THE APPLICATION OF THE RECEIVING WATER QUANTITY MODEL TO THE CONSERVATION AREAS OF SOUTH FLORIDA

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ABSTRACT

The conservation areas of South Florida Everglades are major water storage areas to provide a water supply for the Everglades National Park and Lower East Coast (LEC). Due to the increasing water demands of the area, additional backpumping of the surplus runoff from the LEC area into the conservation areas is being considered as one of several water supply schemes. The Receiving Water Quantity (EPA, 1971) model was adapted and modified for the Conservation Areas to investigate the hydraulic impact of additional inflow under various backpumping cases. The various modifications to the original EPA model are related to Manning's roughness coefficient, depth of flow, width of hypothetical channels through marsh areas, rainfall input, seepage rate, and the use of the Monte Carlo technique for nodal area computations. Comparison of values simulated by this modified model with the recorded values in Conservation Areas 1 and 2A indicated that (a) the model can simulate satisfactorily the hydraulic regime of the Conservation Areas system during wet seasons, and (b) the model can be a useful tool to study the impact of additional inflow resulting from the backpumping as a part of water use planning and management tasks.

NOTATIONS OF KEY TERMS

V	Velocity (ft/sec),
X	Distance along the channel (ft),
H	Water surface elevation above mean sea level,
g	Gravitational acceleration (32.16 ft/sec^2)
F_f	Acceleration due to fluid resistence (ft/sec^2),
F_w	Acceleration due to wind stress (ft/sec^2),
n	Manning roughness factor
R	Hydraulic radius
t	Time
A_j	Water surface area at node j,
Q_i	Flow through incoming link i,
Q_j	Outflow at node j,
B	Width of canal or hypothetical channel
Δt	time interval,
α	proportional constant
ΔX	channel unit length
h	depth of water
$\sqrt{gh}$	clerity of the wave

FIGURES

INTRODUCTION

With the typical seasonal nature of the rainfall pattern coupled with the relatively flat topography of south Florida, the distribution of rainfall inputs in various interconnected parts of a water system becomes a significant piece of information in various water management tasks of planning, regulation and operations. Depending upon the complexities associated with the water system under investigation, the methodology of hydraulic and hydrologic computations varies accordingly. As a part of planning efforts toward the development of the Water Use Plan for the Lower East Coast of South Florida, the South Florida Water Management District has considered several water management schemes to increase the water capabilities of the region to respond to the expected future water demands. One such alternative is the backpumping scheme in which excess surface runoff is to be pumped westward into storage areas instead of allowing that excess runoff to flow eastward to the ocean through the existing canal systems. The storage areas considered in such backpumping alternatives are known as conservation areas of the Florida Everglades and they are covered with sawgrass, red bays, willows, myrtles and various slough aquatics. Currently, these areas function as a water supply storage area for urban, municipal and agricultural uses (including water conveyance to the Everglades National Park). Their indirect functions also include flood control, groundwater recharge, prevention of salt water intrusion and fish, wildlife preservation. Considering these valuable functions performed by the conservation areas, the effects of the increased water quantities as envisioned in backpumping alternatives need to be examined. Furthermore, such assessment should be completed in the present tense for the conditions that are likely to occur in the year 1990 or 2000 or 2020. This particular requirement demands very definitely a mathematical modeling procedure which can adequately simulate the real world complexities of the conservation areas and then estimate consequences of the future water management schemes. To fulfill such a need, the receiving water quantity model of the EPA's storm water management model (known as SWMM model) is explored to estimate the hydraulic distribution of inputs in the conservation areas.

SPECIFIC OBJECTIVES

Basic objectives of applying the receiving water quantity model are:

1. To modify the receiving water quantity model to describe the flow pattern in the interconnected marsh-canal system of the conservation areas,

2. To simulate the discharges and stages at various locations in the conservation areas,

3. To calibrate the model to the extent possible by comparing simulated stages with the historical stages.

4. To perform sensitivity analysis or a trial-error procedure to select optimum parameters and

5. To superimpose backpumping inputs to estimate change in hydraulic regime of the areas under backpumping conditions.

DESCRIPTION OF THE MODEL

The receiving water body of each of three conservation areas is a continuous system even though the flow through their heavily vegetated area is extremely slow as compared to the flow in canals. The water system in three conservation areas is first represented by a network system of nodes and links as shown in Figures 1, 2 and 3. The shape of the grid system is flexible and they can be either orthogonal or triangular or irregular although an acute triangular shape is recommended.

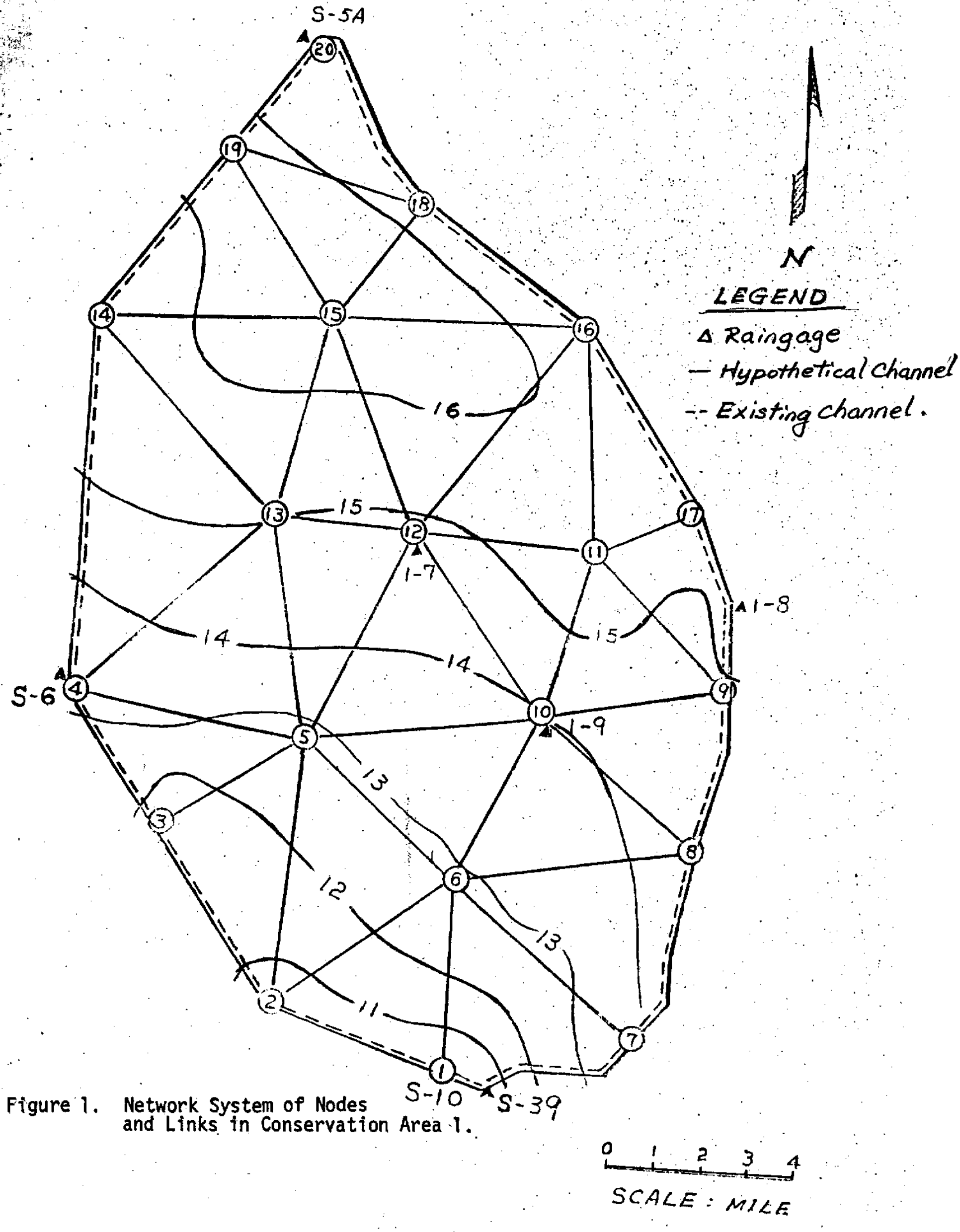

Figure 1. Network System of Nodes and Links in Conservation Area 1.

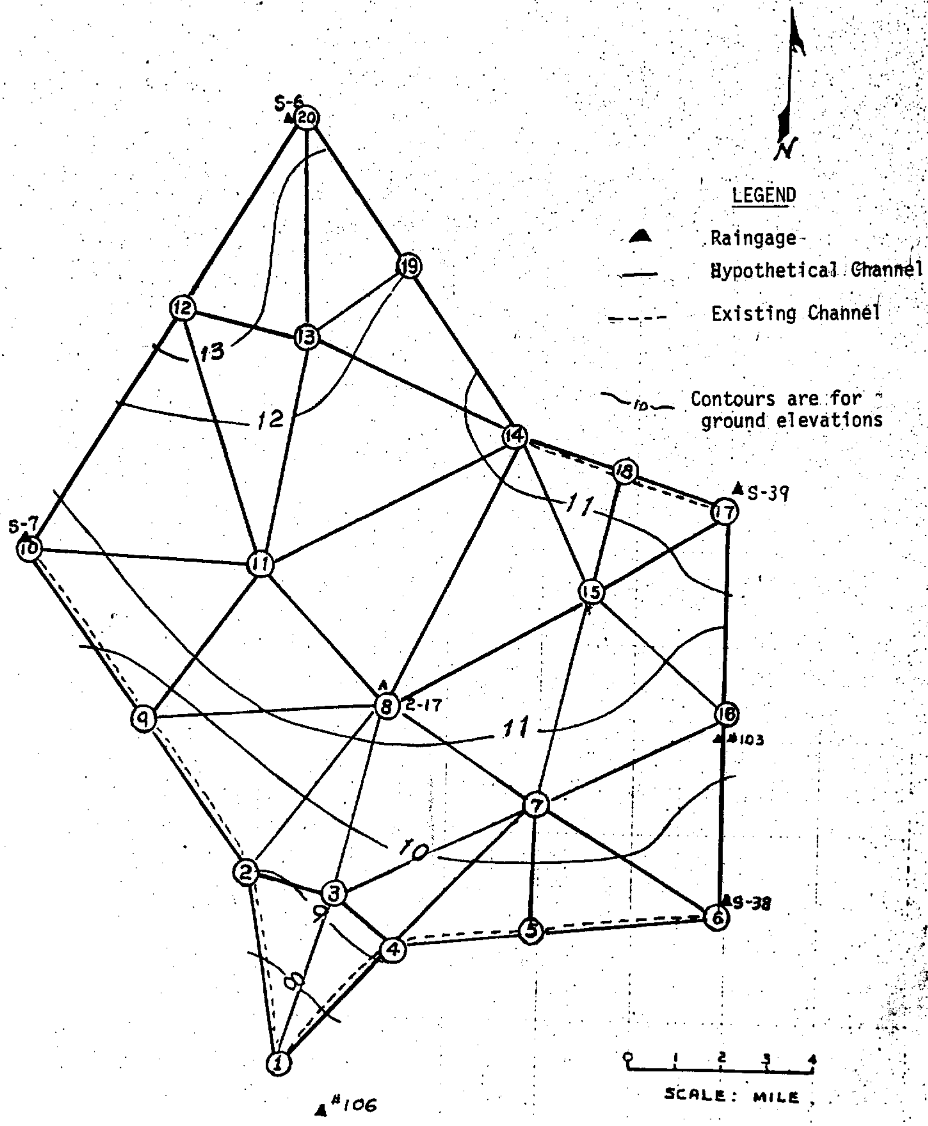

Figure 2. Network System of Nodes and Links in Conservation Area 2A

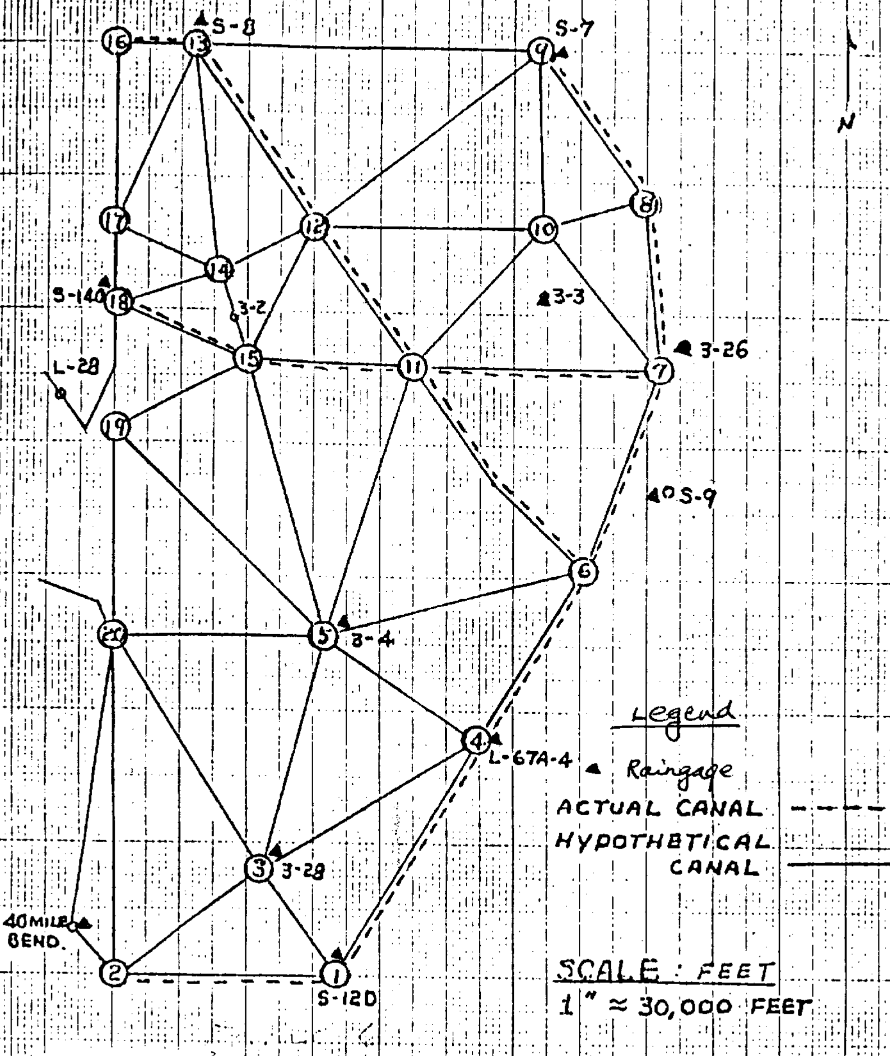

Figure 3. LINK-NODE REPRESENTATION OF CONSERVATION AREA 3A

Conservation Areas 1 and 2A represents two different marsh and canal flow systems. Both areas are surrounded by a dike (levee); however, the deep canal exists all around Area 1 but not Area 2A. The flow movement is generally southward. Sawgrass is the dominant vegetation, occurring as extensive marshes interspersed with tree islands on slightly higher ground elevations. Ground elevations range from 16.5 ft. msl in the northern portion to 11.0 ft. msl at the southern end of Area 1 and from 13.2 ft. msl down to 7.5 ft msl in Area 2A. The network system of area 1 contains 20 nodes and 57 channels, and 51 channels for Area 2A as shown in Figs. 1 and 2. Total area in Area 1 and 2A are approximately 215 and 175 square miles, respectively.

Rainfall stations in Area 1 are S-5A, Gages 1-8, 1-7, 1-9, S-6, and S-39 with only 1-7, and 199 in the interior marsh area. S-10 structures are used as inflow points to Area 2A. Rainfall data for Area 2A are based on the gages at S-6, S-39, S-7, 2-17, FCD #103 and #106 etc. Gage 2-17 is the only gage located inside the interior marsh area, a stage recorder is available on this gage. This gage has been used as an indicator gage to operate S-11 structures. The flow from S-10 travels gradually southward and moves through a vast marsh area before reaching S-11. Therefore, the flow characteristics in Area 2A are quite different from Area 1 in which the major portion of flow occurred in the existing canal and the area adjacent to it.

Conservation Area 3A covering an area of 786.6 square miles is also within the confines of the Everglades. Ground elevations range from 13 ft. msl in the northwesterly portion to 7.0 ft. in the south end. The regulation varies from 9.5 ft. to 10.5 ft. During the dry season, the water storage is largely in the lower southern portion of the area. The construction of Canal 123 traversing the area between pump station S-8 on the north to the south New River Canal enables the more efficient delivery of water to Everglades National Park from

Lake Okeechobee during periods when storage in the south end is inadequate to meet Park demands.

The network system of Area 3A contains 20 nodes and 61 channels as shown in Figure 3. Inflow points of Area 3A are S-8, S-140, S-190, S-11, S-150, and S-9. There are two major openings with an appreciable amount of undefined runoff flowing into the area. One of the major openings is located at the northwest corner of the area along L-2, L-3 and L-4. The other opening is located between L-28 and the L-28 tieback levee which extends for 7 miles. No data was available for S-140,and S-190 prior to September 11, 1969. Junction No. 1 was assumed as the inflow point for backpumping from the Tamiami Canal basin. Outflow points in Area 3A are Junctions 1 and 6 which supply water to ENP and Miami Wellfield. Rainfall stations located within or around Area 3A are S-8, S-7, 3-3, WMD #3-26, S-9, L-28, 3-4, L-67A-4, S-12D and 40 Mile Bend.

FORMULATIONS

The distribution of the water through the given link-node system of conservation areas is sought by the simultaneous solution of two hydrodynamic equations (known as the equation of motion and continuity equation).

The equation of motion for our one-dimensional link system is written as

$$\frac{\partial V}{\partial t} = -V\frac{\partial V}{\partial X} - g\frac{\partial H}{\partial X} - F_f + F_w \qquad (1)$$

where:

V = velocity in ft/sec

t = time, sec

X = distance along the link, ft.

H = water surface elevation, ft. msl.

g = gravitational acceleration

F_f = Acceleration due to fluid resistance

$= \frac{gn^2 V|V|}{2.2 R^{4/3}}$

n = Manning's roughness coefficient (sec/ft)

R = Hydraulic radius (ft)

F_w = Acceleration due to wind stress

= negligible in our study areas

The continuity equation for each node is given as follows:

$$A_j \frac{\partial H_j}{\partial t} = \sum_{i=1}^{K} Q_i + Q_j \qquad (2)$$

where:

A_j = the water surface area of the node j's

H_j = the mean elevation of the water surface in node j, (ft. msl.),

Q_i = water importation rate to the junction j

K = number of incoming links

Numerical solution of Eq. 1 and 2 entails rewriting of both equations in finite difference form. The initial value of various parameters at time "t_o" is used to determine the rate change of flow and water head during a short interval of time (Δt). Based on the rate change, the next value is computed with the modified Range-Kutta technique (Caraha, 1969) and the whole procedure is repeated. The interval of integration is divided into four and applied in sequence with the advantage that the intermediate time-step computations improve the stability and accuracy of the model. The velocity, discharge and stage are computed for each time step and each node and each link to provide the spatial and time distribution of the hydraulic regime (in terms of velocity, discharge and stages). The time step is governed by the following criteria as derived by Garrison et al (1969).

$$\Delta t \leq \alpha \frac{\Delta X}{\sqrt{gh}}$$

where:

Δt = unit time step in seconds,

ΔX = length of the link in ft.

α = proportional constant (0.75)

$\sqrt{gh}$ = celerity of wave, (ft/sec)

The concept of the model, its theoretical development, geometric representation, solution procedure, and computer programs are described in the EPA's report (1971). Other modifications made to the model are described below.

Concept of Parallel Channel:

To better define the hydrodynamics of flow through vegetated marsh area and through the existing canal systems, the concept of parallel channel, originally advocated by Heaney and Huber (1972), is applied to certain nodes where actual channels are located. This concept defined more closely the simultaneous flow through the canal and the overland flow through the heavily vegetated area with different velocities.

Concept of Dual Elevation:

Two bottom elevations for each node are included in the model to be consistent with parallel channel concept. The first elevation refers to ground elevation at each node, and the second elevation refers to minimum stage which can be reached at the node. For a marsh area, the minimum stage would be a ground elevation. For an existing channel the minimum stage would be the crest elevation of the spillway at the outlet point. The bottom elevations of the actual channel are much different from the crest elevation.

Energy Gradient Through Marsh Area:

The conservation areas include a greater portion of the Everglades which is often described as a "river of sawgrasses". During periods of abundant rainfall it is a floodplain. When rainfall is deficient it is often swept by fires which may even consume the peat soil. The water movement through these heavily vegetated marshlands is extremely slow. Diking around conservation areas has changed the flow characteristics of the basin. During dry conditions the water stage is comparably low; the stage in the existing channel differs considerably from the higher elevated marsh area. The operation of water control structures may cause flow in marshy areas towards or away from the outlet structure? Since the bottom elevation of the existing canal is much lower than the marsh area, a discontinuity exists between overland flow and flow in the existing canal. In order to generalize such conditions, the estimation of energy gradient between two nodes is based on the following criteria: a) the water stage is first checked with the ground elevation of the two nodes; if the water stage is above the ground elevations; then the head difference of the two nodes divided by the distance between the two nodes is considered as the energy gradient for the channel; b) if the water stage is below either one of the ground elevations then one-half of the difference between the water stage at one node and the ground elevation of the other node (i.e. dry) divided by the distance between two nodes is used for energy gradient of the channel; c) the energy gradient for the flow through the marsh area is defined

$$S_f = \frac{n^2 V|V|}{h^{4/3}}$$

where

S_f = Energy gradient

n = Manning's roughness

h = flow depth (ft)

V = velocity (ft/sec)

Channel Width for Hypothetical Channel

In the EPA's 1971 report, the width of a hypothetical channel is defined as the distance between two links parallel to the channel and passing through the centroids of the two adjacent triangles sharing the same link. The area of a triangle is equal to one-half of the length between two nodes times the vertical distance between the centroid point and the link of two nodes. This vertical distance has been used as the width of the hypothetical channel in the EPA's model. However, this width has been further reduced by half in this study to provide a greater accuracy in estimation of equivalent depth and volume. (Fig.4).

Surface Area of Nodes

Each node is associated with its area. A Monte Carlo technique developed by Shih (1975-1976) is used to compute the areal coverage of each node. The Monte Carlo technique requires much less time and is a more powerful tool than conventional techniques.

Rainfall Input

The original model assumed a uniform rainfall input over the entire study areas. This is inappropriate for the conservation areas due to the wide spatial and temporal variations in rainfall. The weighting factor based on a modified

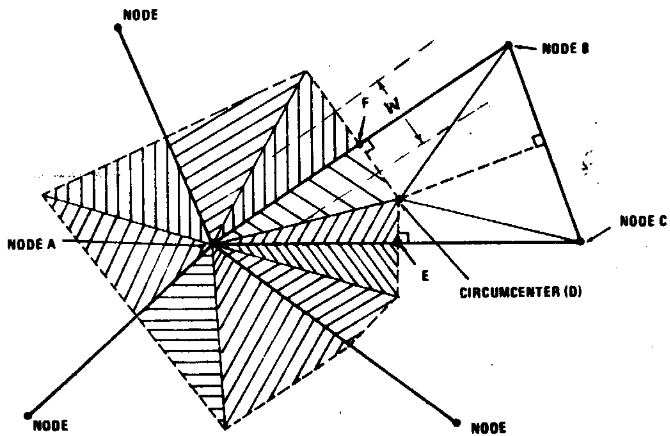

Figure 4. Assignment of Surface Area and Channel Width (w) to an Illustrative Node A

Thiessen polygon of Shih and Hamrick (1975) is used to estimate the rainfall input for each node using the available vicinity gages.

Seepage Rate

A constant rate was used in the original model, however, the seepage rate increases with the depth of water in the study areas. Therefore, a seepage function related to the water stage in the Conservation Areas was developed. When the stages are low and water is confined in the existing borrow canal along the levee, then a certain percentage (10%) of normal rate is applied in the model. A mathematical equation of the seepage function for different water stages is used in the model.

Manning's Roughness Coefficient

Manning's roughness coefficient for grassed channels is known as the retardance coefficient. The retardance coefficient in Conservation Area 2A was reported by the Corps of Engineers (COE, 1954) as shown in Figure 5. Since the vegetation types and their distribution might have changed considerably since then, this set of data was used as a guideline for Manning's n in the study area. In a recent study by Shih and Hallett (1974) on the same subject for the upland marsh area of Chandler Slough in the Kissimmee River Valley (Figure 5) the values for upland marshes is lower than that reported by the Corps of Engineers. However, those two sets of data were used in the model during calibration. Mathematical relations between n-values and flow depths are developed and used in the model.

INPUT DATA REQUIREMENTS

Generally two major types of data are required; they include geometric and hydrologic data types.

A. Geometric Data

This set of data is required by the first program called INDATA and includes:

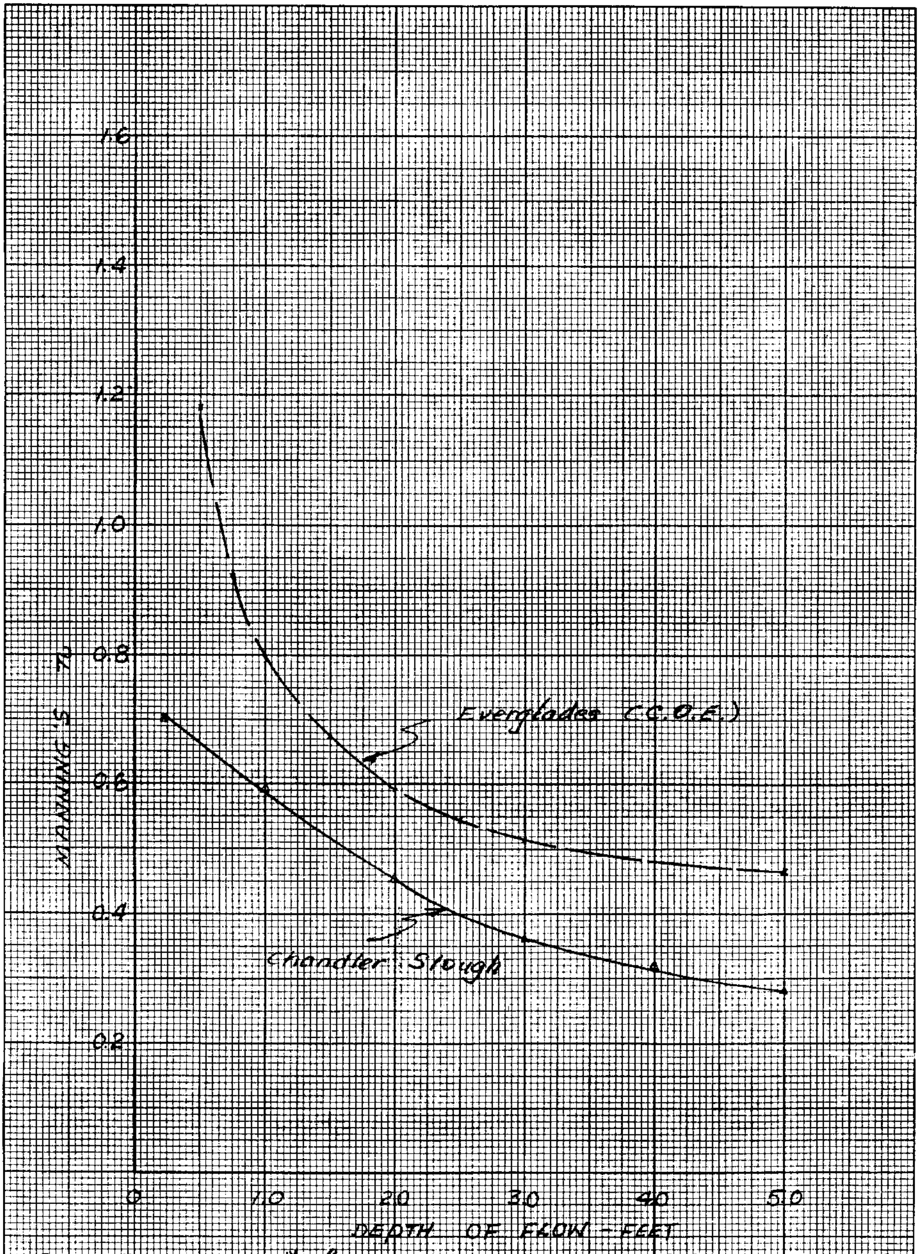

FIGURE 5 Manning "n" in Conservation Area 2A as Compared to Shih's Study in Chandler Slough.

1) Number of days desired

2) The time-step

3) The starting time of hydrograph input

4) Number of junctions of stormwater input

5) Point of rainfall information

6) Total number of nodes and channels in the desired network.

At each node (junction), the input requires:

1) An assigned junction number,

2) Water surface elevation,

3) Bottom elevation

4) Surface Area

5) Junction flow out of receiving water junction

6) Manning's coefficient

7) Junction x- and y- coordinates

B. Hydrologic Data

The hydrologic data included monthly evaporation, daily rainfall at selected gages and daily discharge at all inflow and outflow locations within the study area. The seepage function and Manning's "n" for marshland are also required by the model as mentioned previously.

ASSUMPTIONS

1. The equation of motion used in the model assumes one-dimensional uniform flow of an incompressible fluid in an open-rectangular prismatic channel.
2. Each cross section of the channels is assumed to have a uniform velocity distribution and a hydrostatic pressure distribution.
3. The water surface is assumed to be horizontal across the cross section.

4. The n-values determined for steady flow are applicable to unsteady flow.
5. Flow is well mixed.
6. Historical hydrologic data are assumed for the future conditions due to the lack of reliable projection method.
7. Characteristics of Conservation Areas are as follows

A. Conservation Area 1:

Junction No. 18 in Area 1 was assumed to be a new backpumping station near S-5A to avoid excessive inflow with existing pumping Station S-5A. Junction 1 is generally used as outflow point for regulatory flow. However, S-39 is located close to S-10. Therefore, Junction 1 is also used as a water supply point for Service Area 1. Summation of these two has been used as total outflow from Junction 1 in the model.

B. Conservation Area 2A:

Junctions 14, 18 and 17 in Area 2A are inflow points. Inflow from S-10 was split into junction 14 and 18 with junction 17 assumed as backpumping station from service area 2. Junction 1 is also assumed as a water supply station for Area 2A.

C. Conservation Area 3A:

There are two major openings with an appreciable amount of undefined runoff flowing into Area 3A. The two openings are located at the northwest corner of the Area 3A along L-2, L-3 and L-4 and between L-28 and L-28 tie-back levee which extends about 7 miles. S-140 and S-190 flow has been assumed to represent the amounts of flow through these two openings. Junction 1 of Area 3A was assumed to be an inflow point for backpumping from C-4 basin.

EVALUATION OF RESULTS

A. Calibration of the Model

The purpose of the calibration was to demonstrate the model's ability to simulate the real system under various historical conditions, and to develop a set of parameters which can reproduce adequately the historical events of the real system. If such a parameter can be defined, then the outcome that resulted from the model under various backpumping cases would provide reliable information regarding the impacts to the water regime in the conservation areas. Very little research exists to provide a sound basis for describing the flow characteristics in the Everglades, therefore, the calibration of the model was based on the comparison of the model output with observed historical stages at selected gages located in the conservation areas. The calibration of the model was first approached by selecting several wet periods in the area. The set of Manning's coefficients developed by the Corps of Engineers in Area 2A was then applied to check the simulated results with the recorded values. Occasionally the result on one or two of the selected gages did not check closely with recorded values. Other values were then tried. Sometimes, the bottom elevation of the node points had to be adjusted to account for the variations due to the vegetation types, coverage, presence of tree island etc. This type of trial and error approach was found to be the most difficult part in defining the parameters for the model.

Figure 6 & 7 show the simulation results of 1974 in Area 1 and Area 2A at selected gages. The Manning's n values presented in Figure 5 were used in Areas 1 and 2A. The close agreement between the generated and recorded value indicates the validity of the modified model in reproducing adequately the historical pattern of flow distribution in conservation areas. Two sets of Manning's n values were used in Area 2A and their results are plotted with recorded values as shown on Figure 7. The results with a cross mark (x) were

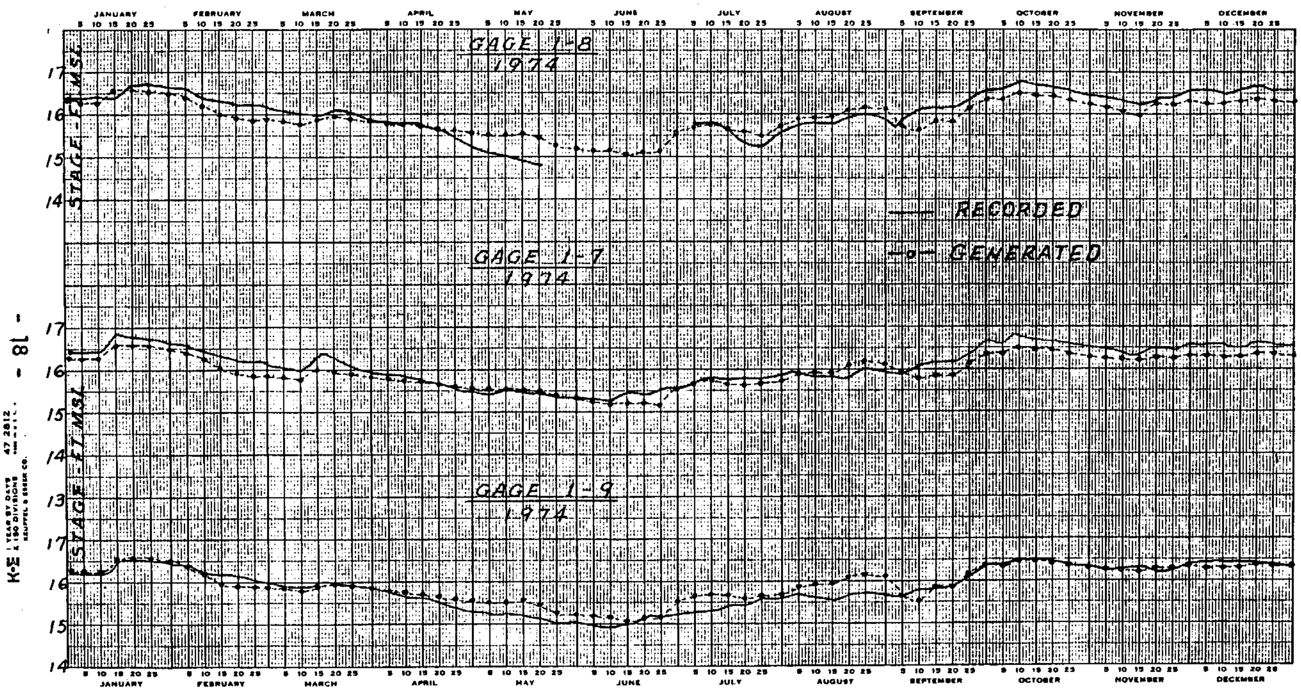

Figure 6. Simulation of 1974 in Conservation Area 1 as Com[illegible]red to Recorded Values at Selected Stages

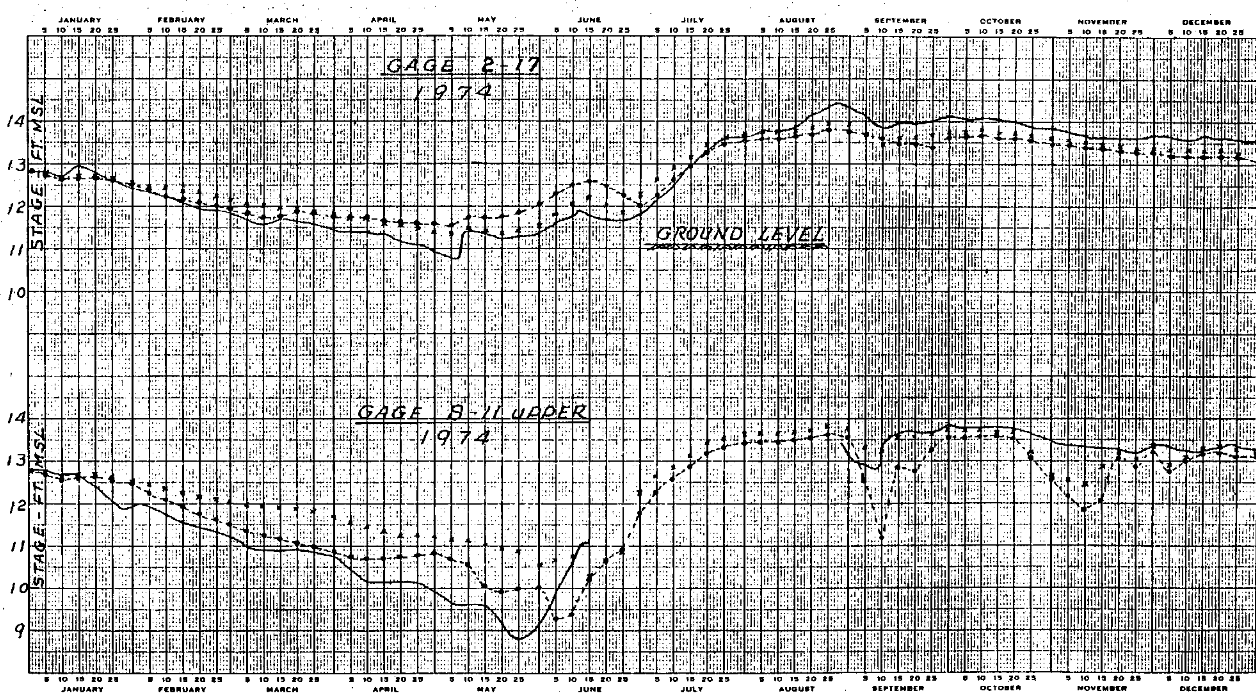

Figure 7. Simulation of 1974 in Area 2A with Two Sets of Manning's "n" Values as Compared to Recorded Values at Selected Sites.

based on Corps of Engineers' value for Area 2A, and the one with a circle mark (o) were based on the values of Shih and Hallett (1975). The later set of values produced much better results for the first five dry months of 1974 for Area 2A; however, the Corps' value produces slightly better results for the wet season of the year. Therefore, the effect of seasonal change to Manning's roughness and flow characteristics is obvious in Area 2A than Area 1. This may also be due to the fact that major flow in Area 1 occurred within the existing canal system rather than in the marsh area, in addition, the water condition in Area 1 were wetter (i.e. most of the marsh area is under water even in the spring of 1974) than Area 2A.

The regulation schedule for Area 2A is shown in Figure 8. If the stage at Gage 2-17 exceeds its regulation schedule, then the gate at S-11 structure would be operated to regulate the water condition. All the historical inflow and rainfall except S-11 flows were inputs to the model. The operation of gates at S-11 structures would be directed by the model according to the generated stage at Gage 2-17 as shown in Figure 8. Figure 8 shows the comparison of generated and recorded stage at Gage 2-17. Figure 9 shows the generated discharge and historical discharge at S-11. From the results indicated in these two figures, the model can be a useful management tool to assess the water distributions in the Conservation Areas under various regulation schedules or assumed storm water

B. Long Term Simulation

Application of the model to generate long term historical conditions for the period from Jan. 1, 1962 through Dec. 31, 1973 was performed in Area 1. The results are presented in Figures 10 and 11. Gage S-6 and 1-8 are gages located in the existing canal system, and gages 1-7, and 1-9 are interior gages located in the central marshland of Conservation Area 1. The circle dots shown on the graphs are the recorded month end stages. This simulation was based on the

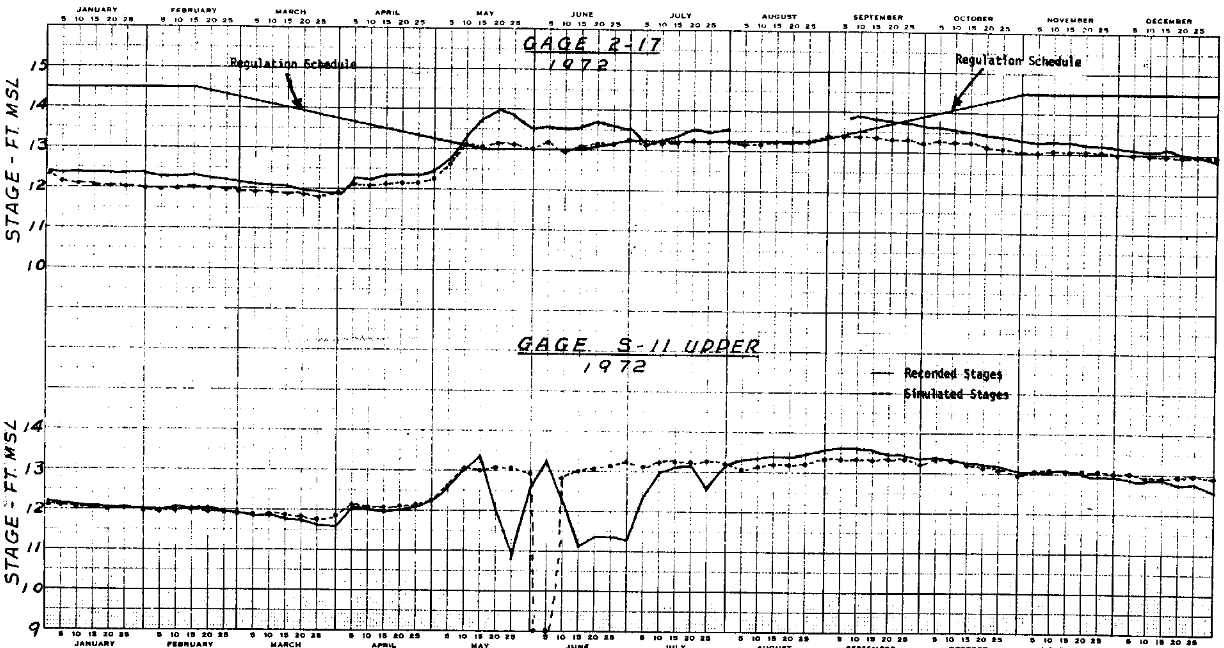

Figure 8. Simulated and Recorded Stages for Gages 2-17 and S-11 in 1972

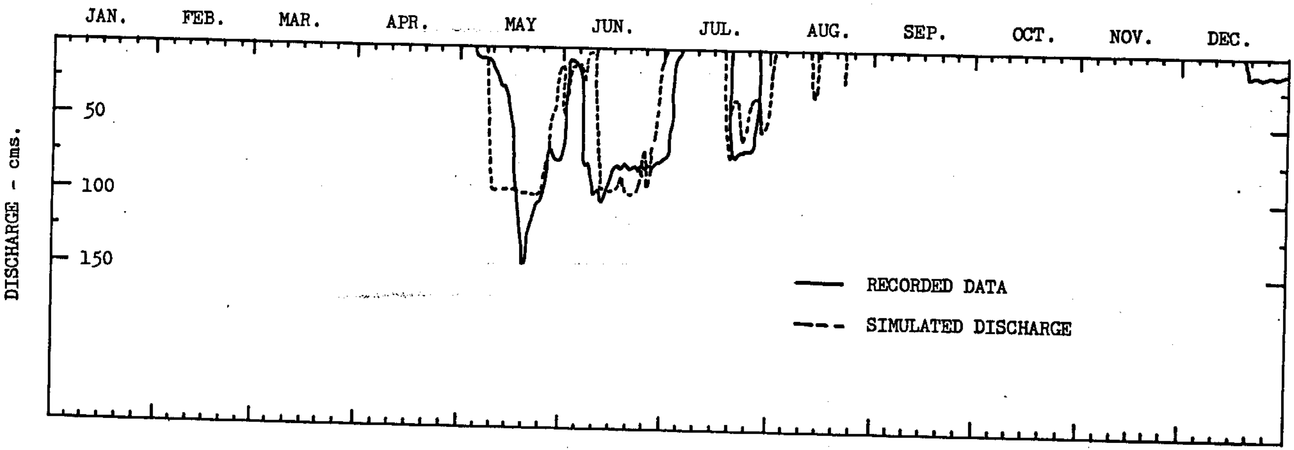

Fig. 9. Comparison of simulated discharge with recorded data at S-11, in 1972.

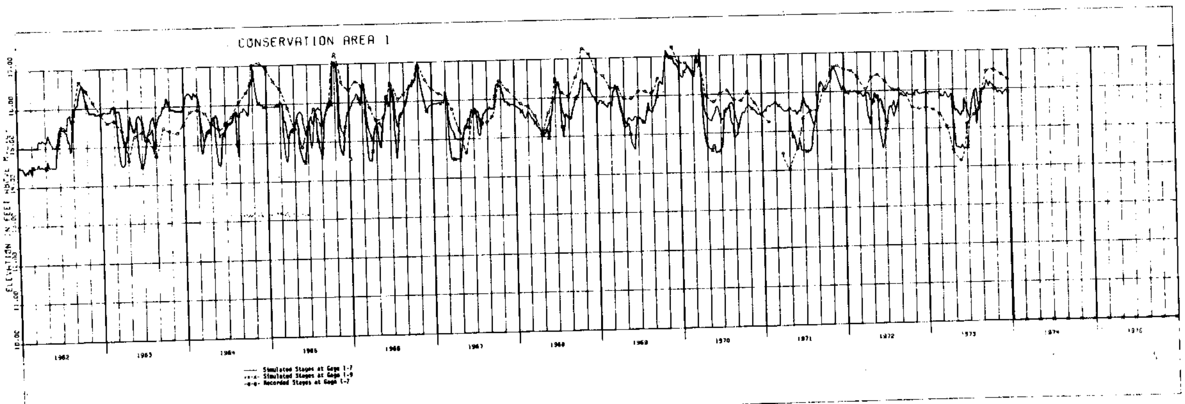

Figure 10. Simulation Results for Conservation Area 1 During 1962-73 Period Using Gages 1-7 and 1-9

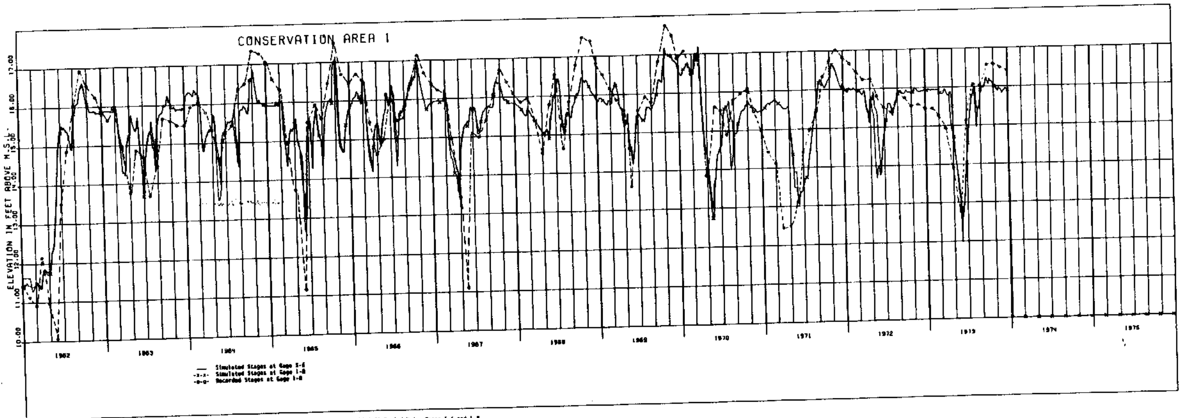

Figure 11. Simulation Results for Conservation Area 1 During 1962-73 Period Using Gages S-6 and 1-8

initial stage on December 31, 1961. All other recorded rainfall, discharge, monthly Et, and seepage function etc. are inputs to the model. Generally speaking, a fairly close relationship exists between the generated and recorded values as can be observed from these plots. The deviation from recorded values for interior gages is far less than the one in the canal system. There are periods in which the generated stage may either be higher or lower than recorded values, these may result from the following reasons:

a. Only six raingages in the area are available to cover the rainfall characteristics of South Florida.

b. The reliability of the historical flow through the water control structures such as S-5A, S-6, S-10 etc. is a variable. The computed flow for these structures are based on different rating curves. These rating curves are off from $\pm$ 8% and more; for example, only three field measurements were available during 1970 and 1971. The current rating was based on these three measurements which are still far from sufficient to determine the amount of flow through S-10. In addition, the current rating is much different from the one used in 1960 as shown in the COE DDM dated 1960. The discharge data was never updated and recomputed.

c. Lack of Manning's n values as a function of vegetation and seasonal changes. The Manning's n values also varies with flow rates. The value of 0.03 is used in canal flow.

d. The assumption of only one outflow point may not reflect the actual field conditions. There are three existing structures at S-10. They are S-10A, C and D with approximately two miles apart. Generally, only one structure (S-10A) was operated, except during high flow condition other structures may operate. Therefore, a second outflow point (Node Point #2) was used if the flow at S-10 exceeds 4000 cfs. This approach did help to a certain degree to the result of simulation; however, a closer network with a detailed flow information on each structure should be developed to reflect the real system better.

e. Errors may accumulate and increase over the years. The results for selected monthly periods are checked within a range of 0.20 ft. with the recorded values. However, the difference more than 0.2 ft. were resulting from a longer term simulation. The error may be caused by the above mentioned factors. In order to eliminate the possibility of accumulated errors in the model, annual simulations were made (i.e. the length of simulation is limited to one year). The results of this type of simulation are shown in Figure 12. Some improvements can be observed from the plots, particularly for the year 1974. The parameters developed for the year 1974 were then applied to other years.

Figure 13 shows the simulated results for gages S-38 and 2-17. Gage S-38 is a canal gage, and gage 2-17 is an interior gage located in the center marshland of Area 2A. The generated stages follow the general pattern of the recorded values fairly well for some of the years. However, the generated stages deviated from recorded values generally over 0.20 ft. The results for the early months of 1969-70,73 and 74 tended to be either lower (1969,1970) or higher (1973 and 1974) when compared to historical stage. However, the simulated stages for the wet months are geneally better. As presented in the calibration run in Area 2A a different set of Manning's n should be applied in the model to cover the change of n-values due to seasonal effects. Since the marsh flow in Area 2A is the dominant factor of the entire flow system, the following reasons may contribute to the poor simulation in Area 2A:

a. Gage 2-17 is the only interior raingage in this 175 sq. miles marsh area. Therefore, the estimation of rainfall input to the system is very approximate.

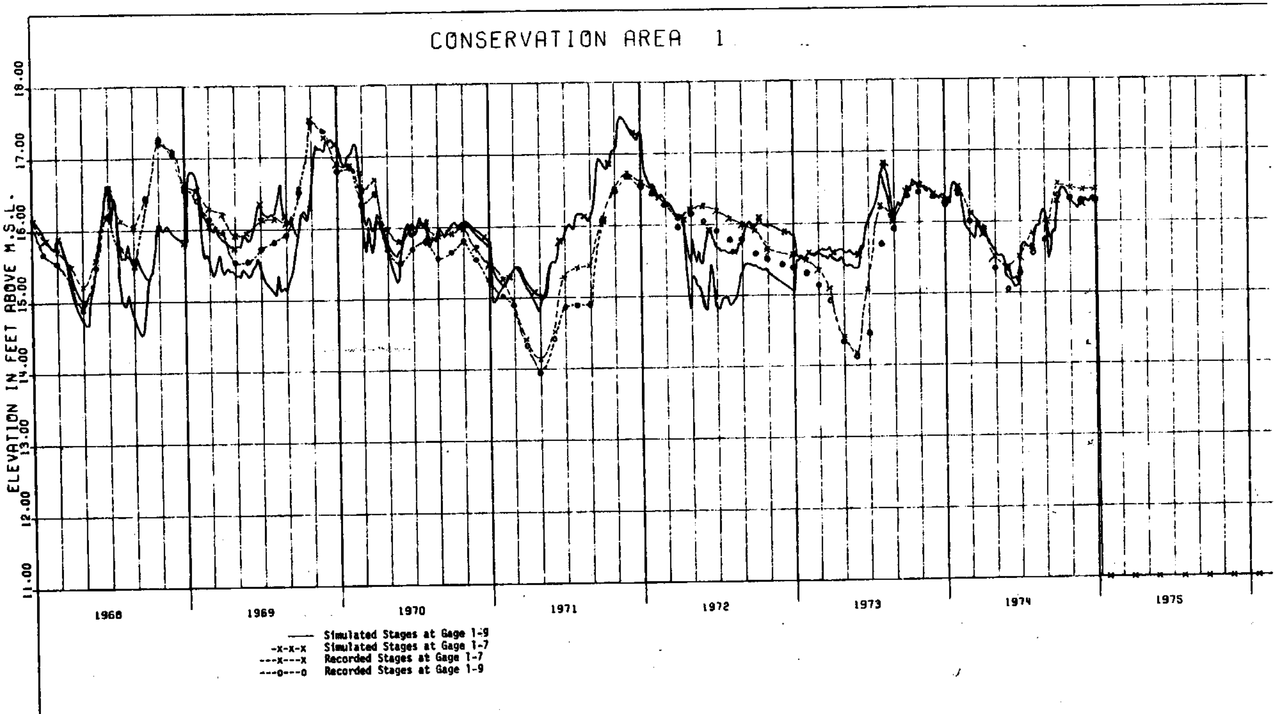

Figure 12. Simulation Results for Conservation Area 1 During 1968-74 Period Using Gages 1-7 and 1-9

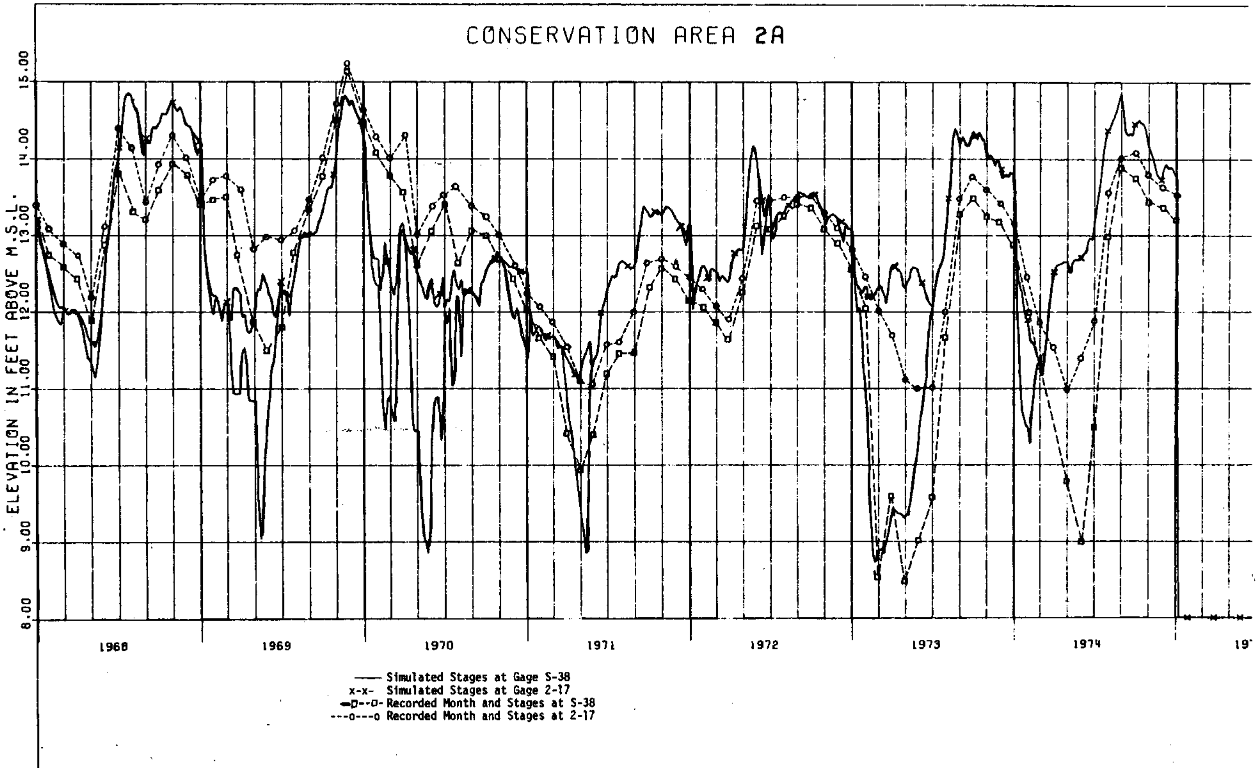

Figure 13. Simulation Results for Conservation Area 2A During 1968-74 Period Using Gages S-38 and 2-17

b. The discharge values at S-11, 7, 10, need to be verified.

c. The variation of Manning's n with flow rate should be further investigated.

Figures 14 and 15 show the generated stages at gages 3-2, 3-4, 3-28 and 3-3 as compared to the recorded month end data. The generated results were based on the initial stage on December 31, 1968 and continued through December 31, 1974 with historical daily flow and rainfall data at those selected raingages. Due to the following reasons, the simulation was not started before 1969.

a. The levee material was directly taken from the borrow canal along L-67A and L-68. Therefore, L-67A and L-68 borrow canal was not a water delivery canal to meet the Everglades National Park demands not until mid 1968. The improvement and enlarging of this borrow canal was done during 1966 through 1968.

b. The Miami Canal in Conservation Area 3A (i.e. C-123) was under improvment until Dec. 1969.

c. Pump station S-140 was not activated until Sept. 1969 and the flow from northwest corner of Area 3A along L-1, L-2, L-3, and L-4 was not available prior to Sept. 1969.

The flow characteristics in Conservation Area 3A prior to mid 1969 were not stable due to these changes mentioned. The geometric information for all existing channels in Area 3A were based on the latest as-built map of these canals. The set of n-values based on the simulation results for the year of 1974 was not suitable for rest of the years. Therefore, two sets of n-values had to be used in the simulation (see Fig. 5). One set of n-values was applied to normal or below normal rainfall years, and the other set of n-values was applied to wet years such as 1969 and 1970. The n-values for yearly low or

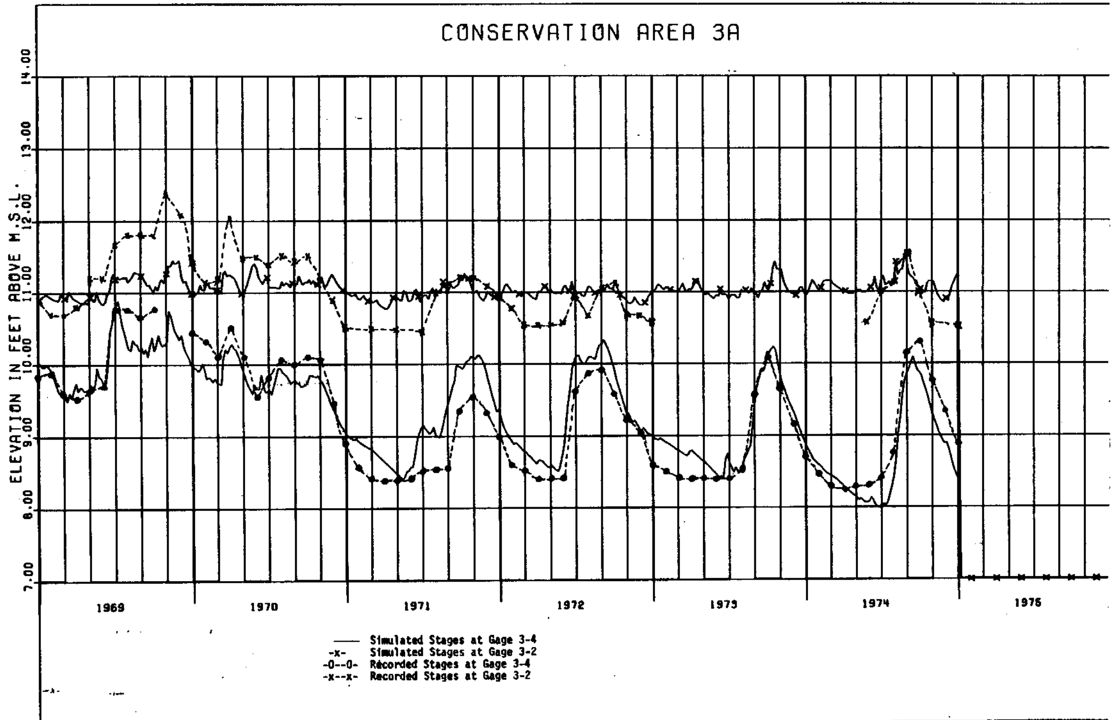

Figure 14. Simulation Results for Conservation Area 3A During 1969-74 Period Using Gages 3-4 and 3-2

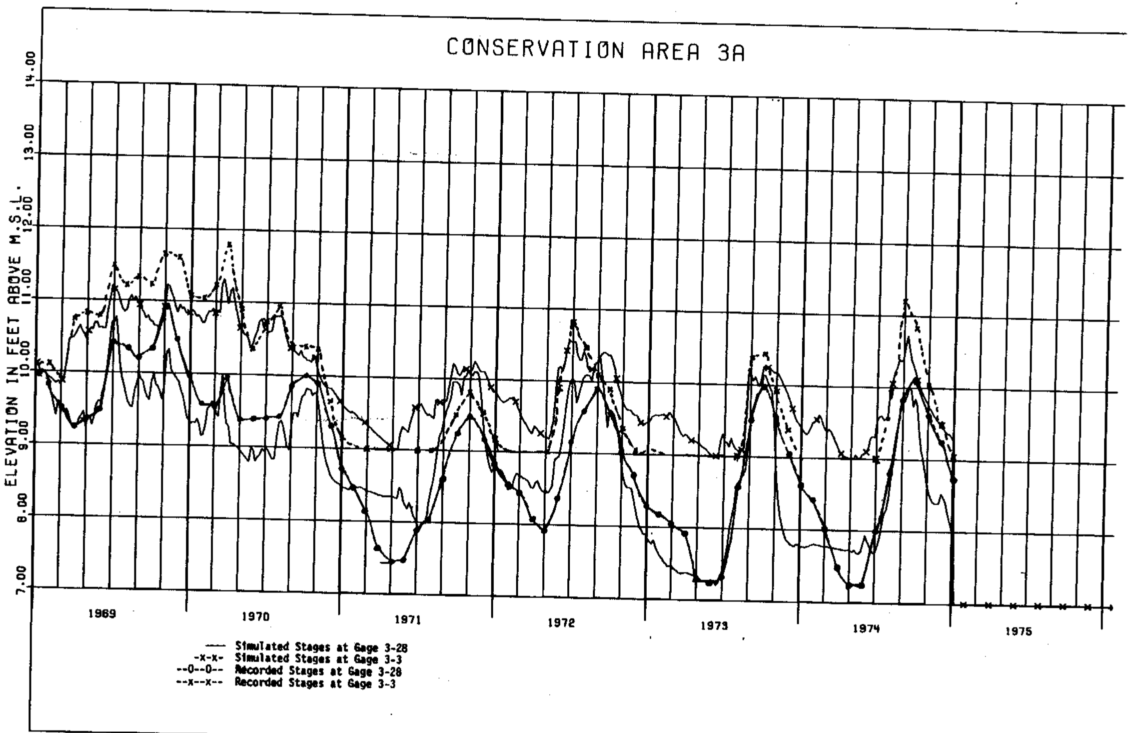

Figure 15. Simulation Results for Area 3A 1963-74 Period Using Gages 3-28 and 3-3

normal periods are slightly lower than the wet year values. This may be due to the frequent fires in the Everglades during dry months such as the fire that occurred during the spring of 1971 and 1973.

Simulated results for gages 3-28, 3-3, 3-4, and 3-2 follow the recorded values fairly good except those months when the water was near or below ground surface. For example, the simulated results for early 1971 is higher than recorded values at gages 3-3 and 3-2. These two gages generally respond to local rainfall more than canal flow or inlfow from water control structures such as S-11, S-140, or S-8 etc. (The influence occurred only during high water conditions). Therefore, the amount of rainfall input to these nodes becomes very improtant. The results at gages 3-3 is generally much better than gage 3-2. This may be due to the fact that no rainfall recording device is available at 3-2. The simulation at gage 3-4 is excellent except the summer of 1971. The simulation at 3-28 is generally good except for the period of early spring where the generated stage always tends to be higher than recorded values. Yet sometime the generated values at this gage did reach down to ground surface during April and May of 1973, but not in 1971 and 1974. Gage 3-28 generally responds to rainfall, backwater flow from the canal at south end of Area 3A and sometime responds to the overland flow from the opening of L-28. In addition, the higher infiltration rate at this gage may be possible due to the location of this gage which is at the western border of Biscayne Aquifer.

The continuous simulation over a number of years tends to increase the accumulated errors in the simulations. The simulation based on an annual basis was done for the period from Jan. 1, 1968 through Dec. 31, 1971. The period was selected so that a typical wet and dry year could be used in the water quality analysis for the conservation areas as a part of the water use plan for the Lower East Coast. The results based on annual simulation are presented in Figures 16 and 17. The results indicate a general improvement for gages 3-3, 3-2 and part of a 304 but not for 3-28. This indicates a need for improving the model in simulation of the flow through the low lying marsh areas in Area 3A.

C. Application of the Model in LEC Water Use Plans

The simulation for selected typical wet and dry years as mentioned in Item B were applied. Alternative plans included in the Water Use Plan are shown as follows:

a. Backpumping from C-51 basin alone,

b. Backpumping from C-51 and Tamiami Canal basins to Conservation Area 3A.

c. Backpumping from C-51 and Tamiami canal basins to Area 3B

d. Backpumping from C-51, Hillsboro and Tamiami Canal to Area 3A

e. Backpumping from C-51 and Hillsboro Canal to Area 2A.

Under each alternative plan, three levels of land use conditions were evaluated:

a. Present land use (based on 1973 land use)

b. County Master Land Use Plan (future land use)

c. Maximum water supply based on maximum backpumping to meet all demand

It was found that the results for the requirement levels under the county master land use plans, and maximum water supply plan were approximately the same as obtained from the optimization model. Therefore, the water requirements under the future land use condition were used in the analysis to represent the requirements of either the county master land use plan or a maximum water supply plan. Figure 18 shows the scheme of the model with the interactive programs.

D. Other Possible Applications

The receiving water body may be an estuary, a stream, or a lake etc. Since the adapted model did not include tidal effect as boundary condition, the model can be applied to a stream, canal, or a shallow well mixing lake. The model can be used to evaluate any structural or nonstructural changes in

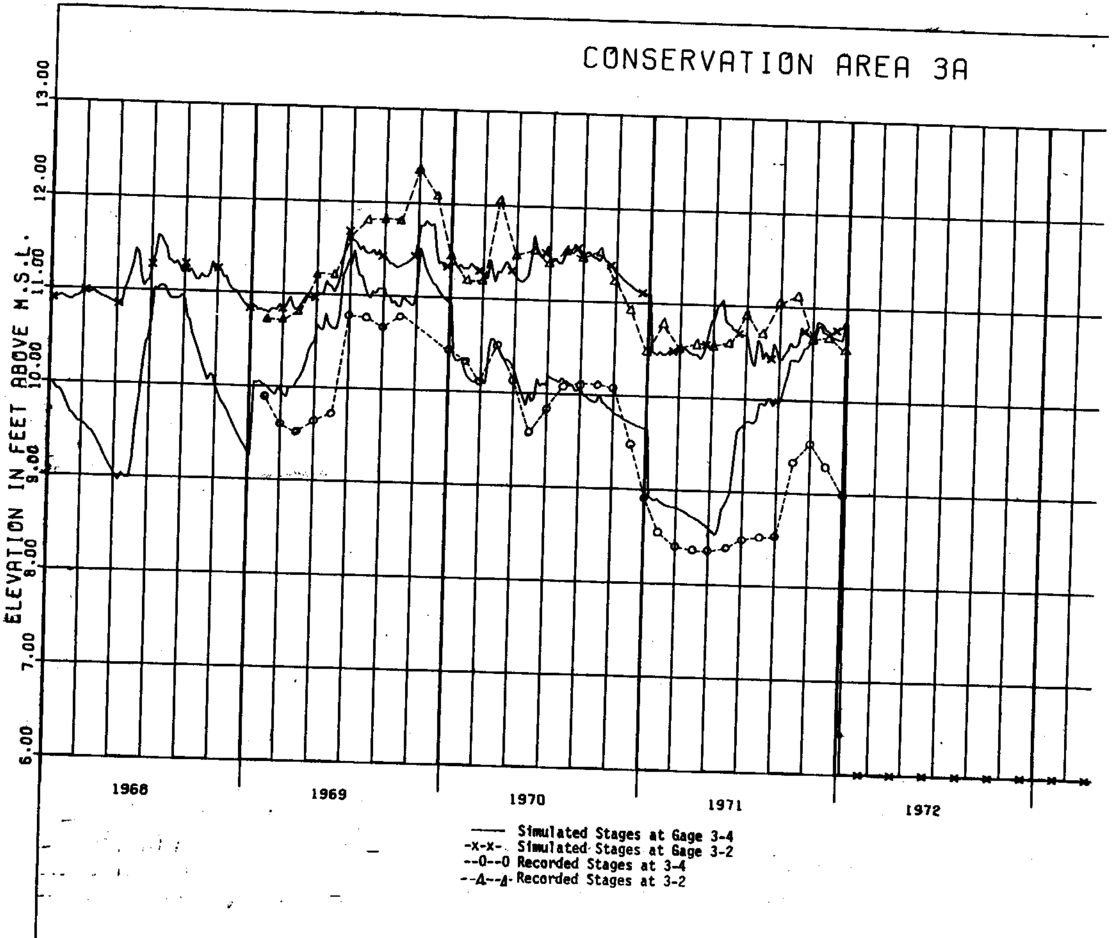

Figure 16. Annual Simulation Results for Conservation Area 3A During 1968-71 Period Using Gages 3-4 and 3-2

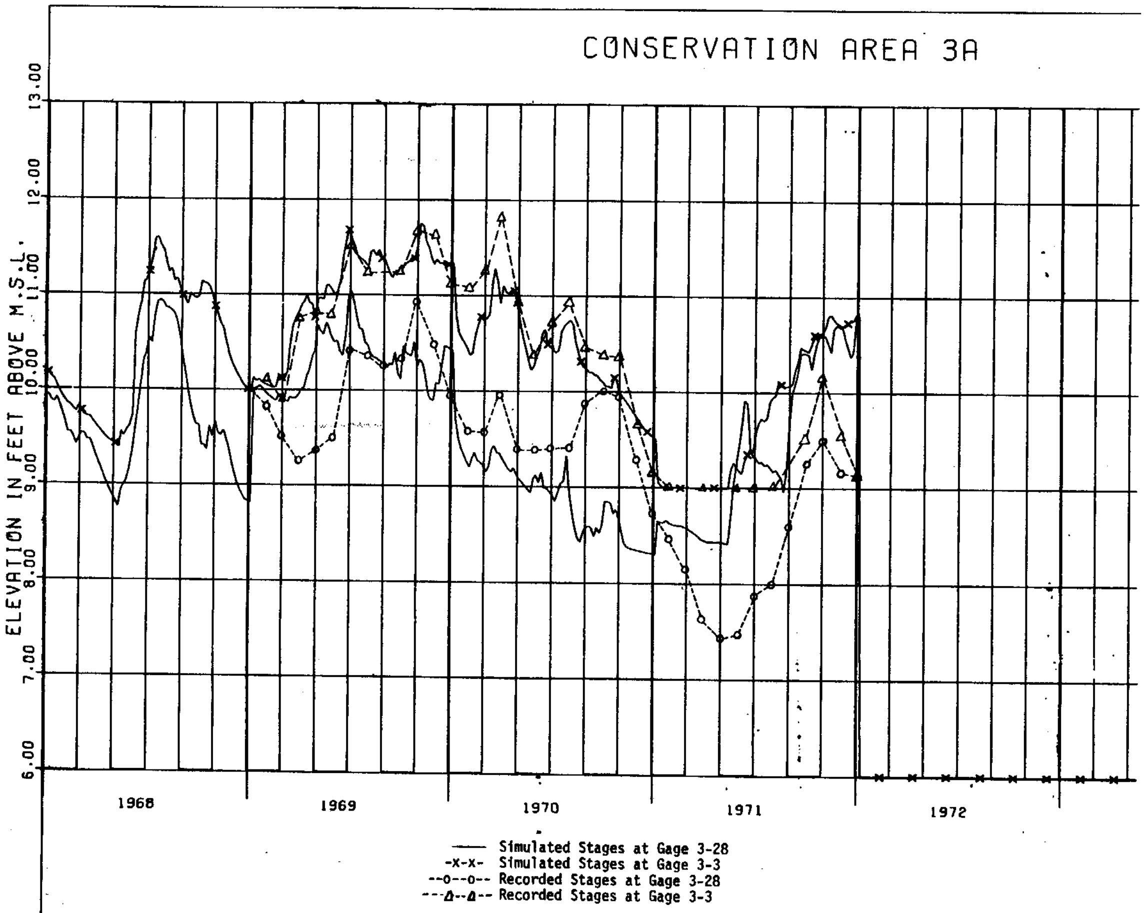

Figure 17.. Annual Simulation Results for Area 3A During 1968-71 Period Using Gages 3-28 and 3-3

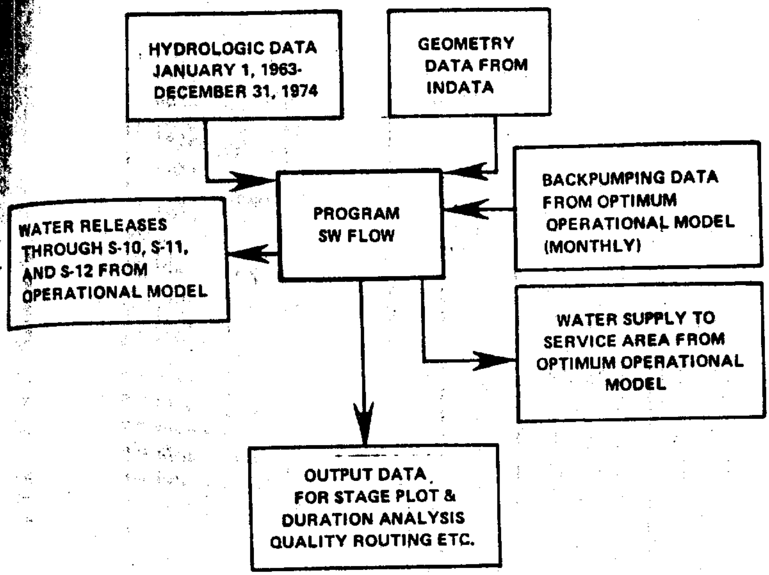

FIGURE 18

Figure 18. An Overall Operational Scheme of the Model

the water systems of the conservation areas. This may include (a) marsh treatment of inflows (backpumping flow) for water quality enhancement, (b) (b) water conveyance due to the additional inflow structure near S-6 to provide inflow to the northern corner of Conservation Area 2 and (c) other flow control structures in borrow canal for better water storage distribution. The applications of the model to the Everglades agriculture or other district areas for the evaluation of water quality distribution resulting from agricultural runoff or urban runoff are also possible.

E. Limitations of the Model

In addition to the assumptions mentioned earlier, some limitations of the model are as follows:

1. Number of nodes and links in the network system is limited to 30 and 91 respectively.
2. No mathematical treatment is given to optimize the parameters of the model.
3. Tidal effects or water structures other than dam or spillway are not included.
4. No bridge losses or losses due to expansion or contraction in the canal are estimated in the model.

CONCLUSIONS:

The concepts of the receiving water quantity model are modified to describe the hydraulic distribution through the marsh and canal system of three conservation areas of the Florida Everglades. The modifications are related to the concept of dual elevation for each node, hydraulic radius, energy gradient for the marsh area, width for the hypothetical channel, use of the Monte Carlo technique to compute area. The modified model is shown to reproduce adequately historical stages and discharge for a short period of one year. However, in some periods, especially during dry years, the generated stage may either be higher or lower than the recorded values. It is expected that the model be improved continually as state-of-the-art improves and additional field data becomes available. Further improvement of the model is possible through the following steps:

1. To provide better representation of the real water body of the conservation areas by increasing the number of nodes in the network system.
2. Existing canal section and topographic elevation in conservation areas need to be refined.
3. Historical flow data at water control structures needs to be updated and to be recomputed through the improved structure ratings.
4. The relationship between Manning's roughness coefficient and the variation of the vegetation communities and their seasonal changes is required.
5. To improve the simulation for low water (or dry year) conditions, a soil moisture accounting model for interior nodes may be helpful.

ACKNOWLEDGEMENTS

This report is based on the work performed under in-house Program 8025 towards the development of the Water Use Plan for the Lower East Coast of South Florida. Thanks are expressed to Barbara Hart, hydrologist, SFWMD for her preparation of daily hydrologic input data for the model. Thanks are also extended to Robert Hamrick and Peter Rhoads for their assistance and suggestions during the development of this model. Dr. Tony Shih is acknowledged for his assistance in application of Monte Carlo techniques and in furnishing the Chandler Slough data. This report is prepared as a part of documentation efforts initiated by Stan Winn, Deputy Director of the Resource Planning Department. The technical editing was done by Ashok N. Shahane of the Water Resources Division.

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APPENDIX: COMPUTER PROGRAM DOCUMENTATION

FLOW CHART

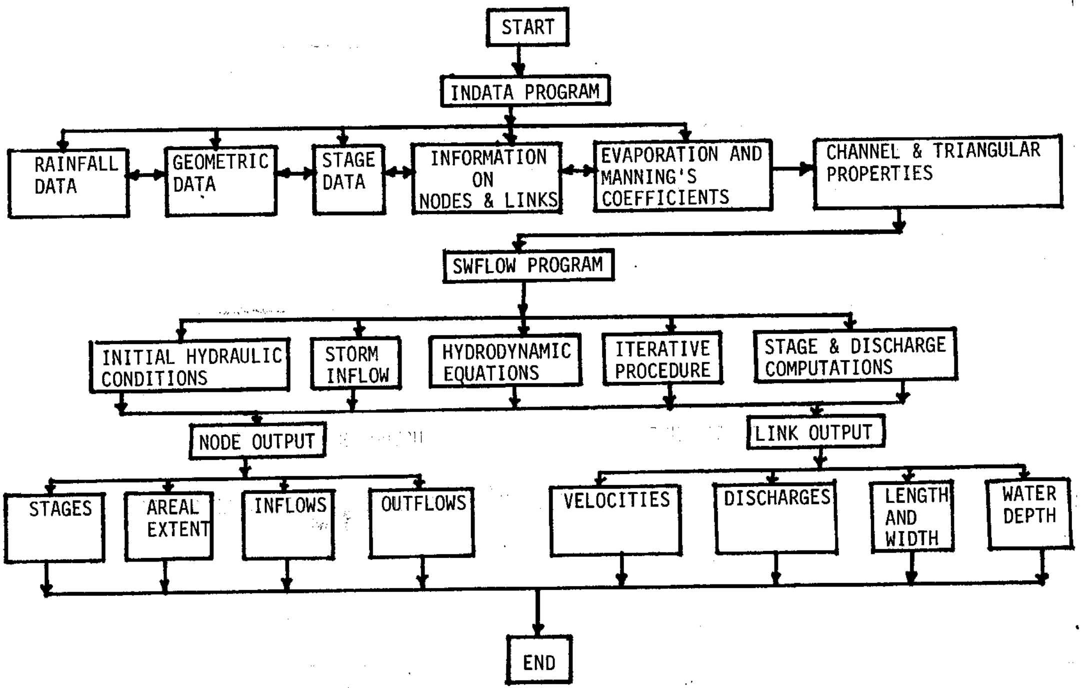
INPUT DATA LIST FOR SWFLOW AND INDATA

PROGRAM LISTING OF SWFLOW AND INDATA

ILLUSTRATIVE INPUT DATA SETS FOR SWFLOW AND INDATA

A SAMPLE OUTPUT

A FLOWCHART OF VARIOUS COMPONENTS OF THE RECEIVING WATER QUANTITY MODEL



INPUT DATA LIST FOR "SFLOW PROGRAM"

INPUT ORDER FOR PROGRAM SWFLOW (CARD INPUT)

Card Group	Format	Columns	Description	Variable Name	Default Value
1	3I5	1-5	Starting month in a year	JMO	None
		6-10	Ending month in a year	NMON	None
		11-15	Backpumping point	IN	0
2	16F5.2	1-5	Min. Water Elev. at Node No. 1	FDEP(1)	None
		6-10	" " " " " " 2	FDEP(2)	None
		⋮	at last node	⋮	⋮
		76-80	Min. Water Elev. at last node	FDEP(NJ)	None
3	16F5.2	1-5	Regulation stage at first day of year	REG(1)	None
		6-10	Regulation stage at 2nd day of year	REG(2)	None
		⋮	⋮	⋮	⋮
		⋮	Regulation stage at last day of year	REG(365)	None
4	16F5.2	1-5	Initial stage at first node	H(1)	None
		6-10	" " " 2nd node	H(2)	None
		⋮	⋮	⋮	⋮
		⋮	⋮ last node	H(NJ)	None
5	20A4	1-80	Title	Title	None
6	3I5	1-5	Conservation Area No.	IRD	None
		6-10	Indicator Gage	IND	None
		11-15	No. of year to be run	ICONT	0
7	16I5		Storm water input control card NJSW		
		1-5	First junction number	JSW(1)	None
		6-10	2nd Junction number	JSW(2)	None
		⋮	⋮		
			Last junction number	JSW(NJ)	None
8			If ISWCH(3) = 4 on card 3 of Program INDATA skip to 15		
	3I5	1-5	Total number of time steps not to exceed 31	NTIMST	None
		6-10	Total No. of raingages (Max. 15)	NGAGE	None
		11-15	Units for time of flow (time-step) 0 = seconds 1 = minutes 2 = hours 3 = days	NTCC	0
9	8F10.0	1-10	Time of flow for each time step	TEEM(NTIMST)= TE	None
		11-20	⋮		
10	16F5.2		Repeat this card for each junction (30)	RCENT	
		1-5	Rainfall weighting factor from first rain gage allocated to junction (NJSW).	(NJSW, NGAGE)	None
		6-10			
		11-15	" " last junction(NJSW)		

Card Group	Format	Columns	Description	Variable Name	Default Value
11	3I5		Same as Card 8		
12	I5	1-5	No. of junction has flow input	LXK	0
13	8F10.0	1-10	Flow rate to junction No. JMM	EXXT	
		11-20	⋮	(NTIMST,	None
				NJSW)	None
			Repeat this card for the no. of junction which has flow input		
14	16F5.2	1-5	Rain in inches/day for first raingage	DRAIN	
		6-10	Rain in inches/day for 2nd raingage	(NGAGE)	None
			⋮		
			Rain in inches/day for last rain gage		
15			If ISWCH(3) = 4, Skip to Card Group 17		
	8F10.0		Repeat this card for each time step		
			Input Hydrograph		
		1-10	Time of day, sec.	TE(1)	None
		11-20	Flow volume in cfs for first junction	QE(1,1)	None
		21-30	Flow volume in cfs for 2nd junction	QE(1,2)	None
		⋮	⋮	⋮	
			Flow volume in cfs for last junction	QE(1,NJ)	None
16	F10.0	1-10	Terminate input hydrograph cards with TE(1) beyond expected time of analysis		None
17	2A4	1-8	Write ENDQUANT This is final data card		None

INPUT DATA LIST FOR "INDATA PROGRAM"

RECEIVING WATER BLOCK CARD DATA
INPUT ORDER FOR PROGRAM INDATA

Card Group	Format	Card Columns**	Description	Variable Name	Default Value
1	15A4	1-60	Run Title Card	ALPHA	None
2	15A4	1-60	Storm Title Card	Title	None
3			Control Switches		
		1-5	=0, System is influenced by down-stream head relationship (dam)	ISWCH(1)	0
	10I5		=2, System has specified outflow		
		6-10	=0, Print input channel and junction data	ISWCH(2)	0
			=1, skip printing of input channel and junction data		
		11-15	=4, QE(NJSW,2) is computed	ISWCH(3)	0
		16-20	=1, Triangles are used in card group and different Manning's are desired for each leg of the triangle	ISWCH(4)	0
		21-25	=1, Parallel channels are used	ISWCH(5)	0
		26-30	=0, and triangles are used in card group 11 junction surface area must be left out of input data card group No. 9	ISWCH(6)	0
			=2, and triangles are used in card group No.11, junction surface area must be furnished card group No. 9		
		31-35	=1, Manning's coefficient for channels is computed.	ISWCH(7)	0
		36-40	Not used	ISWCH(8)	0
		41-45	Not used	ISWCH(9)	0
		46-50	If ISWCH(S) =1, then channel numbers greater than this number (ISWCH(10)) are parallel to other lower numbered channels.	ISWCH(10)	0
4	I5	1-5	Number of day cycles desired	NTCYC	None
	4F5.0	6-10	Number of hr/day cycle	Period	None
		11-15	Length of hydraulic time step, hr.	QINT	None
		16-20	Length of hydraulic time step, sec.	DELT	None
		21-25	Initial time for start of hydrograph input from cards, hr.	TBERO	None
	3I5	26-30	Number of junction for time-history printout	NHPRT	None
		31-35	Number of channels for time-history printout	NQPRT	None
		36-40	Number of plots desired	NPLT	0
	3F5.0	41-45	Evaporation, in./mo.	EVAP	0
		46-50	Wind velocity, mph.	WIND	0
		51-55	Wind direction, clockwise, degrees from North.	WDIR	
	4I5	56-60	Day cycle where printed ouput will start	NQSWRT	None
		61-65	Number of junctions of storm water input from cards	NJSW	None

*Card columns that are not included in the table are "not used"

Card Group	Format	Card Columns	Description	Variable Name	Default Value
		66-70	Number of points of rain information	INRAIN	None
		71-75	Junction number where a head relationship is specified.	JGW	None
5	8F10.0		If INRAIN=0, skip rain input cards 5		
		1-10	Rate of precipitation in./hr.	RAIN(1)	None
		11-20	Time from start of storm, min.	INTIME(1)	None
		21-30	" " " " "	RAIN(2)	None
		31-40	Etc., up to INRAIN points (<50)	INTIME(2)	None
6			Junction selected for stage-history printout, NHPRT values (up to 30)		
	8I10	1-10	First junction number	JPRT(1)	None
		11-20	Second junction number	JPRT(2)	None
		⋮	⋮	⋮	
			Last junction number	JPRT(NHPRT)	None
7					
	8I10		Channels selected for flow print, NQPRT values, 8 per card (max = 90)		
		1-7	Lower junction no. (numerically lower) at end of first desired channel.	CPRT(1)	None
		1-8	Higher junction no. (numerically higher) at end of first desired channel		
		11-17			
		18-20			
		⋮	Lower junction no. (numerically lower) at end of last desired channel.	CPRT(N QPRT)	None
		⋮	Higher junction no. (numerically higher) at end of last desired channel.		
8	8F10.0	1-10	WEIR factor	A1	None
		11-20	Elevation of top of WEIR (ft.),	A2	None
		21-30	Power law for WEIR	A3	None
9			REPEAT CARD 9 FOR EACH JUNCTION (90) JUNCTION CARDS		
	I5	1-5	Junction number	J	None
	F5.0	6-10	Water surface-elevation (ft.) referenced to datum plane.	HEAD(J)*	None
			*****If INTEMP(3) on Card is supplied***** <u>LEAVE SURFACE AREA BLANK.</u>		
	F10.0	11-20	Surface area of junction (millions of sq. ft.)	AS(J)= SURF	None
	2F5.0	21-25	Junction flow into receiving waters(cfs)	QIN(J)= QFI	None
		26-30	Junction flow out of receiving waters(cfs)	QUO(J)= QF2	None
	2F10.0	31-40	Junction depth (ft)**	DEP(J)DT	None
		41-50	Junction Manning's coefficient	COF(J)= CF	None
	20X	71-75	Leave columns blank		
	2F5.0	71-75	X-coordinate (thousands of ft.)	X(J)=X1	None
		76-80	Y-coordinate (thousands of ft.)	Y(J)=Y1	None

*Head is negative when below datum plane.
**Depth is distance to bottom from datum plane (downward is positive).

Card Group	Format	Card Columns	Description	Variable Name	Default Value
10	I5	1-5	To terminate junction cards, write 77777		
11			REPEAT CARD 11 FOR EACH CHANNEL OR TRIANGLE (Max. = 99) Channel or Triangle Cards		
	5I5	1-5	Channel or Triangle Number	N	None
		6-10	Junction at lower end of channel (Numerically lower)	NTEMP(1)	None
		11-15	Junction at upper end of channel (Numerically higher)	NTEMP(2)	None
		16-20	Blank unless program is to develop geometric data through the use of triangles. Then NTEMP(1),NTEMP(2), NTEMP(3) are the vertices of the acute triangle. Program will develop channel characteristics.	NTEMP(3)	0
		21-25	Blank unless it is a number of a fourth junction which lies between a pair of previous three junctions. Program will develop geometric data. If INTEMP(3) is supplied then leave columns 26-80 blank. But if ISWCH(4)=1 on card 3, ALEN=MANNING FOR CHANNEL NTEMP(1) TO NTEMP(2), WIDTH=MANNING FOR CHANNEL NTEMP(2) TO NTEMP(3),RAD=MANNING FOR CHANNEL NTEMP(1) TO NTEMP(3).	NTEMP(4)	0
	5F10.0	26-35	Length of channel (ft)	ALEN	None
		36-45	Width of channel (ft.)	WIDTH	None
		46-55	Average depth of channel (ft. refer to datum)	RAD	None
		56-65	Manning's coefficient, n.	COEF	0.018
		66-75	Initial velocity (fps)	VEL	None
12	I5	1-5	To terminate channel cards, write 99999		

PROGRAM LISTING OF SWFLOW

```
$JOB,8012-304,LIN,45
$RAT,841/3006
$FET,LIN,CA3,512
$RELEASE,ALL
$ALLOCATE,300
$OPEN,20
$FORTRAN,L,X,M
      PROGRAM SWFLOW
C                                        HYDRODYNAMICS PROGRAM             SWFL   2
C                                        TIDAL OPTION                      SWFL   3
C                                        TYPE DESIGNATIONS                 SWFL  57
C                                                                          SWFL  58
      INTEGER CPRT,ALPHA,TITLE                                             SWFL  59
      REAL LEN,INTIME                                                      SWFL  60
C                                                                          SWFL   4
C                                        SPECIFICATION STATEMENTS          SWFL   5
C                                                                          SWFL   6
      DIMENSION EXXT(31,30),TEEM(31),RCENT(30,13),DRAIN(15)                SWFL    7
      DIMENSION DQIN(30),DQOU(30),REG(366)
      DIMENSION IENDER(2),ISN(10)
      DIMENSION BP(31),QNEW(31),FDEP(30)
C                                                                          SWFL   8
C                                        CONTROL                           SWFL   9
C                                                                          SWFL  10
      COMMON TITEL2(20),ISWCH(10)
C                                                                          SWFL  13
C                                        GENERAL                           SWFL  14
C                                                                          SWFL  15
      COMMON ALPHA(15)
C                                                                          SWFL  18
C                                        JUNCTIONS                         SWFL  19
C                                                                          SWFL  20
      COMMON H(30),HN(30),HT(30),HBAR(30)
     1,  NCHAN(30,12),IPOINT(30,12),AS(30),VOL(30),X(30),Y(30)
     2,  DEP(30),COF(30),QIN(30),QOU(30),QINST(30),QINBAR(30),QOUBAR(30)SWFL   2
C                                                                          SWFL  25
C                                        CHANNELS                          SWFL  26
C                                                                          SWFL  27
      COMMON LEN(90),NJUNC(90,2),B(90),R(90),A(90),AT(90),AK(90)           SWFL   28
     1,    Q(90),QBAR(90),QAVE(90),V(90),VT(90),VBAR(90)                   SWFL   29
     2,    FWIND(90),NUMCH(90),NTEMP(12),NCLOS(90)                         SWFL
C                                                                          SWFL  32
C                                        PRINTOUT AND PLOTTING             SWFL  33
C                                                                          SWFL  34
      COMMON JPRT(30),PRTH(1,90)
     1,  CPRT(90),PRTV(1,90),PRTQ(1,90),ICOL(12)
     2,  JPLT(30),HPLT(30),TT(10)
C                                                                          SWFL  38
C                                        STAGE-TIME COEFFICIENTS           SWFL  39
C                                                                          SWFL  40
C                                                                          SWFL  43
C                                        STORMWATER                        SWFL  44
C                                                                          SWFL  45
      COMMON TITLE(15),QE(30,2),JSW(30), RAIN(50),INTIME(50)
C                                                                          SWFL  53
      COMMON        QT(30,2),ISW(30)
C                                                                          SWFL  61
C                                        INITIALIZATION                    SWFL  62
C                                                                          SWFL  63
      DATA (IENDER=8HENDQUANT)
C                                                                          SWFL  84
```

```
      N5=60
      N6=61
      N20=20
      REWIND N20
      N21=0
      N22=22
      NEXIT=0
      DO 70 I=1,90
      Q(I)=0.0
      VT(I)=0.0
      B(I)=0.0
      FWIND(I)=0.0
70    CONTINUE
C                                         SUBROUTINE INDATA CALLED TO      SWFL 85
C                                         READ INPUT DATA                  SWFL 86
C                                                                          SWFL 87
      REWIND 23
      READ(23) NTCYC,PERIOD,DELT,TZERO,NHPRT,NQPRT,NPLT,EVAP,WIND,WDIR
     1,    NQSWRT,NJSW,INRAIN,JGW
      READ(23) NQCYC,NHCYC,NJ,NC,A1,A2,A3,A4,A5,A6,A7,NPDEL
      DO 150 J=1,NJ
      READ(23) I,H(J),DEP(J),AS(J),QIN(J),QOU(J),(NCHAN(J,K),K=1,12)
     1,    X(J),Y(J)
      AS(J)=AS(J)*10.0**6
  150 CONTINUE
      DO 160 J=1,NC
      READ(23) LEN(J),B(J),R(J),A(J),AK(J),V(J),(NJUNC(J,K),K=1,2)
  160 CONTINUE
      DO 165 J=1,NJ
      READ(23) QINST(J),(IPOINT(J,K),K=1,10)
  165 CONTINUE
      READ(23) (CPRT(I),I=1,NQPRT)
      READ(23) (JPRT(I),I=1,NHPRT)
      READ(23) (JPLT(I),I=1,NPLT)
      READ(23) ALPHA,TITLE,(NTEMP(I),I=1,4)
      READ(23) (ISWCH(I),I=1,10)
      WRITE(61,7092) (ISWCH(I),I=1,10)
      READ(23) (RAIN(I),INTIME(I),I=1,50)
      REWIND 23
      DO 4 J=1,NJ
      DQIN(J)=QIN(J)
      DQOU(J)=QOU(J)
    4 CONTINUE
      READ(60,15) JMO,NMON,IN
      READ(60,2332) (FDEP(J),J=1,NJ)
      READ(60,2332) (REG(I),I=1,365)
      READ(60,2332) (H(J),J=1,NJ)
      DELTQ=DELT*FLOAT(NHCYC)
      WRITE(N20) TITLE,ALPHA,NJ,NC,NQCYC,DELTQ,((NCHAN(J,K),K=1,10),
     XAS(J),J=1,NJ),(LEN(N),(NJUNC(N,K),K=1,2),N=1,NC)
      READ(60,7097) TITLE
      WRITE(61,7097) TITLE
      READ(60,15)IRD,IND,ICONT
      RD=0.0
   15 FORMAT(3I5)
      REWIND N22                                                           SWFL 98
C                                                                          SWFL 89
C                                          FURTHER INITIALIZATION          SWFL 90
C                                                                          SWFL 91
      NCGT=ISWCH(10)
      DO 175 J=1,NC
      IF(J.GT.NCGT) GO TO 175
```

```
      B(J)=0.5*B(J)
  175 CONTINUE
      DO 170 J=1,NJ
      DEP(J)=-H(J)
  170 CONTINUE
      IYEAR=1
      LN=JMO
  501 KDAY=0
   50 TEPP=NTCYC*86400.                                                 SWFL 93
      IF(NTCYC.EQ.1)TEPP=PERIOD*3600.                                   SWFL 94
      IF(JMO.EQ.1.OR.3) TEPP=(PERIOD + 24.0)*3600.0
      IF(JMO.EQ.2) TEPP=(PERIOD-48.0)*3600.0
      IF(JMO.EQ.4.OR.6) TEPP=PERIOD*3600.0
      IF(JMO.EQ.5.OR.7) TEPP=(PERIOD + 24.0)*3600.0
      IF(JMO.EQ.8.OR.10) TEPP=(PERIOD + 24.0)*3600.0
      IF(JMO.EQ.9.OR.11) TEPP=PERIOD*3600.0
      IF(JMO.EQ.12) TEPP=(PERIOD + 24.0)*3600.0
      NTINT = 0                                                         SWFL 99
      TT(1) = 0.0                                                       SWFL100
      TT(2) = 0.0                                                       SWFL101
      NINREC=1                                                          SWFL102
      NSTEPS = 0                                                        SWFL103
      MJSW   = 0                                                        SWFL104
      NQUAL = 0                                                         SWFL105
      TDELT = 0                                                         SWFL106
      WEIR1 = A1                                                        SWFL107
      WEIR2 = A2                                                        SWFL108
      WEIR3 = A3                                                        SWFL109
      DO 220 I=1,12
  220 ICOL(I)=I                                                         SWFL112
      DO 222 I=1,30
      ISW(I) = 0                                                        SWFL114
      QT(I,1) = 0.0                                                     SWFL115
      QT(I,2) = 0.0                                                     SWFL116
      QE(I,1) = 0.0                                                     SWFL117
  222 QE(I,2) = 0.0                                                     SWFL118
      TE=0.                                                             SWFL119
      TEP=0.                                                            SWFL120
      DELT2=DELT/2.0                                                    SWFL121
      TZERO=TZERO*3600.0                                                SWFL122
      W=6.2832/(3600.*PERIOD)                                           SWFL123
      EVAP=EVAP/(12.*30.*86400.)                                        SWFL124
      TOLD=0.                                                           SWFL125
      KRAIN=1                                                           SWFL126
      PREC = 0.0                                                        SWFL127
      T=TZERO                                                           SWFL128
      DO  224 I = 1,NHPRT
      MJPRT = JPRT(I)                                                   SWFL130
      PRTH (1,I) = H(MJPRT)                                             SWFL131
  224 CONTINUE                                                          SWFL132
      DO  225 I = 1,NQPRT                                               SWFL133
      MCPRT = CPRT(I)                                                   SWFL134
      PRTQ(1,I) = Q(MCPRT)                                              SWFL135
      PRTV(1,I) = V(MCPRT)                                              SWFL136
  225 CONTINUE                                                          SWFL137
C                                                                       SWFL138
C                                      READING OF INITIAL HYDROGRAPH    SWFL139
C                                      INFORMATION FROM INTERFACING     SWFL140
C                                                                       SWFL141
      IF(N21.EQ.0) GO TO 230                                            SWFL142
      REWIND N21                                                        SWFL143
      READ (N21)          TITEL2                                        SWFL144
```

```
      WRITE (N6,7097)   TITEL2                                          SWFL145
 7097 FORMAT (1H1,(20A4))                                               SWFL146
      READ (N21)       NSTEPS,MJSW,NQUAL,TDELT,TZERO,TAREA              SWFL147
      WRITE(N6,7093)
7093  FORMAT(///1H ,7X,6HNSTEPS,5X,4HMJSW,6X,5HNQUAL,2X,5HTDELT,5X,
    1 5HTZERO,5X,5HTAREA)
      WRITE (N6,7091) NSTEPS,MJSW,NQUAL,TDELT,TZERO,TAREA               SWFL151
 7091 FORMAT (3I10,3F10.2)                                              SWFL152
      READ(N21) (ISW(L),L=1,MJSW)                                       SWFL153
      WRITE(N6,7095)
7095  FORMAT(///1H ,23HSTORM WATER INPUT NODES/)
      WRITE(N6,7092) (ISW(L),L=1,MJSW)
 7092 FORMAT(10I10)                                                     SWFL157
      READ(N21) TT(1),(QT(L,1),L=1,MJSW)                                SWFL158
      WRITE(N6,7096)
7096  FORMAT(///1H ,12HTIME-STEP    ,4X,4HTIME,7X,36HINFLOWS FROM STORM W
     1ATER INPUT NODES/)
      WRITE(N6,7094)NINREC, TT(1),(QT(L,1),L=1,MJSW)
 7094 FORMAT(I7,3X,9F10.1,/,(20X,8F10.1))                               SWFL163
      READ(N21) TT(2),(QT(L,2),L=1,MJSW)                                SWFL164
      NINREC=2                                                          SWFL165
      WRITE(N6,7094)NINREC, TT(2),(QT(L,2),L=1,MJSW)
      I1=1                                                              SWFL167
      I2=2                                                              SWFL168
      TTP=0.                                                            SWFL169
  230 IF(NJSW.EQ.0) GO TO 235                                           SWFL170
      LDD=JMO-LN+1
      IF(IYEAR.GT.1.OR .LDD.GT.1) GO TO 45
      READ(60,100) (JSW(L),L=1,NJSW)
   45 IF(ISWCH(3).NE.4)GO TO 234                                        SWFL172
      READ(N5,231) NTIMST,NGAGE,NTCC
  231 FORMAT(3I5,F5.0)
      IF(IYEAR.GT.1.OR .LDD.GT.1) GO TO 3
      READ(60,232) (TEEM(KM),KM=1,NTIMST)
  232 FORMAT((8F10.0))                                                  SWFL176
      DO 2330 JTT=1,NJSW                                                SWFL177
 2330 READ(60,2332) (RCENT(JTT,ITT),ITT=1,NGAGE)
 2332 FORMAT(16F5.2)                                                    SWFL179
    3 DO 2328 KMT=1,NTIMST
      DO 2328 JMM=1,NJSW
      BP(KMT)=0.0
      QNEW(KMT)=0.0
 2328 EXXT(KMT,JMM)=0.0
      IF(LDD.GT.1.OR.IYEAR.GT.1) GO TO 351
      READ(60,231) NTIMST,NGAGE,NTCC
  351 READ(N5,231) LXK
      IF(LXK.EQ.0) GO TO 23310
      DO 2331 L=1,LXK
      READ(N5,231) JMM
      READ(N5,232) (EXXT(KMT,JMM),KMT=1,NTIMST)
 2331 CONTINUE
23310 TCN=1.                                                            SWFL182
   20 NNTTM=1                                                           SWFL183
      IF(NTCC.EQ.1)TCN=60.                                              SWFL184
      IF(NTCC.EQ.2)TCN=3600.                                            SWFL185
      IF(NTCC.EQ.3)TCN=86400.                                           SWFL186
      READ(N5,462)(DRAIN(LT),LT=1,NGAGE)                                SWFL187
      DO 2333 JLT=1,NJSW                                                SWFL188
      SUMGAG=0.                                                         SWFL189
      DO 233 JLK=1,NGAGE                                                SWFL190
  233 SUMGAG=SUMGAG+RCENT(JLT,JLK)*DRAIN(JLK)                           SWFL191
      JNUM=JSW(JLT)                                                     SWFL192
```

```
 2333 QE(JLT,2)=EXXT(NNTTM,JLT)+.96*AS(JNUM)*SUMGAG/(12*86400)              SWFL193
      TE=TEEM(NNTTM)*TCN                                                    SWFL194
      TEE=TEEM(NTIMST)                                                      SWFL195
      WRITE(N6,102) (JSW(L),L=1,NJSW)
      WRITE(N6,76) JMO
   76 FORMAT(5X,5HMONTH,I5//)
C     WRITE(N6,105)
      DO 2336 I=1,NTIMST                                                    SWFL198
      TFIRST=(TEEM(I)*TCN)/3600.                                            SWFL199
      TSECND=TFIRST/24.                                                     SWFL200
C     WRITE(N6,106) TFIRST,TSECND,(EXXT(I,J),J=1,NJSW)
 2336 CONTINUE
      GO TO 237                                                             SWFL202
  100 FORMAT (16I5)                                                         SWFL203
  234 READ(N5,104) TE,(QE(L,2),L=1,NJSW)                                    SWFL204
C     WRITE(N6,102) (JSW(L),L=1,NJSW)                                       SWFL205
102   FORMAT(1H1,30HHYDROGRAPH  INPUTS  TO  SYSTEM//1H ,24X,16HJUNCTION
     1 NUMBER/1H ,(17X,10I10))
  237 IF(ISWCH(3).EQ.4) WRITE(N6,2337) (JSW(L),L=1,NJSW)
2337  FORMAT(1H1,49HHYDROGRAPH  INPUTS  TO  SYSTEM  WITH  RAIN  ADDED//
     1  1H ,24X,15HJUNCTION NUMBER/1H ,(17X,10I10))
C     WRITE(N6,105)                                                         SWFL211
105   FORMAT(1H ,8X,4HTIME/1H ,14H HOURS    DAYS,10X,12HVOLUME (CFS))
      TEP=TE/3600.                                                          SWFL213
      TEPP2=TEP/24.                                                         SWFL214
C     WRITE(N6,106) TEP,TEPP2,(QE(L,2),L=1,NJSW)                            SWFL215
  106 FORMAT(1X,F6.2,2X,F6.2,3X,10F10.1,/,(18X,10F10.1),/)                  SWFL216
  235 CONTINUE                                                              SWFL217
      TIME=TZERO                                                            SWFL218
C                                                                           SWFL219
C                                  INITIAL TIME-STAGE RELATIONSHIP          SWFL220
C                                  COMPUTED                                 SWFL221
C                                                                           SWFL222
      IF (ISWCH(1).NE.1) GO TO 236                                          SWFL223
      H(JGW)=A1+A2*SIN(W*T)+A3*SIN(2.*W*T)+A4*SIN(3.*W*T)                   SWFL224
     1         +A5*COS(W*T)+A6*COS(2.*W*T)+A7*COS(3.*W*T)                   SWFL225
  236 CONTINUE                                                              SWFL226
C                                                                           SWFL227
C                                  CHANNEL CONSTANTS COMPUTED               SWFL228
C                                                                           SWFL229
      IF(LDD.GT.1) GO TO 2711
      DO 280 N=1,NC
      IF(NJUNC(N,1).LE.0)GO TO 280                                          SWFL231
      NL=NJUNC(N,1)                                                         SWFL233
      NH=NJUNC(N,2)                                                         SWFL234
      R(N)=R(N)+(H(NL)+H(NH))/2.                                            SWFL235
      IF(R(N).LE.0.0) R(N)=0.0
      A(N)=B(N)*R(N)                                                        SWFL236
      IF (WIND.LE.0.0) GO TO 270                                            SWFL237
      FWIND(N)=-WIND**2*COS(WDIR/57.-ATAN(( X(NH)-X(NL)),(Y(NH)-Y(NL))))SWFL238
     1 *8.64E-6                                                             SWFL239
  270 CONTINUE                                                              SWFL240
      AT(N)=A(N)                                                            SWFL241
      QAVE(N)=0.                                                            SWFL242
  280 CONTINUE                                                              SWFL243
C                                                                           SWFL244
C                                  NODAL VOLUMES COMPUTED                   SWFL245
C                                                                           SWFL246
 2711 DO 340 J=1,NJ                                                         SWFL247
      VOL(J)=0.                                                             SWFL248
      IF(AS(J).EQ.0.) GO TO 340                                             SWFL249
      AREA=0.                                                               SWFL250
```

```
      VOLUME=0.
      DO 300 K=1,10
      N=NCHAN(J,K)
      IF(N.LE.0) GO TO 300
      AREA=AREA+B(N)*LEN(N)
      VOLUME=VOLUME+B(N)*LEN(N)*(R(N)+RD)
      IF(VOL(J).LE.0.0) VOL(J)=0.0
  300 CONTINUE
      DEPTH=VOLUME/AREA
      VOL(J)=DEPTH*AS(J)
  340 CONTINUE
C
C                                       START OF PROGRAM CORE, WITH
C                                       MAJOR HYDRAULIC COMPUTATIONS
C
C                                       START OF DAY DO LOOP, OUTER DO
C                                       LOOP OF 3 NESTED DO LOOPS
C
      DO 1300 NT=1,NTCYC
C     WRITE(N22) NEXIT,NHCYC,NT,DELT,TZERO,NHPRT,NQPRT,NJSW
C     DO 1000 J=1,NQPRT
C     WRITE(N22) (NJUNC(J,K),K=1,2)
C1000 CONTINUE
      IF(NT.LT.NQSWRT) GO TO 350
      DO 345 J=1,NPLT
      I=IABS(JPLT(J))
  345 HPLT(J)=H(I)
      HOUR=TZERO/3600.
      WRITE(N20) HOUR,(HPLT(J),J=1,NPLT)
      NPTOT=1
      IF(NINREC.GE.NSTEPS.OR.NINREC.EQ.2)GO TO 347
      WRITE(N6,7097)TITEL2
      WRITE(N6,7093)
      WRITE (N6,7091) NSTEPS,MJSW,NQUAL,TDELT,TZERO,TAREA
      WRITE(N6,7095)
      WRITE(N6,7092) (ISW(L),L=1,MJSW)
      WRITE(N6,7096)
  347 CONTINUE
  350 CONTINUE
      LTIME=0
C
C                                       START OF QUALITY DO LOOP
C
      NQCYC=NTIMST
      DO 1240 NQ=1,NQCYC
      KDAY=KDAY+1
C
C                                       INITIALIZATION OF ARRAYS USED
C                                       FOR HYDRAULIC OUTPUT TO BE USED
C                                       BY THE SWQUAL SUBROUTINE
C
      IF (NT.LT.NQSWRT) GO TO 380
      DO 360 N=1,NC
      VBAR(N)=0.
  360 QBAR(N)=0.
      DO 370 J=1,NJ
      HBAR(J)=0.
      QINBAR(J)=0.
      QOUBAR(J)=0.
  370 CONTINUE
  380 CONTINUE
C
```

```
C                                       START OF HYDRAULIC DO LOOP,
C                                       INNERMOST DO LOOP OF 3 NESTED
C                                       DO LOOPS
C
      S12Q=0.0
      DO 1040 NHH=1,NHCYC
      IF(NT.LE.NQSWRT) GO TO 520
      TIME=TIME+DELT
C
C                                       PRECIPITATION COMPUTATIONS FOR
C                                       EACH TIME STEP
C
      PREC=0.
  390 IF(KRAIN-INRAIN) 395,410,410
  395 IF(TIME-INTIME(KRAIN+1)) 405,400,400
  400 PREC=PREC+RAIN(KRAIN)*(INTIME(KRAIN+1)-TOLD)/(12.*3600.)
      KRAIN=KRAIN+1
      TOLD=INTIME(KRAIN)
      GO TO 390
  405 PREC=(PREC+RAIN(KRAIN)*(TIME-TOLD)/(12.*3600.))/DELT
      TOLD=TIME
  410 CONTINUE
      IF(N21.EQ.0) GO TO 445
      DO 418 L=1,MJSW
      J=ISW(L)
  418 QIN(J)=QINST(J)*DELT
  420 IF(TIME-TT(I2)) 435,425,425
  425 DO 430 L=1,MJSW
      J=ISW(L)
  430 QIN(J)=QIN(J)+QT(L,I1)*(TT(I2)-TTP)
      TTP=TT(I2)
      ITEMP=I2
      I2=I1
      I1=ITEMP
      IF(NINREC-NSTEPS) 431,432,432
  431 READ(N21) TT(I2),(QT(L,I2),L=1,MJSW)
      NINREC=NINREC+1
      WRITE(N6,7094) NINREC,TT(I2),(QT(L,I2),L=1,MJSW)
      GO TO 420
  432 TT(I2)=1000000.
      DO 433 L=1,MJSW
  433 QT(L,I2)=0.
      GO TO 420
  435 DO 440 L=1,MJSW
      J=ISW(L)
  440 QIN(J)=(QIN(J)+QT(L,I1)*(TIME-TTP))/DELT
      TTP=TIME
  445 CONTINUE
      IF(NJSW.EQ.0) GO TO 520
C
C                                       READ HYDROGRAPH INPUT OR AVERAGE
C                                       OR INTERPOLATE FOR TIME STEP
C
      IF(TIME.LE.TE) GO TO 480
      TEO=TE
      DO 460 L=1,NJSW
  460 QE(L,1)=QE(L,2)
C
C                                       READ HYDROGRAPHS
C
      IF(ISWCH(3).NE.4)GO TO 469
      IF(TEEM(NNTTM).EQ.TEE)GO TO 480
```

```
      NNTTM=NNTTM+1                                                     SWFL368
      READ(N5,462)(DRAIN(LT),LT=1,NGAGE)                                SWFL369
  462 FORMAT(16F5.2)                                                    SWFL370
      DO 468 JLT=1,NJSW                                                 SWFL371
      SUMGAG=0.                                                         SWFL372
      DO 463 JLK=1,NGAGE                                                SWFL373
  463 SUMGAG=SUMGAG+RCENT(JLT,JLK)*DRAIN(JLK)                           SWFL374
      JNUM=JSW(JLT)                                                     SWFL375
  468 QE(JLT,2)=EXXT(NNTTM,JLT)+.96*ABS(AS(JNUM))*SUMGAG/(12*86400)     SWFL376
      TE=TEEM(NNTTM)*TCN                                                SWFL377
      GO TO 470                                                         SWFL378
C                                                                       SWFL379
  469 READ (N5,104) TE,(QE(JJ,2),JJ=1,NJSW)                             SWFL380
  104 FORMAT (8F10.0)                                                   SWFL381
  470 CONTINUE                                                          SWFL382
      TEP=TE/3600.                                                      SWFL383
      IF(TE.GT.TEPP)GO TO 480                                           SWFL384
      TEPP2=TEP/24.                                                     SWFL385
C     WRITE(N6,106) TEP,TEPP2,(QE(L,2),L=1,NJSW)                        SWFL386
C                                                                       SWFL387
C                                       INTERPOLATE HYDROGRAPH          SWFL388
      DO 500 L=1,NJSW                                                   SWFL391
C                                                                       SWFL389
      J=JSW(L)                                                          SWFL392
      SLOPE=(QE(L,2)-QE(L,1))/(TE-TEO)                                  SWFL393
  500 QIN(J)=QINST(J)+QE(L,1)+SLOPE*(TIME-TEO)                          SWFL394
  520 CONTINUE                                                          SWFL395
  480 CONTINUE                                                          SWFL390
C                                                                       SWFL396
C                                       INITIALIZATION                  SWFL397
C                                                                       SWFL398
      T2=T+DELT2                                                        SWFL399
      T=T+DELT                                                          SWFL400
      DO 525 N=1,NC                                                     SWFL401
      NCLOS(N)=0                                                        SWFL402
      DO 525 M=1,2                                                      SWFL403
  525 NJUNC(N,M)=IABS(NJUNC(N,M))                                       SWFL404
      DO 530 J=1,NJ                                                     SWFL405
      AS(J)=ABS(AS(J))                                                  SWFL406
      DO 530 K=1,10
  530 NCHAN(J,K)=IABS(NCHAN(J,K))                                       SWFL408
      NTIMS=0                                                           SWFL409
C                                                                       SWFL410
C                                       COMPUTATIONS OF VELOCITIES AT   SWFL411
C                                       HALF TIME STEP, AND FLOWS AT    SWFL412
C                                       QUARTER TIME STEP               SWFL413
C                                                                       SWFL414
  540 CONTINUE                                                          SWFL415
      NDRY=0                                                            SWFL416
      NTIMS=NTIMS+1                                                     SWFL417
      DO 580 N=1,NC                                                     SWFL418
      IF(NJUNC(N,1).LE.0)GO TO 580                                      SWFL419
C                                                                       SWFL420
C                                       DRY CHANNEL CHECK (UNDER 0.1 FT)SWFL421
C                                                                       SWFL422
      IF(R(N).GT.0.10) GO TO 560
      VT(N)=0.0                                                         SWFL424
      Q(N)=0.0                                                          SWFL425
      GO TO 580                                                         SWFL426
  560 CONTINUE                                                          SWFL427
      AD=R(N)+RD
      IF(N.GT.NCGT) AD=R(N)
```

```
      NL=NJUNC(N,1)                                                     SWFL428
      NH=NJUNC(N,2)                                                     SWFL429
      IF(ISWCH(7).NE.1)GO TO 565                                        SWFL430
      IF(ISWCH(5).EQ.1.AND.N.GT.NCGT)GO TO 565                          SWFL431
  564 IF(AD.LT.0.5) AK(N)=5.5
      IF(AD.GE.0.5.AND.AD.LE.5.0) AK(N)=0.39+.4/AD
      IF(AD.GT.5.0) AK(N)=1.8/AD-0.003*AD
  565 IF(AT(N)-A(N)) 7,7,8
    8 IF(A(N).LE.0.0) A(N)=AT(N)
    7 DELV2=V(N)*(1.-AT(N)/A(N))                                        SWFL435
      DDD=DELT2*(V(N)*V(N)*B(N)/A(N)-32.1739)
      DDE=ABS(DDD)
      IF(DDE.LE.1.0E-20) DDD=0.0
      IF(N.GT.NCGT) GO TO 394
      DD1=-FDEP(NH)
      DDC=-FDEP(NL)
      AB=DDC
      IF(DD1.GT.DDC) AB=DD1
      IF(H(NH).GE.AB.AND.H(NL).GE.AB) GO TO 394
      DH=0.5*(H(NH)-H(NL))
      GO TO 393
  394 DH=H(NH)-H(NL)
  393 DELV2=DELV2+DDD*DH/LEN(N)
      DELV2=DELV2+FWIND(N)/R(N)*DELT2
      V2=V(N)+DELV2                                                     SWFL438
      TEMP=DELT2*AK(N)/AD**1.33333                                        SWFL43
      DD1=1./TEMP+2.*ABS(V2)
      DDE=DD1**2-4.*V2*V2
      IF(DDE.LT.0.0) DDE=0.0
      DD2=SQRT(DDE)
      DELV1=0.5*(DD1-DD2)
      DELV1=-SIGN(DELV1,V2)                                             SWFL442
  383 VT(N)=V(N)+DELV1+DELV2                                            SWFL443
      IF(N.GT.NCGT) GO TO 374
      IF(ABS(VT(N)).GT.10.0) VT(N)=0.05
  374 Q(N)=VT(N)*A(N)                                                   SWFL444
  580 CONTINUE                                                          SWFL445
C                                                                       SWFL446
C                                          COMPUTATION OF NODAL STAGE AT  SWFL447
C                                          HALF TIME STEP               SWFL448
C                                                                       SWFL449
      DO 660 J=1,NJ                                                     SWFL450
      SUMQ=0.                                                           SWFL451
      DO 620 K=1,10
      IF(NCHAN(J,K).LE.0) GO TO 620                                     SWFL453
      N=NCHAN(J,K)                                                      SWFL454
      IF(J.NE.NJUNC(N,1))GO TO 600                                      SWFL455
      SUMQ=SUMQ+Q(N)                                                    SWFL456
      GO TO 620                                                         SWFL457
  600 SUMQ=SUMQ-Q(N)                                                    SWFL458
  620 CONTINUE                                                          SWFL459
      IF(AS(J).LE.0.) GO TO 660
      C=0.233*H(J)-2.26
      IF(H(J).LE.10.0) C=0.1
   14 SUMQ=QOU(J)*C-QIN(J)+(EVAP-PREC)*AS(J)+SUMQ
      IF(ISWCH(1).EQ.2)GO TO 644                                        SWFL463
      IF (J.EQ.JGW.AND.ISWCH(1).NE.1) GO TO 650                         SWFL464
  644 HT(J)=H(J)-DELT2*SUMQ/AS(J)                                       SWFL465
      IF(HT(J)+DEP(J).GT.0.) GO TO 660                                  SWFL466
      VOL(J)=VOL(J)-SUMQ*DELT2
      IF(VOL(J).GT.0.0) GO TO  6
      VOL(J)=0.0
```

```
      HT(J)=-DEP(J)
      DDE=ABS(FDEP(J))
      IF(HT(J).LE.DDE) HT(J)=-FDEP(J)
      GO TO 16
    6 DDE=ABS(FDEP(J))
      IF(HT(J).LT.DDE) HT(J)=DDE
      DEP(J)=-HT(J)
   16 AS(J)=-AS(J)
   17 DO 645 K=1,10
      NX=NCHAN(J,K)                                                     SWFL471
      IF(NX.LE.0) GO TO 645                                             SWFL472
      NCLOS(NX)=1                                                       SWFL473
  645 CONTINUE                                                          SWFL474
      NDRY=NDRY+1                                                       SWFL475
      GO TO 660                                                         SWFL476
  650 CONTINUE                                                          SWFL477
      DELHH=0.                                                          SWFL478
      IF(H(IND).GT.REG(KDAY)) GO TO 6551
      DELHH=DELT2/AS(J)*(-SUMQ)
      GO TO 656
 6551 DO 655 ICT=1,3                                                    SWFL479
      BASE=H(JGW)-WEIR2+DELHH/2.0
      IF(H(JGW).GE.13.2) BASE=12.5-WEIR2+DELHH/2.0
      IF(H(JGW).GE.14.0) BASE=13.0-WEIR2+DELHH/2.0
      IF(BASE.LE.0.0) BASE=0.0
      DELHH=DELT2/AS(J)*(-SUMQ-WEIR1*BASE**WEIR3)
  655 CONTINUE                                                          SWFL481
  656 HT(J)=H(J)+DELHH
  660 CONTINUE                                                          SWFL483
      IF(NDRY.EQ.0) GO TO 675                                           SWFL484
      IF(NTIMS.GT.2) GO TO 675                                          SWFL485
      DO 670 N=1,NC                                                     SWFL486
      IF(NJUNC(N,1).LE.0) GO TO 670                                     SWFL487
      IF(NCLOS(N).NE.1) GO TO 670                                       SWFL488
      IF(VOL(J).GT.0.0) GO TO 11
      Q(N)=0.                                                           SWFL489
      V(N)=0.                                                           SWFL490
   11 DO 668 I=1,2
      II=NJUNC(N,I)                                                     SWFL492
      DO 664 J=1,10
      IF(NCHAN(II,J).EQ.N) GO TO 666                                    SWFL494
  664 CONTINUE                                                          SWFL495
      GO TO 668                                                         SWFL496
  666 NCHAN(II,J)=-N                                                    SWFL497
  668 NJUNC(N,I)=-II                                                    SWFL498
  670 CONTINUE                                                          SWFL499
      GO TO 540                                                         SWFL500
  675 CONTINUE                                                          SWFL501
C                                                                       SWFL502
C                                       BOUNDARY STAGE CONDITION AT     SWFL503
C                                       HALF TIME STEP                  SWFL504
C                                                                       SWFL505
      IF (ISWCH(1).NE.1) GO TO 676                                      SWFL506
      HT(JGW)=A1+A2*SIN(W*T2)+A3*SIN(2.*W*T2)+A4*SIN(3.*W*T2)           SWFL507
     1          +A5*COS(W*T2)+A6*COS(2.*W*T2)+A7*COS(3.*W*T2)           SWFL508
  676 CONTINUE                                                          SWFL509
C                                                                       SWFL510
C                                       COMPUTATION OF CHANNEL CROSS-   SWFL511
C                                       SECTIONAL AREAS AT HALF TIME    SWFL512
C                                       STEP, FLOWS AT HALF TIME STEP,  SWFL513
C                                       AND VELOCITIES AT FULL TIME STEPSWFL514
C                                                                       SWFL515
```

```
      DO 740 N=1,NC                                                     SWFL516
      IF(NJUNC(N,1).LE.0)GO TO 740                                      SWFL517
      NL=NJUNC(N,1)                                                     SWFL518
      NH=NJUNC(N,2)                                                     SWFL519
      DELH=0.5*(HT(NH)-H(NH)+HT(NL)-H(NL))                              SWFL520
      RNT=R(N)+DELH+RD                                                  SWFL521
      IF(N.GT.NCGT) RNT=R(N)+DELH
      AT(N)=A(N)+B(N)*DELH                                              SWFL522
C                                                                       SWFL523
C                                     DRY CHANNEL CHECK (UNDER 0.1 FT)SWFL524
C                                                                       SWFL525
      IF(RNT.GT.0.10) GO TO 680
      V(N)=0.                                                           SWFL527
      Q(N)=0.                                                           SWFL528
      GO TO 700                                                         SWFL529
  680 CONTINUE                                                          SWFL530
      IF(ISWCH(7).NE.1)GO TO 685                                        SWFL531
      IF(ISWCH(5).EQ.1.AND.N.GT.NCGT)GO TO 685                          SWFL532
      AD=RNT + RD
  682 IF(AD.LT.0.5) AK(N)=5.5
      IF(AD.GE.0.5.AND.AD.LE.5.0) AK(N)=0.39+.4/AD
      IF(AD.GT.5.0) AK(N)=1.8/AD-0.003*AD
  685 IF(A(N)-AT(N)) 9,9,10
   10 IF(AT(N).LE.0.0) AT(N)=A(N)
    9 CONTINUE
      IF(N.GT.NCGT) GO TO 391
      DDE=-FDEP(NH)
      DDC=-FDEP(NL)
      AB=DDC
      IF(DDE.GT.DDC) AB=DDE
      IF(HT(NH).GE.AB.AND.HT(NL).GE.AB) GO TO 391
      DH=0.5*(HT(NH)-HT(NL))
      GO TO 392
  391 DH=HT(NH)-HT(NL)
  392 DELV2=2.*VT(N)*(1.-A(N)/AT(N))
     1+DELT*((VT(N)*VT(N)*B(N)/AT(N))-32.1739)*DH/LEN(N)                 SWFL537
     1+FWIND(N)/RNT*DELT                                                SWFL538
      V2= V(N)+DELV2                                                    SWFL539
      TEMP=DELT*AK(N)/RNT**1.3333333                                    SWFL540
      AASQRT=(1./TEMP+2.*ABS(V2))*(1./TEMP+2.*ABS(V2))-4.*V2*V2          SWFL541
      IF(AASQRT.LE.1.0E-10)AASORT=0.0                                   SWFL542
      DELV1=0.5*((1./TEMP+2.*ABS(V2))-SQRT(AASORT))                     SWFL543
      DELV1=-SIGN(DELV1,V2)                                             SWFL544
  387 V(N)=V(N)+DELV1+DELV2                                             SWFL545
      IF(N.GT.NCGT) GO TO 385
      IF(ABS(V(N)).GT.10.0) V(N)=0.05
  385 Q(N)=0.5*(Q(N)+V(N)*AT(N))                                        SWFL546
  700 CONTINUE                                                          SWFL547
C                                                                       SWFL548
C                                     CHANNEL FLOWS SUMMED              SWFL549
C                                                                       SWFL550
      IF (NT.LT.NQSWRT) GO TO 720                                       SWFL551
      QBAR(N)=QBAR(N)+Q(N)                                              SWFL552
      VBAR(N)=VBAR(N)+V(N)                                              SWFL553
  720 CONTINUE                                                          SWFL554
C                                                                       SWFL555
C                                     EXCESSIVE VELOCITY CHECK          SWFL556
C                                                                       SWFL557
      IF(ABS(V(N)).LE.20.0)GO TO 740                                    SWFL558
      WRITE(N6,108)N,NT,NQ,NHH,R(N),V(N),Q(N),AT(N),A(N),DELV1,DELV2,V2,SWFL559
     1HT(NH),HT(NL),H(NH),H(NL),AK(N)                                   SWFL560
108   FORMAT(1H ,7HCHANNEL,I5,3X,33HVELOCITY OVER 20 FPS, TIDAL CYCLE,
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```
    1 I4,12H  QUAL CYCLE,I4,13H  HYDRO CYCLE,I4,7H  DEPTH,E7.2/1H ,
    28HVELOCITY,E12.2,6H  FLOW,E12.2,6H  AT =,E12.0,4H  A=,E12.0,
    3 9H  DELV1 =,E12.1/1H ,7HDELV2 =,E12.1,6H  V2 =,E12.1,1X,
    48HHT(NH) =,E12.2,1X,8HHT(NL) =,E12.2,7HH(NH) =,E12.2,1X,7HH(NL) =,
    5 E12.2/1H ,7HAK(N) =,E12.2,10X,8HSWFL 520)
      CALL EXIT
  740 CONTINUE                                                          SWFL568
C                                                                       SWFL569
C                                  COMPUTATION OF NODAL STAGE AND       SWFL570
C                                  VOLUME AT FULL TIME STEP             SWFL571
C                                                                       SWFL572
      DO 900 J=1,NJ
      SUMQ=0.                                                           SWFL574
      HN(J)=-DEP(J)                                                     SWFL575
      DDE=-FDEP(J)
      IF(HN(J).LT.DDE) HN(J)=-FDEP(J)
      IF(AS(J).LE.0.) GO TO 900                                         SWFL576
      DO 800 K=1,10
      IF(NCHAN(J,K).LE.0) GO TO 800                                     SWFL578
      N=NCHAN(J,K)                                                      SWFL579
      IF(J.NE.NJUNC(N,1))GO TO 780                                      SWFL580
      SUMQ=SUMQ+Q(N)                                                    SWFL581
      GO TO 800                                                         SWFL582
  780 SUMQ=SUMQ-Q(N)                                                    SWFL583
  800 CONTINUE                                                          SWFL584
      IF(J.NE.JGW) GO TO 820                                            SWFL585
      IF(ISWCH(1).EQ.2)GO TO 820                                        SWFL586
      IF (ISWCH(1).NE.1) GO TO 802                                      SWFL587
      HN(JGW)=A1+A2*SIN(W*T)+A3*SIN(2.*W*T)+A4*SIN(3.*W*T)              SWFL588
     1          +A5*COS(W*T)+A6*COS(2.*W*T)+A7*COS(3.*W*T)              SWFL589
      GO TO 814                                                         SWFL590
  802 CONTINUE                                                          SWFL591
      DELHH=DELHH*2.                                                    SWFL592
      IF(H(IND).GT.REG(KDAY)) GO TO 8021
      DELHH=DELT/AS(J)*(-SUMQ)
      GO TO 809
 8021 DO 808 ICT=1,3                                                    SWFL593
      BASE=H(JGW)-WEIR2+DELHH/2.0
      IF(H(JGW).GE.13.2) BASE=12.5-WEIR2+DELHH/2.0
      IF(H(JGW).GE.14.0) BASE=13.0-WEIR2+DELHH/2.0
      IF(BASE.LE.0.0) BASE=0.0
      QQ=WEIR1*BASE**WEIR3
      DELHH=DELT/AS(J)*(-SUMQ-QQ)
  808 CONTINUE                                                          SWFL595
      S12Q=S12Q+QQ*DELT/86400.0
  809 HN(J)=H(J)+DELHH                                                  SWFL596
  814 CONTINUE                                                          SWFL597
      DVOL=(HN(JGW)-H(JGW))*AS(JGW)                                     SWFL598
      QOU(JGW)=0.                                                       SWFL599
      QIN(JGW)=(DVOL/DELT)+SUMQ                                         SWFL600
      IF (QIN(JGW).GT.0.) GO TO 815                                     SWFL601
      QOU(JGW)=-QIN(JGW)                                                SWFL602
      QIN(JGW)=0.                                                       SWFL603
  815 VOL(JGW)=VOL(JGW)+DVOL                                            SWFL604
      IF(HN(JGW)+DEP(JGW).GT.0.0) GO TO 825
      IF(VOL(JGW).GT.0.0) GO TO 824
      VOL(JGW)=0.0
      HN(JGW)=-DEP(JGW)
      GO TO 825                                                         SWFL605
  824 IF(HN(JGW).LE.WEIR2) HN(JGW)=WEIR2
      DEP(JGW)=-HN(JGW)
      DDE=ABS(FDEP(JGW))
```

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      IF(HN(JGW).LT.DDE) HN(JGW)=-FDEP(JGW)
      GO TO 825
C                                                                       SWFL606
C                                         COMPUTATION OF [ORDINARY[ NODES SWFL607
C                                         VOLUME AND STAGE              SWFL608
C                                                                       SWFL609
  820 C=0.233*H(J)-2.26
      IF(H(J).LE.10.0) C=0.1
   19 SUMQ=QOU(J)*C-QIN(J)+(EVAP-PREC)*AS(J)+SUMQ
      HN(J)=H(J)-DELT*SUMQ/AS(J)                                        SWFL611
      VOL(J)=VOL(J)-DELT*SUMQ                                           SWFL612
      IF(VOL(J).LE.0.0) VOL(J)=0.0                                      SWFL 613
  825 CONTINUE                                                          SWFL614
  900 CONTINUE                                                          SWFL615
C                                                                       SWFL616
C                                         NODAL VOLUMES AND FLOWS SUMMED SWFL617
C                                                                       SWFL618
      IF (NT.LT.NQSWRT) GO TO 940                                       SWFL619
      DO 920 J=1,NJ                                                     SWFL620
      HBAR(J)=HBAR(J)+HN(J)                                             SWFL621
      QINBAR(J)=QINBAR(J)+QIN(J)                                        SWFL622
      QOUBAR(J)=QOUBAR(J)+QOU(J)                                        SWFL623
  920 CONTINUE                                                          SWFL624
  940 CONTINUE                                                          SWFL625
C                                                                       SWFL626
C                                         FULL TIME STEP COMPUTATION OF SWFL627
C                                         HYDRAULIC RADIUS AND CHANNEL  SWFL628
C                                         CROSS-SECTIONAL AREAS         SWFL629
C                                                                       SWFL630
      DO 980 N=1,NC
      IF(NJUNC(N,1).EQ.0) GO TO 980                                     SWFL632
      NL=IABS(NJUNC(N,1))                                               SWFL633
      NH=IABS(NJUNC(N,2))                                               SWFL634
      DELH=0.5*(HN(NH)-H(NH)+HN(NL)-H(NL))                              SWFL635
      R(N)=R(N)+DELH                                                    SWFL636
      IF(N .GT.NCGT) GO TO 982
      DDE=0.5*(HN(NH)+HN(NL)+FDEP(NH)+FDEP(NL))
      IF(R(N).LT.DDE) GO TO 982
      R(N)=DDE
  982 IF(R(N).LE.0.0) R(N)=0.0
      A(N)=A(N)+B(N)*DELH                                               SWFL637
  980 CONTINUE                                                          SWFL638
C                                                                       SWFL639
C                                         NODAL STAGE ARRAYS SHIFTED    SWFL640
C                                                                       SWFL641
      DO 1020 J=1,NJ
 1020 H(J)=HN(J)                                                        SWFL643
      IF(NT.LT.NQSWRT) GO TO 1040                                       SWFL644
      IF(NPTOT.NE.NPDEL) GO TO 1030                                     SWFL645
      DO 1025 J=1,NPLT                                                  SWFL646
      I=IABS(JPLT(J))                                                   SWFL647
 1025 HPLT(J)=H(I)                                                      SWFL648
      HOUR=HOUR+DELT/3600.*NPDEL                                        SWFL649
      WRITE(N20) HOUR,(HPLT(J),J=1,NPLT)                                SWFL650
      NPTOT=0                                                           SWFL651
 1030 NPTOT=NPTOT+1                                                     SWFL652
C                                                                       SWFL653
C                                         END OF HYDRAULIC OR INNER DO  SWFL654
C                                         LOOP                          SWFL655
C                                                                       SWFL656
 1040 CONTINUE                                                          SWFL657
C                                                                       SWFL658
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C                                          AVERAGING OF FLOWS AND           SWFL659
C                                          VELOCITIES                       SWFL660
C                                                                           SWFL661
      IF (NT.LT.NQSWRT) GO TO 1100                                          SWFL662
      DO 1060 N=1,NC                                                        SWFL663
      IF(NJUNC(N,1).LE.0) GO TO 1060                                        SWFL664
      QBAR(N)=QBAR(N)/FLOAT(NHCYC)                                          SWFL665
      VBAR(N)=VBAR(N)/FLOAT(NHCYC)                                          SWFL666
      QAVE(N)=QAVE(N)+QBAR(N)/FLOAT(NQCYC)                                  SWFL667
 1060 CONTINUE                                                              SWFL668
      DO 1080 J=1,NJ                                                        SWFL669
      QINBAR(J)=QINBAR(J)/FLOAT(NHCYC)                                      SWFL670
      QOUBAR(J)=QOUBAR(J)/FLOAT(NHCYC)                                      SWFL671
      HBAR(J)=HBAR(J)/FLOAT(NHCYC)                                          SWFL672
      IF(QINBAR(J).EQ.0.) GOTO 1080                                         SWFL673
      IF(QOUBAR(J).EQ.0.) GOTO 1080                                         SWFL674
      QINBAR(J)=QINBAR(J)-QOUBAR(J)                                         SWFL675
      QOUBAR(J)=0.                                                          SWFL676
      IF(QINBAR(J).GT.0.) GO TO 1080                                        SWFL677
      QOUBAR(J)=-QINBAR(J)                                                  SWFL678
      QINBAR(J)=0.                                                          SWFL679
 1080 CONTINUE                                                              SWFL680
C                                                                           SWFL681
C                                          WRITE HYDRAULIC INFORMATION FOR SWFL682
C                                          USE IN QUALITY PROGRAM           SWFL683
C                                                                           SWFL684
      WRITE(N20) NQ,(QBAR(N),VBAR(N),N=1,NC),                               SWFL685
     1 (VOL(J),QINBAR(J),QOUBAR(J),J=1,NJ)                                  SWFL686
C                                                                           SWFL687
C                                          STORE OUTPUT FOR SUBSEQUENT      SWFL688
C                                          PRINTOUT                         SWFL689
C                                                                           SWFL690
 1100 IF (NT.EQ.(NQSWRT-1).AND.NQ.EQ.NQCYC) GO TO 1120                      SWFL691
      GO TO 1180                                                            SWFL692
 1120 DO 1140 I = 1,NHPRT                                                   SWFL693
      MJPRT = JPRT(I)                                                       SWFL694
      PRTH (1,I) = H(MJPRT)                                                 SWFL695
 1140 CONTINUE                                                              SWFL696
      DO 1160 I = 1,NQPRT                                                   SWFL697
      MCPRT = CPRT(I)                                                       SWFL698
      PRTQ(1,I) = Q(MCPRT)                                                  SWFL699
      PRTV(1,I) = V(MCPRT)                                                  SWFL700
 1160 CONTINUE                                                              SWFL701
      GO TO 1240                                                            SWFL702
 1180 IF(NT.LT.NQSWRT) GO TO 1240                                           SWFL703
      LTIME = LTIME + 1                                                     SWFL704
C                                                                           SWFL705
C                                          STORE STAGE INFORMATION          SWFL706
C                                                                           SWFL707
      DO 1200 I=1,NHPRT                                                     SWFL708
      MJPRT=JPRT(I)                                                         SWFL709
 1200 PRTH(1,I)=H(MJPRT)
      QNEW(NQ)=S12Q
      WRITE(N22) LTIME,(PRTH(1,I),I=1,NHPRT)
      WRITE(61,1) (PRTH(1,I),I=1,NHPRT)
    1 FORMAT(10E11.3)
C                                                                           SWFL711
C                                          STORE FLOWS AND VELOCITIES       SWFL712
C                                                                           SWFL713
      DO 1220 I=1,NQPRT                                                     SWFL714
      MCPRT=CPRT(I)                                                         SWFL715
      PRTQ(1,I)=Q(MCPRT)
```

```
 1220 PRTV(1,I)=V(MCPRT)
      WRITE(N22)  LTIME,(PRTQ(1,I),I=1,NQPRT)
C     WRITE(61,1) (PRTV(1,I),I=1,NQPRT)
      WRITE(N22)  LTIME,(PRTV(1,I),I=1,NQPRT)
C                                                                       SWFL718
C                                         END OF QUALITY DO LOOP        SWFL719
C                                                                       SWFL720
 1240 CONTINUE                                                          SWFL721
      IF(ISWCH(1).NE.1) GO TO 1280                                      SWFL722
      IF (NT.NE.NQSWRT) GO TO 1280                                      SWFL723
 1280 CONTINUE                                                          SWFL725
C                                                                       SWFL726
C                                         SUBROUTINE PRTOUT CALLED FOR  SWFL727
C                                         HYDRAULIC INFORMATION PRINTOUT SWFL728
C                                         FOR A ONE DAY CYCLE           SWFL729
C                                                                       SWFL730
      IF (NT.LT.NQSWRT) GO TO 1300                                      SWFL731
C     WRITE(N22) (CPRT(I),I=1,NQPRT)
C     WRITE(N22) (JPRT(I),I=1,NHPRT)
C     WRITE(N22) (JSW(I),I=1,NJSW)
C                                                                       SWFL733
C                                         END OF SUBROUTINE SWFLOW      SWFL734
C                                                                       SWFL735
 1300 CONTINUE                                                          SWFL736
      WRITE(61,232) (QNEW(I),I=1,NTIMST)
      IF(JMO-NMON) 2,41,41
    2 JMO=JMO+1
      DELT=3600.0
      TZERO=0.0
      DO 5 J=1,NJ
      H(J)=PRTH(1,J)
      DEP(J)=-H(J)
      IF(AS(J).LT.0.0) AS(J)=-AS(J)
      QIN(J)=DQIN(J)
      QOU(J)=DQOU(J)
    5 CONTINUE
      READ(N5,232) EVAP,WIND,WDIR
      GO TO 50
   41 IF(IYEAR - ICONT) 47,48,48
   47 IYEAR=IYEAR+1
      JMO=1
      GO TO 501
   48 ENDFILE N22
      REWIND 22
      DUMMY=0.0
      TMAX=10000.0
C     WRITE(N20) TMAX,(DUMMY,J=1,NPLT)
      END FILE N20
      REWIND 20
      MCOUNT = 0                                                        SWFL740
1340  READ(N5,110)IFINAL,ICARD
  110 FORMAT (2A4)
      IF (IFINAL.EQ.IENDER(1)) GO TO 1360
      MCOUNT = MCOUNT + 1                                               SWFL744
      IF (MCOUNT.GT.30) GO TO 1380                                      SWFL745
      GO TO 1340                                                        SWFL746
 1360 IF (ICARD.EQ.IENDER(2)) GO TO 1400
      MCOUNT = MCOUNT + 1                                               SWFL748
      IF (MCOUNT.GT.30) GO TO 1380                                      SWFL749
      GO TO 1340                                                        SWFL750
 1380 WRITE (N6,112)                                                    SWFL751
  112 FORMAT (62HOQUALITY PROGRAM HAS READ MORE THAN 30 CARDS AFTER COMPSWFL752
```

PROGRAM LISTING OF INDATA

```
SEQUENCE,536,        ******** EDP ********

 *****************************************************************************
 **
 **     DATE= 12/05/78   TIME= 21/41/59
 **
 **                                        SOUTH FLORIDA WATER MANAGEMENT DISTRICT
 **
 **                                                 SYST= 33   MACH= E
 **
 *****************************************************************************


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                                                        **      **  **     **
                                                        ** **    ** **     **
                                                  *******   *******  ********

JOB,0075-203,U001,10,,,                                  U001
FORTRAN,X

                    FORTRAN DIAGNOSTIC RESULTS  FOR    U001

NO ERRORS


LOAD,56
RUN
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```
$JOB,8636-304,LIN,5
$RONL,854/6201
$RRAT,854/6201
$FET,LIN,INDATA,960
$RELEASE,ALL
$ALLOCATE,29,999999
$OPEN,40
$COSY
INDATA   DECK/     I=60,H=54
      PROGRAM INDATA                                                    INDA  1
C                                                                       INDA  2
C                                                                       INDA  3
C                                    INPUT DATA                         INDA  4
C                                    HYDRODYNAMICS PROGRAM              INDA  5
C                                    SPECIFICATION STATEMENTS           INDA  6
C                                                                       INDA  7
C                                                                       INDA  8
C                                    CONTROL                            INDA  9
C                                                                       INDA 10
C                                                                       INDA 54
C                                    TYPE DESIGNATIONS                  INDA 55
C                                                                       INDA 56
      INTEGER CPRT                                                      INDA 58
      REAL LEN,INTIME                                                   INDA 59
      COMMON N5,N6,ISWCH(10),EN(4),AVGH(99),IICOL(10),T(5),NX(5)
C                                                                       INDA 14
C                                    GENERAL                            INDA 15
C                                                                       INDA 16
      COMMON IALHA(15),NJ,NC
C                                                                       INDA 20
C                                    JUNCTIONS                          INDA 21
C                                                                       INDA 22
      COMMON H(35),NJUNC(99,2),IPOINT(35,12),AS(35),X(35),Y(35),DEP(35)
     1,  COF(35),QIN(35),QOU(35),QINST(35)
C                                                                       INDA 27
C                                    CHANNELS                           INDA 28
C                                                                       INDA 29
      COMMON LEN(99),NCHAN(99,12),B(99),R(99),A(99),AK(99),V(99)
     1,  NUMCH(99),NTEMP(12)
C                                                                       INDA 34
C                                    PRINTOUT AND PLOTTING              INDA 35
C                                                                       INDA 36
      COMMON JPRT(99),CPRT(99),JPLT(99),TT(99)
C                                                                       INDA 40
C                                                                       INDA 41
C                                    STAGE-TIME COEFFICIENTS            INDA 42
C                                                                       INDA 43
C                                                                       INDA 46
C                                    STORMWATER                         INDA 47
C                                                                       INDA 48
      COMMON ITIL(15),RAIN(50),INTIME(50)
      DATA ( YES=4H YES),( BLANK=4H    )
C                                                                       INDA 60
C                    * * *  OPTION  SWITCH,  ISWCH(I)  * * *            INDA 61
C                                                                       INDA 62
C                                 ** ISWCH(1) **                        INDA 63
C                                    IF 0, INFLUENCED BY DOWNSTREAM     INDA 63A
C                                    HEAD RELATIONSHIP (DAM)            INDA 63B
C                                    IF 1, WILL CALL TIDAL              INDA 64
C                                    COEFFICIENTS PROGRAM               INDA 65
C                                    IF 2, SPECIFIED OUTFLOW            INDA 66
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C                                      ** ISWCH(2) **                           INDA 67
C                                         IF 0, PRINT INPUT CHANNEL AND         INDA 67A
C                                         JUNCTION DATA                         INDA 67B
C                                         IF 1, SUPPRESSES CHANNEL AND          INDA 68
C                                         NODAL INFORMATION PRINT               INDA 69
C                                      ** ISWCH(3) **                           INDA 70
C                                         IF 4, QE(NJSW,2) IS COMPUTED          INDA 71
C                                      ** ISWCH(4) **                           INDA 71A
C                                         IF 1, TRIANGLES ARE USED IN CARDINDA 71B
C                                         GROUP 15 AND DIFFERENT MANNING        INDA 71C
C                                         COEFFICIENTS ARE DESIRED FOR          INDA 71D
C                                         EACH LEG OF THE TRIANGLE              INDA 71E
C                                      ** ISWCH(5) **                           INDA 72
C                                         IF 1, PARALLEL CHANNELS ARE USEDINDA 73
C                                      ** ISWCH(6) **                           INDA 74
C                                         IF 0, AND SUBROUTINE TRIAN IS         INDA 75
C                                         USED JUNCTION SURFACE AREA            INDA 76
C                                         MUST BE LEFT OUT OF INPUT DATA        INDA 77
C                                         IF 2, AND SUBROUTINE TRIAN IS         INDA 78
C                                         USED JUNCTION SURFACE AREA            INDA 79
C                                         MUST BE FURNISHED                     INDA 80
C                                      ** ISWCH(7) **                           INDA 81
C                                         IF 1,AK(N) IS COMPUTED IN SWFLOWINDA 82
C                                      ** ISWCH(8) **                           INDA 82A
C                                         NOT USED                              INDA 82B
C                                      ** ISWCH(9) **                           INDA 82C
C                                         NOT USED                              INDA 82D
C                                      ** ISWCH(10) **                          INDA 83
C                                         IF ISWCH(5) = 1,  THEN  CHANNEL       INDA 84
C                                         NUMBERS  GREATER  THAN  THIS          INDA 85
C                                         NUMBER (ISWCH(10)) ARE PARALLEL       INDA 86
C                                         TO OTHER LOWER NUMBERED CHANNELSINDA 87
C                                                                               INDA 88
C                                         STEP ONE                              INDA 89
C                                         INITIALIZATION                        INDA 90
C                                                                               INDA 91
      N5=60                                                                     INDA  92
      N6=61                                                                     INDA  93
      N20=20
      DO 50 I=1,35
      DEP(I)=0.0
      AS(I)=0.0
      QIN(I)=0.0
      QOU(I)=0.0
   50 CONTINUE
      DO 60 I=1,12
      NTEMP(I)=0
      DO 60 J=1,35
      NCHAN(J,I)=0
      IPOINT(J,I)=0
   60 CONTINUE
      DO 70 I=1,99
   70 B(I)=0.0
C                                         N20 ASSIGNED IN RECEIV                INDA 94
      REWIND N20                                                                INDA 95
C                                                                               INDA 96
C                                         STEP TWO                              INDA 97
C                                         TITLES, GENERAL CONTROL DATA,         INDA 98
C                                         AND JUNCTION AND CHANNEL INFOR-       INDA 99
C                                         MATION                                INDA100
C                                                                               INDA101
C                                                                               INDA102
```

```
C                                                READ TYPE A CARDS                 INDA103
C                                                (FIRST TWO CARDS CONTAIN HEAD-    INDA104
C                                                INGS FOR HYDRODYNAMICS, SECOND    INDA105
C                                                TWO CARDS CONTAIN HEADINGS        INDA106
C                                                FOR IDENTIFICATION OF STORMWATERINDA107
C                                                INFORMATION)                      INDA108
C                                                                                  INDA109
      READ(N5,100) IALHA
      READ(N5,100) ITIL
  100 FORMAT(15A4)                                                                 INDA112
C                                                SWITCH INFORMATION                INDA113
C                                                                                  INDA114
      READ (N5,104) (ISWCH(I),I=1,10)                                              INDA115
  104 FORMAT (10I5)                                                                INDA116
      DO 11 I=1,10                                                                 INDA117
   11 IICOL(I)=I                                                                   INDA118
      WRITE(N6,6)IICOL,ISWCH
6     FORMAT(1H1,55X,16HSWITCH  SETTINGS//1H ,14HSWITCH NUMBER ,10I10/
     1 1H ,14HSWITCH SETTING,10I10)
      WRITE(N6,102) IALHA
  102 FORMAT(1H1,15A4,20X,36HC ^ S FLORIDA FLOOD CONTROL DISTRICT/1H ,80
     1X,22HW. PALM BEACH, FLORIDA/1H ,80X,29HRECEIVING WATER HYDRODYNAMI
     2CS//)
C                                                                                  INDA125
C                                                READ TYPE B CARDS                 INDA126
C                                                                                  INDA127
C                                                READ TYPE C CARDS                 INDA128
C                                                CONTROL INFORMATION               INDA129
C                                                                                  INDA130
      READ (N5,106) NTCYC,PERIOD,QINT,DELT,TZERO,NHPRT,NQPRT,NPLT,EVAP  INDA131
     1,WIND,WDIR,NQSWRT,NJSW,INRAIN,JGW                                            INDA132
  106 FORMAT (I5,4F5.0,3I5,3F5.0,4I5)                                              INDA133
      NCGT=ISWCH(10)                                                               INDA134
      TTZERO=TZERO*3600.                                                           INDA135
      IPERID = PERIOD + 0.1                                                        INDA136
      IQINT=QINT*3600.+0.1                                                         INDA137
      IDELT = DELT + 0.1                                                           INDA138
      NQCYC=(IPERID *3600)/IQINT                                                   INDA139
      NHCYC = IQINT/IDELT                                                          INDA140
      NINT = (IPERID*3600)/IDELT                                                   INDA141
      NPDEL = (NINT+50)/100                                                        INDA142
C                                                                                  INDA143
C                                                READ TYPE D CARDS                 INDA144
C                                                PRECIPITATION IS READ AT THIS     INDA145
C                                                POINT, RATE IS INCHES PER HOUR,  INDA146
C                                                TIME IS READ IN MINUTES FROM      INDA147
C                                                START OF STORM                    INDA148
C                                                                                  INDA149
      DO 210 N=1,50
      RAIN(N)=0.0                                                                  INDA151
      INTIME(N)=0.0                                                                INDA152
  210 CONTINUE                                                                     INDA153
      IF (INRAIN.EQ.0) GO TO 215                                                   INDA154
      READ(N5,110)(RAIN(I),INTIME(I),I=1,INRAIN)                                   INDA155
  110 FORMAT (8F10.0)                                                              INDA156
  215 CONTINUE                                                                     INDA157
      DELTQ=DELT*FLOAT(NHCYC)                                                      INDA158
      WRITE(N6,112) NTCYC                                                          INDA159
  112 FORMAT (15HODAYS SIMULATED,I4)                                               INDA160
      WRITE(N6,114) NQCYC                                                          INDA161
  114 FORMAT (29HOWATER QUALITY CYCLES PER DAY,I4)                                 INDA162
      WRITE (N6,116) NHCYC                                                         INDA163
```

```
  116 FORMAT (43HOINTEGRATION CYCLES PER WATER QUALITY CYCLE,I4)         INDA164
      WRITE(N6,118) DELT
  118 FORMAT (30HOLENGTH OF INTEGRATION STEP IS,F6.0,8H SECONDS)         INDA166
      WRITE(N6,120) TZERO
  120 FORMAT (13HOINITIAL TIME,F6.2,6H HOURS)                            INDA168
      WRITE(N6,122)EVAP                                                  INDA169
  122 FORMAT(18HOEVAPORATION RATE,F5.1,17H INCHES PER MONTH)             INDA170
      WRITE(N6,124)WIND,WDIR                                             INDA171
  124 FORMAT(15HOWIND VELOCITY,F5.0,22H MPH   WIND DIRECTION,F5.0,19H DEINDA172
     1GREES FROM NORTH)                                                  INDA173
      IF (ISWCH(1).NE.1) GO TO 216                                       INDA174
      WRITE (N6,126)                                                     INDA175
  126 FORMAT (16HOESTURIAL SYSTEM)                                       INDA176
      GO TO 218                                                          INDA177
  216 CONTINUE                                                           INDA178
      WRITE (N6,127)                                                     INDA179
  127 FORMAT (19HOSTREAM/LAKE SYSTEM)                                    INDA180
  218 CONTINUE                                                           INDA181
      WRITE (N6,128) NQSWRT                                              INDA182
  128 FORMAT (26HOWRITE CYCLE STARTS AT THE,I4,11H TIME CYCLE//)         INDA183
      IF (INRAIN.LE.0) GO TO 225                                         INDA184
      WRITE (N6,130)                                                     INDA185
  130 FORMAT(75HORAIN IN INCHES PER HOUR, AND TIME IN MINUTES, MEASURED INDA186
     1FROM START OF STORM/)                                              INDA187
      WRITE (N6,131)                                                     INDA188
  131 FORMAT (15X,8H IN./HR.,2X,8H MINUTES,4X,8H IN./HR.,2X,8H MINUTES, INDA189
     14X,8H IN./HR.,2X,8H MINUTES,4X,8H IN./HR.,2X,8H MINUTES,4X,8H IN./INDA190
     2HR.,2X,8H MINUTES/)                                                INDA191
      DO 220 I=1,50,5
      L =MINO(I + 4,50)
      WRITE (N6,132) I, L, (RAIN(J),INTIME(J), J=I,L)                    INDA194
132   FORMAT(I4,4H TO ,I3,10F11.3)
  220 CONTINUE                                                           INDA196
      DO 222 I=1,50
  222 INTIME(I)=INTIME(I)*60.                                            INDA198
      GO TO 230                                                          INDA199
  225 CONTINUE                                                           INDA200
      WRITE (N6,133)                                                     INDA201
  133 FORMAT (23HONO PRECIPITATION INPUT)                                INDA202
  230 CONTINUE                                                           INDA203
C                                                                        INDA204
C                                        READ TYPE E CARDS               INDA205
C                                        JUNCTION NUMBERS FOR DETAILED   INDA206
C                                        PRINTOUT                        INDA207
C                                                                        INDA208
      READ(N5,134)(JPRT(I),I=1,NHPRT)                                    INDA209
  134 FORMAT(8I10)                                                       INDA210
      WRITE(N6,136)NHPRT,(JPRT(I),I=1,NHPRT)                             INDA211
  136 FORMAT (32HOPRINTED OUTPUT AT THE FOLLOWING,I3,10H JUNCTIONS,//    INDA212
     1 (10X,16I6))                                                       INDA213
C                                                                        INDA214
C                                        READ TYPE F CARDS               INDA215
C                                        CHANNEL NUMBERS FOR DETAILED    INDA216
C                                        PRINTOUT                        INDA217
C                                                                        INDA218
      READ(N5,134)(CPRT(I),I=1,NOPRT)                                    INDA219
      WRITE(N6,138)NOPRT,(CPRT(I),I=1,NOPRT)                             INDA220
138   FORMAT(//1HO,32HPRINTED OUTPUT FOR THE FOLLOWING,I3,9H CHANNELS,
     1//(10X,8I10))
C                                                                        INDA223
C                                        READ TYPE G CARDS               INDA224
C                                        READ THE JUNCTION NUMBERS IF    INDA225
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C                                             PLOTS ARE REQUESTED, OTHERWISE   INDA226
C                                             SKIP THIS READ                   INDA227
C                                                                              INDA228
      IF (NPLT.NE.0) READ(N5,134) (JPLT(N),N=1,NPLT)                           INDA229
C                                                                              INDA230
C                                             TIDAL OPTION AT THIS POINT       INDA231
C                                                                              INDA232
  560 CONTINUE                                                                 INDA240
  142 FORMAT (8F10.0)                                                          INDA237
      IF(ISWCH(1).EQ.2)GO TO 580                                               INDA241
      READ (N5,142) A1,A2,A3                                                   INDA242
      A4=0.                                                                    INDA243
      A5=0.                                                                    INDA244
      A6=0.                                                                    INDA245
      A7=0.                                                                    INDA246
      WRITE(N6,162)JGW,A1,A2,A3                                                INDA247
162   FORMAT(//1H ,38H   WEIR BOUNDARY CONDITION AT JUNCTION,I5//1H ,
     118H   WEIR1  =  A1  =,F12.2,4X,14H  WEIR2  =  A2,F12.2,4X,
     2 11H   WEIR3  =,F12.2//)
  580 CONTINUE                                                                 INDA251
      NJ=0                                                                     INDA252
C                                                                              INDA253
C                                             READ CARDS FOR                   INDA254
C                                             NODAL INFORMATION                INDA255
C                                                                              INDA256
      DO 620 I=1,35
      READ(N5,166) J,HEAD,SURF,QF1,QF2,DT,CF,X1,Y1                             INDA258
166   FORMAT(I5,F5.0,F10.0,2F5.0,2F10.0,20X,2F5.0)
      IF(J.GT.30) GO TO 640
      IF(J.GT.NJ)NJ=J                                                          INDA261
      H(J)=HEAD                                                                INDA262
      AS(J)=SURF*10.0**6                                                       INDA 263
      QIN(J)=QF1                                                               INDA264
      QINST(J)=QF1                                                             INDA265
      QOU(J)=QF2                                                               INDA266
      X(J)=X1*10.0**3                                                          INDA 267
      Y(J)=Y1*10.0**3                                                          INDA 268
      DEP(J)=DT                                                                INDA269
      COF(J)=CF                                                                INDA270
  620 CONTINUE                                                                 INDA271
  640 CONTINUE                                                                 INDA272
      NC=0                                                                     INDA273
C                                                                              INDA274
C                                             READ CARDS FOR                   INDA275
C                                             CHANNEL INFORMATION              INDA276
C                                                                              INDA277
      DO 660 I=1,80
      READ(N5,172)N,(NTEMP(K),K=1,4),ALEN,WIDTH,RAD,COEF,VEL                   INDA279
  172 FORMAT(5I5,5F10.0)                                                       INDA280
      IF(N.GT. 80) GO TO 670                                                   INDA 281
      IF(NTEMP(3).NE.0) GO TO 655                                              INDA282
      NC=NC+1                                                                  INDA283
      N=NC                                                                     INDA284
      NNTEM1=NTEMP(1)                                                          INDA285
      NNTEM2=NTEMP(2)                                                          INDA286
      R(N)=(DEP(NNTEM1)+DEP(NNTEM2))/2.                                        INDA287
      IF(ISWCH(5).EQ.1.AND.N.GT.NCGT)R(N)=RAD                                  INDA288
      A(N)=R(N)*WIDTH                                                          INDA289
      AVGH(N)=(H(NNTEM1)+H(NNTEM2))/2.                                         INDA290
      LEN(N)=ALEN                                                              INDA291
      B(N)=WIDTH                                                               INDA292
      AK(N)=COEF                                                               INDA293
```

```
      V(N)=VEL
      NJUNC(N,1)=MINO(NTEMP(1),NTEMP(2))
      NJUNC(N,2)=MAXO(NTEMP(1),NTEMP(2))
      K=NJUNC(N,1)
      DO 643 J=1,12
      IF(ISWCH(5).EQ.1)GO TO  642
      IF(IPOINT(K,J).EQ.NJUNC(N,2))GO TO 648
  642 IF(IPOINT(K,J).EQ.0) GO TO 646
  643 CONTINUE
  646 IPOINT(K,J)=NJUNC(N,2)
      NCHAN(K,J)=NC
      GO TO 660
  648 NC=NC-1
      M=NCHAN(K,J)
      NNTEM1=NTEMP(1)
      NNTEM2=NTEMP(2)
      R(M)=(DEP(NNTEM1)+DEP(NNTEM2))/2.
      A(M)=R(M)*WIDTH
      AVGH(M)=(H(NNTEM1)+H(NNTEM2))/2.
      LEN(M)=ALEN
      B(M)=B(M)+WIDTH
      AK(M)=COEF
      V(M)=VEL
      GO TO 660
  655 IF(ISWCH(4).EQ.0)GO TO 657
      EN(1)=ALEN
      EN(2)=WIDTH
      EN(3)=RAD
      EN(4)=COEF
  657 CALL TRIAN(NTEMP(1),NTEMP(2),NTEMP(3),NTEMP(4))
  660 CONTINUE
  670 CONTINUE
      IF (ISWCH(2).EQ.1) GO TO 674
      LDELT=DELT
      WRITE(N6,170) LDELT
  170 FORMAT(129H1CHANNEL   LENGTH   WIDTH      AREA     MANNING   VELOCIT
     1Y   HYD RADIUS            JUNCTIONS AT ENDS      MAX TIME STEP   EXC
     2EEDED BY/1H ,                                                  123H
     3 NUMBER     (FT)   (FT)      (SQ FT)    COEF.       (FPS)        (FT)
     4                                        (SEC)       STEP OF,I6/)
  674 CONTINUE
      DO 695 N=1,NC
      IF (AK(N).LE.0.0) AK(N)=0.018
      IF(B(N).GT.0.) GO TO 683
      K=NJUNC(N,1)
      NJUNC(N,1)=0
      IDEL=0
      DO 682 J=1,12
      IF(IPOINT(K,J).EQ.0) GO TO 682
      IF(IPOINT(K,J).NE.NJUNC(N,2)) GO TO 681
      WRITE(N6,168) N,K,NJUNC(N,2)
  168 FORMAT (8H CHANNEL,I4,8H JOINING,I4,4H AND,I4,38H DELETED DUE TO Z
     1ERO OR NEGATIVE WIDTH)
      NCHAN(K,J)=0
      IPOINT(K,J)=0
      NJUNC(N,2)=0
      GO TO 695
  681 CONTINUE
  682 CONTINUE
  683 CONTINUE
      K=NJUNC(N,2)
      DO 684 J=1,12
```

```
      IF(ISWCH(5).EQ.1.AND.N.GT.NCGT)GO TO 6683                          INDA356
      IF(IPOINT(K,J).EQ.NJUNC(N,1)) GO TO 687                            INDA357
 6683 IF(IPOINT(K,J).EQ.0) GO TO 685                                     INDA358
  684 CONTINUE                                                           INDA359
  685 CONTINUE                                                           INDA360
      IPOINT(K,J)=NJUNC(N,1)                                             INDA361
      NCHAN(K,J)=N                                                       INDA362
  687 CONTINUE                                                           INDA363
      NUMCH(N)=NJUNC(N,2)+NJUNC(N,1)*1000                                INDA364
      DO 688 J=1,NQPRT                                                   INDA365
      IF(CPRT(J).NE.NUMCH(N)) GO TO 688                                  INDA366
      CPRT(J)=N                                                          INDA367
      GO TO 690                                                          INDA368
  688 CONTINUE                                                           INDA369
  690 CONTINUE                                                           INDA370
      NLL=NJUNC(N,1)                                                     INDA371
      NHH=NJUNC(N,2)                                                     INDA372
      RRR=R(N)+(H(NLL)+H(NHH))/2.                                        INDA373
      TF=LEN(N)/SQRT(32.2*(RRR+2.))                                      INDA374
      XMK=BLANK                                                          INDA375
      IF(TF.LT.DELT) XMK=YES                                             INDA376
      IF(ISWCH(2).EQ.1) GO TO 695                                        INDA377
      IF(AVGH(N).LT.0.0)GO TO 700                                        INDA378
      RRRR=AVGH(N)+R(N)                                                  INDA379
      IF(RRRR.LE.0.0) RRRR=0.0
      GO TO 710                                                          INDA380
  700 RRRR=ABS(AVGH(N)+R(N))                                             INDA381
  710 AAREA=RRRR*B(N)
      WRITE(N6,174)  N,LEN(N),B(N),AAREA,AK(N),V(N),RRRR,(NJUNC(N,K),    INDA383
     1 K=1,2),TF,XMK                                                     INDA384
  174 FORMAT(I5,F11.0,F10.2,  F10.0,  F9.3,F10.2,F11.1,I19,I6,F19.0,8X, I
     1A4)                                                                INDA386
  695 CONTINUE                                                           INDA387
      IF (ISWCH(2).EQ.1) GO TO 698                                       INDA388
      WRITE(N6,182)                                                      INDA389
  182 FORMAT(129H1JUNCTION   INITIAL HEAD  DEPTH    SURFACE AREA      INP
     1UT     OUTPUT         CHANNELS ENTERING JUNCTION              COO
     2RDINATES)
      WRITE(N6,8661)
 8661 FORMAT(1H ,68H NUMBER          (FT)         (FT)    (10**6 SQ FT)     (
     1CFS)        (CFS),53X,1HX,5X,1HY/)
      WRITE(N20) NTCYC,PERIOD,DELT,TZERO,NHPRT,NQPRT,NPLT,EVAP,WIND
     1,    WDIR,NQSWRT,NJSW,INRAIN,JGW
      WRITE(N20) NQCYC,NHCYC,NJ,NC,A1,A2,A3,A4,A5,A6,A7,NPDEL
      ATOT=0.                                                            INDA397
      DO 696 J=1,NJ                                                      INDA398
      AS(J)=AS(J)/10.0**6
      X(J)=X(J)/10.0**3
      Y(J)=Y(J)/10.0**3
      ATOT=ATOT+AS(J)                                                    INDA399
      WRITE(N6,184)J,H(J),DEP(J),AS(J),QIN(J),QOU(J),(NCHAN(J,K),K=1,12)INDA400
     1,X(J),Y(J)                                                         INDA401
  184 FORMAT(I6,F13.2,F12.1,   F15.2,  2F10.0,I5,11I4,    F8.1,F6.1)     I
      X(J)=X(J)*10.0**3
      Y(J)=Y(J)*10.0**3
      WRITE(N20)J,H(J),DEP(J),AS(J),QIN(J),QOU(J),(NCHAN(J,K),K=1,12)
     1,    X(J),Y(J)
  696 CONTINUE                                                           INDA403
      ATOTM=ATOT/27878400.*10.0**6                                       INDA404
      WRITE(N6,190) ATOT,ATOTM
190   FORMAT(/1H ,26HTOTAL AREA FOR THE SYSTEM ,   F10.2,
     1 22H * 10**6  SQ FT   OR  ,  F9.2,10H  SQ MILES//)
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  698 CONTINUE                                                            INDA408
      WRITE(N6,192) ITIL
  192 FORMAT(1H0,15A4)
C                                                                         INDA411
C                                       STORE SYSTEM DATA ON QUALITY      INDA412
C                                       OUTPUT TAPE                       INDA413
C                                                                         INDA414
      DO 6950 J=1,NC
      WRITE(N20)LEN(J),B(J),R(J),A(J),AK(J),V(J),(NJUNC(J,K),K=1,2)
 6950 CONTINUE
      DO 1920 J=1,NJ
      WRITE(N20) QINST(J),(IPOINT(J,K),K=1,10)
 1920 CONTINUE
      WRITE(N20)(CPRT(I),I=1,NQPRT)
      WRITE(N20)(JPRT(I),I=1,NHPRT)
      WRITE(N20)(JPLT(I),I=1,NPLT)
      WRITE(N20) IALHA,ITIL,(NTEMP(I),I=1,4)
      WRITE(N20)(ISWCH(I),I=1,10)
      WRITE(N20)(RAIN(I),INTIME(I),I=1,50)
      END FILE N20
      CALL EXIT
      END                                                                 INDA418
      SUBROUTINE TRIAN(II,JJ,KK,LL)                                       TRIA   1
C                                       SUBROUTINE TRIAN                  TRIA   2
C                                       HYDRODYNAMICS PROGRAM             TRIA   3
C                                       SPECIFICATION STATEMENTS          TRIA   4
C                                                                         TRIA   5
C                                                                         TRIA  55
C                                       TYPE DESIGNATIONS                 TRIA  56
C                                                                         TRIA  57
      INTEGER CPRT                                                        TRIA  58
      REAL LEN                                                            TRIA  59
C                                                                         TRIA   6
C                                       CONTROL                           TRIA   7
C                                                                         TRIA   8
      COMMON N5,N6,ISWCH(10),EN(4),AVGH(99),IICOL(10),T(5),NX(5)
C                                                                         TRIA  11
C                                       GENERAL                           TRIA  12
C                                                                         TRIA  13
      COMMON IALHA(15),NJ,NC
C                                                                         TRIA  17
C                                       JUNCTIONS                         TRIA  18
C                                                                         TRIA  19
      COMMON H(35),NJUNC(99,2),IPOINT(35,12),AS(35),X(35),Y(35),DEP(35)
     1,  COF(35),QIN(35),QOU(35),QINST(35)
C                                                                         TRIA  24
C                                       CHANNELS                          TRIA  25
C                                                                         TRIA  26
      COMMON LEN(99),NCHAN(99,12),B(99),R(99),A(99),AK(99),V(99)
     1,  NUMCH(99),NTEMP(12)
C                                                                         TRIA  31
C                                       PRINTOUT AND PLOTTING             TRIA  32
C                                                                         TRIA  33
      COMMON JPRT(99),CPRT(99),JPLT(99),TT(99)
C                                                                         TRIA  37
C                                       STAGE-TIME COEFFICIENTS           TRIA  38
C                                                                         TRIA  39
C                                                                         TRIA  42
C                                       STORMWATER                        TRIA  43
C                                                                         TRIA  44
      COMMON ITIL(15),RAIN(50),INTIME(50)
C                                                                         TRIA  51
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C                                                                       TRIA 52
C                                                                       TRIA 54
      IF(II.NE.0) GO TO 300                                             TRIA 60
C                                                                       TRIA 61
C                                           ZERO POINTER ARRAY          TRIA 62
      DO 250 I=1,NJ                                                     TRIA 63
      DO 250 J=1,12                                                     TRIA 64
      IPOINT(I,J)=0                                                     TRIA 65
      NCHAN(I,J)=0                                                      TRIA 66
  250 CONTINUE                                                          TRIA 67
      RETURN                                                            TRIA 68
C                                                                       TRIA 69
C                                           SET UP TRIANGLE PARAMETERS  TRIA 70
C                                                                       TRIA 71
300   NX(1)=II                                                          TRIA 73
      NX(2)=JJ                                                          TRIA 74
      NX(3)=KK                                                          TRIA 75
      NX(4)=II                                                          TRIA 76
      NX(5)=JJ                                                          TRIA 77
      T(1) = (X(JJ) - X(KK))**2 + (Y(JJ) - Y(KK))**2                    TRIA 78
      T(2) = (X(KK) - X(II))**2 + (Y(KK) - Y(II))**2                    TRIA 79
      T(3) = (X(II) - X(JJ))**2 + (Y(II) - Y(JJ))**2                    TRIA 80
      T(4)=T(1)                                                         TRIA 81
      T(5)=T(2)                                                         TRIA 82
C                                                                       TRIA 83
C                                           DO ALL THREE SIDES          TRIA 84
C                                                                       TRIA 85
      NB=2                                                              TRIA 86
      IF(LL.EQ.0) NB=1                                                  TRIA 87
      DO 600 N=1,3,NB                                                   TRIA 88
C                                                                       TRIA 89
C                                           LOCATE CHANNELS ON POINTER ARRAYTRIA 90
C                                                                       TRIA 91
      I=MIN0(NX(N+1),NX(N+2))                                           TRIA 92
      J=MAX0(NX(N+1),NX(N+2))                                           TRIA 93
      DO 350 K=1,12                                                     TRIA 94
      IF(IPOINT(I,K).EQ.J) GO TO 370                                    TRIA 95
      IF(IPOINT(I,K).EQ.0) GO TO 360                                    TRIA 96
  350 CONTINUE                                                          TRIA 97
  360 IPOINT(I,K)=J                                                     TRIA 98
      NC=NC+1                                                           TRIA 99
      NCHAN(I,K)=NC                                                     TRIA100
  370 M=NCHAN(I,K)                                                      TRIA101
C                                                                       TRIA102
C                                           M IS CHANNEL NUMBER JUST    TRIA103
C                                           ASSIGNED                    TRIA104
C                                                                       TRIA105
      NJUNC(M,1)=I                                                      TRIA106
      NJUNC(M,2)=J                                                      TRIA107
      SUB=T(N+1)+T(N+2)-T(N)                                            TRIA108
      IF(SUB.LT.1)SUB=1                                                 TRIA109
      G=SQRT(T(N))/2.                                                   TRIA110
      LEN(M)=2.*G                                                       TRIA111
      C=G/SQRT(4.*T(N+2)*T(N+1)-SUB**2)*SUB                             TRIA112
      G=G/2.*C                                                          TRIA113
      WRITE(61,2) I,K,IPOINT(I,K),LEN(M),B(M),H(I),H(J)
    2 FORMAT(1X,3I5,4F20.3/)
      IF(ISWCH(6).EQ.2)GO TO 390                                        TRIA114
      AS(I)=AS(I)+G                                                     TRIA115
      AS(J)=AS(J)+G                                                     TRIA116
  390 CONTINUE                                                          TRIA117
      IF(C.LE.0.) WRITE(N6,102) M,C
```

```
102   FORMAT(1H ,26HNEGATIVE WIDTH CHANNEL NO.,I5,9H  WIDTH =,E12.4)
      B(M)=B(M)+C
      R(M)=(DEP(I)+DEP(J))/2.
      AVGH(M)=(H(I)+H(J))/2.
      A(M)=B(M)*R(M)
      IF(ISWCH(4).NE.1)GO TO 500
      IF(I.EQ.II.AND.J.EQ.JJ.OR.I.EQ.JJ.AND.J.EQ.II)GO TO 400
      IF(I.EQ.JJ.AND.J.EQ.KK.OR.I.EQ.KK.AND.J.EQ.JJ)GO TO 410
      AK(M)=EN(3)
      GO TO 580
  400 AK(M)=EN(1)
      GO TO 580
  410 AK(M)=EN(2)
      GO TO 580
  500 AK(M)=(COF(I)+COF(J))/2.
  580 V(M)=0.0
  600 CONTINUE
      IF(LL.EQ.0) RETURN
      DO 750 NN=3,4
      I=MIN0(NX(NN),LL)
      J=MAX0(NX(NN),LL)
      DO 620 K=1,12
      IF(IPOINT(I,K).EQ.J) GO TO 640
      IF(IPOINT(I,K).EQ.0) GO TO 630
  620 CONTINUE
  630 IPOINT(I,K)=J
      NC=NC+1
      NCHAN(I,K)=NC
  640 M=NCHAN(I,K)
      NJUNC(M,1)=I
      NJUNC(M,2)=J
      SUB=T(3)+T(4)-T(2)
      G=SQRT(T(2))/2.
      LEN(M)=G
      C=G/SQRT(4.*T(3)*T(4)-SUB**2)*SUB
      G=G/2.*C
      IF(ISWCH(6).EQ.2)GO TO 690
      AS(I)=AS(I)+G/2.
      AS(J)=AS(J)+G/2.
  690 CONTINUE
      IF(C.LE.0.) WRITE(N6,102) M,C
      B(M)=B(M)+C
      R(M)=(DEP(I)+DEP(J))/2.
      AVGH(M)=(H(I)+H(J))/2.
      A(M)=B(M)*R(M)
      IF(ISWCH(4).EQ.0)GO TO 700
      IF(NN.EQ.3)AK(M)=EN(3)
      IF(NN.EQ.4)AK(M)=EN(4)
      GO TO 710
  700 AK(M)=(COF(I)+COF(J))/2.
  710 V(M)=0.
  750 CONTINUE
      RETURN
      END
         ENDCOSY/
$FORTRAN,I=54,L,M,X=40
$REWIND,54
$CROSSREF
$INPUT=54
$END
```

ILLUSTRATIVE INPUT DATA SET FOR SWFLOW

```
    1PLETION)                                                           SWFL753
      CALL EXIT
 1400 WRITE (N6,114)                                                    SWFL755
  114 FORMAT (33HOCOMPLETION OF RECEIVING QUANTITY)                     SWFL756
C                                                                       SWFL758
C                                    RETURN TO SUBROUTINE RECEIV        SWFL759
C                                                                       SWFL760
      CALL EXIT
      END                                                               SWFL762
         FINIS
$EQUIP,22=MT,23=MT
$LOAD,56,M
$RUN
```

ILLUSTRATIVE INPUT DATA SETS FOR SWFLOW

```
    1    5    7
 -7.0 -7.0 -9.0 -7.0 -7.3 -7.5-10.5-11.2 -7.3 -7.5-11.5-13.2-12.5-10.5-11.5-10.5
-10.5-10.5-12.0-13.5-11.5-11.5-11.2-11.5-11.3-11.0-11.5-10.5 -7.5 -7.0
14.5014.5014.5014.5014.5014.5014.5014.5014.5014.5014.5014.5014.5014.5014.5014.50
14.5014.5014.5014.5014.5014.5014.5014.5014.5014.5014.5014.5014.5014.5014.5014.50
14.5014.5014.5014.5014.5014.5014.5014.5014.5014.5014.5014.5014.5014.5014.4814.47
14.4514.4314.4214.4014.3814.3714.3514.3314.3114.3014.2814.2614.2514.2314.2114.20
14.1814.1614.1514.1314.1114.1014.0814.0614.0514.0314.0113.9913.9813.9613.9413.93
13.9113.8913.8813.8613.8413.8313.8113.7913.7813.7613.7413.7213.7113.6913.6713.66
13.6413.6213.6113.5913.5713.5613.5413.5213.5113.4913.4713.4613.4413.4213.4013.39
13.3713.3513.3413.3213.3013.2913.2713.2513.2413.2213.2013.1913.1713.1513.1413.12
13.1013.0813.0713.0513.0313.0213.0013.0013.0013.0013.0013.0013.0013.0013.0013.00
13.0013.0013.0013.0013.0013.0013.0013.0013.0013.0013.0013.0013.0013.0013.0013.00
13.0013.0013.0013.0013.0013.0013.0213.0313.0513.0713.0813.1013.1213.1313.1513.17
13.1813.2013.2213.2313.2513.2513.2513.2513.2513.2513.2513.2513.2513.2513.2513.25
13.2513.2513.2513.2513.2513.2513.2513.2513.2513.2513.2513.2513.2513.2513.2513.25
13.2513.2513.2513.2513.2513.2513.2513.2513.2513.2513.2513.2513.2513.2513.2513.25
13.2513.2513.2513.2513.2513.2513.2513.2513.2513.2513.2513.2713.2913.3013.3213.34
13.3613.3813.3913.4113.4313.4513.4713.4913.5013.5213.5413.5613.5813.5913.6113.63
13.6513.6713.6813.7013.7213.7413.7613.7813.7913.8113.8313.8513.8713.8813.9013.92
13.9413.9613.9713.9914.0114.0314.0514.0614.0814.1014.1214.1414.1614.1714.1914.21
14.2314.2514.2614.2814.3014.3214.3414.3514.3714.3914.4114.4314.4514.4614.4814.50
14.5014.5014.5014.5014.5014.5014.5014.5014.5014.5014.5014.5014.5014.5014.5014.50
14.5014.5014.5014.5014.5014.5014.5014.5014.5014.5014.5014.5014.5014.5014.5014.50
14.5014.5014.5014.5014.5014.5014.5014.5014.5014.5014.5014.5014.5014.5014.5014.50
14.5014.5014.5014.5014.5014.5014.5014.5014.5014.5014.5014.50
11.5011.5011.5011.5011.5011.5011.5011.5011.5011.5011.5013.2012.5011.5011.5011.50
11.5011.5012.0013.5011.5011.5011.5011.5011.5011.5011.5011.5011.5011.50
 ** CA 2A DRAWDOWN - S7 BACKPUMP - 1975
    2    6    1
    1    2    3    4    5    6    7    8    9   10   11   12   13   14   15   16
   17   18   19   20   21   22   23   24   25   26   27   28   29   30
   31    6    3
          1         2         3         4         5         6         7         8
          9        10        11        12        13        14        15        16
         17        18        19        20        21        22        23        24
         25        26        27        28        29        30
            1.00                                                        2AWF 1
            0.70           0.30                                         2AWF 2
            0.70           0.30                                         2AWF 3
            0.75           0.25                                         2AWF 4
            0.40 0.40      0.20                                         2AWF 5
                 1.00                                                   2AWF 6
                 0.60      0.40                                         2AWF 7
                           1.00                                         2AWF 8
       0.40                0.60                                         2AWF 9
       1.00                                                             2AWF10
       0.40                0.60                                         2AWF11
  0.50 0.50                                                             2AWF12
```

0.70	0.20				0.10	2AWF13
0.10				0.70	0.20	2AWF14
			0.40	0.40	0.20	2AWF15
			1.00			2AWF16
				1.00		2AWF17
				1.00		2AWF18
1.00						2AWF19
1.00						2AWF20
			0.50	0.50		2AWF21
				1.00		2AWF22
				0.90	0.10	2AWF23
				0.10	0.90	2AWF24
					1.00	2AWF25
			0.90	0.10		2AWF26
			0.50		0.50	2AWF27
	0.10				0.90	2AWF28
	1.00					2AWF29
		1.00				2AWF30
31	6	3				
0						
						CA2750101
						CA2750102
						CA2750103
0.05			0.10			CA2750104
						CA2750105
	0.02					CA2750106
						CA2750107
						CA2750108
						CA2750109
						CA2750110
						CA2750111
						CA2750112
						CA2750113
						CA2750114
						CA2750115
						CA2750116
						CA2750117
			0.05			CA2750118
						CA2750119
						CA2750120
						CA2750121
0.10						CA2750122
	0.08		0.22			CA2750123
						CA2750124
						CA2750125
	0.30		0.05		0.09	CA2750126
						CA2750127
						CA2750128
						CA2750129
						CA2750130
						CA2750131
	3.20					
28	6	3				
0						
						CA2750201
		0.03				CA2750202
		0.01				CA2750203
			0.02	0.01		CA2750204
			0.18			CA2750205
		0.06		0.21		CA2750206
				0.85		CA2750207
						CA2750208

						CA2750209
	0.10	0.05				CA2750210
0.35	0.05	0.05				CA2750211
		0.05				CA2750212
			0.19			CA2750213
				0.85		CA2750214
						CA2750215
						CA2750216
						CA2750217
						CA2750218
						CA2750219
		0.10	0.05			CA2750220
						CA2750221
	0.05					CA2750222
				0.02		CA2750223
				0.03		CA2750224
						CA2750225
						CA2750226
						CA2750227
						CA2750228
	4.2					
31	6	3				
0						
						CA2750301
						CA2750302
						CA2750303
		0.05				CA2750304
0.45	0.08			0.13	0.08	CA2750305
						CA2750306
						CA2750307
						CA2750308
						CA2750309
						CA2750310
						CA2750311
						CA2750312
						CA2750313
				0.03		CA2750314
		0.18			0.05	CA2750315
		0.02	0.02	0.04	0.02	CA2750316
						CA2750317
						CA2750318
						CA2750319
				0.01		CA2750320
						CA2750321
						CA2750322
0.05						CA2750323
						CA2750324
						CA2750325
						CA2750326
						CA2750327
						CA2750328
						CA2750329
						CA2750330
	5.0					
30	6	3				
2						
18						

0	0	0	0	265	491	484	479
479	480	483	482	479	476	471	467
466	468	467	469	471	473	475	1570
2307	2206	2161	2073	2010	1951		

10										
	177		177		177	677	617	7		
	0.05									CA2750401
										CA2750402
										CA2750403
										CA2750404
										CA2750405
										CA2750406
										CA2750407
										CA2750408
										CA2750409
				0.01						CA2750410
		0.10	0.01		0.05					CA2750411
0.27										CA2750412
0.12				0.02	0.05					CA2750413
										CA2750414
			0.02							CA2750415
			0.03	0.05	0.02					CA2750416
										CA2750417
										CA2750418
										CA2750419
										CA2750420
	0.05									CA2750421
		0.42	0.20		0.20					CA2750422
			0.03		0.03					CA2750423
										CA2750424
										CA2750425
										CA2750426
										CA2750427
				0.35						CA2750428
										CA2750429
										CA2750430
	4.25									
31	6	3								
1										
10										
	0		0		0	0	0	56	189	235
	148		57		54	56	61	66	396	585
	272		30-		671-	-27	7	0^	33	7
	7		7		7	^4	343	6777	6777	
										CA2750501
										CA2750502
										CA2750503
										CA2750504
	1.25	0.47	0.26		1.00					CA2750505
			0.21	0.27	0.20					CA2750506
0.20	1.47	1.68	1.17	0.31	1.51					CA2750507
	0.02	0.06	0.02	0.40	0.15					CA2750508
		0.05	1.87		1.23					CA2750509
		0.02	1.50		0.92					CA2750510
		0.03	0.02		0.07					CA2750511
0.06		0.03	0.05							CA2750512
0.24	1.23	2.00	1.22		0.11					CA2750513
0.21	1.24	0.25	0.03		0.81					CA2750514
		0.07	0.08		0.11					CA2750515
0.10	0.15	0.03	0.16							CA2750516
	0.28	0.20	0.47		1.19					CA2750517
0.12					0.20					CA2750518
										CA2750519

						CA2750520
						CA2750521
0.10						CA2750522
						CA2750523
				1.99		CA2750524
		0.05		0.02		CA2750525
0.17		0.60	0.35			CA2750526
1.12		1.08	0.05	0.02		CA2750527
0.33	0.33	1.15	0.50		1.00	CA2750528
0.05	0.09	0.08	0.08	0.99	0.66	CA2750529
	0.05	0.01	0.01	0.45	2.11	CA2750530
				0.28	0.11	CA2750531
1.70	2.70	3.22	0.13			CA2750601
0.02	0.25	0.90	0.02			CA2750602
0.95	1.92	3.47	1.77	0.72	0.14	CA2750603
0.60	0.02		0.02	0.32	0.05	CA2750604
0.30		0.32	0.20	0.19		CA2750605
			0.05			CA2750606
						CA2750607
0.50	0.27					CA2750608
	0.86	0.20	0.05	0.28		CA2750609
	0.20		0.03	0.03	1.66	CA2750610
				0.23	0.05	CA2750611
						CA2750612
						CA2750613
					0.03	CA2750614
						CA2750615
0.13			0.05	0.01		CA2750616
0.02	0.05		0.05			CA2750617
				0.15		CA2750618
	0.05		0.19	0.25		CA2750619
			0.88	0.01	0.27	CA2750620
	0.28	0.33	2.65	0.29	0.35	CA2750621
0.35	2.63	0.04	0.10		0.20	CA2750622
	1.43	0.08	0.02		0.03	CA2750623
0.13	1.68	0.43	1.27			CA2750624
	0.05	2.72	1.38	0.10	0.15	CA2750625
	0.05	0.06	0.18	1.37	0.20	CA2750626
		0.01	0.05	0.26	0.22	CA2750627
	0.05	0.03	0.10			CA2750628
					0.20	CA2750629
	0.15	0.50	0.02			CA2750630
	2.90					
31	6	3				
4						

17								
	659	656	659	670	686	659	662	696
	810	926	883	863	851	816	803	790
	776	767	758	748	729	431	0	0
	0	0	0	0	0	0	0	
18								
	636	636	639	651	667	664	675	686
	799	895	871	846	825	803	776	763
	748	734	729	714	689	542	329	349
	359	367	368	372	375	378	384	
14								
	636	634	639	648	662	664	675	680
	784	859	851	838	821	799	767	753
	739	729	719	699	679	499	324	344
	354	356	363	368	371	372	375	
10								
	6777	6777	6777	6777	0-2	6777	137	-57

	0^7		067		-27	257	13-	037	107	^27
	6777		6777		0-7	^77	^77	6777	-27	6777
	3-7		017		6777	6777	6777	6777	6777	
				0.90	1.88					CA2750701
				0.20	0.40					CA2750702
		1.80	0.67	0.20						CA2750703
	0.83			0.10						CA2750704
										CA2750705
2.39				0.01	0.03					CA2750706
				0.30	0.03					CA2750707
										CA2750708
										CA2750709
				0.20	0.34					CA2750710
	0.92	0.24	0.91	0.75	0.88					CA2750711
				1.00	2.04					CA2750712
				0.05	0.06					CA2750713
4.39				0.50						CA2750714
				0.05	0.11					CA2750715
										CA2750716
										CA2750717
	0.53	1.49	3.70	0.80						CA2750718
										CA2750719
										CA2750720
				0.10						CA2750721
										CA2750722
										CA2750723
										CA2750724
		1.98	0.54	0.20						CA2750725
										CA2750726
0.10				0.01						CA2750727
				0.30	0.57					CA2750728
				0.70	1.48					CA2750729
				0.03	0.07					CA2750730
0.55	2.04	4.46	2.22	1.00						CA2750731
	4.34									
31	6	3								
2										
14										
	768		774		773	767	776	786	808	483
	0		0		0	0	0	0	0	0
	0		0		0	0	0	0	0	0
	0		0		0	0	0	0	0	
10										
	6777		037		5^7	6777	6-7	617	0-2	7
	367		467		627	7	327	502	317	367
	507		327		307	337	177	^77	7	7
	577									
	0.25			0.88	0.52					CA2750801
				0.07	0.24					CA2750802
										CA2750803
0.18										CA2750804
										CA2750805
										CA2750806
		0.39	0.70							CA2750807
	0.17									CA2750808
										CA2750809
										CA2750810
3.58										CA2750811
										CA2750812
					0.43					CA2750813
					0.52					CA2750814
	3.25	3.26	0.08		0.02					CA2750815

						CA2750816
						CA2750817
2.74				0.22	0.20	CA2750818
				0.08	0.08	CA2750819
				0.05		CA2750820
		0.18		2.40		CA2750821
	0.23		2.07	2.61		CA2750822
				0.03		CA2750823
						CA2750824
0.80						CA2750825
						CA2750826
				0.04		CA2750827
						CA2750828
	0.13	0.37	0.32			CA2750829
						CA2750830
1.33	1.21	0.14	0.48			CA2750831

ENDQUANTITY

ILLUSTRATIVE INPUT DATA SET FOR INDATA

ILLUSTRATIVE INPUT DATA SETS FOR INDATA

```
$JOB,8012-304,LIN,5
$EQUIP,20=MT
$RONL,854/6201
$FET,LIN,INDATA,960
$OPEN,40
$LOAD,40,M
$RUN
 HYDROLOGIC ANALYSIS OF WATER CONS. AREA 2A
 ANALYSIS OF OCT. 1969 CONDITION
              4    1    1    2    1             70
    1 720    24 3600    0   30   81    8    2    0    0    0   30    0    1
         1         2         3         4         5         6         7         8
         9        10        11        12        13        14        15        16
        17        18        19        20        21        22        23        24
        25        26        27        28        29        30
      4 30      1  4      1 30      2  3      3 30      2 30      3  4      4  7
      3  7      5  7      4  5      7  8      3  8      2  8      8 28      2 28
      9 28      2  9     28 29      9 29     10 11     11 29     10 29     11 28
     10 12     11 12     12 13     11 13     13 24     11 24     24 25     11 25
      8 25      8 11     25 27      8 27      7 27     16 27      7 16      6 16
      6  7      5  6     15 16     15 27     21 26     16 21     16 26     21 22
     22 26     15 22     15 26     22 23     15 23     23 25     15 25     23 24
     17 21     17 22     17 18     18 22     18 23     14 18     14 23     14 24
     14 19     19 24     13 19     19 20     13 20     12 20      1 30      2 30
      2  9      9 29     10 29      2  3      1  4      4  5      5  6     17 18
     14 18
         1        30         2        10         8         6        18        16
   235.0    7.5       1.58
    113.75    40.017    0   5.     -8.20                                29.57 1.16
    213.78   104.410    0   5.     -9.50                                25.8723.23
    313.90   220.190    0         -11.00                                35.9021.12
    413.80   113.610    0  15.    -11.00                                42.2415.05
    513.80   133.080    0  15.    -11.00                                58.0816.79
    613.80   120.640    0  20.    -10.60                                79.2019.01
    714.00   299.718    0    0    -12.20                                58.0831.68
    814.01   330.550    0    0    -11.20                                40.6641.98
    913.80    88.186    0  10.    -12.00                                16.3736.43
   1013.90   157.970    0    0    -12.80                                 0.0059.14
   1114.00   505.840    0    0    -12.50                                26.4058.08
   1214.10   203.960    0    0    -13.20                                16.9086.38
   1314.10   345.700    0    0    -13.00                                31.6883.69
   1414.05    97.380  20.    0    -12.50                                54.9173.39
   1514.05   106.036    0    0    -11.70                                63.3655.97
   1614.01   146.610    0  20.    -11.60                                78.9940.39
   1714.05    45.440  10.    0    -12.00                                78.7865.47
   1814.05    41.656  10.    0    -11.80                                67.5869.17
   1914.10   140.660  5.     0    -13.00                                42.7791.34
   2014.10    95.757    0    0    -13.50                                30.62109.3
   2114.02    54.640    0  20.    -11.80                                78.9453.33
   2214.05    77.900    0    0    -12.20                                70.7560.19
   2314.05    90.350    0    0    -11.80                                58.8764.94
   2414.05   260.220    0    0    -12.80                                45.6768.64
   2514.03   256.980    0    0    -11.60                                49.1056.76
   2614.03   122.265    0    0    -12.40                                70.7549.10
   2714.01   185.560    0    0    -12.00                                59.9343.82
   2814.00   233.710    0    0    -12.00                                26.4043.03
   29 13.80  161.759    0   5.    -12.50                                84.4847.26
   30 13.80   74.920    0  10.     -8.40                                27.7212.14
77777
    1    1   30    4
    2   30    2    3
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3	30	3	4				
4	3	7	4				
5	4	7	5				
6	3	8	7				
7	3	2	8				
8	2	28	8				
9	2	9	28				
10	9	29	28				
11	29	10	11				
12	29	11	28				
13	11	10	12				
14	11	12	13				
15	11	13	24				
16	11	24	25				
17	8	11	25				
18	8	28	11				
19	8	25	27				
20	8	27	7				
21	7	27	16				
22	7	16	6				
23	5	7	6				
24	27	15	16				
25	16	26	21				
26	26	22	21				
27	26	15	22				
28	15	23	22				
29	15	25	23				
30	15	27	25				
31	25	24	23				
32	22	17	21				
33	22	18	17				
34	22	23	18				
35	23	14	18				
36	23	24	14				
37	24	19	14				
38	24	13	19				
39	13	20	19				
40	13	12	20				
41	1	30	0	10500.0	80.00	8.50	0.025
42	30	2	0	10600.0	80.00	8.50	0.025
43	2	9	0	15800.0	60.00	7.00	0.028
44	9	29	0	13700.0	60.00	5.00	0.025
45	29	10	0	14800.0	55.00	5.00	0.025
46	2	3	0	10500.0	85.00	-7.00	0.050
47	1	4	0	18500.0	70.00	8.50	0.025
48	4	5	0	15800.0	65.00	6.50	0.030
49	5	6	0	21100.0	65.00	6.00	0.030
50	18	17	0	12600.0	35.00	0.00	0.030
51	14	18	0	12600.0	35.00	0.00	0.030
99999							

A SAMPLE OUTPUT

JUNCTION NUMBER	INITIAL HEAD (FT)	DEPTH (FT)	SURFACE AREA (10**6 SQ FT)	INPUT (CFS)	OUTPUT (CFS)	CHANNELS ENTERING JUNCTION												COORDINATES X	Y
1	16.49	-11.0	140.60	0.	10.	2	3	5	71	79	0	0	0	0	0	0	0	48.6	2.6
2	16.49	-11.0	146.70	0.	5.	16	17	18	20	72	73	0	0	0	0	0	0	24.3	10.6
3	16.40	-12.4	108.18	0.	0.	19	22	74	20	73	0	0	0	0	0	0	0	12.2	27.7
4	16.35	-13.8	169.16	0.	0.	21	24	27	75	22	74	0	0	0	0	0	0	.0	45.4
5	16.50	-13.3	303.03	0.	0.	14	15	23	18	19	21	0	0	0	0	0	0	22.2	35.4
6	16.50	-13.3	436.91	0.	0.	1	4	7	9	13	2	15	16	0	0	0	0	42.6	21.9
7	16.49	-13.9	139.57	0.	10.	6	80	4	5	79	0	0	0	0	0	0	0	65.0	7.9
8	16.50	-14.4	186.28	0.	10.	8	10	81	6	7	80	0	0	0	0	0	0	69.2	21.9
9	16.52	-14.8	128.50	0.	5.	11	38	40	82	10	81	0	0	0	0	0	0	74.4	43.3
10	16.50	-14.5	303.03	0.	0.	12	35	37	8	9	11	0	0	0	0	0	0	56.0	41.2
11	16.51	-15.5	170.28	0.	0.	43	44	45	47	49	50	0	0	0	0	0	0	53.3	67.2
12	16.51	-15.1	368.57	0.	0.	30	31	32	33	51	50	0	0	0	0	0	0	37.5	65.5
13	16.51	-15.7	290.15	0.	0.	28	29	52	54	56	30	0	0	0	0	0	0	20.1	76.8
14	16.20	-15.7	174.76	0.	10.	55	57	59	76	77	56	0	0	0	0	0	0	.3	88.7
15	16.50	-16.4	256.54	0.	0.	53	58	61	63	54	55	0	0	0	0	0	0	25.1	77.6
16	16.40	-15.7	112.59	0.	10.	46	48	65	84	85	47	0	0	0	0	0	0	56.4	74.5
17	16.50	-15.4	80.90	0.	5.	41	42	83	43	46	84	0	0	0	0	0	0	70.0	69.4
18	16.30	-15.3	39.60	0.	10.	66	67	68	86	87	0	0	0	0	0	0	0	31.1	112.7
19	16.20	-16.0	140.72	0.	10.	60	70	78	58	59	77	0	0	0	0	0	0	14.8	108.2
20	16.16	-15.0	45.70	0.	0.	69	68	70	78	87	0	0	0	0	0	0	0	25.3	120.4
21	16.40	-15.6	182.84	0.	0.	62	60	61	67	69	0	0	0	0	0	0	0	25.3	109.5
22	16.35	-15.6	131.63	0.	10.	64	62	63	65	66	85	86	0	0	0	0	0	38.0	102.7
23	16.50	-16.1	308.63	0.	0.	48	49	51	52	53	64	0	0	0	0	0	0	39.1	85.5
24	16.30	-15.5	238.62	0.	10.	26	27	28	57	75	76	0	0	0	0	0	0	.2	64.4
25	16.45	-15.2	435.78	0.	0.	25	23	24	26	29	31	0	0	0	0	0	0	20.7	55.4
26	16.50	-15.3	243.66	0.	0.	34	36	33	35	45	0	0	0	0	0	0	0	52.8	54.4
27	16.50	-15.3	166.92	0.	0.	39	36	37	38	41	44	0	0	0	0	0	0	63.6	54.6
28	16.50	-15.2	84.90	0.	10.	39	40	42	82	83	0	0	0	0	0	0	0	74.2	54.9
29	16.49	-14.5	359.04	0.	0.	12	13	14	25	32	34	0	0	0	0	0	0	37.0	42.2
30	16.49	-10.9	121.70	0.	5.	1	3	17	71	72	0	0	0	0	0	0	0	37.5	6.1

TOTAL AREA FOR THE SYSTEM 6015.49 * 10**6 SQ FT OR 215.78 SQ MILES

ANALYSIS OF MAR. 1970 CONDITION

@EOF
@EOF IGNORED - IN CONTROL MODE

@BRKPT PRINTS

SAMPLE OUTPUT OF INDATA PROGRAM

HYDROGRAPH INPUTS TO SYSTEM WITH RAIN ADDED

JUNCTION NUMBER

1 10 21	2 12 22	3 13 23	4 14 24	5 15 25	6 16 26	7 17 27	8 18 28	9 19 29	10 20 30
.165+002	.165+002	.165+002	.165+002	.165+002	.165+002	.165+002	.165+002	.165+002	.164+002
.164+002	.164+002	.164+002	.165+002	.165+002	.165+002	.165+002	.165+002	.165+002	.165+002
.165+002	.165+002	.165+002	.165+002	.165+002	.164+002	.165+002	.165+002	.164+002	.165+002
.164+002	.164+002	.164+002	.164+002	.164+002	.164+002	.164+002	.164+002	.164+002	.164+002
.164+002	.164+002	.164+002	.165+002	.165+002	.165+002	.164+002	.165+002	.165+002	.165+002
.165+002	.165+002	.165+002	.165+002	.164+002	.164+002	.164+002	.164+002	.164+002	.164+002
.164+002	.164+002	.164+002	.164+002	.164+002	.164+002	.164+002	.164+002	.164+002	.164+002
.164+002	.164+002	.164+002	.165+002	.165+002	.164+002	.164+002	.165+002	.165+002	.165+002
.165+002	.165+002	.165+002	.164+002	.164+002	.164+002	.164+002	.164+002	.164+002	.164+002
.164+002	.164+002	.164+002	.164+002	.164+002	.164+002	.164+002	.164+002	.164+002	.164+002
.164+002	.164+002	.164+002	.164+002	.165+002	.164+002	.164+002	.164+002	.164+002	.164+002
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.164+002	.164+002	.164+002	.164+002	.165+002	.164+002	.164+002	.163+002	.163+002	.163+002
.163+002	.163+002	.164+002	.164+002	.164+002	.164+002	.164+002	.164+002	.164+002	.163+002
.164+002	.164+002	.164+002	.164+002	.164+002	.164+002	.164+002	.164+002	.164+002	.164+002
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.164+002	.164+002	.164+002	.164+002	.164+002	.164+002	.164+002	.164+002	.164+002	.164+002
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.164+002	.164+002	.165+002	.164+002	.164+002	.164+002	.164+002	.164+002	.164+002	.164+002
.167+002	.167+002	.166+002	.166+002	.166+002	.166+002	.166+002	.167+002	.167+002	.166+002
.166+002	.165+002	.165+002	.166+002	.166+002	.167+002	.167+002	.167+002	.167+002	.167+002
.167+002	.167+002	.166+002	.166+002	.166+002	.166+002	.167+002	.167+002	.166+002	.166+002
.167+002	.167+002	.167+002	.167+002	.167+002	.167+002	.167+002	.167+002	.167+002	.167+002
.167+002	.166+002	.166+002	.167+002	.166+002	.167+002	.167+002	.167+002	.167+002	.168+002
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.167+002	.167+002	.167+002	.167+002	.167+002	.167+002	.167+002	.167+002	.167+002	.167+002
.167+002	.167+002	.167+002	.167+002	.166+002	.167+002	.167+002	.167+002	.167+002	.167+002
.167+002	.167+002	.167+002	.167+002	.167+002	.167+002	.167+002	.167+002	.167+002	.166+002

SAMPLE OUTPUT OF SWFLOW PROGRAM