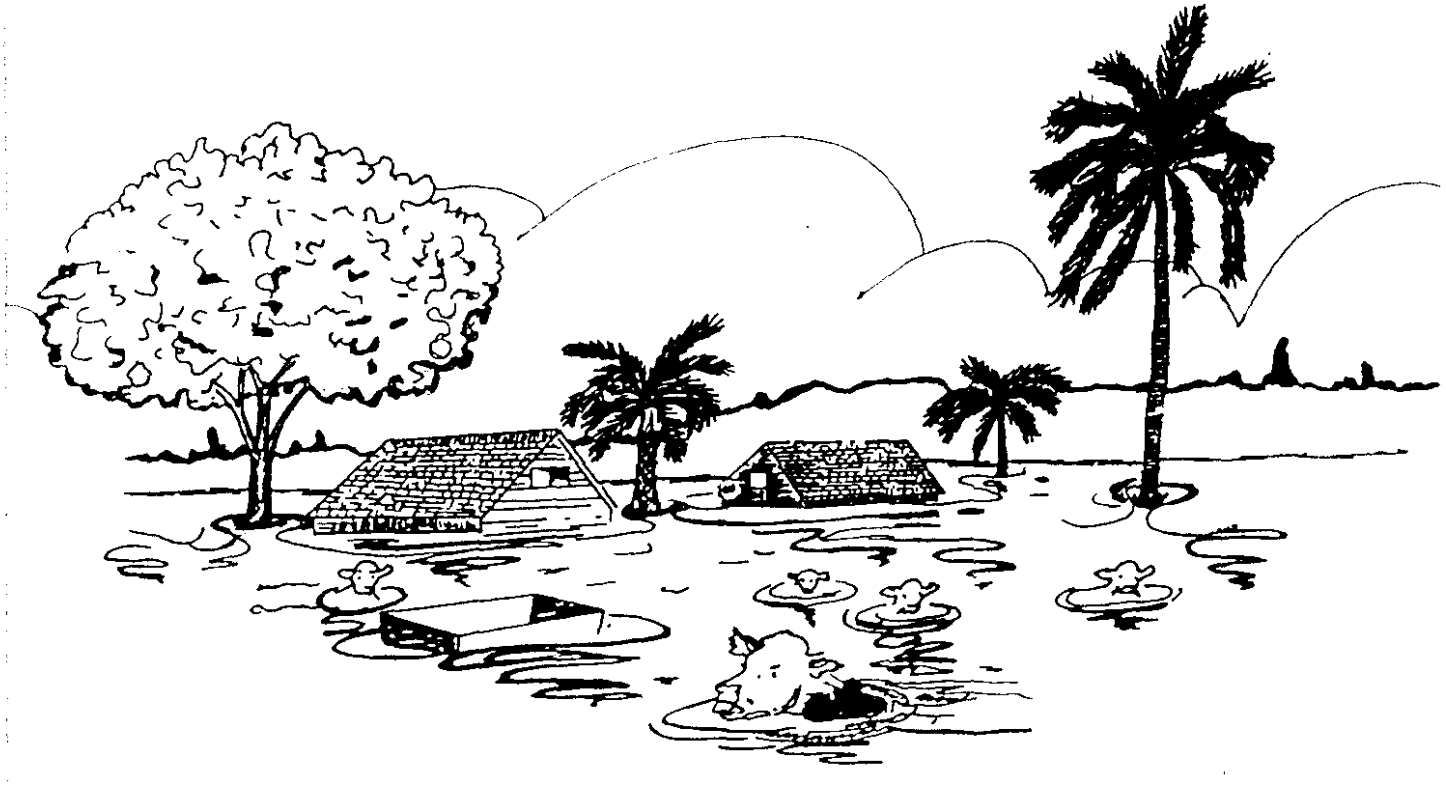
FLOOD PLAIN MANAGEMENT STUDY

COW PEN SLOUGH WATERSHED

SARASOTA COUNTY, FLORIDA



PREPARED BY

U.S. DEPARTMENT OF AGRICULTURE

SOIL CONSERVATION SERVICE

GAINESVILLE, FLORIDA

IN COOPERATION WITH

THE FLORIDA DEPARTMENT OF COMMUNITY AFFAIRS

AND

SARASOTA SOIL & WATER CONSERVATION DISTRICT

1985

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INTRODUCTION

Cow Pen Slough is part of the Sarasota West Coast Watershed project. Under the authority of the Watershed Protection and Flood Prevention Act (Public Law 566, 83rd Congress; 68 Stat. 666) as amended, the Soil Conservation Service (SCS) provides assistance in developing watershed protection plans which include inventory and analyzation of problems, formulation of alternative plans to resolve the problems, determination of cost effectiveness and economic defensibility and selection of plan. In March 1961, the watershed work plan for Sarasota West Coast Watershed was prepared by the Sarasota Soil Conservation District, the Sarasota County Board of Commissioners, and the Manatee River Soil Conservation District with assistance by the SCS. It was approved for construction in June 1961.

Construction was initiated in 1965 and continued through 1971. The three flood control structures and channel work completed are described in this report. When the project was 65 percent completed, opposition to the project by environmental groups caused a halt of the construction.

Since the construction stopped, the Board of County Commissioners has granted a number of zoning changes, and much residential development is occurring along the new channel. Since the channel design is based on a removal rate for agricultural use of the land, it was thought that the improved channel might not provide adequate protection to the residential property owners along the slough. With the rapid population growth in Sarasota County, and accompanying demands for additional land to accommodate this growth, the land along the slough is threatened even more.

The information presented in this report was developed for use by local decisionmakers and the public in making flood plain management decisions. It is hoped that this information will assist with development decisions in such a way that future intensive rainfalls will result in minimal inconvenience to residents of the area. This report identifies the major flood-prone areas and will be useful in flood plain management decisions.

Requesting and Participating Entites

The Sarasota Soil and Water Conservation District Board of Supervisors requested a flood plain management study in May 1981 on Cow Pen Slough to assist in identifying local flood problems and making decisions related to land use planning and future development. This study was conducted in accordance with a plan of study developed September 1981.

Sarasota County employees aided in gathering base data for the study as well as historical flood information. The photogrammetric contour mapping was provided by the Southwest Florida Water Management District.

Study Authorities

The SCS is authorized to provide technical assistance to federal, state, and local governing bodies in the development, revision, and implementation of their flood plain management programs by carrying out flood plain management studies (FPMS's) in accordance with Federal Level Recommendation 3 of "A Unified National Program for Flood Plain Management", and Section 6 of Public Law 83-566. This is in accordance with Executive Order 11988 dated May 24, 1977.

In Florida, these studies are authorized under the December 1978 Joint Coordination Agreement between the SCS and the Florida Department of Community Affairs. The Department Secretary is under the direction of the Governor of Florida and is responsible for receiving requests, setting priorities, and coordinating flood plain management studies conducted by the SCS and other state and federal agencies.

Study Objectives

The Local Government Comprehensive Planning Act (LGCPA) of 1975 requires all Florida communities to adopt comprehensive development plans. A land use plan is developed after considering the drainage characteristics and limitations of an area. In addition, a drainage element is a requirement of the LGCPA.

The objective of this flood plain management study is to furnish technical information to the Sarasota Soil and Water Conservation District in the form of maps, graphs, and tables depicting various flood discharge and elevation frequency data. This flood plain information is needed as a basis for local flood plain management and land use programs so as to reduce flood losses and enhance the environment of natural flood plain areas.

DESCRIPTION OF STUDY AREA

The study area is a part of the Cow Pen Slough Watershed characterized by a complex hydrological system. The area is threatened with urban development because of its numerous desirable attributes.

Location

Located east and south of the city of Sarasota, the part of the Cow Pen Slough that is being studied here is from State Highway 780 south to Laurel Road, a distance of approximately 15 miles (See Figure 1). Below Laurel Road the slough is tidal and is less than one mile from Dona Bay.

Stream System

The study area is located within the United States Geological Survey's (USGS's) hydrologic unit number 03100201. The average stream temperature is between 72° and 76°F. The largest freshwater use in Sarasota County is for irrigation with municipal use the second largest. Between 10 and 49 million gallons are used per day. The sources of ground water are aquifers in the Hawthorn and Tampa Formations, supplied from a depth of from 100 to 720 feet. Calcium and magnesium sulfate are common in the water with hardness between 400 and 550 milligrams per liter.

In a 1981 USGS report, 200 well samples in Sarasota County were analyzed for radionuclides by the USGS National Water Quality Laboratory in Arvada, Colorado. Eighty-six of these samples equaled or exceeded the maximum contaminate level for combined radium-226 and radium-228 of 5 picocuries per liter. This health risk level was set by the National Interim Primary Drinking Water Regulations, U.S. Environmental Protection Agency.

The Cow Pen Slough Watershed consists of approximately 70 square miles in Sarasota County and 7 square miles in Manatee County (see figure 1). The hydrologic boundary in many areas is largely indeterminate and subject to change because of the flat topography and swampy conditions. It can be altered considerably by the installation of a small dike or ditch.

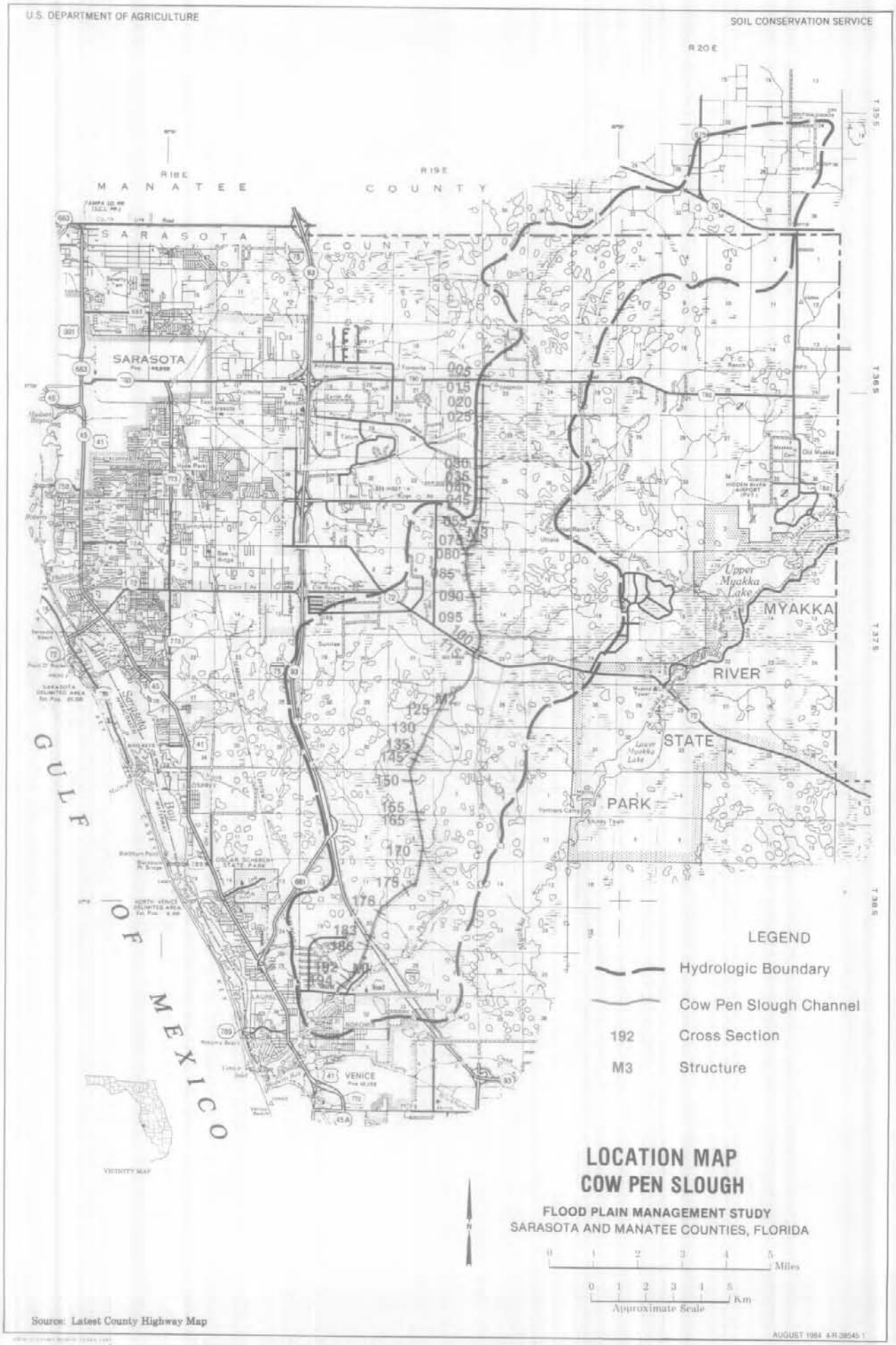

Figure 1. Study Area Location Map with Hydrologic Boundary

Cow Pen Slough has 14 miles of improved channel with several gravity drains to allow water to enter through the sides and two operational flood control structures. The construction began in 1962 and continued through 1971 at which time opposition to the project by environmental groups caused a halt of the construction.

The channel improvement was designed to alleviate flooding from a 10-year frequency storm. The excavation started at Laurel Road in the southern end of the watershed and was originally planned to be improved to the Manatee County line in the northern part of the watershed but construction was terminated 1000-2000 feet above Structure 3. The excavated material was placed on both sides of the channel to form levees. Levees were built by Fruitville Drainage District many years prior to SCS construction extending to Highway 780. Typical valley cross sections are in Appendix C.

The largest channel entering Cow Pen Slough is the Vegetable Relief Channel (see figure 2). It enters the slough from the west side between Highways 72 and 780. Other smaller drains have structures which aid in draining vegetable growing areas (see figure 3) improved pasture and more recently, subdivisions.

10 year Design

(4)

Figure 2. The Vegetable Relief Channel (right) enters Cow Pen Slough from the west

Figure 3. Installation of this gravity drain took place May 16, 1967.

Although the original plans called for five flood control structures, only three were built. These structures are for grade stabilization and water conservation. They are reinforced concrete drop spillways with 20 foot weirs and 3 foot high radial gates (see figures 12 & 14). They were designed to be "island" type structures with dikes constructed to divert part of the flow around the structure to prevent overtopping. Structure 1 is located just north of Laurel Road. Structure 2 is located slightly more than a mile south of Highway 72, and Structure 3 is located approximately midway between Highway 72 and Highway 780 (see figure 1). Structure 3 failed in August 1967 after 5.17 inches of rain fell over a 3-day period. The flood flows carried a heavy concentration of water hyacinths to Structure 3, significantly restricting its discharge capacity. Flood waters then overflowed around Structure 3. A 54-inch pipe side inlet, located 500 feet downstream of the structure on the east bank, washed out. This washout started the formation of a gully that cut upstream around Structure 3, following the original channel of Cow Pen Slough which had been filled in during channel improvement and realignment. The formation of this large bypass gully caused severe erosion and downstream sedimentation. Figure 4 depicts the present situation.

Figure 4. Cow Pen Slough looks similar today to this December 1967 photo showing the washout of Structure 3 (looking upstream)

Geology

In the study area, between 350 and 400 feet of confining bed material overlie the Floridan Aquifer. This confining bed, or surficial material, separates the surficial aquifer from the underlying Floridan Aquifer. The surficial sediments in the watershed are made up of parts of several marine terraces that were laid down by ocean waters during the Pleistocene Age. The Penholoway, Talbot, and Pamlico Terraces occur at approximate elevations of 70, 40, and 25 feet, respectively. At 25 feet and below, the surficial terraces (Holocene Age) typically consist of from 3 to 5 feet of reddish brown and gray unconsolidated quartz sand which contains no fossils. Below that, there is from 0 to 1/2-foot of fine to medium grained unconsolidated tan sandy shell marl which is marine in origin. It contains many mollusk shells and some vertebrate fossils including teeth of the Pleistocene horse Equus (Equus) leidyi. Below that, there is from 0 to 1/2 foot of oyster marl occurring locally as lenses. This is underlain by more than 1/2 foot of freshwater unconsolidated marl which is grey in color and contains mollusk and vertebrate remains.

Below these surficial deposits and the surficial aquifer are Miocene to Holocene beds of clay, sandy clay, and marl - undifferentiated with respect to age. Those that may exist are the Tamiami Formation, upper and lower units of the Hawthorn Formation, the Tampa Limestone, the Suwannee Limestone, the Ocala Limestone and the Avon Park Limestone. The Miocene Hawthorn Formation, the most prominent, is comprised mainly of phosphatic clays and poorly indurated limestone and dolomite lenses.

Soils

The soils of the Cow Pen Slough Watershed are primarily nearly level and poorly or very poorly drained. Three soil associations are dominant throughout the area (see figure 6). The largest is association 5 which consists of soils of the Immokalee, Myakka, and Pomello series (see figure 5). These soils are on flatwoods. The Pomello soils are on slightly higher, better drained knolls and ridges within the flatwoods. The soils of this association have dark, organic-stained subsoils underlain by sandy material. The dominant vegetation is saw palmetto, south Florida slash pine, and pineland threeawn.

Figure 5. Native pasture containing chopped and rested bluestem on a Myakka soil.

The second largest association in the study area is association 4 which consists of soils of the Pineda, Bradenton, and Boca series. These soils are on sloughs, hammocks, and flatwoods (see figure 7). They are sandy in the surface and loamy in the subsoil. The Boca soils are underlain by limestone at depths between 24 and 40 inches of the surface. Little blue maidencane is the dominant vegetation in the sloughs in this association. Saw palmetto, south Florida slash pine, and pineland threeawn are predominant in the flatwoods. The hammock areas consist of soils of the Bradenton series with cabbage palm as the dominant vegetation.

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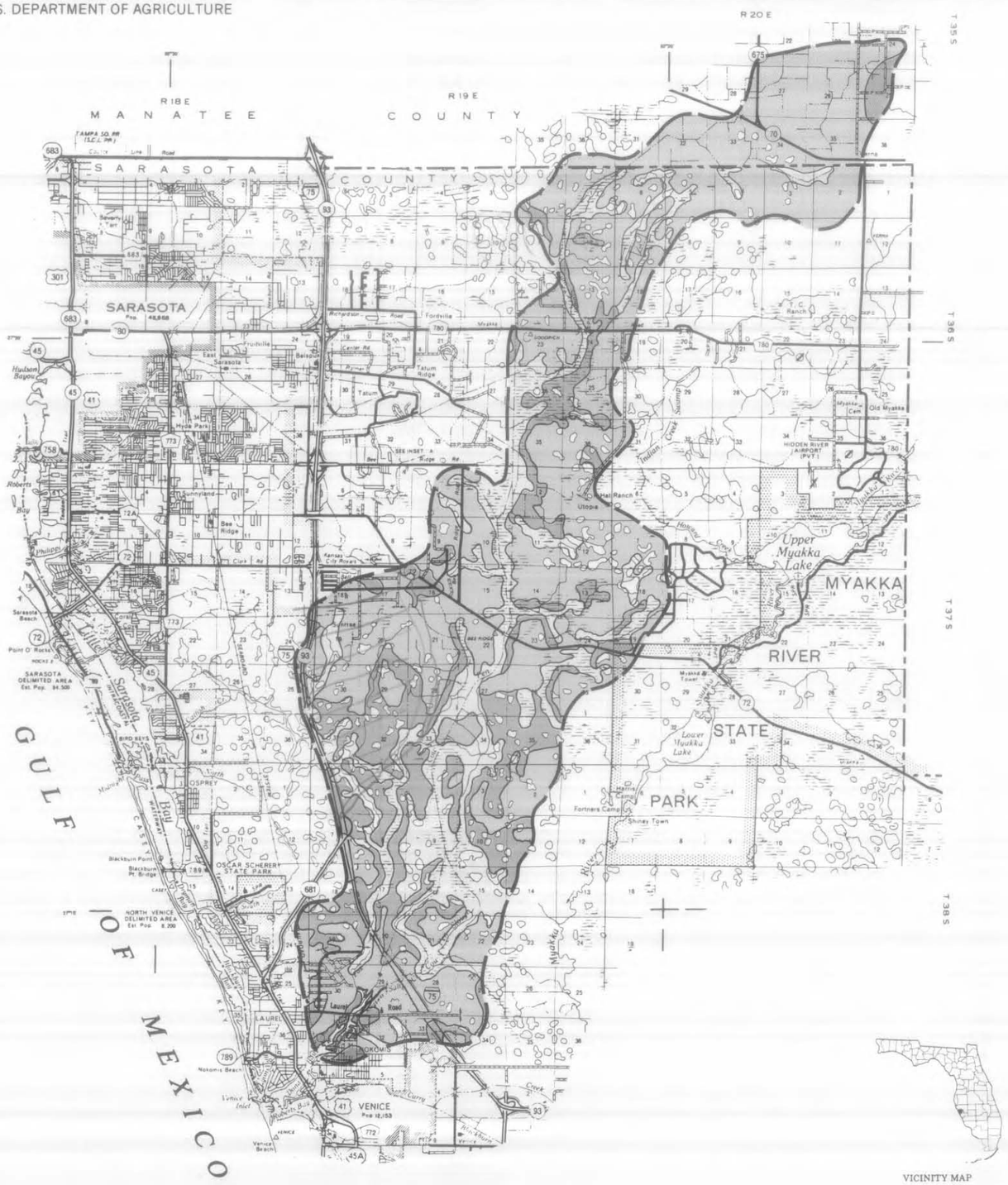

VICINITY MAP

Source: Latest County Highway Map And Published Soil Survey

USDA-SCS-FORT WORTH, TEXAS 1985

Figure 6. General Soil Map of Study Area

LEGEND

- Excessively drained deep soils: Lakewood, St. Lucie
- Somewhat excessively to moderately well drained deep soils: Blanton, Lakeland
- Somewhat poorly drained deep soils: Ona, Scranton
- Somewhat poorly drained soils, shallow over alkaline materials: Adamsville, Bradenton, Broward, Keri, Parkwood, Sunniland
- Somewhat poorly drained soils, shallow over organic hardpans: Immokalee, Leon, Pomello
- Poorly to very poorly drained soils, shallow over alkaline materials: Arzell, Charlotte, Manatee, Felda, Delray, Pompano
- Very poorly drained organic soils: Pamlico, Terra Ceia
- Miscellaneous: Beaches, made land, marsh, and swamp

GENERAL SOIL MAP

COW PEN SLOUGH

FLOOD PLAIN MANAGEMENT STUDY
SARASOTA AND MANATEE COUNTIES, FLORIDA

0 1 2 3 4 5 Miles

0 1 2 3 4 5 Km

Approximate Scale

FEBRUARY 1985 4-R-38545-2

Figure 7. The background is a cabbage palm hammock with Bradenton and the foreground is the Holopaw Series of association 6.

Association 6 consists of soils of the Holopaw, Malabar, and Floridana series (see figures 7 and 8). Other soils of minor extent throughout this association are of the Felda and Delray series. All of these soils are sandy in the surface and subsurface layers and loamy in the subsoil. They occur in sloughs and depressions. The dominant vegetation in the sloughs is blue maidencane and wiregrass. The depressions are vegetated with St. Johnswort, pickerelweed, maidencane or sawgrass. The depressions have water above the surface for several months each year.

Figure 8. Celery growing in Floridana mucky fine sand.

Under natural conditions, all three soil associations in the study area have severe drainage limitations which affect their suitability for septic tank absorption fields, roads, and building site development. Soils are grouped into four hydrologic soil groups, A through D. These groupings are used primarily in estimating runoff from rainfall. The Cow Pen Slough watershed area is comprised of soils primarily in hydrologic group D, or a dual grouping of A/D or B/D. The groups are defined as follows:

Hydrologic group A - (Low runoff potential). Soils that have high infiltration rates even when thoroughly wetted and a high rate of water transmission.

Hydrologic group B - (Moderately low runoff potential). Soils that have moderate infiltration rates when thoroughly wetted and a moderate rate of water transmission.

Hydrologic group C - (Moderately high runoff potential). Soils that have slow infiltration rates when thoroughly wetted and a slow rate of water transmission.

Hydrologic group D - (High runoff potential). Soils having very slow infiltration rates when thoroughly wetted and a very slow rate of water transmission.

Dual groupings are used only when adequate artificial drainage can be obtained (e.g. A/D - A represents the drained situation).

The SCS is presently updating the soil survey of Sarasota County. Field work is complete and the new survey should be printed and available to the public by 1986.

Climate

The study area has a subtropical climate, characterized by long, warm and humid summers and mild, dry winters. The average temperature is 72°F (see Table 1) and the annual rainfall exceeds 56 inches. More than half of this rain occurs from June through September, which is also the hurricane season. On the average, freezing can be expected five or six times during the winter. It is quite likely that a temperature of 28°F or lower will occur once or twice each winter. The approximate median dates of the first and last freezes are December 15 and February 5.

Table I. Temperature and Precipitation Data - Sarasota County, Florida
Cow Pen Slough Watershed FPMS

Precipitation Normals

JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
2.68	2.87	3.65	2.43	2.60	7.63	8.94	9.55	8.68	3.24	1.91	2.17	56.35

Mean Temperature

JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
61.3	62.5	66.3	71.3	76.1	79.9	81.2	81.4	80.4	74.7	67.4	62.6	72.1

From: U.S. Department of Commerce, National Oceanic and Atmospheric Administration Environmental Data Service for Bradenton Weather Station 1941-1970.

Natural Values

The entire study area is characterized by broad, low flatwoods interspersed with sloughs, marshes and cabbage palm hammocks with waters generally draining southwestward.

The South Florida flatwoods community occurs on nearly level, poorly drained soils. During the rainy season these soils have high water tables, with water often at or above the surface. Typical natural vegetation on these areas consists of slash pine, sawpalmetto, and perennial grasses such as wiregrass, bluestems, and lopsided indiangrass. The flatwoods were logged over in the early part of this century and the grazing-burning practices since then have helped to keep this area in a relatively open savannah-type.

The broad drainageways through the flatwoods are known as sloughs or wet prairies. The slough community appears as an open expanse of grasses, sedges, and rushes where the soil is saturated throughout the growing season. Most sloughs are relatively long and narrow and slightly lower in elevation than the surrounding flatwoods. Characteristic natural vegetation consists of grasses (blue maidencane, bluejoint panicum, wiregrass, low panicum, and sand cordgrass), beak-rushes, and sloughgrass.

Depressional areas within the sloughs are occupied by the freshwater marsh vegetative communities. These are very poorly drained areas where the soil is saturated or covered with water for months during the growing season. Characteristic plants occurring in these marshes include maindencane, pickerelweed, arrowheads, sawgrass, fire flag, and cattail.

The cabbage palm hammock community is easily identified by the occurrence of thick stands of cabbage palm with scattered oaks. It occurs on slightly elevated areas within the slough and south Florida flatwoods communities. The cover that these hammocks provide to wildlife is especially important in this relatively open country.

The interspersed flatwoods, hammocks, sloughs, and marshes support a large variety of wildlife. Mammals include raccoon, otter, opossum, skunk, marsh rabbit, armadillo, deer, bobcat, and feral hogs. Birds include bobwhite quail, hawks, woodpeckers, several owls, numerous songbirds, and a large variety of wetland birds including herons, egrets, ibis, bitterns, sandhill cranes, gallinules, and Florida ducks. There are a variety of frogs, turtles, and snakes, with alligators in the larger marshes and ponds.

Endangered or threatened species that occur, or whose range indicates they might occur in the area include the alligator, indigo snake, wood stork, peregrine falcon, ivory-billed woodpecker, red-cockaded woodpecker, bald eagle, southeastern kestrel, Florida sandhill crane, and Florida panther.

The fisheries resource includes species such as largemouth bass, several species of sunfish, pickerel, catfish, small minnows, bowfin, and gar. Few large fish are produced, but the population explosion of small individuals that occurs each rainy season when the habitat expands serves as the base of the food chain for many of the other animals occurring in the area.

Land Use and Development Trends

In 1961, when plans were being made to construct channels in the Cow Pen Slough watershed, much of the area was in grassland with a small percentage in winter vegetables and citrus groves. Due to its mild climate and other natural values and proximity to the gulf beaches, the study area has experienced a rapid population increase over the past 12 years. The 1970 census showed Sarasota County having a population of 120,400. The 1982 census showed 215,400 - a 79 percent increase! Sarasota County accounts for 2.08 percent of Florida's population, ranking it 13th in the State and 8th in population density. Population projections estimate 396,900 for the year 2000.

Much of this population will settle in rural areas. In 1982, the population in the City of Sarasota was 49,492 compared to 143,114 in unincorporated parts of the county - an 18 percent shift out of the city compared to the 1970 data. Zoning changes are allowing new homes to be built along the Cow Pen Slough. Of the 202,251 persons counted in the 1980 census, 93,635 were males, 108,616 were females; and 60,609 were 65 or older.

Sarasota County is a major production area for cabbage, celery, sweet corn, escarole, lettuce, radishes and tomatoes. The estimated county farm acreage is 235,000 acres. The net farm income in 1981 was $1,549,000 with 4.8 percent of the population working in agriculture.

Of the 72,859 persons employed in Sarasota County in 1982, 7,824 worked in construction; 6,342 in manufacturing; 3,790 in transportation, communication, and public utilities; 2,476 in wholesale trade; 20,248 in retail trade; 5,965 in finance, insurance and real estate; 3,644 in government; 958 in agriculture, fishing and mining; and the remainder in service and other miscellaneous occupations. The mining industry in Sarasota County is mainly sand, gravel, and stone. The fishing industry earned $78,506 in 1980 by harvesting 231,892 pounds of fish and 23,864 pounds of shellfish. There is no forestry industry in Sarasota County.

FLOOD PROBLEMS

There are two types of floods which occur in the study area. Most of the floods are from rainfall occurring between the months of June and September as short duration, high intensity afternoon or evening thundershowers. From December through May, rainfall is less frequent, usually of longer duration from frontal type storms and may cause flooding. The rainfall type flood is strictly of a fresh water nature. This report deals with the rainfall type flood.

The other type of flood is the tidal or saltwater type. It is due to abnormal rises in the water surface of the Gulf and subsequent rises in Dona and Roberts Bay. The tidal floods are associated with tropical storms and accompanied by high winds or hurricanes. The damages caused by tidal floods are far worse than those caused by rainfall floods, but the rainfall floods are 10 times more frequent. The damage associated with rainfall floods is a result of water damage alone and is generally not life threatening. The water moves very slowly and the floods are not accompanied by high winds as with hurricanes that are associated with the tidal floods. Occasionally, the tidal floods will be accompanied by torrential rains resulting in both types of floods occurring simultaneously.

Flood History

Prior to construction of the channel and flood control structures on Cow Pen Slough, flooding occurred several times a year with water standing on pasture and range lands from 20 to 30 days. The objectives of the watershed project were to reduce flood damage frequency in the vegetable producing area (see figure 9) to about once in 10 years, and to provide adequate drainage of improved pastures.

Historic excessive rainfall events are listed in Table 2. There are three recorded flood events prior to the flood control work. A 10-year frequency storm occurred on September 19, 1926, during which it rained 8 inches in 24 hours. On June 26, 1943, a storm occurred that exceeded the 5-year frequency during which it rained 7.48 inches in 24 hours. The largest recorded storm occurred on June 23, 1945, when 10.80 inches of rain fell in 24 hours, which exceeded the 50-year frequency storm.

During the flood control work one storm occurred which exceeded a 5-year frequency storm. On September 21, 1962, it rained 7.37 inches in 24 hours. The three-day storm total of 13.83 inches caused significant flooding (see figures 10 and 11).

Table 2. Historic Excessive Rainfall Events (records from Bradenton Experiment Station, Florida 01-15-13 to 08-21-72) Cow Pen Slough Watershed FPMS

Date	Precipitation (Inches)	Frequency Storm
09-19-1926	8.00	10-year
06-26-1943	7.48	exceeds 5-year
06-23-1945	10.80	exceeds 50-year
09-21-1962	7.37	exceeds 5-year

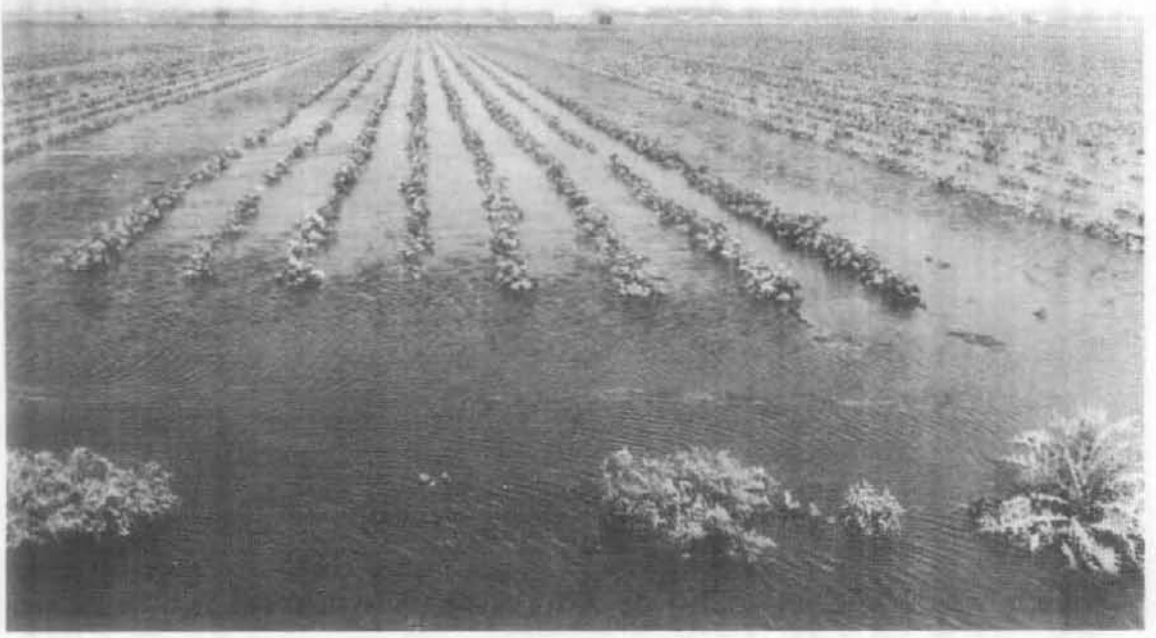

Figure 9. Vegetables under 12 inches of flood water. The photo was taken March 12, 1958 after 4.98 inches of rain (less than a 2 -year storm) that day. This storm occurred prior to the flood control work installation.

Figure 10. The September 1962 storm caused damage to houses near Sarasota. Damage to dwellings from Cow Pen Slough flooding was negligible because of the absence of residences in the immediate vicinity.

Figure 11. The Hi-Hat Ranch looking south over Cow Pen Slough Watershed 2 days after the September 21, 1962 storm. The weather station in Sarasota reported 13.83 inches in 3 days for that storm.

Flood Potential

Seasonal flooding is common in parts of the study area. During periods of intense or prolonged rainfall, particularly during the summer rainy season, the water table rises above ground surface and begins to flow overland, slowly southward. The soil becomes saturated and the natural sloughs and ponds fill. These slightly flooded conditions can last for 30 days or more. Some problems can occur as a result of seasonal flooding.

Even when houses are built on earth pads high enough to avoid letting water inside, oftentimes driveways and other parking areas, storage buildings, yards, patios, and septic systems are not sufficiently elevated to escape flooding. To some families, it may be a major inconvenience not to have the use of their car or yard for several days or even weeks; but a flooded, and likely malfunctioning septic system can cause a health threat to the entire community. Problems resulting from this type of flooding are largely the result of uncontrolled and uncoordinated land development.

In addition to this yearly flooding, larger storms occasionally occur. A flood having an average frequency of occurrence on the order of once in 100 years (a one percent chance of being equaled or exceeded in any given year) is generally used for criteria when designing highway bridges and other structures within a flood plain. However, floods larger than the 100-year flood can and will occur. Even though the maximum known flood on any given stream may have been extremely severe, eventually a larger flood can and probably will occur. In this study, floodwater elevations and peak discharges were generated for the 500-, 100-, 50-, 25-, 10-, 5-, 2- and 1-year frequency events. The magnitudes of each of these floods were determined by an analysis of the rainfall and runoff characteristics of the contributing drainage areas and by flood routing. The rainfall depths of flood producing storms for the study area are presented on Table 3.

Table 4 gives some actual stream flow measurements taken from a stream gauge at Highway 72 monitored by the USGS. The amount of discharge is given along with the elevation of the water and the amount of rainfall.

Table 3. Rainfall Frequencies (for a 24-hour storm), Sarasota County, Florida, Cow Pen Slough Watershed FPMS

1-year	4.2 inches
2-year	5.2 inches
5-year	7.0 inches
10-year	8.1 inches
25-year	9.5 inches
50-year	10.7 inches
100-year	12.0 inches
500-year	15.3 inches

Table 4. Stream Gauge Data at Highway 72, Sarasota County, Florida - Drainage Area=41.61 square miles, Cow Pen Slough Watershed FPMS

Date	Maximum Discharge for the year (cfs)	Elevation (msl)	Rainfall for past 72 hrs (from Sarasota Weather Sta.)
September 21, 1962	4110	25.9	11.59
August 23, 1963	395	21.7	1.11
September 6, 1964	394	21.7	0.84
August 1, 1965	2940	24.7	6.14
June 24, 1966*	200	20.6	0.37

*USGS Gauge discontinued in June 1966

Flood Hazard Photomaps

There are 15 flood hazard maps in this report (Appendix A) showing the areas flooded by the base rainfall flood or 100-year frequency flood. A flood hazard photomap index (Figure 9) is also located in the appendix. The shaded areas on these maps are projected to be flooded by the base flood.

Actual dimensions measured on the ground may vary slightly from those measured on the flood hazard maps of this report due to map scale and reproduction limitations. Also due to scale, small, raised areas such as houses built on earth pads will not be

detectable. Originally, the 500-year frequency flood line was to be shown on these maps, but the 100- and 500-year lines were often so close together that it was difficult to show both.

Information on the possibility of future floods of various magnitudes and the extent of flooding which might occur is included for the study area. Tables showing the elevations of the 10-, 50-, 100-, and 500-year flood events are included in Appendix C for selected cross sections of the various streams. Cross section locations are shown on individual maps.

Flood Profiles

Flood profiles for various storm frequencies are included in this report as appendix B. The flood profiles show the water surface elevations of the 10-, 50-, 100-, and 500-year frequency floods for present conditions. Included on the profiles are elevations of the stream bed, pertinent bridge and roadway data, and other location data. The profile stationing is in terms of stream distance in feet and is based upon high channel flow distances measured from the 1981 flight of aerial photomaps. Flood depths can be estimated at any location from the water surface profiles.

FLOOD PLAIN MANAGEMENT ALTERNATIVES

By using the maps, tables, and profiles presented in the appendices to this report, flood elevations at locations along the stream may be determined. This information will permit local units of government to implement flood plain management programs which recognize potential flood hazards. Such programs usually limit flood-prone areas to specific uses that would not result in serious economic loss nor loss of life during flood events. Building codes may preclude the flood plain from being used for housing, or they could require that houses be constructed at a specific height above flood frequency elevation by building on earth pads or pilings. Generally, flood plain management must be worked out with the landowners involved, with consideration given to alternatives available for the local area.

The maps, tables, and profiles are based on conditions that existed in 1983. Such factors as increased urbanization, encroachment on flood-prone areas, relocation or modification of bridges and other stream crossings, and stream channel modification can have significant effects on flood stages and areas inundated. Therefore, the results of any flood hazard evaluations should be reviewed periodically by appropriate state and local officials and planners to determine if changed watershed conditions would significantly affect future flood elevations.

Based on the flood plain areas identified in this report, the SCS recommends that an effective flood plain management program be implemented and maintained. It is recommended that the county develop a program to publicize the availability of flood insurance and encourage community residents to participate in the program, especially those located in or near flood-prone areas. Residents in flood-prone areas should be made aware of the potential consequences of non-participation in the National Flood Insurance Program.

Flood insurance was established by the National Flood Insurance Act of 1968 (Public Law 90-448, as amended) to make limited amounts of flood insurance, which was previously unavailable from private insurers, available to property owners and occupiers. The Flood Disaster Protection Act of 1973 (Public Law 93-234, as amended) was a major expansion of the National Flood Insurance Program. Flood insurance is available through local insurance agents and brokers only after a city or county applies and is declared eligible for the program by the Federal Insurance Administrator, U. S. Department of Housing and Urban Development (HUD). Adoption and enforcement of a local flood prevention ordinance which meets HUD minimum flood plain

management criteria is necessary to qualify and maintain community eligibility. The Federal Emergency Management Agency (FEMA) provides large scale flood maps for many urban areas. HUD uses these maps to determine rates of insurance. In those communities participating in the HUD program, owners and occupiers of all buildings and mobile homes in the entire community are eligible to obtain flood insurance coverage.

The SCS can provide technical assistance through the Sarasota Soil and Water Conservation District to Federal, State, and local agencies in the interpretation and use of the information contained herein and will provide additional technical assistance and data needed in local flood plain managment programs upon request, as funding and personnel limitations permit.

Flood damage reduction can only be achieved through proper recognition of the hazards associated with flood plain development. Flood damages can be minimized by careful planning and proper flood plain management. Flood plain management programs should contain both preventive and corrective measures.

Preventive measures do not prevent flooding. These measures reduce the threat of damage or loss of life from flooding by regulating development in the flood plains. Preventive measures can include flood plain regulations, development policies, greenbelts or open spaces, tax adjustments, and flood warning systems.

Corrective measures also do not necessarily eliminate flooding. These measures can reduce the extent of flooding and flood damages. Corrective measures are usually physical measures and can include land treatment, floodwater retarding structures, channel rectification, floodproofing of structures, and evacuation of flooded areas.

Preventive Measures

Encroachment lines are the lateral boundaries of a designated floodway. They are distinct lines, one on each side of the stream. Between these lines no construction or filling which causes an impediment to flow should be permitted.

Zoning is a legal method used to implement and enforce the details of the flood plain management program, to preserve property values, and to achieve the most appropriate and beneficial use of available land. Clear, concise, and thorough zoning bylaws, with enforcement of the bylaws, are essential to make zoning effective.

Subdivision regulations are used to specify the manner in which land may be subdivided. Regulations may state the required width of streets, requirements for curbs and gutters, size of lots, percentage of open space, and other points pertinent to the welfare of the community.

Building codes are developed to set up minimum standards for controlling the design, construction, and quality of materials used in buildings and structures within a given area to provide safety for life, health, property, and public welfare. Building codes can be used to minimize construction and subsequent damages resulting from inundation. Proper building restriction codes can specify adequate anchorage to prevent flotation of buildings from their foundations, prohibit storage of hazardous chemical or electrical equipment storage and establish minimum building foundation elevations.

Sound development policies and decisions which are designed to prevent construction of streets and utility systems in flood prone areas tend to slow development of the flood plains.

Greenbelt is a term related to the development and retention of stream frontages and flood plains. The use of these public and private lands for pasture or grazing, picnic areas, golf courses, and similar uses would materially reduce the damage potential in a high hazard flood plain area.

Tax adjustments for land that is used for agriculture, recreation, conservation, or other open space uses, may be effective in preserving natural floodways along streams.

Flood warning systems should be coordinated with local disaster plans. The National Weather Service issues warning of potential flood producing storms. On small watersheds, staff gauges set at key locations in flood prone areas can be monitored to give advance warnings. A float activated, battery powered signal connected to the local police or fire station would be desirable if high risks are involved.

Corrective Measures

Maintain Improved Channels and Flood Control Structures so that they can work effectively against flooding. Keep channel banks fenced to keep cattle off and prevent erosion and reduced water flow. Keep structures clear of debris and aquatic vegetation

Figure 12. Water hyacinths and torpedo grass blocking flow through Structure No. 3 may have caused excessive flows around the structure creating a by-pass channel (looking upstream)
Date: 6/11/80

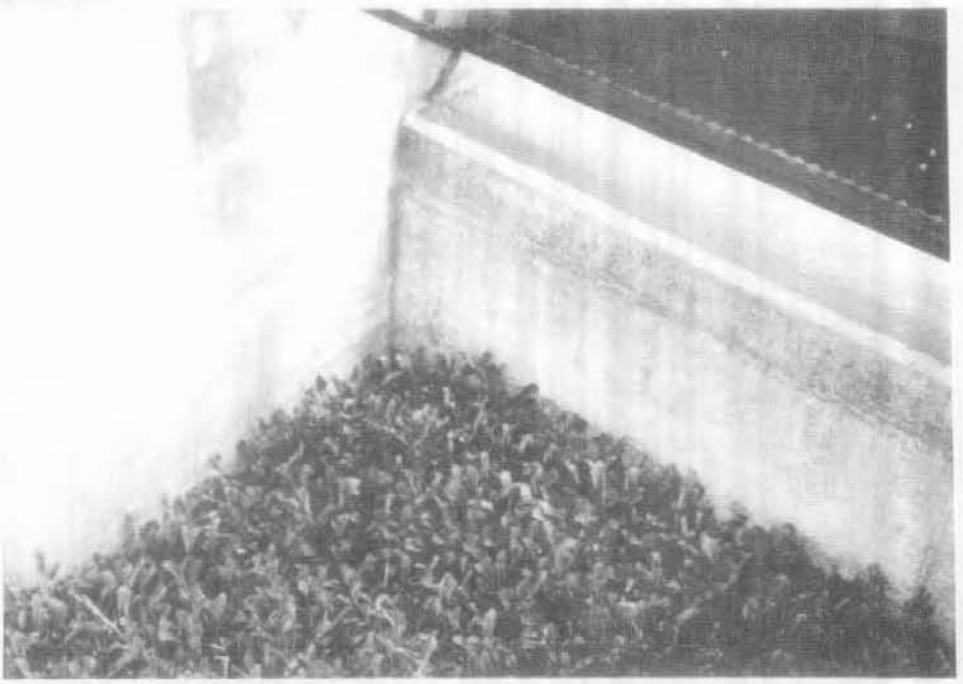

Figure 13. Close-up view of water hyacinths at Structure No. 3.

Figure 14. Debris blocking flow through Structure No. 3 (looking downstream)
Date: 8/17/67

Land treatment practices lessen the severity of floods by increasing infiltration and decreasing the amount and rate of runoff. Practices include vegetative cover, runoff interceptors and diversions, erosion control structures, and cropping management practices. They can be especially important in reducing erosion and the resulting amount of sediment and pollutants carried downstream.

Floodwater retarding structures are earthfill or concrete impoundments that check the uncontrolled flow of floodwater. These structures are usually located to intercept water from large drainage areas, thus providing the maximum possible amount of downstream protection. Retarding structures may include dug pits in areas where ground water tables are well below the ground surface. Such pits require that stored water be emptied following each storm event.

Permanent evacuation of developed areas subject to inundation usually involves the acquisition of lands by purchase, the removal of improvements, and the relocation of the population from such areas. Such lands could be used for parks and other purposes that would not suffer large flood damages and would not interfere with flood flows.

Flood proofing can reduce flood damages by a combination of structural provisions and changes or adjustments to properties subject to flooding. Examples of flood proofing are sealing low windows and door openings, and modifying floor drains to prevent the entrance of flood waters.

Combinations of various types of practices, both structural and nonstructural, can normally provide a higher degree of flood protection, at less cost, than most individual types of practices by themselves, especially in highly developed flood plains similar to the Lee County flood hazard area. Careful intermixing of the most cost effective and socially acceptable individual measures can enhance the potential to provide a socially acceptable level of protection.

Local Recommendations

This report should be adequately publicized so its findings can be made available to property owners and occupiers in the study area.

GLOSSARY OF TERMS

Bridge Area -- The effective hydraulic flow area of a bridge opening accounting for the presence of piers, attached conduits, and skew (alignment), if applicable.

Discharge -- The capacity of a stream to allow a quantity of flow to pass through a particular cross section during a definite period of time (usually expressed in cubic feet per second).

Channel -- A natural or artificial water course of perceptible extend with definite bed and banks to confine and conduct continuously or periodically flowing water.

Flood -- An overflow of water on lands not normally covered by water. Floods have two essential characteristics: the inundation of land is temporary; and the land is adjacent to and inundated by overflow from a river, stream, ocean, lake, or other body of standing water.

Flood Crest -- The maximum stage of elevation reached by the waters of a flood at a given location.

Flood Frequency -- A means of expressing the probability of flood occurrences as determined from a statistical analysis of representative streamflow or rainfall and runoff records. It is customary to estimate the frequency with which specific flood stages or discharges may be equalled or exceeded, rather than the frequency of an exact stage or discharge. Such estimates by strict definition are designated "exceedance frequence", but in practice the term "frequency" is used. The frequency of a particular stage or discharge is usually expressed as occurring once in a specified number of years. Also see definition of "recurrence interval." For example, see "100-year Flood" below:

> 100-year flood - a flood having an average frequency of occurrence in the order of once in 100 years. It has a 1 percent chance of being equalled or exceeded in any given year. It is based on statistical analyses of rainfall and runoff characteristics in the general region of the watershed.

Flood Hazard Area -- Synonymous with Flood Plain (general). Commonly used in reference to flood map.

Flood Peak -- The highest stage or discharge attained during a flood event; also referred to as peak stage or peak discharge.

Flood Plain (general) -- The relatively flat area or low lands adjoining the channel of a river, stream, or watercourse; ocean, lake, or other body of standing water which has been or may be covered by floodwater.

Flood Plain (specific) -- A definitive area within a flood plain (general) or flood-prone area known to have been inundated by a historical flood, or determined to be inundated by floodwater from a potential flood of a specific frequency.

Flood Prone Area -- Synonymous with Flood Plain (General).

Flood Profile -- A graph showing the relationship of water surface elevation to stream bed. It is generally drawn to show the water surface elevation for the peak of a specific flood, but may be prepared for conditions at a given time or stage.

Hydrologic Boundary - The divide separating adjoining watersheds.

Potential flood -- A spontaneous event (natural phenomenon) capable of occurring from a combination of meteorological, hydrological, and physical conditions; the magnitude of which is dependent upon specific combinations. See Flood and Flood Frequency.

Recurrence Interval -- The average interval of time based on a statistical analysis of actual or representative streamflow records which can be expected to elapse between floods equal to or larger than a specified stage or discharge. Recurrence interval is generally expressed in years. Also see definition of Flood Frequency.

Runoff -- That part of precipitation as well as any other flood contributions, which appears in surface streams of either perennial or intermittent form.

Stream Bed -- The lowest part of the stream channel (either in a constructed cross section or a natural channel). Bottom elevations at a series of points along the length of a stream may be plotted and connected to provide a stream bottom profile. (This is often referred to as the "stream bed" and is so designated on the flood profiles in Appendix B).

Stream Channel Flow -- That water which is flowing within the limits of a defined watercourse.

Structural Bottom of Opening -- The lowest point of a culvert or bridge opening with a constructed bottom through which a stream flows that could tend to limit the stream channel bottom to that specific elevation. This structural bottom may be covered with sediment or debris which further restricts the size of the opening.

Watershed -- A drainage basin or area which collects and transmits runoff usually by means of streams and tributaries to the outlet of the basin.

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APPENDIX A

FLOOD HAZARD PHOTOMAPS

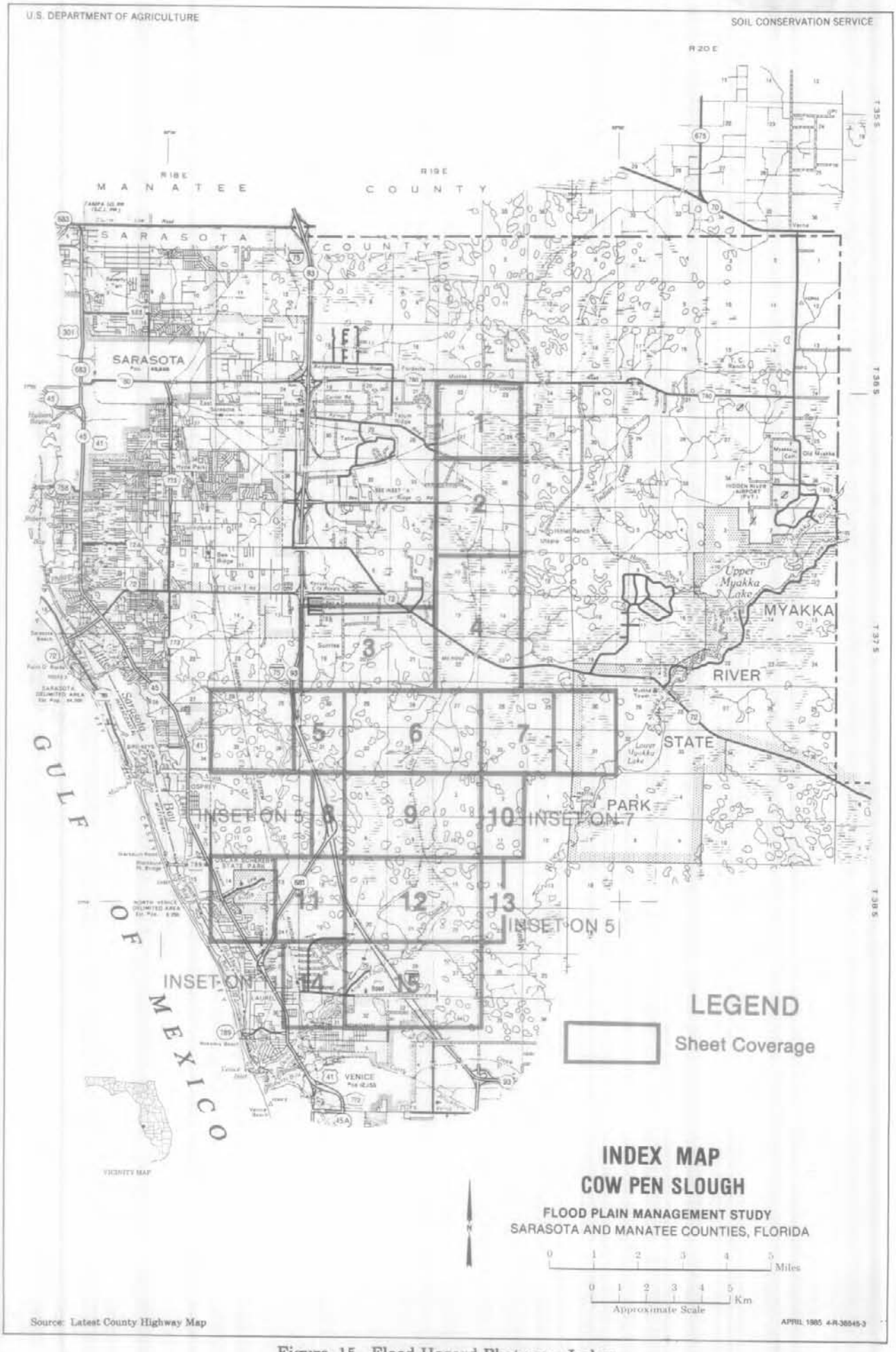


Figure 15. Flood Hazard Photomap Index

LEGEND

100 Year Flood Hazard Area

Cross Section Location

× Elevation Reference Marks

Cross section locations are approximate-see profiles for exact locations.

Limits of flooding shown may vary from actual locations on the ground and due to inherent aerial photographic displacement the photographic image may vary from true ground location.

0 1000 2000 FEET

0 200 400 600 METERS

APPROXIMATE SCALE

3-79 Photography

SHEET 1 OF 15

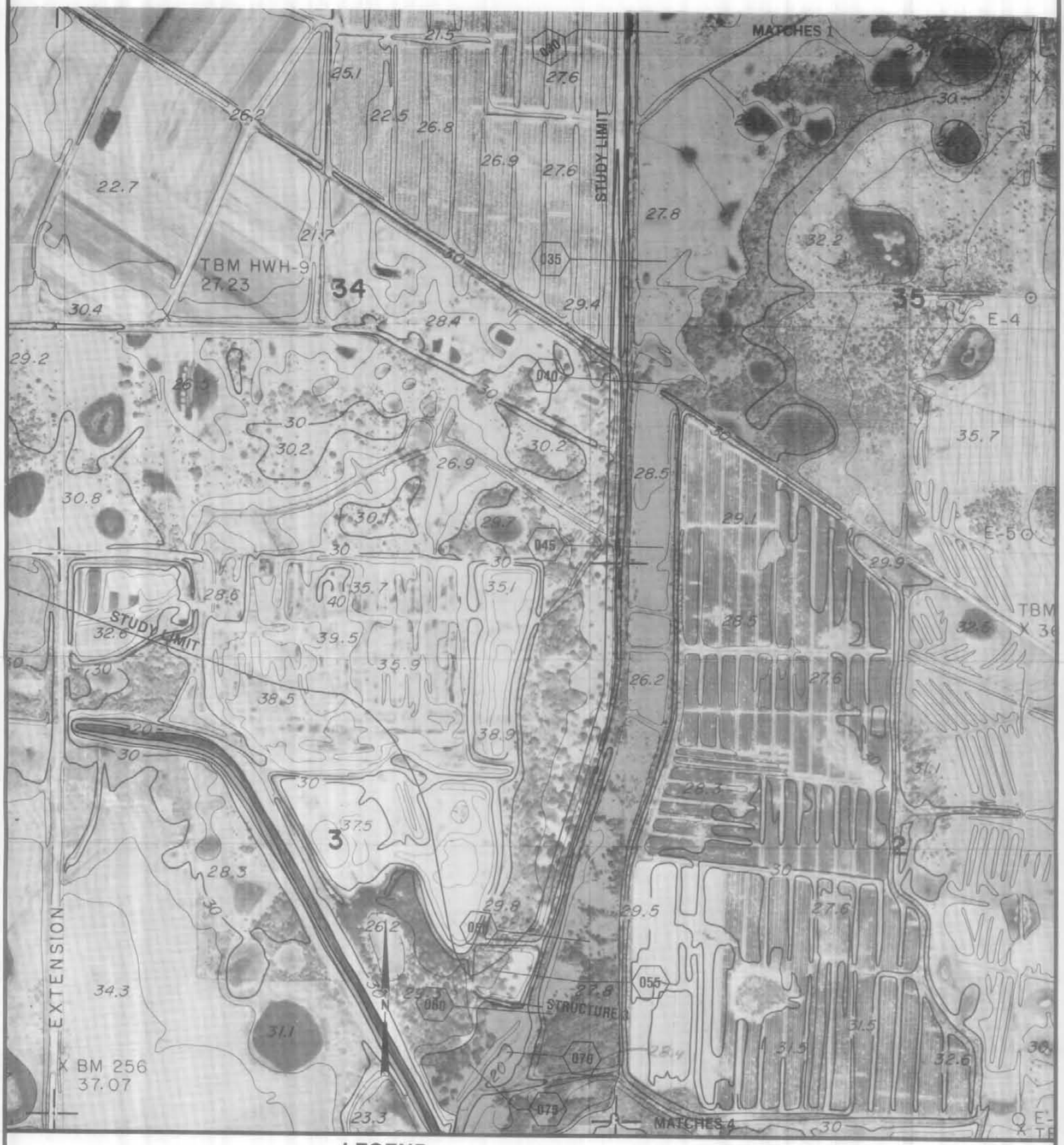
U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

COW PEN SLOUGH
FLOOD PLAIN MANAGEMENT STUDY
SARASOTA COUNTY, FLORIDA

FLOOD HAZARD AREA

COW PEN SLOUGH

4-R-39,137-1



LEGEND

100 Year Flood Hazard Area

Cross Section Location

X Elevation Reference Marks

Cross section locations are approximate-see profiles for exact locations.

Limits of flooding shown may vary from actual locations on the ground and due to inherent aerial photographic displacement the photographic image may vary from true ground location.

0 1000 2000 FEET

0 200 400 600 METERS

APPROXIMATE SCALE

10-79 Photography

SHEET 2 OF 15

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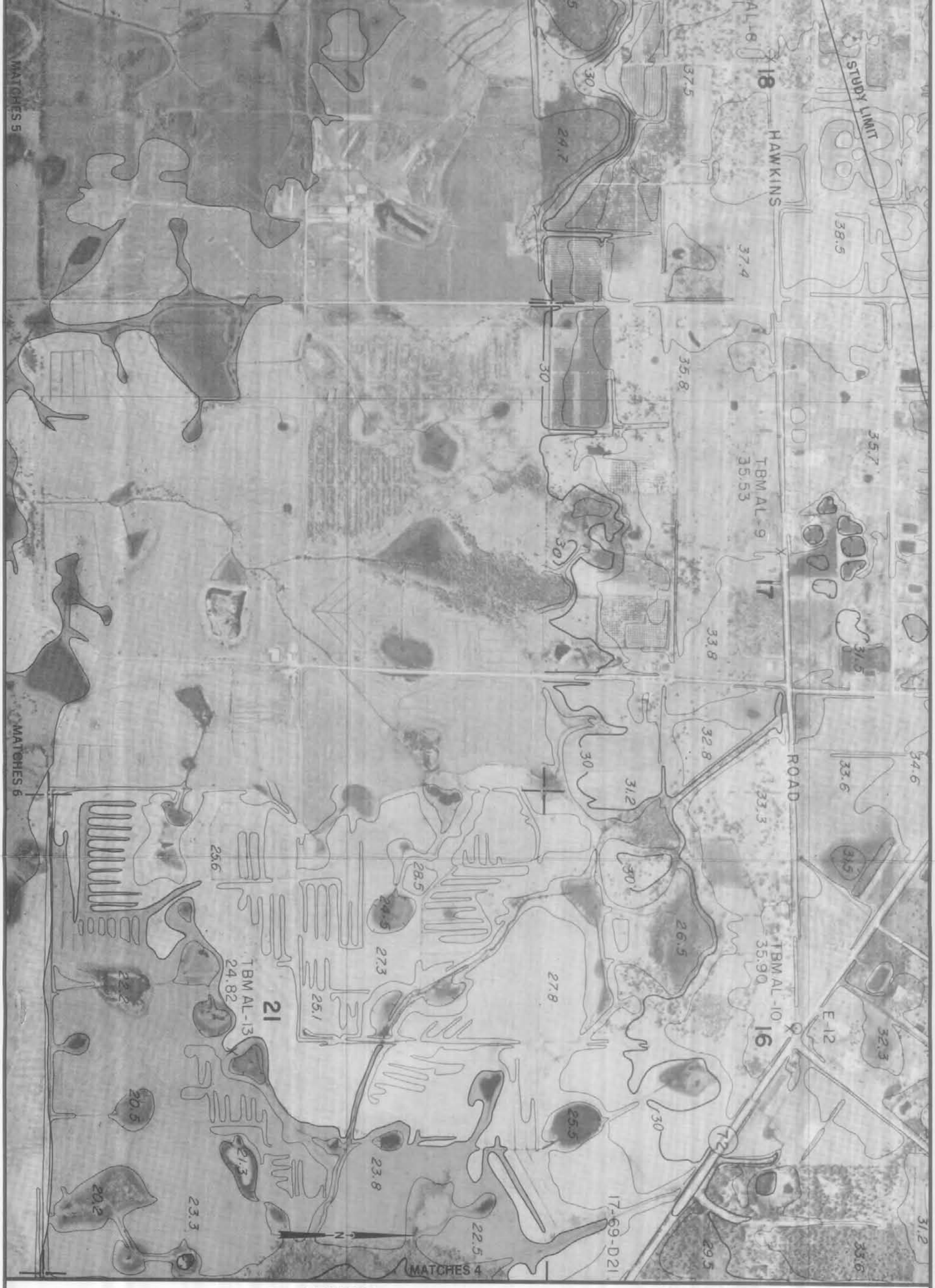
COW PEN SLOUGH
FLOOD PLAIN MANAGEMENT STUDY
SARASOTA COUNTY, FLORIDA

FLOOD HAZARD AREA

COW PEN SLOUGH

4-R-39,137-2



LEGEND

100 Year Flood Hazard Area

Cross Section Location

× Elevation Reference Marks

Cross section locations are approximate-see profiles for exact locations.

Limits of flooding shown may vary from actual locations on the ground and due to inherent aerial photographic displacement the photographic image may vary from true ground location.

0 1000 2000 FEET

0 200 400 600 METERS

APPROXIMATE SCALE

10-79 Photography

SHEET 3 OF 15

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SARASOTA COUNTY, FLORIDA

FLOOD HAZARD AREA

COW PEN SLOUGH

4-R-39,137-3

LEGEND

100 Year Flood Hazard Area

Cross Section Location

× Elevation Reference Marks

Cross section locations are approximate-see profiles for exact locations.

Limits of flooding shown may vary from actual locations on the ground and due to inherent aerial photographic displacement the photographic image may vary from true ground location.

0 1000 2000 FEET

0 200 400 600 METERS

APPROXIMATE SCALE

10-79 Photography

SHEET 4 OF 15

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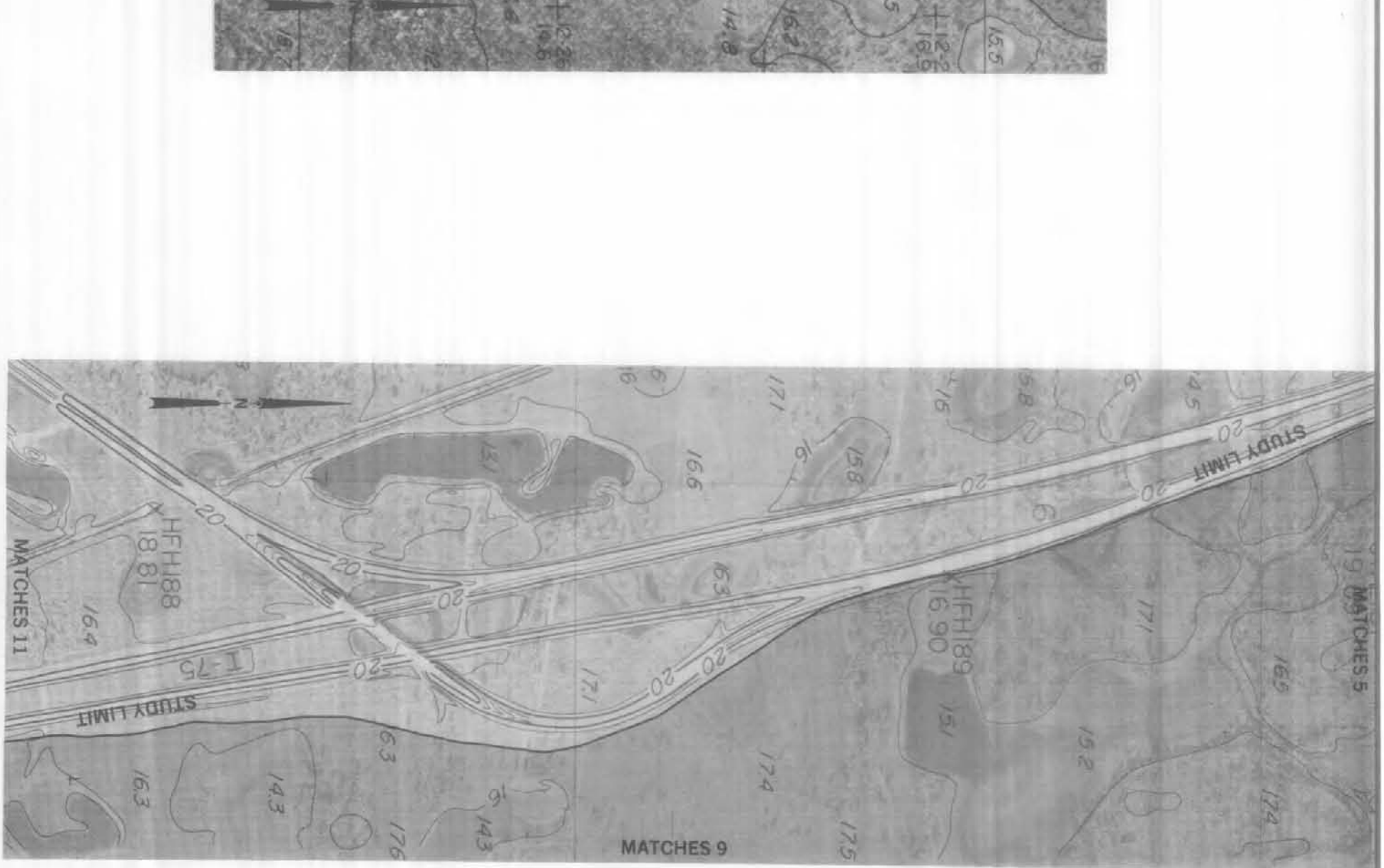
SOIL CONSERVATION SERVICE

COW PEN SLOUGH
FLOOD PLAIN MANAGEMENT STUDY
SARASOTA COUNTY, FLORIDA

FLOOD HAZARD AREA

COW PEN SLOUGH

4-R-39,137-4



LEGEND

100 Year Flood Hazard Area

Cross Section Location

× Elevation Reference Marks

Cross section locations are approximate-see profiles for exact locations.

limits of flooding shown may vary from actual locations on the ground and due to inherent aerial photographic displacement the photographic image may vary from true ground location.

0 1000 2000 FEET

0 200 400 600 METERS

APPROXIMATE SCALE

10-80 Photography

SHEET 5 OF 15

SHEET 134

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SOIL CONSERVATION SERVICE

COW PEN SLOUGH
FLOOD PLAIN MANAGEMENT STUDY
SARASOTA COUNTY, FLORIDA

FLOOD HAZARD AREA

COW PEN SLOUGH

4-R-39,137-5

LEGEND

100 Year Flood Hazard Area

Cross Section Location

× Elevation Reference Marks

Cross section locations are approximate-see profiles for exact locations.

limits of flooding shown may vary from actual locations on the ground and due to inherent aerial photographic displacement the photographic image may vary from true ground location.

0 1000 2000 FEET

0 200 400 600 METERS

APPROXIMATE SCALE

10-80 Photography

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COW PEN SLOUGH
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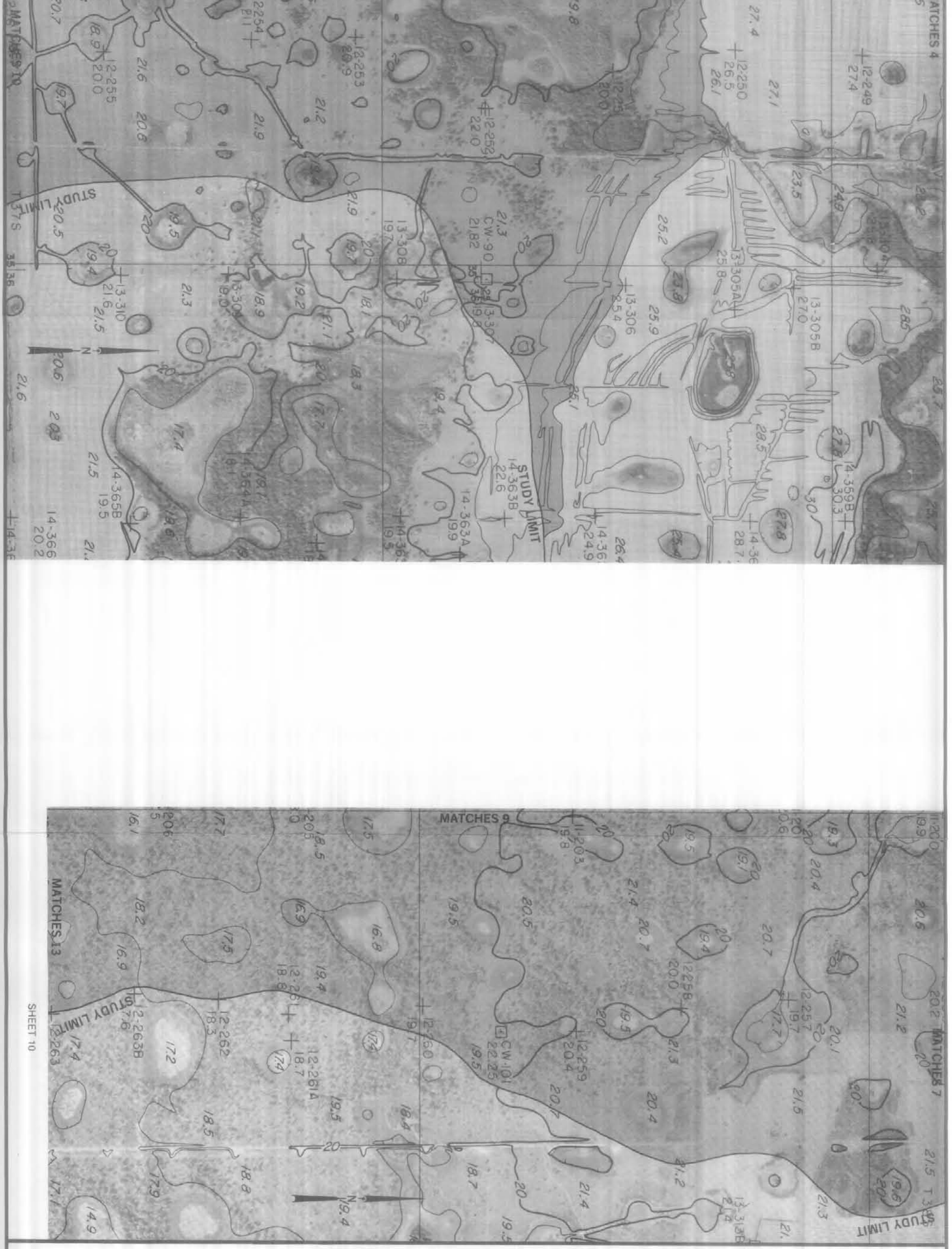
SARASOTA COUNTY, FLORIDA

SHEET 6 OF 15

FLOOD HAZARD AREA

COW PEN SLOUGH

4-R-39,137-6



LEGEND

100 Year Flood Hazard Area

Cross Section Location

Elevation Reference Marks

Cross section locations are approximate-see profiles for exact locations.

limits of flooding shown may vary from actual locations on the ground and due to inherent aerial photographic displacement the photographic image may vary from true ground location.

0 1000 2000 FEET

0 200 400 600 METERS

APPROXIMATE SCALE

10-80 Photography

SHEET 7 OF 15

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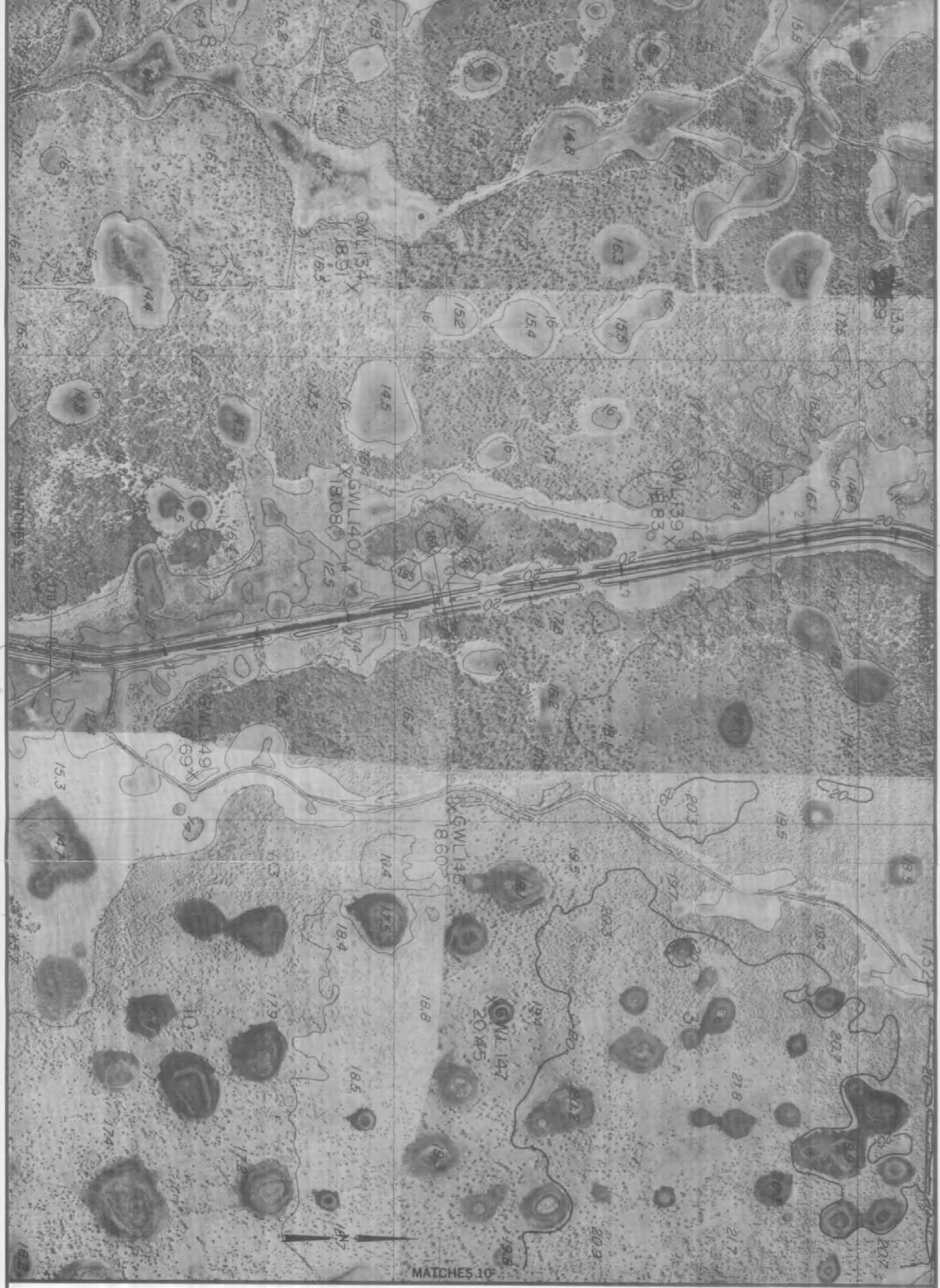
FLOOD PLAIN MANAGEMENT STUDY
SARASOTA COUNTY, FLORIDA

FLOOD HAZARD AREA

COW PEN SLOUGH



LEGEND

- 100 Year Flood Hazard Area
- Cross Section Location
- × Elevation Reference Marks

Cross section locations are approximate-see profiles for exact locations.

Limits of flooding shown may vary from actual locations on the ground and due to inherent aerial photographic displacement the photographic image may vary from true ground location.

0 1000 2000 FEET
0 200 400 600 METERS
APPROXIMATE SCALE

9-81 Photography

SHEET 9 OF 15

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FLOOD PLAIN MANAGEMENT STUDY
SARASOTA COUNTY, FLORIDA

FLOOD HAZARD AREA

COW PEN SLOUGH

4-R-39,137-6

LEGEND

- 100 Year Flood Hazard Area
- Cross Section Location
- × Elevation Reference Marks

Cross section locations are approximate-see profiles for exact locations.

Limits of flooding shown may vary from actual locations on the ground and due to inherent aerial photographic displacement the photographic image may vary from true ground location.

0 1000 2000 FEET
0 200 400 600 METERS
APPROXIMATE SCALE

9-81 Photography

SHEET 11 OF 15

U.S. DEPARTMENT OF AGRICULTURE
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COW PEN SLOUGH
FLOOD PLAIN MANAGEMENT STUDY
SARASOTA COUNTY, FLORIDA

FLOOD HAZARD AREA

COW PEN SLOUGH

4-R-39,137-9

LEGEND

- 100 Year Flood Hazard Area
- Cross Section Location
- × Elevation Reference Marks

Cross section locations are approximate-see profiles for exact locations.

Limits of flooding shown may vary from actual locations on the ground and due to inherent aerial photographic displacement the photographic image may vary from true ground location.

0 1000 2000 FEET
0 200 400 600 METERS
APPROXIMATE SCALE

2-81 Photography

SHEET 12 OF 15

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SARASOTA COUNTY, FLORIDA

FLOOD HAZARD AREA

COW PEN SLOUGH

4-R-39,137-10

LEGEND

100 Year Flood Hazard Area

Cross Section Location

× Elevation Reference Marks

Cross section locations are approximate-see profiles for exact locations.

Limits of flooding shown may vary from actual locations on the ground and due to inherent aerial photographic displacement the photographic image may vary from true ground location.

0 1000 2000 FEET
0 200 400 600 METERS
APPROXIMATE SCALE

2-81 Photography

SHEET 15 OF 15

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COW PEN SLOUGH
FLOOD PLAIN MANAGEMENT STUDY
SARASOTA COUNTY, FLORIDA

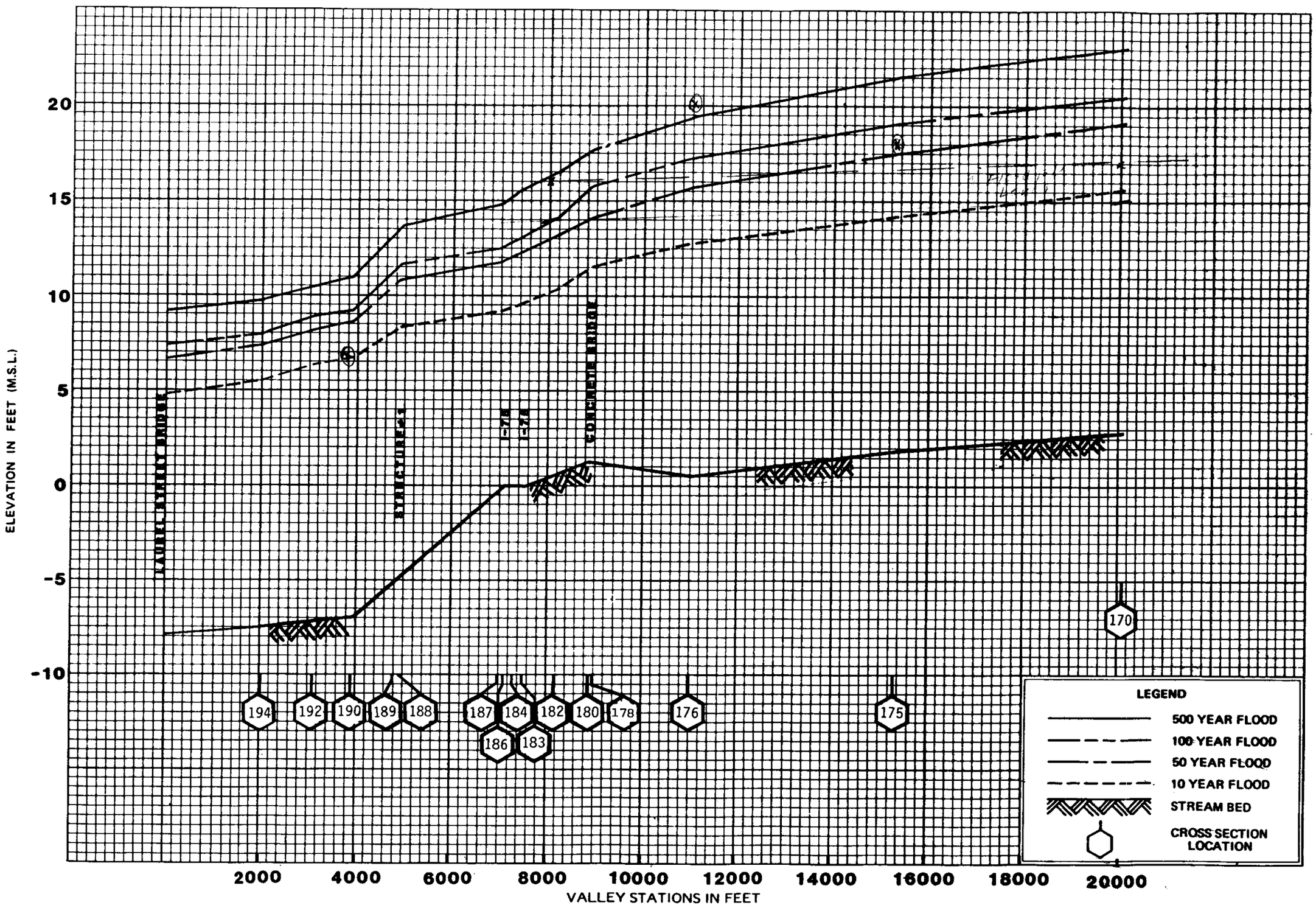
FLOOD HAZARD AREA

COW PEN SLOUGH

4-R-30 137-11

APPENDIX B

FLOOD PROFILES



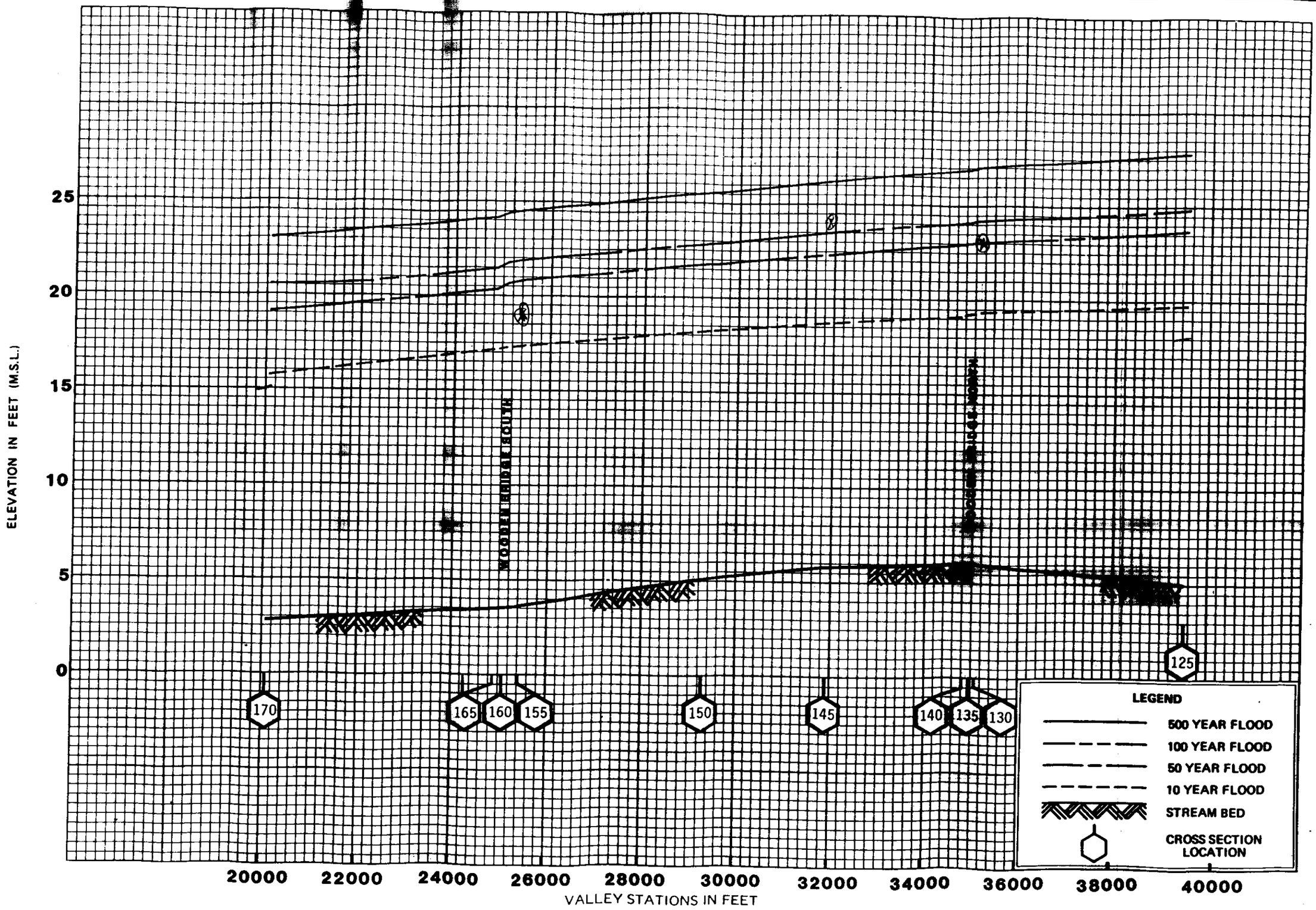
FLOOD PROFILES

COW PEN SLOUGH CROSS SECTION 194-170

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

SARASOTA COUNTY
FLORIDA

Fig. 16



FLOOD PROFILES

COW PEN SLOUGH CROSS SECTION 170-125

U.S. DEPARTMENT OF AGRICULTURE
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FLORIDA

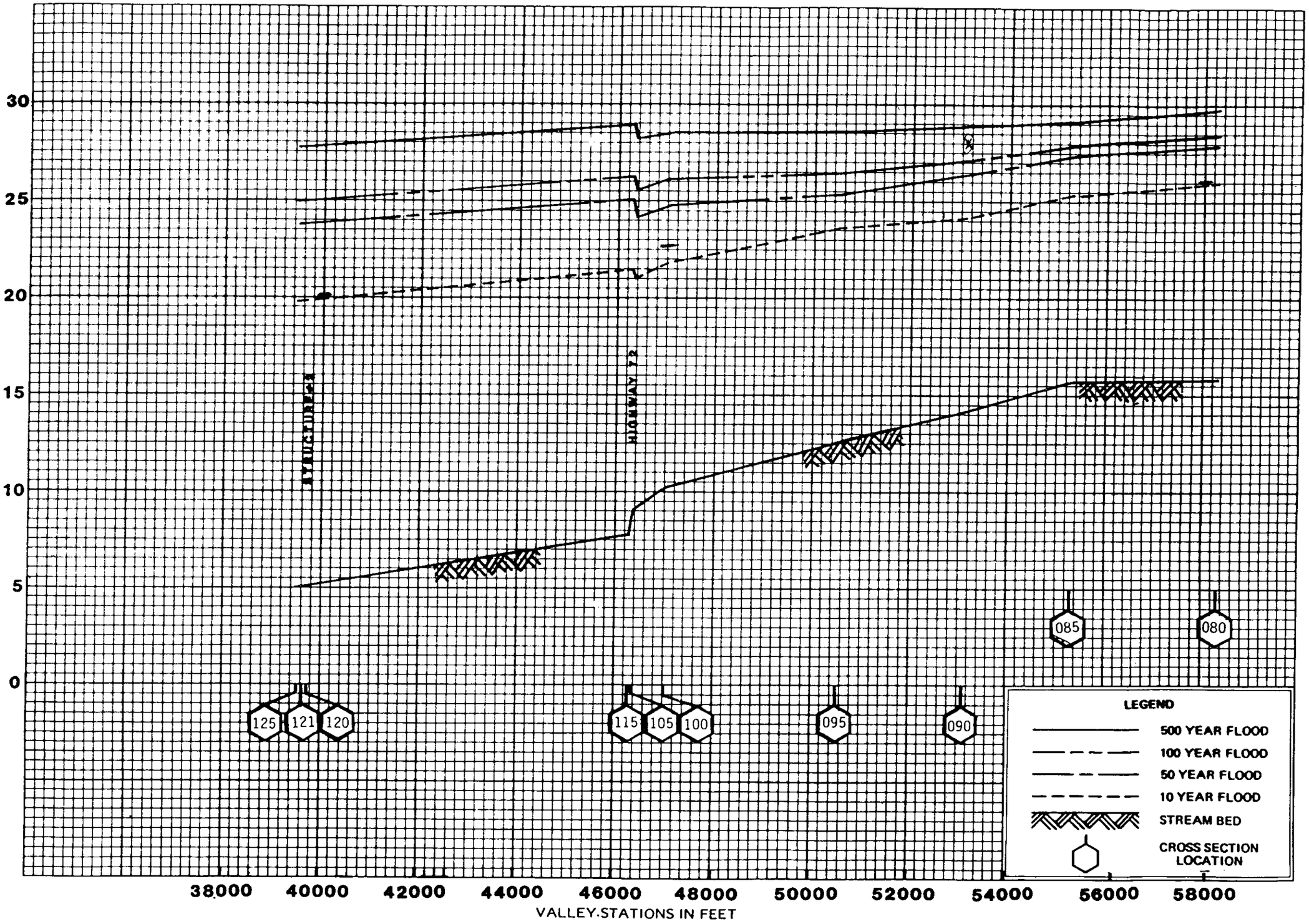
Fig. 17

ELEVATION IN FEET (M.S.L.)

30
25
20
15
10
5
0

38000 40000 42000 44000 46000 48000 50000 52000 54000 56000 58000

VALLEY-STATIONS IN FEET



FLOOD PROFILES

COW PEN SLOUGH CROSS SECTION 125-080

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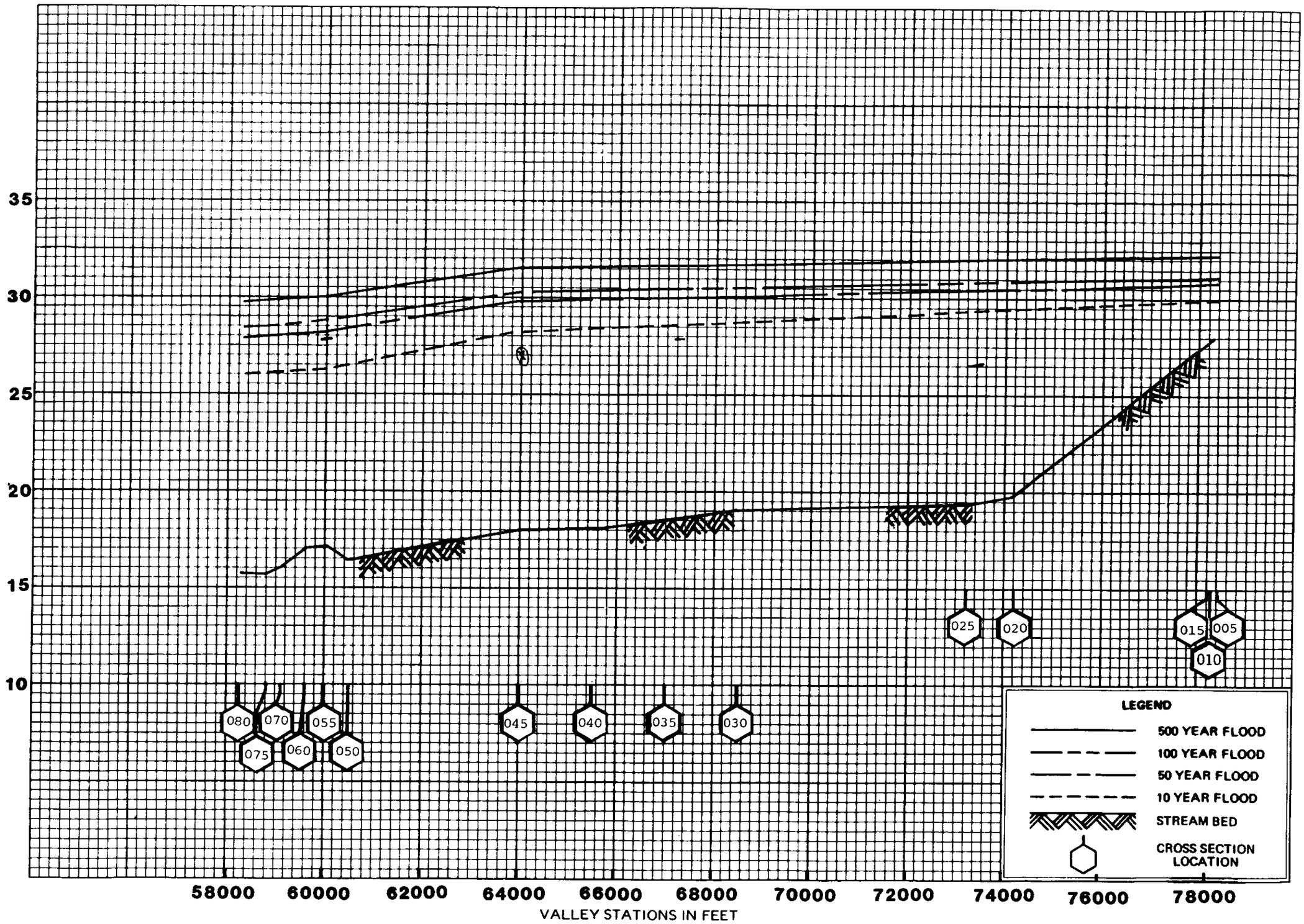
SARASOTA COUNTY
FLORIDA

Fig. 18



FLOOD PROFILES

COW PEN SLOUGH CROSS SECTION 080-005

U.S. DEPARTMENT OF AGRICULTURE
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SARASOTA COUNTY
FLORIDA

Fig. 19

APPENDIX C

TYPICAL VALLEY CROSS SECTIONS

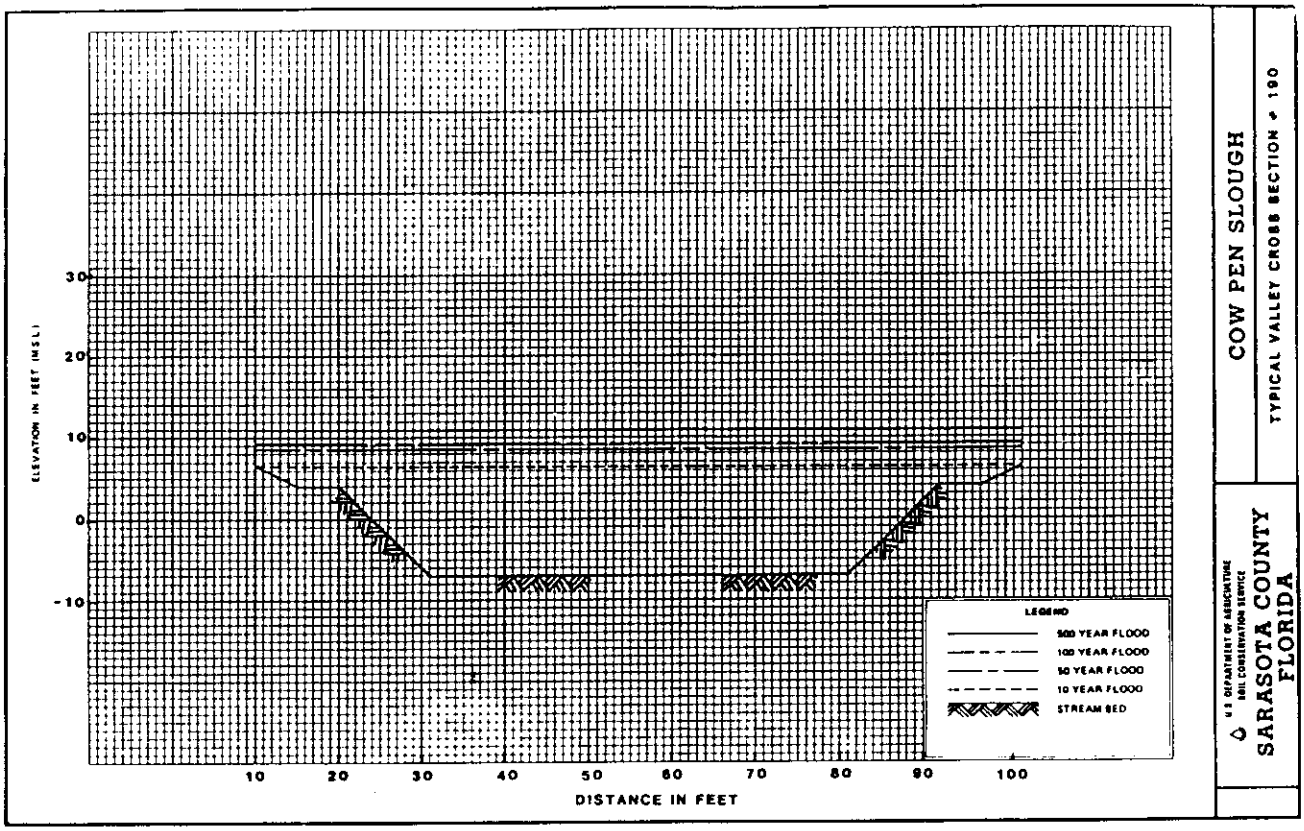

Figure 20. Cross Section 190

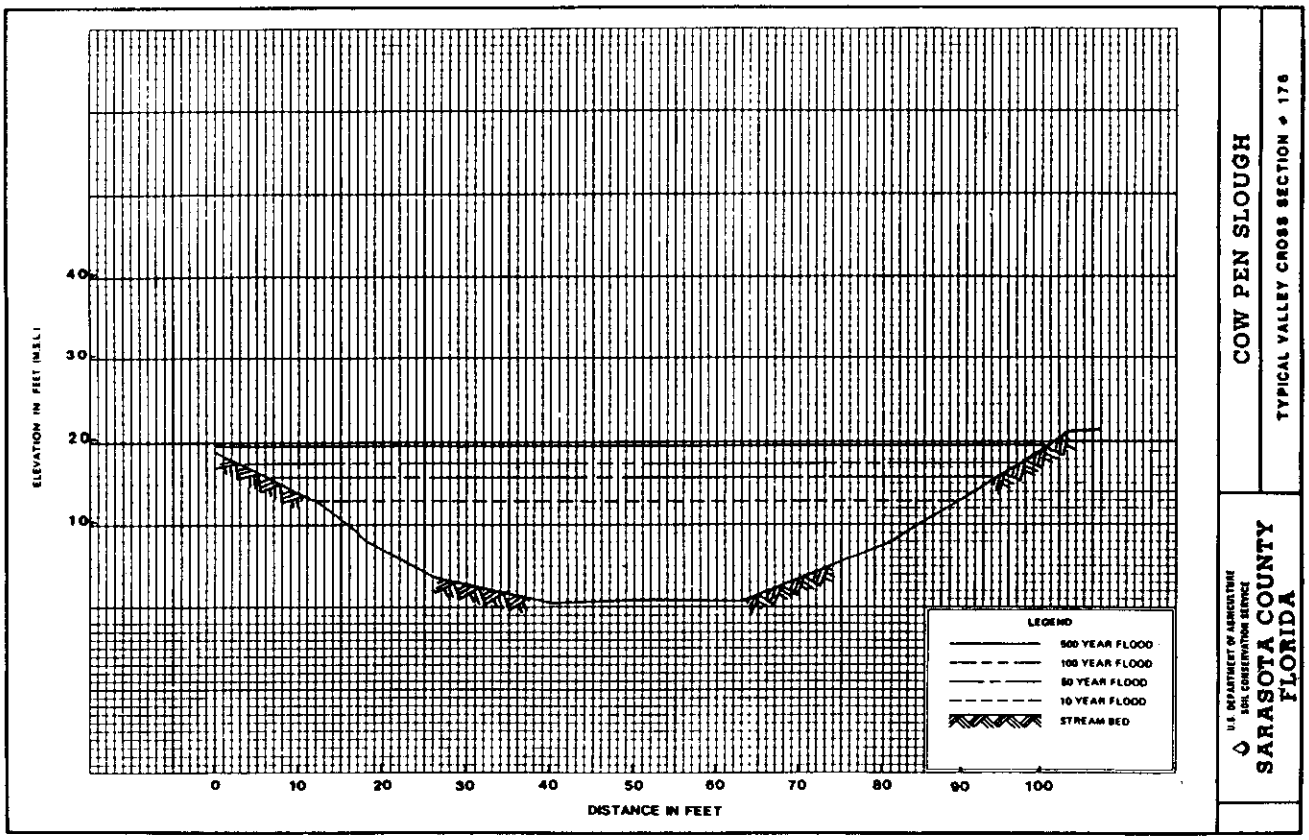

Figure 21. Cross Section 176

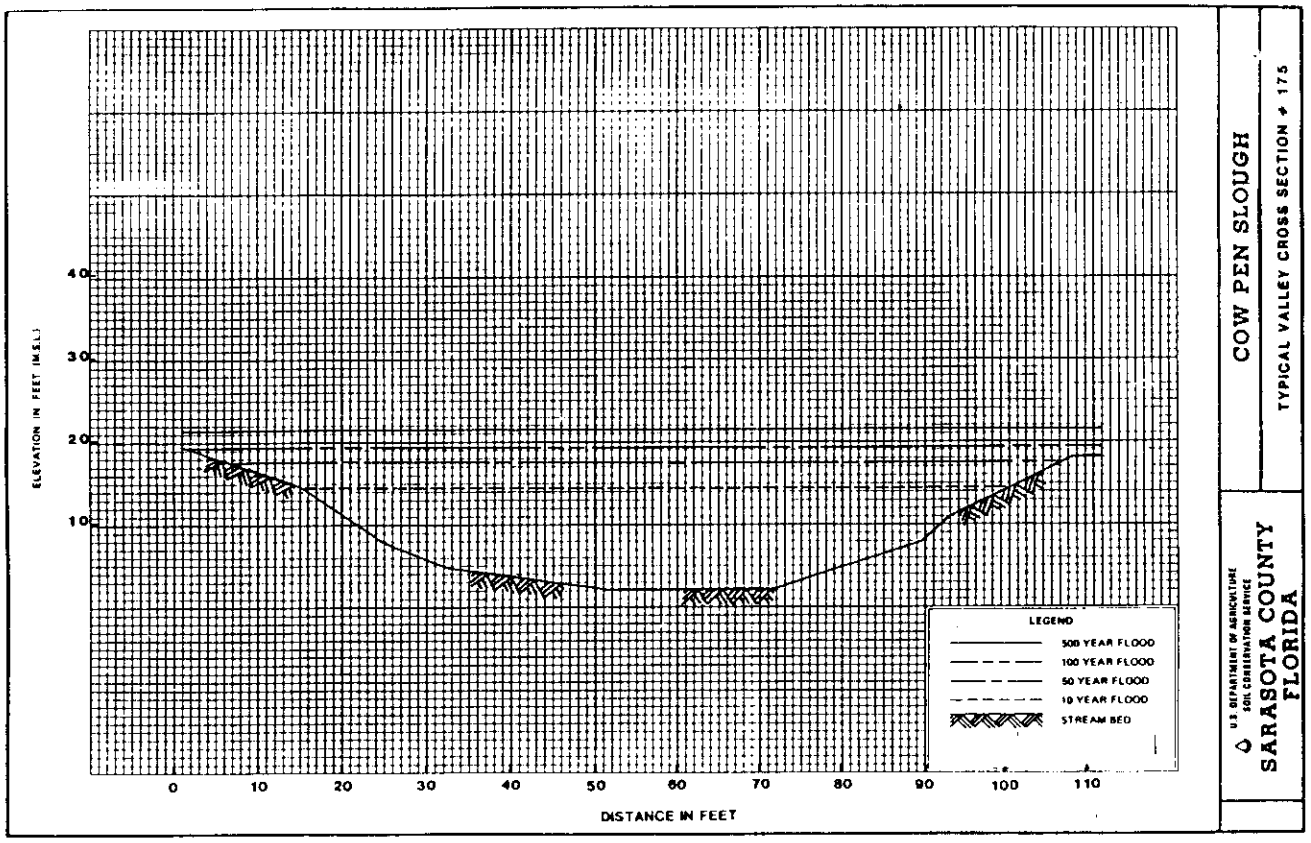

Figure 22. Cross Section 175

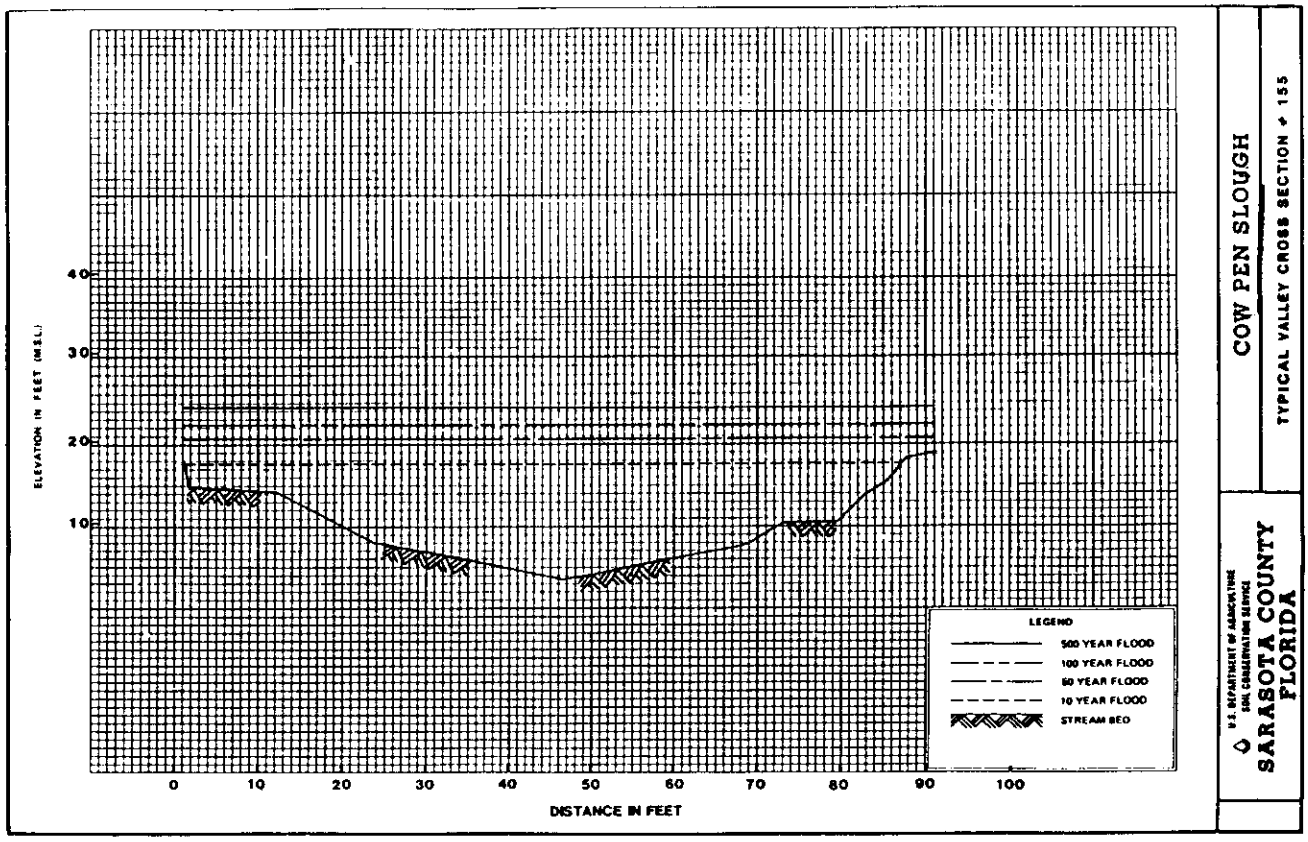

Figure 23. Cross Section 155

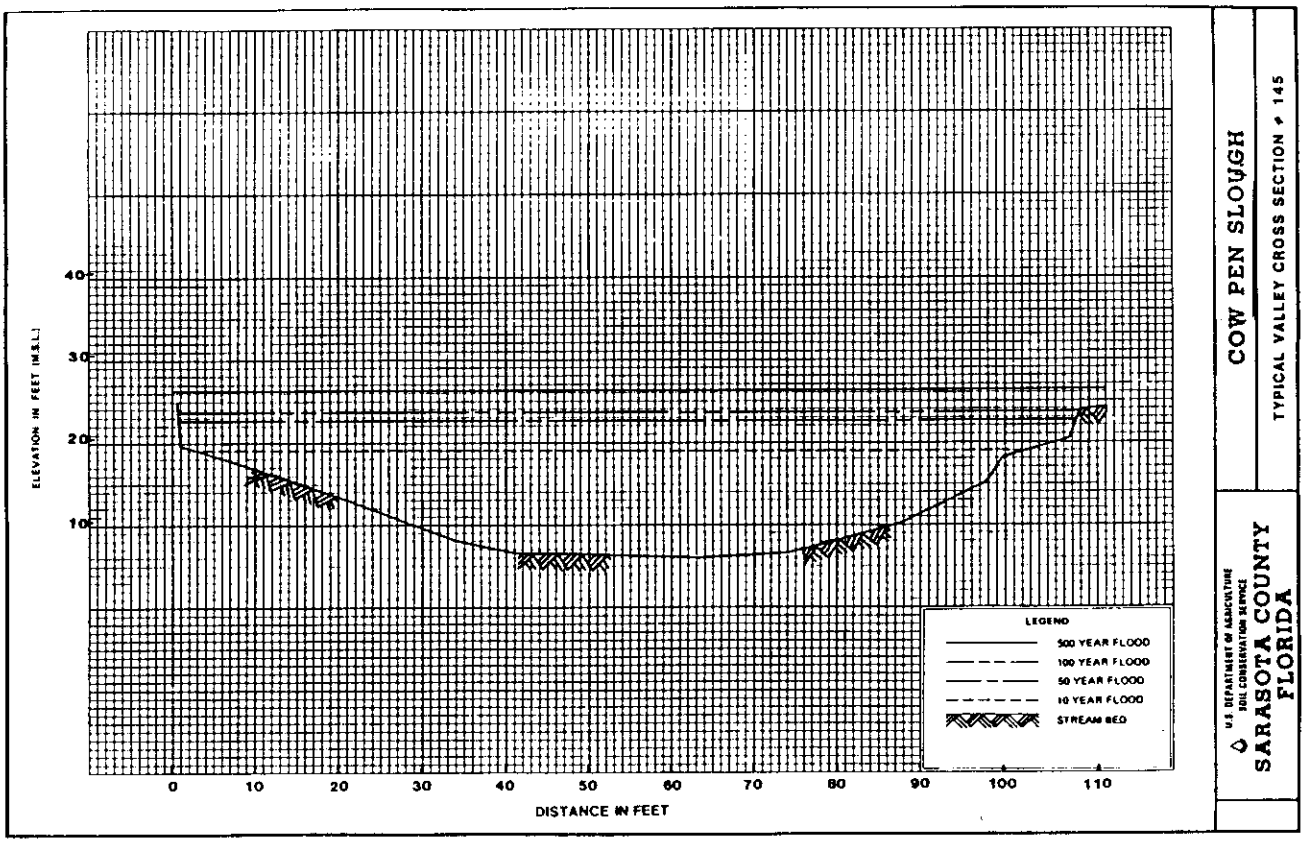

Figure 24. Cross Section 145

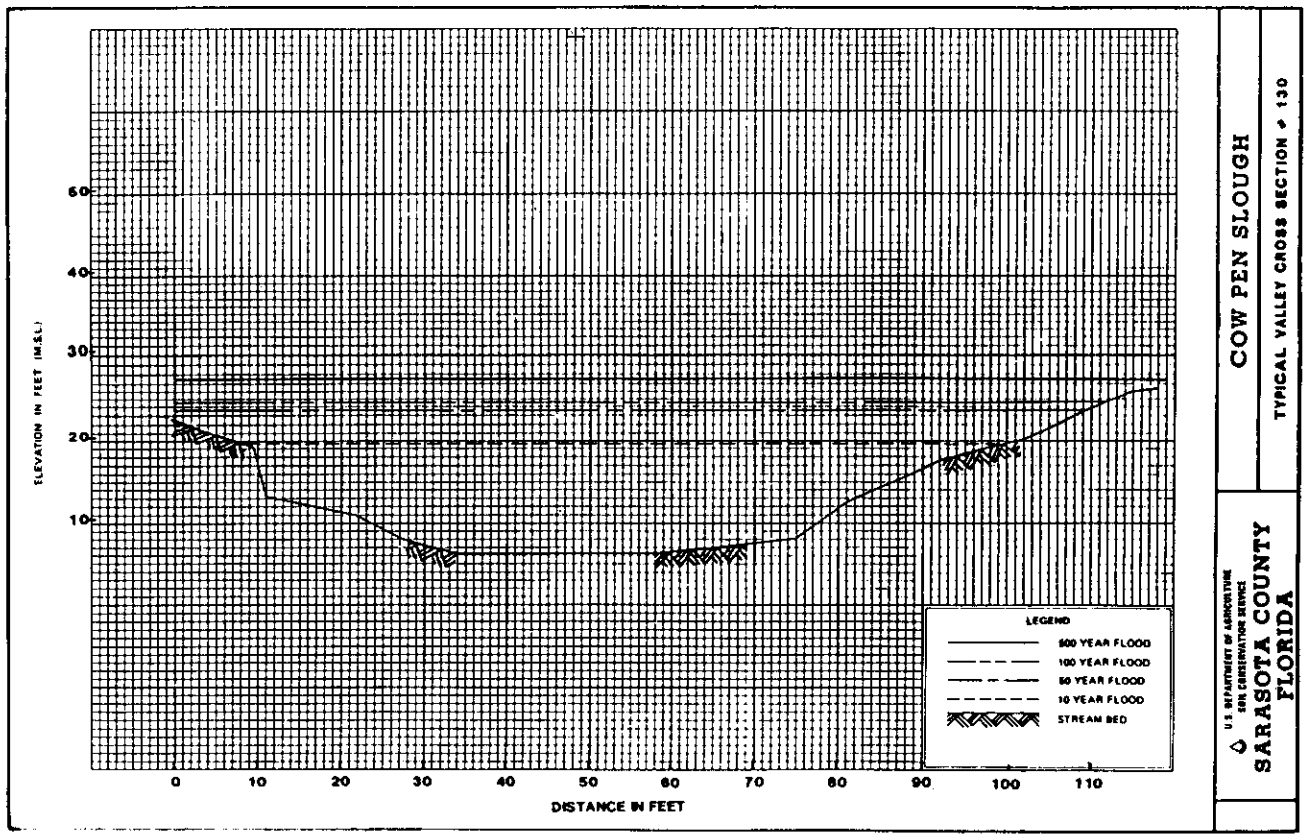

Figure 25. Cross Section 130

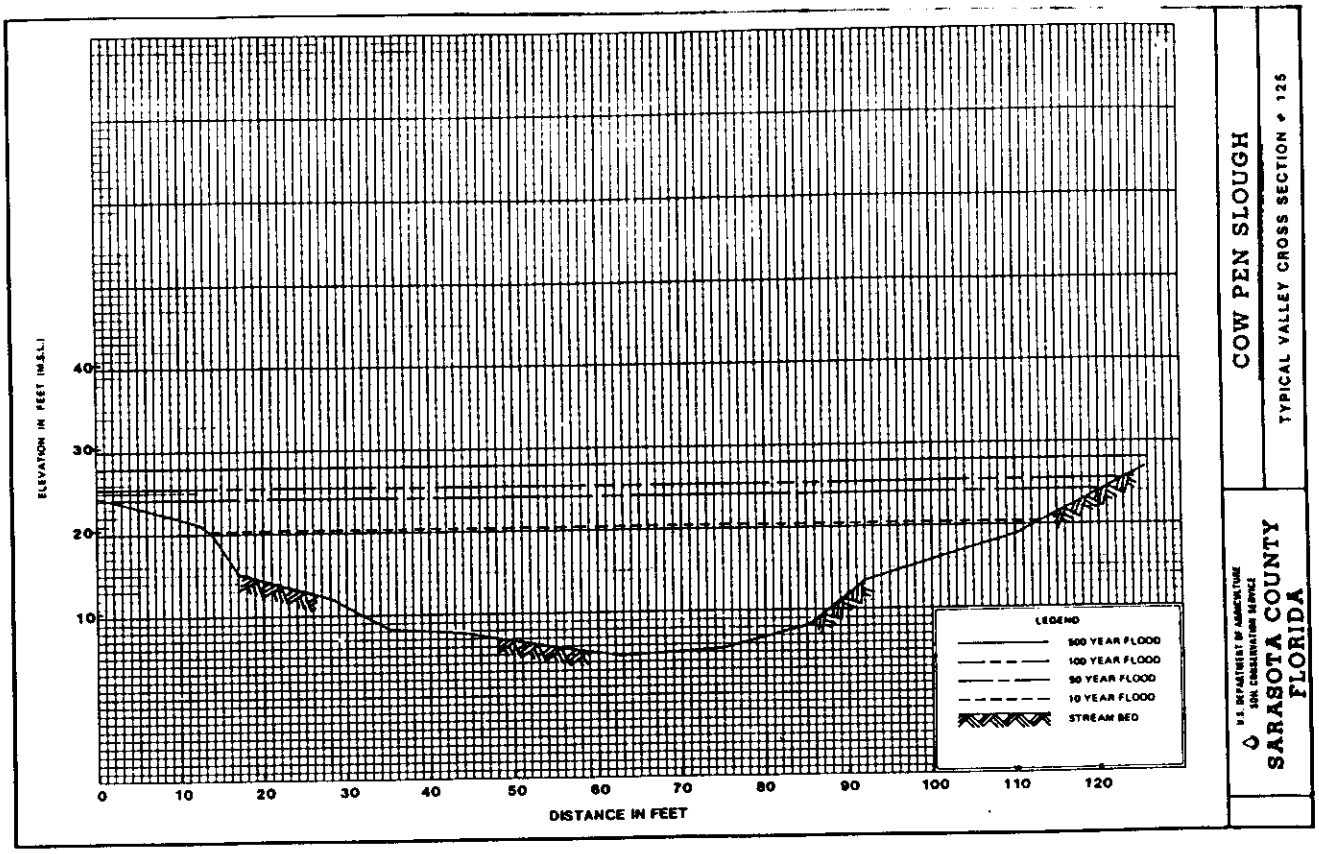

Figure 26. Cross Section 125

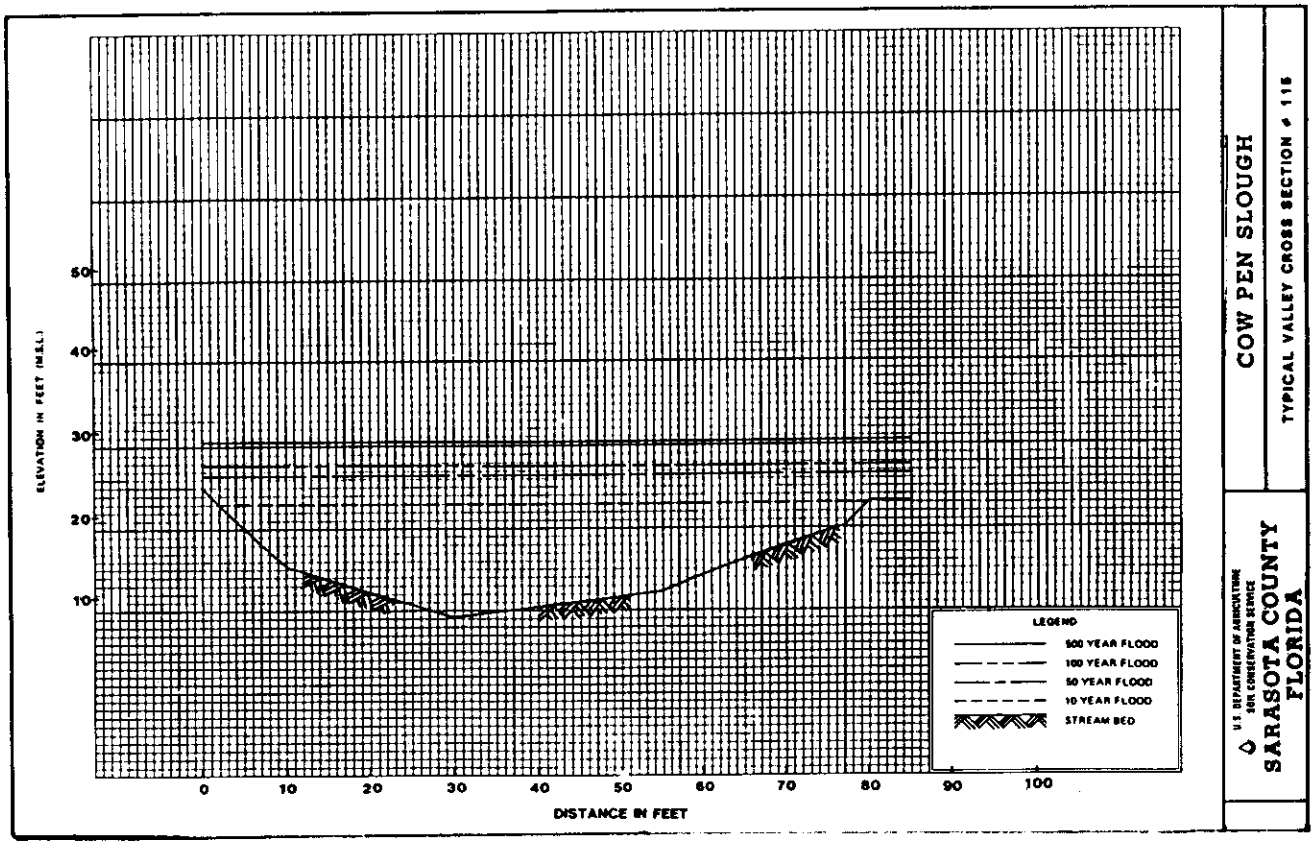

Figure 27. Cross Section 115

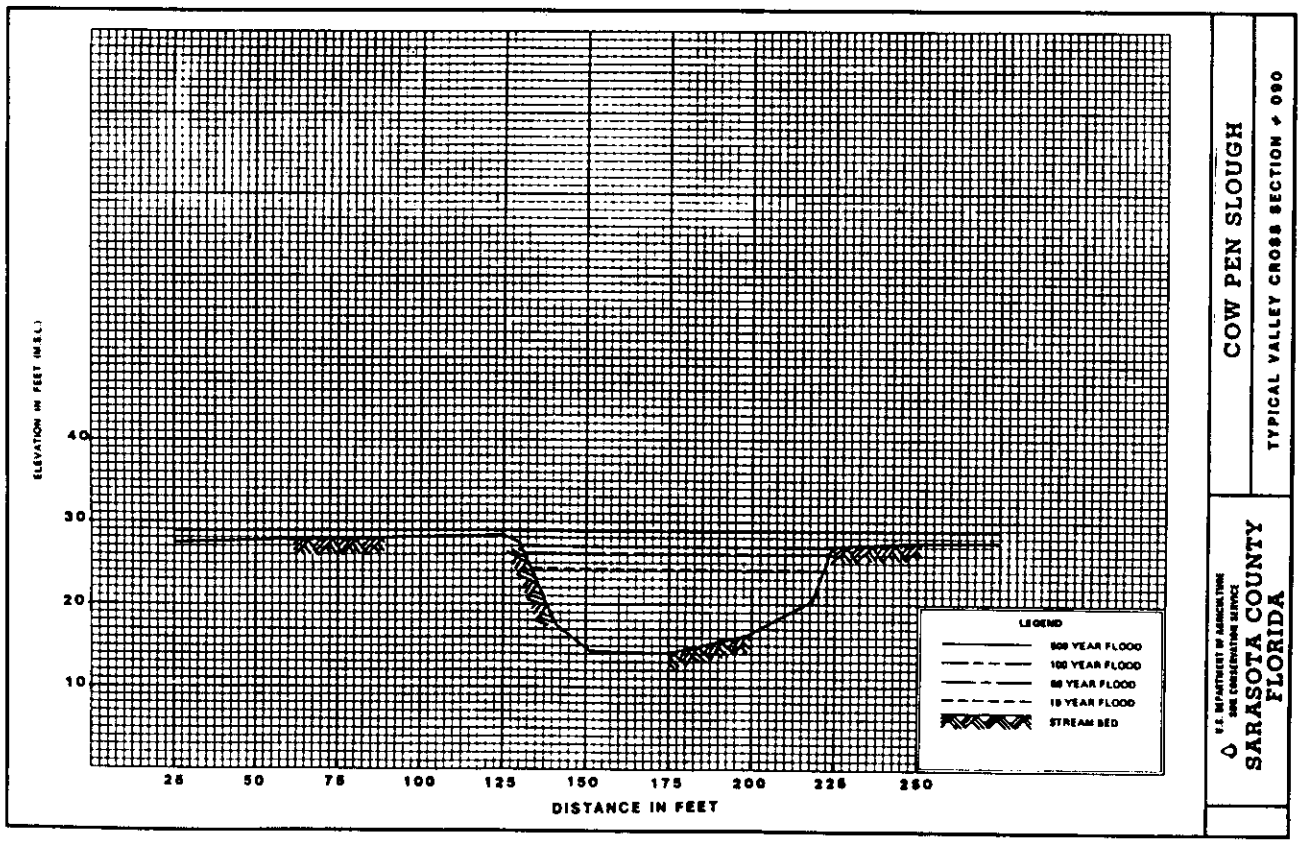

Figure 28. Cross Section 090

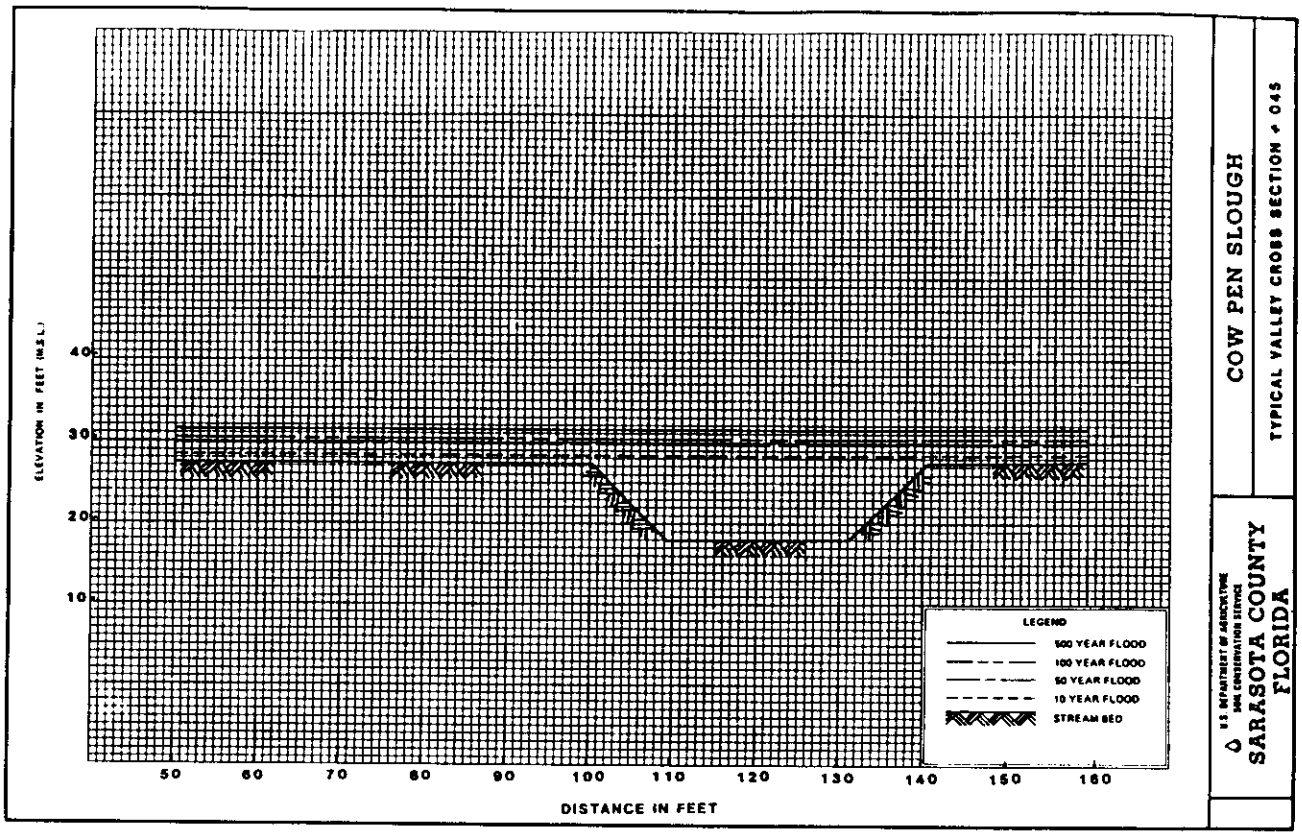

Figure 29. Cross Section 045

APPENDIX D

TECHNICAL APPENDIX

INVESTIGATIONS AND ANALYSES

This study was conducted in accordance with a plan of study dated September 1981, by the SCS and local sponsors (see page 1). A review of pertinent literature was made by SCS personnel in order to become as familiar as possible with the complex hydrology of the study area. Bridge, cross-section and other base field data were obtained in the field by SCS and Sarasota County employees and estimated by photogrammetric methods. A topographic survey on a photo base with one foot contour intervals at a scale of 1 inch = 200 feet was obtained from Southwest Florida Water Management District and used as work maps. In addition, a 1 inch = 1000 feet scale was obtained for publication.

Flood discharges were estimated using the USGS Water Resource Investigations 82-4012 titled "Technique for Estimating Magnitude and Frequency of Floods on Natural Flow Streams in Florida." A program was developed from the method to be used on an IBM XT. The discharges that were generated were then used in the SCS water surface profile program, WSP-2 (step backwater method), to determine water surface elevations for the range of discharge utilizing roughness coefficient data and the field data collected on cross sections, bridges, and culverts.

The flood plain limits are delineated on the aerial photomaps (see Appendix A). The width of the flood plain at each cross section was plotted with the area between cross sections interpolated.

Normal bridge flow conditions are assumed in making computations. No consideration is made for openings blocked by debris, flood plain filling or other encroachments which could affect the water surface profile. Computations for this study considered only those features in the flood plain at the time the field surveys were made. Additional watershed and flood plain development and/or stream modifications will require revised water surface profile computations. The methods used to determine the flood elevations are considered accurate within plus or minus 1/2 foot. Due to scale however, some buildings on raised pads appear to be flooded when in actuality they will probably not.

TABLE 5. DISCHARGE - ELEVATION - FREQUENCY DATA

Cow Pen Slough, Sarasota County, Florida
Cow Pen Slough Watershed FPMS

Cross Section	Station	Drainage Area (Mi^2)	10-Year Elevation: MSL-Ft.	10-Year Discharge CFS	50-Year Elevation: MSL-Ft.	50-Year Discharge CFS	100-Year Elevation: MSL-Ft.	100-Year Discharge CFS	500-Year Elevation: MSL-Ft	500-Year Discharge CFS
194	2000	79.41	5.5	3078	7.4	5321	8.0	6346	9.6	9351
192	3100	63.88	6.3	2639	8.2	4579	8.8	5467	10.4	8086
190	3900	57.71	6.7	2456	8.6	4269	9.2	5100	10.9	7555
188	4880	57.62	8.3	2453	10.8	4265	11.6	5094	13.6	7548
187	6980	57.55	9.2	2451	11.7	4261	12.5	5090	14.8	7541
186	7080	57.54	9.3	2450	11.8	4261	12.7	5089	15.0	7541
184	7270	57.51	9.5	2449	12.1	4259	12.9	5088	15.3	7538
183	7460	57.49	9.6	2449	12.3	4258	13.2	5086	15.7	7536
182	8160	57.44	10.4	2447	13.1	4255	14.8	5083	17.8	7532
180	8860	57.39	11.5	2446	14.1	4253	15.8	5080	17.9	7527
178	8880	57.36	11.5	2445	16.3	4251	16.7	5078	18.3	7525
176	10980	57.18	12.8	2440	16.8	4242	17.2	5068	18.6	7509
175	15272	56.37	14.3	2415	17.8	4201	18.2	5018	19.5	7438
170	20024	54.88	15.6	2370	18.4	4124	18.8	4927	20.0	7306
165	24204	47.49	16.9	2139	18.9	3732	19.4	4462	20.6	6633
160	25004	47.48	17.0	2139	19.0	3731	19.6	4462	20.9	6632
155	25304	47.39	17.0	2136	19.3	3727	19.7	4456	21.0	6624
150	29264	46.91	17.9	2120	20.0	3700	20.4	4425	21.7	6579
145	31904	46.68	18.4	2113	20.3	3688	20.8	4410	22.1	6557
140	34804	46.52	18.8	2108	20.8	3679	21.0	4400	22.7	6542
135	34938	46.47	18.9	2106	20.9	3676	21.5	4396	22.8	6538
130	35072	45.88	19.0	2087	21.0	3644	21.5	4358	22.8	6482
125	39552	42.70	19.2	1984	21.2	3468	21.7	4149	23.0	6178
115	46302	41.66	21.0	1949	23.4	3409	23.9	4079	24.9	6077
105	46352	41.61	21.5	1948	23.6	3407	24.0	4076	25.5	6072
100	47002	40.86	21.8	1923	23.9	3364	24.6	4025	26.4	5999
095	50502	35.21	23.6	1731	25.0	3036	25.4	3635	26.9	5431
090	53102	33.73	24.2	1679	26.3	2947	26.7	3530	27.7	5278
085	55302	33.01	25.3	1653	27.3	2904	27.6	3478	28.4	5202
080	58302	32.54	26.0	1637	27.9	2875	28.2	3444	29.1	5153
075	58802	31.22	26.1	1589	28.0	2794	28.4	3348	29.3	5012

TABLE 5. (Continued)---

Cross Section	Station	Drainage Area (Mi^2)	10-Year Elevation: MSL-Ft.	10-Year Discharge CFS	50-Year Elevation: MSL-Ft.	50-Year Discharge CFS	100-Year Elevation: MSL-Ft.	100-Year Discharge CFS	500-Year Elevation: MSL-Ft	500-Year Discharge CFS
070	59102	27.09	26.2	1437	28.0	2533	28.4	3038	29.3	4559
060	59602	27.05	26.2	1436	28.1	2531	28.4	3035	29.3	4554
055	60002	27.03	26.4	1435	28.2	2529	28.6	3033	29.6	4552
050	60502	27.01	26.6	1434	28.4	2528	28.7	3031	29.7	4550
045	64002	26.94	28.2	1432	29.6	2524	30.2	3026	31.0	4542
040	65502	26.91	28.4	1431	29.9	2522	30.4	3024	31.5	4538
035	67002	26.76	28.6	1425	30.1	2512	30.5	3012	31.6	4522
030	68492	23.41	28.9	1296	30.3	2291	30.8	2748	31.8	4135
025	73192	23.38	29.3	1295	30.5	2288	30.8	2746	31.8	4132
020	74182	0.66	29.4	103	30.6	195	30.9	238	31.8	381
015	78182	0.39	29.7	71	30.6	135	30.9	166	31.9	268
010	78282	0.27	29.7	55	30.6	105	30.9	129	31.9	209
005	78382	0.04	29.7	14	30.6	28	30.9	34	31.9	58