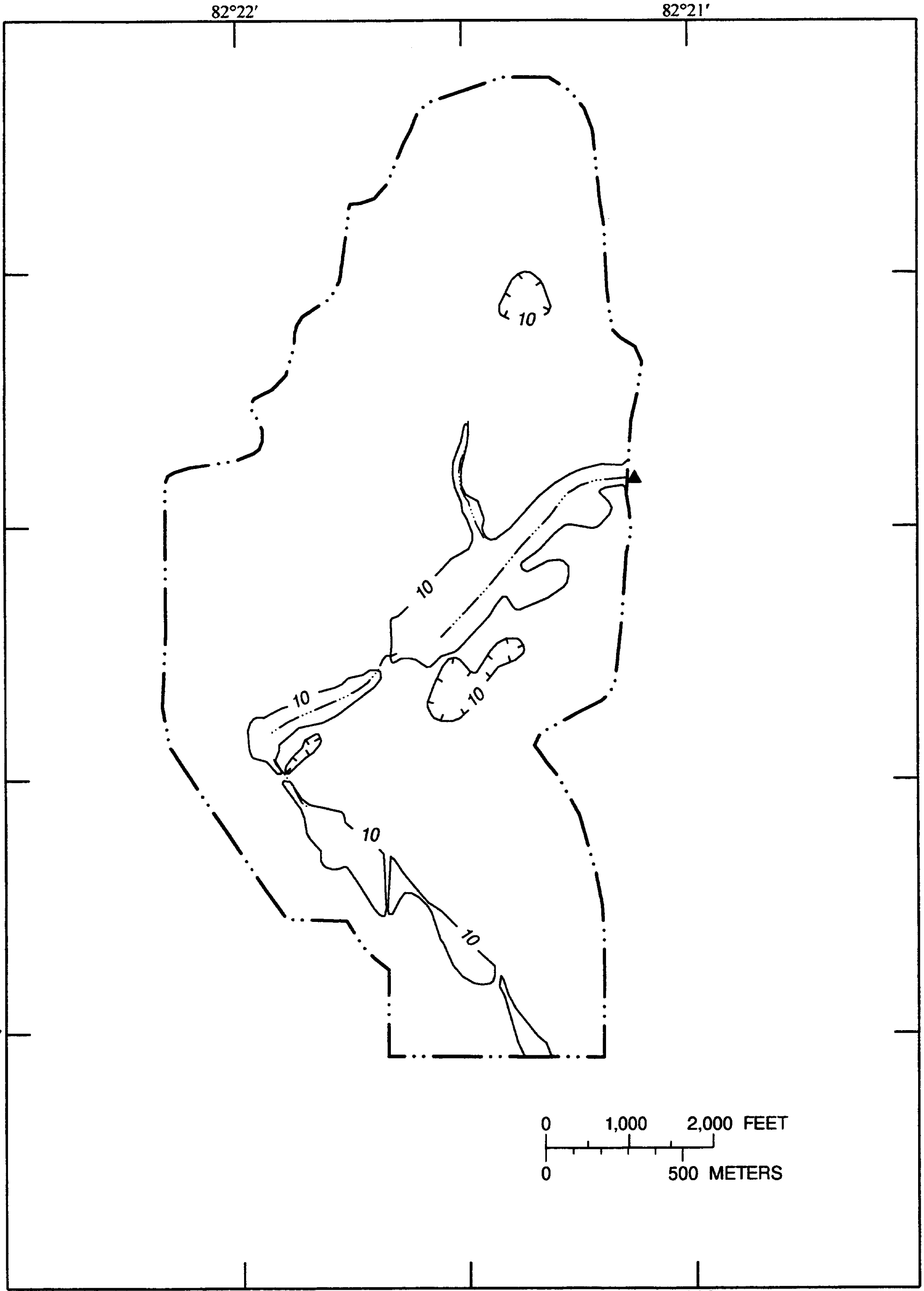
TOPOGRAPHIC CONTOUR- Showing altitude of land surface. Contour intervals 5 feet. Hachures indicate depresion. Datum is sea level

APPROXIMATE WATERSHED BOUNDARY ABOVE THE GAGING STATION

APPROXIMATE LOCATION OF THE STREAM CHANNEL

▲ STREAM GAGING STATION

Figure 16. Forked Creek watershed.



Base from Southwest Florida Water Management District digital data, 1:500,000, 1992
Universal Transverse Mercator projection, Zone 17

EXPLANATION

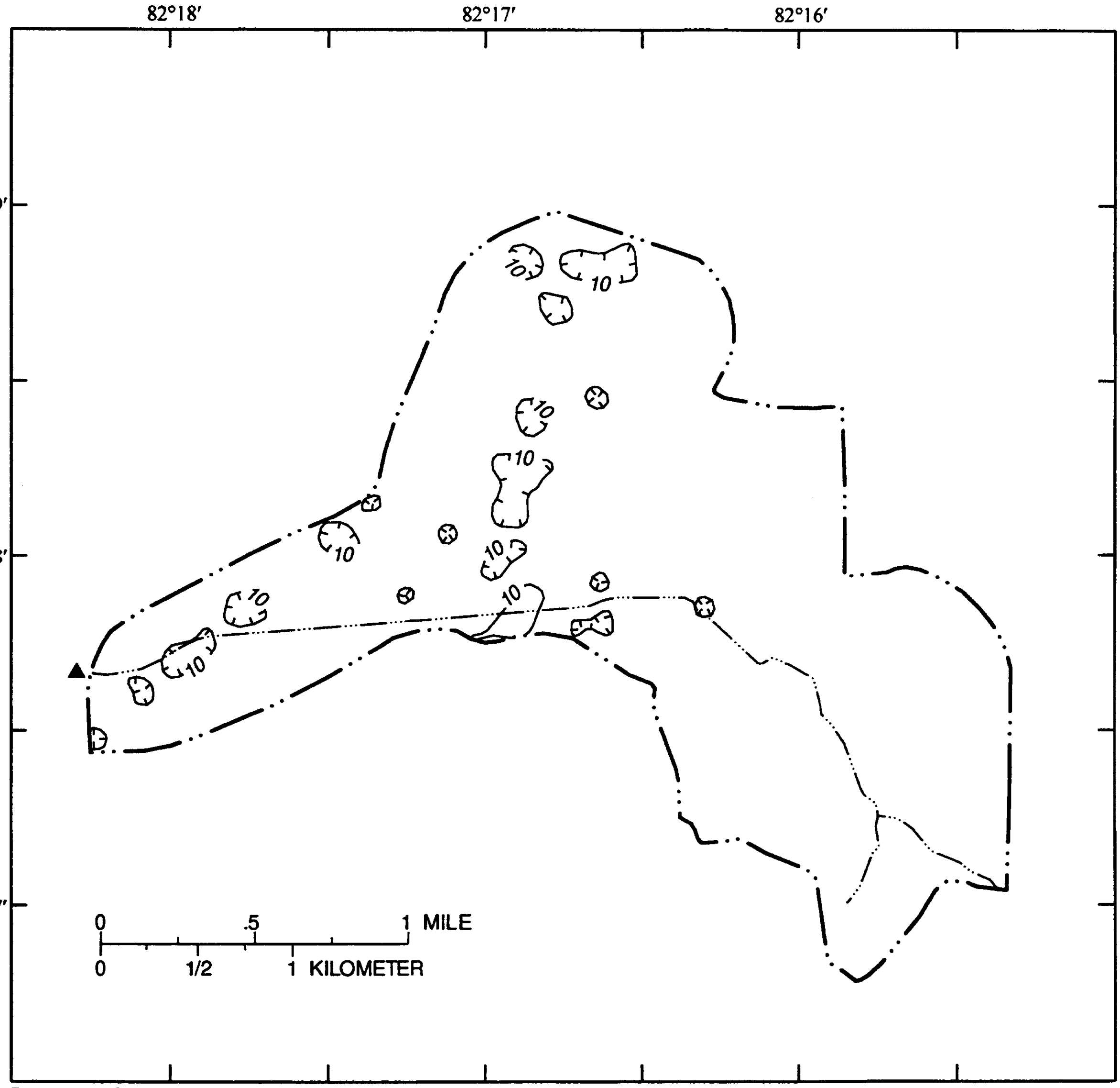
——— TOPOGRAPHIC CONTOUR- Showing altitude of land surface. Contour intervals 5 feet. Hachures indicate depression. Datum is sea level

—— · · APPROXIMATE WATERSHED BOUNDARY ABOVE THE GAGING STATION

—···— APPROXIMATE LOCATION OF THE STREAM CHANNEL

▲ STREAM GAGING STATION

Figure 17. Gottfried Creek watershed.



Base from Southwest Florida Water Management District digital data, 1:500,000, 1992
Universal Transverse Mercator projection, Zone 17

EXPLANATION

TOPOGRAPHIC CONTOUR- Showing altitude of land surface. Contour intervals 5 feet. Hachures indicate depression. Datum is sea level

APPROXIMATE LOCATION OF THE STREAM CHANNEL

APPROXIMATE WATERSHED BOUNDARY ABOVE THE GAGING STATION

▲ STREAM GAGING STATION

Figure 18. Rock Creek (Ainger Creek) watershed.