SOUTHWEST FLORIDA REGIONAL PLANNING COUNCIL (813) 334-7382

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AREAWIDE WATER QUALITY MANAGEMENT PROGRAM (SECTION 208)

WATER QUALITY AND HYDRODYNAMIC

SAMPLING PROGRAM DESIGN

AUGUST 1976

WATER QUALITY

AND

HYDRODYNAMIC

SAMPLING PROGRAM

DESIGN

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Background

In early summer 1976, the completed Plan of Study (POS) for the Southwest Florida 208 Program was submitted for review and approval. That POS contained, among other things, a preliminary scope of work for water quality sampling and analysis for four case studies to be performed within the region. It was realized that the sampling and analysis programs would require substantial elaboration and perhaps revision before actual work began. Thus, finalization of sampling program designs was included among the lists of anticipated tasks. Also included were tasks to provide the necessary supportive data to permit this finalization. This document is a report of the elaboration and specification of the sampling program to be accomplished. In all cases the initial nature of case studies remains; however, slight modifications, in light of information recently required, have been made wherever appropriate.

Format

This document presents in detail the water quality sampling program designs for each of four case study areas. These are in order of presentation:

Phillippi Creek Case Study

Charlotte Harbor Case Study

Caloosahatchee River Case Study

Big Cypress Water Quality Monitoring Program

Following these is a section devoted to the detailed design of two hydrodynamic studies corollary to the Phillippi Creek and Charlotte Harbor studies, respectively.

Each section is similar in content. Specification of sampling station locations are made, a description of the purpose of sampling site is presented, and a detailed discussion of the factors influencing its selection, characteristics, types of expected pollutant loads and other pertinent information is given. Also specified are sampling times, numbers of samples collected, and types of analyses to be performed for each.

Each station is assigned an identification reference. Each reference is composed of a letter, followed by a dash, followed by another letter and a number. The first letter indicates the study area, as follows:

S (Sarasota) - Phillippi Creek

H (Harbor) - Charlotte Harbor

C - Caloosahatchee River

B - Big Cypress

The second letter denoted the type of station, as follows:

B - Background or baseline station

R - Rainfall event station

N - Nonpoint source station

D - Dye, drogue station

T - Tributary

The number which follows is the numerical sequence indicator for the particular type and location of station. For example, the fourth station located and assigned a reference for rainfall event sampling in the Phillippi Creek case study is identified as: S-R4.

Included in each section are maps which delineate the locations of the sampling sites according to identification reference.

Following the main body of this report are four appendices. These provided detail and documentation for the facts presented in the main report. An appendix is included for three of the case study areas plus one summarizing pertinent meteorologic data.

Approach

The information contained in this report represents a substantial effort to investigate the water resources of each of the four study areas. The emphasis of the water quality sampling program, as typified in the POS, is to examine and characterize nonpoint pollution to various receiving water bodies. Furthermore, a general concept of those categories of non-point loads is also outlined in the POS and serves as a model for the work reported here. The POS gives the approach by which general sampling definition is to be made more specific.

The detail necessary to determine specific places to sample could not be obtained without a thorough examination of land use, topography and hydrography. For each study area existing summaries of land use were studied as were aerial photographs. Topographic data was obtained from

U.S. Geological Survey Quadrangle Maps and detailed local maps which often delineated one-foot topographic contours. Water flow and water body morphology information was also used.

Since much of the lands being studied are in or near urban areas, it was necessary to ascertain those types of nonpoint source control practices being employed by local agencies. Information regarding such things as street sweeping was accumulated. These had to be delined in order to establish needed communication which will permit coordination during actual sampling.

For example, the pollutant loading from a parking area which is swept regularly will probably be less than loadings from an area not being swept. Loading data obtained from an area being swept cannot be used as typical of all parking areas. Coordination between sweeping activities and sampling will enable estimates of the extent to which sweeping diminished runoff loads to be made.

Both urban and non-urban areas are subjected to an array of activities which contribute to nonpoint source pollution. Many land use activities involve the use of substances which eventually enter area water courses. Livestock and crop production involves the continual application of chemical substances to the lands. Urban areas have weed control or insect control programs which regularly dose the surrounding lands with various substances. Recreational functions, such as golf courses,

repeatedly add chemicals to the land. Lands, contributing runoff to waterways which had been tentatively selected for sampling were examined. Investigations were made to learn about those practices which involved the application of substances which might runoff. Schedules, practices and procedures of application were studied.

The occurrence of rainfall is of key importance to this type of study of nonpoint source pollution. Meteorologic data was used to define the nature of rainfall in each of the study areas. Summaries of historic data provided insight into weather trends.

The methods of accumulating the information discussed above varied. Some data was collected during Phase I of the 208 Program, some data was available from published references, but, by far, the most information was obtained by personnaly interviewing different people in each area. In most cases, assistance came from various governmental agency employees who were familiar with the regions being studied. Additional cooperation was received from area residents, farmers and business people.

The information and data gathered has been used to select, describe and evaluate the sampling sites as presented in the report. In most cases that information is reflected in the text of the sections which follow. Details of personal interviews are presented in the respective appendices.

Constituent Coverage

The water quality constituents to be included in the analysis of receiving water samples varies among sampling sites. The different sites involve different sampling purposes (e.g., baseline characterization, rainfall event), different types of water bodies (e.g., bays, streams, canals), and different expected pollutant loadings due to, for example, different land uses being drained. However, the constitutent list for all the locations is similar. The following is a list of all the water quality variables for which analyses will be made including a brief description of the basis for selecting that variable. Many other water quality indicators exist. Besides the chemical, physical, and microbiologic constituents included below, others exist which are useful, but those included provide the basic information needed to accomplish the various stated goals of the program. Other types of water quality constituents, for instance, biologic indicators, have not been included in the program design. These often provide very descriptive information of the condition of the receiving waters, especially from an historic viewpoint. The focus of the studies included here is to specify current water quality, that which exists now or even during a particular event. Also, the funds available to conduct sampling and perform laboratory analyses are limited. Therefore, the group of constituents for any sampling site is far from being all inclusive, yet within the framework of this program, will suffice for the objectives stated.

** pH - provides a definition of the concentration of H^+ ions in the water. Aquatic biologic processes are very sensitive to pH and pH change.

** Dissolved oxygen - provides a measure of gaseous oxygen available for life processes in the water body.

** Alkalinity - provides a measure of the buffering capacity of the water. This is ability to withstand additions of (chemically) acidic or basic substances without displaying substantial pH change.

** Color - is a measure of color level in the water. Color indicates the presence of various substances and affects the light transmission of the water body. This both influences organisms living in the water and those who use the water.

** Turbidity - is a measure of the light scattering properties of the water, and hence, an indication of suspended and dissolved material content. Highly turbid waters will not transmit light well.

** Solids content - provides information about foreign materials in the water from a physical standpoint.

* Dissolved solids - is a measure of dissolved materials which are chemically bound to the water molecules.

* Suspended solids - is a measure of solids materials which are not chemically bound. Much suspended matter will settle out of quiescent water. Much turbidity is caused by these solids. Besides blocking light, suspended solids may clog pores or otherwise interfere with aquatic life. Also, many other pollutants in natural waters may cling to suspended matter, thereby influencing the water quality and being transported by the solids particles.

** Total phosphorus - indicates the amount of phosphorus in the water. Phosphorus is a nutrient which is critical to water life and may help cause harmful proliferation of life, especially plants.

** Orthophosphate - is a measure of the dissolved phosphorus in the water body. This form is that most readily available as a nutrient.

** Nitrogen - is another nutrient and therefore important to aquatic life processes. It is present in several forms, all of which are important.

* Ammonia (NH_3) nitrogen - is a measure of the nitrogen available in the unoxidized form. Hence, it is an indicator of the (chemical) oxidation-reduction status of the water as well as a measure of nitrogen potentially available as a nutrient. Ammonia is toxic to certain aquatic life.

* Nitrate/nitrite (NO_3-NO_2) nitrogen - is an oxidized form of nitrogen. It also indicates oxidation-reduction status and is potentially a nutrient.

* Total Kjeldahl nitrogen - is a measure of organic plus ammonia nitrogen. Subtracting ammonia nitrogen yields a value of organic nitrogen content.

** Carbon - is yet another important nutrient. It also exists in several forms.

* Organic carbon - is a measure of carbon occurring in organic form. It is less available as nutrient, but ultimately will support growth.

* Inorganic carbon - is a measure of the (usually) more readily available form of carbon which is used by plants for growth.

** Heavy metals - provide an indication of the content of metallic substances which are toxic to life in varying concentrations. However, some organisms store metals which causes even slight levels in the water to be critical. Aquatic organisms as well as other life (including human) using the waters for life support may be harmed due to metals contamination. Various heavy metals analyses are included: arsenic, mercury, manganese, lead, copper, and zinc.

** Fluoride - is a measure of the concentration of fluoride ion. This substance is potentially toxic to in-water and out-of-water life.

** Pesticides - provides concentrations of various organochlorine and organophosphorus pesticides. These substances may be lethal or harmful to aquatic life. Besides they may be retained in animal tissue and passed from animal to animal up natural food chains. At each step in the chain, the concentrations may be amplified.

** Fecal indicators - provide a measure of fecal pollution of the waters. By measuring both fecal coliform and fecal streptococcus concentrations, the ratio of the two may be found. While either alone merely indicates some fecal contamination, the ratio is a good indicator of whether human versus other animal wastes (e.g., cattle) are present.

** Biochemical oxygen demand (BOD) - is a measure of the concentation of biologically oxidizable substances in the water. This may indicate sewage pollution but is not conclusive. It indicates whether or not oxygen loads on the system are such that dissolved oxygen levels may drop to harmful levels.

** Oil and grease - indicates the concentrations of these substances in the water. They are indicators of urban pollution and are harmful to life in the water and life using the water.

Meteorologic (Rainfall) Analysis

An analysis of the meteorologic data gathered during Phase I of the 208 program has provided information for the scheduling of storm event sampling and for the interpretation of the significance of each storm event sampled.

Precipitation data collected by the United States Department of Commerce, National Climatic Center, N.O.A.A. was analyzed to coordinate storm event sampling with the wet and dry seasons in the Sarasota area, Punta Gorda area, and Fort Myers/La Belle area. The data represents monthly average mean precipitation over a thirty period between 1941 and 1970. This data indicates that the wet season begins during mid-May and ends during the first two weeks of October. The period best suited for wet season sampling is July through September. An analysis of data from the United States Department of Agriculture, Soil Conservation Service, Rainfall Frequency Atlas has provided the information necessary to determine the significance of the intensity and duration of each storm sampled. This information, as well as, the monthly rainfall data is tabulated in Appendix D.

Interim Determination of Adequacy of Constituent Coverage

It is possible to analyze sets of data to determine whether or not certain data may be dropped or disregarded without any significant loss of information. Rigorous statistical methods are available to accomplish this; however, it is impractical to subject limited numbers of data to such analysis. The water quality data gathered from this sampling program will be thusly limited, at least until the results of several monthly samples are available.

The analysis results will be examined subjectively as they become available. This examination may indicate that certain constituents should not be sampled further. If this situation arises, recommendations will be made to discontinue the analysis for the pertinent constituent.

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There is little likelihood that seasonal or rainfall event sampling will produce sufficient data for statistical examination. Monthly baseline data may be amenable to such examination after six or seven months. Multi-variable analysis of monthly baseline data sets will be performed if the amount of data permits useful results. Should these results so indicate, recommendation will be made to discontinue the analysis in question.

PHILLIPPI CREEK CASE STUDY

WATER QUALITY SAMPLING PROGRAM

PHILLIPPI CREEK CASE STUDY WATER QUALITY SAMPLING PROGRAM

The design for the water quality sampling program in the Phillippi Creek case study systematically addresses the character of storm water runoff in urban and nonurban land use categories. Both the wet and dry season sampling programs include sampling stations (1) on Phillippi Creek to sample urban and non-urban sources of pollution and (2) on tributaries to Phillippi Creek to characterize runoff from residential, commercial and open space areas. Incorporated in the dry season sampling program are sampling stations in Roberts Bay and South Sarasota Bay. The wet season sampling program consists of two (2) rainfall event sampling locations on Phillippi Creek and five (5) rainfall event sampling locations on tributaries to Phillippi Creek which represents various types of urban land use. The dry season sampling program is composed of three (3) background sampling locations on Phillippi Creek, four (4) background sampling locations in Roberts and South Sarasota Bay, and three (3) rainfall event stations in urban settings.

Sampling Locations and Land Use Criteria

Sample site location, land use category, and nonpoint source practices and procedures are as follows:

Rainfall Event Stations

S-R1 This station is located on Phillippi Creek, in the Fruitville Drainage District, adjacent to the bridge at the intersection of Main A Canal and Cattleman's Road. The location is 1/4 mile west of the junction of drainage ditch No. 52 and Main A Canal (Figure 1).

This upland station has been chosen to characterize nonurban sources of pollution. Other nearby nonurban land is drained by branch canals entering below S-R1. However, downstream sites could not be used due to other types of land uses contributing. Sampling will take place during four (4) storm events of different intensities and duration during the wet season. Six (6) samples will be taken per storm event.

Samples from this location will characterize a predominately agricultural land use, having a drainage area approximately fourteen square miles in size. Farming activities, mainly celery, cabbage and corn growing, are located in the eastern and western sections of the drainage basin. Citrus production is located along the eastern most margin of the basin. Developed parcels, two to five acres per unit, and planned development define the northern margin of the basin. The central and southern sections are improved pasture lands for cattle production. Ranchettes, which may contain cattle, horses, gardens, groves, etc., are scattered throughout the drainage basin. Also included within this drainage area are two golf courses and a large camping ground.

Nonpoint source control practices for the maintenance of water flow within the S-R1 drainage area are:

(a) A man-made dike extending along Cow Pen Slough and forming the eastern boundary of the drainage area.

(b) A weir located on ditch No. 52, approximately 1/4 mile north of the junction of Main A Canal and ditch No. 52. The primary purpose of this structure is to maintain a suitable water level during the dry season for farming activities in the western section. Water flow is allowed to move freely during most of

the wet season. Specific control schedule for water flow is determined by need and meterologic conditions.

(c) A weir located on Main A Canal, approximately 1/2 mile west of Cow Pen Slough, maintains the water level during the dry season for farming activities in the eastern section. Specific control schedule is similiar to that described above.

(d) Irrigation ditches are used to maintain water levels in farming fields during the dry season.

(e) Irrigation pumps are located along ditches to transport water to fields.

(f) Mechanical and chemical maintenance of ditches. Refer to Appendix A for complete discussion of chemical application and maintenance schedule.

The practices and procedures of nonpoint source land users within sample site S-R1's drainage area include:

(a) Farming activities, such as the planting and maintenance of seed beds, and the preparation of fields (i.e., cutting and turning cover crops into the ground) occur during the wet season. The growing season extends from September through mid May. During this period, fertilizer is applied four (4) times directly on the ground and turned into the ground by tractor. Sprays, pesticides and fungicides, are applied as need occurs. Meteorologic conditions determine the type of spray. Sprays are applied directly on plants from a cart with a boom covering 12 rows.

(b) Citrus growing activities including maintenance of young groves (2 years) and older groves (14 years). The grove age determines the type, amount, method and schedule of application of fertilizers, pesticides and herbicides.

(c) Pasture maintenance for cattle production may include annual, multi-annual or no fertilizer application. The cattle market price influences the maintenance, such that it may not be economical for cattle producers to fertilize pasture areas.

(d) Ranchette management activities are less dependent on the cattle market price and therefore may carry on a more regular maintenance program. Fertilizer application will vary between land owner and may not be applied in areas where grass grows easily.

(e) Golf course maintenance varies between courses and depends on individual needs. Generally greens and tees are fertilized more regularly than fairways. Fertilizers, pesticides and fungicides are applied from low pressure tractor or truck systems.

(f) The Sarasota County mosquito control program is designed to treat only areas showing evidence of mosquitos or larvae. (Diesel fuel No. 2 containing triton X-207 additive is the primary pesticide used and is applied through high pressure hoses from trucks or portable manual tanks.)

(g) A regular street sweeping program does not exist within the drainage area. Hazardous materials and road debris, however,

are removed upon request to the Sarasota County Department of Public Works, Road and Bridge Division.

Appendix A contains further reference to chemical types and application methods associated with local land use practices.

S-R2 This sampling site is located near the mouth of Phillippi Creek at the Riverview High School (Figure 1). The location has been selected because it is adjacent to the USGS/SCECD flow gage station and is downstream of the Sarasota urban area. This sampling site, therefore is subject to both the upland agricultural runoff loads and the urban loads from various land users including residential, recreational, open and commercial lands. Wet season sampling will occur during four (4) storm events. Six (6) samples will be taken per storm event.

Nonpoint source control practices within the S-R2 drainage area include:

(a) Mechanical and chemical maintenance of drainage ditches to prevent restriction of water flow.

(b) Regular street sweeping activities exist within Sarasota City Limits. Street sweeping in Sarasota County, excluding city area, is limited to the removal of hazardous and undesirable road debris, and the sweeping of commercial parking areas.

(c) The Sarasota County Mosquito Control Program, which is designed only to treat areas having evident of mosquito habitats.

(d) Weirs and dams, exclusive of thoses described for site S-R1, located on Phillippi Creek and tributary ditches are no longer used to control water flow.

Appendix A contains a complete discussion of the type and method of chemical application for the ditch and mosquito maintenance programs.

The practices and procedures of potential nonpoint source land users within the S-R2 drainage basin include:

(a) Upland agricultural land use activities, primarily those discussed in the S-R1 drainage basin.

(b) Urban land use activities, such as residential lawn care and golf course maintenance.

Information concerning specific types of chemical application and methods within the S-R2 drainage basin is found in Appendix A.

S-R3 This sampling site is located at a bridge, at the intersection of Bahia Vista Street and drainage ditch No. 2, in the Fruitville Drainage District (Figure 1). The drainage basin is 0.6 square miles in area and represents an undeveloped land use. The area is indicative of a pine/saw palmetto flatwood association commonly found in Florida's coastal areas. This location will be sampled during one (1) storm event in the wet season. Six (6) samples will be taken during the storm event.

Nonpoint source control practices include mechanical/chemical maintenance of drainage ditches and mosquito control treatment in mosquito habitats. The practices of nonpoint source land users in negligible due to the land use category.

S-R4 This sampling location is on drainage ditch No. 34-A at Fruitville Road, SR 780, (Figure 1). This site has been selected because it is located in a region of urban recreational lands. The recreational land use category includes a golf course, a school yard, and other open areas. A small portion of the golf course covers a reclaimed landfill. The drainage area is about one square mile. One (1) storm event will be sampled during the wet season. During the dry season one (1) storm event will be sampled. Six (6) samples will be taken per storm event .

Nonpoint source control practices include the mechanical/chemical maintenance of the drainage ditch and mosquito habitat.

The practices and procedures of nonpoint source land users are primarily the maintenance program for the golf course and the ranchette land use activities at the drainage basins eastern section of the basin.

Appendix A contains a detailed description of the chemical application program on the golf course area.

S-R5 This sampling site is located at the Southeast Shopping Plaza, on the south side of Bee Ridge Road, and about 1000 feet west of the McIntosh Road (Figure 1). This station has been chosen because it represents a typical commercial land use. The Southeast Shopping Plaza includes a grocery store, a drug store, a bank, a service station and various specialty stores. Drainage from the paved parking area is predominately

toward Bee Ridge Road. Runoff is collected in a grass roadside ditch and transported westward to a culvert leading under Bee Ridge Road.

Nonpoint source control practices include:

(a) The regular grass cutting of the drainage ditches for improved water flow,

(b) Semi-annual sweeping of the entire parking area and

(c) Regular vacuuming of sidewalks, curbs/gutters and areas that concentrate sand, debris, etc.

To determine pollution loading in the commercial land use area, storm event sampling will be coordinated with the shopping center's vacuuming schedule.

This station will be sampled during two (2) storm events in the wet season. Six (6) samples will be taken during each storm event. During the dry season one (1) storm event will be sampled. Six (6) samples will be taken per storm event.

S-R6 This sampling location is located on drainage ditch No. 9, in the Hyde Park Drainage District, north of the intersection of Tanglewood Drive and Dawson Street and near the entrance to Phillippi Creek (Figure 1). This site has been selected because it represents an artificial drainage ditch receiving runoff from residential areas with runoff from adjacent golf course lands. All streets in the drainage

area are paved. Storm water runoff is transported to ditch No. 9 via concrete street gutters.

The drainage area is approximately 0.25 square miles in size.

Nonpoint source control practices include:

(a) Mechanical/chemical maintenance of drainage ditches and

(b) Treatment for mosquito control, only if mosquito habitats exist.

(Sweeping activities are restricted to the removal of road debris only upon request to the Sarasota Department of Public Works, Road and Bridge Division.)

The practices and procedures of nonpoint source land uses include:

(a) The maintenance of the Forest Lakes County Club Golf Course, and

(b) Lawn maintenance for single unit residential housing.

Refer to Appendix A for a detailed discussion of the chemical application for the golf course, mosquito control and ditch maintenance programs.

The location will be sampled during two (2) storm events in the wet season. Six (6) samples will be taken per storm event. During the dry season one (1) storm event will be sampled. Six (6) samples will be taken during each storm event.

S-R7 This sampling site is located on drainage ditch No. 7, just north of the junction of ditch No. 7 and No. 8 in the Fruitville Drainage District (Figure 1). This location represents a residential land use area of about

0.7 square miles. Streets are paved and unpaved. Grass lined ditches border most streets, transporting runoff to drainage ditches No. 7 and No. 8.

Nonpoint source control practices include the maintenance of drainage ditches, mosquito control treatment, and individual home owner lawn care. Street seeping activities are restricted to the removal of road debris only upon request to the Sarasota County Department of Public Works, Road and Bridge Division.

Appendix A includes descriptions of the chemical ditch maintenance and mosquito control programs.

This station will be sampled during two (2) storm events in the wet season. Six (6) samples will be taken during each storm.

S-B1 Dry Season Background Stations

The dry season background sampling will commence the third or fourth week of January 1977. The initial round will be followed by two other rounds. Time between each round will be about four weeks.

The constituents analyzed in the background samples will be identical to those analyzed at Stations S-R4, S-R5, S-R6, S-R7. Conductivity measurement, however, will be for the vertical water profile. Readings will be made at one-foot intervals in waters ten feet deep or less; at two-foot intervals in water deeper than 10 feet; starting at the surface.

S-B1 This station is the dry season analog of station S-R1. See the discussion of station S-R1 for pertinent information (Figure 1).

S-B2. This station is located on Phillippi Creek at an unused salinity control structure, approximately 300 yards upstream from the Tuttle Avenue bridge. The station is situated in the midst of an urban residential area which is predominately single-family dwellings of high density. Heavy storm water runoff loads are carried to the creek by a network of drainage ditches and culverts. The stream at this point is also impacted by pollutant loadings transported from upstream, including non-urban area drainage, sewage treatment plant effluents, open land runoff, recreational land runoff, and upstream residential land runoff (Figure 2).

S-B3 This station is the dry season analog of station S-R2. See the discussion of station S-R2 for pertinent information (Figure 2).

S-B4 This station is located at the north end of Roberts Bay about one-quarter mile south of the SR 789 bridge at mid-channel (Figure 2).

The site has been selected because the relatively narrow cross-section will probably insure a representative sample of Roberts Bay water quality. The sample should be taken near the end of ebb tide.

S-B5 This station is located in Big Sarasota Pass at its narrowest point at mid-channel (Figure 2).

This station will typify water quality exiting in the main portion of the Sarasota Bay system when sampled near the end of ebb tide. It may not include significant Phillippi Creek influence.

S-B6 This station is located about one-quarter mile south of the SR 72 bridge at the north end of Little Sarasota bay (Figure 2).

When sampled near the middle of flood tide it should be indicative of bay water quality.

S-B7 This station is located at the south end of Bird Keys near Midnight Pass (Figure 2).

Sampling will be done near the end of ebb tide. This will be representative of water quality in the southern portion of Little Sarasota Bay. By sampling S-B7 and S-B5, the variation in bay water quality with distance from Phillippi Creek may be estimated.

Water Quality Constituent Analysis

Samples taken will be analyzed for the water quality constituents listed below:

For the small urban drainage basins, sampling locations S-R4, S-R5, S-R6 and S-R7:

Temperature, *in situ*
Dissolved oxygen, *in situ*
pH, *in situ*
Alkalinity
Color
Turbidity
Suspended solids
Fecal coliform
Fecal streptococci
Total phosphorus
Dissolved orthophosphate
NO_2 - NO_3 as N
NO_3 as N
Total Kjeldahl Nitrogen
Arsenic, Mercury, Manganese
Organochlorine pesticides
Organophosphorus pesticides
Total organic carbon
Oil and grease
Biochemical Oxygen Demand (BOD) (5-day)
Lead, Copper
Conductivity
Flow, *in situ*

For the undeveloped, open land use small basin, sampling location S-R3:

The original constituents listed above less:
- Organochlorine pesticides
- Organophosphorus pesticides

For the upland sampling station S-R1:

The original constituents lised above less:
- Oil and grease
- Lead and copper
- Conductivity

For the Phillippi Creek downstream station S-R2:

The original constituents listed above less:
- Conductivity
- Organochlorine pesticides
- Organophosphorus pesticides

Salinity, in situ, will be measured.

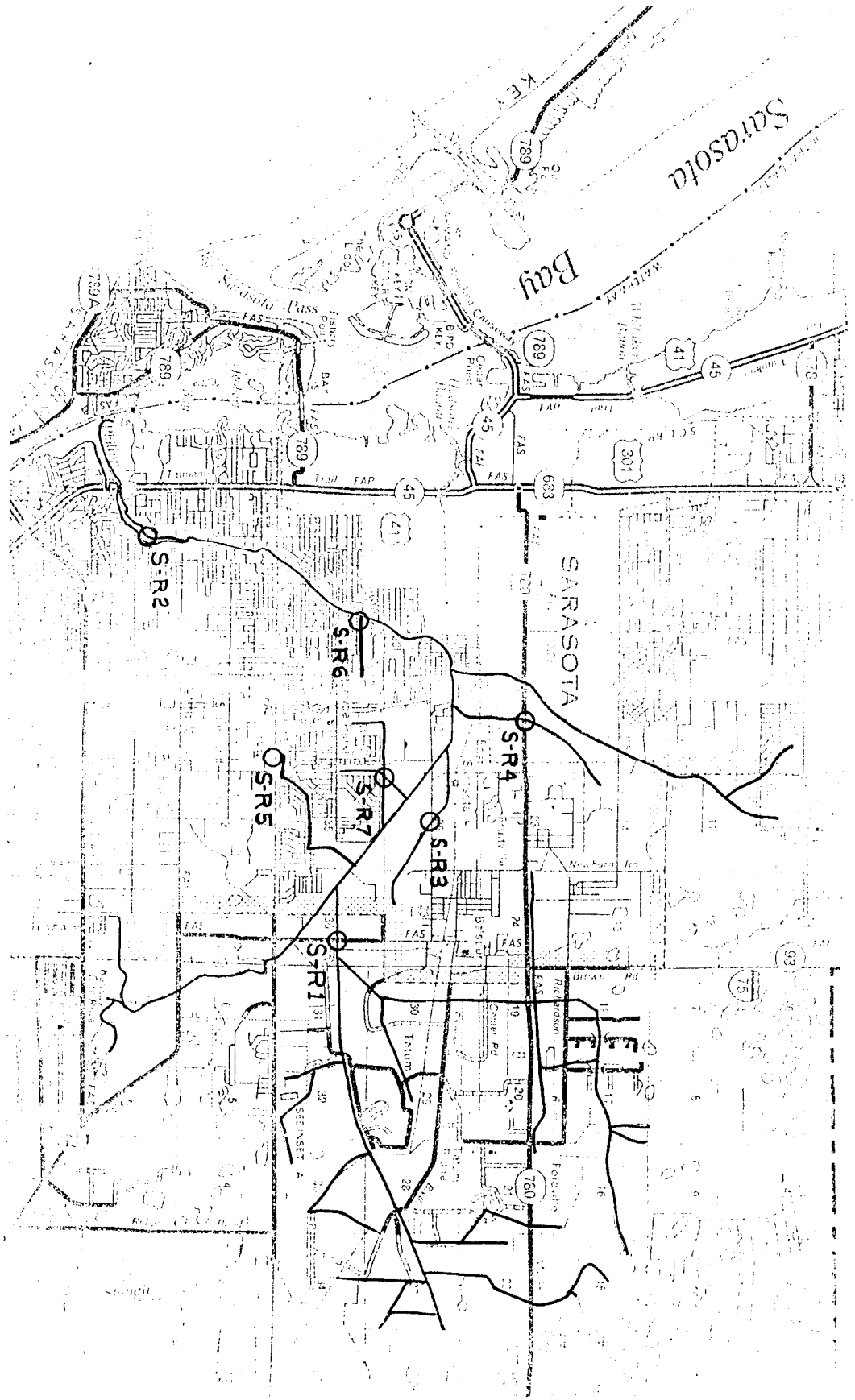


Figure 1. Phillippi Creek Rainfall Event Sampling Station Locations.

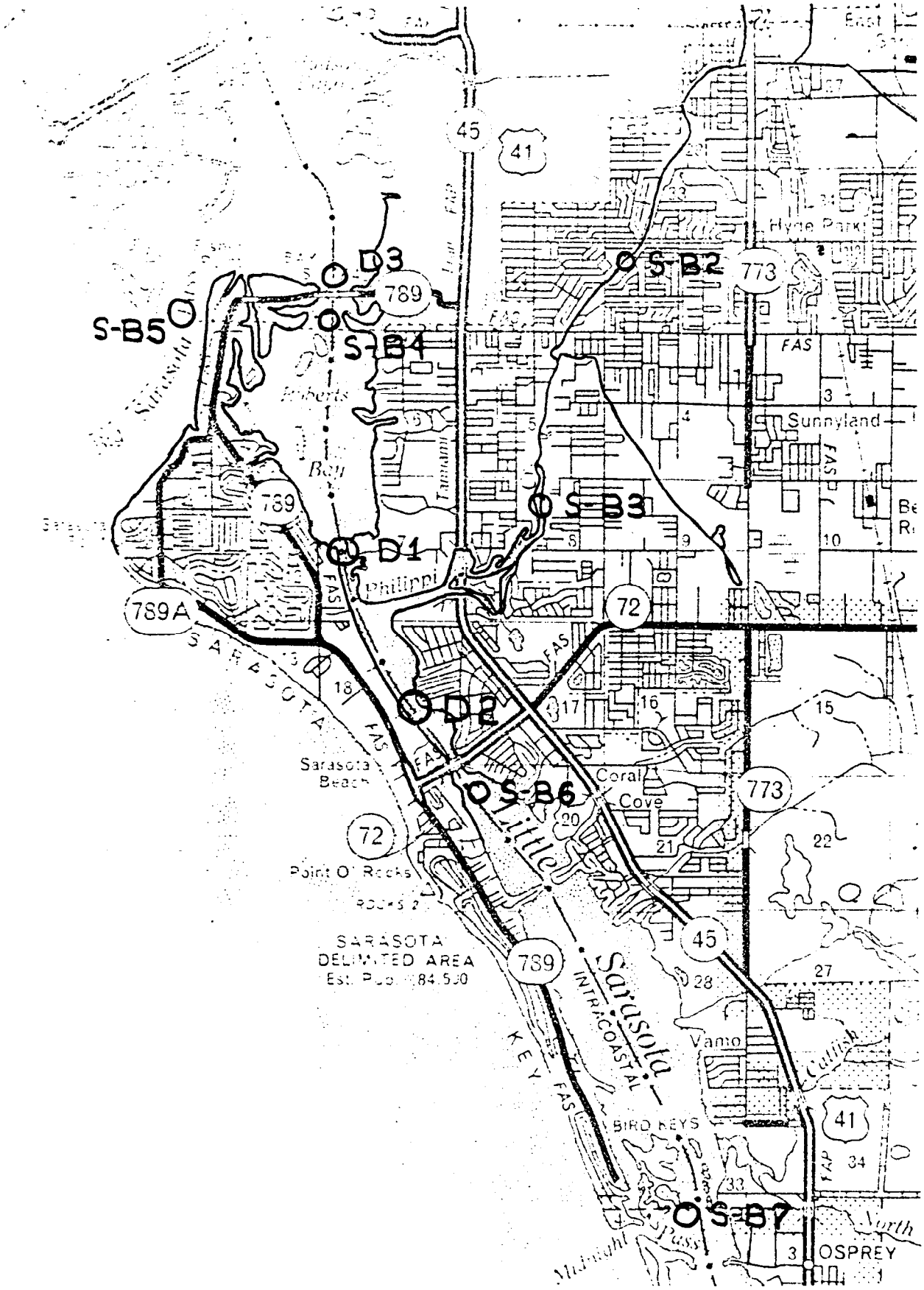


Figure 2. Phillippi Creek Dry Season Background Station Locations.

CHARLOTTE HARBOR CASE STUDY

WATER QUALITY SAMPLING PROGRAM

CHARLOTTE HARBOR CASE STUDY WATER QUALITY SAMPLING PROGRAM

Introduction

The Charlotte Harbor estuary system represents one of the more significant and complex systems within the planning region, it is also one of the largest estuarine environments in the State of Florida. The system is fed by three major tributaries, the Peace, Myakka and Caloosahatchee Rivers. Pollutant contributions from hydrographic modification, urbanization, rangeland, wetlands and point sources are among the notable potential problems. The water quality sampling program has been designed to characterize primary sources of pollutants contributed by principal tributaries and inflow sources, and the baseline water quality of the system. Another objective of the study is to determine, to a degree, the spatial and temporal distribution of contaminants introduced to the estuary. Overall water quality resulting from contaminant inflow will be approximated by monitoring, to a limited extent, pollutant loads to the harbor from the major contributing sources. The data gathered will later be used to calculate a mass balance of input and output substances, yielding average substance concentrations within the harbor. The water quality data collection program will sample the baseline water quality of the Charlotte Harbor Estuary system and the loadings on the system imposed by major tributary sources and runoff from certain land use categories.

Wet and dry season sampling will be conducted for the harbor system and tributary sources. This baseline sampling program will be conducted monthly for a ten month period beginning in July 1976, at a total of thirty sites. The nonpoint source, rainfall event, sampling will be used to characterize

the nonpoint source loads to the harbor from open land use and the canal land use. Sampling will be from two storms of different intensities and durations. Most of the samples will be gathered during the rising limb of the runoff hydrograph. Flow and rainfall measurements will be made coincidently with the water quality sampling.

Harbor Baseline Sampling

Charlotte Harbor will be sampled monthly beginning in July 1976 and continuing for ten months. The purpose of this sampling is to document the variability of water quality with location and with time from season to season. The sampling sites have been selected such that areas near points of inflow and outflow and points throughout the harbor interior are represented. The multiple stations will provide data which will later be analyzed to assess: the degree of pollutant loadings to the harbor from various inflow; the level of loadings to adjacent waterbodies via various outflows; the variation of near surface water quality at different places in the harbor; and an average, or typical, water quality specification using some of all of the multiple samples.

One sample will be taken at each station. Water from approximately one foot below the surface will be collected. Samples at multiple depths will not be taken due to the limited scope of the program; however, variation of water quality with depth may be expected due to horizontal density stratification. This stratification is caused by densimetric differences between saline and fresh waters. The amount the two water types mix after contact depends on many factors, such as wind speed and direction, water temperature, water velocity, water depth, bottom topography and roughness, and concentrations of suspended and dissolved materials in each water mass, among others. It is likely that conditions are stable, in other words, the stratifying forces are stronger than those promoting mixing. If stability exists, then the fresh water mass

will retain its integrity and "float" on top of the more dense saline water. The near surface samples taken will, under those conditions, satisfactorily reflect the harbor water quality as impacted by runoff and fresh-water inflow.

Because of the question of degree of stability, the sampling program will include a limited check of vertical water quality variation. Salinity measurements at each sample site will be made at points in the water column. For waters less than ten feet deep one-foot increments starting at the surface will be used. For waters over ten feet deep, two-foot increments will be used. Three sets of these measurements will be made coincident with regular sampling during September, January, and April. — Good

Tidal flow will affect the spacial variation of water quality. The sampling must be accomplished during uniform tidal conditions. Samples will be taken in the harbor during ebb flows.

The water quality constituents sampled for this baseline sampling program are:

pH, in situ
Dissolved oxygen, in situ
Alkalinity
Color
Turbidity
Suspended solids
Fecal coliform
Fecal streptococci
Total phosphorous
Dissolved orthophosphate
NO_2 - NO_3 as N
NH_3 as N

Total Kjeldahl Nitrogen
Arsenic, mercury, manganese
Organochlorine pesticides
Organophosphorus pesticides
Total organic carbon, total carbon, total inorganic carbon
Oil and grease
Lead
Copper
Flouride
BOD

The organochlorine and organophosphorus pesticides will not be sampled during August. They may or may not be included for subsequent months depending upon the analysis results of the July samples. If pesticides are not indicated as prominent at various places in the harbor, they will not be included in subsequent analyses.

Below is a list of harbor baseline station locations. The locations are also indicated in Figure 3.

H-B1 Center of Myakka River between Shoal Point and Trout Creek.

H-B2 Center of Peace River between Locust Point and Punta Gorda.

H-B3 Center of harbor between red marker "1" and black marker "9" approximately two miles west of Mangrove Point.

H-B4, H-B5, H-B6 A line of three stations due west of Silcox Key, at 2, 4, and 6 miles to the west of that point.

H-B7, H-B8, H-B9 Three stations located on a line from Key Point to Cape Haze.

H-B7 - one mile east of Cape Haze,

H-B8 - center of harbor,

H-B9 - one mile west of Key Point.

H-B10 Center of harbor between Cape Haze and Bokeelia Island.

H-B11 Center of Gasparilla Sound.

H-B12 Center of Turtle Bay

H-B13 Center of harbor between Bull Bay and Patricio Island at the markers.

H-B14 Center channel between Pine Island and eastern shore. Approximately one mile from the east shore.

H-B15 Center of Gasparilla Sound entrance between Boca Grande and Cayo Pelan, approximately one mile south of Devilfish Key.

H-B16 Center entrance to Pine Island Sound, mid harbor between north point of Cayo Costa and Bokeelia Island, approximately two miles east of Cayo Costa north point.

H-B17 Center channel Boca Grande Passage.

H-B18 Gulf of Mexico beyond influence of Charlotte Harbor tide waters (receiving water sample).

Tributary Source Sampling

This tributary source sampling program is designed to be compatible with the harbor sampling program described in the preceding section. Pollutant loads to Charlotte Harbor enter either through advected inflow waters or fall directly into the harbor. Loadings from the latter (e.g., air pollutants) are relatively small in amount. Advected waters enter via tributary flow or direct runoff. Tributary flow will account for substantially more volume than runoff, and probably more pollutant loadings also. A series of samples will be taken at twelve tributary inflow points to the harbor.

Sampling considerations are similar to those for the harbor sites. Samples will be taken on ebb tides. One sample will be taken near mid-channel, at about one foot from the water surface at each site.

Sample times will coincide with harbor baseline sampling. Ten monthly samples will be gathered commencing July 1976.

The constituents sampled at each tributary are the same as those sampled in the harbor. The list appears in the preceding section and will not be repeated here. Also, the tentative deletion of pesticides from the list applies.

The locations of the tributary source sampling stations are as follows. These are also incidated on maps which follow.

H-T1 Coral Creek. Approximately 200 yards upstream (northwest) of S.R. 771 bridge (Figure 4).

H-T2 Tidal portion of Myakka River. Mid-channel about 100 yards west of El Jobean bridge (Highway 771) (Figure 5).

H-T3 Big Slough. About 100 yards upstream (east) of Sarasota/Charlotte County lines in Charlotte County (Figure 6).

H-T4 Nontidal portion of the Myakka River. Above the U.S. 41 bridge (Figure 7).

H-T5 Port Charlotte. In Alligator Bay, northeast of Grassy Point, near canal mouth (Figure 8).

H-T6 Little Alligator Creek. One-quarter mile upstream from creek mouth (Figure 8).

H-T7 Sam Knight Creek. About 200 yards downstream from Seaboard Coast Line bridge (Figure 5).

H-T8 Alligator Creek. Just downstream from SR 765 bridge (Figure 9).

H-T9 Key Point Creek (Bear Branch). About one-quarter mile upstream from creek mouth (Figure 10).

H-T10 Tidal portion of Peach River. Mid-channel off Shell Point (Figure 11).

H-T11 Shell Creek. About 100 yards upstream of Seaboard Coast Line bridge (Figure 11).

H-T12 Nontidal portion of Peace River. About 100 yards downstream of old railroad grade (northeast corner Sec. 15, of R 23 E, T 39 S, Desoto County) (Figure 12).

Hydrographic Modification Storm Water Sampling

H-R1 The sampling point is on an unnamed canal, parallel to Conway Street in the Port Charlotte development. The site is located just north of Highway 45 above a concrete flow structure in the canal (Figure 13). The site was selected because the sampling point represents eleven (11) miles of artificial canal waterway which flows ultimately to Charlotte Harbor through Alligator Bay. Primary drainage to the canal is contributed from more than ten square miles of concentrated urban development, partially developed land, and drainage from upland sources. The site is also beyond tidal influence due to the dyke structure.

The land use is typical of single family residental housing located on a hydrographically modified canal system. Included within the drainage area is the Port Charlotte Golf Club. All streets are paved and runoff is transported to the canal through ditches, grass swales and storm sewers.

The drainage canal is approximately one-hundred feet wide. The margins of the canal consist of grass slopes behind residential units. Culverts at road crossways allow free water flow in the canal. Two overflow structures are located about two and one-half miles up from the sampling site. A controlled water barrier is located approximately three miles up from the sampling location. The quantity of floating vegetation increases up canal from the sampling site and completely covers the canal at some locations.

The nonpoint source control practices in the drainage areas do not include street sweeping activities or a regular canal maintenance program. Water flow in the canal is partially controlled by the mechanical water barrier and by the overflow struture. Periodic mechanical or chemical treatment may occur in the canal. A local resident reported that canal maintenance has been by a selective method and that the aquatic vegetation completely covering the canal adjacent to some homes has not been treated for over one and a half years.

The practices of nonpoint source land users include residential lawn maintenance and golf course maintenance. Since most residents in the Port Charlotte development are retired citizens, much of the lawn care activity is provided by professional lawn service personnel. Although the specific maintenance schedules will vary among residential units, fertilizer application may be applied up to four times per year. Within the study area, grass cutting occurs about once every ten days. The lawn cuttings are either removed by the lawn care personnel or placed

in plastic or metal containers along the roadside to be removed during regular garbage collection. Many home owners pump water from the canal for lawn conditioning. The golf course maintenance program includes fertilizer application to fairways at the end of May and in mid-September. Fertilizer application to greens and tees occurs on a more regular schedule. Recommendations by the Florida Agricultural Extension Service for fertilizer, pesticide and herbicide application are closely followed by the golf course superintendent.

Open Space Storm Water Sampling

H-R2 The majority of the open or undeveloped areas within the region are characteristically poorly drained or drainage efficiency has been enhanced by channelization. The selection of the sampling location has included interviews with governmental personnel familiar with the land use and drainage characteristics in the region, extensive review of topographic maps and aerial photographs, and on site exampination of various site candidates.

The sampling site has been determined to be on the north prong of Alligator Creek at its intersection with Jones Loop Road, adjacent to a USGS stream gauging station, and at a point beyond significant tidal influence and salinity intrusion (Figure 14). The drainage basin approximately four square miles in area and is characterized by open space, woodlands, some pasture area and an area of planned development. The area to be developed consists of about two square miles of platted open and pine lands. Drainage is transported to Alligator Creek through

grass and dirt roadside ditches. Less than one-half dozen houses are located within the entire drainage area. The open space, the woodlands and the pasutre areas are located in the Cecil Webb Wildlife Management Area and are drained by natural flow and small improved ditches. The sampling location is above citrus grove and livestock areas within Jones Loop Road.

The land use practices in the area include the treatment of roadside ditches for mosquito control and the mechanical maintenance of roadside and cross ditches to sustain water flow. The treatment for mosquito control in ditches is the application of No. 2 desel fuel plus a ten percent solution of motor oil and three pints of tuton x-207 per one hundred gallons of water. This solution is applied at four gallons per acre from vehicles with high pressure hoses. The mechanical maintenance of ditches is by mower, by dragline, or by hand depending on the specific area treated.

Storm Event Sampling - General

The sampling will be performed during the wet season months of August and September, 1976. Two storm events will be sampled at each station and ten samples will be taken during each storm. The samples taken will be analyzed for the same constituents listed earlier during the discussion of the harbor baseline sampling, less organochlorine and organophosphorus pesticides.

CALOOSAHATCHEE RIVER

WATER QUALITY SAMPLING PROGRAM

THE CALOOSAHATCHEE RIVER WATER QUALITY SAMPLING PROGRAM

Introduction

The Caloosahatchee River water quality sampling program is designed to estimate the relative contribution of pollutants entering the Caloosahatchee from Lake Okeechobee to the Franklin lock. Further, the program will estimate or quantify the relative loading entering the Caloosahatchee from its tributaries and via direct runoff.

A nonpoint source study will include the monitoring of storm runoff from small drainage basins consisting of specific urban and nonurban land categories. This information will aid in characterizing the pollution loading from land uses typically found in the Caloosahatchee River watershed. Nonurban storm runoff will be studied by monitoring runoff water quality following storm events in two livestock operation land uses, and two crop agriculture land uses. Urban runoff will be investigated at one station in La Belle.

A baseline water quality sampling network in the Caloosahatchee Basin will provide background receiving water quality information necessary to evaluate pollution loading. Four sampling locations on major tributaries other than those used in the nonpoint study, and six stations sited at strategic points longitudinally along the river will be sampled. This program will provide the required information to estimate the relative contributions of pollutants entering the Caloosahatchee.

Nonpoint Agricultural Sampling Stations

The nonpoint agricultural runoff sampling locations consist of two drainage areas representative of livestock operation land use, and two drainage areas representative of major agricultural crop land use. Each drainage area will be sampled during two (2) storm events in the wet season. Eight (8) samples per storm will be taken. The location, land use description and land use practices are described below:

C-R1 This sampling site is located on Jack's Branch, north of highway 78 and about 3.5 miles west of La Belle, Florida (Figure 15). It has been chosen because it represents a major agricultural crop land use. The primary storm water runoff is from the citric groves that border the creek. Because the grove area is divided into numerous ownerships, from less than 10 acres to greater than 50 acres per ownership, the examination of runoff from this area offers an excellent comparison to that in large citris operations by a single ownership.

Due to the porous nature of the soil in the Jack's Branch drainage area, very heavy rainfall is necessary to cause excessive storm water runoff. Two ditches extending south from Jack's Branch are used to transport water during unusually high rainfall periods.

The practices and procedures of nonpoint source land users include:

(a) Multi-annual application of liquid or dry fertilizer,

(b) nutrient spray application,

(c) pesticide application to specific problem areas, and

(d) herbicides when necessary.

Appendix C includes a detailed discussion of type and method of chemical application in the citrus grove land use.

C-R2 The location of this sampling site is approximately two miles west of La Belle, Florida, about 100 yards south of highway 80, and on an unnamed drainage ditch (Figure 15). The drainage basin incorporates 5,000 acres of citrus grove under one ownership.

Nonpoint source practices for the control of water flow includes a man-made drainage ditch system to transport nearly all the grove runoff to the main drainage ditch. Systematically located weirs, approximately one each 1/2 mile on the drainage ditches, allows water levels to be maintained for dry season irrigation. During the wet season water is permitted to flow from the grove to the Caloosahatchee River via the S-R2 sampling location drainage ditch. If the rainfall is unusually low, however, the weirs are used to hold water for irrigation.

Further nonpoint source practices include:

(a) Fertilizer application--a 16-0-16 formula depending, however, on type of fruit desired and meteorologic conditions. Application is three times per year (January, May and September), 400 to 500 lb per acre, and spread on the ground by trucks.

(b) Nutrient sprays--such as Copper, Manganese and Zinc are either sprayed on groves or mixed with fertilizer; five pounds of each

element may be applied per acre. The application schedule depends on plant conditions.

(c) Pesticides--include oil, sulpher, and chlorobenzilate, in application of 4 to 6 gallons per acre. Application is by air or ground during the summer months.

(d) Herbicides--application of Diuran for the control of hydrilla.

C-R4 This sampling site is located on the Silver Lake Ranch drainage system, three miles south of La Belle and one mile east of highway 29 (Figure 15). The land use is improved pasture for cattle production and consists of a three square mile drainage area. The sampling location is just below the junction of west and south drainage ditchs. A man made dike borders along the southward-extending ditch directing water towards the sampling location.

Nonpoint source land use practices are limited to an annual, March, application of 300 pounds of 10-10-10 formula fertilizer per acre.

C-R5 The location of this sampling site is on Deadman's Creek at the Highway 78 bridge. The drainage area is about one square mile in size and represents improved pasture land for cattle production (Figure 15).

Nonpoint source land use practices will include semi-annual or annual application of fertilizer, depending on economic considerations (i.e. the cattle market or fertilizer price). Approximately 1/3 of the drainage area is used for cattle production with no fertilizer application, 1/3

used for cattle production with semi-annual application of 300 pounds of 16-8-8 formula fertilizer per acre, and 1/3 although recently used for cattle production will not contain cattle or field treatment during the sampling duration.

Nonpoint Source Urban Sampling Stations

The sampling program to sample and characterize urban storm runoff is located within the La Belle city limits. The sampling location will be sampled during two (2) significant storms of different intensities and duration. Eight (8) samples will be taken per storm event.

C-R3 This sampling location is on a strom water drainage ditch, in the northeastern section of La Belle (Figure 15). The drainage area is 0.25 square miles in size and represents an urban land use having commercial and residential lands. The sampling location is at the intersection of a Department of Transportation drainage ditch and Missouri Street. Direct drainage into the ditch is from a residential area having paved and unpaved streets. Storm water runoff from commercial land use along Highway 26, between Highway 80 and Oklahoma Street, is transported to the drainage ditch through a single storm sewer.

Nonpoint source land use practice within this drainage area include:

(a) Mechanical maintenance of the Department of Transportation drainage ditch,

(b) mosquito control application by fog truck,

(c) manual street sweeping in the curb and gutter area of central La Belle, and

(d) Herbicide application to roadside ditches in eastern La Belle. The application of herbicides, however, has not taken place for six months and will not take place during the wet season sampling program.

Caloosahatchee River/Canal Baseline Sampling Stations

The baseline water quality monitoring program in the Caloosahatchee Basin includes:

(a) Six (6) sampling stations sited at strategic points longitudinally along the river/canal.

(b) Four (4) sampling stations on tributaries to the river/canal other than the above stations used in the nonpoint study. (Figures 15 and 16).

This network of stations will be sampled two (2) times during the wet season and two (2) times during the dry season. One round of wet season sampling will be coincided as closely as feasible with the times of collection of storm event samples.

River/Canal Longitudinal Profile Station Locations

C-B1 The sampling station is mid-distance between the US 27 bridge and the Caloosahatchee entrance from Lake Okeechobee. This sampling site has been chosen to define water entering the Caloosahatchee (Figure 15).

C-B3 This sampling location is mid-channel about 1/2 mile downstream from the entrance of L-1 canal to the river. A region of intensive sugar cane growing is located above this sampling site (Figure 15).

C-B5 The sampling station is mid-channel approximately four miles upstream from SR 29 bridge at La Belle. The station will provide water quality data on the Caloosahatchee below a region of heavy livestock production while above the urban areas of La Belle and Port La Belle (Figure 15).

C-B6 The sampling site is mid-channel about one-quarter mile upstream of the entrance of Banana Branch, i.e., about one mile downstream from SR 29 at the bridge at La Belle. This location is below the urban areas yet above intensive citrus growing (Figure 15).

C-B8 This sampling location is mid-channel about one mile upstream from the SR 78 bridge at Alva. The site is below heavy citrus growing areas above the urban area of Alva and the developing area of Leheigh (Figure 16).

C-B9 The sampling site is mid-channel at the downstream boundry of the Caloosahatchee River State Park, i.e., about one-half mile upstream from the entrance of Hickey's Creek and below Alva (Figure 16).

Tributary Station Locations

C-B2 This sampling site is located mid-channel of a canal about 100 yards above the entrance to Lake Hicpochee from east in section 34, R.32E, T.42S. The sampling station is in a canal draining lands of heavy sugar cane growing. The watershed approaches 50 square miles in area (Figure 15).

C-B4 The station located mid-channel of a canal, about 400 yards upstream of the entrance to the Caloosahatchee from north section 30, R.31 E., T.42 S., is approximately 2.5 miles upstream from the Ortona Locks. The canal drains about 20 square miles of predominately improved and unimproved pasturelands (Figure 15).

C-B7 This sampling location is located mid-channel at a point in the Townsend Canal about 900 yards upstream from the entrance into the Caloosahatchee. The drainage area is over 50 square miles in a heavy citrus growing region (Figure 16).

C-B10 The sampling location is mid-point of Hickey's Creek about 400 yards upstream of the confluence with the river. Hickey's Creek receives loadings from a variety of land uses. Sparse residential lands, improved and unimporved pastureland, citrus growing regions, and canals from Leheigh area developments, all contribute to creek flow. The drainage area is greater than 20 square miles (Figure 16).

Water Quality Constituents

Each station will collect water quality and flow data. The parameters to be examined at each station shall include:

1) All baseline stations and agricultural crop runoff stations:

Temperature
pH
Dissolved Oxygen
Alkalinity
Color
Turbidity
Total solids
Fecal Coliform
Fecal Streptococci

Biochemical Oxygen Demand (BOD)(5-day)
Total phosphate
Dissolved orthophosphate
NO_2 - NO_3 as N
NH_3 as N^3
Total Kjeldahl Nitrogen
Arsenic, Mercury, Manganese
Organochlorine pesticides
Organophosphate pesticides
Total organic carbon

2) The livestock production runoff stations will collect all the above, except for:

Organochlorine pesticides
Organophosphate pesticides

3) The urban runoff station near La Belle will collect all the above, except:

Organochlorine pesticides
Organophosphate pesticides

but will also collect:

Oil and grease
Fluoride
Copper
Lead

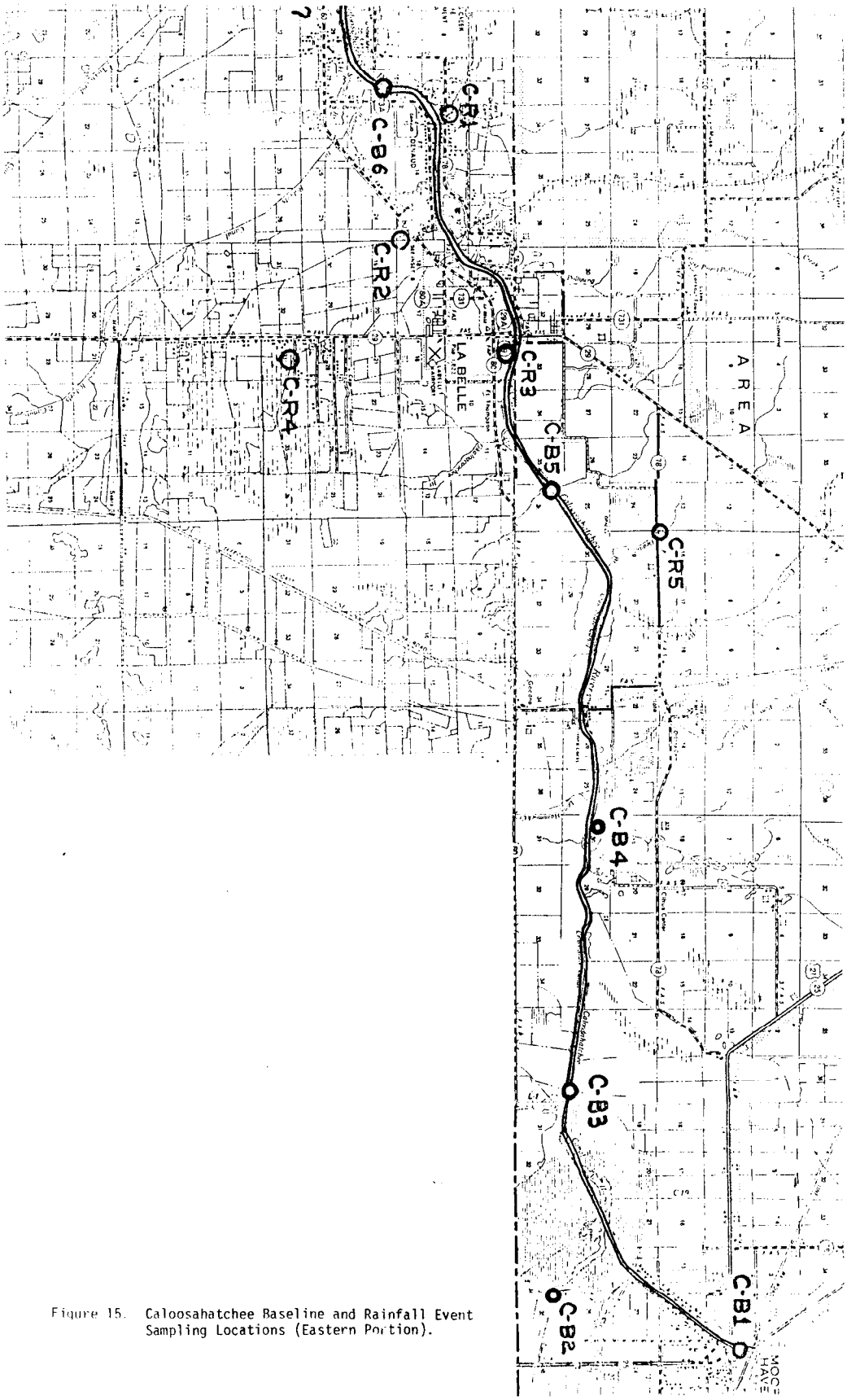


Figure 15. Caloosahatchee Baseline and Rainfall Event Sampling Locations (Eastern Portion).

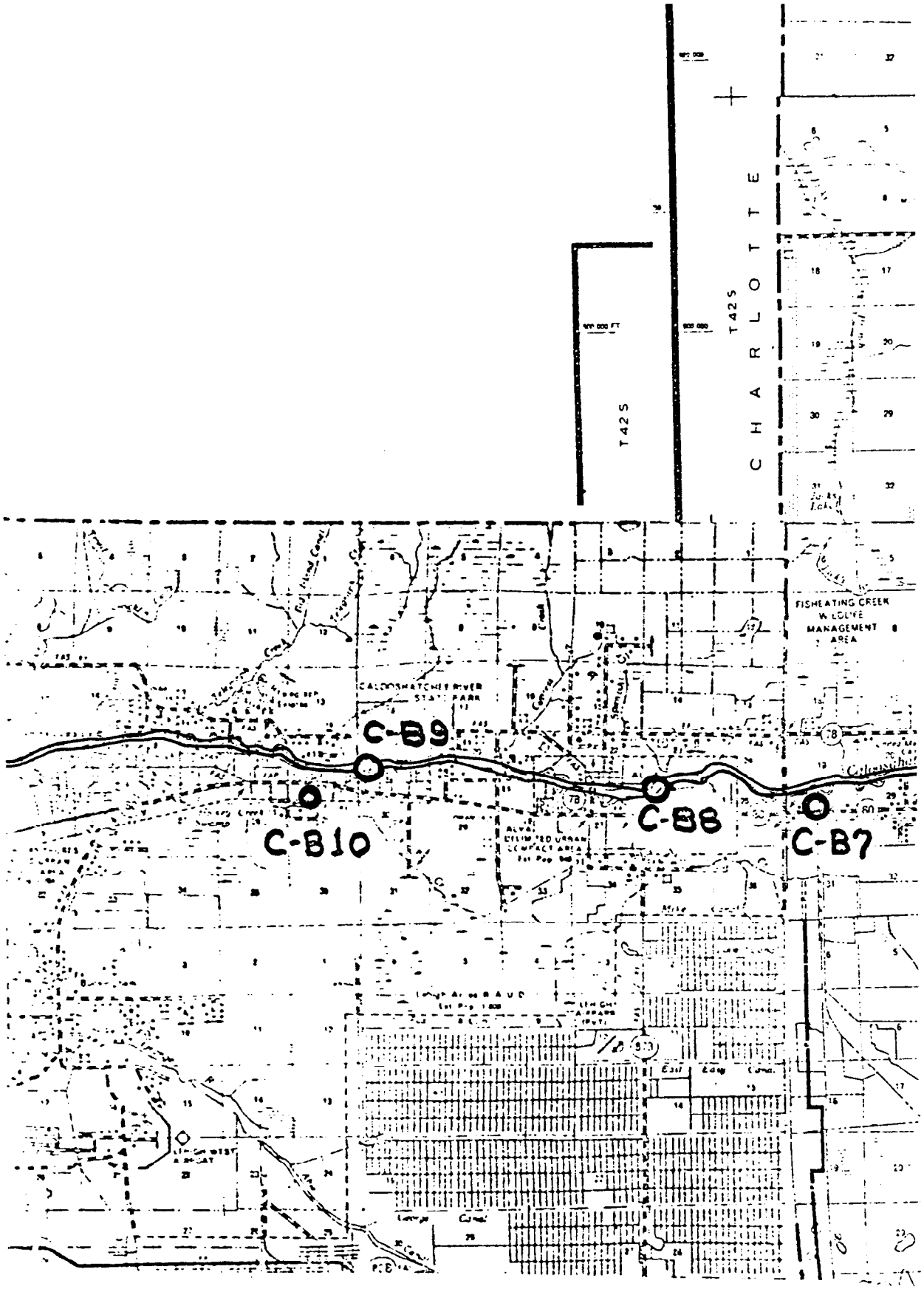


Figure 16. Caloosahatchee Baseline Locations (Western Portion).

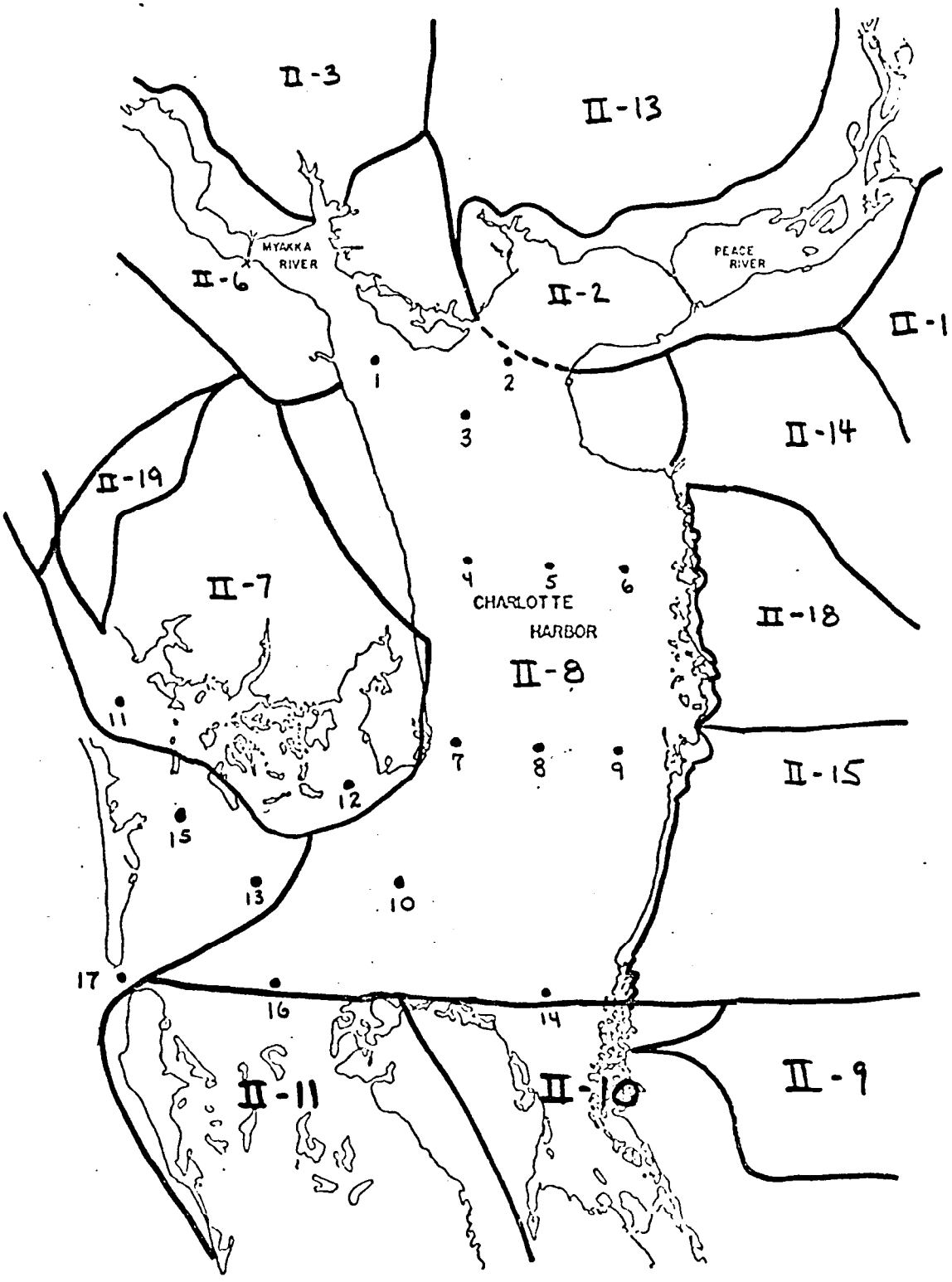


Figure 3. CHARLOTTE HARBOR CASE STUDY MAP

•2 : BASELINE SAMPLE STATIONS (H-82).

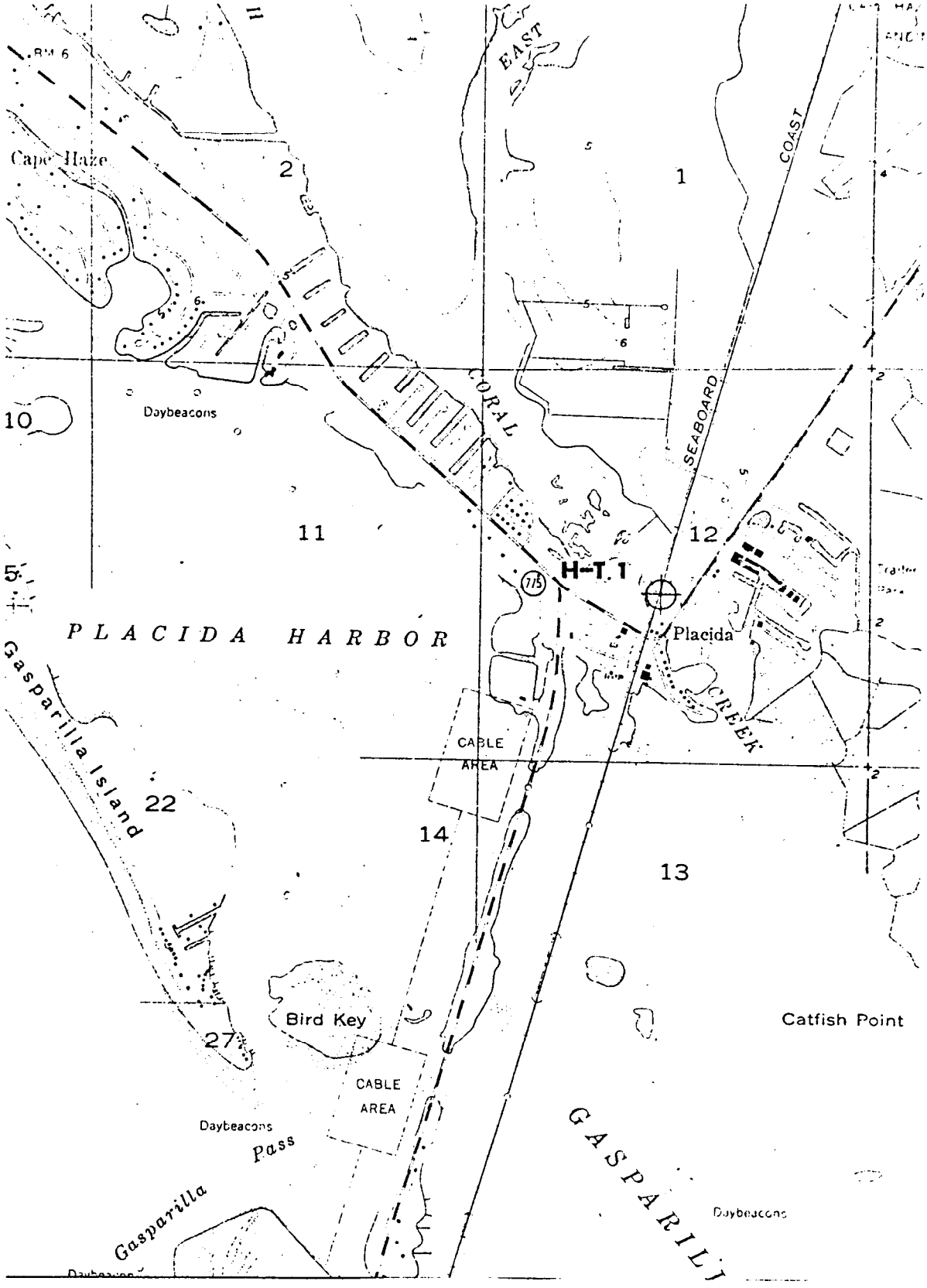

EAST
COAST
Cape Haze
2
1
Daybeacons
10
CORAL
SEABOARD
11
12
H-T 1
PLACIDA HARBOR
Placida
CREEK
CABLE
AREA
Gasparilla Island
22
14
13
Bird Key
Catfish Point
27
CABLE
AREA
Daybeacons
Pass
Gasparilla
GASPARILLA
Daybeacons

Figure 4

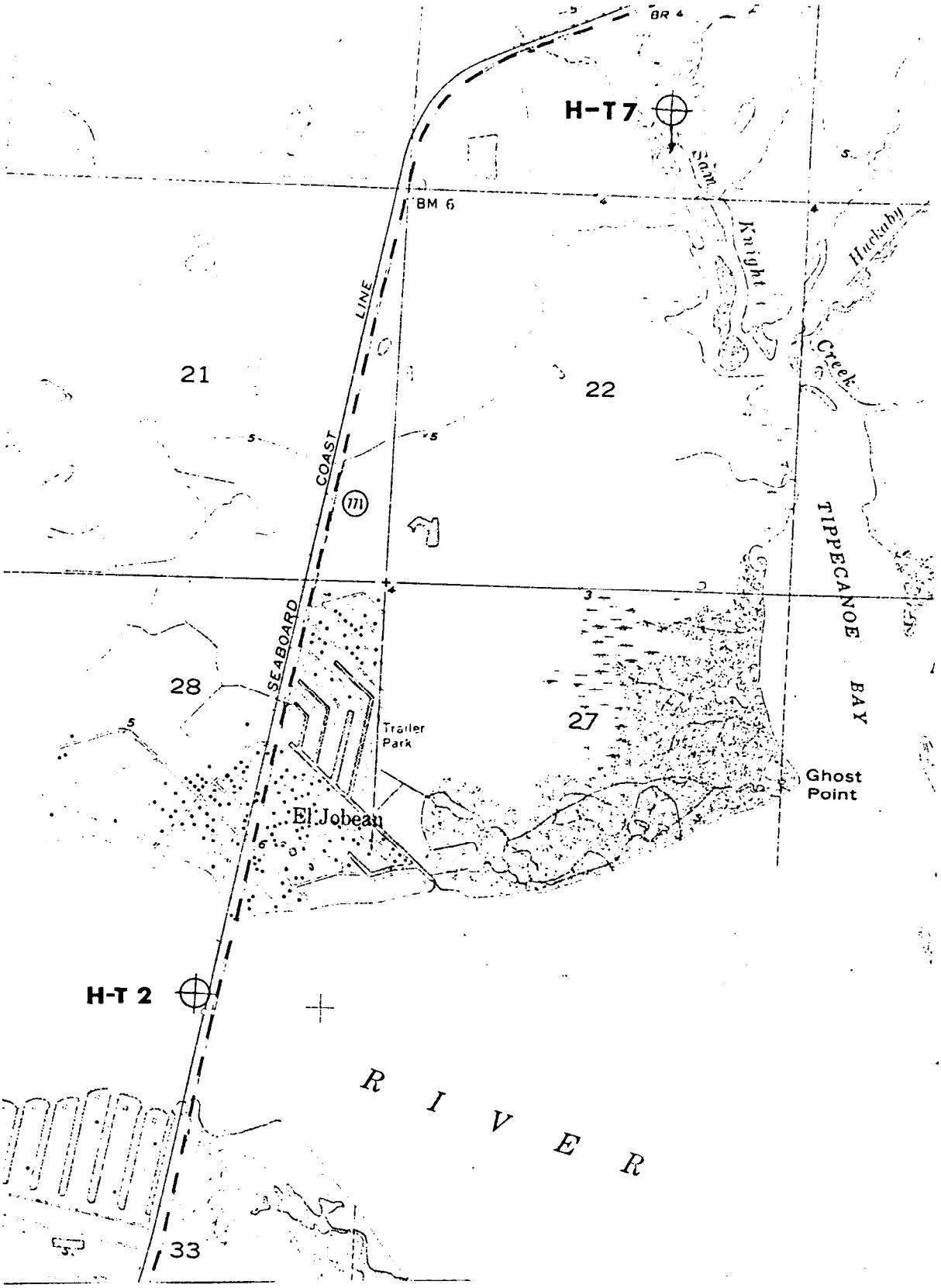

H-T 7
BM 6
Knight
Creek
Hackaby
21
22
COAST LINE
SEABOARD
TIPPECANOE BAY
28
27
Trailer Park
El Jobean
Ghost Point
H-T 2
R I V E R
33

Figure 5

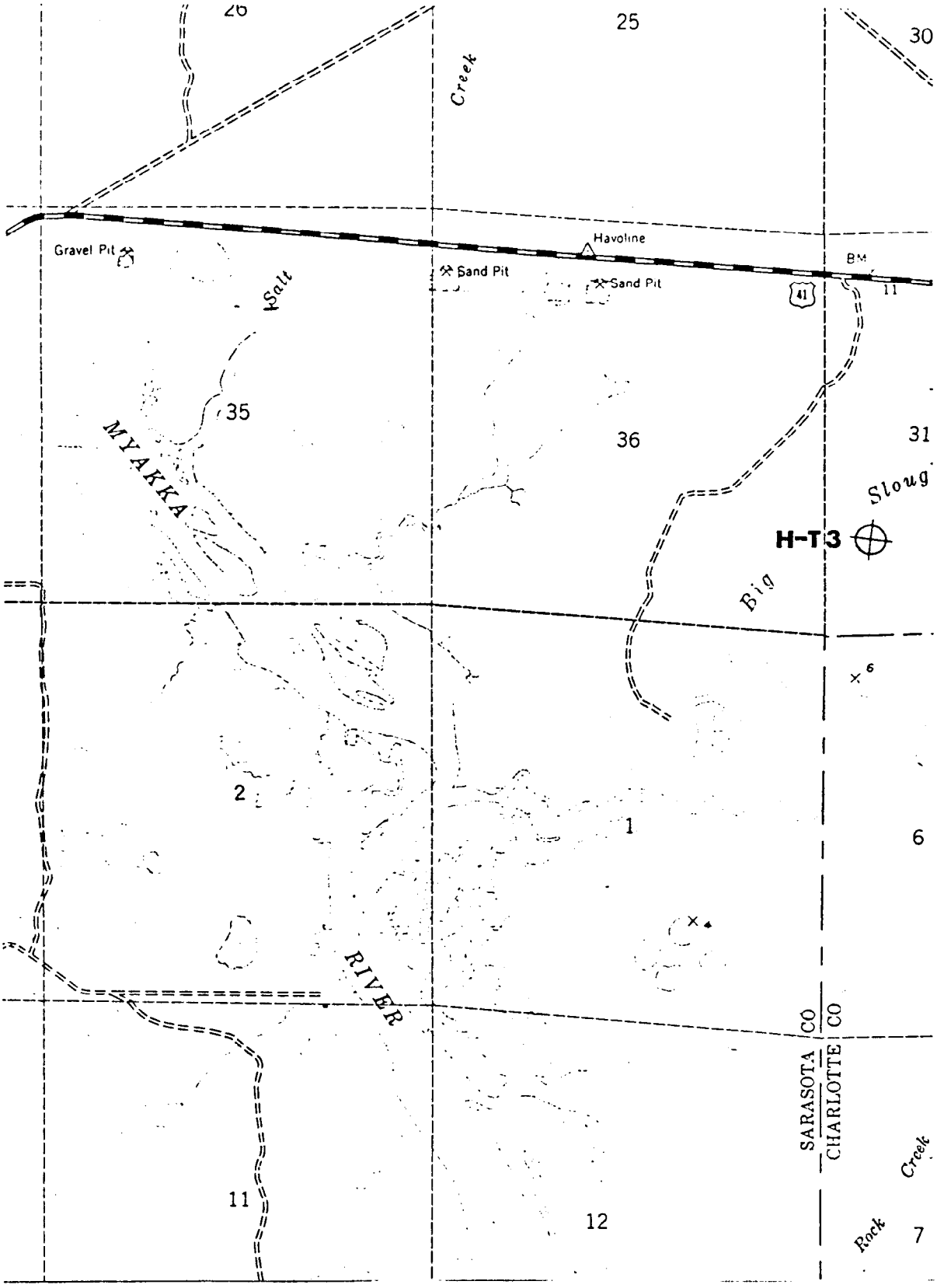

26
25
30
Creek
Gravel Pit
Havoline
Sand Pit
Sand Pit
BM
41
11
Salt
35
36
31
MYAKKA
Slough
H-T3
Big
2
1
6
RIVER
SARASOTA CO
CHARLOTTE CO
11
12
Creek
Rock
7

Figure 6

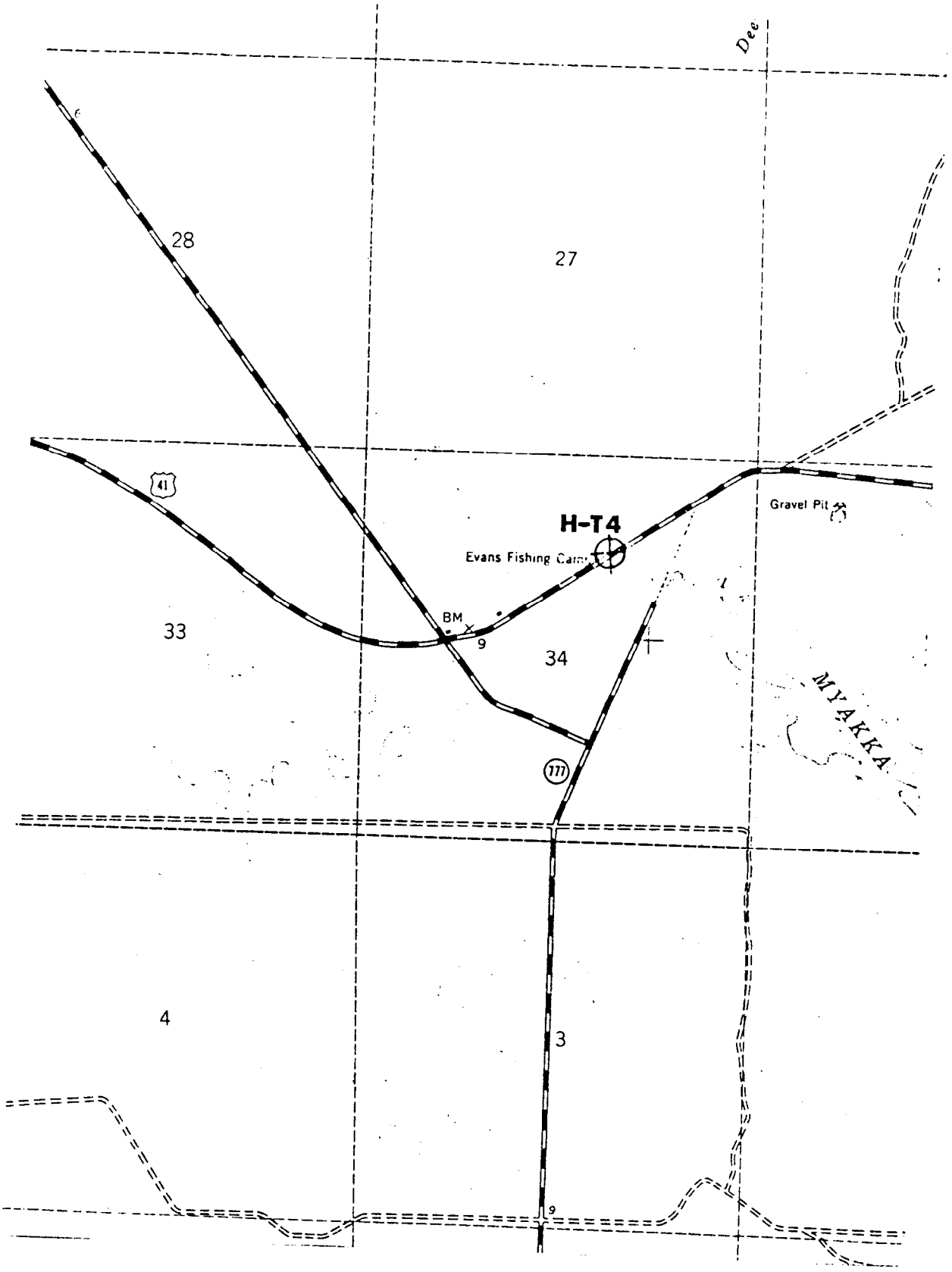

Dee
28
27
41
H-T4
Evans Fishing Camp
Gravel Pit
BM
9
33
34
MYAKKA
777
4
3
9

Figure 7

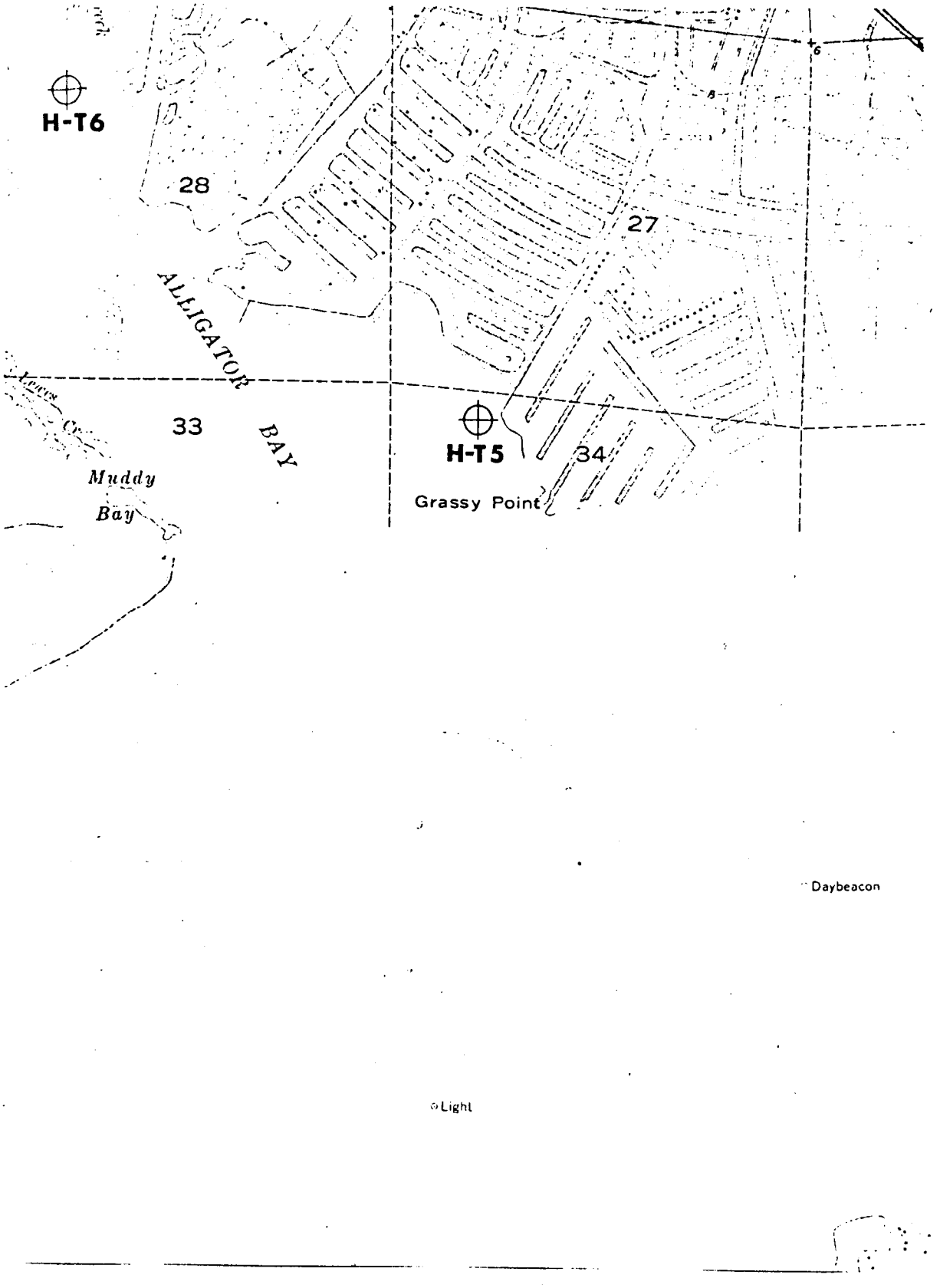

H-T6
28
27
ALLIGATOR
BAY
33
H-T5
34
Grassy Point
Muddy
Bay
Daybeacon
Light

Figure 8

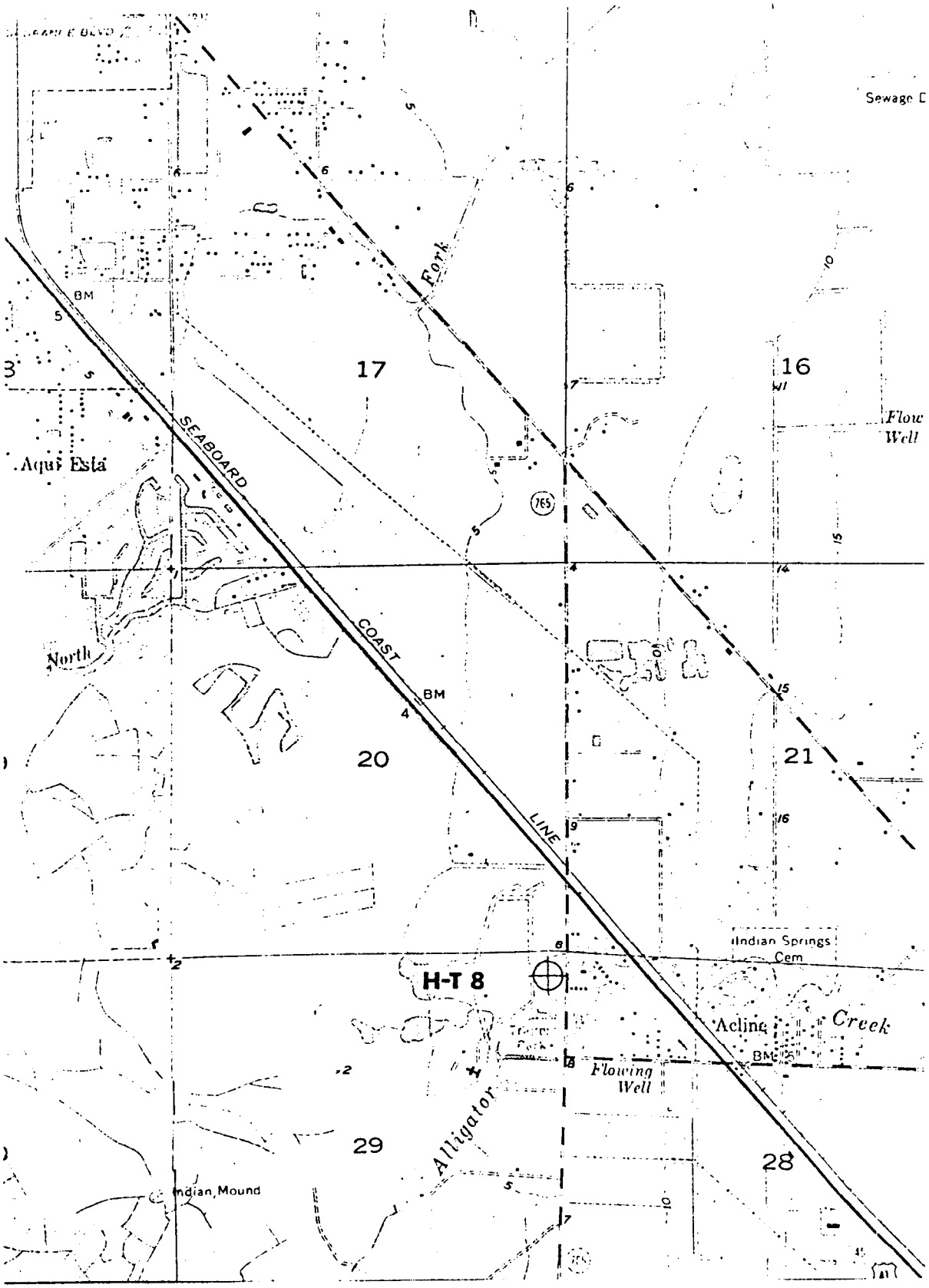

Sewage D
Fork
BM
17
16
Flow
Well
SEABOARD
Aqui Esta
765
COAST
North
BM
20
21
LINE
Indian Springs
Cem
H-T 8
Acline
Creek
BM
Flowing
Well
29
Alligator
28
Indian Mound

Figure 9

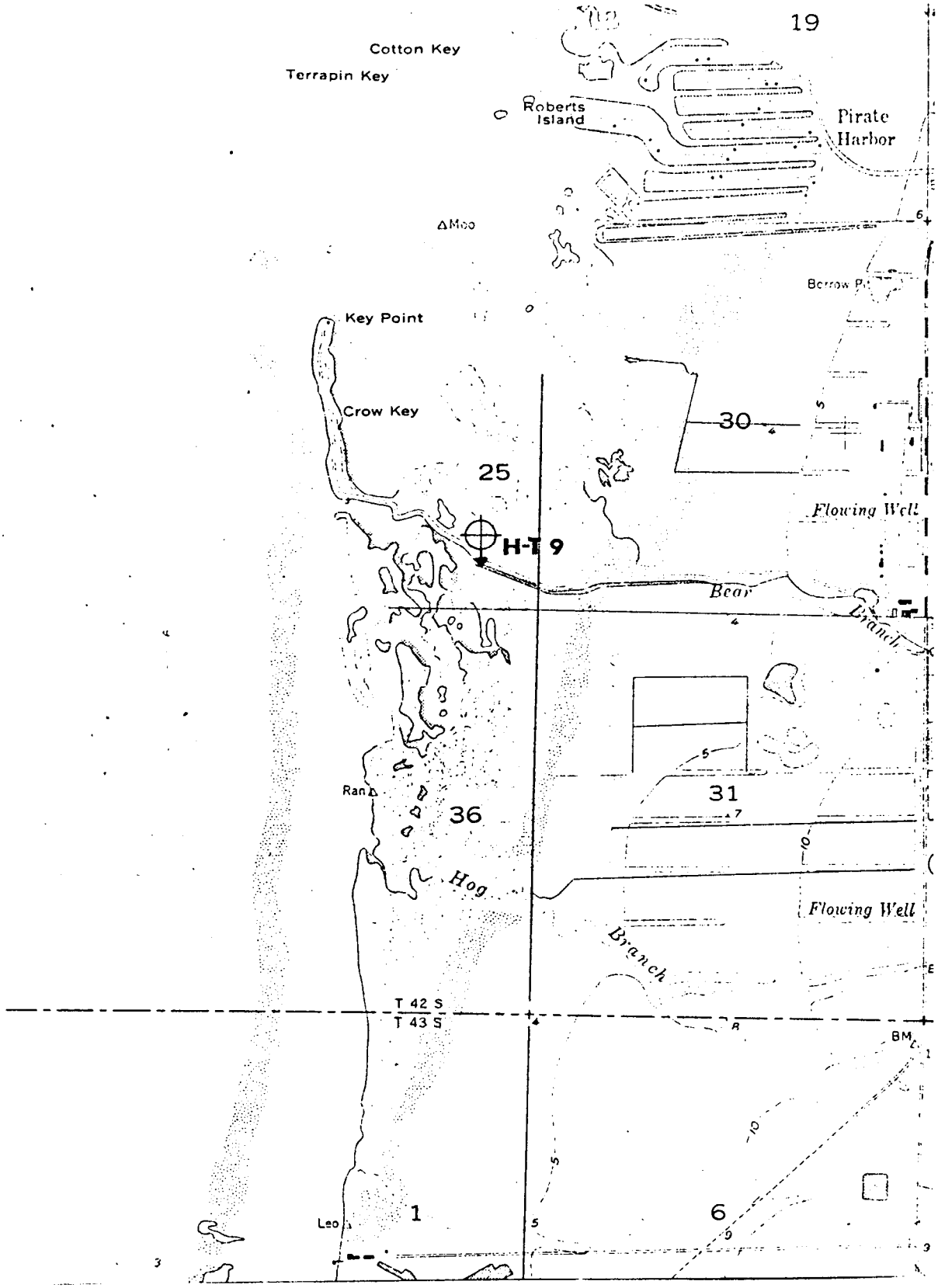

Cotton Key
Terrapin Key
Roberts Island
Pirate Harbor
19
Key Point
Crow Key
30
25
H-T 9
Flowing Well
Bear
Branch
31
36
Hog
Flowing Well
Branch
T 42 S
T 43 S
BM
1
6
Leo

Figure 10

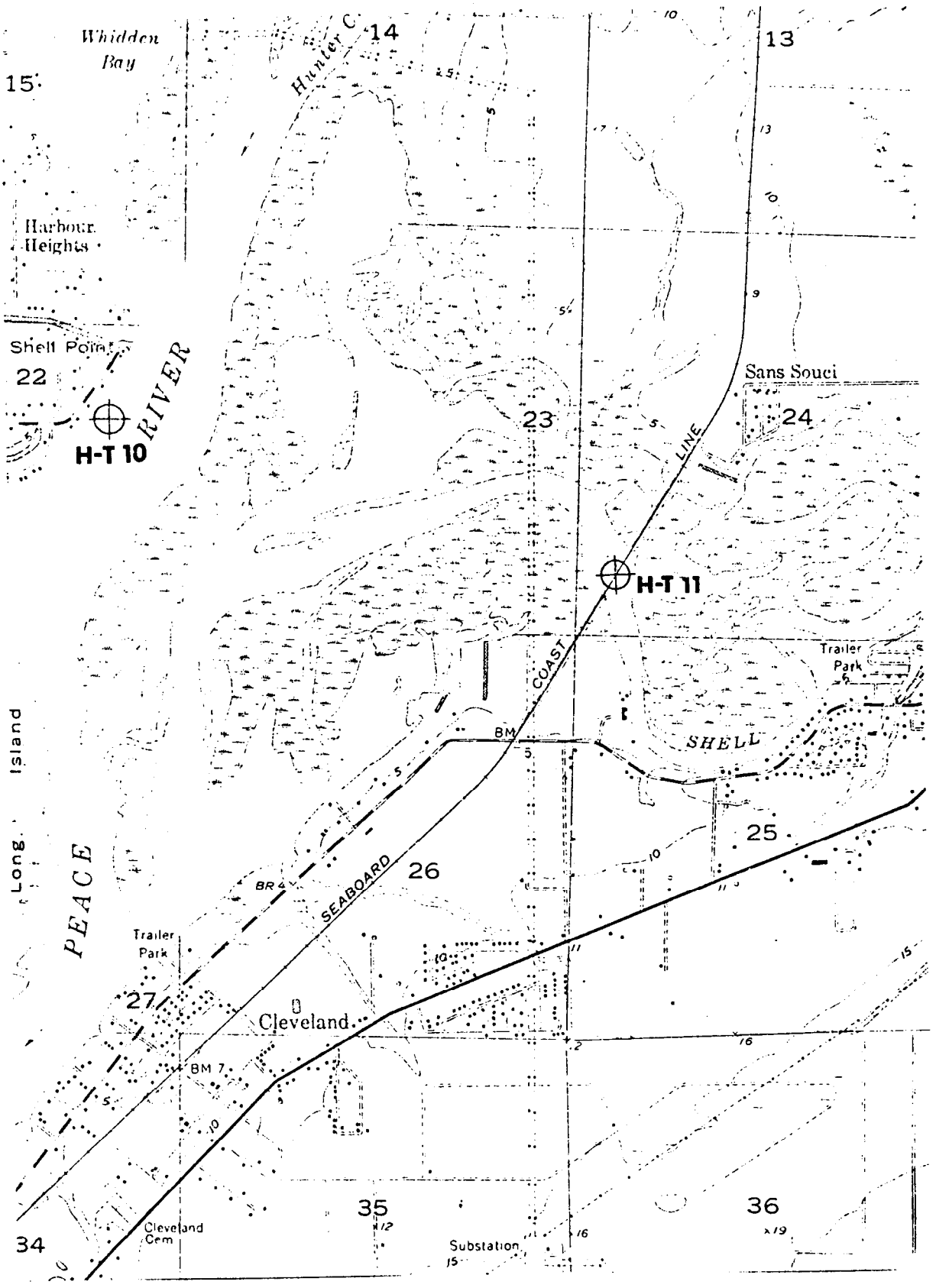

Whidden Bay
Hunter C.
14
13
15
Harbour Heights
Shell Point
22
RIVER
H-T 10
23
Sans Souci
24
LINE
H-T 11
COAST
Trailer Park
SHELL
BM
Long Island
PEACE
SEABOARD
26
25
Trailer Park
27
Cleveland
BM 7
35
36
34
Cleveland Cem
Substation

Figure 11

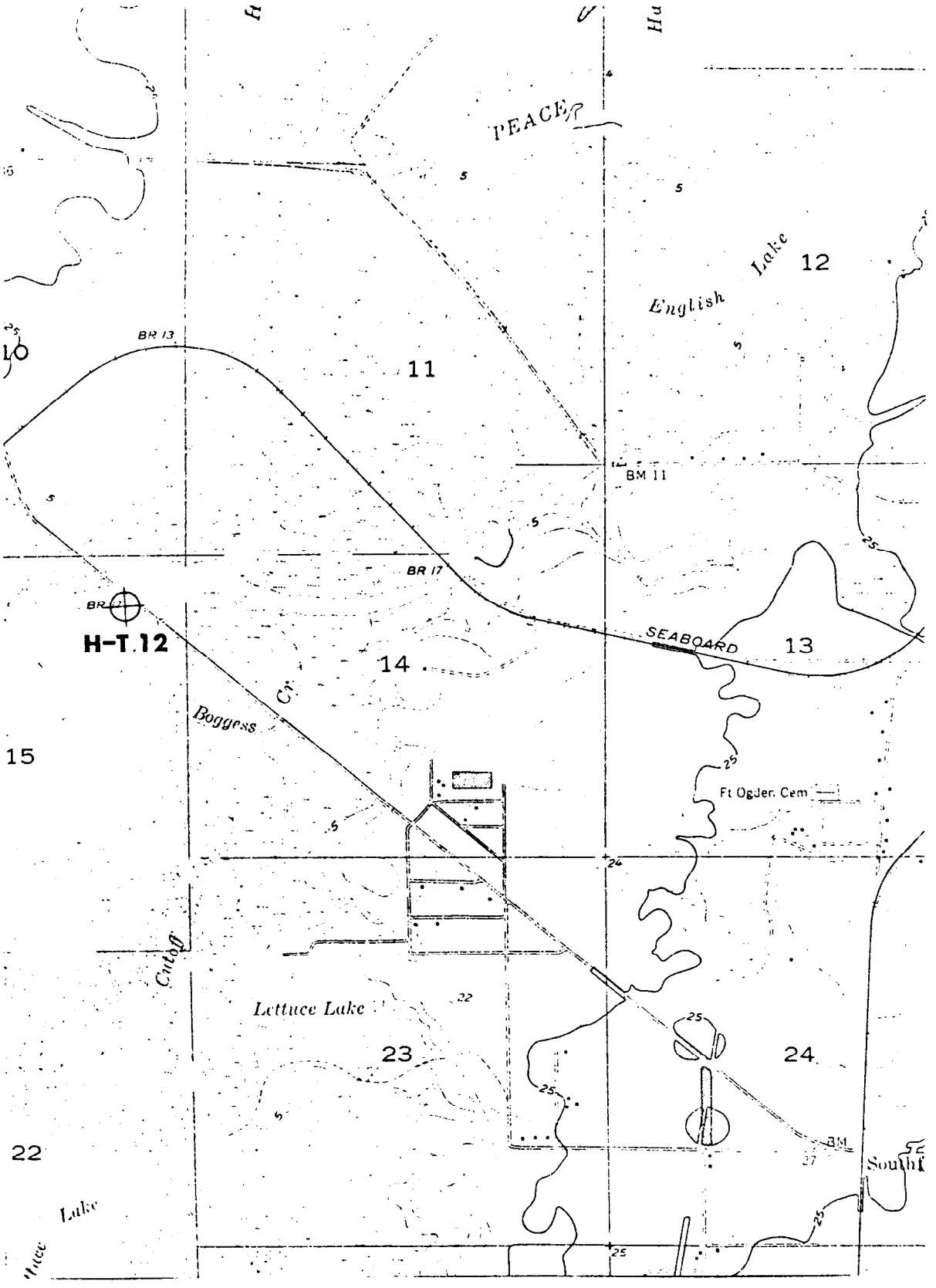

PEACE R
English Lake
12
11
BR 13
BM 11
BR 17
BR
H-T.12
SEABOARD
13
14
Boggess
15
Ft Ogden Cem
Lettuce Lake
22
23
24
BM
South
Lake

Figure 12

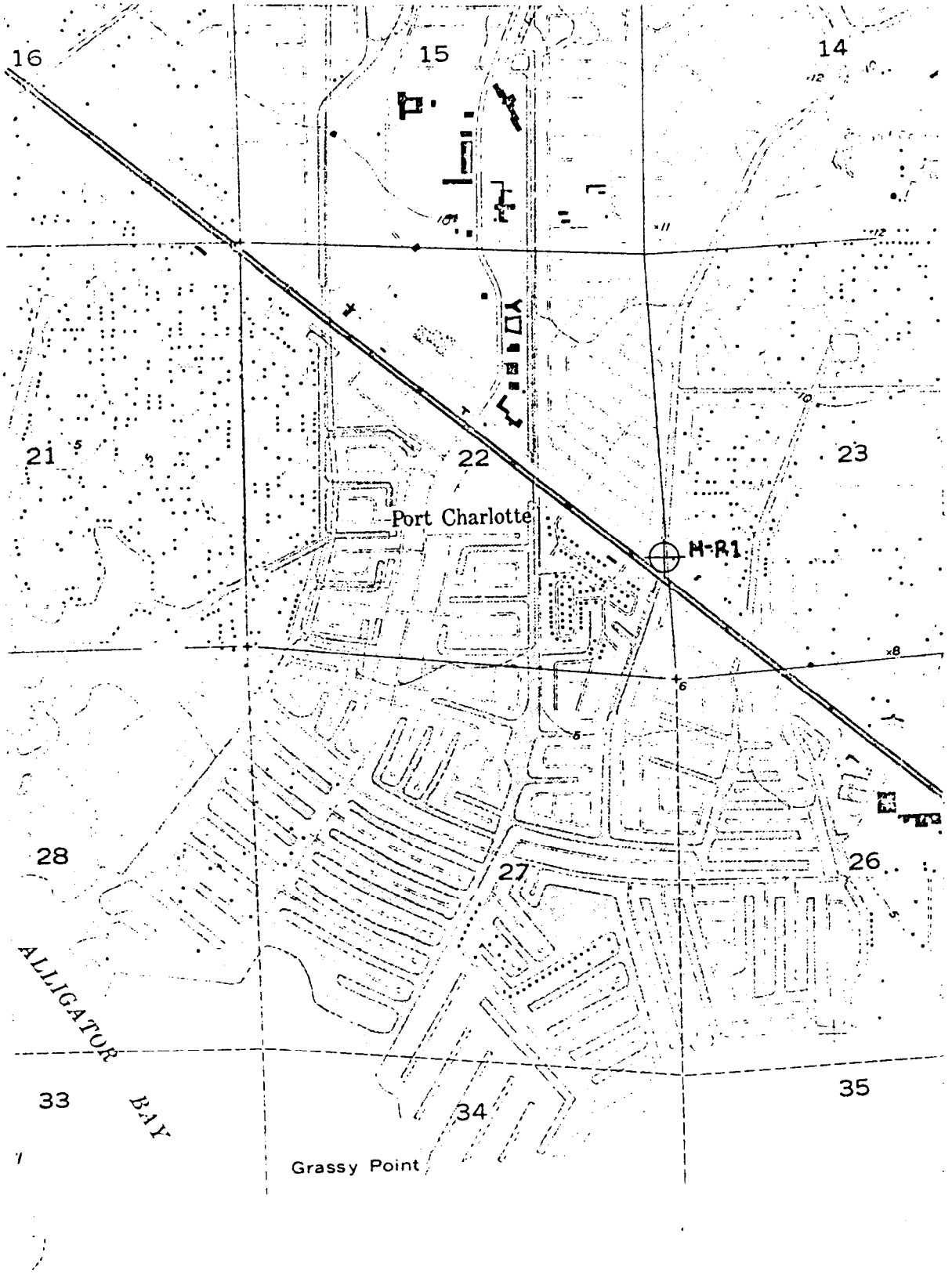
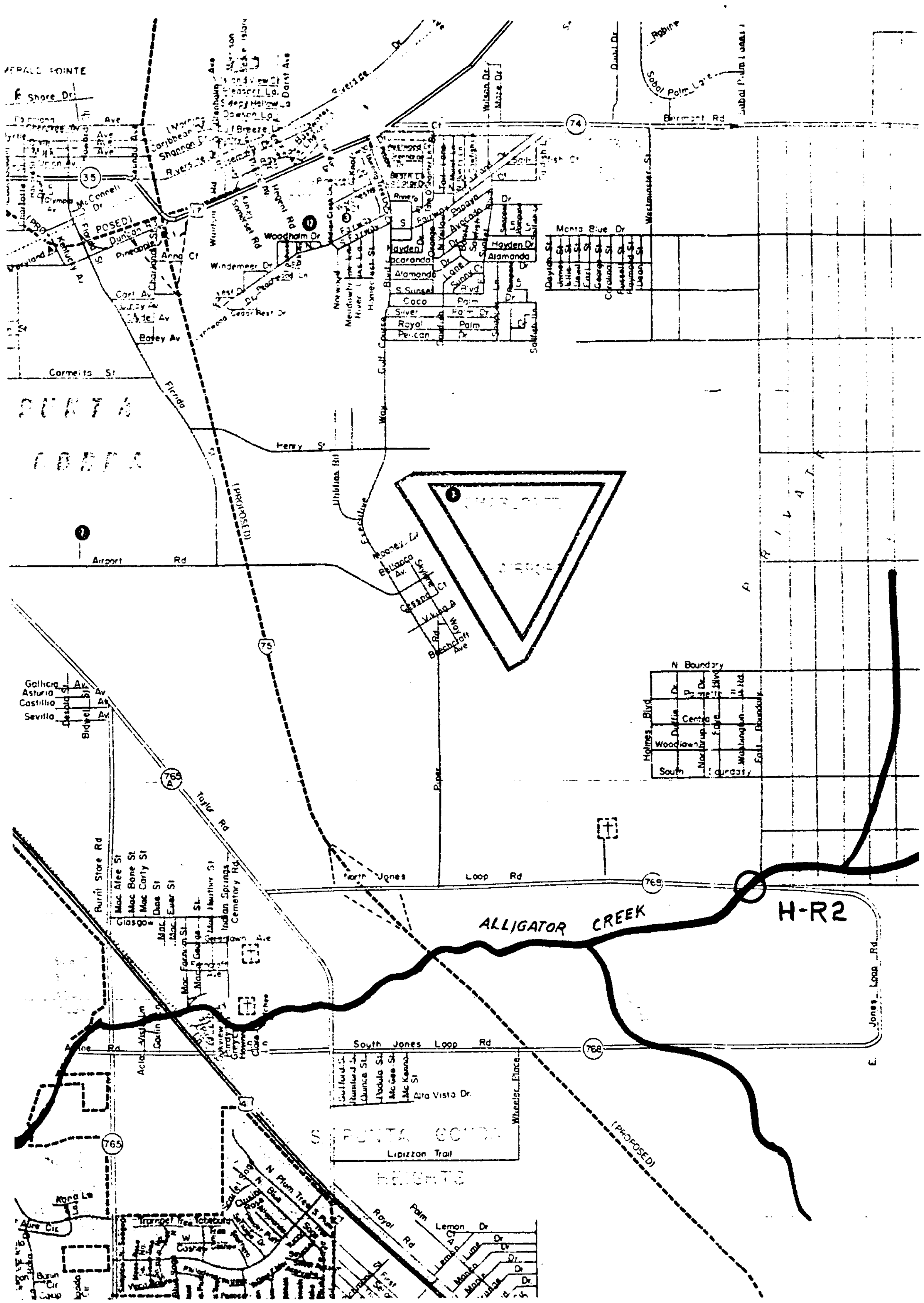

16
15
14
21
22
23
Port Charlotte
H-R1
28
27
26
ALLIGATOR
BAY
33
34
35
Grassy Point

Figure 13



ALLIGATOR CREEK
H-R2
Airport Rd
North Jones Loop Rd
South Jones Loop Rd
Taylor Rd
Burnt Store Rd
Henry St
Piper
Bermont Rd
N Boundary
Holmes Blvd
Jones Loop Rd
Lipizzan Trail
(PROPOSED)

Figure 14

BIG CYPRESS BASIN

WATER QUALITY SAMPLING PROGRAM

BIG CYPRESS BASIN WATER QUALITY SAMPLING PROGRAM

Introduction

Big Cypress Basin, comprised mostly of Collier County, encompasses an area of predominant wetland and water resources. Four major canal systems drain much of the western regions of this basin, the Cocohatchee River Canal System, the Golden Gate Canal System, the Fahka Union Canal System, and the Barron River Canal System. These canal systems discharge into some of the most productive estuarine areas of Southwest Florida.

The water quality sampling program has been designed to establish baseline water quality within the basin and to characterize major nonpoint sources. Initial data from the sampling sites will be reviewed and analyzed to determine if modifications in constituent coverage, sampling frequencies, and sites will be necessary for future monitoring.

Wet and dry season sampling will be conducted at five canal system outflows, and ten estuary system sites for baseline water quality determinations. These sites will be sampled once each month for two wet season months (August and September), and for two dry season months (March and April).

Four nonpoint source stations will be sampled monthly for ten consecutive months to characterize constituent loads to coastal receiving waters.

Samples will be taken at approximately one foot below the water surface. Water depths and flows at the sample sites suggest adequate mixing for characterization of the water column from a uniform sampling depth.

Nonpoint source control practices in the Big Cypress Basin do not include regularly scheduled street cleaning or sweeping activities. For areas outside of incorporated towns (Naples and Everglades City), the county maintains an aquatic weed control program in most of the major canals and along primary roadways. Most aquatic weed control is chemical, although some mechanical harvesting is used. The Naples Mosquito Control District (covering 200 square miles of coastal Collier County) utilizes aerial application of pesticides for mosquito control.

The practices of nonpoint source land users include residential lawn and golf course maintenance, as well as agricultural use of fertilizers, herbicides, and pesticides. Maintenance schedules and applications vary, however, the Collier County Agricultural Department regularly schedules seminars and programs on the uses of chemical products.

Water Quality Constituent Analyses

All of the samples taken in the Big Cypress study will be analyzed for the following constituents:

Temperature, *in situ*
pH, *in situ*
Salinity, *in situ*
Dissolved oxygen, *in situ*
Alkalinity
Color
Turbidity
Suspended solids
Fecal coliform
Fecal streptococci
Total phosphorus
Orthophosphate
NO_2 - NO_3 as N
NH_3 as N
Total Kjeldahl Nitrogen
Arsenic, Mercury, Manganese
Total organic carbon
Biochemical Oxygen Demand (BOD)(5-day)

Locations and Descriptions of Wet Season Baseline Stations - Canal System

B-B1 Cocohatchee River Canal

Location. Cocohatchee River immediately downstream of Seaboard Coastline Railroad (SCR) Bridge. This sampling site is downstream of the confluence of Palm River, Horse Creek and unnamed creek with the Cocohatchee River Canal (Figure 17).

The SCR Bridge is located approximately 1700 feet north of the intersection of seaboard coastline railroad and State Road (S.R.) 846. Access to the sampling site may be obtained by a dirt road leaving S.R. 846 some 600 feet west of the railroad - S.R. 846 intersection.

Description - The Cocohatchee River Basin is one of the major drainage basins of western Collier County. The present drainage area is 18.7 square miles with a drainage density of 0.428 mi./sq. mile.

Land use in the Cocohatchee River Basin is diverse. Agricultural uses predominate at this time; mostly truck crops with some tree crops and unimproved pasture. Residential uses are on the increase with developments such as Palm River Estates and Willoughby Acres. A few commercial rock and fill quaries are also operated in this basin. The Wiggens Pass Estuary is the receiving body for the Cocohatchee River outflow of 25,014 acre-feet per year.

B-B2 Golden Gate Canal

Location - Main Golden Gate Outfall Canal immediately above salinity weir (final weir before emptying into Gordon River); approximately 2400 feet downstream (west) of S.R. 31 bridge that crosses canal. Access may be obtained by a dirt road that leaves S.R. 31 and runs west, parallel to the north side of the canal (Figure 17).

Description - The Golden Gate Canal Watershed is largely platted and subdivided by a series of roads and canals for residential use, but is still primarily undeveloped. Golden Gate City is one portion which has residential development.

The main canal is the outfall for a canal system that drains 130 square miles with a drainage density of 0.785 mi./sq. mile. This watershed is the second largest watershed in Western Collier County. The high drainage density is considered a primary factor in the forest fire frequency for this area. The nutrient contributions to the canal system from forest fire turnover and soil erosion in this area is unknown at this time.

Naples Bay is the receiving body of a mean annual discharge of 249,000 acre-feet from the Golden Gate Watershed.

B-B3 Henderson Creek Canal

Location - Henderson Creek immediately upstream from S.R. 951 Bridge. This segment of S.R. 951 runs from U.S. 41 (Tamiami Trail) to Marco Island (Figure 17).

Description - Henderson Creek Canal extends south from the Golden Gate Watershed to Rookery Bay. Runoff from the Collier County Sanitary Landfill, which is located near the southern edge of the Golden Gate Watershed, is directed into the Henderson Creek Canal.

Henderson Creek Canal drains an area of 7.4 square miles with a drainage density of 0.541 mi./ sq. mile. It is the smallest of four major watersheds in Western Collier County, but is located in an area of increasing development. Immediately upstream of the sampling site, residential mobile homes on septic systems lie adjacent to the canal. The receiving body, Rookery Bay, is an estuarine sanctuary of County importance. Annual runoff for Henderson Creek Canal is 16,746 acre-feet.

B-B4 Fahka Union Canal

Location - Fahka Union Canal immediately upstream of salinity control weir above Remuda Ranch Bridge on S.R. 41. The salinity control weir is visible from the bridge, only 300 feet upstream from it. Unpaved roads access the weir on either side of the canal (Figure 18).

Description - The Fahka Union Canal is the major outfall canal for the largest watershed (234 square miles) in western Collier County. This canal concentrates water from 88 miles of collector canals and dumps it into Fahka Union Bay.

Land sales speculation led to the development of roads and canals which extend throughout most of the Fahka Union Watershed. Very little residential

development has taken place, but most of the land is held in individual ownership subject to future residential use. The northern portion of this watershed is used predominately for agricultural purposes because of the Immokalee fine sands. Some agricultural lands have been abandoned due to the extensive dewatering by the canal system. High forest fire frequency resulting in rapid turnover of nutrients, and potential soil erosion contributions to surface waters are unknown.

The City of Naples is presently drilling potable water supply wells in this watershed (near the western edge) to meet increased coastal demand. Mean annual discharge from the Fahka Union outfall canal is 206,600 acre-feet.

B-B5 Barron River (S.R. 29) Canal

Location - Barron River Canal immediately upstream of salinity control structure at junction of S.R. 29 and Jane's Scenic Drive. This junction is approximately 1 1/4 miles north of Carnestown (intersection of U.S. 41 and S.R. 29) (Figure 18).

Description - The Barron River Canal extends from Immokalee to Everglades City adjacent to S.R. 29. It is a major drainage canal flowing 70-75,000 acre-feet of water per year into Chokoloskee Bay. The canal intercepts much of the historic flow from the Okaloacoochee Slough to the Fahkahatchee Strand, so the contributing drainage area extends east and northeast of Immokalee into Hendry County.

The northern reaches of the canal drain primarily agricultural lands; improved pasture, truck crops, and some tree crops. Southern portions

drain relatively natural lands with some private residences located along the canal bank. Very small comunities such as Sunniland and Copeland border the Barron River Canal.

The Barron River Canal delineates the western boundary of the National Freshwater Reserve being purchased by the State and Federal Governments. It partially drains an area of the Freshwater Reserve which is considered an important freshwater contributor to Everglades National Park.

Locations and Descriptions of Wet Season Baseline Stations - Estuary System

B-B6 Cocohatchee Estuary/Wiggins Pass

Location. Cocohatchee Estuary/Wiggins Pass approximately 100 yards west (seaward) of the outlet of Water Turkey Bay. Sampling at this site on ebb tides may provide maximum outflow from constituent sources. This site can be reached via a beach road through Delnor State Park. The entrance to the State Park is just north of the Ramada Inn on Vanderbilt Beach (Figure 17).

Description. The Cochatchee Estuary and Wiggins Pass are shallow coastal systems indicative of the Gulf Coast of South Florida; depths range from 1 to 10 feet at mean low water. The water is designated as Class II, suitable for shellfish propagation, by the state. In addition to receiving Cocohatchee River drainage, the Cocohatchee Estuary/Wiggins Pass area receives water flushed from Vanderbilt Lagoon via Water Turkey Bay.

A commercial marina operates in the Wiggins Pass area, with large tracts of land from Vanderbilt Beach north to Bonita Shores slated for development. The Dougherty Company, which owns all the land around Water Turkey Bay and some north of the Cocohatchee River mouth, has submitted a request for development which includes 30-foot deep lakes as part of the storm water management plan.

Vanderbilt Beach development is both commercial and residential. This area has been operating on septic systems for several years, but is scheduled to hook up to the North Naples Sewerage District soon. The septic contributions to Vanderbilt Lagoon have not been characterized,

nor have the subsequent inputs to the Cocohatchee Estuary as a result of flushing. The "recovery" of Vanderbilt Lagoon due to central sewerage may alter constituent flow through Wiggins Pass.

Gulf Harbor is a small subdivision which lies along the Cocohatchee River between SR 865A and US 41. This subdivision is a finger canal community that is converting from septic sewerage to a central system. As this community continues to develop, constituent contributions to the Cocohatchee estuarine area may be expected.

As a popular boat harbor, navigation and recreation area, the Cocohatchee Estuary/Wiggins Pass system is an important segment of coastal Collier County.

B-B7 Upper Clam Bay

Location. Upper Clam Bay is located west of US 41 between SR 862 (Vanderbilt Beach Road) and Seagate Drive (Fig. 17). Historically, Upper Clam Bay was connected (via mangrove tidal channels) to the southern end of Vanderbilt Lagoon. However, construction of SR 862 blocked this flow, leaving the only tidal connection south through Inner and Outer Clam Bays to Clam Pass. Access to Upper Clam Bay is possible only by launching a small, shallow draft boat near the end of Seagate Drive on Outer Clam Bay and proceeding up tidal channels through Inner Clam Bay northward. Sampling should be done in mid-bay with particular attention paid to the tides for ingress and egress.

Description. The present estuarine system of Upper Clam Bay is characteristic of "backwater" or basin mangroves: reduced tidal flushing, highly colored water and noticeable hydrogen sulfide odor. The entire tract of land west of US 41 between SR 862 and Seagate Drive is referred to as Pelican Bay and encompasses Upper, Inner and Outer Clam Bays. At the present time this area is undeveloped, however a development plan has been submitted to the Southwest Florida Regional Planning Council, with the highest number of dwelling units proposed around Upper Clam Bay. The Pelican Bay Development Plan as presently submitted represents one of the largest planned unit developments (PUD's) in Collier County.

B-B8 Doctors Pass (Moorings Pass)

Location. Doctors Pass 400 yards east of the pass entrance to the Gulf. This station should be sampled on an ebb tide. Access to this station may be obtained by boat from the Gulf (Figure 17).

Description. Doctors Pass serves as the outlet for Doctors Bay (Moorings Bay), Bowline Bay, Compass Cove, Hurricane Harbour and Venetian Bay (south of Seagate Drive). Almost all of these bays are vertically seawalled with single and multi-family residences surrounding. This area is approaching full development with some of the remaining land in the Parkshore area being prepared for construction.

The bay systems flushing through Doctors Pass represent all the major estuarine bays of North Naples.

B-B9 Naples Bay

Location. Naples Bay one mile south of US 41 Bridge crossing Gordon River at head of Naples Bay. This site is in mid-bay on a direct line with 18th Avenue south due west and Marlin Drive due east. This site will be sampled on an ebbing tide (Figure 17).

Description. Naples Bay is the estuarine heart of the City of Naples and the surrounding area. Portions of the bay have been dredged and filled for finger canals; most of the shoreline is seawalled, some is still mangrove. Naples Bay receives stormwater runoff from the residential and commercial areas of Naples as well as secondarily-treated municipal sewage, large freshwater (and aquatic plant material) inputs from the Golden Gate Canal System, septic contributions from developments on Halderman Creek, and outflow from the Gordon River. The upper reaches of the Gordon River drain extensive golf course areas and expanding residential developments.

The Collier County Conservancy initiated a study of the water quality of the Naples Bay and finger canal system just recently. Sampling at this site should be correlated with the Conservancy program.

B-B10 Johnson Bay

Location. Johnson Bay on the north side of Isles of Capri can be reached by boat via the intercoastal waterway from Naples Bay, or by boat launched from Jim and Eydies Marina on Isles of Capri. The sample site will not be more than 1/4 mile north of the Isles as measured from Jim and Eydies Marina. This will put the site approximately midway between a mangrove

island to the west and a portion of the Isles to the east. Samples will be taken early on a flood tide (Figure 17).

Description. Johnson Bay is in an area of coastal Collier County which is relatively undeveloped. The southern portion of the bay washes the residential finger canal community of Isles of Capri, while the rest of the bay perimeter is mangrove systems.

The intercoastal waterway passes along the northwest portion of the bay and serves to direct most boat traffic around, rather than through, Johnson Bay. The Isles of Capri are presently served by septic systems.

B-B11 Big Marco River

Location. Big Marco River about 1/2 mile southeast of SR 951B bridge (Figure 17). Sampling at the approximate center of the river channel will put the small undeveloped mangrove islands 1/4 mile to the south and the Marco Island shore about 1/2 mile to the south. This site should be sampled during the first half of the ebb stage.

Description. The Big Marco River flows along northern shores of Marco Island from Goodland Bay to the Gulf of Mexico. For as much as half of its length, Big Marco River flushes estuarine areas along developed shores of Marco Island. The Marco Island development is one of dredge and fill of mangrove areas to construct finger canals for boat passage and waterfront lots. The finger canals are usually dredged to depths greater than those found in the natural state of the area.

With the exception of the Collier Bay area, most of the finger canal construction on Marco Island is complete. Development proposed for Big Key and Barfield Bay areas was blocked by the Corps of Engineers, and the ultimate fate is now with the courts. Stringent controls in wetlands make further development surrounding Marco Island unlikely.

Marco Island is primarily a recreation, retirement community oriented toward the estuarine and Gulf waters of the area. Sport fishing is the main attraction due to the abundant estuarine nursery areas surrounding the island. Home construction on the island is only 20-30% complete, which at full build-up will make it one of the largest residential communities in Collier County. Stormwater runoff is directed toward the finger canals. Marco Island Utilities provides secondary sewage treatment.

B-B12 Goodland Bay

Location. Goodland Bay at mid-bay. Goodland Bay can be reached by SR 92 from US 41 to Goodland, or by the Big Marco River from Marco Island (Fig. 17). Situated at the major entrance to Goodland Bay is the fishing and retirement community of Goodland. This bay will be sampled at flood tide.

Description. The perimeter of Goodland Bay is mostly mangroves with the developed portion of Goodland consisting of a few finger canals and sea-walled areas. The community of Goodland is on septic systems, and the bay is also subject to drainage input from the SR 92 barrow ditch. SR 92 passes mostly through undeveloped mangrove areas.

B-B13 Fahka Union Bay

Location. Fahka Union Bay, just east of Fahka Union River channel. This site can be reached by the Fahka Union canal from the Remuda Ranch Marina adjacent to US 41. Sampling will be done during ebb tide (Figure 18).

Description. Fahka Union Bay is situated in an undeveloped mangrove area of the Ten Thousand Islands. This shallow bay receives a tremendous freshwater input from the Fahka Union canal which serves as the major outfall canal for the Fahka Union watershed. Drainage area of the Fahka Union watershed extends almost to Corkscrew Swamp in the northwest portion of Collier County. The present land uses contributing runoff to the Fahka Union canal are primarily agricultural and natural with isolated commercial/recreational contributions from the Remuda Ranch Resort. The potential residential land use is great due to the existance of roadways and drainage canals in a major portion of the Fahka Union watershed.

B-B14 Fakahatchee Bay

Location. Fakahatchee Bay, mid-bay. This shallow, estuarine bay can be reached from Fahka Union Bay. Sampling will be done during ebb tide (Figure 18).

Description. Fakahatchee Bay is in a relatively natural state. It receives runoff from the Fakahatchee and East Rivers and general sheet flow from the Fakahatchee Strand. Land to the west and east of the Fakahatchee Strand is drained by man-made canals, so some reduction in natural freshwater inflows may have occurred in Fakahatchee Bay.

Fakahatchee Bay, as part of the Ten Thousand Islands area, is surrounded by mangrove systems and the attendant estuarine communities.

B-B15 Chokoloskee Bay

Location. Chokoloskee Bay, mid-bay, approximately 1/2 mile south of causeway between Everglades City and Chokoloskee Island. Sample during ebb tide (Figure 18).

Description. Everglades City lies at the mouth of the Barron River at Chokoloskee Bay. The Barron River canal receives drainage water from northern agricultural lands of Collier County as well as natural inputs enroute to Chokoloskee Bay. Everglades City is a commercial fishing community surrounded by mangroves. Portions of Chokoloskee Bay are within the Everglades National Park boundary.

Locations and Descriptions of Nonpoint Source Stations

B-N1 Horse Creek

Location. Horse Creek south of SR 846 bridge. Sample immediately above self-actuating salinity control weir. Site can be easily accessed by walking a short distance from SR 846 (Figure 17).

Description. The Horse Creek Station receives runoff from agricultural lands to the south and east. These lands are primarily truck and tree crops. Some residential development is taking place in this area. Horse Creek is part of the Cocohatchee River watershed and is near to the site of the Collier County Sewer District A treatment plant.

B-N2 Royal Poinciana Golf Club Lake

Location. The southernmost water retention lake on Royal Poinciana Golf Course. This lake lies approximately 200 feet west of Poinciana Village, a residential community. Access to the lake must be gained through the entrance to the golf club off of Goodlette Road, or may possibly be obtained at the end of Coach House Lane (the road 1,000 feet south of Poinciana Village)(Figure 17).

Description. This is an artificial lake designed as part of a stormwater retention system. This type of lake retention system is becoming widely used in the Big Cypress Basin and is potentially a major nonpoint source of the future.

B-N3 Gordon River

Location. Gordon River immediately downstream of SR 951 (Goodlette Road Extension) Bridge. Sample immediately above self-actuating salinity control structure (Figure 17).

Description. The Gordon River Station receives drainage from an extensive area to the north and east. Within this area are agricultural land uses (mostly truck crops), urban uses (residential and recreational), and undeveloped lands. The Gordon River and adjacent wetlands recharge the Pine Ridge Aquifer which presently provides most of the potable water for the Naples Urban Area. Naples Bay is the receiving body for Gordon River drainage.

B-N4 Halderman Creek

Location. Halderman Creek. Midstream about 1/2 mile west of SR 858 (Kelly Road) Bridge. Access to this station may be from Naples Bay. This creek is under tidal influence and will be sampled at ebb tide (Figure 17).

Description. Halderman Creek receives a variety of urban runoff. Residential uses from light to dense border this creek. Commercial areas and areas under construction are within this drainage system. Runoff from the Glades Country Club and Gulfgate Shopping Center reaches this area, and subsequently may flow directly into Naples Bay.

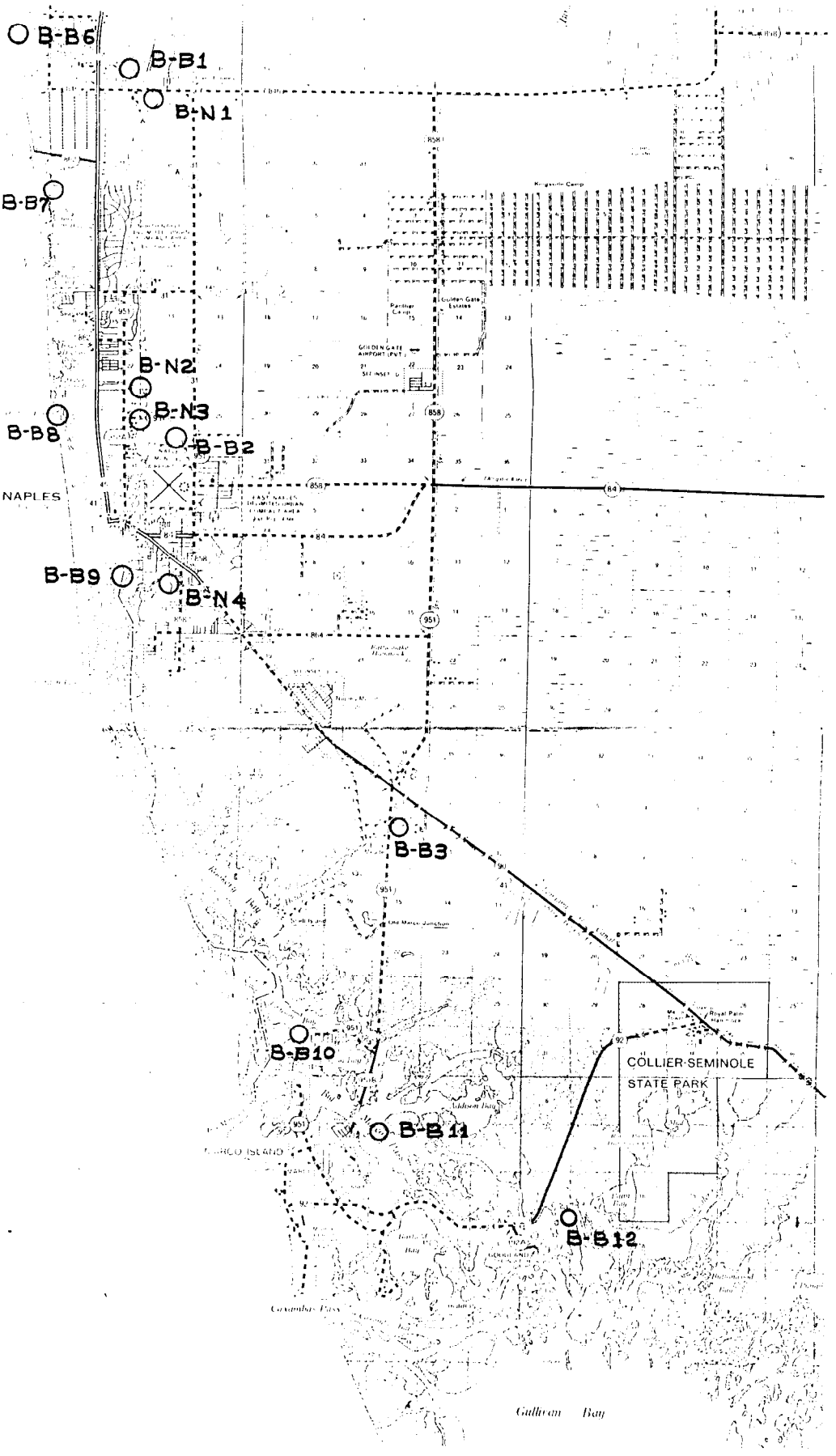


Figure 17. Big Cypress Sampling Station Locations (Western portion).

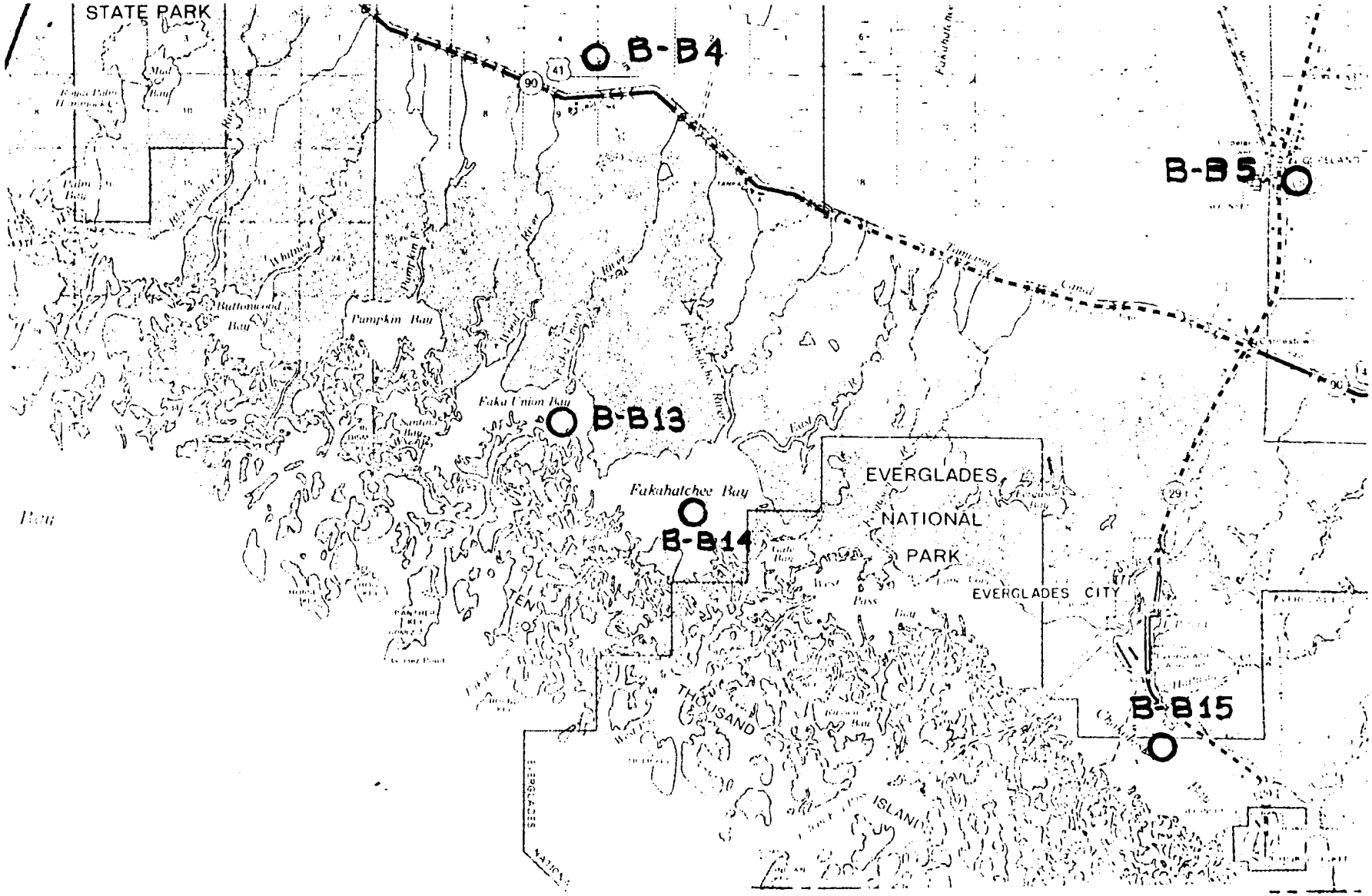


Figure 18. Big Cypress Sampling Station Locations (Eastern portion).

HYDRODYNAMIC SAMPLING PROGRAM

HYDRODYNAMIC SAMPLING PROGRAM

Phillippi Creek Case Study

The purpose of the hydrodynamic portion of this case study is to provide data for subsequent analyses. The objectives of these analyses are:

1. To determine the net direction of discharge of Phillippi Creek waters to bay waters.
2. To determine, to the extent possible, the relative fractions of total creek discharge flowing north to Roberts Bay versus south to Little Sarasota Bay.
3. To assess the impact of creek discharge on either, or both, bays by estimating the extent to which substances in Phillippi Creek waters accumulate in the bays.
4. To examine the pathways by which Phillippi Creek waters ultimately exit northward, should this be the case, to the Gulf of Mexico, thereby to assess which specific regions of bay shoreline are impacted by creek waters.

The first of these objectives needs little further explanation. Phillippi Creek enters the bay system between Roberts Bay (to the north) and Little Sarasota Bay (to the south). There is a question as to which direction creek waters flow in route to the Gulf.

The second objective is an elaboration upon the first. Should creek waters flow both northward and southward, the subsequent impact of creek waters upon the respective bays will depend on the amounts of

discharge flowing in each direction. Therefore quantification of the portions of flow northward versus southward will provide useful management information.

The third objective is an extension of the first two. The creek waters do not exit directly to the Gulf. They mix with bay waters and are removed from the bay system by advection of tidal water. Advection describes the transport of any substance by means of being physically carried along with a travelling parcel of water. A certain portion of bay water is flushed from the system during each tidal cycle. Because this process flushes only a portion of bay water with each tide, there is an accumulation of Phillippi Creek waters (and the substances they carry) in the bays. Estimating flushing times for the bays yields an approximation of the extent of this accumulation.

The forth objective is directly related to the third, because the migration of creek waters toward the Gulf may involve various degrees of mixing with bay waters. Mixing in both vertical and horizontal directions is important. The irregular geometry of the bays, inlets, and outlets may cause likewise irregular circulation, or water movement, patterns in the estuaries. This circulation causes the advection of creek waters mentioned earlier. It is of interest to better understand these patterns. Emphasis, in this case, is on establishing the northward route of Phillippi Creek waters on the way out of the bay system. It is desirable to know if creek waters move somewhat directly seaward by flowing through Roberts Bay, around Fishery Point, and out Big Sarasota

Pass; or if they are advected into the southern region of Sarasota Bay, perhaps impacting water quality in the Hudson Bayou or Bird Key areas. Should it be established that most Phillippi Creek discharge flows to the Gulf via Little Sarasota Bay, the matter of circulation patterns to the north will become insignificant.

Methodology

The effort required to make highly refined determinations of the hydrodynamic parameters discussed above is substantial. The scope of the project will not permit such refinement. However, within a limited budget, valuable approximations may be made. The following methodology will be used.

A dye study will be undertaken to determine the relative portions of Phillippi Creek discharge flowing north versus south. Dye will be injected into the freshwater portion of the creek near its mouth during an ebbing tide. Observations, approximately hourly, will be made to record dye concentration, water velocity and direction of flow at points both north and south of the creek mouth. These points are indicated on the map (Figure 19) as D1 and D2. Measurements will continue throughout the ebb tide and into the following flood tide. The following day, the spacial distribution of the dye will be sampled to further establish the fate of creek discharge. It is not known whether or not the dye will be detectable at this time. Calculations based on creek discharge during the study will be made to estimate the dye location. Meteorologic and tidal conditions during the study will be used to estimate dye dispersion

and thereby estimate dye location. Initial efforts to locate the dye will begin with available daylight. Intensive measurements will be made near and at slack water to reduce errors caused by time differences in measurements.

The flushing characteristics of Roberts and Little Sarasota Bays will be determined using tidal prism theory. This is probably the best method that can be used without the benefit of extensive field dispersion, tidal current, and wind current data. Using the tidal prism approach requires only tidal stage data which will be obtained from existing and field data.

Provided the dye studies indicate a substantial portion of creek waters flowing north, a study of circulation within the Roberts Bay to Big Sarasota Pass region will be performed using drogues as tracers. Several drogues will be released near the bascule bridge (point D3 on the map, Figure 19) at the beginning of an ebb tide. The drogues will be followed by observers in boats who will record the drogue paths with time. The study will continue throughout the ebb tide and into the flood tide. It will be necessary to terminate near dark. If possible, a scan of the area the following day will be made to attempt to locate the drogues. The feasibility of this will be determined at the time of the study.

Work Scope

Dye Study

Tracer dye will be injected into the upper waters of Phillippi Creek at a suitable location at or near the U.S. 41 Highway bridge. Injection

will continue at a constant rate to be determined based on existing creek flow at that time. The amount must be sufficient to enable detection after dilution with creek water.

Measurements of dye concentration, water velocity and flow direction will be made every hour throughout the ebb tide, and into the following flood tide if practicable. Measurements will be made at approximately two-foot increments from surface to bottom. Points of measurement will be mid-channel of the Gulf Intracoastal Waterway: 1) South of Phillippi Creek at a point mid-way between buoys 65 and 67 (about 3500 feet south of creek mouth); 2) North of Phillippi Creek at GIWW mile 70 (about 3000 feet north of creek mouth). The depth of water at these points is approximately ten feet.

Measurements of creek discharge will be made at beginning and end of ebb tide.

The following day, longitudinal transects along or near the GIWW will be made in an effort to relocate dye. Spacing of measurements will be 1000 feet. Determination of position will be by reference to GIWW buoys and markers using navigation charts.

The time of study will be during the week of October 17, 1976, weather and other factors permitting. Tides at this time are suitable for the study.

Drogue Study

Drogues will be constructed to be used as tracers. They must be readily visible, yet not have extensive area above water. This will diminish influences of wind.

A group of six drogues will be released at the beginning of ebb tide. The SR 789 bridge at the north end of Siesta Key will be the point of release. The movement of the drogues will be observed by personnel in one or two boats. The paths of the movement will be denoted with time throughout the remainder of the daylight period. Depending on drogue movement and weather conditions during the time of the study, efforts to relocate the drogues will be made the following day. If the drogue construction is such that it poses a dangerous threat to navigation, all drogues will be collected before dark on the first day of the study.

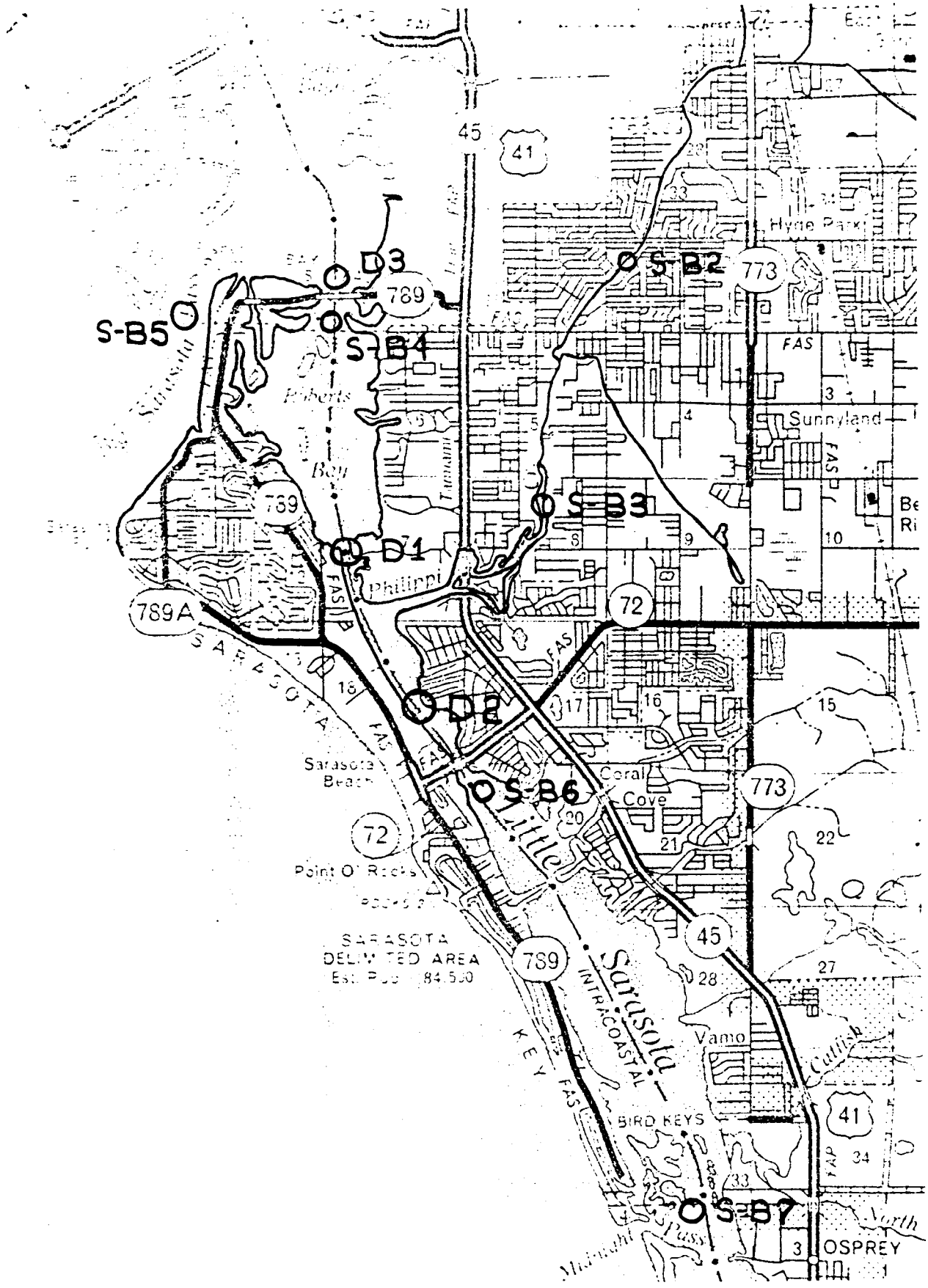


Figure 19. Phillippi Creek Dye and Drogue Station Locations

HYDRODYNAMIC SAMPLING PROGRAM

Charlotte Harbor Case Study

Presently the fate of any substance introduced into the Charlotte Harbor or those waters that directly affect it cannot be assessed. In order to determine the significance of a pollutant in this system, its movement into and out of the system as well as its time spent within the system must be defined. Thus the hydrodynamic framework of the Charlotte Harbor and those waters directly affecting it requires definition. The goal of this study is to characterize the baseline input-output relationships between Charlotte Harbor and those waters connected with it. The overall contributions of:

(a) the Peace River

(b) the Myakka River

(c) the channel between Turtle Bay and Charlotte Harbor

(d) Gasparilla Sound

(e) Boca Grande Passage

(f) Pine Island Sound

(g) the channel between Pine Island and the eastern shore need to be established.

In order to accomplish this, the following measurements need to be taken; 1) current velocities and directions, 2) tide level, 3) wind speed and direction and 4) bathymetric profiling. Analyses of the data acquired will yield a satisfactory conception of the overall physical oceanography of this study area.

Measurements of current velocities and direction will give information that will show the circulation patterns that develop at high and low tide periods. Current information will also be used to determine the volumes of waters that are being discharged from the system, being transported into the system or are moving within the system. The frequency of occurrence of a particular circulation pattern will be indicated as well. This is of major importance when concerned with the presence of a pollutant(s) and its availability to the ecosystem. When circulation is good, pollutants at a particular concentration level may be assimilated over a large area by the biota without detriment. With poor circulation these same pollutants may be allowed to build to toxic levels.

Tide measurements will reveal the response of circulation to tidal stage. In part, the transportation of substances in the water column will be tidal driven. Tidal currents will have varying importance on circulation depending upon location within the system.

Typically, areas such as Charlotte Harbor have a primarily wind driven circulation. Here wind speed and direction measurements when correlated with the other data will exhibit the relationships between wind driven circulation and tidal circulation. The influence of wind upon circulation will have a large effect upon tidal influence. An easternly wind may impede flood tides and enhance ebb tides in the lower Harbor. A southernly wind may enhance flood tides but impede ebb tides in the upper Harbor.

Wind influence in such shallow waters as these will be significant and quasi-predictable. But wind measurements will provide support and a guideline for determining the hydrodynamic baseline here.

The topography of the basin is needed in order to calculate the volumes of water being moved about this sytem. This will indicate the singular impact of the various water bodies upon the whole system. Also features found may give an idea of the movements and past activities of sediments along the investigated lines.

Methods

A number of measurement transects have been selected in order to isolate and quantify the impact of the various input-output areas. Two comparably equipped and manned vessels will be utilized for data collection. They will divide the oceanographic tasks between the northern section of Charlotte Harbor (Peace and Myakka River transects) and the southern portion (the remaining transects). Field measurements will coincide with high and low tides.

At selected stations (normally at each end of transects and $\pm$ 1 nautical mile intervals along transects) current, tide and wind measurements will be taken. Along these transects (Figure 20) bathymetric profiles will be charted using a recording fathometer.

Station sites have been selected which coincide with navigational aids where possible. Otherwise the stations will be located by triangulation

with fixed structures and landmarks. Where necessary stations will be marked with buoys to ease later location. Copius field notes will be taken on all pertinent aspects of the field work.

Work Scope

Current Study

At each station the research vessels will be firmly anchored. Currents will be measured using digital current meters. The velocity and direction of flow will be measured near the surface and bottom in order to detect vertical velocity shears. Such velocity shears, (gradients in current velocity with depth) if undetected, would mislead investigators into the assumption that surface velocities characterize the total volume transport of the water body. To assume so would distort the hydrodynamic framework developed and give an inaccurate portrayal of the input-discharge characteristics of the system.

Tide Study

Tidal measurements will be done by "tape down" technique on fixed structures whenever possible. Time-data correlations with tidal stations established by the Florida Department of Natural Resources in Punta Gorda, Pine Island, the railroad bridge across the Myakka River near El Jobean, and Boca Grande Passage will provide a reliable and accurate reference for mean low water elevation.

Bathymetric Profiles

Bottom topography will be mapped via shipborne recording fathometer. Location references will be keyed to the chart paper and field notes. Boat speed will be maintained at as constantspeed as possible in order to minimize horizontal distortion of the profiles. Cross-sectional areas of the water bodies along each transect will be calculated from these bathymetric profiles. The volumes thus obtained in conjunction with current velocities along each transect will yield an estimate of the quantity of water moving through that plane at the time of sampling.

Wind Measurements

Wind speed and direction will be determined at each station via portable wind velocitometers. During sampling the sea state will also be noted. Peculiar wind shifts or buffeting will also be recorded. Flow and wind direction differences may be measurable at time of sampling. Although it is presupposed that the driving force of the currents in this area is the wind, these measurements will reinforce this judgement and aid in the interpretation of the combined data. Also the importance of the wind in vertical mixing can be variously estimated.

The importance of each of the above parameters toward development of the hydrodynamic regime in this area and the ultimate application of the hydrodynamics toward the entire baseline study is implicit. It is now evident that the combination of the isolated conditions will lead to definitive statements on the circulation, dilution and impounding times of the Charlotte Harbor and those waters which directly effect it.

Sampling Plan for Northern Charlotte Harbor

I. Transect N-A

Southeastern Charlotte Harbor City across the Peace River to northeast of Punta Gorda. Line will run paralled but upstream (±0.5 nautical miles) of Bascule Bridge (U.S. 41)

Stations:

N-A1 Near shallows (3'-5') northeast of Charlotte Harbor City

N-A2 Mid-river (mid-bridge) of the Peace

N-A3 Near shallows (3'-5') adjacent to Punta Gorda

At each station verify position via sextant angle plot and drop marker buoy. Distance along transect N-2 = 1 nautical mile. Projected time required on N-A = 35 minutes.

II. Transect N-B

West Punta Gorda near mouth of creek across the Peace river to unnamed creek above Myakka Cutoff

Stations:

N-B1 Near shore Punta Gorda

N-B2 Mid-river (14' depth) of the Peace River

N-B3 Shallows northeast of Myakka Cutoff

At each station verify position via sextant angle plot and drop marker buoy. Distance along N-B = 1.5 nautical miles. Projected total elapsed time required to complete work at N-B3 = 2 hours 5 minutes.

III. Transect N-C

Hog Island (Shoal Point) across Myakka River to mouth of Trout Creek

Stations:

N-C1 Near shore shallows Shoal Point

N-C2 Mid-river of the Myakka

N-C3 Near shore shallows off Trout Creek

At each station verify position via sextant angle plot and drop marker buoy. Distance along N-C = 1 nautical mile. Projected elapsed time required to finish northern portion data collection is 3 hours 30 minutes.

Sampling Plan for Southern Portion

I. Transect S-A

Marker south of Bull Bay due west to mid-channel of Intracoastal Waterway

Stations:

S-A1 Marker southeast of channel into Bull Bay, get tape down measurement at that unnumbered marker

S-A2 Midway between S-A1 and ICWW mark location with buoy and verify position via triangulation

S-A3 Middle of ICWW locate and identify channel marker, get tape down measurement

Distance along S-A = 2.3 nautical miles. Projected time required on S-A = 45 minutes.

II. Transect S-B

Across the Boca Grande Inlet north to south

Stations:

S-B1 Near marker north side of inlet, get tape dwon measurement at that marker

S-B2 Mid-inlet

S-B3 South side of inlet near Cayo Costa, drop marker buoy

Distance along S-B = 0.7 nautical miles. Projected total elapsed time to S-B3 = 1 hour and 25 minutes.

III. Transect S-C

Marker northeast corner of Cayo Costa to Bokeelia

Stations:

S-C1 Channel marker ICWW near Cayo Costa

S-C2 1 nautical mile east along S-C. drop buoy and verify position via triangulation

S-C3 Eastern shallows of Jug Creek Shoal, drop marker buoy and verify position via sextant angle plot

S-C4 Course around Jug Creek Shoal to 2nd marker into channel, tape down measurement on marker

S-C5 Marker north of Bokeelia Island

Distance along S-C = 5.3 nautical miles. Project total elapsed time to S-C5 = 3 hours 25 minutes.

IV. Transect S-D

Bokeelia marker to Matlach Pass

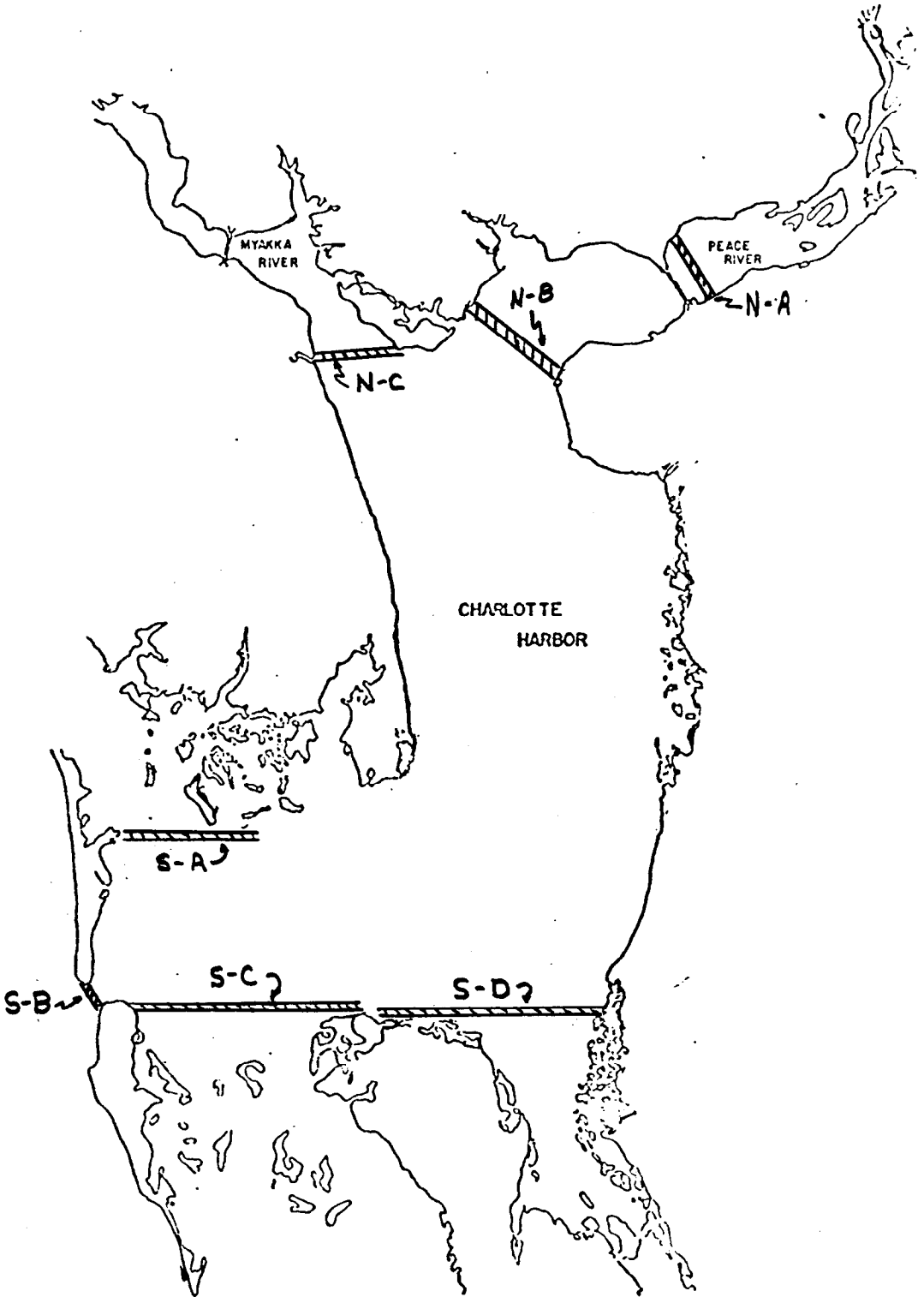
Stations:

S-D1 1 nautical mile east of Bokellia, drop marker buoy and verify position via sextant angle plot

S-D2 Course north around shoal to midpoint between eastern Pine Island and Matlach Pass on a line due east of northern most Pine I., drop marker buoy and verify position via sextant angle plot.

S-D3 Shallows near Matlach Pass, drop marker buoy and verify position via sextant angle plot

Distance along S-D = 4.5 nautical miles. Projected total elapsed time to complete southern portion data collection = 4 hours. At each station the time will be recorded in order for later correlation with tidal stage and measurements.



CHARLOTTE HARBOR CASE STUDY MAP

Figure 20. Transect Locations for Hydrodynamic Study.

APPENDICES

APPENDIX A

Appendix A contains summaries of the interviews with persons employed by governmental agencies and industry and private citizens. The people were contacted in an effort to collect land use information pertaining to the Phillippi Creek drainage basin. Each summary identifies the sampling location or locations to which the information obtained applies. The synopses presented are abbreviated. In most cases, the actual interviews were extensive; however, only the most significant of aspects of each are related here.

Mr. Heinzmann Mr. Perry	Environmental Control Environmental Control	Wet and Dry Season Sampling
Mr. Dennis Wilkinson		Wet and Dry Season Sampling
Mr. Frank Stafford	Aquatic Plan Control Coordinator	S-R1 through S-R7
Mr. Norman Thomas	Director Co. Mosquito Control	S-1 through S-7
Mr. McKinney Ms. Lynch	Public Works Dept. Foreman Public Works Dept. Secretary	S-R1 through S-R7
Mr. Johns	Re-evaluation Appraiser	S-R1
Mr. Dick Balduzzi Mr. Frank Reinhardt	District Conservationist Conservation Technician	S-R1
Mr. Edwin Pastorius	Extension Agent	S-R2, S-R4, S-R5, S-R6
Fla. Dept. of Transportation		C-R5
Mr. William Eastwood	Asst. City Engineer	S-R5
Francis Brown Realty		S-R5
Mr. Mills	Morris Trading Corp.	S-R5
Mr. Martin Alder	Manager Golf Course	S-R4
Mr. Patrick Tisu II	Superintendent Country Club	S-R6
Mr. R.M. Slagle	Homeowner	S-R6
Mr. Chamberlin	Homeowner	
Ms. Johnston Mr. T. Johnston	Homeowner Resident	S-7
Mr. Wynn	Horse Mart Owner	S-R1
Mr. George Turner	Resident	S-R1
Mr. Jabo Browning	Manager Pasture Land	S-R1
Ms. Owen Mizell	Owner Ranchette	

Mr. Daniels	Manager of Produce Farm	S-R1
Mr. Ron Masters	Golf Club Maintenance Manager	S-R1
Mr. Bruce Cook	Citrus Grove Manager	S-R1

Wet and Dry Season Sampling

Mr. Heinzmann, Director
Mr. Perry
Sarasota Department of Environmental Control
Sarasota, Florida

Drainage maps and aerial photography were provided for the determination of probable sampling locations. Inputs into the sampling program, including a field trip to numerous probable sampling locations, was provided. Information has been obtained at various times through telephone calls and personal interviews.

Wet and Dry Season Sampling

Mr. Dennis Wilkinson

Mr. Wilkinson supplied numerous detailed contour maps for the determination of drainage basin character. Numerous types of aerial photography, including real estate photographs, were made available for the determination of specific land use sampling sites. Mr. Wilkinson has been available for interviews at various times.

S-R1 through S-R7

Mr. Frank Stafford, Coordinator
Sarasota Aquatic Plan Control
Sarasota, Florida

The maintenance programs for drainage ditches and canals consist primarily of the treatment of vegetation to control water flow. Problem vegetation, mainly floating and dense submerged aquatic plants, can impede water possibly causing flooding and washout problems. Manual and dragline operations are commonly used in the removal of aquatic vegetation from canals and ditches.

Drainage ditch and canal travelways in nonurban areas are cut once per year. Urban areas are groomed regularly by work crews composed of prisoners.

The treatment of vegetation by chemical application is a low concentration, high volume program. The herbicides used are:

1) Dalapon - treatment of grasses
2) 2,4-D - treatment of broad leaf vegetation
3) 2,4,5-TP - treatment of wood vegetation
4) Organic copper
5) Diuron
6) Diquat

Meteorologic conditions and the type of vegetation will determine the application schedule. Water hyacinths and terrestrial grasses are treated during the summer months. Submerged vegetation is treated during the fall and winter months. The concentration of chemical herbicides applied is always less than the concentration recommended by the United States Environmental Protection Agency and the State of Florida regulations.

Chemical herbicides are applied by high pressure piston pumps from manual mobile units and trucks. The application of sprays from helicopter is common at large problem areas.

Mr. Stafford will provide information of maintenance procedures during the sampling period. A Fruitville Drainage District map was provided by Mr. Stafford for the identification of sampling sites.

S-1 through S-7

Mr. Norman Thomas, Director
Sarasota County Mosquito Control
Sarasota, Florida

The treatment for mosquito control is only in areas that show evidence of existing mosquitos or larvae. Any drainage ditch or canal having minnow habitats are not sprayed.

A No. 2 diesel fuel with a Triton X-207 additive, applied at five gallons per acre, is the major pesticide used for mosquito control. A new program, using Altosid SR-10, is applied in a limited number of areas. The concentration of the pesticide is always less than the Federal and State regulation laws. The application of the pesticide is either by a portable mobile spray tank or a high pressure spray system on trucks.

S-R1 through S-R7

Mr. McKinney, General Foreman
Mrs. Lynch, Secretary
Public Works Department
Road and Bridge Division

A street sweeping program does not exist for the Sarasota County street system. Spot clean-ups, traffic hazards, trash, glass, etc. are removed from streets upon request from the public or governmental office personnel.

The design and direction of flow in drainage ditch No. 7 was discussed with Mr. McKinney. The direction of the water flow from ditch No. 8 to ditch No. 7 must be determined from an on-site inspection.

S-R1

Mr. Johns, Re-evaluation Appraiser
for Agricultural Lands
Sarasota Property Appraiser Office
Sarasota, Florida

Enlarged soil survey maps containing pasture land use locations and pasture classifications were examined for the S-R1 drainage basin. The categories listed for Sarasota pasture land were clover, improved, semi-improved and native pasture. Cattle production in the S-R1 drainage basin is primarily improved and native flat pasture lands.

S-R1

Mr. Dick Balduzzi
District Conservationist
Mr. Frank Reinhardt
Conservation Technician
USDA Soil Conservation Service
Sarasota, Florida

The interview with Mr. Balduzzi consisted of (1) a discussion of the objectives and approach of the water sampling design for the 208 program, (2) land uses in the S-R1 drainage basin, and (3) a list of suggested data references for the study area.

Mr. Reinhardt located specific agricultural and nonagricultural land use categories on a reference topographic map. Land use categories include pasture land, celery crop land, citrus grove, golf courses, camping areas, semi-developed and planned developed areas and ranchette lands. Further, the drainage to Main A Canal extends from the Cow Pen Slough dike eastward to the sampling site location.

According to Mr. Balduzzi, the application of fertilizers on large pastures may be dependent on cattle prices, whereas ranchette maintenance would more likely not be affected by the cattle market.

S-R2, S-R4, S-R5, S-R6

Mr. Edwin Pastorius
Extension Agent
Ornamental Horticulture
Fla. Agricultural Extension Service
Sarasota, Florida

A recommendation program for the care of residential lawns and golf course maintenance is performed by Mr. Pastorius.

For residential lawn care, a 16-4-8 formula fertilizer is recommended for application prior to or after the rainy season. A soil test for pH and the identification of insects are services commonly performed for the public.

The maintenance programs are recommended through a weekly newspaper article, garden clinics, individual requests and monthly golf course manager meetings. Mr. Pastorius provided a soil survey manual for the identification of soil type.

C-R5

Florida Dept. of Transportation
Sarasota, Florida

In determining a suitable location for sampling commercial land use, the Department of Transportation drainage maps were reviewed for Highway 41 area north of the Southgate Shopping Center.

S-R5

Mr. William Eastwood
Assistant City Engineer
Sarasota Engineering Dept.
City Hall, Sarasota, Florida

Drainage maps for the Southgate Shopping Center were reviewed for the selection of a sampling location. Runoff is carried through storm sewers to the shopping center northwest corner and then towards Phillippi Creek. A potential sampling location is at the northwest corner via a manhole cover.

S-R5

Francis Brown Realty
Sarasota, Florida

The Francis Brown Realty Co. manages the parking area sweeping program for the Southgate Shopping Center. During the telephone interview, it was reported that the parking area would be extensively repaired during the sampling period.

S-R5

Mr. Mills
Morris Trading Corp.
Sarasota, Florida

The Morris Trading Corp. manages the maintenance program for the Southeast Shopping Plaza. The parking area drainage is towards a grass ditch on Bee Ridge Road and is then transported towards Phillippi Creek through ditch No. 9 in the Fruitville Drainage District. The entire parking area is cleaned twice per year. The sidewalks, gutters, and areas of high debris collection are vacuumed regularly

APPENDIX B

Appendix B contains sumaries of the interviews with persons employed by government agencies and industry and private citizens. The people were contacted in an effort to collect land use information pertaining to drainage from watersheds surrounding Charlotte Harbor. Each summary identifies the sampling location or location to which the information applies. The synopses presented are abbreviated. In most cases, the actual interviews were extensive; however, only the most significant of aspects of each are related here.

Mr. Michel Best	Assistant to County Regional Planning Council Director	Tributaries H-1, H-2
Mr. John Thomas Mr. Jay Riggs Mr. Bilbrey	Map Section at Appraiser Office Field Appraiser Field Appraiser	H-R1
Mr. Dallas Stratton Mr. Arnold Verwey	Draftsman Civil Engineer Technician	Tributary Sampling Locations H-R1, H-R2
Mr. Steven Perry	District Agent	H-R2
Mr. Glesson	Extension Agent	H-R1
Mr. Shoemaker	Road and Bridge Dept. Coordinator	Tributaries H-R1, H-R2
Mr. Robert Ward	Director Mosquito Control	Harbor Samples, Tributary Samples H-R1, H-R2
Mr. Sanderson	Golf Club Superintendant	H-R1
Mr. Gardner	Lawn Maintenance Man	H-R1
Mr. Sharrow	Lawn Maintenance Man	H-R1
Mr. Alan Mileski	Owner, Lawn Service	H-R1
Mr. Jim Ginge	Amaco Station Attendant	H-R1
Mr. Patrick	Homeowner	H-R1
Mr. Keith Marks	Resident	H-R1
Ms. M. Slemmer	Homeowner	H-R1

Tributaries

H-1, H-2

Mr. Michel Best
Assistant to the Exec. Director
Charlotte County Regional
Planning Council
Punta Gorda, Florida

Aerial photography and topographic maps at Mr. Best's office were examined to determine drainage characteristics at potential sampling site locations. The Southwest Regional Water Management District's Peace River Phase IV aerial photograph series was intensely examined. These area photographs contained an appropriate scale and detailed contour information to identify the drainage characteristics of the basin. A large map of the Charlotte Harbor area was received from Mr. Best for the coordination of land use and sample site information.

H-R1

Mr. John Thomas - Map Section
Mr. Jay Riggs - Field Appraiser,
Agriculture
Mr. Bilbrey - Field Appraiser,
Residential/Commercial
Charlotte County Property
Appraiser Office
Punta Gorda, Florida

The Charlotte County Property Appraiser Office was contacted to help determine specific land uses of the potential sampling site location. Further, the accessability of each location, as well as, alternate locations were discussed. The areas considered were the Shell Creek basin, the Prairie Creek basin, a location near Jones Loop Road, an area adjacent to the Peace River and the Cecil Webb Wildlife Management Area. The Shell Creek drainage basin consists of open space land used primarily for cattle production. This area was accessable at Washington Loop Road. Due to the numerous logs and stumps, examination of the

upland portion of the drainage basin by boat would be difficult. The Prairie Creek area had similar characteristics to the Shell Creek drainage basin. The land use consisted of over 1,895 acres of native pasture, 165 acres of semi-improved pasture, 140 acres of swamp and 160 acres of citrus groves. The location in the Jones Loop Road vicinity discussed was a platted section at the northeastern corner of the loop. This area drained an open land use category consisting of wooded lands, planned development and a small section of pasture land. The planned development area presently consists of two residential houses. This area is easily accessable by car via Jones Loop Road. An area on the Peace River, north of Bay Harbor, was suggested as a possible sampling location for an open space land use category. This area, however, was found to have dredging and development activities presently existing. The land use category of the Cecil Webb Wildlife Management Area was described as primarily leased pasture land. The tax appraiser office personnel reported that all open space land in Charlotte County has previously been used for cattle production, or is presently being used for cattle production, or may periodically be used for livestock operation.

Tributary Sampling Locations

H-R1, H-R2

Mr. Dallas Stratton
Chief Draftsman
Mr. Arnold Verwey
Civil Engineer Technician
Charlotte Co. Engineering Dept.
Punta Gorda, Florida

The drainage characteristics of the Charlotte County drainage system including the ditch/canal system, the direction of runoff flow in

various drainage basins, and the location of flow structures were discussed with Mr Stratton and Mr. Verwey.

Nearly all of the drainage canals in the Port Charlotte area have structures, located at their respective intersections with Highway 45, to prevent saltwater intrusion from the harbor. A location at Airport Road, west of downtown Punta Gorda was suggested as a possilbe open space land use sampling site. The ditch draining the area, however was found not to be beyond tidal influences. The accessability to the Shell Creek drainage basin for sampling the open space land use category was determined to be restricted to the intersection of Shell Creek and Washington Loop. A more upland sampling site location was eliminated because of very poor unimproved road conditions.

H-R2

Mr. Steven Perry
District Agent
USDA Soil Conservation Service
Punta Gorda, Florida

Mr. Perry was interviewed to collect information in choosing an open land use area for the wet season sampling program. Recent, 1976, aerial photography and topographic maps were reviewed to determine land use, drainage, and accessability for sampling. The locations discussed were:

1) Shell Creek drainage basin - an extremely large drainage basin with good drainage, primarily used for pasture land.

2) Prairie Creek drainage basin - similar characterstics to the Shell Creek area.

3) Cecil Webb Wildlife Management area - Mr. Larry Campbell, the director of the Cecil Webb area, was called for permission to have an on-site examination of the drainage and land use within a section of the wildlife management area. The area consisted of a pine/palmetto flatwood environment common in the coastal areas of Florida. Portions of the area examined exhibited evidence of heavy cattle grazing. Topographic maps of the Jones Loop area were received from Mr. Perry.

H-R1

Mr. Glesson, Extension Agent
Ornamental Horticulture
Fla. Agriculture Extension Service
Punta Gorda, Florida

The Florida Agriculture Extension Service recommends fertilization programs for established lawns in Charlotte County, Florida. These programs are excerpts from Circular No. 357. It suggests the type and amount of fertilizer and the schedule for applications to Bahia, Bermuda, Centipede and St. Augustine grass types. The Extension Service also makes green, tee and fairway maintenance recommendations for the Port Charlotte Golf Club.

Tributaries

H-R1, H-R2

Mr. Shoemaker, Coordinator
Road and Bridge Dept.
Charlotte County

The Road and Bridge Department maintains roadside ditches and cross ditches through fields. The program consists of mechanical maintenance of ditches by mower, dragline or manual cleaning. Chemical application for aquatic vegetation has not occurred within the last two years.

Although chemical herbicides are presently being reviewed for use, they will not be applied during the sampling period.

Harbor Samples, Tributary Samples

H-R1, H-R2

Mr. Robert Ward
Director Mosquito Control
Charlotte County
Punta Gorda, Florida

The Charlotte County mosquito control program is conducted on a non-routine schedule. Mosquito control treatment occurs only when mosquito or larvae habitats exist. Areas of specific concern are the margins of Charlotte Harbor, including (1) mangrove areas, marshlands and lowlands, and (2) ditches, canals and poor drainage areas in the highlands.

The principal larvacide used is a No. 2 diesel fuel plus a 10 percent solution of motor oil and three pints of Triton X-207 per 100 gallons. The larvacide is nomianlly sprayed at four gallons per acre or at heavier applications for dense growth. The marshlands are sprayed from aircraft. This application takes five days to spray the entire marsh area. Ditches and canals are sprayed with larvacide at five gallons per minute from ground vehicles. Populated areas are checked weekly to determine if treatment is necessary. Nonpopulated areas are checked and treated only after examination and treatment of the populated areas has been completed. Canals are not sprayed if sport fishing occurs in the canal area.

Organophosphate pesticides include Macathion, Dybrom 14, and Baytex. These adultacides are applied at ultra-low concentrations and undergo a

rapid degradation. Application may be by aircraft between 2:00 AM and 4:00 AM.

H-R1

Mr. Sanderson, Superintendent
Port Charlotte Golf Club
Port Charlotte, Florida

The golf course maintenance program for the application of fertilizers, herbicides, and pesticides closely follows the recommendations of the Florida Agricultural Extension Service Office. The drainage from the golf course is to an adjacent canal having an overflow structure about 1½ miles up canal from the sampling location. During the rainy season water will flow through the overflow structure to a small urban lake and then towards the sampling site location. Mr. Sanderson will be available to provide information on specific land use activities during the sampling period.

H-R1

Mr. Gardner
Professional Lawn Maintenance
314 Normandy Street
Port Charlotte, Florida

Mr. Gardner services numerous residential lawns in the drainage basin to be studied. Grass is cut and the clippings removed once each ten days. Fertilizer is applied once per year at the beginning of the rainy season.

H-R1

Mr. Sharrow
Professional Lawn Maintenance
630 NE Conway Street
Port Charlotte, Florida

Mr. Sharrow's residence is adjacent to the H-R1 drainage canal sampling location. He provides professional lawn services to many residents in

the drainage basin to be sampled. Fertilizer application may be twice per year, once per year or not at all depending on the individual resident owner's wishes and the type of grass. Scheduling of fertilizer application is during the summer and winter months. When lawns are fertilized, a premium fertilizer applied at 100 pounds per lawn is preferred by Mr. Sharrow.

H-R1

Mr. Alan Mileski, Owner
Clean Cut Lawn Service
145 S.W. Mundella Circle
Port Charlotte, Florida

Mr. Mileski maintains numerous residential lawns in the drainage basin to be studied. The maintenance program consists of grass cutting once per week and fertilizer application twice during the fall and twice in late winter or early spring. The fertilizer primarily applied is Scott's Weed and Feed.

H-R1

Mr. Jim Ginge
Amaco Station Attendant
288 N. Highway 45
Port Charlotte, Florida

The Amaco service station is located adjacent to the overflow structure at the sampling site H-R1. According to Mr. Ginge, water does not flow constantly over the structure unless preceded by a rain event.

H-R1

Mr. Patrick, Homeowner
359 Oswego Street
Port Charlotte, Florida

Mr. Patrick maintains lawns and removes grass cuttings for personal friends. According to Mr. Patrick, most resident owners contract professional lawn maintenance personnel for yard care.

H-R1

Mr. Keith Marks, Resident
519 Hayworth Road
Port Charlotte, Florida

Mr. Marks resides adjacent to an overflow structure in the drainage basin to be studied, and approximately 1½ north, up canal, from the H-R1 sampling location. Water flow through the overflow structure, as well as water hyacinth movement down the canal, occurs regularly during the rainy season. The flow in the canal has increased between periods of little rain. This may be due to the opening of the mechanical water control structure up the canal.

H-R1

Ms. M. Slemmer, Homeowner
1124 Beacon Drive NE
Port Charlotte, Florida

Ms. Slemmer resides adjacent to the canal to be sampled during the wet season sampling program. Intense aquatic vegetation growth has occurred along the canal at Ms. Slemmer's residence, approximately 2.5 miles up canal from the sampling site. Ms. Slemmer reported that removal of the vegetation, primarily water hyacinths, has occurred down canal, but maintenance of the canal has not taken place in the area of her residence for the last 1.5 years. The hyacinths presently cover the canal between banks and emit an unpleasant odor. Previous movement of water has been both towards and away from the sampling site.

S-R4

Mr. Martin Alder, Manager
Bobby Jones Golf Course
Sarasota, Florida

The maintenance program for green and tees at the Bobby Jones Golf Course consists of 125 pounds of type 6-6-6 fertilizer and 50% natural organic applied per course, and minor amounts of copper, manganese, zinc and iron. Herbicide applications include AMA+2, and Super Pal-e-rod at 120 gallons per year. All applications are through power sprayers. Dursban pesticide is spread on greens with a base for the treatment of mole cricket. Fairway maintenance includes types 6-6-6 fertilizer at 15 tons per application by tractor drawn spreader. The last application was in Fall, 1975 and the next will be September, 1976.

S-R6

Mr. Patrick Tisu II, Superintendent
Forest Lakes Country Club
Sarasota, Florida

Maintenance practice includes the fertilizing of greens and tees once per month with one ton of 10-4-8 granular. Fairways were fertilized last November with 18-6-12 at about seven tons per entire course. This application is through tractor sprayers.

S-R6

Mr. R.M. Slagle, Home owner
2316 Tanglewood Drive
Sarasota, Florida

Mr. Slagle, a retired chemist, has resided adjacent to ditch No. 9 in the Hyde Park Drainage District since 1970. Ditch No. 9 periodically fills due to urban stormwater runoff, overflows the roads and has caused soil washouts. Water in Phillippi Creek adjacent to Mr. Slagle's home, is tidally influenced, but does not go up ditch No. 9.

Mr. Chamberlin, Home owner
3106 Tanglewood Drive
Sarasota, Florida

Mr. Chamberlin, a retired chemical engineer, has resided next to the dam on Phillippi Creek since 1969. The dam is reported to be nonfunctional as a control for saltwater intrusion up Phillippi Creek.

S-R7

Ms. Johnston, Home owner
Mr. Terry Johnston, Resident
4423 Tanglewood Street
Sarasota, Florida

Ms. Johnston was unaware of the direction of flow in ditch No. 7 behind her house, but allowed an on-site inspection via her property.

S-R1

Mr. Wynn, Owner
Sarasota Horse Mart
Sarasota, Florida

The Sarasota Horse Mart consists of a stable and fourteen acres of pasture. An 8-8-8 type fertilizer plus ammonium nitrate is applied in May or June by tractor spreader.

S-R1

Mr. George Turner, Resident
Shilo Road
Sarasota, Florida

Mr. Turner leases about 175 acres of pasture land which contains approximately 100 head of cattle. A 16-8-8 type fertilizer is applied at 200 pounds per acre in March and 150 pounds per acre in September. The application is by tractor spreader.

S-R1

Mr. Jabo Browning, Manager
Shilo Road
Sarasota, Florida

Mr. Browning last applied fertilizer two years ago to 750 acres of pasture land. This area contains 200 to 300 head of cattle.

Mrs. Owen Mizell, Owner
Delft Road
Sarasota, Florida

Fertilizer is not applied to the 20 acre ranchette which contains 15 cows and calves. The neighboring ranchette owner also does not apply fertilizer to the pasture land.

S-R1

Mr. Daniels, Manager
Fancy Farm, Inc.
Sarasota, Florida

Fancy Farms, Inc. produces primarily celery, cabbage and corn. Seed beds are first planted in June. Additional seed beds are planted throughout the summer. The main growing season is a period between September and May. A 10-10-20 type fertilizer is applied at about one ton per acre every three weeks during the growing season. The fertilizer is spread on the ground and turned in by tractors.

Meteorologic conditions determine the pesticide and fungicide spraying schedule. The primary sprays are Copper, Lonnate, Vydate, Monzate 200 and Benlate. These sprays are applied from a cart sprayer directly onto the plants.

The weir on ditch No. 52 is used to maintain an adequate water level for dry season irrigation.

S-R1

Mr. Ron Masters, Maintenance Manager
Sarasota Golf Club
Sarasota, Florida

The Sarasota Golf Club schedules a preventive maintenance program for herbicides and pesticides. Application of herbicides and pesticides are dependent upon need, temperature, and humidity. Fertilizer application is only applied to greens and tees. Fairways are presently being treated for the removal of undesireable grasses. Fertilizer application of a 16-4-8 granular type is spread once per month. One pound of nitrogen is also applied per 3½ acres per month. Herbicide applications include:

1) MSMA, about two quarts per acre are applied for weed control.
2) 2-40 + Banvel, three pints per acre are applied to fairways as a weed killer.

All application is by lower pressure tractor sprayer.

Pesticide application includes:

1) Malathion, mosquito control by fogging from jeep.
2) Baygon, insecticide for greens, about six pounds per acre applied.

S-R1

Mr. Bruce Cook, Manager
Citrus Groves, Weber Road
Sarasota, Florida

Approximately 300 acres of citric crops are maintained adjacent to Cow Pen Slough. Older groves, 14 years old, consisting of 100 acres are

fertilized with a 16-0-16 type three times per year at twenty tons per application. Fertilizer is spread on the ground in February, June and in the Fall. Fertilizer application to younger groves, 200 acres of two year old trees, consists of a 8-2-8 type mixture plus magnesium, manganese, and boron. Application is every six weeks between March and September. Pesticide and herbicide applications include:

1) Chlorobenilate, sprayed three pints per acre each July.
2) Copper, five pounds per acre.
3) Manganese, ten pounds per acre.
4) Boron, one pound per acre for older groves and 1/4 pound per acre younger groves.

The application of these chemicals is either by ground spraying or by air.

APPENDIX C

Appendix C contains summaries of the interviews with persons employed by governmental agencies and industry and private citizens. The people were contacted in an effort to collect land use information pertaining to the Caloosahatchee River watershed. Each summary identifies the sampling location or locations to which the information obtained applies. The synopses presented are abbreviated. In most cases, the actual interviews were extensive; however, only the most significant of aspects of each are related here.

Mr. Thomas O'Donnell	US Geological Survey, Hydrology	Baseline Sampling Program C-R1 through C-R5
Mr. John Clemons	USDA Soil Conservation Service, District Soil Technician	Baseline Sampling Program C-R1 through C-R5
Mr. Brian Womble	Assistant Co. Property Appraiser	C-R1, C-R2, C-R3, C-R4
Mr. William Burke	District Conservationist	Baseline Sampling Program C-R1 through C-R5
Mr. Bennett	Superintendent of Public Works	C-R3
Mr. George Davis	County Engineer	C-R3, C-R4
Mr. Burgess Mr. Wade	County Agricultural Agency Asst. County Agricultural Agent	C-R1, C-R2, C-R3
Mr. Boatright	Coordinator Florida DOT	C-R3
Mr. Oliver Murry	Land owner	C-R1
Mr. Woodrow Henderson	Manager, Silver Lake Ranch	C-R4
Mr. Brown	Land owner	C-R5
Mr. Jack Paul	Manager, Bob Paul Inc.	C-R2

Baseline Sampling Program

C-R1 through C-R5

Mr Thomas O'Donnell
Hydrologist
United States Geological Survey
Fort Myers, Florida

Aerial photography and topographic maps were reviewed to determine the drainage characteristics in potential sampling drainage basins.

Baseline Sampling Program

C-R1 through C-R5

Mr. John Clemons
District Soil Technician
USDA Soil Concervation Service
Fort Myers, Florida

Aerial photography was examined to identify potential sampling locations representative of specific land use categories.

C-R1, C-R2, C-R3, C-R4

Mr. Brian Womble
Assistant County Property Appraiser
Hendry Co. Property Appraiser Office
Court House, La Belle, Florida

The information gathered during the interview with Mr. Womble included the identification of land use and property ownership for the selection of sampling locations. Aerial photography, land use maps and tax records were examined.

Baseline Sampling Program

C-R1 through C-R5

Mr. William Burke
District Conservationist
USDA Soil Conservation Service
Court House, La Belle, Florida

The identification of land use, land use practices, property ownership and drainage patterns were included in the interview with Mr. Burke. Citrus growing and cattle production were determined to be the primary agricultural land uses in the study area. The interview consisted of the review of aerial photographs, topographic maps and a field trip to

probably sampling locations. The land use practices in the citrus area include the planting of grass around citrus trees to reduce soil erosion and the use of weirs to control water level in the ditches.

C-R3

Mr. Bennett
Superintendent of Public Works
City Hall, La Belle, Florida

The interview with Mr. Bennette included the description of the stormwater drainage system in La Belle and the land use practices characteristic of potential sampling locations. The transportaion of storm water from La Belle is basically through two drainage systems. One, a ditch system, transports urban and nonurban storm water runoff and periodically point source runoff. The other drainage ditch, the Department of Transportation ditch, was chosen to be sampled because it represents only an urban land use category.

Land use practices include street sweeping, mosquito control and ditch maintenance as previously discussed in the Water Quality Sampling Report.

C-R3, C-R4

Mr. George Davis
County Engineer
Hendry County Court House
La Belle, Florida

The information collected during the interview included the review of a topographic map to determine drainage around the La Belle area. Maintenance of the canal on the Siler Lake Ranch was reported to be performed by the land owner.

C-R1, C-R2, C-R3

Mr. Burgess
County Agricultural Agency
Mr. Wade
Assistance County Agricultural Agent
Florida Cooperative Extension Service
Hendry County Court House
La Belle, Florida

The identification of land use category and land use practices were discussed with Mr. Burgess and Mr. Wade. Citrus crop growing and cattle production were determined to be the major agricultural land use in Hendry County. The interview included a field trip to various citrus groves to examine different irrigation procedures and pesticide problems that may require chemical treatment. Irrigation systems in the citrus area include overhead sprinkling or trickle sprinkling. Upon the identification of pesticide problems the Agricultural Extension Service will recommend an appropriate chemical treatment.

C-R3

Mr. Boatright
Coordinator
Florida Department of Transportation
La Belle, Florida

The interview included a discussion of the stormwater drainage ditch system in La Belle. Information such as the location and land use category lead to the selection of sampling site C-R3.

C-R1

Mr. Oliver Murry
Land owner
Ft. Denoud Road
La Belle, Florida

Mr. Oliver Murry maintains a 50 acre citrus grove on Jack's Branch and has been involved with the maintenance of the other citrus gorves within the C-R1 drainage basin. Approximately 800 pounds of a 12-4-10

liquid fertilizer is applied per acre in May or June and Fall. One quarter unit of copper and 1/4 unit of magnesum may be applied if needed. The fertilizer is applied from booms on trucks, and then turned into the ground by tracter. Spray nutrients, primarily copper, zinc, and manganese, may be applied at twenty five pounds of material per acre. Pesticide application includes 3/4 to one pint of ethion per acre and of 97 percent oil at five gallons per acre. The maintenance programs on other citrus groves on Jack's Branch are:

1) Norris Brother Groves maintenance program is basically the same as on the Murry Groves. Fertilizer applications, however, is a 20-10-12 dry type. Nutrient spraying consisting on the same amount of material per acre in higher concentrations and applied by air.
2) Mills Groves apply a dry fertilizer three times per year at 650 pounds per acre.
3) Dyese Groves apply a dry fertilizer two times per year at 700 pounds per acre.

According to Mr. Murry the soil in the Jack's Branch drainage area is very porous such that significant runoff does not occur unless rainfall is greater than five inches.

C-R4

Mr. Woodrow Henderson
Manager
Silver Lake Ranch, Kell Road

The Silver Lake Ranch is primarily improved pasture for cattle production. An annual application of 300 pounds of 10-10-10 fertilizer is applied per acre in March. This procedure is spread by a truck. Mr. Henderson

suggested a sampling location in a drainage ditch on the Silver Lake Ranch. At this location, C-R4, water flow is not hindered by aquatic vegetation. Drainage to the suggested location is from the primary pasture area on the ranch.

C-R5

Mr. Brown
Land owner
Highway 78 E

Drainage to Deadman's Branch is through improved pasture land. Mr. Brown's livestock operation is primarily cattle, but horses and hogs are present on the land. The pasture area is fertilized once per year due to cost. A 16-8-8 type fertilizer is applied at 300 pounds per acre. Mr. Brown reported, the pasture area adjacent to his land is draining into Deadman's Branch and has been used for cattle production, but will not be used this year.

C-R2

Mr. Jack Paul
Manager
Bob Paul Inc.
La Belle, Florida

The drainage basin to be sampled consists of 5000 acres of citrus groves owned and maintained by Bob Paul Incorporated. Land use activities for the maintenance of the citrus area include the application of fertilizer, pesticides and nutrients. A detailed maintenance program has previously been discussed in the Quality Sampling Program Report. Mr. Paul will be available to provide information on specific land use activities during the sampling period.

APPENDIX D

Meteorologic Data

30 YEAR AVERAGE MEAN PRECIPITATION

1941 - 1970

Month	Sarasota-Bradenton	Punta Gorda	Ft. Myers/La Belle		Naples / Everglades	
J	2.68	1.91	1.64	1.76	1.87	1.67
F	2.87	2.30	2.03	2.23	1.88	1.79
M	3.65	2.79	3.06	3.25	2.40	1.96
A	2.43	2.37	2.03	2.54	2.00	2.43
M	2.60	3.64	3.99	4.52	3.80	4.66
J	7.63	9.12	8.89	9.65	8.16	9.49
J	8.94	7.39	8.90	8.52	8.36	8.60
A	9.55	7.20	7.72	7.70	8.17	6.79
S	8.68	8.02	8.71	7.49	9.45	9.60
O	3.24	4.06	4.37	4.20	4.25	4.76
N	1.91	1.34	1.31	1.25	1.37	1.42
D	2.17	1.65	1.30	1.51	1.29	1.23
Annual	56.35	51.79	53.95	54.62	53.00	54.40

SARASOTA

MAXIMUM RAINFALL (Inches)

Duration (Hour)	Return Period (Years)						
	1	2	5	10	25	50	100
0.25	1.1	1.2	1.5	1.7	1.9	2.2	2.4
0.5	1.5	1.7	2.1	2.4	2.7	3.0	3.4
1.0	2.0	2.1	2.8	3.0	3.3	3.7	3.9
2.0	2.3	2.7	3.5	4.0	4.5	5.0	5.5
3.0	2.6	3.0	3.7	4.5	5.1	5.6	6.2
6.0	3.0	3.6	4.7	5.5	6.5	7.2	8.1
12.0	3.6	4.5	5.7	6.8	8.1	9.1	10.2
24.0	4.1	5.2	7.0	8.1	9.5	10.8	12.2

PORT CHARLOTTE-PUNTA GORDA

MAXIMUM RAINFALL (Inches)

Duration (Hour)	Return Period (Years)						
	1	2	5	10	25	50	100
0.25	1.2	1.3	1.5	1.7	1.9	2.1	2.4
0.5	1.6	1.8	2.1	2.4	2.7	2.9	3.3
1.0	2.0	2.2	2.8	3.0	3.3	3.8	4.0
2.0	2.2	2.6	3.4	3.9	4.4	4.9	5.4
3.0	2.5	3.0	3.6	4.2	5.0	5.5	6.0
6.0	3.0	3.6	4.6	5.5	6.2	7.0	7.8
12.0	3.6	4.3	5.6	6.6	7.5	8.8	9.9
24.0	4.0	5.0	6.5	7.9	9.2	10.3	11.7

FORT MYERS

MAXIMUM RAINFALL (Inches)

Duration (Hour)	Return Period (Years)						
	1	2	5	10	25	50	100
0.25	1.2	1.3	1.6	1.7	2.0	2.2	2.4
0.5	1.6	1.8	2.2	2.4	2.8	3.0	3.3
1.0	2.0	2.2	2.8	3.0	3.4	3.8	4.0
2.0	2.2	2.6	3.4	3.9	4.4	4.9	5.4
3.0	2.4	3.0	3.5	4.1	4.5	5.4	6.3
6.0	2.9	3.5	4.5	5.0	6.0	6.6	7.3
12.0	3.5	4.0	5.2	6.3	7.0	8.0	9.0
24.0	3.7	4.7	6.0	7.0	8.4	9.6	11.0

NAPLES-EVERGLADES

MAXIMUM RAINFALL (Inches)

Duration (Hour)	Return Period (Years)						
	1	2	5	10	25	50	100
0.25	1.2	1.4	1.7	1.8	2.1	2.2	2.4
0.5	1.6	1.9	2.3	2.5	2.9	3.1	3.4
1.0	2.1	2.3	2.8	3.1	3.6	3.9	4.3
2.0	2.3	2.7	3.5	4.0	4.5	5.0	5.5
3.0	2.4	3.0	3.7	4.3	4.8	5.5	6.1
6.0	3.0	3.5	4.5	5.4	6.0	6.7	7.5
12.0	3.5	4.0	5.3	6.3	7.2	8.3	9.1
24.0	3.7	4.5	6.1	7.3	8.7	9.8	10.8